Published in final edited form as:
Can J Diet Pract Res. 2007 ; 68(1): s1–s56.

Influences on the Development of Children's Eating Behaviours: From Infancy to Adolescence

Leann Birch,
Dr. Leann Birch is Distinguished Professor of Human Development and Nutritional Sciences at the Pennsylvania State University, and Director of the Center for Childhood Obesity Research. Dr. Birch is a developmental psychologist, and she is internationally recognized for her research on how early experience and family environments shape children's developing food preferences, eating behaviors, and weight status. She obtained her Ph.D. in Psychology from the University of Michigan, Ann Arbor.

Jennifer S. Savage, and
Jennifer S. Savage is a research assistant in the Center for Childhood Obesity Research at the Pennsylvania State University. She completed her M.S. in Nutritional Sciences as well as a dietetic internship from the Department of Nutritional Sciences at Penn State University, University Park. Jennifer is interested in how parenting practices influence children's food preferences and weight status.

Alison Ventura
Alison Ventura is a research assistant in the Center for Childhood Obesity Research at the Pennsylvania State University. She has degrees in both Nutrition & Human Development and Family Studies, and is interested in health promotion in families with infants and young children.

Introduction

Eating behaviours evolve during the first years of life; children learn what, when, and how much to eat through direct experiences with food and by observing the eating behaviours of others. In light of the increasing prevalence of overweight and obesity in North America among all age groups[1], including very young children, an understanding of the factors that influence eating behaviours during childhood is needed to improve the dietary patterns and health status of this age group. In this review, we will describe behavioural factors that shape the development of food acceptance, including food selection and food preferences, as well as the regulation of food intake in young children. Although a range of environmental factors may directly influence the development of child eating behaviours[2,3], the primary focus of this review will be on ways in which caregivers influence children's eating environments and eating behaviours.

The Current State of Children's Diets

Across human history, undernutrition and food scarcity have been major threats to children's survival, and parental feeding practices have evolved in response to these threats. These feeding practices, which include behaviours such as providing large portions of palatable foods and encouraging children to eat, are still pervasive in most cultures, despite the fact that in many regions the balance has shifted from food scarcity to food excess and over-consumption has become a new threat.[4,5] The impact of these ongoing practices on children's dietary intake can be seen in several recent dietary surveys.

The Feeding Infants and Toddlers Study (FITS), which provided data on the dietary patterns of 3022 infants and toddlers, revealed that 4 to 24 month old children typically consumed

significant amounts of developmentally inappropriate, energy-dense, nutrient poor foods.[6] Of particular concern was the finding that 18% to 33% of infants and toddlers consumed no distinct servings of vegetables on a typical day and when vegetables were consumed the most common choice was french fries. Additionally, reported energy intakes exceeded requirements by 10 to 30%.[7] Unfortunately, there is also evidence that these patterns tend to persist throughout childhood and into adolescence, and that diet quality tracks and declines from early childhood through adolescence.[8,9] The Canadian Community Health Survey (CCHS) suggests that seven out of ten children aged 4 to 8 years fail to meet the minimum number of servings for vegetables and fruit in Canada's Food Guide to Healthy Eating.[10] These children also fall short of reaching the recommended servings for grains and milk products, thereby suggesting that poor eating habits among children are endemic.

The transition into late childhood and adolescence can also be characterized by undesirable changes in eating behaviours such as increased consumption of sugar sweetened beverages (e.g., soda)[8], calorie-dense, nutrient poor snacks[11] and food away from home (e.g., fast food)[12] and a decline in the consumption of milk and other nutrient-dense foods.[13] Meal patterns also tend to change, as teenagers are more likely to skip breakfast[8] and less likely to participate in family dinners.[14] All of these trends are associated with decreased diet quality[3,5,9,14] and may partially explain the fact that most adolescents are failing to meet the majority of dietary recommendations.[5]

Influences during Infancy and the Toddler Years

The first year of life is a period of rapid physical, social and emotional growth, during which eating patterns also develop. During this first year, infants transition from consuming a single food (i.e., breast milk or formula) to consuming a variety of foods more characteristic of an adult diet. This transition allows infants to learn about food through direct experience, as well as through observation of others' eating behaviours.

Data indicate that breastfeeding and parental modeling in the toddler years play significant roles in establishing longer-term eating behaviours. As reviewed below, children who are not breastfed still derive a significant benefit from the behaviours that their parents impart as they grow and develop. Breastfeeding is recommended as the optimal feeding method for the first 6 months of life[15], in part because of the mounting evidence that breastfeeding has a positive impact on the development of a child's later eating behaviours.[16-18]

Breastfeeding plays a role in the development of a child's response to internal hunger and satiety cues[19], and may foster the development of self-regulatory abilities during feeding.[20] Variations in the composition of breast milk during a single feed, as well as differences in composition across the first months of life, foster this heightened sensitivity to energy intake.[20,21] Emerging scientific evidence also supports the role of breastfeeding in early metabolic imprinting, which partially accounts for later differences in eating behaviours.[22,23] Breastfeeding also has a positive impact on later eating behaviour because it may promote acceptance of flavours in the maternal diet that are passed through breast milk.[24,25] As a result, breastfed infants are exposed to a more varied flavour experience, depending on the variety of the mother's diet and this exposure may affect food acceptance during the transition to solid foods and later in life.[26]

Infants are born with a preference for sweet and salty taste,[27] thus sweet and salty foods have a greater likelihood of being accepted by infants when compared to foods with bitter flavours, such as certain vegetables. Both infants and young children can learn to accept a greater variety of foods and flavours through repeated exposure.[28] Thus, in a sense, breastfeeding gives the infant early, repeated exposure to the flavours of the mother's diet, providing a flavour bridge that promotes the infant's acceptance of familiar flavours when they appear in solid foods.[25]

As a result, breastfed infants may be more accepting of new foods and likely to consume a more varied diet later in life, depending on the variety of the mother's diet during breastfeeding.[26,29]

Parental Feeding Practices: Parents as Providers, Models, and Regulators

Parents influence children's eating behaviour in a variety of ways: parents actively make food choices for the family, serve as models for dietary choices and patterns, and use feeding practices to reinforce the development of eating patterns and behaviours that they deem appropriate. Parenting practices are also influenced by the child's characteristics, including age, gender, weight status and eating behaviour.[12,30] Thus, parent and child affect and react to one another's eating behaviour. Additionally, parenting practices are often a response to parents' perceived threats to their children's health and development.[31] As discussed above, food scarcity has historically been the major threat to children's health and development and traditional feeding practices have developed accordingly. In this context, many societies perceive larger infants as healthy and a sign of successful parenting.[32] Therefore, feeding strategies in these societies are designed to increase children's intake, reduce distress and promote weight gain. However, when these strategies persist in environments with over-abundance of food, they tend to promote unhealthy diets, accelerated weight gain, and obesity.

With respect to the foods parents select for their children, the FITS study[6] suggests that the “bigger is better” mentality may also be influencing parental feeding practices regarding the portion sizes and energy density of foods offered to children, both of which can increase children's total energy intake. Parents participating in FITS reported serving large portions of energy dense foods[7], which may negatively impact children's eating behaviour and weight status.[33] The few studies that have investigated the influence of portion size on children's eating behaviours reveal that it is positively associated with increased energy intake and body weight.[33,34]

Children also learn about food by observing the eating behaviours modeled by others. For example, research reveals that children's intake of fruits, vegetables, and milk increased after observing adults consuming the foods.[35] When children observed the eating behaviour of their peers, the effect was similar such that selection and consumption of vegetables increased.[36] Thus, positive social modeling is an indirect, yet effective practice for promoting healthier diets in children.

Parents who are concerned about their child's diet may attempt to limit what and how much food is eaten, pressure their child to eat a healthier diet, or reward their child for eating healthy foods, practices which may all lead to unintended consequences.[27,37,38] Excessive restriction of children's access to, and intake of, highly palatable foods can promote increased preference for, and over consumption of, those restricted foods when they are readily available.[37,38] Highly restricted children have poorer self regulation of energy intake, which is associated with greater weight gain across childhood.[27,37,38] Similarly, research indicates that encouraging or pressuring children to consume more fruits and vegetables is associated with lower fruit and vegetable intakes[39], and higher intakes of dietary fat.[40] In addition, using food as a reward may also have inadvertent effects in that rewarding children for consuming healthy foods actually results in decreased preference for those foods.[41] These findings indicate that, regardless of parents' rationale for controlling their child's eating behaviours, excessive control may have negative impacts on child food intake and weight status.

With respect to parenting styles, an authoritarian style of feeding, in which eating demands placed on children are high and responsiveness to children's needs are low, promote overeating, overweight, food rejection and picky eating.[42] In contrast, an authoritative style of feeding, characterized by placing high demands on eating behaviour while also being highly responsive

to eating cues, may promote healthier eating behaviours.[43] In combination with what is known about the effect of parental modeling on children's eating behaviours there is consistent evidence that the responsive “do as I do” approach has a stronger positive effect on children's consumption patterns than the unresponsive “do as I say” approach to parenting.

Children's Eating Away From Home: Childcare and School

A higher percentage of mothers are entering or re-entering the workforce than ever before[44] and as a consequence young children are routinely being fed by someone else. Child care settings should provide appropriate food to meet one half to two thirds of children's daily energy and nutrient requirements.[45] However, evaluation of actual intakes at childcare centers in the United States reveals that children often fail to consume recommended intakes of energy, iron, zinc, and magnesium.[46] Furthermore, a recent study comparing dietary intakes of U.S. children who attend childcare with recommendations in the Food Guide Pyramid found that only 5% of 4-year-old and 25% of 5-year-old children met two thirds of their estimated energy requirements, and their intake of grains, vegetables, and dairy were inadequate.[47] These findings indicate that there exists a tremendous opportunity to improve the role of childcare centers in serving as a venue for children to learn to accept and consume healthy foods.[48]

Similarly, the school environment can also help to teach children about dietary patterns and eating behaviours. Almost 50% of school children in the United States participate in the National School Lunch Program (NSLP)[49] which requires the meals served to be consistent with the Dietary Guidelines for Americans and adhere to the RDAs for protein, vitamin A, vitamin C, iron, calcium, and calories.[50] Yet, students' measured intakes from the NSLP often do not meet recommended intakes of energy, vitamin A, and iron.[51] Furthermore, schools also provide access to competitive food sources (such as vending machines), which may contribute to poor diet quality depending on the nature of the foods sold.[52,53]

Changing Eating Behaviours: What Works?

Many school based interventions have attempted to modify children's eating behaviour, diet, nutrition knowledge, and television viewing.[45] A recent examination of the progress made since the release of the 2004 Institute of Medicine report on the Progress in Prevention of Childhood Obesity by school-based obesity prevention initiatives in the United States revealed that many of the current interventions are focusing on improving the nutritional quality and portion sizes of foods and beverages available in schools.[48] However, this report highlighted two major limitations to these efforts: (1) comparison of the effectiveness of different interventions is difficult because schools vary widely in their resources, commitment to improvement, and intervention evaluation efforts; and (2) insufficient attention is being placed on improving preschool and childcare environments.[48]

Despite these limitations, several recent reviews summarizing the effectiveness of school-based nutrition interventions show some success has been achieved in changing eating behaviour, but less success has been achieved in changing indicators of obesity.[54-56] It should be noted that the majority of these interventions only lasted 3 to 6 months; the few studies that do report long term follow-up data reveal that changes in eating behaviour and weight status are less pronounced over longer periods of time.[55] Moreover, a study examining the effectiveness of Canadian school-based programs indicates that rates of overweight are significantly lower among students participating in the Annapolis Valley Health Promoting Schools Project (see Table 1 for details on the project)[57], than among students from schools without a nutrition program. However, rates of overweight did not differ between students attending schools that provided healthy menu alternatives and students from schools without programs.[58] Thus, more work is needed to improve the effectiveness of the school-based interventions currently available.

There are several strengths and weaknesses associated with school-based intervention strategies. One strength is that most U. S. children attend school and are estimated to eat between 19% and 50% of their daily energy intake at school.[59] Schools also provide a host of resources such as gyms, tracks, fields, physical education, health curriculum, food service systems, and program implementers such as teachers and nurses.[60] As well, schools also provide ready access to a variety of racial and ethnic groups of varying age and socioeconomic status.[61] Studies also indicate that school-based interventions are cost-effective.[56] One major limitation of school-based prevention is that interventions are typically administered at the local level, making wide-scale evaluation of prevention strategies difficult. In addition, teachers and administrators report that time-constraints, other curriculum priorities, and lack of financial resources are obstacles to effective implementation and evaluation.[48] Another limitation is that by the time a child enters school, they already have many preferences for food and eating.[27, 28,41] Additionally, programs targeting younger children have been shown to be more successful than those with adolescents.[61] Given these findings, and the fact that approximately 20% of children entering school are already overweight[1] waiting until children are in school overlooks what may be our best opportunity to prevent obesity: the first few years of life.

Suggestions for Healthy Eating Interventions

Conclusions from several comprehensive reports examining the modifiable determinants of childhood obesity (including eating behaviours) suggest that early intervention, i.e., prenatal and the first years of a child's life, may be the optimal window for promoting the development of healthy eating behaviours in children.[45,62] As reviewed above, experiences with food and food preferences begin in infancy and continue to develop as children transition to solid foods. During this time, children's food preferences are also influenced by availability, accessibility, and familiarity to foods as well as parental modeling. Thus, if children are to learn to prefer and select healthy foods, they need early, positive, repeated experiences with those foods.

Table 2 highlights several aspects of parent and caregiver behaviour related to child feeding practices that should be targeted by education, prevention and intervention efforts. The evidence reviewed above also supports the importance of parents and caregivers as primary influencers and gatekeepers of children's eating behaviours. It is not surprising that caregivers play a critical role in developing children's food preferences, but the poor diet quality of North American children suggests that parents need guidance in this area. Interventions targeting parent and caregiver attitudes and behaviours may prove most effective for the promotion of healthy dietary habits in children.

Even with an emphasis on early prevention, healthy eating behaviours will also need to be taught and reinforced in family, school and community environments throughout childhood and adolescence, as these contexts continually have influences on and interactions with characteristics and behaviours of both parents and children. Early intervention alone is not enough; effective prevention requires consistent, continuing and age appropriate strategies. Additionally, many of the interventions used today to modify eating behaviours adopt the “kitchen sink” approach: a large number of intervention components are included with the hope that at least one or two will have an effect on the desired outcome.

However, as discussed above, to date there have been few successful interventions to improve children's dietary patterns. New approaches to developing effective interventions, such as the multiphase optimization strategy (MOST) proposed by Collins and colleagues[64], where program components are individually tested before inclusion into an intervention, may provide insights into more efficient ways to design and implement more effective interventions to establish and promote optimal eating behaviours during childhood.

In conclusion, children's eating behaviours are susceptible to many external influences within their families, schools and communities. Currently, many of these influences promote dietary patterns that predispose to obesity. Fortunately, these influences can also act to promote healthy dietary practices. Incorporation of the current knowledge concerning the multifaceted influences on children's eating behaviours into evidence-based prevention and intervention efforts is needed to help improve the diet quality and eating behaviours of youth.

References

1. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999-2004. Jama 2006;295(13):1549–1555. [PubMed: 16595758]
2. Nielsen SJ, Siega-Riz AM, Popkin BM. Trends in energy intake in U.S. between 1977 and 1996: similar shifts seen across age groups. Obes Res 2002;10(5):370–378. [PubMed: 12006636]
3. Bowman SA, Gortmaker SL, Ebbeling CB, Pereira MA, Ludwig DS. Effects of fast-food consumption on energy intake and diet quality among children in a national household survey. Pediatrics 2004;113 (1 Pt 1):112–118. [PubMed: 14702458]
4. Nielsen SJ, Popkin BM. Patterns and trends in food portion sizes, 1977-1998. Jama 2001;289(4):450–453. [PubMed: 12533124]
5. Munoz KA, Krebs-Smith SM, Ballard-Barbash R, Cleveland LE. Food intakes of US children and adolescents compared with recommendations. Pediatrics 1997;100(3 Pt 1):323–329. [PubMed: 9282700]
6. Fox MK, Devaney B, Reidy K, Razafindrakoto C, Ziegler P. Relationship between portion size and energy intake among infants and toddlers: evidence of self-regulation. J Am Diet Assoc 2000;106(1 Suppl 1):S77–83. [PubMed: 16376632]
7. Fox MK, Pac S, Devaney B, Jankowski L. Feeding infants and toddlers study: What foods are infants and toddlers eating? J Am Diet Assoc 2004;104(1 Suppl 1):S22–30. [PubMed: 14702014]
8. Lytle LA, Seifert S, Greenstein J, McGovern P. How do children's eating patterns and food choices change over time? Results from a cohort study. Am J Health Promot 2000;14(4):222–228. [PubMed: 10915532]
9. Mannino ML, Lee Y, Birch LL, Mitchell DC, Smiciklas-Wright H. The quality of girls' diets declines and tracks across middle childhood. International Journal of Behavioral Nutrition and Physical Activity 2004;1:5. [PubMed: 15169562]
10. Garnguet, D. Statistics. Health Statistics Division; Canada: 2004. Nutrition Findings from the Canadian Community Health Survey Overview of Canadians' Eating Habits.
11. Siega-Riz AM, Carson T, Popkin B. Three squares or mostly snacks–what do teens really eat? A sociodemographic study of meal patterns. J Adolesc Health 1998;22(1):29–36. [PubMed: 9436064]
12. Nielsen SJ, Siega-Riz AM, Popkin BM. Trends in food locations and sources among adolescents and young adults. Prev Med 2002;35(2):107–113. [PubMed: 12200094]
13. Fiorito LM, Mitchell DC, Smiciklas-Wright H, Birch LL. Dairy and dairy-related nutrient intake during middle childhood. J Am Diet Assoc 2006;106(4):534–542. [PubMed: 16567149]
14. Gillman MW, Rifas-Shiman SL, Frazier AL, Rockett HR, Camargo CA Jr. Field AE, Berkey CS, Colditz GA. Family dinner and diet quality among older children and adolescents. Arch Fam Med 2000;9(3):235–240. [PubMed: 10728109]
15. American Academy of Pediatrics. Breastfeeding and the use of human milk Work group on breastfeeding. Pediatrics 1997;100(6):1035–1039. [PubMed: 9411381]
16. Dewey KG. Is breastfeeding protective against child obesity? J Hum Lact 2003;19(1):9–18. [PubMed: 12587638]
17. Kramer MS. Do breast-feeding and delayed introduction of solid foods protect against subsequent obesity? J Pediatr 1981;98(6):883–887. [PubMed: 7229789]
18. Owen CG, Martin RM, Whincup PH, Smith GD, Cook DG. Effect of infant feeding on the risk of obesity across the life course: a quantitative review of published evidence. Pediatrics 2005;115(5): 1367–1377. [PubMed: 15867049]

19. Wright, P. Hunger, satiety and feeding behavior in early infancy. In: Boakes, R.; Popplewell, D.; Burton, M., editors. Eating habits: Food, physiology and learned behavior. John Wiley and Sons; New York: 1987. p. 75-95.
20. Crow RA, Fawcett JN, Wright P. Maternal behavior during breast- and bottle-feeding. J Behav Med 1980;3(3):259–277. [PubMed: 7441727]
21. Wright P, Fawcett J, Crow R. The development of differences in the feeding behaviour of bottle and breast fed human infants from birth to two months. Behavioural Processes 1980;5:1–20.
22. 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. [PubMed: 6104082]
23. Savino F, Costamagna M, Prino A, Oggero R, Silvestro L. Leptin levels in breast-fed and formula-fed infants. Acta Paediatr 2002;91(9):897–902. [PubMed: 12412862]
24. Mennella JA, Beauchamp GK. Early flavor experiences: research update. Nutr Rev 1998;56(7):205–211. [PubMed: 9697386]
25. Mennella JA, Jagnow CP, Beauchamp GK. Prenatal and postnatal flavor learning by human infants. Pediatrics 2001;107(6):E88. [PubMed: 11389286]
26. Mennella JA, Griffin CE, Beauchamp GK. Flavor programming during infancy. Pediatrics 2004;113 (4):840–845. [PubMed: 15060236]
27. Birch LL, Fisher JO. Development of eating behaviors among children and adolescents. Pediatrics 1998;101(3 Pt 2):539–549. [PubMed: 12224660]
28. 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.
29. Galloway AT, Lee Y, Birch LL. Predictors and consequences of food neophobia and pickiness in young girls. J Am Diet Assoc 2003;103(6):692–698. [PubMed: 12778039]
30. Shanahan MJ, Hofer SM. Social context in gene-environment interactions: retrospect and prospect. J Gerontol B Psychol Sci Soc Sci 2005;60(Spec No 1):65–76. [PubMed: 15863711]
31. Costanzo P, Woody E. Domain-specific parenting styles and their impact on the child's development of particular deviance: The example of obesity proneness. Journal of Social & Clinical Psychology 1985;3(4):425–445.
32. Baughcum AE, Burklow KA, Deeks CM, Powers SW, Whitaker RC. Maternal feeding practices and childhood obesity: a focus group study of low-income mothers. Arch Pediatr Adolesc Med 1998;152 (10):1010–1014. [PubMed: 9790612]
33. McConahy KL, Smiciklas-Wright H, Mitchell DC, Picciano MF. Portion size of common foods predicts energy intake among preschool-aged children. J Am Diet Assoc 2004;104(6):975–979. [PubMed: 15175599]
34. Orlet Fisher J, Rolls BJ, Birch LL. Children's bite size and intake of an entree are greater with large portions than with age-appropriate or self-selected portions. Am J Clin Nutr 2003;77(5):1164–1170. [PubMed: 12716667]
35. Young EM, Fors SW, Hayes DM. Associations between perceived parent behaviors and middle school student fruit and vegetable consumption. J Nutr Educ Behav 2004;36(1):2–8. [PubMed: 14756976]
36. Birch LL. Effects of peer models' food choices and eating behaviors on preschoolers' food preference. Child Development 1980;51:489–496.
37. Fisher JO, Birch LL. Restricting access to palatable foods affects children's behavioral response, food selection, and intake. Am J Clin Nutr 1999;69(6):1264–1272. [PubMed: 10357749]
38. Faith MS, Scanlon KS, Birch LL, Francis LA, Sherry B. Parent-child feeding strategies and their relationships to child eating and weight status. Obes Res 2004;12(11):1711–1722. [PubMed: 15601964]
39. Fisher JO, Mitchell DC, Smiciklas-Wright H, Birch LL. Parental influences on young girls' fruit and vegetable, micronutrient, and fat intakes. J Am Diet Assoc 2002;102(1):58–64. [PubMed: 11794503]
40. Lee Y, Birch LL. Diet quality, nutrient intake, weight status, and feeding environments of girls meeting or exceeding the American Academy of Pediatrics recommendations for total dietary fat. Minerva Pediatr 2002;54(3):179–186. [PubMed: 12070476]

41. Birch LL, Marlin DW, Rotter J. Eating as the “means” activity in a contingency: effects on young children's food preferences. Child Development 1984;55:432–439.
42. Hughes SO, Power TG, Orlet Fisher J, Mueller S, Nicklas TA. Revisiting a neglected construct: parenting styles in a child-feeding context. Appetite 2005;44(1):83–92. [PubMed: 15604035]
43. Rhee KE, Lumeng JC, Appugliese DP, Kaciroti N, Bradley RH. Parenting styles and overweight status in first grade. Pediatrics 2006;117(6):2047–2054. [PubMed: 16740847]
44. U. S. Census Bureau. A databook. US Department of Labor; 2004. Women in the labor force.
45. Koplan JP, Liverman CT, Kraak VI. Preventing childhood obesity: helath in the balance: executive summary. J Am Diet Assoc 2005;105(1):131–138. [PubMed: 15635359]
46. Roberts SB, Heyman MB. Micronutrient shortfalls in young children's diets: common, and owing to inadequate intakes both at home and at child care centers. Nutr Rev 2000;58(1):27–29. [PubMed: 10697392]
47. Padget A, Briley ME. Dietary intakes at child-care centers in central Texas fail to meet Food Guide Pyramid recommendations. J Am Diet Assoc 2005;105(5):790–793. [PubMed: 15883557]
48. Institute of Medicine Committee on Progress in Preventing Childhood Obesity. Progress in preventing childhood obesity: How do we measure up?. Koplan, JP.; Liverman, CT.; Kraak, VI.; Wisham, SL., editors. The National Academies Press; Washington, D.C.: 2006.
49. U. S. Department of Education. National Center for Education Statistics. U. S. Department of Education; Washington D.C.: 2002. Projections of education statistics to 2012. Report 2002-030 [Online] Available: http://www.nces.ed.gov/pubs2002/2002030.pdf
50. Dietz WH. Critical periods in childhood for the development of obesity. American Journal of Clinical Nutrition 1994;59:955–959. [PubMed: 8172099]
51. Lee HS, Lee KE, Shanklin CW. Elementary students' food consumption at lunch does not meet recommended dietary allowance for energy, iron, and vitamin A. J Am Diet Assoc 2001;101(9): 1060–1063. [PubMed: 11573762]
52. French SA, Story M, Fulkerson JA, Gerlach AF. Food environment in secondary schools: a la carte, vending machines, and food policies and practices. Am J Public Health 2003;93(7):1161–1167. [PubMed: 12835203]
53. Cullen KW, Eagan J, Baranowski T, Owens E, de Moor C. Effect of a la carte and snack bar foods at school on children's lunchtime intake of fruits and vegetables. J Am Diet Assoc 2000;100(12): 1482–1486. [PubMed: 11138440]
54. Sharma M. School-based interventions for childhood and adolescent obesity. Obes Rev 2006;7(3): 261–269. [PubMed: 16866974]
55. Collins CE, Warren J, Neve M, McCoy P, Stokes BJ. Measuring effectiveness of dietetic interventions in child obesity: a systematic review of randomized trials. Arch Pediatr Adolesc Med 2006;160(9): 906–922. [PubMed: 16953014]
56. Flodmark CE, Marcus C, Britton M. Interventions to prevent obesity in children and adolescents: a systematic literature review. Int J Obes (Lond) 2006;30(4):579–589. [PubMed: 16570086]
57. Annapolis Valley Health Promoting Schools. Making the healthy choice the easy choice. Accessed January 12, 2007, Available at: http://www.hpclearinghouse.ca/features/AVHPSP.pdf
58. Veugelers PJ, Fitzgerald AL. Effectiveness of school programs in preventing childhood obesity: a multilevel comparison. Am J Public Health 2005;95(3):432–435. [PubMed: 15727972]
59. Gleason, P.; Suitor, C.; U. S. Food and Nutrition Service. Special Nutrition Programs. U.S. Department of Agriculture. Food and Nutrition Service; Alexandria, Va: 2001. Children's diets in the Mid-1990's. Dietary intake and its relationship with school meal participation. Report no. CN-01-CD1
60. Ebbeling CB, Pawlak DB, Ludwig DS. Childhood obesity public-health crisis, common sense cure. Lancet 2002;360(9331):473–482. [PubMed: 12241736]
61. Story M. School-based approaches for preventing and treating obesity. Int J Obes Relat Metab Disord 1999;23(Suppl 2):S43–51. [PubMed: 10340805]
62. Gidding SS, Dennison BA, Birch LL, Daniels SR, Gilman MW, Lichtenstein AH, Rattay KT, Steinberger J, Stettler N, Van Horn L. Dietary recommendations for children and adolescents: a guide for practitioners. Pediatrics 2006;117(2):544–559. [PubMed: 16452380]

63. Bronfenbrenner, U.; Morris, P. The ecology of human developmental processes. In: Damon, W.; Eisenberg, N., editors. Theoretical Models of Human Development. John Wiley & Sons; New York: 1998. p. 993-1028.

64. Collins LM, Murphy SA, Nair VN, Strecher VJ. A Strategy for Optimizing and Evaluating Behavioral Intervetions. Annals of Behavioral Medicine 2005;30(1):65–73. [PubMed: 16097907]

Table 1

Annapolis Valley Health Promoting Schools Project Details

Goal: To enable children to make healthy food and physical activity choices on a daily basis and provide them with skills to develop healthy eating and activity behaviours for life.

Scope: A 2½ year project evaluated in 8 schools in the Annapolis Valley Regional School Board in Nova Scotia.

Strategy:

- Student involvement and family inclusion
- Community cooperation
- Healthy menu choices
- Affordable food pricing
- School food policies
- Daily physical activity
- Fitness equipment; affordable and accessible physical activity opportunities
- Health and nutrition curriculum
- Healthy environments
- Modeling healthy attitudes and behaviours

Results:

- Better diets
- More physically active
- Less screen time
- 59% decrease in prevalence of overweight
- 72% decrease in prevalence of obesity

Table 2

Recommendations for parents and caregivers to be included in early prevention and intervention efforts

• Encourage breastfeeding when possible for the first 6 months of life
• Eat a varied diet during pregnancy and lactation to create for your infant a “flavour bridge” to the modified adult diet
• Practice responsive parenting by discriminating hunger from other distress cues and avoiding always using food to comfort your child
• Provide positive, repeated exposure to novel foods (especially typically rejected foods, such as vegetables) to promote acceptance of and preference for those foods
• Offer developmentally appropriate and healthy foods to your child during the transition to solids
• Serve portion sizes that are developmentally appropriate for your child's age and nutrient needs
• Choose when and what your child should eat, but let your child decide how much to eat
• Trust a child of normal weight status to self-regulate his own intake
• Make a wide variety of nutrient-dense rather than energy-dense, nutrient poor foods available and accessible to your child
• Use your own behaviours and attitudes to model healthy dietary patterns
• Create a positive feeding environment by initiating regular family meals