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Consistency of food preferences in Australian children from 2 to 5 years of age

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Abstract:

While it is generally accepted that food habits established during infancy will track into later childhood, longitudinal analysis of children's food preferences is rare. This paper examines whether maternal-reported child food preferences at five years of age are the same as that reported at two years; and identifies any patterns of change from two- to five- years.

Mothers in the Australian NOURISH trial reported child food preferences at two and five years of age. A four point scale was utilised - 'like', 'neither like or dislike', 'dislike', 'never tried'. The proportion of children having the same preference at the two time points was calculated (95%CI) for 48 foods (cereals, 4; vegetables, 20; fruit, 14; meat/alternatives, 6; dairy, 4). For foods where ≤50% children had consistent preferences, the pattern of food preference change was determined.

For 40/48 foods, more than half of the children were reported to have the same preference at two years of age, and three years later, at age five. Foods for which ≤50% children had the same preference at both ages were high-sugar breakfast cereals, zucchini, mushrooms, eggplant, spinach, lettuce, cabbage and celery.

Findings reinforce the importance of promoting a consistent message regarding early and frequent exposure to a variety of healthy foods, particularly during the first 2 years of life, as the preferences established in these early years are likely to be maintained over time.

Keywords: Food preferences, early childhood, variety, longitudinal, fruit, vegetables

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Introduction

The importance of establishing healthy food preferences in early childhood is well recognised [1]. Diets consisting of a variety of fruit, vegetables, wholegrains and lean meats are associated with decreased morbidity and mortality throughout the life span, through the prevention of chronic diseases such as cancer, cardiovascular disease and overweight/obesity [2-3]. However infants and young children have innate preferences for sweet and salty tastes with concomitant predisposition to dislike of sour and bitter tastes [4]. This means children will generally dislike vegetables and have a preference for energy-dense, nutrient-poor foods that are ubiquitous in our 'obesogenic' environment. However, parents can potentially modify these initial flavour preferences by exposing children to a wide variety of healthy foods in early life [5-6]. Exposure to foods starts via flavour transfer in utero and while breastfeeding, and continues during introduction to solid foods [7]. It is recommended that parents introduce a wide variety of flavours and textures from around six months of age, as children younger than 24 months of age may be more receptive to new foods than older children [8-9]. This is because neophobia i.e. fear and rejection of new foods, increases rapidly during the second year of life [10], resulting in children being less likely to like and accept a new food introduced after that time.

While it is generally accepted that food habits established during infancy will track into later childhood and adolescence, longitudinal analysis of children's food preferences is rare [11]. In the United States, Skinner et al measured food preferences of 70 young children with the 196 item Food Preference Questionnaire [12]. Consistency in children's food preferences was demonstrated by the percent agreement between maternal reported food preferences at 2-3, 4 and 8 years. Preferences for fruits, meat, dairy and cereal foods were most consistent over time. While this study purported to measure the preferences of 196 foods, results were presented aggregated into 16 food categories e.g. 33 individual vegetables were collapsed into the category 'cooked vegetables'.

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A second longitudinal study identified was conducted in France and evaluated the impact of food choices at two–three years of age on food preferences in childhood through to early adolescence [13]. Participants were divided into four groups depending on their age at follow-up, 4-7 years (n=83); 8–12 (n=99); 13–16 (n=68); and 17–22 (n=91) years. Early 'preference' was determined by observing and categorising child food choices (from a selection of eight dishes) during lunch time meals at nursery school. No 'sweet' foods were offered. Early 'preference' was significantly linked to child-reported food preference at follow-up (measured by questionnaire) for 36 out of 62 foods on a specified list. These tended to be for strongly flavoured foods such as mature cheese. Vegetable preference at follow up was predicted both by early 'preference' and by age, leading the authors to conclude that generally, preference for vegetables increases during adolescence and early adulthood.

General discussion of food preferences in the literature tends to focus on the consumption of, and preference for fruits and vegetables. There is less focus on foods such as fish and wholegrains, though these foods tend to be eaten less often than recommended [8]. Improved understanding of the extent of tracking of children's preferences for a wide variety of foods - not just fruit and vegetables - is necessary to assist in the provision of evidence-based advice to parents. Therefore the aims of this paper were to examine the hypothesis that maternal-reported child food preferences at five years of age are the same as that reported at two years of age - for a comprehensive list of individual foods; and for those foods for which preference was not consistent over time, explore the pattern of change from two- to five- years.

Methods

This is a secondary analysis of longitudinal data from the Australian NOURISH randomised controlled trial [14]. Mothers aged at least 18 years with facility in English were recruited from major maternity hospitals in two Australian capital cities (Brisbane, Queensland and Adelaide, South Australia) following the birth of their first child (a healthy, term infant). Full enrolment in the study occurred

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when the child was aged 4-7 months, at which time baseline assessment and randomisation into control and intervention groups occurred (N=698). The intervention modules, commencing at child age 4 and 14 months, provided anticipatory guidance regarding responsive feeding strategies with the aim of reducing indicators of child obesity risk. Recruitment procedures and the intervention modules have been described in detail elsewhere [15-16]. The NOURISH study was approved by the Queensland University of Technology and Flinders University Human Research Ethics Committees and the relevant hospital ethics committees (Australasian Clinical Trials Registration ACTRN 1260800056392; QUT HREC 00171 Protocol 0700000752).

Mothers completed questionnaires at recruitment and baseline assessment to collect demographic data, such as child gender and age of introduction to solids. Questionnaires were also completed by the mother when the child was aged two and five years, recording child food preferences for a variety of foods and drinks. Questions were based on those developed by Wardle et al (2001) [17] with wording adapted to suit Australian foods. Responses were measured on a six point scale: like a lot, like a little, neither like or dislike, dislike a little, dislike a lot, never tried. Parents were instructed to indicate liking even if the child liked the food but did not usually eat or drink it.

Height and weight of mother and child were measured by research staff at child at the 2 year old assessment, and used to derive BMI (kg/m^2) and BMI z-score [18] respectively.

Analysis

All analyses were conducted in SPSS version 23 [19]. Both intervention and control groups were included in this analysis, as the hypothesis is whether food preferences established by 2 years of age are consistent at age 5 years, regardless of whether mothers implemented strategies between 14 months and 2 years that modified quality of food preferences overall. Furthermore, the intervention had only limited impact on food preferences [20].

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Demographic data is presented as n (%) for categorical, and mean (standard deviation) or median (interquartile range) for continuous data.

Prior to analysis, responses 'like a lot' and 'like a little' were aggregated to form a single category of 'like', and similarly responses of 'dislike a little' and 'dislike a lot' were aggregated to 'dislike' . This is because it was deemed that moving between 'like a little' and 'like a lot' represented a consistent preference over time. Thus a four point scale was utilised: 'like', 'neither like or dislike', 'dislike', 'never tried'. The proportion of children having the same reported food preference at two and five years was calculated, along with the 95%CI, for 48 foods: cereals,4; vegetables, 20; fruit, 14; meat & alternatives, 6; dairy, 4.

For those foods where ≤50% of the sample had consistent food preferences over time, the proportion of children in each category of food preference change was determined (supplementary table 1), and the highest three proportions reported in the results.

Results

Food preference data were available for 444 children at two years and 371 at five years, resulting in N=340 with data at both time points. Sample characteristics are shown in table 1.

Table 1. Sample characteristics of mothers and children with food preference data available at two and five years of age (n=340).

Variable	n (%)	Mean (sd)	Median (IQR)
Child			
Sex (male)	159 (47)		
BMI z score at 2 years of age[a]		.77 (.99)	
Age at introduction to solids (weeks)			23.8 (21.7-26)
Breastfeeding duration (weeks)		39.4 (25.7)	
Mother			
University education	70 (238)		
Age at child's birth (years)		31.0 (5.1)	
Body mass index (kg/m^2) at child age 2 years[b]			25.1 (21.9-27.8)

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[a] n=336
[b] n=240

The proportion of children with the same reported food preference at age 2 years and 5 years, for each of the core foods is shown in table 2. While there were one or two responses missing for some foods (see table 2 footnotes), notably food preference for cauliflower at age five years was reported for only 254/340 children.

Foods for which ≥80% children had the same preference at both ages were pasta, high fibre breakfast cereals, and rice; apples, grapes, strawberries/other berries, watermelon and bananas; carrots; poultry, red meat, eggs, and fish; cheese and flavoured yoghurt. By age five years, 48% of children had not tried paw-paw and 36% had not tried dairy desserts. Legumes (32%), eggplant (37%), and brussel sprouts (51%) were the three vegetables that had the highest proportion of 'never tried' by the sample at age five years. For a visual representation of the data, horizontal bar graphs showing the proportion of children in each preference category at two and five years for each food, are provided in the supplementary material.

Foods for which ≤50% of children were reported to have the same preference at both ages were high-sugar breakfast cereals, zucchini, mushrooms, eggplant, spinach, lettuce, cabbage and celery. The three main changes in food preference category for these foods are shown in table 3.

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Table 2. Prevalence of children with the same reported food preferences for specified foods at age two years and five years (N=340)

Food	Age	Like n (%)	Neither n (%)	Dislike n (%)	Never tried n (%)	% children with same preference at 2y & 5y (95% CI)
Cereals						
Pasta	2y	326 (96)	8 (2)	6 (2)	0	93 (90-96)
	5y	323 (95)	8 (2)	9 (3)	0	
High fibre breakfast cereals	2y[a]	316 (93)	7 (2)	14 (4)	2 (1)	85 (80-88)
	5y[a]	294 (86)	18 (5)	23 (7)	5 (2)	
Rice	2y	301 (88)	20 (6)	18 (5)	1 (1)	83 (76-88)
	5y	305 (90)	17 (5)	18 (5)	0	
High sugar breakfast cereals	2y[b]	69 (20)	21 (6)	10 (3)	238 (71)	47 (42-53)
	5y	195 (57)	26 (8)	13 (4)	106 (31)	
Vegetables						
Carrots	2y	289 (85)	22 (7)	29 (8)	0	83 (79-87)
	5y	308 (91)	12 (3)	19 (6)	0	
Corn	2y[a]	285 (84)	26 (8)	25 (7)	3 (1)	77 (72-81)
	5y[a]	280 (82)	21 (6)	37 (11)	1 (1)	
Green Peas	2y[a]	265 (79)	32 (9)	37 (11)	3 (1)	69 (65-75)
	5y	242 (71)	23 (7)	74 (21)	1 (1)	
Broccoli	2y	213 (43)	37 (18)	87 (20)	3 (18)	68 (63-73)

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	5y	242 (72)	30 (9)	66 (19)	0	
Tomato	2y	211 (62)	40 (12)	83 (24)	6 (2)	67 (62-72)
	5y	210 (62)	16 (5)	111 (32)	3 (1)	
Cauliflower	2y[a]	168 (49)	73 (22)	68 (20)	30 (9)	66 (59-71)
	5y[d]	123 (48)	43 (17)	74 (29)	14 (5)	
Cucumber	2y	196 (58)	46 (13)	78 (23)	20 (6)	66 (61-71)
	5y[a]	230 (68)	16 (5)	77 (23)	16 (5)	
Pumpkin	2y	272 (80)	26 (8)	42 (12)	0	61 (56-66)
	5y	188 (55)	40 (12)	109 (32)	2 (1)	
Sweet Potato	2y[b]	269 (80)	31 (9)	30 (9)	8 (2)	61 (56-67)
	5y	212 (62)	41 (12)	77 (23)	10 (3)	
Avocado	2y[a]	239 (70)	40 (12)	51 (15)	9 (3)	61 (56-67)
	5y	198 (58)	36 (11)	95 (28)	11 (3)	
Green Beans	2y[b]	188 (56)	48 (14)	91 (27)	11 (3)	58 (53-64)
	5y[b]	176 (52)	43 (13)	115 (34)	4 (1)	
Brussels Sprouts	2y	48 (14)	41 (12)	54 (16)	197 (58)	51 (46-57)
	5y[a]	38 (11)	29 (9)	100 (29)	172 (51)	
Capsicum	2y	173 (51)	68 (20)	67 (20)	32 (9)	51 (45-56)
	5y	143 (42)	53 (16)	124 (36)	20 (6)	
Zucchini	2y[a]	212 (23)	57 (27)	45 (17)	25 (33)	50 (45-56)
	5y[b]	151 (45)	52 (15)	118 (35)	17 (5)	
Mushrooms	2y	196 (58)	63 (18)	59 (17)	22 (7)	49 (43-54)

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	5y	144 (42)	35 (10)	143 (42)	18 (5)	
Eggplant	2y	73 (21)	74 (22)	40 (12)	153 (45)	48 (43-53)
	5y	46 (13)	55 (16)	114 (34)	125 (37)	
Spinach	2y[b]	146 (44)	61 (18)	69 (20)	62 (18)	44 (40-51)
	5y[c]	116 (35)	64 (19)	114 (34)	42 (13)	
Lettuce	2y	80 (24)	80 (23)	156 (46)	24 (7)	43 (38-49)
	5y	165 (49)	44 (13)	126 (37)	5 (1)	
Cabbage	2y	78 (23)	92 (27)	58 (17)	112 (33)	39 (34-49)
	5y[b]	74 (22)	66 (19)	127 (38)	71 (21)	
Celery	2y[a]	93 (27)	86 (25)	65 (19)	95 (28)	38 (33-44)
	5y	129 (38)	56 (16)	113 (33)	42 (12)	
Fruit						
Apples	2y	325 (96)	7 (2)	8 (2)	0	94 (91-96)
	5y	330 (97)	4 (1)	6 (2)	0	
Grapes	2y	308 (91)	14 (4)	18 (5)	0	87 (83-90)
	5y	310 (91)	5 (2)	25 (7)	0	
Strawberries/other berries	2y	300 (88)	14 (4)	25 (7)	1 (1)	87 (83-90)
	5y	312 (92)	4 (1)	23 (7)	1 (1)	
Watermelon	2y	299 (88)	12 (3)	28 (8)	1 (1)	86 (84-92)
	5y	307 (90)	3 (1)	30 (9)	0	
Bananas	2y[f]	317 (94)	6 (2)	12 (4)	0	82 (78-86)
	5y	298 (88)	14 (4)	28 (8)	0	

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Sultanas	2y	306 (90)	13 (4)	17 (5)	1 (1)	78 (73-82)
	5y[h]	251 (80)	18 (5)	44 (14)	1 (1)	
Pears	2y	291 (86)	21 (6)	23 (7)	5 (1)	76 (71-80)
	5y	268 (79)	26 (8)	42 (12)	4 (1)	
Citrus fruit	2y[a]	250 (74)	35 (10)	44 (13)	10 (3)	73 (68-77)
	5y	269 (79)	22 (6)	47 (14)	2 (1)	
Peaches/nectarines	2y	277 (82)	23 (6)	33 (10)	7 (2)	72 (67-77)
	5y	253 (75)	35 (10)	44 (13)	8 (2)	
Rockmelon	2y	228 (67)	38 (11)	57 (17)	17 (5)	62 (57-68)
	5y	205 (60)	29 (8)	89 (26)	17 (5)	
Pineapple	2y	208 (61)	46 (14)	45 (13)	41 (12)	59 (54-65)
	5y	232 (68)	41 (12)	63 (19)	4 (1)	
Kiwi fruit	2y	189 (55)	44 (13)	64 (19)	43 (13)	58 (52-63)
	5y[g]	186 (61)	25 (8)	71 (23)	26 (8)	
Pawpaw	2y	90 (27)	34 (10)	41 (12)	175 (51)	58 (53-64)
	5y[a]	80 (24)	28 (8)	68 (20)	163 (48)	
Plums	2y	177 (52)	47 (14)	30 (9)	86 (25)	54 (48-59)
	5y	182 (53)	58 (17)	53 (16)	47 (14)	
Meat/alternatives						
Poultry (home-made)	2y[a]	318 (94)	10 (3)	7 (2)	4 (1)	90 (86-93)
	5y[a]	316 (93)	5 (2)	14 (4)	4 (1)	
Red meat (home-made)	2y[b]	302 (89)	18 (5)	13 (4)	5 (2)	81 (77-85)

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	5y[a]	293 (86)	15 (4)	25 (7)	6 (2)	
Eggs	2y[e]	277 (82)	21 (6)	35 (10)	4 (1)	81 (76-85)
	5y[b]	274 (81)	16 (5)	43 (13)	5 (2)	
Fish (home-made)	2y[a]	286 (84)	23 (7)	18 (5)	12 (4)	80 (75-84)
	5y[a]	286 (84)	15 (4)	28 (8)	10 (3)	
Baked Beans	2y[e]	211 (63)	34 (10)	52 (15)	40 (12)	60 (55-66)
	5y[a]	220 (65)	24 (7)	63 (19)	32 (9)	
Legumes	2y[a]	153 (45)	42 (12)	22 (7)	122 (36)	57 (52-62)
	5y[a]	124 (37)	46 (14)	59 (17)	110 (32)	
Dairy						
Cheese	2y[b]	318 (95)	5 (1)	10 (3)	5 (1)	93 (89-95)
	5y[b]	321 (95)	5 (2)	8 (2)	4 (1)	
Yoghurt - flavoured	2y[a]	307 (90)	7 (2)	7 (2)	18 (6)	86 (82-89)
	5y[a]	309 (91)	10 (3)	15 (4)	5 (2)	
Yoghurt - unflavoured	2y[b]	223 (66)	30 (9)	30 (9)	55 (16)	58 (52-63)
	5y[b]	209 (62)	45 (13)	58 (17)	26 (8)	
Dairy dessert e.g. custard	2y[b]	88 (26)	8 (3)	7 (2)	235 (69)	56 (50-61)
	5y[a]	187 (55)	14 (4)	16 (5)	122 (36)	

*** $p \leq .001$; [a] n=339; [b] n=338; [c] n=336; [d] n=254; [e] n=337; [f] n=335; [g] n=308; [h] n=314

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Table 3. Changes in food preferences between two and five years of age, for those foods where ≤50% of the sample had consistent food preferences over time

Food	Top three categories of preference change (%) from 2y to 5y	
High -sugar breakfast cereals[a]	Never tried *to* **Like**	36
	Never tried *to* **Neither like or dislike**	5
	Neither like or dislike *to* **Like**	4
Zucchini[b]	Like *to* **Dislike**	18
	Like *to* **Neither like or dislike**	11
	Neither like or dislike *to* **Dislike**	7
Mushrooms[c]	Neither like or dislike *to* **Like**	16
	Dislike *to* **Like**	15
	Like *to* **Neither like or dislike**	8
Eggplant[d]	Never tried *to* **Dislike**	14
	Neither like or dislike *to* **Dislike**	9
	Like *to* **Dislike**	7
Spinach[e]	Like *to* **Dislike**	11
	Like *to* **Neither like or dislike**	9
	Neither like or dislike *to* **Like**	7
Lettuce[b]	Dislike *to* **Like**	19
	Neither like or dislike *to* **Like**	13
	Like *to* **Dislike**	6
Cabbage[f]	Never tried *to* **Dislike**	13
	Neither like or dislike *to* **Dislike**	11
	Like *to* **Neither like or dislike**	7
Celery[g]	Neither like or dislike *to* **Like**	12
	Never tried *to* **Dislike**	11
	Neither like or dislike *to* **Dislike**	8

Food preference category at five years of age is in bold, to assist with readability of the table.
[a] n=330, [b] n=337, [c] n=238, [d] n=307, [e] n=312, [f] n=309, [g] n=323

Discussion:

This paper is one of the first to compare consistency of reported food preferences across early childhood for a wide range of foods, including cereals, meat/alternatives and dairy as well as vegetables; and the first to do so amongst Australian children.

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For 40 out of 48 foods considered, more than half of the children in the sample were reported to have the same preference at two and five years of age. That is, if they were reported to like the food at two years of age, they were also reported as liking this food when their mother was asked three years later, at age five years; and similarly for the categories, 'neither like or dislike' and 'dislike'. Foods for which a large proportion (≥80%) of children had the same preference at both ages were pasta, high fibre breakfast cereals, and rice; apples, grapes, strawberries/other berries, watermelon and bananas; carrots; poultry, red meat, eggs, and fish; cheese and flavoured yoghurt. The majority of these foods are considered staple foods in the Australian diet [21], and there were very few children who had not tried these foods at two years of age - the exception being n=12 (4%) children who had not tried fish and n=18 (6%) who had not had flavoured yoghurt. These foods for which preferences are consistent are also similar to Nicklaus et al who found that preferences amongst French children were most stable over time for 'starchy foods' and 'animal products' [13].

Foods for which ≤50% of the sample were reported to have the same preference at two and five years - i.e. the majority of children *did not* have a consistent preference over time - were high -sugar breakfast cereals, zucchini, mushrooms, eggplant, spinach, lettuce, cabbage and celery. Consistent with the understanding that young children have an innate preference for sweet tastes [4] the preference for high-sugar breakfast cereals overwhelmingly shifted to 'Like' at five years of age, despite 71% of children not having tried this food at two. Preference for mushrooms and celery tended to shift to 'like', while more children disliked zucchini, cabbage and eggplant over time. The sensory properties of these foods i.e. "*visual (food colour), auditory (crispiness), tactile (viscosity, creaminess), or olfactory (odour) characteristics*" [22] may also influence their acceptance, or otherwise, by children. Strategies recommended to parents to increase acceptance and liking, may have to become more specific, depending on a food's properties [9], i.e. is there a pattern of exposure that enhances the liking of certain tastes or textures, for example offering a food every day, versus every second day, or more specific advice on the combinations of food to be offered.

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Fourteen percent of children moved from 'never tried' to 'dislike' for eggplant and 13% for cabbage. While the category 'not tried' is not a food preference *per se*, it is an important consideration in the development of food preferences. Contemporary advice to parents is to limit young children's exposure to discretionary (i.e. sweet) foods for as long as possible [23] (71% of children in this sample had 'not tried' high sugar breakfast cereals at age two) while ensuring early exposure to healthy foods in order to support the development of optimal food preferences, particularly learning to like less palatable/bitter vegetables. Legumes and brussel sprouts were 'never tried' at two years of age by 33% and 58% of the sample respectively. These foods are also those which tend to be eaten less often by Australian adults. Australian Healthy Survey data show that the cabbage, broccoli and brassica vegetable group, which includes brussel sprouts, were consumed by only 10% of adults on the day of the recall – the lowest proportion of consumers of all the vegetable groups [21]. Furthermore, only 5% of the adult population consumed legumes or legume based dishes. This raises the question of how parents can practically implement advice on introducing a wide variety of foods when they themselves do not eat a wide variety, and similarly how we encourage parents to use repeated exposure as a strategy to increase preference and intake [24]. Parents may be understandably reluctant to purchase and prepare a food that they dislike, such that the child has the opportunity to try it 7-10 times before learning to like it. In this instance, children will also not have the opportunity to see parents modelling intake of these foods. Maternal food preferences are linked with child food preferences in this cohort [25], which makes sense, given parents are the gatekeepers of food purchasing for young children, and hence to what they are exposed [26].

A limitation of this analysis is the reliance on maternal memory of child food preferences. For six foods a higher number of children were reported as having 'not tried' the food at five years of age compared with two years, e.g. eight children had not tried sweet potato at two and this increased to 10 children at age five years. However the increase ranged from only one to three participants across the six different foods. Reliance on memory may also be a strength of the study, given that it is very unlikely mothers completing the questionnaire at five years remembered what preference

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was reported for any given food three years prior, and instead are relying on children's current behaviour to determine food preferences. It is also unclear why a considerable number of mothers (n=86) did not report the food preference for cauliflower at age five years. It may be because the questionnaire was paper-based and this question was the final item at the bottom of the left-hand page of the booklet, and thus was overlooked.

In addition, this sample was comprised of mothers who were older and a higher proportion had a tertiary education compared to Australian first-time mothers generally [27]. Infant feeding indicators (breastfeeding and age at introduction to solids) also aligned more closely to national guidelines in this sample, compared to most infants [28].

Conclusion:

This paper examined children's food preferences for a range of cereals, vegetables, fruit, dairy and meat/alternatives at 2 and five years of age. For 40 out of 48 of the foods examined, more than half of the children in the sample were reported to have the same preference at two years of age, and three years later, at age five. These findings reinforce the importance of promoting a strong and consistent message regarding early and frequent exposure to a variety of healthy foods, particularly during the first 2 years of life, as the preferences established in these early years are likely to be maintained over time.

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