

1 **"Temporal change in maternal dietary intake during pregnancy and lactation between and**
2 **within two pregnancy cohorts assembled in the United Kingdom"**

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18 **Clinical implications:**

19 Advice regarding peanut intake during pregnancy has changed over the last 20 years. Future
20 guidance on peanut intake during pregnancy, lactation and complementary feeding should be
21 clearly communicated by the government and professional bodies, to prevent unnecessary
22 dietary exclusion.

23 **Key words:** pregnancy, lactation, allergy prevention, maternal diet, maternal nutrition,
24 peanut, birth cohort.

25 Abstract

26 Background: The association between maternal and infant dietary exposures and risk of
27 allergic disease development is an area of considerable scientific uncertainty.

28 Objective: This study aims to compare dietary habits during pregnancy and lactation in two
29 pre-birth cohorts from the same location approximately 10 years apart, a timeframe
30 characterised by changes in government dietary advice.

31 Methods: The FAIR cohort is an unselected birth cohort born between 2001-2002. The 3rd
32 generation cohort was born between 2010-2018. Both cohorts were established on the Isle of
33 Wight (UK) to investigate prevalence of allergic diseases. Nutrition and allergy data was
34 collected prospectively from recruitment and throughout the infant's early life. Here we
35 present dietary data collected in the third trimester of pregnancy and at three months of age.
36 Differences between cohorts were tested using t-tests, Wilcoxon rank sum tests, chi-squared
37 and Fisher's exact tests.

38 Results: Data was available for 1331 participants (969 FAIR and 362 3rd generation). The
39 proportion of mothers that reported excluding peanuts during pregnancy was significantly
40 lower for the 3rd generation compared to the FAIR cohort (16.0% vs. 55.6%, $p < 0.01$). Cohort
41 membership, primiparity, and maternal education were significantly associated with
42 excluding peanuts during pregnancy ($p < 0.01$). The proportion of mothers who reported
43 excluding any foods during breastfeeding was significantly lower for the 3rd generation
44 compared to the FAIR cohort (22.8% vs. 43.4%, $p < 0.01$).

45 Conclusion: Maternal exclusion of peanut during pregnancy was lower for mothers giving birth
46 between 2012-2018, compared to mothers giving birth between 2001-2002.

47

48 To The Editor

49 The association between maternal and infant dietary exposures and risk of allergic disease
50 development has been an area of considerable scientific uncertainty and debate in recent
51 years (1). Overall research has been largely inconclusive, with no evidence supporting
52 maternal exclusion diets for the prevention of food allergy or atopic disease in the offspring
53 (2). The inconsistency in scientific evidence is reflected in contradictory dietary guidelines
54 about peanut intake over the past 20 years. In the United Kingdom, the Department of Health
55 issued a report in 1998, advising that pregnant mothers with a family history of atopy should
56 avoid peanuts during pregnancy/lactation (3). Ten years later, this advice was no longer
57 deemed appropriate and was rescinded based on data from our group (4, 5) (see Figure 1).
58 Similar advice was recommended internationally. Since then, the concept that exposure to
59 potential food allergens could be protective of allergic disease has now been widely adopted.
60 The aim of this study was to compare dietary habits during pregnancy and lactation in two
61 allergy birth cohorts born in the same geographical location approximately 10 years apart.

62 The FAIR cohort is a whole population birth cohort born on the Isle of Wight, United
63 Kingdom, between 2001-2002 (n = 969) (Figure 1). Demographic, socioeconomic and family
64 history of allergy information was collected from pregnant women at 12 weeks gestation.
65 A validated food frequency questionnaire was completed at 36 weeks gestation (6) (see file 1
66 in online repository). Information about infant feeding was collected prospectively via a
67 standardized questionnaire at 3 and 6 months postpartum. The 3rd generation cohort is the
68 offspring of the Isle of Wight Whole Population Birth Cohort (n = 1456), born in 1989.
69 Participants of this cohort were followed up to 27 years of age. Since 2010 their offspring have
70 been enrolled in the 3rd generation study (7). The majority of 3rd generation participants were
71 recruited antenatally at 12 weeks gestation. Dietary data was collected by questionnaire at 28
72 weeks gestation using a modified version of the FAIR questionnaire and again at 3 and 6

73 months postpartum (6). Details of statistical methods are included in supplementary file 2.
74 Ethical approval for both studies was obtained from the Isle of Wight, Portsmouth and South
75 East Hampshire Research Ethics Committee.

76 Data was available for 1331 participants (969 FAIR and 362 3rd generation). Maternal
77 characteristics are shown in Table E1 (supplementary file 2). The proportion of mothers that
78 reported excluding peanuts during pregnancy was significantly lower for the 3rd generation
79 compared to the FAIR cohort (16.0% vs. 55.6%, $p < 0.01$). Results of the multivariable logistic
80 regression model showed that cohort membership, primiparity, and maternal education were
81 significantly associated with excluding peanuts during pregnancy (supplementary file 1, Table
82 E2). Specifically, 3rd generation mothers had 0.18 times the odds of excluding peanuts during
83 pregnancy compared to FAIR mothers (OR: 0.18, 95% CI: 0.12-0.27, $p < 0.01$). First time
84 mothers had 65% greater odds of excluding peanuts during pregnancy (OR: 1.65, 95% CI: 1.25-
85 2.17, $p < 0.01$). Vegetarian diet, maternal food allergy, and maternal age were not significantly
86 associated with exclusion of peanuts during pregnancy.

87 Figure 2 illustrates differences between the FAIR and 3rd generation cohorts in terms
88 of maternal frequency of consumption of key food allergens during pregnancy. A significantly
89 greater proportion of 3rd generation mothers reported regular consumption (once per week
90 or more) of peanuts, tree nuts, and seeds during pregnancy compared to FAIR mothers (all p
91 < 0.01). Information regarding infant feeding and maternal dietary intake during lactation is
92 shown in Table E1 (supplementary file 2). The proportion of mothers who reported excluding
93 any foods during breastfeeding was significantly lower for the 3rd generation compared to the
94 FAIR cohort (22.8% vs. 43.4%, $p < 0.01$).

95 Figure 3 shows that among participants from the 3rd generation cohort only, exclusion
96 of peanuts during pregnancy showed a decreasing trend over time from 2013 to 2018. The
97 results of the multivariable logistic regression model found an overall significant difference in

98 the proportion of mothers excluding peanuts during pregnancy between any of the offspring
99 years of birth (Wald $\chi^2 = 10.27$, $df = 4$, $p = 0.036$). Results of the pairwise tests (Table E3
100 supplementary file 2) found that women who gave birth in 2017 had 0.1 times the odds of
101 excluding peanuts during pregnancy compared to women who gave birth in 2013 (OR: 0.10,
102 95% CI: 0.02-0.57, $p = 0.01$). Primiparity, maternal education, maternal food allergy, nor
103 maternal age were significantly associated with exclusion of peanuts during pregnancy among
104 the 3rd generation participants.

105 Dietary data on peanut consumption may not be consistently reported as peanuts are
106 not usually differentiated from tree nuts and may be included under broad categories (e.g.
107 “nuts and seeds”) (8). Qualitative research with mothers of young children suggests that
108 peanuts are considered primarily in the form of whole peanuts, or in the form of peanut
109 butter, rather than being ingredients in food, meaning that study participants may in fact
110 consume more than they realise (8). In both the FAIR and 3rd generation studies, the same
111 validated questionnaire was used (6), which separated peanut, tree nuts and seeds into
112 different categories and gave several examples for each item (supplementary file 1). Research
113 from the Europrevall birth cohort study, a multicentre study in nine European countries
114 indicated wide practices in peanut intake; with only 2.7% of Dutch women avoiding eating
115 peanut in pregnancy, compared to 44.4 % of British women (8). In addition, pregnant women
116 in the UK were the highest avoiders of peanut and tree nuts (16.8%) compared to the other
117 eight countries. The UK was the only country at the time to have any national guidance on
118 peanut consumption during pregnancy, advocating peanut avoidance in high-risk families.

119 Against a backdrop of changing scientific evidence surrounding food allergy
120 prevention, the importance of providing clear dietary advice to the public, is paramount. In
121 the case of peanut exclusion variations in information provision, a lack of clarity in relation to
122 risks and the importance of atopy have been highlighted as potential issues (9). Due to this
123 confusion, there has been a concern that the 1998 advice (3) could possibly have *increased*

124 the prevalence of peanut allergy in the UK, as the advice may have been acted upon by non-
125 high-risk families, to whom the advice was not targeted (4, 10). Ongoing data collection by
126 our group of the 3rd generation participants will allow us to assess whether any changes in
127 peanut sensitisation and clinical allergy have occurred as a result of changes in their dietary
128 behaviour.

129 A strength of this study is that it was conducted in one area of the UK, although this
130 limits external generalization. There were some differences between the two cohorts,
131 meaning there is a risk of residual confounding. Maternal food allergy was self-reported and
132 data was collected at one pregnancy time point. In conclusion, maternal exclusion of peanut
133 during pregnancy was lower for mothers giving birth between 2012-2018 when compared to
134 mothers giving birth between 2001-2002. These results align with the change in government
135 dietary advice in 2008 and a paradigm shift towards exposure to dietary allergens via infant
136 feeding, as a preventative approach to food allergy in infancy.

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143 **Conflicts of interest:** None declared.

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178 prevalence of peanut allergy in United Kingdom children at school entry. *The Journal of Allergy
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Figure legends

Figure 1: Timeline illustrating the two different cohorts and timing of dietary recommendations and new guidance.

COT: Committee on Toxicity of Chemicals in Food (5).

FAIR: Food Allergy and Intolerance Research Study.

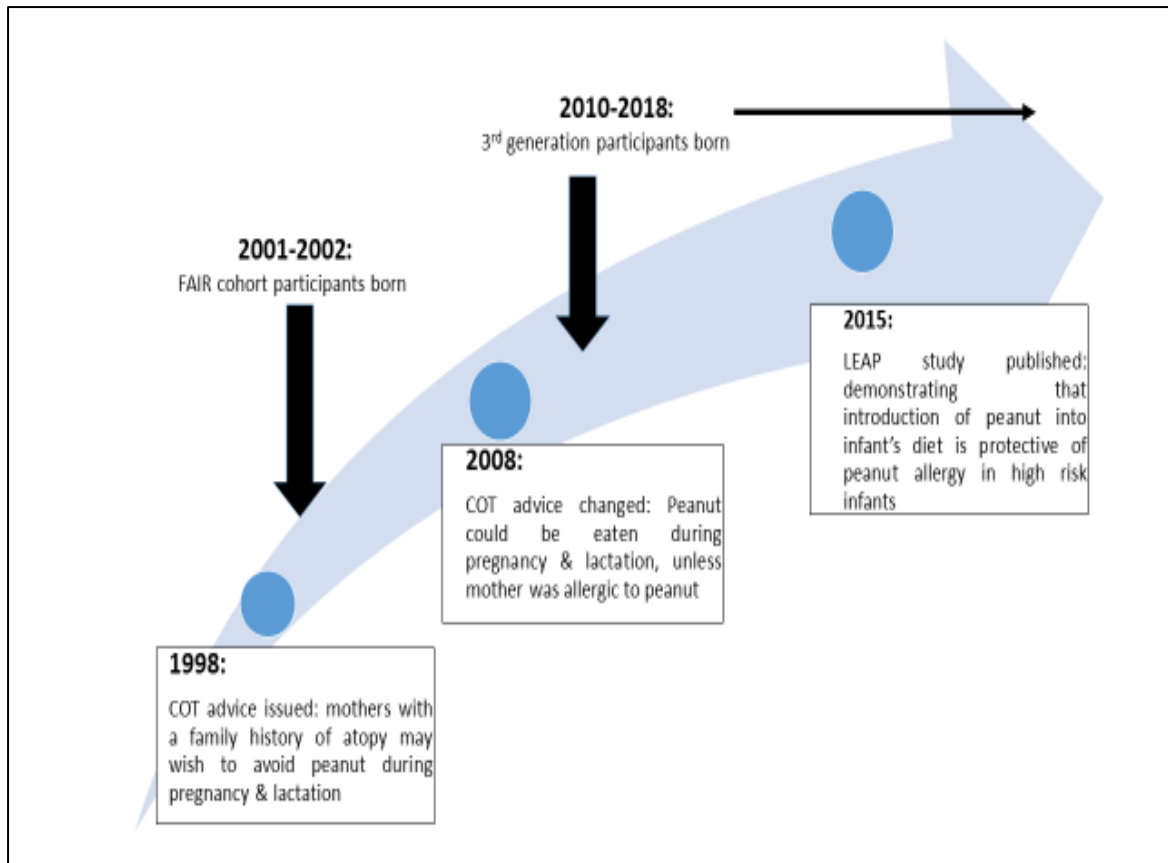
LEAP: Learning Early About Peanut Allergy (11).

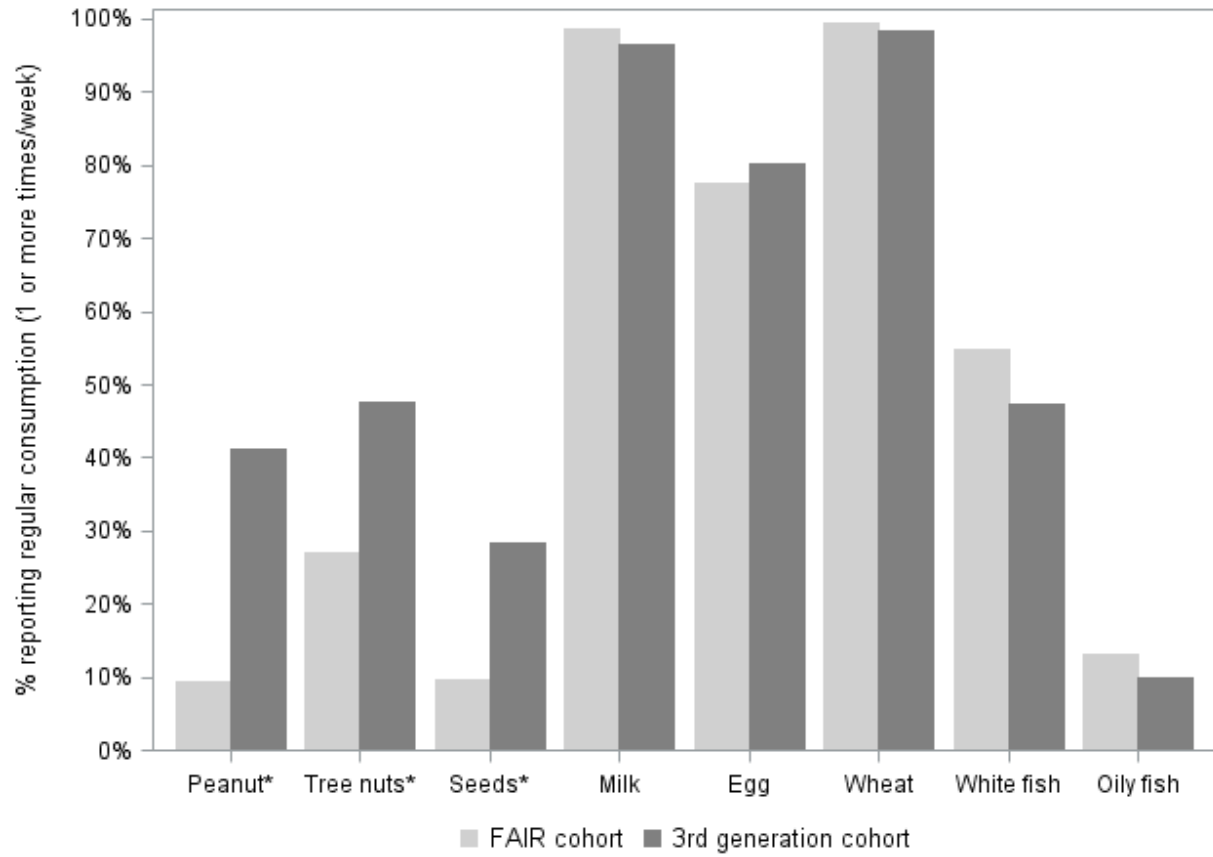
Figure 2. Percent of participants in the FAIR and 3rd generation cohorts that regularly consumed various food allergens during the third trimester of pregnancy.

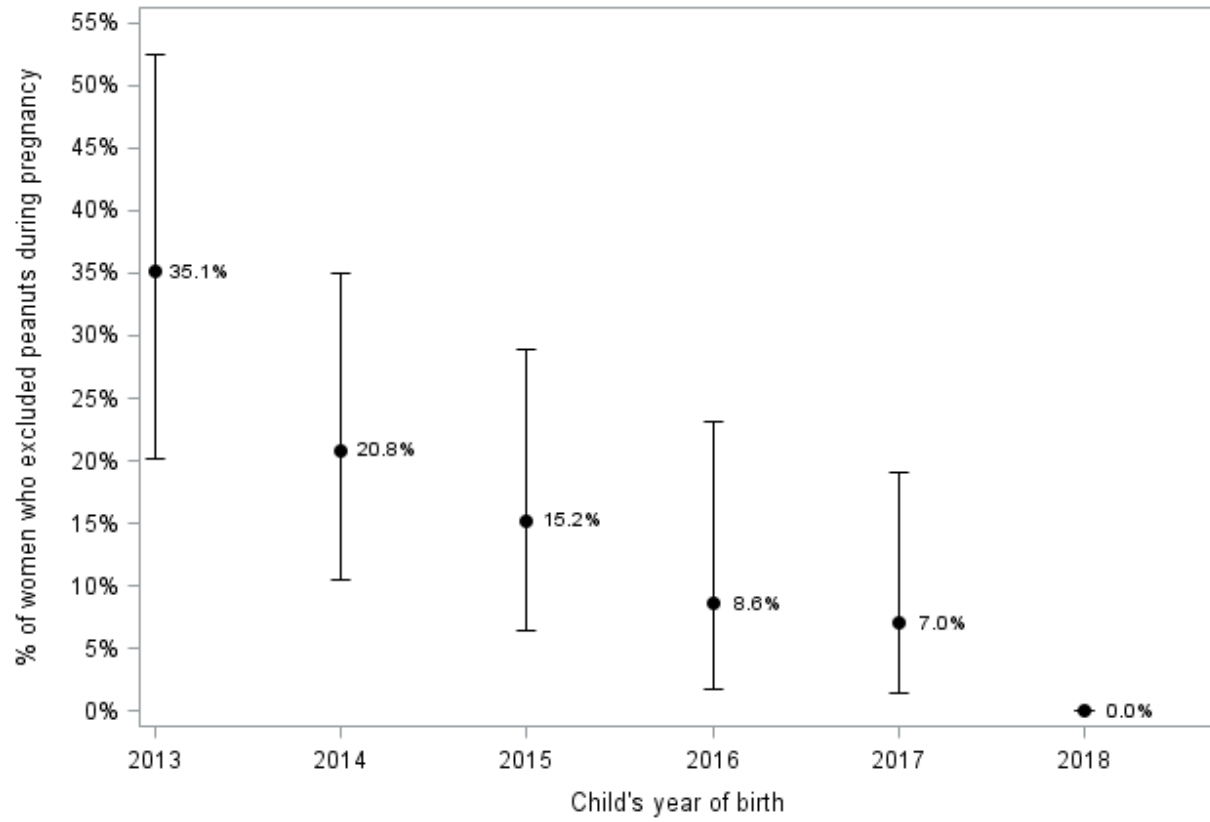
*Significant difference at Bonferroni-corrected alpha level: $p < 0.0001$

Figure 3. Percent of 3rd generation cohort participants that excluded peanut during pregnancy by child's year of birth (with exact 95% confidence limits).

Due to a small number of observations ($n=2$) with a birth year of 2012, Figure 3 only presents data from births between 2013 and 2018.







Supplementary file 1
Excerpt from FAIR pregnancy questionnaire

Q1. Please tick all of the following statements that are applicable to you:

- a. I am following a normal diet Yes No
- b. I am following a vegetarian diet Yes No
- c. I am following a vegan diet Yes No
- d. I am excluding raw eggs, unpasteurised soft cheese, to my pregnancy Yes No liver etc. due
- e. I am excluding PEANUTS due to my pregnancy Yes No
- f. I am following a special diet due to medical reasons (please state medical condition) Yes No
- g. I am excluding certain foods due to personal choice (please list foods) Yes No

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Q2. On average, how often have you eaten these foods during pregnancy?

	Never	Rarely (1-2 or less per month)	Occasionally (1-3 per week)	4 or more times per week	Uncertain
Milk and milk products (e.g. custard, yoghurt, ice cream, chocolate, butter, margarine, cheese – pizza, cheese sauce, lasagne, cheesy biscuits)					
Egg (e.g. omelettes, flans, meringues, cakes, cookies, batter mixes, egg pasta, quorn, mayonnaise, quiches)					
Wheat (e.g. bread, cereals, pasta, pizza, cakes, pies, pastry)					
White fish (e.g. tuna, fish cakes, battered fish, fish fingers)					
Shellfish (e.g. crab, prawns, shrimp, lobster, crayfish)					
Oily fish (e.g. mackerel, salmon, sardines, pilchards, herring, kipper, white bait, trout, crab, FRESH tuna)					
Peanuts (e.g. Bombay mix, peanut butter, peanut brittle, peanut cookies, sate, some vegetarian meals)					
Tree nuts - almonds, brazil nuts, pecan nuts, hazel nuts, walnuts etc (e.g. in chocolate, crunchy nut cornflakes, stuffing mix, sweet mincemeat, choc chip cookies, almond slice, marzipan, pesto sauce. Vegetarian meals, Greek desserts like baklava)					
Seeds – sesame, poppy, sunflower (e.g. on bread rolls, tahini paste)					
Citrus Fruits (e.g. orange, tangerine, grapefruit, lemon, lime)					