A COMPARISON OF PRE-PREPARED COMMERCIAL INFANT FEEDING MEALS TO HOME-COOKED RECIPES

Sharon A Carstairs, Leone CA Craig, Debbi Marais, Ourania E Bora, Kirsty Kiezebrink

Health Services Research Unit, School of Medicine and Dentistry, University of Aberdeen, Aberdeen AB25 2ZD. Sharon Carstairs, PhD Student.
The Rowett Institute of Nutrition and Health, University of Aberdeen, Aberdeen AB25 2ZD. Leone Craig, Research Fellow.
Warwick Medical School, The University of Warwick, Coventry, CV4 7AL. Debbi Marais, Principal Teaching Fellow.
Division of Applied Health Sciences, School of Medicine and Dentistry, University of Aberdeen, Aberdeen AB25 2ZD. Ourania Bora, Masters Student.
Division of Applied Health Sciences Postgraduate Education Group, School of Medicine and Dentistry, University of Aberdeen, Aberdeen AB25 2ZD. Kirsty Kiezebrink, Senior Lecturer.

Correspondence to: Sharon A Carstairs email: sharon.carstairs@abdn.ac.uk telephone: 01224 438034.

Keywords: Infant feeding; commercial foods; home-cooked; food variety; child feeding

Word Count: 2491

Number of figures and tables: 5

ABSTRACT

Objectives To compare the cost, nutritional and food variety contents of commercial meals and published infant and young child feeding (IYCF) home-cooked recipes, and to compare nutritional contents to age-specific recommendations.

Design Cross-sectional study.

Setting Full range of pre-prepared main-meals available within the UK market. Main meal recipes identified from a survey of Amazon's top 20 bestsellers and IYCF cookbooks available from local libraries.

Samples 278 commercial IYCF savoury meals from UK market and 408 home-cooked recipes from bestselling IYCF published cookbooks.

Main Outcome Measures Cost and nutritional content per 100g and food variety per meal for both commercial meals and home-cooked recipes.

Results Commercial products provided more 'vegetable' variety per meal (median=3.0; r=-0.33) than home-cooked recipes (2.0). Recipes provided 26% more energy and 44% more protein and total fat compared to commercial products (r=-0.40, -0.31, -0.40 respectively) whilst costing less (£0.33/100g and £0.68/100g respectively). The majority of commercial products (65%) met energy density recommendations but 50% of home-cooked recipes exceeded the maximum range.

Conclusions The majority of commercial meals provided an energy dense meal with greater vegetable variety per meal to their home-cooked counterparts. Home-cooked recipes provided a cheaper meal option however the majority exceeded recommendations for energy and fats.

INTRODUCTION

The introduction of solid foods, also known as complementary feeding or weaning, is the transitional period of an infant's life where a milk-based diet no longer meets the nutritional needs of the growing child. This period is recommended to begin from six months and should include the introduction of; a selection of fruits and vegetables, foods from animals and fish, together with other food groups to encourage a balanced diet rich in nutrients.[1,2] Evidence suggests that the development of taste preference begins in childhood[3-5] and by repeated exposure we can encourage the acceptance of foods.[6,7]

The availability of commercial food products on the market provides parents with a convenient alternative to home-cooked family meals,[8,9] and despite the fact that homemade is seen as the ideal option, commercial foods can provide a variety of flavours to help identify and develop infants' preferences.[10] Evidence from Germany indicates that there is a low variety of vegetables in both commercial and home-cooked infant meals, and that fish is rarely offered, suggesting that food variety is not being encouraged during the early years.[11] A comparison of adult-based commercial ready-meals and recipes concluded that both ready-meals and recipes fail to meet dietary recommendations.[12] However, findings by Garcia *et al* (2013) showed that home-cooked family infant meals were more nutrient dense than commercial infant foods.[13] The aim of this study was to investigate the nutritional content, price and food variety of UK available commercial IYCF meals compared to home-cooked recipes obtained from cookbooks, and to determine whether each met national age-specific dietary recommendations.

METHODS

Comparative analysis of the price, nutritional content, and variety was conducted between commercially available meals and home-cooked recipes within IYCF cookbooks in the UK. Savoury meals that could be eaten as a main-meal and targeted towards children under the age of five years were included. Breakfast foods, savoury snacks were excluded.

Selection of commercial infant meals

A search of UK-based commercial infant food manufacturers was conducted using Google.co.uk (search terms included; "baby foods", "baby food manufacturers", "infant foods", and "toddler foods") and within supermarkets with the largest market shares[14] (Asda, Tesco, Morrisons, Sainsburys, Aldi, Lidl) and non-food retailers (Boots and Superdrug) (May – June 2015). The full market of savoury main-meals was included for analysis (n=278).

Selection of home-cooked recipes

Cookbooks were identified from a search of local lending catalogues (May – July 2013) and Amazon's top 20 best-selling IYCF cookbooks (June 2013) (www.amazon.co.uk). Search terms included; "infant recipes", "toddler recipes", "infant food", "weaning", "infant feeding", and "complementary feeding". Resulting in 55 cookbooks with 4438 eligible main-meal recipes. A stratified sample of 408 main-meal recipes with proportional numbers from each of the categorised food types (seafood, poultry, red meat, and vegetable) was randomly selected, using randomiser software.[15]

Comparison of commercial products to home-cooked recipes

Cost Comparison

Individual product price was recorded for commercial products using MySupermarket.co.uk (May – July 2015) and manufacturers' online shops. For home-cooked recipes average prices

of raw ingredients per 100g were obtained from a food pricing database. A sample of eight food product prices were collected across four supermarkets for food items and together with an adjustment for seasonal variation, median price values were calculated per 100g.

Food variety

Food variety was compared between commercial and home-cooked meals. A vegetable variety score was calculated using the number of vegetable varieties within a meal to establish the variety exposure to this first taste recommended food. No limitation to the quantity of food was applied for the calculation as recommended for young children.[16]

Nutritional Comparison

Details of ingredients and nutritional content of products were obtained from commercial manufacturers' websites and product labels using a piloted data extraction form. Recipe ingredients and measurements were collected and entered into dietary analysis software[17] to calculate the nutritional compositions of recipes per 100g using McCance and Widdowson's food tables.[18] Nutritional analysis of raw ingredients was used due to limited published nutritional composition data for cooked foods. Energy density and percentage fat contribution were estimated from the nutrition analysis. For the early years' period recommendations for ED for individual meals is between 0.6 and 1.0kcal/g and the total energy derived from fats should be between 30 and 45%.[1,2] One gram of salt and pepper was included where optional.

Age-Specific Recommendations

The proportion of meals which comply with age-specific recommendations was calculated. Two age-specific recommendations (energy density and dietary fat) can be evaluated at a

single meal level the other two recommendations are set at a daily level (protein and salt) and therefore cannot be included in this meal-based comparison.[19,20]

Matched meal comparison

Commercial and home-cooked meals were categorised into meal types i.e. Spaghetti Bolognese to allow a matched meal comparison. Due to the lack of matches 17 products and 165 recipes were excluded from the analysis.

Sample Size

No formal power calculation has been carried out for this study. The sample size for the full data comparison was derived for another study and was deemed sufficient to allow comparison between commercial and home-cooked meals across food types. In the reduced sample size of the matched meals statistical findings should be viewed with caution. Non-significant results may indicate no differences or may be due to the small sample size being insufficient to observe differences.

Statistical Analysis

Price, food variety and nutritional data for meals were not normally distributed thus the non-parametric Mann-Whitney U Test was conducted to examine differences. As it is unknown what level of difference is required to provide a nutritional significance, effects sizes were calculated for nutritional and food variety comparisons. P-values <0.05 were considered statistically significant. Statistical analysis was conducted using IBM SPSS Statistics 22 software.[21]

RESULTS

In 2015, the UK market offered 278 commercial main-meals from eight manufacturers, of which six produced organic meals (174 meals (62.6%)).

A total of 4438 recipes were included within 55 55 cookbooks. A stratified sample of 408 of these were included in the study, of these 16% poultry-based in comparison to 27% of commercial meals, 19% seafood-based (commercial 7%), 21% red meat-based (commercial 35%) and 44% vegetable-based recipes (commercial 31%).

The average cost of commercial meals was found to be significantly higher (£0.68/100g) than home-cooked recipes (£0.33/100g; $p \leq 0.001$) and this remained in the sample of matched meals (£0.67/100g vs £0.33/100g; $p \leq 0.001$).

Both commercial and home-cooked poultry-based meals predominantly used chicken (92.0% and 90.8% of poultry-based meals respectively) (Table 1). Within red meat-based meals beef was predominantly used in both commercial (67.3%) and home-cooked meals (43.0%). Salmon was predominant in commercial seafood-based meals (50.0%) but not home-cooked recipes (18.2%) which had more cod-based meals (28.4%). A greater selection of red meat (n=4) and seafood species (n=14) were used across home-cooked recipes compared to commercial meals (n=3 and n=6 respectively).

Table 1: The percentage contribution of different meat and seafood species used within commercial meals and home-cooked IYCF recipes.

	Full sample		Matched Meals	
	Commercial Meals n=278	**Home-cooked Recipes n=408**	**Commercial Meals n=261**	**Home-cooked Recipes n=243**
	% Meals		**% Meals**	
Poultry	**n=75**	**n=65**	**n=72**	**n=37**
Chicken	92.0	90.8	93.1	100.0
Turkey	6.7	9.2	6.9	0.0
Red Meat	**n=98**	**n=86**	**n=84**	**n=51**
Beef	67.3	43.0	66.7	52.9
Lamb	12.2	27.9	11.9	31.4
Pork	20.4	22.1	21.4	13.7
Veal	0.0	1.2	0.0	0.0
Seafood*	**n=18**	**n=77**	**n=18**	**n=39**
Clams	0.0	1.3	0.0	0.0
Cod	16.7	28.4	11.1	35.9
Eel	0.0	1.3	0.0	2.6
Flounder	0.0	2.6	0.0	0.0
Haddock	0.0	9.1	0.0	10.3
Hake	5.6	0.0	5.6	0.0
Mackerel	0.0	6.5	0.0	7.7
Plaice	0.0	9.1	0.0	10.3
Pollock	27.8	1.3	22.2	2.6
Prawns	0.0	9.1	0.0	5.1
Salmon	50.0	18.2	44.4	25.6
Sardines	0.0	1.3	0.0	0.0
Sole	5.6	2.6	5.6	0.0
Tuna	16.7	16.9	16.7	17.9
Whiting	0.0	3.9	0.0	5.1

*combinations of two seafood species were often used in commercial and home-cooked meals

Across the range of commercial meals and home-cooked recipes, recipes used a greater variety of vegetables (n=33) compared to commercial (n=22) (Table 2). Carrot was the predominant vegetable used within commercial meals (79.1%) and second greatest in home-cooked recipes (31.6%) following onions (50.0%).

Table 2: The percentage contribution of different vegetable varieties within the range of commercial meals and home-cooked IYCF recipes.

	Full Sample		Matched meals	
	Commercial Meals n=278	Home-cooked Recipes n=408	Commercial Meals n=261	Home-cooked Recipes n=243
Vegetable Type	**% Meals**		**% Meals**	
Asparagus	0.0	0.2	0.0	0.4
Aubergine	3.2	3.7	3.4	2.5
Avocado*	0.0	1.7	0.0	0.8
Beetroot	0.4	0.7	0.4	0.8
Broccoli	12.2	8.8	12.3	7.0
Brussel sprouts	0.0	0.7	0.0	0.8
Butternut Squash	10.4	6.4	11.1	7.0
Cabbage	0.7	3.7	0.0	1.6
Carrot	79.1	38.0	79.3	36.2
Cauliflower	4.3	4.2	4.2	6.6
Celery	7.2	9.3	7.3	6.2
Courgette	12.2	11.5	13.0	9.1
Cucumber	0.0	2.0	0.0	0.4
Green beans	4.3	5.9	4.2	4.5
Leeks	8.3	11.0	8.0	8.6
Lettuce	0.0	3.2	0.0	0.8
Mangetout/sugar snap peas	0.0	2.2	0.0	1.6
Mushrooms	62.6	10.8	4.6	8.2
Okra	0.0	0.2	0.0	0.4
Onions/shallots/spring onions	16.9	59.8	64.0	47.3
Parsnip	22.7	5.1	17.2	6.2
Peas	13.3	15.9	23.4	15.2
Peppers	3.2	17.4	14.2	11.9
Pumpkin	5.4	2.5	3.4	2.5
Runner beans	0.0	0.2	0.0	0.4
Spinach	6.8	7.1	5.7	4.9
Spring greens/kale	0.0	0.2	0.0	0.0
Swede	8.3	3.9	7.3	4.9
Sweetcorn	14.4	9.8	8.8	7.0
Sweet Potato	53.2	9.1	13.8	11.5
Tomato*	3.2	34.1	53.6	28.4
Turnip	0.0	0.5	0.0	0.0
Watercress	0.0	0.5	0.0	0.4

* included due to this foods predominant use in savoury meals

Commercial meals had a greater 'vegetable' variety score per meal (median=3.0) than home-cooked recipes (2.0) (r=-0.33; p≤0.001) which remained evident in a matched meal comparison (median 4.0 versus 2.0 respectively; r=-0.36; p≤0.001) (Figure 1).

Figure 1: Boxplots of the median and 2.5% and 97.5% percentiles of vegetable variety score per meal between commercial products and home-cooked recipes for full sample and matched meals. ***** denotes a significant differences (p<0.05) between commercial products and home-cooked recipes

Home-cooked recipes contained 51% more energy (101.0kcal vs 67.0kcal/100g; r=-0.47; p≤0.001) than commercial products (Table 4). Home-cooked recipes contained higher carbohydrate (9.0g/ vs 8.4g/100g; r=-0.11; p=0.005), salt (0.24g vs 0.08g/100g; r=-0.50; p≤0.001), protein (5.9gvs 2.9g/100g; r=-0.41; p≤0.001), total fat (4.4g vs 2.2g/100g; r=-0.48; p≤0.001) and saturated fat (1.5 vs 0.6g/100g; r=-0.37; p≤0.001) compared to their commercial counterparts providing 7-200% more nutrients. Similar trends were evident in matched meals providing 6-77% more nutrients. In addition, in the match meals home-cooked meals provided higher sugar contents (2.5g vs2.2g/100g; r=- 0.10; p=0.026) (Table 3).

Table 3: A comparison of the nutritional content per 100g of full sample of IYCF commercial meals and home-cooked recipes and matched meals.

	Full Sample			Matched Meal Sample		
	Commercial Meals n=278	Home-cooked Recipes n=408	P value*	Commercial Meals n=261	Home-cooked Recipes n=243	P value*
Nutritional Content	Median (Interquartile Range)			Median (Interquartile Range)		
Energy (kcal)	67.0 (59.0, 77.0)	101.0 (74.3, 151.0)	≤0.001	68.0 (59.0, 77.0)	92.0 (71.0, 127.0)	≤0.001
Protein (g)	2.9 (2.5, 3.6)	5.9 (3.0, 8.5)	≤0.001	3.0 (2.5, 3.6)	5.3 (2.4, 7.7)	≤0.001
Carbohydrate (g)	8.4 (6.9, 9.5)	9.0 (5.7, 14.4)	0.005	8.4 (7.0, 9.5)	8.9 (6.4, 13.8)	0.024
Sugar (g)	2.2 (1.7, 3.0)	2.3 (1.4, 3.3)	0.861	2.2 (1.7, 3.1)	2.5 (1.8, 3.6)	0.026
Fibre (g)	1.5 (1.2, 1.9)	1.4 (1.0, 2.0)	0.139	1.5 (1.2, 1.9)	1.5 (1.1, 2.0)	0.761
Total Fat (g)	2.2 (1.5, 2.7)	4.4 (2.5, 7.3)	≤0.001	2.2 (1.5, 2.8)	3.9 (2.2, 6.7)	≤0.001
Saturated Fat (g)	0.6 (0.1, 1.0)	1.5 (0.6, 2.9)	≤0.001	0.6 (0.3, 1.1)	1.4 (0.5, 2.8)	≤0.001
Salt (g)	0.08 (0.05,0.13)	0.24 (0.12, 0.43)	≤0.001	0.08 (0.05, 0.13)	0.21 (0.10, 0.34)	≤0.001

*Mann-Whitney U Test comparing commercial meals to home-cooked recipes.

Energy density (ED) meal-based recommendations were met by 64.6% of commercial products and 36.6% of home-cooked recipes (Table 4). A higher percentage of commercial products (28.5%) failed to meet the minimum ED compared to home-cooked meals (13.2%) which mainly exceeded (50.2%) the maximum range. The majority of commercial meals (52.0%) were below the recommended meal-based range for energy from total fat (30-45%) with 47.3% within the recommended range. In contrast, 34.1% of home-cooked recipes met the recommendation whilst the majority (37.0%) exceeded recommendations. Similar trends were evident in a matched meal comparison.

Table 4: The percentage of commercial meals and home-cooked IYCF recipes which meet age-specific recommendations**.**

Nutrient	Range per Meal	Full Sample		Matched Meals	
		Commercial Meals	Home-cooked Recipes	Commercial Meals	Home-cooked Recipes
		% Meals		% Meals	
Energy	>0.6	28.5	13.2	26.8	16.5
Density	**0.6-1.0**	64.6	36.6	65.9	39.5
(kcal/g)	>1.0	6.9	50.2	7.3	44.0
Total Fat	<30%	52.0	28.9	50.2	33.7
(% of total	**30-45%**	47.3	34.1	47.9	31.7
energy)	>45%	0.7	37.0	1.9	34.6

DISCUSSION

Parents must address multiple competing factors when considering what foods to provide their children. Within this choice parents consider whether to provide solely commercial or home-cooked meals or use a combination of both during early years' feeding. Parents may consider factors, such as the cost, nutritional adequacy, and food variety, in addition to the perceived convenience of these options. This study provided an opportunity to compare commercial products to home-cooked recipes available to parents. We found that home-cooking can provide a lower cost option to commercial meals however this difference is likely to be reduced when organic ingredients are used. Nonetheless, the potential price difference between organic and non-organic foods is estimated to be 33% higher for purchasing organic (estimated from Kantar database) resulting in a price rise to £0.44/100g which remains cheaper than the average commercial products' cost. Previous studies show that parents are willing to pay more for organic infant foods[8,22] and the fact that the majority of manufacturers produce organic foods seems to reflect the market demand for these products. It is important to consider that some food items, such as sugar and herbs present at less than 10g, were excluded in the cost calculation of recipes as these were deemed general

items already present in the kitchen and would not need to be purchased specifically for the recipe. By not including these items or the cost of cooking we may have underestimated the true cost of home-cooking in addition evidence suggests the fuel costs for home-cooking are greater than for convenience foods.[23]

Unlike adult recommendations which encourage reducing ED and fats it is important in infants that food is suitably ED in appropriate sized meals to aid growth and development. Dietary fats contribute essential fatty acids (EFA) and fat-soluble vitamins together with energy and sensory qualities thus are vital for the growing child, however excessive intakes may impact on childhood obesity and health.[24] Our study found that the majority of commercial meals fall within the recommended ED range for meals whereas 50% of the home-cooked recipes exceeded recommendations. These findings contradict conclusions by Garcia *et al* (2013) who deemed commercial meals to be unsuitable for adding to the infant diet however they compared commercial foods to breastmilk and not age-specific recommendations.[13] The majority of commercial and home-cooked meals failed to meet the recommendations for energy derived from fats.[1,2] With evidence showing that infant finger foods and snacks contain high fat contents,[13] the lower fat intakes from commercial meals may be balanced within the context of the daily diet. Home-cooked meals which exceed recommendations however will further augment excessive fat intakes when added to the intake of high fat snacks.

From a direct nutritional comparison, the higher ED of home-cooked recipes appears to predominantly result from higher levels of total and saturated fats. The level of nutrient difference required to determine nutritional significance is unknown however, differences in fat and protein contents found in this study showed medium effect sizes providing some

indication of the magnitude of the differences found. The higher nutrient contents found in home-cooked recipes support those findings previously reported.[13,25] There is a possibility that the lower protein content evident in commercial meals may be due to the higher proportion of early stage meals in the commercial market[26] and a predominance of vegetable-based meals as recommended for first tastes.[1,2] There may be a greater cost implication for including protein-based ingredients and thus manufacturers use less of these ingredients within the meal to limit the cost of production and the final sale price of the product. It should be considered that discrepancies may exist in the nutrient composition of commercial ready-meals and declared values,[27,28] as legislation states that tolerances of approximately 20% are permitted for declared macronutrients.[29] In addition, parents may use cookbooks prescriptively or only as guidance and thus the nutritional content of home-cooked recipes can vary greatly and this can be augmented further by natural variations in the nutritional composition of raw ingredients. The authors may have overestimated the values for salt within home-cooked recipes as it was often cited as optional thus these results should be considered with caution.

For parents concerned with providing a varied diet, if the parent relied solely on the commercial market then it is likely that the child would be exposed to a lower overall range of food types in terms of vegetables, meats and fish options. The predominance of beef as a red meat source and the lower prevalence of seafood–based commercial meals support previous findings,[11] and mirror UK consumption trends[30,31] whilst the common use of carrot also corroborates previous findings.[11,32] The predominance of salmon, tuna and cod in both commercial and home-cooked seafood-based meals complements the most commonly consumed species within Europe.[33] Despite encouragement towards a broad variety of meats and both white and oil-rich seafood species, the high proportion of red meat-based meals and

recipes and low seafood meals are of concern when dietary recommendations encourage an increase in oil-rich fish consumption and limitation of red and processed meats.[34,35] Despite a broader range of ingredients included across home-cooked recipes, greater 'vegetable' variety per meal was evident in commercial meals. These findings contrast those from a German study which found no significant differences in variety between commercial and home-cooked meals at 6-9 months.[11] However, Mesch *et al* (2014) used a 10g cut-off for the food variety calculation[11] which is suggested for use in adults[16] and could have underestimated the vegetable variety found within meals. The range of different foods included in the meals and recipes helps to increase exposure to different tastes which may contribute to reduce food neophobia.[6,7] Specifically the variety of vegetables evident in commercial meals and the broad range of seafood species in home-cooked meals is encouraging.

This study is the first to compare the full range of available commercial and home-cooked meals for cost, nutritional adequacy and food variety. Our study provides an overall comparison of commercial to home-cooked meals. In addition we have included a matched meal comparison to allow a like-for-like meal comparison which showed broadly similar findings to the full sample comparison. However, caution should be made with these findings due to the small sample size.

Investigating cookbooks available in libraries together with UK best-seller lists this study aimed to evaluate a populist sample of cookbooks however parental use of these books was not investigated. Other aspects may be important in parents' consideration of commercial or home-cooked meals including the micronutrient content of meals. As these were not provided on commercial product labels we were unable to compare with home-cooked recipes in this

study. Furthermore, the diversity of meal texture was not examined which is another important aspect to consider in IYCF.[1,2]

The majority of commercial meals met ED recommendations and can provide a convenient alternative which includes a greater vegetable variety per meal. Home-cooked recipes provided 6-77% more nutrients than commercial however, the majority of these recipes exceeded ED and fat recommendations.

What is already known on this topic

Commercial adult-targeted ready-meals available in the UK provide less macronutrients than recipes from television chefs, whilst commercial infant meals provide nutrient levels similar to breast and formula milk will little food variety.

What this study adds

Home-cooked recipes provided a cheaper meal option than commercial providing 6-77% greater nutrient levels and a broad range of vegetable and meat and fish species across the range of recipes.

However, the majority of home-cooked recipes exceeded ED and dietary fat recommendations.

The majority of commercial meals met ED recommendations and had a greater 'vegetable' variety score per meal than home-cooked meals but often failed to meet the minimum 30% of energy from dietary fats.

Transparency Declaration: The lead author (SC) affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Acknowledgements: The authors would like to thank Jennie Macdiarmid, Stephen Whybrow, Christian Reynolds, Graham Horgan and Janet Kyle of the University of Aberdeen who contributed to the food ingredients costing database. For further details please contact Christian Reynolds (christian.reynolds@abdn.ac.uk). The authors would additionally like to thank the statistical team within the Division of Applied Health Sciences at the University of Aberdeen for their support in analysing the data. This work was supported by The Scottish Government's Rural and Environment Science and Analytical Services (RESAS) division (LC grant).

Conflict of interest: The authors confirm there are no conflicts of interest. The funding for this research study was for a PhD scholarship by the Seafish Authority and Interface Food and Drink Scotland which do not financially benefit from this research or have any influence on the results found and presented here.

Sources of funding: This study was funded by the Seafish Authority and Interface Food and Drink Scotland as part of a PhD scholarship for SC.

Contribution into other languages, create adaptations, reprints, include within collections and create summaries, extracts and/or, abstracts of the Contribution, iii) create any other derivative work(s) based on the Contribution, iv) to exploit all subsidiary rights in the Contribution, v) the inclusion of electronic links from the Contribution to third party material where-ever it may be located; and, vi) licence any third party to do any or all of the above."

Disclaimer: The authors views expressed in the submitted article are their own and are not an official position of the University of Aberdeen or any of the funding bodies.

Contributorship: Substantial contributions to the conception or design of the work; data collection, analysis, and interpretation of data for the work were conducted by Sharon Carstairs (SC) under the supervision of Dr K Kiezebrink (KK), Dr D Marais (DM) and Dr L Craig (LC). Data collection was additionally conducted by Ourania Bora (OB). Drafting of the publication was done by SC with the revision for important intellectual content and final approval of the version to be published given by KK, DM, LC and OB. There is agreement between the authors that SC is accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Ethical Approval: No ethical approval was required for undertaking this work.

REFERENCES

1. Pan American Health Organization and World Health Organization. (2003) Guiding principles for complementary feeding of the breastfed child. Washington DC: Pan American Health Organization and World Health Organization.

2. World Health Organization. (2005) Guiding principles for feeding non-breastfed children 6-24 months of age. Geneva: World Health Organization.

3. Birch LL, McPhee L, Steinberg L, et al. (1990) Conditioned flavor preferences in young children. *Physiol Behav* **47,** 3, 501-505.

4. Sullivan SA, Birch LL. (1994) Infant dietary experience and acceptance of solid foods. *Pediatrics* **93,** 2, 271-277.

5. Birch LL, Fisher JO. (1998) Development of eating behaviors among children and adolescents. *Pediatrics* **101,** Supplement 2, 539-549.

6. Birch LL, Gunder L, Grimm-Thomas K, et al. (1998) Infants' consumption of a new food enhances acceptance of similar foods. *Appetite* **30,** 3, 283-295.

7. Caton S, Blundell P, Ahern S, et al. (2014) Learning to eat vegetables in early life: The role of timing, age and individual eating traits. *PLOS One* **9,** 5, e97609.

8. Maguire K, Owens N, Simon N. (2004) The price premium for organic babyfood: A hedonic analysis. *Journal of Agricultural and Resource Economics* **29,** 1, 132-149.

9. Synott K, Bogue J, Edwards C, et al. (2007) Parental perceptions of feeding practices in five European countries: an exploratory study. *European Journal of Clinical Nutrition* **61,** 946-956.

10. Hoddinott P, Craig L, Britten J, et al. (2010) A prospective study exploring the early infant feeding experiences of parents and their significant others during the first 6 months of life: what would make a difference? Edinburgh: NHS Health Scotland.

11. Mesch CM, Stimming M, Foterek K, et al. (2014) Food variety in commercial and homemade complementary meals for infants in Germany. Market survey and dietary practice. *Appetite* **76,** 0, 113-119.

12. Howard S, Adams J, White M. (2012) Nutritional content of supermarket ready meals and recipes by television chefs in the United Kingdom: cross sectional study. **345,** e7607,.

13. Garcia AL, Raza S, Parrett A, et al. (2013) Nutritional content of infant commercial weaning foods in the UK. *Archives of Disease in Childhood* **98,** 10, 793-797.

14. Kantar Worldpanel. Grocery Market Share UK - Grocery Market Beats Inflation. 2012; Available at: http://www.kantarworldpanel.com/global/News/Grocery-Market-Share-UK-Grocery-Market-Beats-Inflation. Accessed September/30, 2012.

15. Urbaniak GC, Plous S. (2007) Research Randomizer (Version 4.0). 2014.

16. WHO, UNICEF, USAID, et al. (2008) Indicators for assessing infant and young child feeding practices: conclusions of a consensus meeting held 6–8 November 2007 in Washington D.C., USA. Geneva: World Health Organization.

17. Tinuviel Software. (2006) NetWISP Dietary Analysis Software.

18. Food Standards Agency editor. (2002) McCance and Widdowson's The Composition of Foods. 6th ed. Cambridge: Royal Society of Chemistry.

19. Department of Health. (1994) Weaning and the Weaning Diet. Report on Health and Social Subjects 45. London: HMSO.

20. Scientific Advisory Committee on Nutrition. (2003) Salt and health. Norwich: The Stationary Office.

21. IBM Corp. (2013) Statistical Package for the Social Sciences. 22.0.

22. Harris M. (1997) Consumers pay a premium for organic baby foods. *Food Review* **20,** 2, 13-16.

23. Richardson S, Phillips JA, Axelson JM, et al. (1985) Cost of Preparing Convenience and Home-Prepared Foods With an Electric Range and a Microwave Oven. **14,** 1, 29-40.

24. Milner JA, Allison RG. (1999) The Role of Dietary Fat in Child Nutrition and Development: Summary of an ASNS Workshop. *The Journal of Nutrition* **129,** 11, 2094-2105.

25. Hilbig A, Foterek K, Kersting M, et al. (2015) Home-made and commercial complementary meals in German infants: results of the DONALD study. **28,** 6, 613-622.

26. Carstairs S, Marais D, Craig L, et al. (2015) Seafood inclusion in commercial main meal early years' food products. **Published Online First,** 20 April 2015, DOI: 10.1111/mcn.12185.

27. Zand N, Chowdhry BZ, Pollard LV, et al. (2015) Commercial ready-to-feed infant foods in the UK: macro-nutrient content and composition. **11,** 2, 202-214.

28. Kanzler SM, M, Lammer G, Wagner K. (2015) The nutrient composition of European ready meals: Protein, fat, total carbohydrates and energy. **172,** 190.

29. The Commission of European Communities. (2012) Guidance document for competent authorities for the control of compliance with EU legislation on: setting of tolerances for nutrient values declared on a label. The Commission of European Communities.

30. Scottish Government. (2013) Diet and Nutrition Survey in Infants and Young Children in Scotland 2011. Edinburgh: Scottish Government.

31. Public Health England and Food Standards Agency. (2014) National Diet and Nutrition Survey: Results from Years 1,2,3 and 4 (combined) of the Rolling Programme (2008/2009 - 2011/2012). London: Public Health England.

32. O'Donovan SM, Murray DM, Hourihane JO, et al. (2015) Adherence with early infant feeding and complementary feeding guidelines in the Cork BASELINE Birth Cohort Study. *Public Health Nutr* **FirstView,** Supplement -1, 1-10.

33. European Commission. (2014) The EU Fish Market. Brussels: Directorate-General for Maritime Affairs and Fisheries of the European Commission.

34. Scottish Government. (2013) Revised Dietary Goals for Scotland. Edinburgh: Scottish Government.

35. Public Health England in association with the Welsh Government, Food Standards Scotland and FSA in Northern Ireland. 2016 The Eatwell Guide.