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Commentary

Would offering vegetables to children for breakfast increase their total daily vegetable intake?

Abstract

The consumption of vegetables is vitally important for children's health and development. However, in many Westernised countries, most children do not eat sufficient quantities of vegetables and consume many energy-dense and high-sugar foods; a health behaviour associated with the onset of non-communicable diseases. To address this important public health concern, it is necessary to think 'outside the box' and consider innovative and pragmatic ways to increase children's daily vegetable intake. In many countries, caregivers implementing best-practice child feeding methods typically offer children vegetables at lunch, dinner and for snacks. It is unusual for children to be routinely offered vegetables for breakfast, yet there is no nutritional, physiological or medical reason why vegetables should not be eaten at breakfast. Indeed, in some countries, children frequently consume vegetables for breakfast. Increasing children's exposure to vegetables at breakfast from an early age would allow for the development of a positive association between eating vegetables and breakfast, thus providing another opportunity in the day where vegetables might be regularly consumed by children. In this paper, we propose a rationale for why vegetables should be routinely offered to young children at breakfast time in countries where this may not be the norm. Future research assessing the feasibility and acceptability of such a public health intervention would provide health policy agencies with evidence about a potentially effective and easily implementable approach for increasing children's vegetable intake, thus improving their overall nutritional status, as well as their heath and development.

Keywords
Children
Feeding practices
Healthy eating
Vegetables
Health behaviour change

The consumption of vegetables is critical for children's health and development[1] with many economically developed countries implementing public health strategies to promote vegetable consumption early in childhood[2]. This is necessary because the majority of children in these countries do not eat sufficient vegetables each day that may negatively impact their health, well-being and development[3,4]. For example, in the UK, fewer than one in five children eat five portions of fruit and vegetables each day, the recommended daily intake[5], with one in three 5–10-year-olds eating less than one portion of vegetables a day[6]. These concerning UK-based data are reflected similarly in other Westernised countries[7–9]. Children's consumption of a diet based on energy-dense highly palatable foods lacking in fruit and vegetables is a significant public health issue as this diet composition is associated with the onset of noncommunicable diseases such as obesity, some cancers and CVD[10–13].

Strategies for increasing children's vegetable consumption

To optimise the way in which parents/caregivers feed their children, practical guidelines have been developed from empirical research findings[14]. These guidelines reinforce the importance of children being exposed to vegetables from an early age for optimal health and development[15]. For example, Mennella *et al.*[16] found that mothers who drank carrot juice during pregnancy had children who were more likely to eat and enjoy the flavour of carrots at the complementary feeding stage compared to a control group. Research has also shown that the approach taken to introduce children to solid foods can substantially influence their liking and consumption of foods[17]. Of relevance here is evidence showing that young children who are exposed to raw vegetables during complementary feeding, compared to those who are not, demonstrated greater liking and consumption of raw vegetables in later childhood[18]. Research also shows that it can take up to fifteen attempts at trying a food before children learn to like it[1,19,20]. This highlights the need for persistence in offering children a disliked food which is likely to be particularly true for vegetables as they are frequently rejected and require repeated offering before acceptance[21]. It is also important to highlight that although children's vegetable (and micronutrient) intake can be increased covertly, such as by adding or masking vegetables in other foods (e.g. smoothies[22,23],

overt repeated exposure is required to support many children with learning to like the taste of vegetables so that vegetables become an accepted part of their diet across their lifespan[24].

Over the past two decades, substantial evidence has been presented showing that most children do not meet the WHO's recommendation that the public consumes five or more portions (≥400 g) of fruit and vegetables each day[25,26]. While many countries have attempted to increase children's vegetable intake through national child feeding guidance and public health interventions, these strategies and policies have been relatively ineffective as a high proportion of children in most Westernised countries continue to consume an insufficient amount of vegetables each day[6,27]. To address this, it is necessary to consider more innovative and pragmatic ways to increase children's vegetable intake. In Westernised countries, caregivers implementing best practice child feeding methods offer children vegetables at lunch, dinner and for snacks, but it is unusual for children to be routinely offered vegetables for breakfast. One reason for this may be that vegetables are perceived as an 'inappropriate' food to be offered/served to children at this time of the day.

Food-to-mealtime associations

In various countries across the world – particularly Westernised countries – breakfast typically consists of high glycaemic index foods such as cereals, bread products such as toast/bagels with spread, yogurt and/or fruit[28,29]. These foods are likely to be consumed for breakfast because of cultural influences and social norms about food choice and time constraints for families in the morning[30]. Through repetition and reinforcement from an early age, food-related routines form and influence perceptions about the appropriateness of when to consume particular foods[31]. Research suggests that children aged 2–3 years begin to associate foods with particular contexts (e.g. a cake is eaten at birthdays, cereal is eaten for breakfast)[32,33], with other research demonstrating that these food-to-mealtime associations persist into adulthood[31]. Indeed, the significant role of food-to-mealtime-associations in influencing people's eating behaviours is such that consuming a particular food outside of its appropriate context can impact how the food will be perceived and eaten[34,35]. Food-to-mealtime routines become embedded in everyday eating decisions with research showing that perceived situational appropriateness can predict the food chosen in a given context, as well as the expected and actual momentary liking of the food[36]. An important point to consider is that the nutrient composition of a food remains the same regardless of where and when it is consumed. However, individuals' perception of a food, whether it will be chosen for consumption and how it is eaten, can differ depending on the time or context in which it is eaten.

The case for offering children vegetables at breakfast time

As highlighted earlier, through a process of repetition and reinforcement, vegetable consumption is often associated with midday and evening mealtimes, and for snacks, but vegetables are seldom associated with and consumed for breakfast. However, there is no nutritional, physiological or medical reason why children should not be routinely offered vegetables at breakfast. Indeed, in some countries across the world (e.g. China, Japan, Romania and Finland), breakfast foods are often indistinguishable from lunch or dinner foods[37] with vegetables (e.g. cucumbers and sweet peppers) frequently offered for breakfast from childhood[38–41]. Moreover, offering vegetables at breakfast is already part of current government guidance for early-years settings in England[42] (p.11).

There are several reasons why routinely offering children vegetables at breakfast time might be an important public health intervention. First, breakfast is a routine time in the day when most children eat; therefore, this would be a salient time to target increasing children's daily vegetable intake. Second, children regularly consume vegetables as snacks or at other mealtimes so offering children vegetables at breakfast is not an entirely new behaviour. More specifically, as food-to-context associations start to form around the age of 2–3 years, offering vegetables to children early in life should mean that there is no pre-conditioned negative association between vegetables and breakfast time. Instead, children should learn from an early age that vegetables can be eaten at any mealtime. Primary caregivers have a key role to play in facilitating this learning through regular and frequent role-modelling, positive reinforcement and repeatedly offering vegetables to children in this context. However, primary caregivers (e.g. parents/guardians) may face barriers to facilitating this learning; for example, research has shown that primary caregivers who are full-time employed may face time constraints and competing commitments contributing to fewer meals prepared and eaten with their children and poorer nutritional quality of the meal[43]. Individuals within a child's social network (e.g. grandparents, childminders and teachers) also have a key role to play in setting norms surrounding vegetable consumption[44], and one particular component of a child's social network that presents a pragmatic location for normalising the consumption of vegetables at breakfast time is at nursery/kindergarten. Most children attend nurseries/kindergarten and other early-learning settings prior to attending school, so the routine implementation of vegetables at breakfast within these

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settings would facilitate development of the healthy habit of eating vegetables at breakfast around their peers, further normalising this offering which can be replicated by parents/caregivers at home.

As vegetables often have a low energy density due to their high water content and low levels of dietary fat, it is likely that their consumption would have little impact on children's overall daily energy intake, limiting the contribution they would have on the development of overweight/obesity in children[45,46]. It is also likely that vegetables can be included at breakfast both in addition to typical breakfast foods (e.g. in a bowl alongside toast or cereal) and/or to replace typical breakfast foods (or at least energy-dense high-sugar foods) to help improve children's overall health.

Would offering vegetables to children at breakfast increase their daily vegetable intake?

Previous research is clear that repeated exposure to a food increases children's familiarity with that food and, subsequently, their willingness to eat it[33]. Research has also shown that increasing the vegetable offering (in variety and frequency) to children in a childcare setting increases consumption and the likelihood that vegetables are selected[47]. It is also clear that, when vegetables are consumed by children, this rarely occurs at breakfast time with researchers calling for further investigation to understand how to encourage vegetable intake in atypical contexts (e.g. breakfast)[48]. It therefore follows that offering vegetables to young children at breakfast would provide additional exposures, support children's learning that eating vegetables for breakfast is a typical behaviour and increase children's willingness to eat vegetables. Furthermore, eating vegetables at breakfast time may also encourage children to increase their vegetable consumption at other times of the day through additional exposure and normalisation of vegetables as part of a varied diet. If research was undertaken and the findings demonstrated that offering vegetables to children for breakfast at nursery/kindergarten increased children's daily vegetable intake and/or liking of vegetables, it would be necessary to interact with stakeholders on all levels presented in the socio-ecological model[49] to instigate effective behaviour change. For example, national policymakers globally should be consulted to disseminate the information to all nurseries/kindergartens encouraging the provision of vegetables at breakfast. Even in countries such as England where offering vegetables at breakfast is already part of national guidance[42] (p.11), a communication and education strategy would need to be implemented to support the transfer of guidance into routine behaviour. National accreditation boards (such as OFSTED in the UK) should also be part of the plans to implement the guidance in nurseries/kindergartens by mandating the provision of vegetables at breakfast to adhere to accreditation criteria.

However, while there may be many benefits to offering children vegetables at breakfast time, consideration should also be given to potential issues around the everyday implementation of such an approach. For instance, it may be that parents are reluctant to offer children vegetables at this mealtime because it would require additional preparation time and cost (both in regard to home shopping bills and nursery/kindergarten fees). Furthermore, in out-of-home contexts, nursery/kindergarten staff are typically very busy in the mornings and may find it difficult to prepare vegetables for children at breakfast. With these issues in mind, it would be important to undertake research to assess the feasibility and acceptability of this approach.

Conclusion

In many Westernised countries, children do not eat sufficient vegetables to support their optimal health and development, and therefore interventions are required to address this. Indeed, with governments and policymakers realising the importance of increasing children's vegetables intake to improve public health for generations to come, but with current strategies having limited success, it is now necessary to think outside the box and consider innovative public health interventions to increase children's vegetable intake. One novel way of increasing children's daily intake of vegetables is to capitalise on the opportunity to offer vegetables at breakfast time and to normalise this practice, as occurs in other countries around the world. Whether this type of intervention is feasible and acceptable to both children and their caregivers is not currently known. However, such research is vital to provide health policy agencies with much-needed evidence about a potentially effective, easily implementable way of increasing children's daily vegetable.

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References

1. Nekitsing C, Blundell-Birtill P, Cockroft JE *et al.* (2018) Systematic review and meta-analysis of strategies to increase vegetable consumption in preschool children aged 2–5 years. *Appetite* **127**, 138–154.
2. Koletzko B, Hirsch NL, Jewell JM *et al.* (2020) National recommendations for infant and young child feeding in the World Health Organization European region. *J Pediatr Gastroenterol Nutr* **71**, 672–678.
3. Hayhoe R, Rechel B, Clark AB *et al.* (2021) Cross-sectional associations of schoolchildren's fruit and vegetable consumption, and meal choices, with their mental well-being: a cross-sectional study. *BMJ Nutr Prev Health* **4**, e000301.
4. Hoerr SL, Hughes SO, Fisher JO *et al.* (2009) Associations among parental feeding styles and children's food intake in families with limited incomes. *Int J Behav Nutr Phys Act* **6**, 55–62.
5. NHS Digital (2018) Health Survey for England [NS]. https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england/2018 (accessed August 2022).
6. The Food Foundation (2020) Veg Facts 2020: In Brief. https://foodfoundation.org.uk/publication/veg-facts-2020-brief (accessed August 2022).
7. Glenn ME, Patlan K, Stidsen CM *et al.* (2021) Dietary intakes of children enrolled in US early child care programs on child care and non-child care days. *J Acad Nutr Diet* **122**, 1141.e3–1157.e3.
8. Attorp A, Scott JE, Yew AC *et al.* (2014) Associations between socioeconomic, parental and home environment factors and fruit and vegetable consumption of children in grades five and six in British Columbia, Canada. *BMC Public Health* **14**, 150.
9. Australian Bureau of Statistics (2014) Australian Health Survey: Nutrition First Results – Foods and Nutrients. https://www.abs.gov.au/statistics/health/health-conditions-and-risks/australian-health-survey-nutrition-first-results-foods-and-nutrients/latest-release (accessed August 2022).
10. Riboli E & Norat T (2003) Epidemiologic evidence of the protective effect of fruit and vegetables on cancer risk. *Am J Clin Nutr* **78**, 559S–569S.
11. Maynard M, Gunnell D, Emmett P *et al.* (2003) Fruit, vegetables, and antioxidants in childhood and risk of adult cancer: the Boyd Orr cohort. *J Epidemiol Community Health* **57**, 218–225.
12. Aune D, Giovannucci E, Boffetta P *et al.* (2017) Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all-cause mortality – a systematic review and dose-response meta-analysis of prospective studies. *Int J Epidemiol* **46**, 1029–1056.
13. Mellendick K, Shanahan L, Wideman L *et al.* (2018) Diets rich in fruits and vegetables are associated with lower cardiovascular disease risk in adolescents. *Nutrients* **10**, 136.
14. Haycraft E, Witcomb GL & Farrow C (2020) The child feeding guide: a digital health intervention for reducing controlling child feeding practices and maternal anxiety over time. *Nutr Bull* **45**, 474–482.
15. Daniels LA (2019) Feeding practices and parenting: a pathway to child health and family happiness. *Ann Nutr Metab* **74**, Suppl. 2, 29–42.
16. Mennella JA, Jagnow CP & Beauchamp GK (2001) Prenatal and postnatal flavor learning by human infants. *Pediatrics* **107**, E88.
17. Brown A, Jones SW & Rowan H (2017) Baby-led weaning: the evidence to date. *Curr Nutr Rep* **6**, 148–156.
18. Chambers L, Hetherington M, Cooke L *et al.* (2016) Reaching consensus on a 'vegetables first' approach to complementary feeding. *Nutr Bull* **41**, 270–276.
19. Sullivan SA & Birch LL (1990) Pass the sugar, pass the salt: experience dictates preference. *Dev Psychol* **26**, 546–551.
20. Holley CE, Haycraft E & Farrow C (2015) "Why don't you try it again?" A comparison of parent led, home based interventions aimed at increasing children's consumption of a disliked vegetable. *Appetite* **87**, 215–222.
21. Holley CE, Haycraft E & Farrow C (2018) Predicting children's fussiness with vegetables: the role of feeding practices. *Matern Child Nutr* **14**, e12442.
22. Rollins BY, Stein W, Keller KL *et al.* (2021) Preschoolers will drink their GREENS! Children accept, like, and drink novel smoothies containing dark green vegetables (DGVs). *Appetite* **162**, 105148.
23. Spill MK, Birch LL, Roe LS *et al.* (2011) Hiding vegetables to reduce energy density: an effective strategy to increase children's vegetable intake and reduce energy intake. *Am J Clin Nutr* **94**, 735–741.
24. Caton SJ, Blundell P, Ahern SM *et al.* (2014) Learning to eat vegetables in early life: the role of timing, age and individual eating traits. *PLoS ONE* **9**, e97609.
25. World Health Organisation (1990) *Diet, Nutrition, and the Prevention of Chronic Diseases*. Geneva: WHO. https://apps.who.int/iris/bitstream/handle/10665/39426/WHO_TRS_797_(part1).pdf?sequence=1 (accessed August 2022).
26. Cooke L (2004) The development and modification of children's eating habits. *Nutr Bull* **29**, 31–35.
27. Beal T, Morris SS & Tumilowicz A (2019) Global patterns of adolescent fruit, vegetable, carbonated soft drink, and fast-food consumption: a meta-analysis of global school-based student health surveys. *Food Nutr Bull* **40**, 444–459.
28. Gibney MJ, Barr SI, Bellisle F *et al.* (2018) Breakfast in human nutrition: the international breakfast research initiative. *Nutrients* **10**, 559.
29. Bian L & Markman EM (2020) Why do we eat cereal but not lamb chops at breakfast ? Investigating Americans' beliefs about breakfast foods. *Appetite* **144**, 104458.
30. Spence C (2021) Explaining diurnal patterns of food consumption. *Food Qual Prefer* **91**, 104198.
31. McLeod CJ, James LJ & Witcomb GL (2020) Food-to-mealtime associations influence food selection in a UK-based sample. *Arch Nutr Food Sci* **1**, 15–19.
32. Nguyen SP (2007) Cross-classification and category representation in children's concepts. *Dev Psychol* **43**, 719–731.
33. Paroche MM, Caton SJ, Vereijken CMJL *et al.* (2017) How infants and young children learn about food: a systematic review. *Front Physiol* **25**, 1046.

https://doi.org/10.1017/S1368980022002002 Published online by Cambridge University Press

34. McLeod CJ, James LJ & Witcomb GL (2020) Eating rate and food intake are reduced when a food is presented in an 'unusual' meal context. *Appetite* **154**, 104799.
35. McLeod CJ, James LJ, Brunstrom JM *et al.* (2020) The influence of expected satiety on portion size selection is reduced when food is presented in an 'unusual' meal context. *Appetite* **147**, 104550.
36. Giacalone D & Jaeger SR (2019) Perceived situational appropriateness as a predictor of consumers' food and beverage choices. *Front Psychol* **10**, 1–21.
37. Bian L & Markman EM (2020) What should we eat for breakfast? American and Chinese children's prescriptive judgments about breakfast foods. *Cogn Dev* **54**, 100873.
38. Suma M (2016) The Many Traditions of the Traditional Romanian Breakfast. https://roadsandkingdoms.com/2016/many-traditions-traditional-romanian-breakfast/ (accessed August 2022).
39. Varpu (2020) The Complete Guide to Finnish Breakfast. https://herfinland.com/finnish-breakfast/ (accessed August 2022).
40. Yang S-S & Zhang Y-X (2010) The research of the differences between Chinese and western diet cultures. *Cross-Cultural Commun* **6**, 75–83.
41. Sproesser G, Imada S, Furumitsu I *et al.* (2018) What constitutes traditional and modern eating? The case of Japan. *Nutrients* **10**, 118.
42. The Children's Food Trust for Public Health England (2017) Example Menus for Early Years Settings in England. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/658870/Early_years_menus_part_1_guidance.pdf (accessed August 2022).
43. Alsharairi NA & Somerset S (2018) Parental work status and children's dietary consumption: Australian evidence. *Int J Consum Stud* **42**, 522–532.
44. Hendrie GA, Lease HJ, Bowen J *et al.* (2017) Strategies to increase children's vegetable intake in home and community settings: a systematic review of literature. *Matern Child Nutr* **13**, e12276.
45. Heo M, Kim RS, Wylie-Rosett J *et al.* (2011) Inverse association between fruit and vegetable intake and BMI even after controlling for demographic, socioeconomic and lifestyle factors. *Obes Facts* **4**, 449–455.
46. Vernarelli JA, Mitchell DC, Hartman TJ *et al.* (2011) Dietary energy density is associated with body weight status and vegetable intake in U.S. children. *J Nutr* **141**, 2204–2210.
47. Roe LS, Meengs JS, Birch LL *et al.* (2013) Serving a variety of vegetables and fruit as a snack increased intake in preschool children. *Am J Clin Nutr* **98**, 693–699.
48. Chawner LR, Blundell-Birtill P & Hetherington MM (2020) Predictors of vegetable consumption in children and adolescents : analyses of the UK national diet and nutrition survey (2008–2017). *Br J Nutr* **126**, 295–306.
49. Bronfenbrenner U (1992) Ecological systems theory. In *Six Theories of Child Development: Revised Formulations and Current Issues*, pp. 187–249 [R Vasta, editor]. London: Jessica Kingsley.

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