MMJ

Malta Medical Journal, 32 (2): Pages (2020)
http://mmsjournals.org/index.php/mmj/article

ORIGINAL ARTICLE

High levels of sugar and salt in commercial baby foods in Malta: results from a pilot study using the World Health Organization draft nutrient profile model

Lucienne Pace, Margarida Bica, Julianne Williams, Jayne Hutchinson, Janet E. Cade, Kremlin Wickramasinghe, Charlene Vassallo, João Breda

Background

A major determinant of healthy growth and development is good nutrition during infancy and early childhood. The high level of marketing and wide-spread availability of commercially available complementary foods (baby foods) have led to various concerns about the nutritional content and potentially problematic marketing strategies used to promote these products, since this may adversely affect the parents' practices and the health status of young children. The aim of this pilot study was to assess the nutritional characteristics of commercially available foods for infants and young children under the age of 36 months in Malta, and to identify if these foods met the nutritional standards outlined in the WHO draft nutrient profile model (NPM) for this age group.

Methods

A pilot study was carried out in two supermarkets and one large pharmacy that consented the photographing of over 243 food labels of foods marketed for infants and young children under 36 months in Malta. The nutritional quality of these foods was analysed using a validated World Health Organization NPM.

Results and Conclusion

Only 88 (36%) out of the 243 food products tested according to a draft of the WHO NPM met the appropriate nutritional standards criteria used by this model. Tested products were found to contain high amounts of sugar and salt. The findings suggest that the quality of most of the food and beverages marketed for infants and young children currently available on the local market are not suitable for infants and young children in this age group.

Lucienne Pace M.Sc Human Nutrition (Aber), B.Sc. Nursing Studies (Hons)
Health Promotion and Disease Prevention Directorate,
Ministry of Health, Valletta, Malta

Margarida Bica* B.Sc.,
Division of Noncommunicable Diseases and Promoting Health through the Life-Course, World Health Organization Regional Office for Europe, Copenhagen, Denmark
margaridasbica@gmail.com

Julianne Williams, PhD, MPH,
World Health Organization European Office for Prevention and Control of Noncommunicable Diseases, Moscow, Russian Federation, Division of Country Health Programs, Regional Office for Europe

Jayne Hutchinson, PhD.
Nutritional Epidemiology Group, School of Food Science and Nutrition, University of Leeds, Leeds, UK

Janet E. Cade, PhD.
Nutritional Epidemiology Group, School of Food Science and Nutrition, University of Leeds, Leeds, UK

Kremlin Wickramasinghe, PhD.
World Health Organization European Office for Prevention and Control of Noncommunicable Diseases,
Moscow, Russian Federation.

Charlene Vassallo, M. Sc. Biomedical Science (Ulster), B.Sc. Medical Laboratory Science (Hons) (Melit).
Health Promotion and Disease Prevention Directorate,
Ministry of Health, Valletta, Malta

João Breda PhD.
World Health Organization European Office for Prevention and Control of Noncommunicable Diseases, Moscow, Russian Federation, Division of Country Health Programs, Regional Office for Europe

Introduction

The World Health Organization (WHO) recommends exclusively breastfeeding until 6 months of age (meaning that the infant receives no other food or liquid aside from breastmilk), with continued breastfeeding along with appropriate complementary foods up to two years of age or beyond.[1] Despite this recommendation and a growing body of evidence which corroborates the beneficial effects of following the recommendations, nearly two thirds of infants under 6 months are not exclusively breastfed.[2]

The introduction of solid food is an important transition in the life of an infant and young child.[3] It is a time where infants are exposed to different foods, varying in texture, taste, smell, and sight, as well as to the surrounding adults and siblings that, in turn, will affect their food preferences and their eating behaviour.[4-5] This phenomenon is well documented and known as the first 1,000 days (from conception to age two years) where a child's eating pattern is programmed[6] and this is relevant since the behaviours and preferences established in early childhood tend to carry over into later years.[4] Breastfed infants, who are exposed to varying flavours in breast milk, normally show better food acceptance to a wider variety of foods later in life.[7-9]

Incorrect eating patterns, inadequate nutrition and unhealthy behaviours are known to contribute to the development of childhood obesity.[10] In Malta around 35% of girls and 37% of boys are overweight or obese, and this has drawn attention as an important public health issue.[11] Prevention of overweight and obesity requires a life-course approach, and actions must be taken to promote healthy nutrition at all stages of life, including infancy.[12]

Young children and babies have an innate preference for sweet tastes and dislike of bitter and sour flavours.[13] Therefore, early and repeated exposure to sweet complementary foods is particularly worrying as it may further reinforce sweet preferences.[14] Furthermore, premature introduction of complementary foods may displace breastfeeding, which brings a host of benefits including reduced risk of obesity and diabetes later in life.[15]

As the use of commercial baby foods has increased, there have been concerns about their poor nutritional content (and potential negative health consequences) and the marketing strategies used to promote these products.[16] More specifically, the nutrition-related concerns include: their sweet-taste profile, the lack of diverse ingredients, the limited food texture, as well as their poor nutritional quality; both in nutrition composition as well as in micronutrient bioavailability, quantities do not reach the recommended levels that may pose long term effects.[17-20] Another concern is that many baby food products have marketing statements which indicate suitability for children at 4 months of age, a marketing strategy which does not align with WHO recommendations, and which may encourage premature introduction of complementary foods.

Previous work has been done to assess the sugar and sodium levels in packaged baby and toddler foods (n=240 foods from nine retail stores), where it was found that 58% of the products assessed either had a high level of sodium or more than 20% of calories from sugar.[21] WHO also recently conducted research on foods for infant and young children in four cities of four European countries in the WHO European Region and found that baby foods were too high in sugar

and often contained marketing messages that did not align with WHO recommendations.[22]

To further understand the situation, this pilot study aimed to obtain a snap-shot of commercially available complementary foods, its quality and its level of appropriate promotion for infants and young children in Malta at common points of sale, examining its composition according to the draft Nutrient Profile Model (NPM), developed by the WHO for infants and young children under 36 months. Nutrient profiling models offer a reliable method to assess the nutritional quality of food products and can be defined as 'the science of categorising foods according to their nutritional composition'.[23] Nutrient profile models can help countries to identify products which can and cannot be promoted for infants and young children up to 36 months. This is a crucial step in developing effective legal and policy measures to promote health, which ultimately benefits consumers and, consequently, improves public health.[24]

The WHO Regional Office for Europe recently published a report which proposed criteria for identifying products appropriate for promotion for infants and young children.[16] The criteria together referred to as a 'nutrient profile model' (NPM) were developed using an established WHO approach, including an extensive literature review. The model establishes compositional thresholds and provides guidance on product-labelling and promotions. The compositional thresholds of an early version of the NPM was validated using 1,328 products on the market in Denmark, Spain and the UK in 2016/2017, amended and pilot tested in seven additional countries (Estonia, Hungary, Italy, Malta, Norway, Portugal and Slovenia) in 2018 with a further 1314 products. Details of pilot testing with products sold in Malta is provided here. The proposed NPM was updated following the pilot test and feedback from the countries involved; this involved amendments to some of the thresholds (notably protein was lowered to the European Commission threshold) and simplification of some categories. The published version can be adapted by governments, to restrict inappropriate promotion of foods for infants and young children in their own countries.[16]

Materials and Methods

The Health Promotion and Disease Prevention Directorate (Malta) participated in a pilot testing study for WHO to provide nutrition and market data on commercially prepared baby food products.

Data Collection

Data were collected in August of 2018 from three local retailers in Malta, two local main supermarkets and one pharmacy outlet. Retailers were invited to participate and consented to allow the photographing of the baby foods products. The 243 baby food products found in these retailers were photographed and data were collected, including information about ingredient list and nutrition information (Figure 1). The main manufacturers from which collected information in Malta were: Cuore di Natura, Ella's Kitchen, Good Gout, Heinz, Hipp, Kiddylicious, Maltova, Milupa, Nestle, Organix, Organu, Piccolo, Plasmon and Tesco.

The foods marketed as suitable for infants and young children 6-36 months of age were classified as follows (Supplementary Table 1):

- Dry powdered and instant cereal/starchy food

- Soft–wet spoonable, ready-to-eat foods, typically smooth or semi-puréed packaged in jars or pouches and can be spoon-fed
- Meals with chunky pieces, often sold in trays or pots
- Dry finger foods and snacks
- Juices and other drinks

Testing the compositional thresholds of the WHO Nutrient Profile Model

The nutrition information, mainly calories, protein, sugar and the type of sugar, total fat, saturated fat and salt, were evaluated according to the compositional thresholds of the WHO NPM, as detailed below.

The data were entered into a pre-designed spreadsheet which determined the number of products that passed the nutrient requirements of the NPM, after selecting an appropriate food category. This was sent to WHO and the WHO Collaborating Centre at University of Leeds for final cleaning and analysis.

NPM requirements for foods and nutritional composition

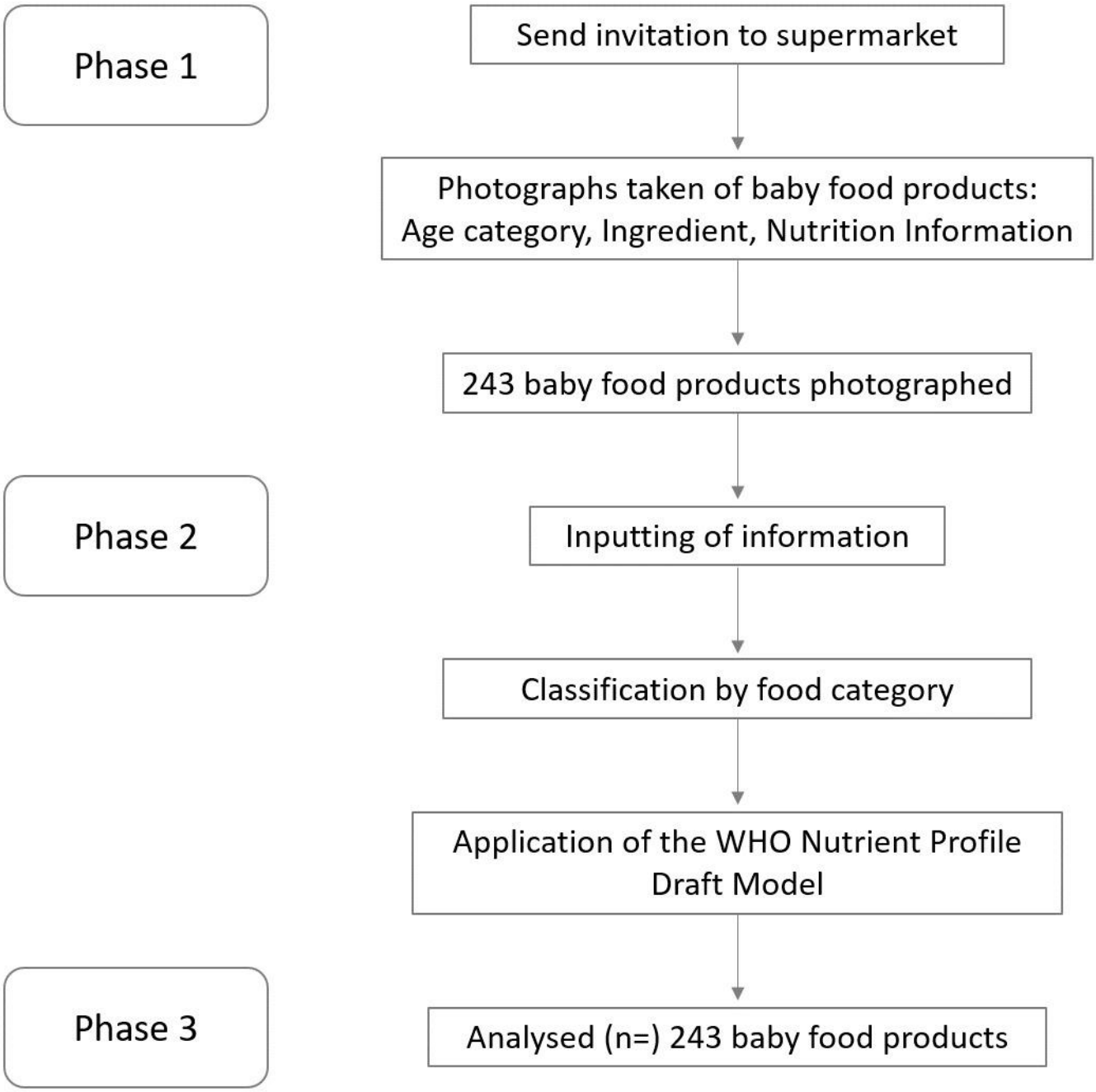
Six main compositional criteria of the draft NPM, relating to commercially available complementary foods (CACF) for infants and young children up to 36 months, could be assessed. The nutritional information for each product was compared with these requirements and specifications of the draft NPM version pilot tested, which were as follows:

1. Products marketed as suitable for this age group should not contain any added sugars or other sweetening agents. The following listed ingredients were classed as added sugars and sweeteners for this analysis: sugar, (any) syrup, juice (but lemon or lime juice are not), molasses, malt extract, barley malt, malted barley extract, maltose, dextrose, fructose, glucose, sucrose and honey (Added lactose was not classed as an added sugar as it is a component of milk, neither galacto-oligosaccharides, fructo-oligosaccharides, inulin, maltodextrose, maltodextrin and glycerol, which are often found in breast-milk substitutes). Based on the criteria above, fruit drinks did not meet the requirements of the piloted NPM;
2. Savoury snacks and finger foods should contain less than 15% energy from total sugars;
3. A minimum energy density threshold of 60 kcal/100 g was set for some soft–wet spoonable puréed foods intended for infants being weaned off breast milk.
4. The maximum permitted sodium content was set to be 50 mg/100 kcal and 50 mg/100 g for all foods (or only < 50 mg/100 kcal if dry cereal) except cheese purées and cheese meals (where cheese was listed in the front-of-pack product name and the protein content from dairy was 2.2 g/100 kcal), where the suggested limit was 100 mg/100 kcal and 100 mg/100 g of product.
5. Protein was considered sufficient in puréed meals that had the word ‘cheese’ in its name if total protein was ≥ 3 g/kcal in initial pilot tests. In foods where the first word contained “fish” or “meat” in the product title, protein was considered sufficient if ≥ 15% of total weight of the product and total protein was > 6g/kcal. Protein was considered sufficient in other puréed meals if named protein was ≥ 10% of total weight of the product and total protein was ≥ 3.75g/kcal.

6. Total fat requirement was set at < 4.5 g/100 kcal for all products except dry cereals (< 3.3 g/100 kcal, no added high protein) and cheese, fish or meat meals (6 g/100 kcal). Industrially produced trans fatty acids should not be included in CACFs.

Additionally, the packaging of the products was assessed for messages related to age at which the product would be suitable for consumption and any nutritional composition or health claims.

Figure 1 Steps of the pilot study



RESULTS

In August 2018, a total of 243 CACF products were sampled in Malta.

The number of CACF products in the pilot test and the percentages of products meeting the Nutrient Profiling Model (NPM) requirements from the Maltese data by different composition criteria are represented in Figure 2 and Table 1.

The food categories that were least likely to meet the NPM requirements were the soft-wet spoonable, ready to eat foods (33%) and the dry finger foods and snacks (18%). Of this latter category, only 37% had no added sugars and only around half of these products (47%) had less than 15% of total energy from sugar. The confectionery and bars, as well as the rusks and teething biscuits *did not meet any* NPM requirements relating to sugar content.

Regarding the sodium content, the one tray/pot meal examined with chunky meat or fish exceeded the recommended levels for salt and did not meet any of the NPM requirements. Also, only 66% of the dry finger foods and snacks fell below the recommended sodium levels.

Another concern was related to the low quantity of protein in these products, namely in the soft-wet spoonable and ready to eat foods, with only 25% meeting the protein requirements.

82 products out of a total 243 products (34%) were found to be promoted as suitable for infants under 6 months. 182 products were classed as having a nutrition, compositional or health claim – no information given for 2 products – so we could say that about 75% of products had a nutrition, compositional or health claim.

Figure 2 Summary of CACF products meeting proposed NPM requirements by compositional criteria for Malta (%)

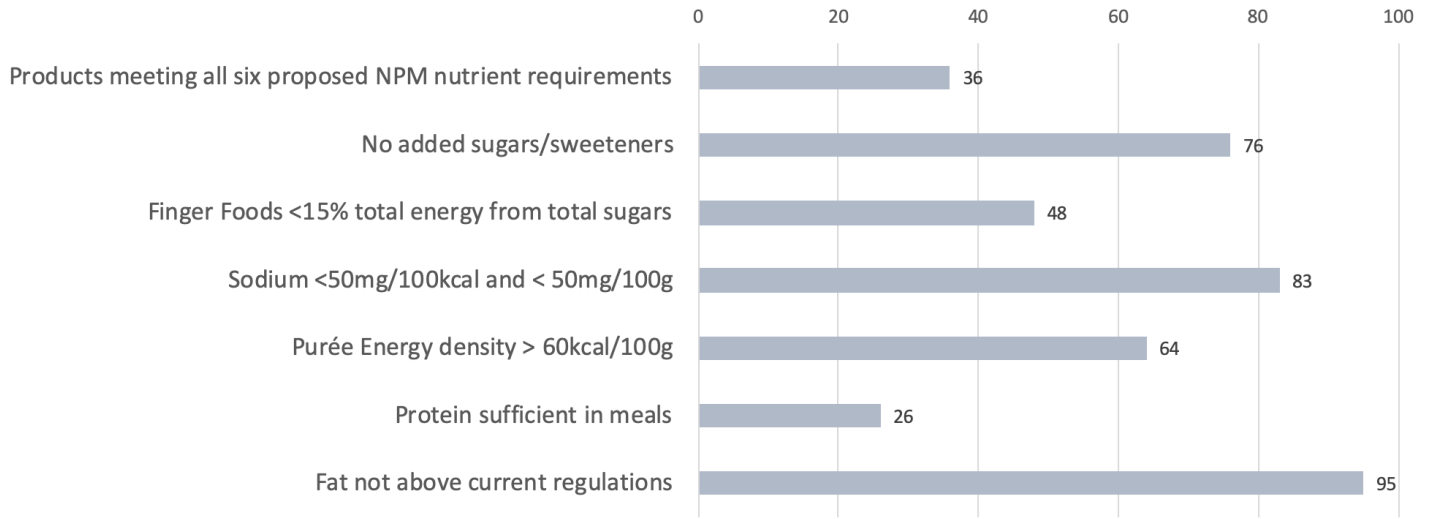


Table 1 Percentage of products meeting NPM requirements by subcategories

Food category	Total number of products	Meet all six proposed NPM nutrient requirement (%)	No added sugar/ sweeteners (%)	Finger Foods <15% total energy from total sugar	Sodium <50mg/100kcal and <50mg/100g[b] (%)	Energy density >60 kcal/100g[c] (%)	Protein sufficient in meals[d] (%)	Fat not current regulation[e] (%)
1. Dry powdered and instant cereal/starchy food	**38**	**71**	**76**	**n/a**	**95**	**n/a**	**n/a**	**100**
1a Dry instant cereal	18	100	100	n/a	100	n/a	n/a	100
1b Dry cereal (with high protein foods)	20	45	55	n/a	90	n/a	n/a	100
2. Soft-wet spoonable, ready-to-eat foods	**159**	**33**	**87**	**n/a**	**85**	**64**	**25**	**96**
2a Fruit purée (with or without vegetables)	53	42	89	n/a	100	51	n/a	100
2b Vegetable purées	17	47	100	n/a	47	n/a	n/a	94
2c Fruit purée with cereal or milk	12	67	83	n/a	92	92	n/a	92

2d Vegetables with cereal, soft-wet spoonable	8	13	88	n/a	63	25	n/a	100
2e Cheese meal, soft–wet spoonable	3	67	100	n/a	67	100	100	100
2f Fish meal, soft-wet spoonable	5	0	100	n/a	60	100	0	100
2g Meat/poultry meal, soft-wet spoonable	8	25	100	n/a	100	38	25	100
2h Meal/other, soft-wet spoonable	28	4	96	n/a	79	64	21	86
2i Dairy, soft-wet spoonable	17	35	41	n/a	88	100	n/a	100
2j Meat only purée	8	25	100	n/a	100	n/a	25	100
2k Fish only purée	0	-	-	n/a	-	n/a	-	-
3. Meals with chunky pieces	**2**	**50**	**50**	**n/a**	**50**	**n/a**	**100**	**100**
3a Tray/pot chunky meat or fish meal	1	0	0	n/a	0	n/a	100	100
3b Tray/pot chunky vegetable meal	1	100	100	n/a	100	n/a	n/a	100

4. Dry finger foods and snacks	**44**	**18**	**37**	**47**	**66**	**n/a**	**n/a**	**88**
4a Confectionery and bars	1	0	0	0	0	n/a	n/a	100
4b Sweet snacks	31	16	23	35	77	n/a	n/a	90
4c Rusks and teething biscuits	1	0	0	0	100	n/a	n/a	100
4d Savoury snacks	10	30	80	100	40	n/a	n/a	80
4e Fruit (fresh or dry whole fruit or pieces) snacks	1	0	100	0	0	n/a	n/a	100
5. Juices and other drinks	**0**	**-**	**-**	**n/a**	**-**	**n/a**	**n/a**	**-**
5a Fruit juices and drink	0	-	-	n/a	-	n/a	n/a	-
5b Vegetable juices	0	-	-	n/a	-	n/a	n/a	-
5c Other drinks non-milk/non-formula	0	-	-	n/a	-	n/a	n/a	-
Total percentage of applicable product passing	**243**	**36**	**76**	**48**	**83**	**64**	**26**	**95**

n/a = the criteria were not applicable to that category.

[a]The following listed ingredients have been classed as added sugars and sweeteners for this analysis: sugar, (any) syrup, juice (but lemon or lime juice are not), molasses, malt extract, barley malt, malted barley extract, maltose, dextrose, fructose, glucose, sucrose and honey. Added lactose was not classed as an added sugar as it is a component of milk. Additionally, galacto-oligosaccharides, fructo-oligosaccharides, inulin, maltodextrose, maltodextrin and glycerol, which are often found in breast-milk substitutes, were not classed as sweeteners.

[b] Or < 100 mg sodium/100 kcal and 100 mg sodium/100 g if cheese meal; or only < 50 mg/100 kcal if dry cereal.

[c] Energy density requirements were not set for the dry foods.

[d] Protein was sufficient in puréed meals with cheese in name if total protein was ≥ 3 g/kcal. Protein was sufficient in puréed meals with a fish or meat first-named food if these were ≥ 15% of total weight of product and total protein was > 6 g/kcal. Protein was sufficient in other puréed meals if named protein was ≥ 10% of total weight of product and total protein was ≥ 3.75 g/kcal.

[e]Total fat requirement was < 4.5 g/100 kcal for all products except dry cereals (< 3.3 g/100 kcal, no added high protein) and cheese, fish or meat meals (6 g/100 kcal).

Discussion

The current study was conducted to investigate the situation of the commercially available complementary foods in Malta suitable to be marketed for infants and young children up to 36 months. This study has provided a snapshot of the nutritional characteristics of baby food, indicating that these food products are high in sugar quantities and high in salt. As mentioned, infants are born with a preference for sweet and salty tastes[8], so it is important that measures are taken to diversify exposure to other flavours and to ensure the acceptability of a wider range of nutritious foods later in life.[25]

From 243 food products tested, only 36% were suitable and complied with the composition requirements of the nutrient profile model pilot tested. These results are broadly comparable with the results from the other countries that participated in the pilot test, and also with the validation undertaken for Danish, Spanish and United Kingdom products marketed in 2016/2017.[16] Between countries, there is a gap in food regulation and each country applies different legislation[17], which in this study was confirmed through the wide range and form of products tested.

The WHO recommends exclusively breastfeeding until 6 months of age (meaning that the infant receives no other food or liquid aside from breastmilk), with continued breastfeeding along with appropriate complementary foods up to two years of age or beyond.[1] However, the evidence from this study demonstrates that parents and carers of infants and young children are likely to encounter marketing which conflicts with the WHO recommendations, where 34% of the marketed products were found to be promoted as suitable for infants under 6 months. A study conducted in the UK also verified that many products available were targeted at infants from age 4 months and that such products were sweet.[26]

Updated guidelines, regulations and legislation are needed to ensure that product promotions and labelling do not undermine important public health recommendations. The draft NPM model published by the WHO provides guidance on product-labelling and promotions to end all forms of inappropriate promotion of these products.[16] First, baby foods should not be marketed as suitable for children under 6 months. Front-of-package age restrictions for heavily puréed and very smooth products intended as weaning foods (e.g. suitable for age 6-12 months) should be added, as well as a ban on misleading labels and claims related to sugar and product healthiness and all types of marketing of fruit drinks and juices, confectionary and sweet snacks. Additionally, and according to evidence, the consumption of commercial complementary feeding is, in some cases, higher than homemade baby foods, what can be associated, among others, with higher intakes of added sugar.[25, 28-30] In fact, the global market for commercially available complementary foods is growing rapidly.[31]

A potential limitation of this study is the small sample and low number of retailers that were surveyed (two supermarkets, one pharmacy). Only the stores who agreed to participate were included, and this was likely to result in sampling bias. Furthermore, this paper used labels to assess the nutritional content of baby food, but previous work comparing laboratory determined sugar content against nutrition labels indicated that labels may be inaccurate, and often they may underestimate the actual amount of sugar found in baby foods.[27] Future

work may be needed to assess the nutrient content of baby foods in Malta using laboratory analysis and companies must be held accountable for the accuracy of their food labels.

Following the pilot test and feedback from the countries involved, the draft NPM was updated with amendments to some of the thresholds and simplification of some categories. The main amendments to thresholds were as follows:

- Notably protein was lowered back in line with the current European Commission threshold.[32] In the published NPM, for soft-wet spoonable meals total protein ≥ 3g/10 kcal from all protein sources, or ≥4g/10 kcal if protein source is named as first food (of which ≥ 2.2g/100 kcal protein from dairy if cheese mentioned in front-of-pack name). Each named protein not less than 25% by weight of total named protein. Protein source mentioned in the product name must be ≥ 8% by weight of the total product, or ≥ 10% If protein named as the first food(s) in front-of-pack name.
- Additionally a limit was set on the amount (≤ 5% by weight) of processed or concentrated 100% fruit (whole fruit that is puréed or dried) to be used as ingredients (for instance, powder of dried apple and purée of dried strawberries) in certain categories such as meals, with a maximum of 2% from dried fruit.

More research on this topic is needed. Besides the assessment of products available, there is a need to examine other marketing strategies employed by the companies which sell CACFs, such as their approach on social media and their digital marketing strategies.

The results of this study provide a valuable insight of the available food products in the Maltese islands. The poor nutritional quality of baby foods may have a negative impact on the growth and development of infants in the short and long term if no action is taken. In addition to developing a NPM, the WHO discussion paper also highlights requirements for labelling, marketing and promotion that are needed alongside the NPM to ensure that consumers are not misled, and that appropriate infant feeding is protected.[16] It is important that a multisectoral approach be adopted to implement updated guidelines, regulations and legislation to protect the health of young people.

Summary Box

- Exclusively breastfeeding until 6 months of age (meaning that the infant receives no other food or liquid aside from breastmilk), with continued breastfeeding along with appropriate complementary foods up to two years of age or beyond is recommended by the WHO;
- Commercially available complementary foods are widely used by parents, and the global market for these products is growing rapidly;
- In Malta, 82 products out of the total 243 products (34%) were found to be promoted as suitable for infants under 6 months;
- Only 36% of the CACFs analysed in Malta were in accordance with the requirements of a draft version of the WHO Nutrient Profile Model;
- The results of this pilot study have offered a baseline for future work.

Acknowledgements

We would like to acknowledge that the researcher Holly Rippin supported cleaning the data, ensuring correct coding of products and updating the NPM after pilot testing.

References

1. World Health Organization. The optimal duration of exclusive breastfeeding. Report of an expert consultation. Geneva: World Health Organization; 2002.
2. Kramer MS, Kakuma R. Optimal duration of exclusive breastfeeding. Cochrane Database Syst Rev. 2012 Aug 15;2012(8):CD003517.
3. Amezdroz E, Carpenter L, O'callaghan E, Johnson S, Waters E. Transition from milks to the introduction of solid foods across the first 2 years of life: findings from an Australian birth cohort study. J Hum Nutr Diet 2015 Aug;28(4), 375-83.
4. Harris G, Coulthard H. Early eating behaviours and food acceptance revisited: breastfeeding and introduction of complementary foods as predictive of food acceptance. Curr Obes Rep. 2016 Mar;5(1):113-20.
5. Mura Paroche M, Caton SJ, Vereijken CM, Weenen H, Houston-Price C. How infants and young children learn about food: A systematic review. Front Psychol. 2017 Jul 25;8:1046.
6. Birch L, Savage JS, Vetura A. Influences on the Development of Children's Eating Behaviours: From Infancy to Adolescence. Can J Diet Pract Res. 2007;68(1):s1-s56.
7. Nehring I, Kostka T, von Kries R, Rehfuess EA. Impacts of in utero and early infant taste experiences on later taste acceptance: a systematic review. J Nutr. 2015 Jun;145(6):1271-9.
8. De Cosmi V, Scaglioni S, Agostoni C. Early taste experiences and later food choices. Nutrients. 2017 Feb 4;9(2):107.
9. Ventura AK, Worobey J. Early influences on the development of food preferences. Curr Biol. 2013 May 6;23(9):R401-8.
10. Betoko A, Charles MA, Hankard R, Forhan A, Bonet M, Saurel-Cubizolles MJ. Infant feeding patterns over the first year of life: influence of family characteristics. Eur J Clin Nutr. 2013 Jun;67(6):631-7.
11. COSI Factsheet. Childhood Obesity Surveillance Initiative Highlights 2015-2017. Copenhagen: World Health Organization Regional Office for Europe; 2018.
12. Mikkelsen B, Williams J, Rakovac I et al. Life course approach to prevention and control of non-communicable diseases. BMJ. 2019 Jan 28;364:l257.
13. Ventura AK, Mennella JA. Innate and learned preferences for sweet taste during childhood. Curr Opin Clin Nutr Metab Care. 2011 Jul;14(4):379-84.
14. Crawley H, Westland S. Baby foods in the UK. A review of commercially produced jars and pouches of baby foods marketed in the UK. London: First Steps Nutrition Trust; 2017
15. Horta BL, Victora CG. Long-term effects of breastfeeding. Geneva: World Health Organization; 2013.
16. World Health Organization Regional Office for Europe. Ending inappropriate promotion of commercially available complementary foods for infants and young children between 6 and 36 months in Europe - discussion paper outlining the first steps in developing a nutrient profile model to drive changes to product composition and labelling and promotion practices in the WHO European Region. Copenhagen: World Health Organization Regional Office for Europe; 2019.
17. Maslin K, Venter C. Nutritional aspects of commercially prepared foods in developed countries: a narrative review. Nutr Res Rev. 2017 Jun;30(1):138-148.

18. Elliott CD. Sweet and salty: nutritional content and analysis of baby and toddler foods. J Public Health (Oxf). 2011 Mar;33(1):63-70.

19. Maalouf J, Cogswell ME, Bates M, Yuan K, Scanlon KS, Pehrsson P, Gunn JP, Merritt RK. Sodium, sugar, and fat content of complementary infant and toddler foods sold in the United States, 2015. Am J Clin Nutr. 2017 Jun;105(6):1443-52.

20. Maslin K, Venter C. Nutritional aspects of commercially prepared infant foods in developed countries: a narrative review. Nutr Res Rev. 2017 Jun;30(1):138-148.

21. Elliott CD, Conlon MJ. Sugar and sodium in packaged children's food. Pediatr Obes. 2015 Apr;10(2):149-55.

22. World Health Organization Regional Office for Europe. Commercial foods for infants and young children in the WHO European Region - A study of the availability, composition and marketing of baby foods in four European countries. Copenhagen: World Health Organization Regional Office for Europe; 2019.

23. Scarborough P, Rayner M, Stockley L. Developing nutrient profile models: a systematic approach. Public Health Nutr. 2007 Apr;10(4):330-6.

24. World Health Organization. Nutrient Profiling [Internet]. World Health Organization. Available from: https://www.who.int/nutrition/topics/profiling/en/

25. Foterek K, Buyken AE, Bolzenius K, Hilbig A, Nöthlings U, Alexy U. Commercial complementary food consumption is prospectively associated with added sugar intake in childhood. Br J Nutr. 2016 Jun;115(11):2067-74.

26. García AL, Raza S, Parrett A, Wright CM. Nutritional content of infant commercial weaning foods in the UK. Arch Dis Child. 2013 Oct;98(10):793-7.

27. Walker RW, Goran MI. Laboratory Determined Sugar Content and Composition of Commercial Infant Formulas, Baby Foods and Common Grocery Items Targeted to Children. Nutrients. 2015 Jul 16;7(7):5850-67.

28. McAndrew F, Thompson J, Fellows L, Large A, Speed M, Renfrew MJ. Infant Feeding Survey 2010. Leeds: Health and Social Care Information Centre, NHS; 2012.

29. Foterek K, Hilbig A, Alexy U. Breast-feeding and weaning practices in the DONALD study: age and time trends. J Pediatr Gastroenterol Nutr. 2014 Mar;58(3):361-7.

30. Roess AA, Jacquier EF, Catellier DJ, Carvalho R, Lutes AC, Anater AS, Dietz WH. Food Consumption Patterns of Infants and Toddlers: Findings from the Feeding Infants and Toddlers Study (FITS) 2016. J Nutr. 2018 Sep 1;148(suppl_3):1525S-1535S.

31. Infant Formula– Global Market Analysis, Insights and Forecast, 2019-2026. Fortune Business Insights; 2019.

32. Annex II of Commission Directive 2006/125/EC of 5th December 2006 on processed cereal-based foods and baby foods for infants and young children. European Commission; 2006.

Supplementary Table 1 Food categories used in pilot testing the nutrient profile model for all foods marketed as suitable for infants and young children 6–36 months of age used in sugar analyses.

	Food category	Definition and examples
1	Dry, powdered and instant cereal/starchy food	
1a	Dry or instant cereals/starch with or without naturally sweet foods	Dry rice, cereal, pulverized rusks or starchy root (at least 25% cereal and/or starch root content) with or without naturally sweet foods (e.g., dry fruit) To be prepared for consumption with milk or other appropriate nutritious liquid (e.g., formula) Includes dry instant-type porridges and dry breakfast cereals (e.g., puffed rice or cereal hoops), if marketed as suitable for infants and young children Excludes wet ready-to-eat cereals
1b	Dry or instant cereals/starch with an added high-protein food	Dry rice, cereal, pulverized rusks or starchy root (at least 25% cereal and/or starchy root content) with an added high-protein food (e.g., milk or whey powder) to be prepared for consumption with water or other appropriate protein-free liquid
2	Soft–wet spoonable, ready-to-eat foods	
2a	Fruit purée with or without vegetables	≥ 95% single or mixed fruit (or mixed with vegetables) Includes fruit-only smoothie purée/drinks and any spoonable fruit-only or fruit-and-vegetable purée
2b	Vegetable purée	≥ 95% single or mixed vegetables or legumes Excludes products containing any fruit
2c	Fruit with cereal or milk products	Largest ingredient is single or total fruit, plus cereals or dairy Includes foods such as smoothies with > 5% dairy or cereal, high-fruit breakfast foods (e.g., fruit-based breakfast rice/ porridge) and desserts (e.g., apple crumble or fruit-based baby rice) Excludes fruit/vegetable-based purées with < 5% cereal or dairy, which are categorized as 2a or 2b
2d	Vegetables with cereals or milk products	Puréed or semi-puréed vegetables/legumes with > 5% cooked weight in cereal (e.g., pasta, rice, barley), or a pseudocereal (e.g., quinoa, chia, buckwheat) Includes savoury-type meals with cereals (e.g., pasta with tomato and courgette) or pseudocereal (e.g., butternut squash, carrot and quinoa) or with milk products (e.g., cauliflower cheese/ macaroni cheese) Includes vegetable-based foods containing cheese, where cheese is not mentioned in the product name

	Food category	Definition and examples
2e	Meal with cheese mentioned in the name	A puréed or semi-puréed meal containing vegetables, other carbohydrates and cheese (e.g., cheesy pasta with tomato and vegetables)
2f	Meal with fish mentioned first (as food) in name of product	A puréed or semi-puréed meal containing vegetables, other carbohydrates and fish Fish is mentioned as first food in product name (e.g., "Tasty fish pie" or "Salmon and pea risotto")
2g	Meal with meat or poultry or other traditional source of protein mentioned first (as food) in name of product	A puréed or semi-puréed meal containing vegetables, other carbohydrates and meat, poultry or other traditional source of protein, where the source of protein is mentioned as first food in product name (e.g., "Hearty beef hotpot" or "Chicken and potato pie")
2h	Meals with meat, poultry, fish, offal or other traditional source of protein (but not named as the first food in product name)	A puréed or semi-puréed meal containing vegetables, other carbohydrates and traditional source of protein, where the meat/protein is not listed as first food in product name (e.g., "Hearty shepherd's pie", "Cottage pie" or "Carrot, potato and lamb hotpot")
2i	Dairy with or without fruit or other naturally sweet foods	Foods with dairy as the largest main ingredient by weight (i.e., greater than the sum of total fruit or total grain ingredients) such as yogurt, fromage frais, custard, porridge or rice pudding, made with or without other naturally sweet foods such as fresh fruit, fruit juice or dried fruit (excluding honey and other added sugars)
2j	Only meat or poultry in name of product	Puréed or semi-puréed poultry, where poultry is the only food listed in product name and constitutes the single largest ingredient (except water)
2k	Only fish or other traditional source of protein in name of product	Puréed or semi-puréed fish or other traditional source of protein, where this is the only food listed in product name and constitutes the single largest ingredient (except water)
3	Meals with chunky pieces	
3a	Meat, fish or other traditional source of protein-based tray or pot meal	Non-puréed soft meals containing chunky pieces of vegetables, legumes or other carbohydrates and meat, fish or other traditional source of protein (often sold in trays)
3b	Vegetable-based tray or pot meal	Non-puréed soft meals containing chunky pieces of vegetables, legumes or other carbohydrates (often sold in trays)
4	Dry finger foods and snacks	
4a	Sweet confectionery, sweet spreads and fruit chews	Confectionery includes: chocolate and other products containing cocoa; white chocolate; jelly sweets and boiled sweets; chewing gum and bubble gum; caramels; liquorice sweets; marzipan; sweetened or "yogurt"-coated fruit etc. Sweet spreads: spreadable chocolate and any other sweet sandwich/toast topping such as jam, marmalade or honey and sweet nut spreads etc.

	Food category	Definition and examples
		Fruit chews include any dried and processed fruit products such as fruit gums, bars or fruit strips/leathers/roll-ups (i.e., a dense chewy food made from pulped and dehydrated/dried fruit)
4b	Sweet snacks and finger foods	Any sweet baked, fried, dried or dehydrated food intended to be eaten between meals with ≥ 15% energy from total sugar (≥ 2.5 g/100 kcal) is classed as a sweet snack or finger food Any starchy food, fruit-based or vegetable-based product where the sugar content is < 15% of total energy may be classed as a savoury snack (category 4d) Including foods such as: sweet pastries; croissants; cookies/biscuits; sponge cakes; wafers; fruit pies; sweet buns; chocolate-covered biscuits; cake mixes and batters; cereal or energy bars (i.e., cereal/ granola or muesli bars); and crisps/puff products made from fruit, vegetables or starchy foods (which may be coated in fat/oil)
4c	Rusks and teething biscuits	Light, crumbly or twice-baked dry sweet biscuit or bread to be chewed for teething or softened with liquid
4d	Savoury snacks and finger foods	Foods consisting of ≥ 95% single or mixed grains, rice, potato, nuts, seeds, fruits or vegetables, including popcorn and maize corn with total sugar content < 15% energy from total sugar (< 2.5 g/100 kcal) Any product with ≥ 15% energy from total sugar is classed as a sweet snack (category 4b) Includes foods such as savoury biscuits and pretzels, baked chips/crisps (e.g., potato, grain or other starchy food etc.), rice cakes coated in powdered fruit or vegetables, cereal bars and rusks made without added sugars
4e	Fruit (fresh or dry whole fruit or pieces)	Includes fresh whole or peeled fruit (e.g., apple) and dried fruit (e.g., dry slices of plain apple, freeze-dried strawberries, raisins, dry apricots, prunes) Excludes fruit pieces coated in sugar or oils/fats (e.g., banana chips, sweetened cranberries or yogurt raisins)
5	Juices and other non-formula drinks	
5a	Single or mixed fruit juices	Drinks made using anything other than ≥ 95% whole fruit (or fruit and vegetables) including fruit/vegetable cell walls (i.e., not ≥ 95% blended fresh fruit (or fruit and vegetable) pulp (which are classified in category 2a)) Includes drinks made using concentrated or strained/sieved fruit (e.g., apple juice, orange juice) Excludes smoothies/purées which are ≥ 95% whole fruit (or fruit and vegetables) (see category 2a)
5b	Single or mixed vegetable juices	Drinks made using "modified" vegetable pulp (i.e., not ≥ 95% blended fresh vegetables) Includes drinks made using concentrated or strained/sieved vegetables Excludes vegetable purées made using ≥ 95% vegetables (see category 2b)

	Food category	Definition and examples
5c	Other non-milk-based drinks	Includes ready made from cordials, energy drinks, ices, cola, lemonade, orangeade, other soft drinks, and mineral and/or flavoured waters (including aerated) with added sugars or sweetener

a Exclusions to the food categories:

- products not specifically marketed for children younger than 3 years of age;
- vitamin and mineral food supplements, whether to be consumed as tablets/drops or added to foods at home (e.g., home fortification products such as micronutrient powders, lipid nutrient powders);
- products that function as breast-milk substitutes (i.e., formula milk, follow-on formula milk);
- products whose labels state that they are intended only for pregnant women, mothers or children older than 3 years.

b Products considered to be marketed as foods complementary to breast milk or breast-milk substitutes as being suitable for this age group if they:

- are labelled with the words “baby”, “infant,” “toddler” or “young child”;
- are recommended for introduction at an age of less than 3 years;
- have a label with an image of a child who appears to be younger than 3 years of age or feeding with a bottle; or
- are in any other way presented as being suitable for children under the age of 3 years.