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* Number of genes tested will vary in each country, ranging from a single gene to over 400+ genes

~ The genetic basis of epilepsy has a range according to country and publication from 14% -24.4%,² to 50%¹, to 70-80%³

References:

1) Pal DK et al. Genetic evaluation and counseling for epilepsy. *Nature Rev Neurology*. 2010;6:445-453. 2) Truty et al. Possible precision medicine implications from genetic testing using combined detection of sequence and intragenic copy number variants in a large cohort with childhood epilepsy. *Epilepsia Open*. 2019;4:397-408. 3) Amadori et al. 'Targeted re-sequencing for early diagnosis of genetic causes of childhood epilepsy' *Italian Journal of Pediatrics* (2020) 46:92 <https://doi.org/10.1186/s13052-020-00860-1> 4) Mei D, Parrini E, Marini C, Guerrini R. The Impact of Next-Generation Sequencing on the Diagnosis and Treatment of Epilepsy in Paediatric Patients. *Mol Diagn Ther*. 2017;21(4):357-373. doi:10.1007/s40291-017-0257-0 5) Berg AT, Coryell J, Saneto RP, et al. Early-Life Epilepsies and the Emerging Role of Genetic Testing. *JAMA Pediatr*. 2017;171(9):863-871. doi:10.1001/jamapediatrics.2017.1743



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GL/CLN2/0033 EU/CLN2/0922 August 2020

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ORIGINAL ARTICLE

Low allergen content of commercial baby foods

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Aim: Introduction of allergenic solid foods, especially peanut and hen's egg reduces the risk of food allergy development in early childhood. Ideally, parents will offer their infants home-prepared foods; however, many rely on the availability of convenient ready to purchase infant foods. This audit aimed to assess the major food allergen content of commercial infant foods.

Methods: Infant foods available for sale in 2019 in Australia were the focus of this audit. The major food allergens investigated were peanut, tree nuts, hen's egg, cows milk, wheat, fish, shellfish, soy, sesame and lupin. Websites of infant food manufacturers and major supermarkets were used to identify ingredient lists of infant foods available for purchase. Where ingredients listings were unavailable this information was sourced directly from the product labels in the supermarket.

Results: Fourteen companies were identified, manufacturing over 251 foods specifically for the infants aged less than 1 year of age. Although there were many choices available containing wheat (27 products) and cows milk proteins (73 products), none contained peanut, tree nuts, sesame, shellfish or lupin.

Conclusions: Despite infant feeding advice encouraging early introduction to food allergens, of 251 commercial baby foods surveyed only 1% contained egg and none contained peanut, the most common food allergies in young Australian infants. This low food allergen content may be disadvantageous for infants fed mostly commercial infant foods as they are unlikely to be exposed to sufficient amounts of the major food allergens on a regular basis during infancy.

Key words: allergy; food allergen; infant; prevention; weaning.

What is already known on this topic

- 1 Food allergy is common in Australian infants.
- 2 Early introduction of common food allergens reduces the risk of allergy to these foods.
- 3 Commercial baby foods may be used by parents as a safe and convenient way to feed their babies.

What this paper adds

- 1 Commercial baby foods sold in Australia are low in common allergens.
- 2 Parents require specific practical advice regarding the introduction of peanut and egg into their baby's diet to reduce the risk of allergy.
- 3 Commercial infant foods containing common allergens should be developed.

Over the past decade, level 1 evidence from randomised controlled trials^{1–4} and a meta-analysis,⁵ have found that the regular inclusion of egg and peanut in infant diets resulted in reduced egg and peanut food allergy development. Resulting from this new evidence, many food allergy prevention guidelines globally have recently been updated to recommend the introduction of foods containing these allergens (especially peanut, egg, wheat and dairy) into the infant diet, including infants at high risk of food allergy.^{6–9} On a background of rising food allergy incidence in many developed countries,¹⁰ and the increasing recognition of

burden on quality of life,¹¹ the implementation of these new food allergy prevention guidelines is an important public health issue.

Infant feeding plays an important role in influencing future health and eating patterns. At around 6 months of age, infants are developmentally ready for the inclusion of solid foods in their diet. Parents are encouraged to offer their infants home-cooked foods, progressing to a modified version of the family meal by 1 year of age.¹² Despite this, there is a strong consumer demand for commercially prepared infant foods, and many companies supply the infant food market, as part of an industry estimated to be worth US\$182 m in 2019 in Australia alone.¹³ The rate of consumption of commercial baby foods was not collected in the Australian National Infant Feeding study¹⁴; however, cross-sectional studies in the USA estimated that 60–95% of 4–12 month olds regularly consume commercial baby foods.¹⁵

Given the recent changes in infant feeding guidelines specific to allergy prevention advising regular inclusion of common

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Conflict of interest: None declared.

Accepted for publication 2 June 2020.

allergens in the diet during infancy, we aimed to evaluate the content of common food allergens (cows milk, soy, hen's egg, wheat, peanut, tree nuts, fish, shellfish, lupin and sesame) present in commercial infant foods.

Methods

Foods marketed for infants less than 1 year of age were identified by searching websites of the major Australian supermarkets (Coles, Woolworths, Foodland and Aldi) and infant food manufacturers. The search was conducted between May and July 2019 using the Google web browser. Ingredient lists for the foods were obtained from manufacturers websites, supermarket websites or, directly from food packets on supermarket shelves if unavailable online.

Ingredient lists were audited for the presence of cows milk, soy, hen's egg, wheat, peanut, tree nuts, fish, shellfish, sesame and lupin, which are all food allergens required to be declared by Food Standards Australia and New Zealand. Due to similar allergenicity, where spelt was listed as an ingredient, this was included as wheat. The estimated grams of food allergen per serve of food were calculated for products where the percentage of the allergen was specified in the ingredients list.

Results

We identified 14 companies manufacturing 251 products marketed specifically for infants aged less than 1 year of age in Australian supermarkets (Table 1). The products were designed for different age groups based on their texture (4 months+, 5 months+, 6 months+, 7 months+, 8 months+ and 10 months+). Most of the

Table 1 Common allergens identified in baby foods

Brand	Number of products	Allergen listed in ingredients	Cows milk	Soy	Egg	Wheat	Fish
4–5 months+							
Heinz	16	–	–	–	–	–	–
Rafferties	17	1	1	–	–	–	–
Bellamies	13	2	2	–	–	–	–
Only Organic	9	–	–	–	–	–	–
Bubs Organic	4	–	–	–	–	–	–
Nestle Cerelac	3	–	–	–	–	–	–
Aldi Mamia	7	–	–	–	–	–	–
6–7 months+							
Heinz	20	17	12	–	1	3	–
Rafferties	18	13	12	–	–	1	1
Bellamies	11	5	3	–	–	3	–
Only Organic	10	6	5	4	–	1	–
Bubs Organic	9	–	–	–	–	–	–
Annabel Karmel	4	3	3	–	–	–	1
Baby Macro	13	5	4	–	–	1	–
Nestle Cerelac	4	2	–	2	–	–	–
Aldi Mamia	11	7	3	–	–	–	–
Woolworths Smiling Tums	7	2	2	–	–	–	–
Baby Bellies	7	2	2	–	–	–	–
8 months+							
Heinz	14	6	6	1	2	3	1
Rafferties	9	8	8†	–	–	2	–
Bellamies	3	3	1	–	–	2	–
Only Organic	14	6	5	4	–	1	–
Nestle Cerelac	2	2	–	2	–	–	–
Baby MumMum	2	–	–	–	–	–	–
Kidilicious	3	–	–	–	–	–	–
10 months+							
Rafferties	7	3	1	–	–	4	1
Only Organic	5	5	3	–	–	4	–
Baby Bellies	3	1	–	–	–	1	–
Aldi Mamia	4	2	–	–	–	1	–
Bambini Bars	3	3	–	–	–	–	3 (DHA)
Total	252	104	73	13	3	27	7

†In one product cows milk was present in coconut milk powder used as an ingredient.

Summary of total number of products, the total listing major allergens in the ingredients and the allergens present.

products ($n = 204$) were ready to eat pureed fruits, vegetables, meat and vegetables, custards or yoghurts, 20 were dry cereal products or pasta, and 29 were 'finger food' snacks. Most of the products (166 of 251) were sold in plastic pouches with a spout, 18 were in pouches without a spout (designed to be served from a bowl), 15 were sold in glass jars, and 5 were frozen in cubes.

Allergens identified in ingredients lists

No infant food products contained peanut, tree nuts, sesame, shell-fish or lupin. Hen's egg was only found in three products and fish in seven products (however three of these were products fortified with fish oil, docosahexaenoic acid, with limited if any allergenic properties compared to fish protein). The most common food allergen included was cows milk protein-based ingredients, and these were present in 73 of 251 (30%) of the infant food products. Wheat was identified in 27 of 251 (10.7%) of the products. Although soy was listed as an ingredient in 13 products, it was predominately included in the limited allergenic form of soy lecithin (an emulsifier).

Estimated allergen content

Sixty-eight of the 251 products listed the percentage of milk, egg, wheat or fish present, enabling an estimation of the grams of food allergen present per serve (see Table 2). Amounts per serve of cows milk protein ranged from 0.01 to 2.8 g (equivalent to 0.3–82 mL of whole cows milk). A total of 0.16 g egg protein (2% of a whole egg) was present in one product; wheat-containing products were estimated to contain 0.8–3.4 g wheat protein (equivalent to 1/3 to 1 1/2 slices of bread), and fish containing products ranged from 0.5 to 3.4 g protein.

Precautionary allergen labelling

In Australia, precautionary allergen labelling (statements on food products such as 'may contain traces of x') is voluntary and not standardised. In this audit, 87 of 251 products had some form of precautionary allergen labelling. Of concern, 32 of 251 products had warnings that they contained 'traces of allergens' not listed as primary ingredients (including cows milk, wheat and soy).

Table 2 Estimated allergen content per serve of food

Brand	Number of products specifying the percentage of allergen	Estimated allergen content (g protein) per serve of products			
		Cows milk, g	Egg, g	Wheat, g	Fish, g
Rafferties 4+	1 (milk)	0.3	-	-	-
Bellamies 4+	1 (milk)	0.01	-	-	-
Bellamies 5+	1 (milk)	0.01	-	-	-
Heinz 6/12+	10 (milk)	0.13–1.2	0.16	0.87	-
	1 (egg)				
	1 (wheat)				
Rafferties 6+	3 (milk)	0.4–3.1	-	-	3.4
	1 (fish/tuna)				
Bellamies 6+	3 (milk)	0.9–2.7	-	0.8–2.1	-
	2 (wheat/spelt)				
Only Organic 6+	5 (milk)	0.04–1.8	-	-	-
Annabel Karmel 6+	1 (milk)	0.3	-	-	0.5
	1 (fish/hoki and salmon)				
Baby Macro 6+	4 (milk)	0.25–0.89	-	0.9	-
	1 (wheat)				
Aldi Mamia 6+	7 (milk)	0.5–2.4	-	-	-
Heinz 8/12+	4 (milk)	0.42–1.2	-	2.8–3.4	3.3
	3 (wheat)				
	1 (fish)				
Rafferties 8+	4 (milk)	1.3+† to 2.8	-	0.8	-
	1 (wheat)				
Bellamies 8+	1 (milk)	2.6	-	-	-
Only Organic 8+	5 (milk)	0.3+ to 1.8	-	-	-
Rafferties 10+	3 (wheat)	-	-	1.9–2.8	-
Only Organic 10+	1 (milk)	1.3	-	0.86–1.1+	-
	2 (wheat)				

†Underestimate as this product contains more than one source of cows milk, and percentages of each cows milk based ingredient were not reported. Number of products specifying the percentage of allergen, and estimated grams of allergen calculated per serve of product.

Discussion

Given new evidence from randomised controlled trials published over the past decade, and the resulting recent changes to infant feeding and food allergy prevention guidelines, the emphasis of the majority of commercial infant foods available for purchase for the whole population should now be on food allergen inclusion to promote oral tolerance and reduce the risk of food allergy development. However, the results of this audit indicate that commercial infant weaning foods available in Australia have a generally low content of common food allergens (especially hen's egg, peanut, tree nuts, fish, shellfish, sesame and lupin). While this provides a suitable source of commercial food options for infants with existing food allergy, these products do not reflect contemporary infant feeding and allergy prevention guidelines, which encourage deliberate regular inclusion of common food allergen-containing foods in the diet during infancy.^{6–9} This is especially important for the introduction of peanut and egg-containing foods, which were the allergens focused on in randomised controlled trials,^{1–4} which have provided level 1 evidence for the recent infant feeding and allergy prevention guideline updates. In Australia, early regular introduction of egg and peanut in infant diets is especially critical given the findings from the large cohort study where egg and peanut food allergies were identified to affect 1 in every 10 infants.¹⁰ Over the last 20 years, we have experienced a major turnaround from the previous recommendations of food allergen avoidance during early childhood as an allergy prevention strategy,¹⁶ to now the promotion of deliberate and regular dietary intake of foods containing these major food allergens during the introduction of complementary solid foods in infancy. The infant food packets advertising that their products are 'free from' common allergens now leads to parental confusion about the changing infant feeding guidelines, as these warnings infer that these are the better choice for parents to give their infants and that food allergens should be excluded from the diets of all infants. Instead, to align with current infant feeding and allergy prevention guidelines, infant food packaging should be actively promoting 'a good source of peanut or egg' as a more appropriate marketing strategy and to reinforce these new recommendations.

When the allergen content could be estimated, the allergen content per serving in the weaning foods was low compared with the dose of allergens used in the allergy prevention randomised controlled trials. For example, the Enquiring about Tolerance Trial reported that consumption of 2 g of peanut or 4 g of egg protein per week was associated with a lower prevalence of these respective food allergies.² However, there are as yet no completed randomised controlled trials testing the optimal dose of the various food allergens required to be consumed by infants for effective food allergy prevention.

Regular inclusion of cows milk, wheat, hen's egg, peanut, tree nuts, fish, shellfish, soy, sesame and lupin containing foods make important contributions to infant nutrition, including contributing to diet diversity which has been linked to improved future health outcomes, including reduced allergic diseases.¹⁷ While several reviews have focussed on nutritional, textural and flavour analysis of weaning foods in Australia,¹⁸ the UK¹⁹ and in the USA,²⁰ we are not aware of any other systematic analysis of the allergen content of weaning foods. The recent review of the

nutritional content of UK weaning foods included an ingredient listing, surveillance of which indicates that weaning foods available in the UK are also low in common allergens.¹⁹

The change in infant feeding guidelines for allergy prevention has required translation into country-specific education material for parents. We have previously identified that infant feeding guides vary in their wording and have the potential to be confusing for parents and health professionals.²¹ In Australia, this has been addressed by the development of evidence-based consensus wording for infant feeding guidelines for allergy prevention,⁸ adopted by the Australasian Society of Clinical Immunology and Allergy.⁹ The Australasian Society of Clinical Immunology and Allergy has also published practical infant feeding advice for parents,²² and the Australian federally funded National Allergy Strategy 'Nip Allergies in the Bub' program²³ has used a public health approach to promote the change in feeding guidelines to reduce the risk of food allergy, including practical information for parents about how to include common allergens (particularly peanut and egg) in infant diets using home-prepared food options. Given the insufficient quantities of many food allergens in commercial infant foods in Australia that we have identified during this audit, clear messaging of the use of home-prepared foods including the major food allergens requires ongoing public health messaging approaches. In the UK, specific practical guidance regarding the introduction of allergens (egg and peanut) into the weaning diet has been published by the British Society of Allergy and Clinical Immunology.⁷ In the USA, the allergy prevention guidelines published by the National Institute of Allergy and Infectious Diseases⁶ have been used as the basis of practical infant feeding information available from the American Academy of Allergy Asthma and Immunology website.²⁴

Conclusions

Ideally, parents will offer their infants home-prepared foods; however, there will always be a need for safe and convenient ready to purchase infant foods. Currently on the Australian market the available infant foods are low in food allergen content, especially egg and peanut. Infants fed mostly these commercial infant foods are unlikely to meet the current allergy prevention infant feeding guidelines to introduce common food allergens into the diet on a regular basis in the first year of life. Therefore, in addition to specific practical advice, commercial infant foods should be developed that include, rather than avoid, common food allergens.

Acknowledgements

MJ Netting and DJ Palmer report research fellowship funding from the National Health and Medical Research Council (NHMRC of Australia (APP1144544; APP1156518)).

References

- 1 Du Toit G, Roberts G, Sayre PH *et al.* Randomized trial of peanut consumption in infants at risk for peanut allergy. *N. Engl. J. Med.* 2015; **372**: 803–13.
- 2 Perkin MR, Logan K, Tseng A *et al.* Randomized trial of introduction of allergenic foods in breast-fed infants. *N. Engl. J. Med.* 2016; **374**: 1733–43.

- 3 Palmer DJ, Metcalfe J, Makrides M *et al.* Early regular egg exposure in infants with eczema: A randomized controlled trial. *J. Allergy Clin. Immunol.* 2013; **132**: 387–92.e1.
- 4 Palmer DJ, Sullivan TR, Gold MS, Prescott SL, Makrides M. Randomized controlled trial of early regular egg intake to prevent egg allergy. *J. Allergy Clin. Immunol.* 2017; **139**: 1600–7.
- 5 Ierodiakonou D, Garcia-Larsen V, Logan A *et al.* Timing of allergenic food introduction to the infant diet and risk of allergic or autoimmune disease: A systematic review and meta-analysis. *JAMA* 2016; **316**: 1181–92.
- 6 Togias A, Cooper SF, Acebal ML *et al.* Addendum guidelines for the prevention of peanut allergy in the United States: Report of the National Institute of Allergy and Infectious Diseases-sponsored expert panel. *J. Allergy Clin. Immunol.* 2017; **139**: 29–44.
- 7 Turner PJ, Feeney M, Meyer R, Perkin MR, Fox AT. Implementing primary prevention of food allergy in infants: New BSACI guidance published. *Clin. Exp. Allergy* 2018; **48**: 912–5.
- 8 Netting MJ, Campbell DE, Koplin JJ *et al.* An Australian consensus on infant feeding guidelines to prevent food allergy: Outcomes from the Australian infant feeding summit. *J. Allergy Clin. Immunol. Pract.* 2017; **5**: 870–5.
- 9 Joshi PA, Smith J, Vale S, Campbell DE. The Australasian Society of Clinical Immunology and Allergy infant feeding for allergy prevention guidelines. *Med. J. Aust.* 2019; **210**: 89–93.
- 10 Osborne NJ, Koplin JJ, Martin PE *et al.* Prevalence of challenge-proven IgE-mediated food allergy using population-based sampling and pre-determined challenge criteria in infants. *J. Allergy Clin. Immunol.* 2011; **127**: 668–76.e2.
- 11 National Academies of Sciences, Engineering, and Medicine; Health and Medicine Division. Oria M, Stallings VA, editors. Food and Nutrition Board. *Committee on Food Allergies: Global Burden, Causes, Treatment, Prevention, and Public Policy.* Washington: National Academies Press; 2017.
- 12 National Health and Medical Research Council. *Infant Feeding Guidelines: Information for Health Workers.* The Council: Canberra; 2012.
- 13 Statista Market Research. *Baby Food Australia.* New York, NY, USA: The Research; 2019. Available from: <https://www.statista.com/outlook/40120000/107/baby-food/australia> [accessed 8 September 2019].
- 14 Australian Institute of Health and Welfare. *2010 Australian National Infant Feeding Survey: Indicator Results.* Canberra: The Institute; 2011.
- 15 Hamner HC, Perrine CG, Gupta PM, Herrick KA, Cogswell ME. Food consumption patterns among U.S. children from birth to 23 months of age, 2009–2014. *Nutrients* 2017; **9**: 942–53.
- 16 National Health and Medical Research Council. *Dietary Guidelines for Children and Adolescents in Australia Incorporating the Infant Feeding Guidelines for Health Workers.* Commonwealth of Australia: Canberra; 2003.
- 17 Roduit C, Frei R, Depner M *et al.* Increased food diversity in the first year of life is inversely associated with allergic diseases. *J. Allergy Clin. Immunol.* 2014; **133**: 1056–64.
- 18 Moumin NA, Green TJ, Golley RK, Netting MJ. Are the nutrient and textural properties of Australian commercial infant and toddler foods consistent with infant feeding advice? *Br. J. Nutr.* 2020: 1–19. <https://doi.org/10.1017/S0007114520001695>.
- 19 Crawley H, Westland S. *Baby Foods in the UK. A Review of Commercially Produced Jars and Pouches of Baby Foods Marketed in the UK.* First Steps Nutrition Trust; 2017.
- 20 Beauregard JL, Bates M, Cogswell ME, Nelson JM, Hamner HC. Nutrient content of squeeze pouch foods for infants and toddlers sold in the United States in 2015. *Nutrients* 2019; **11**: 1689.
- 21 Netting MJ, Allen KJ. Advice about infant feeding for allergy prevention: A confusing picture for Australian consumers? *J. Paediatr. Child Health* 2017; **53**: 870–5.
- 22 Australian Society of Clinical Immunology and Allergy. *ASCIA Information on How to Introduce Solid Foods to Babies for Allergy Prevention.* Balgowlah, NSW, Australia: ASCIA; 2019. Available from: <https://www.allergy.org.au/patients/allergy-prevention/ascia-how-to-introduce-solid-foods-to-babies> [accessed 3 August 2019].
- 23 National Allergy Strategy. *National Allergy Strategy Nip Allergies in the Bub (Allergy Prevention Project).* Balgowlah, NSW, Australia: National Allergy Strategy; 2018. Available from: <https://preventallergies.org.au/> [accessed 3 August 2019].
- 24 American Academy of Allergy Asthma and Immunology. *Prevention of Allergies and Asthma in Children.* Milwaukee, WI, USA: American Academy of Allergy, Asthma and Immunology; 2020. Available from: <https://www.aaaai.org/conditions-and-treatments/library/allergy-library/prevention-of-allergies-and-asthma-in-children> [accessed 15 August 2019].