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Vegetable preparation practices for 5–6 years old Australian children as reported by their parents; relationships with liking and consumption

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ABSTRACT

Vegetables are the food category least accepted by children, which is a key reason for their low intake. Common sense suggests that vegetable preparation, liking and consumption is idiosyncratic to each vegetable, e.g. carrots may be eaten raw, but raw broccoli may be unacceptable, however scientific evidence is largely lacking. This study measured children's experiences, liking and consumption of vegetables in relation to preparation practices at home. Questionnaire data were collected for a comprehensive range of preparation methods (raw, boiling, steaming, frying, roasting, and seven ways of preparing it with other dishes (e.g. soup)) across five common vegetables, i.e. carrot, potato, broccoli, cauliflower, and green beans. Measures included experience with preparation methods (yes/no), liking (9 point hedonic scale) and consumption frequency (5 point scale). Data were reported by parents for their child ($N = 82$, 5–6 years, low and high vegetable intake), and child/parent pairs were recruited from the Sydney metropolitan area. Parents reported that children consumed an average of 6.8 (SD 3.4) different preparation methods for vegetables at home, including many mixed dishes. The number and type of preparations the child consumed depended on the vegetable type ($p < .0001$). Preparation method was associated with liking of carrot and potato (both $p < .0001$), and with consumption frequency of all vegetables (all $p < .05$). The most and least liked preparations were vegetable specific. Parents reported that vegetables in mixed dishes were generally well accepted by their children, and flavourings were added on average by 54%. The results also showed that a higher vegetable consumption was related to a higher liking, and exposure to more preparation methods. This study demonstrates the potential for further experimental research into preparation practices to increase vegetable acceptance and intake in children. A vegetable by vegetable approach is recommended, with potential cross-vegetable opportunities for flavour–flavour learning and flavour masking strategies including the use of mixed dishes.

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1. Introduction

It has been well established that vegetables are essential for good health, but vegetable intake of children is below recommendations in Australia (CSIRO, 2012) and elsewhere (Lorson, Melgar-Quinonez, & Taylor, 2009; Yngve et al., 2005). Recommended intake for children (4–8 years) in Australia is 2 serves of vegetables per day, but 78% of children do not meet these recommendations (CSIRO, 2012). Sensory acceptance is a key determinant of children's consumption of vegetables, and of foods in general (Bere & Klepp, 2005; Rasmussen et al., 2006; Schwartz, Scholtens, Lalanne, Weenen, & Nicklaus, 2011), and vegetables are the food

category least accepted by children (Caporale, Policastro, Tuorila, & Monteleone, 2009; Cooke & Wardle, 2005; Nicklaus, Boggio, & Issanchou, 2005). The burden of non-communicable disease could be considerably reduced by increased vegetable intake (Lock, Pomerleau, Causer, Altmann, & McKee, 2004). From this perspective, increasing children's vegetable acceptance is important, as food preferences and dietary behaviours developed in childhood often carry through to adulthood (Craigie, Lake, Kelly, Adamson, & Mathers, 2011; Harris, 2008).

Several studies suggest that the way vegetables are prepared influences acceptance and intake in children (Blanchette & Brug, 2005; Caporale et al., 2009; Nicklaus, Boggio, et al., 2005; Zeinstra, Koelen, Kok, & de Graaf, 2007). Recently several experimental taste studies investigated the effect of preparation on children's liking of vegetables. Steaming and boiling without added condiments were equally acceptable (Poelman, Delahunty, & de

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Graaf, 2013; Zeinstra, Koelen, Kok, & de Graaf, 2010), and liking for raw vegetables depended on the vegetable type (Donadini, Fumi, & Porretta, 2012). Boiling and steaming were accepted better than preparations in which heat, or heat and oil, were applied (e.g. baking or frying) in most vegetables when no condiments were added (Poelman & Delahunty, 2011; Zeinstra et al., 2010). However, Donadini et al. (2012) found oven baking with added cheese equally acceptable to boiling across several vegetables, suggesting other ingredients interact with liking for preparation methods.

Low liking for vegetables has in particular been attributed to their flavour, including strong vegetable flavour and bitter taste (Drewnowski & Gomez-Carneros, 2000; Zeinstra, Koelen, Kok, & de Graaf, 2009). Other ingredients in a dish may make these disliked flavours more desirable either by (1) direct masking, whereby the perception changes; (2) by flavour–flavour learning, whereby the positive valence of other ingredients transfers to the vegetable (Hausner, Olsen, & Møller, 2012; Havermans & Jansen, 2007), or (3) by flavour–nutrient learning, whereby positive post-ingestive feedback from energy-providing ingredients increase appreciation. Some first attempts have been made to investigate condiments as a means to increase children's liking for vegetables. Added salt increased green bean intake of toddlers, whereas added fat did not (Bouhali, Issanchou, & Nicklaus, 2011). Addition of a plain or herb-flavoured reduced-fat dip improved vegetable intake in preschoolers (Savage, Peterson, Marini, Bordini, & Birch, 2013), and Fisher et al. (2012) found the same result using a salt and fat containing dip, but only in bitter sensitive children. However, the use of condiments contributing energy, salt and fat to increase vegetable acceptance needs to be carefully considered, due to their potential adverse effects on energy intake and health when consumed in excess.

Overall, these results suggest that the liking for particular vegetables is highly idiosyncratic on preparation method and interaction with other ingredients. There are many different preparation methods, and so far only a small number have been investigated. For example, use of mixed dishes has been suggested as a viable way to increase children's vegetable liking due to its masking effect on flavour (Baxter, Jack, & Schröder, 1998), but as far as we know, has not yet been formally investigated. We sought to explore the influence of preparation method on acceptance using a survey questionnaire so we could include a comprehensive range of preparation methods across several vegetables. Insights from this research can help guide the direction for further experimental research, which by its nature is limited in the number of vegetables and/or preparation methods that can be studied simultaneously, especially in children, who have limited attention span.

The objective of the current study was to explore the association between vegetable preparation practices used by the parent in the home environment, and the child's liking and consumption of 5 commonly consumed vegetables. The hypotheses were that preparation influences vegetable acceptance and intake in children, and that the effect of preparation is vegetable-specific. This study aimed to provide insights to inform parents and practitioners how best to promote vegetable intake in children. Children with low and high vegetable intake were included to determine whether they differed in the role that preparation had on their vegetable acceptance, which can help design tailored strategies to increase intake in low vegetable consumers.

2. Material and methods

2.1. Participants

Data were collected from 82 parents from the Sydney metropolitan area, Australia, (75% female, mean age 39.2 ± 3.9 years) whose child participated in an experimental taste test. Children were 5 or

6 years old (mean age 6.0 ± 0.5 years), and the children's sample was balanced for gender. As we also sought to understand whether different preparation advice was needed for children differing in their vegetable intake, we balanced the sample for vegetable intake. Average daily consumption of vegetables of Australian children between 4 and 8 years is a bit over 1.2 serves (Bowen, Klose, Syrette, & Noakes, 2009), and recommended vegetable intake for this age group is 2 serves/day or more in Australia. Therefore we adopted the criteria of ≤1 serve as low vegetable intake since it was below average, and 2 serves or more as high vegetable intake, as above average and meeting recommendations. Children with an average intake between 1 and 2 serves were excluded. Children/parent pairs were recruited by advertising in local media, schools, childcare centres and nearby worksites, and partially via an external recruitment agency. Results of the taste test are presented elsewhere (Poelman et al., 2013). The study protocol was approved by the CSIRO Human Research Ethics Committee. Written informed consent was obtained, and each parent/child pair received a \$50 retail voucher for their participation.

2.2. Questionnaire

The questionnaire addressed acceptance and consumption frequency of a comprehensive range of preparation methods across 5 commonly consumed vegetables; carrot, potato, broccoli, cauliflower and green beans. For each vegetable, the parent responded for 12 preparation methods how often their child had consumed the vegetable prepared in this way at home (using a 5-point scale ranging from 'very rarely' to 'very frequently'), and how much their child liked the vegetable prepared in this way (using a 9-point hedonic scale (Peryam & Pilgrim, 1957)). The measurement of consumption frequency was subjective, and may have been interpreted by different parents in a slightly different way. However, it allows comparing frequency of consumption of different vegetable preparations relative to each other, which was the main objective of this study, and as such it was analysed as an ordinal variable. If the child had never consumed the vegetable prepared in this way before, they ticked the box "Never consumed it" for this preparation method (Fig. 1).

The preparation methods were generated from earlier data on vegetable home preparation practices (Poelman, Delahunty, Gilbert, & Forde, 2009). Five preparation methods were listed in which the vegetable was consumed "on its own", as part of the main meal served separate on the plate from other meal components e.g. meat/fish: boiled, steamed, roasted, fried, raw; and seven preparations where the vegetable was consumed as part of "a mixed dish", i.e. ingredients of the meal are mixed together: pasta, curry, stew, stir fry, soup, salad and mixed vegetables. For consistency and comparison all preparations were listed for all vegetables (with exception of 'raw' for potato). Respondents could also list and rate other preparations they used. For vegetable preparations "on its own", information was further collected on whether flavourings and/or condiments were added, and if so, what type (e.g. salt/butter).

The vegetables in the study were selected on the basis that they could potentially be prepared at home in a multitude of ways (thereby excluding salad vegetables), they were commonly consumed by children (Poelman et al., 2009), and were available year round. The main focus of this study was on preparation practices, and to keep consumer burden to an acceptable level, the study was limited to five vegetables. Potato is a vegetable for Australian Healthy Eating guidelines (National Health and Medical Research Council, 2003), although it is recognised that its nutritional composition differs from many other vegetables.

Parents completed the questionnaire whilst their child took part in a taste test. Parents received oral instructions how to

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