HELEN KELLER INTL | ARCH ASSESSMENT & RESEARCH ON CHILD FEEDING

CAMBODIA LABELLING STUDY

FULL REPORT

Nutrition composition and labelling practices of commercially produced complementary foods sold in the Khsach Kandal District, Cambodia

ARCH 3, Workstream 3, Labelling Study

FINAL VERSION 2

September 2021

ABBREVIATIONS

ARCH	Assessment and Research on Child Feeding Project of Helen Keller International
CBF	Canned baby food
Codex	Codex Alimentarius
CPCF	Commercially produced complementary foods
FCF	Formulated complementary foods
GC	Global checklist
IYCF	Infant and young child feeding
kCal	Kilocalorie
kJ	Kilojoule
MOH	Ministry of Health
NRV	Nutrient reference values
NC	National checklist
NI	Nutrition information
PCF	Processed cereal-based complementary foods
RTE	Ready-to-eat
UNICEF	United Nations International Children's Emergency Fund
WFP	World Food Programme
WHA	World Health Assembly
WHO	World Health Organization

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1. EXECUTIVE SUMMARY

A critical window of opportunity exists during the first 1000 days of life when appropriate early nutrition interventions can help prevent malnutrition in children and establish positive dietary habits that can carry on into adulthood – impacting individuals and economies (Schwarzenberg et al., 2018; Black et al., 2013). According to the World Health Organization (WHO), appropriate complementary feeding involves providing adequate amounts, frequency, variety, and consistency of foods that meet the growing child's nutritional needs when breastmilk alone is no longer sufficient to meet those needs (WHO, 2003).

According to the 2014 Cambodian Demographic and Health Survey (CDHS), stunting, underweight, wasting and overweight affect 32%, 24%, 10% and 7% of Cambodian children under 5, respectively (NIS, 2015). Anaemia and zinc deficiency are highly prevalent, affecting 53% and 65% of children 6-24 months old, respectively (NIS, 2015). In Kandal Province, where the current study was implemented, 28% of children under-5 years are stunted, 26% are underweight, 9% are wasted and anaemia prevalence is 59%, indicative of a severe public health problem (NIS, 2015). In addition, only 51% of children in Cambodia were exclusively breastfed at 4–5 months, and just 32% of children 6–23 months received a minimum acceptable diet (NIS, 2015), indicating that over two-thirds of children do not meet recommended quantity and quality for energy and nutrients in their complementary feeding diet.

Commercially produced complementary foods (CPCF), increasingly a component of diets among older infants and young children, can vary widely in nutritional quality. Some CPCF may improve nutrient intake by providing critical micronutrients, while others are of concern because they have high levels of added salt or sugar or contain industrially produced trans fatty acids or pro-inflammatory additives (Zinöcker & Lindseth, 2018; Chassaing et al., 2015). While WHO guidelines recommend the use of low-cost fortified commercially produced complementary feeding products in some circumstances, these products must be promoted in a way that protects breastfeeding and the consumption of diverse diets based on locally available foods (Dewey & Brown, 2003). World Health Assembly (WHA) Resolution 69.9 urges countries to end the inappropriate promotion of food for infants and young children (WHA, 2016).

This study forms part of the third phase of Helen Keller Intl's (Helen Keller) Assessment and Research on Child Feeding (ARCH) project, which seeks to improve infant and young child feeding policies, guidelines, and practices through the generation of country-specific evidence and technical expertise. The study assessed the composition, nutrient content, nutrient content claims and related labelling practices as declared on the labels of 68 CPCF sold in Khasch Kandal District, Kandal Province, Cambodia in 2020 against global guidance and standards (Codex Alimentarius and WHO), and relevant aspects of national legislation. The study also compared the nutrient content (as determined by laboratory assessment) of a sub-sample of 11 of the most commonly available CPCF sold in the Khsach Kandal District and purchased in Khsach Kandal and Phnom Penh in 2020, to their declared nutritional information.

The 68 CPCF represented products from 16 manufacturers (1 local and 15 international) and included cereal-based infant snacks (54%, n=37), cereal-based infant cereals/porridges/meals (35%, n=24) and refrigerated ready-to-eat yoghurts (10%, n=7).

Key findings

Objective 1: Assessment of relevant labelling practices

- Nearly all CPCF products (94%, n=64) provided a recommended age of introduction of 6 months of age or older, as recommended by global guidance. Three products (4%) provided an age recommendation of less than 6 months in contravention of global guidance .
- Only 7% (n=5) of CPCF products provided a warning that addressed all elements related to the health hazards of introducing CPCF before six months of age[1], as required by national regulations, in one of the study languages[2].
- Only 12% (n=8) of CPCF products provided a complete statement that the product should only be used on the advice of a health worker[3], as required by national regulations, in one of the study languages.
- Only 10% (n=7) of CPCF products provided a complete statement regarding the superiority of exclusive breastfeeding for the first 6 months of age and sustained breastfeeding until the child reaches the age of 2 years or beyond[4], as required by national regulations, in one of the study languages.
- While most CPCF products (90%, n=61) provided a serving size on the label, only 12% (n=8) of products provided a proposed daily ration (or a recommended number of servings per day) in addition to a serving size, as recommended by global guidance. There are currently no national regulations requiring the provision of serving sizes and daily rations on CPCF labels.
- A recommended daily ration exceeding globally recommended daily energy intake from complementary foods for the breastfed child was found in one in five (20%, n=10/49) of CPCF products marketed as suitable for older infants 6 to 8.9 months. This practice may negatively impact on continued breastfeeding by encroaching on the energy that should be provided by breastmilk.
- Of the national regulations' labelling requirements pertaining to the appropriate preparation and use of the product, none of the products provided the required warning against inappropriate use[5], less than one third (31%, n=21) provided instructions for appropriate use in Khmer, and only 43% (n=29) provided instructions for appropriate preparation in Khmer.
- Two-thirds (66%, n=45) of CPCF products made one or more nutrient content claims on their label, despite such claims not being provided for in national regulations. Nutrition and health claims are not permitted by global guidance unless specifically provided for in national regulations.

[1] The Sub-decree on Marketing of Products for Infant and Young Child Feeding (Regulation 133 A Nor Kra Bor, 18 November 2005) does not specifically require this label message to be provided in Khmer.
[2] Study languages included English and Khmer.
[3] The Sub-decree on Marketing of Products for Infant and Young Child Feeding (Regulation 133 A Nor Kra Bor, 18 November 2005) does not specifically require this label message to be provided in Khmer.
[4] The Sub-decree on Marketing of Products for Infant and Young Child Feeding (Regulation 133 A Nor Kra Bor, 18 November 2005) does not specifically require this label message to be provided in Khmer.
[5] The Sub-decree on Marketing of Products for Infant and Young Child Feeding (Regulation 133 A Nor Kra Bor, 18 November 2005) does not specifically require this label message to be provided in Khmer.

Objective 2: Assessment of composition and nutrient content

- There is no national legislation regulating the nutrient content or composition of CPCF.
- Less than one-third (31%, n=21) of CPCF product labels provided an ingredient list and only 28% (n=19) included a declaration of nutrition information in Khmer, as required by national regulations.
- Free sugars[6] were highly prevalent across all categories of CPCF. Despite global guidance that free sugars should not be added to CPCF, nearly all (90%, n=61) products in this study listed free sugars in their ingredient list, ranging between 1 and 3 sugars per product. The most common free sugars listed were cane sugar/ sucrose/ brown sugar (92%, n=56/61).
- Despite global guidance that salt should not be added to CPCF, just over a third (35%, n=24) of CPCF products, all of which were cereal-based infant snacks (both sweet and savoury varieties), contained added salt.
- Nearly three-quarters of CPCF products (72%, n=49) were fortified with vitamins and/or minerals, including all (100%, n=24) cereal-based infant cereals/porridges/meals, over half (59%, n=22) of cereal-based infant snacks, and just under half (43%, n=3) of ready-to-eat yoghurts.
- Of the micronutrients of interest to this study (calcium, iron, vitamin C and zinc), CPCF products were commonly fortified with iron (41%, n=28), followed by calcium (34%, n=23), vitamin C (28%, n=19) and zinc (15%, n=11). Close to a third of products fortified with iron (29%) and calcium (35%) did not specify the form of fortificant used. Those CPCF products that did specify the form of the fortificant were generally found to use an appropriate form.
- Only 32% (n=9/28) of CPCF products fortified with iron, 5% (n=1/20) fortified with calcium, and none (0%, n=11) of the products fortified with zinc, provided adequate amounts of the micronutrient (global guidance recommends a minimum of 50% of the RNI) in the products' recommended daily rations.
- Nearly three-quarters (74%, n=50) of products contained 1 or more food additive, with emulsifiers (a food additive of interest to this study) present in 41% (n=28) of products.
- More than half (56%, n=38) of the CPCF products contained added flavourings. Sweet flavourings (46%, n=31) were found to be far more common than savoury flavourings (10%, n=7).
- The processed cereal-based CPCF products generally met all the requirements of the global standards for protein, lipids, sodium and calcium, where relevant. The exception was that 19% (n=7) of the processed cereal-based snacks (e.g., biscuits and rusks) exceeded the recommended maximum lipid threshold. Seventy-four percent (n=45/61) of all processed cereal-based foods met the minimum energy density recommended by global guidance.
- Of the 42 CPCF products that were fortified and provided usable nutrition information, 83% (n=35) met the global energy density recommendations and 64% (n=27) met the protein content recommendations. Less than one-third (29%, n=12) met the global fat content recommendations.

[6] Free sugars include monosaccharaides, disaccharides, honey, syrups, fruit juice and/or fruit juice concentrate.

Objective 3: Comparison to laboratory assessment

- Laboratory assessment of a sub sample of 11 CPCF products found that the energy values were the most aligned with their declared value (ranging from 95% to 109% of the declared value), while protein and sodium values showed the greatest variation (ranging from 130% to 23900%[7] and from 78% to 79000%[8] of the declared value, respectively).
- The laboratory assessment also found that among products that declared sugar content (45%; n=5), almost two-thirds (60%, n=3/5) contained more sugar than was declared. Sugar values ranged from 84% to 195% of the declared value.

This study found that none of the 68 CPCF products assessed complied with all relevant global standards/guidance for composition, nutrient content, nutrient content claims and related labelling practices. It further found that none of the CPCF products complied with all relevant national regulations/standards with regards to the assessed labelling practices. All CPCF products assessed in this study therefore fall short of the WHO Guidance on Ending the Inappropriate Promotion of Foods for Infants and Young Children (WHO, 2017b) prerequisites for product promotion and fail to sufficiently protect, promote, and support optimal older infant and young child feeding in Cambodia.

Manufacturers can only be held legally accountable for their practices by national legal measures, such as national regulations/standards. Only a small number of labelling requirements relevant to CPCF exist in present Cambodian regulations and there are currently no Cambodian regulations/standards that specifically and comprehensively govern the composition, nutrient content and labelling (including appropriate nutrient content claims) of CPCF.

It is recommended that the Cambodian government use the national checklist developed for this study to assess whether available CPCF products are compliant with current national regulations and standards and are therefore permitted to be on the market. It is important to note that due to the limited scope of the existing Cambodian CPCF regulations, ensuring that products are compliant will not provide sufficient protection against the negative practices reported in this study. In order to address these practices, it is essential that the Cambodian government urgently develop national CPCF regulations/standards that comprehensively prescribe acceptable composition, nutrient content and labelling practices. As a first step, it is recommended that the Cambodian government review how the national checklist differs from the global checklist used in this study to determine the changes required to bring national regulations and standards in line with global standards and guidance.

Nutrient profiling is the science of classifying or ranking foods according to their nutritional composition for reasons related to preventing disease and promoting health and can be incorporated by governments into policy to improve the overall nutritional quality of diets (WHO, 2019). As recommended by WHO guidance (WHO, 2017b), a nutrient profiling model for foods for older infants and young children should be developed and utilized to guide decisions on which foods are inappropriate for promotion. A comprehensive nutrient profiling model provides a clear output - categorizing a product as appropriate or inappropriate for promotion, based on its composition, and providing national governments with the option to permit only CPCF categorized as appropriate to make relevant and measurable nutrient content claims that potentially assist in addressing micronutrient deficiencies of national concern.

[7] The extreme discrepancies are seen in products that indicate to contain 0g/mg of the nutrient, where laboratory analysis detected existing content.

[8] The extreme discrepancies are seen in products that indicate to contain 0g/mg of the nutrient, where laboratory analysis detected existing content.

While a nutrient profiling model for CPCF in Cambodia or the Southeast Asia region does not yet exist, WHO Europe has recently drafted a nutrient profiling model to assess the nutritional quality of CPCF marketed in the European region and to assess if labelling practices are in line with WHO recommendations (WHO, 2019). This model could be adapted for use in the Asia region, including the addition of micronutrient content evaluation given deficiencies in the region, and piloted in contexts such as Cambodia.

Strong, unambiguous, and enforced national regulation is required to ensure appropriate composition, nutrient content, labelling and promotion of products specifically targeted at the vulnerable age group of 6-36 months of age. Without such regulations and enforcement to hold manufacturers accountable, progress addressing the high rates of undernutrition and micronutrient deficiencies in Cambodia will be limited.

Study recommendations:

A. Recommendations related to CPCF labelling practices:

Policy/Regulatory environment:

1. Update CPCF labelling regulations/guidelines to be in line with global standards and guidance, including age related recommendations and statements; the provision of clear feeding instructions (specifically including appropriate serving size, daily ration and recommended number of servings a day); and compulsory warnings and instructions regarding preparation and use.
2. Update guidelines to improve the implementation, monitoring and enforcement of Sub-decree 133 (Ministry of Health, 2015) by including a sample standard label for CPCF that is in line with global standards and guidance, and to ensure that all CPCF labels conform to this standard before they are marketed in Cambodia.
3. Monitor and enforce current labelling regulations and standards to ensure that CPCF provide required labelling information in Khmer.

CPCF Manufacturers:

1. Ensure that CPCF comply with existing Cambodian CPCF labelling regulations (Sub-decree 133, 2005, Article 9) and global guidance and standards.
2. Ensure that CPCF comply with the Cambodian standard for Labelling of Pre-packaged Food (CS 001:2000, section 4.3 and 8.2) as well as the Law on the Management of Quality and Safety of Products and Services (No. 126 CL, 26 June 2000, chapter 2, article 3), which require all pre-packaged foods to provide an ingredient list, declaration of nutrition information and instructions for appropriate preparation and use in Khmer.

Recommendations for future research:

1. As this study only assessed CPCF purchased in a peri-urban area of Khsach Kandal District, assessment of the labelling practices of additional CPCF available in other urban localities, particularly Phnom Penh, would be beneficial to understand the larger Cambodia CPCF landscape.

B. Recommendations related to CPCF composition:

Policy/Regulatory environment:

1. Develop national regulations/standards for CPCF composition in line with latest global guidelines and standards, including:
   a) Permitted additives and their concentrations
   b) Prohibiting the addition of salt and sugar
2. Legislate the mandatory fortification of CPCF sold in Cambodia with micronutrients of public health importance at recommended levels and in recommended forms, in line with global guidance and standards.
3. Once established, ensure that regulations/standards are monitored and enforced.

CPCF Manufacturers:

1. When fortifying CPCF with vitamins/minerals:
   a) Ensure that the level and form of fortificant used is in line with global guidance and standards and with nutrient gaps identified in the target age group;
   b) Declare the form of the fortificant used in the ingredient list.
2. Be transparent regarding the concentration of emulsifiers in CPCF when called upon by governments/other interested parties.
3. Avoid misleading consumers as to the true taste (e.g., sweet or savoury) of CPCF.
4. Avoid the addition of salt and sugar to CPCF, in line with global guidance.

Recommendations for future research:

1. Further research is recommended regarding:
   a) The use and safety of emulsifiers in CPCF.
   b) The impact of exposure of older infants and young children to predominantly sweet flavourings in CPCF on food choices/preferences in later childhood and adulthood.

C. Recommendations related to CPCF nutrient content:

Policy/Regulatory environment:

1. Develop national regulations/standards for CPCF nutrient content in line with global guidelines and standards and adapted to address the specific needs of Cambodia's older infants and young children.

CPCF Manufacturers:

1. Ensure that CPCF comply with global (Codex Alimentarius and WHO) guidance and standards on nutrient content.
2. Provide adequate label information (nutrient content, serving size, daily ration, recommended number of servings a day) to facilitate assessment of the adequacy of CPCF nutrient content.

D. Recommendations related to nutrient content claims and nutrient content versus label declaration:

Policy/Regulatory environment:

1. Develop national regulations/standards for CPCF in line with latest global guidelines/standards and national dietary guidance, including:
   a) Mandatory fortification with micronutrients of public health importance at recommended levels and in recommended forms;
   b) Declaration of nutrition information on product labels;
   c) Tolerance levels for label declaration deviations;
   d) Permitted and prohibited nutrition and health claims.
2. Develop dietary guidelines for older infants and young children and develop/adopt a relevant nutrient profiling model to determine whether CPCF available for sale are appropriate for promotion.
3. Consider the appropriateness of nutrient content claims on CPCF, for micronutrients of public health concern, and regulate accordingly.

CPCF Manufacturers:

1. Ensure that CPCF comply with global guidance and standards on nutrition information label declarations and nutrient content claims.
2. Manufacturers must provide comprehensive label information pertaining to ingredients and nutrition information to avoid potentially misleading consumers.

Civil society:

1. Be aware of the misleading practices and lack of regulatory enforcement related to foods for older infants and young children. Expose manufacturers that do not protect, promote and support optimal older infant and young child health, thereby putting the future of individuals, communities and countries at risk and hold governments accountable for regulatory enforcement.

2. INTRODUCTION AND STUDY JUSTIFICATION

This study forms part of the third phase of Helen Keller Intl's (Helen Keller) Assessment and Research on Child Feeding (ARCH) project, which seeks to improve infant and young child feeding policies, guidelines, and practices through the generation of country-specific evidence and technical expertise. Results from the first phase of the ARCH project found that labelling practices of commercially produced complementary foods (CPCF) sold in Phnom Penh, Cambodia; Kathmandu Valley, Nepal; Dakar Department, Senegal; and Dar es Salaam, Tanzania do not fully comply with international guidance on their promotion and relevant aspects of national legislation, and so do not sufficiently protect and promote optimal infant and young child feeding (IYCF) practices (Sweet et al., 2016). Several practices were found that have the potential to undermine public health messages regarding optimal breastfeeding and the timely and appropriate introduction of complementary foods and could lead to displacement of continued breastfeeding and use of locally available and appropriate foods.

Inappropriate promotion of CPCF can mislead and confuse caregivers as to the nutrition and health-related qualities of these products and their age-appropriate and safe use. While World Health Organization (WHO) guidelines recommend the use of low-cost fortified commercially produced complementary feeding products in some circumstances, these products must be promoted in a way that protects breastfeeding and the consumption of diverse diets based on locally available foods (WHO, 2003).

CPCF can vary widely in nutritional quality. Some CPCF may improve nutrient intake by providing critical micronutrients that may be limited in the diets of young children, while others are of concern because they have high levels of added salt or sugar or contain industrially produced trans fatty acids or pro-inflammatory additives (Zinöcker & Lindseth, 2018; Chassaing et al., 2015). The World Health Assembly (WHA) Resolution 69.9 urges countries to end the inappropriate promotion of food for infants and young children. The WHO Guidance on Ending the Inappropriate Promotion of Foods for Infants and Young Children (referred to as WHO Guidance from hereon), that was warmly welcomed as part of WHA 69.9, states in recommendation 3: '*Foods for infants and young children that are not products that function as breast-milk substitutes should be promoted only if they meet all the relevant national, regional and global standards for composition, safety, quality and nutrient levels and are in line with national dietary guidelines*' (WHA, 2016). While this recommendation is critical to the guidance, much is required for countries to be able to determine which products meet the necessary standards and therefore can be promoted. To fully implement this recommendation, national, regional and global standards for composition, safety, quality and nutrient levels for these products are needed. Products then need to be evaluated (profiled) against these standards to determine their suitability. National dietary guidelines for infants and young children are also required.

A strong evidence base regarding the appropriateness of the composition and related labelling practices of CPCF at a national level is needed to contribute towards achieving the recommendations of WHA resolution 69.9.

This study focused on assessing the composition, nutrient content, nutrient content claims and related labelling practices as declared on the labels of CPCF sold in Khsach Kandal District of Kandal Province, Cambodia against global standards and guidance, and relevant national legislation.

Khsach Kandal District was selected in order to allow for data sharing with a parallel study - the ARCH 3 Cambodia survey titled 'Consumption of unhealthy commercial foods/beverages and nutritional status during the complementary feeding period: a cohort study among young children in rural/peri-urban Kandal, Cambodia' (hereafter referred to as 'the Cambodia Unhealthy Foods Study').

The study also compared the nutrient content (as determined by laboratory assessment) of a sub-sample of the most commonly available CPCF to their declared nutritional information.

It is anticipated that this work will assist the Cambodian Government in identifying areas where improved, updated and/or new IYCF policies, regulations, standards, guidelines and monitoring may be required. It will in addition add to the global body of evidence regarding labelling practices and nutrient content of CPCF.

3. BACKGROUND TO THE STUDY

Globally, with high rates of undernutrition and the increasing prevalence of the triple burden of malnutrition (micronutrient deficiencies together with under- and overnutrition), new evidence is needed for planning future interventions to address this growing and evolving epidemic (Rocha et al., 2016). The triple burden is growing more rapidly in low-and middle-income countries (LMICs) due to ongoing economic transition, growing income inequalities and rapid changes in the structure of food systems (Popkin, 2006).

A window of opportunity exists during the first 1000 days of life when appropriate early nutrition interventions can help prevent malnutrition in children and establish positive dietary habits that can carry on into adulthood (Schwarzenberg et al., 2018). Investment in optimal feeding during this time can improve national and global economy by means of human capital improvement (Black et al., 2013), whereby USD1 spent can have a USD16 economic return (Haddad et al., 2013).

The WHO states that optimal IYCF includes exclusive breastfeeding from birth to 6 months, with appropriate complementary feeding and continued breastfeeding thereafter (WHO, 1981; WHA, 2002). Complementary feeding starts at the age of 6 months when semi-solid foods are introduced into the older infant's diet with the continuation of breastfeeding until the age of 2 years and beyond. Complementary foods can be home-prepared but are now often commercially produced.

In many LMICs, exclusive and continued breastfeeding rates are below the globally recommended levels. There is often minimal or weak national legislation to protect optimal IYCF practices, and even less national legislation that directs what constitutes the appropriate marketing of CPCF for children of this age group. Standards for composition, safety, quality, and nutrient levels for these products are often incomplete or lacking.

Child malnutrition remains a challenge in the Cambodian context. According to the 2014 Cambodia Demographic and Health Survey (CDHS), stunting (height-for-age z-scores <-2 SD with respect to the WHO 2006 Growth Standards), underweight (weight-for-age z-scores <-2 SD), wasting (weight-for-height z-scores <-2 SD) and overweight (weight-for-height z-scores >2 SD) affect 32%, 24%, 10% and 7% of children under 5, respectively (NIS, 2015). Anaemia and zinc deficiency are highly prevalent, affecting 53% and 65% of children 6-24 months old, respectively, but prevalence of iron deficiency was very low at 3.3%.

Deficiencies of vitamin A (9.2%), B_9 (8.0%), B_{12} (1.7%), and calcium (0.6%) were less common while vitamin D deficiency was relatively high at 15.3% (NIS,2015). In Kandal Province, where the current study was implemented, 28% of children under-5 years are stunted, 26% are underweight, 9% are wasted and anaemia prevalence is 59%, indicative of a severe public health problem (NIS, 2015).

Despite a significant improvement of child health and development indicators in past years, including reduced child mortality and child stunting, inadequate and inappropriate IYCF practices leave many Cambodian children at high risk of malnutrition during the early stages of life (Som et al., 2018).

Inadequate IYCF practices and limited dietary adequacy during the complementary feeding period contribute to the elevated prevalence of growth faltering, anaemia and zinc deficiency among young children. CDHS data shows that exclusive breastfeeding rates for children under 6 months have declined from 73.5% in 2010 to 64.6% in 2014, while in 2014 only 63% of Cambodian children (70% in Kandal Province) were put to the breast within one hour of birth and only 65% of children 0–6 months were exclusively breastfed (NIS, 2011; NIS, 2015).In addition, only 51% of children were exclusively breastfed at 4–5 months, and just 32% of children 6–23 months received a minimum acceptable diet (NIS, 2015), indicating that over two-thirds of children do not meet recommended quantity and quality for energy and nutrients in their complementary feeding diet.

Breastmilk contains many of the essential macro- and micronutrients required by older infants. Complementary foods introduced to the older infant's diet must contain optimal amounts of nutrients to meet their growing needs and limited gastric capacity (PAHO & WHO, 2003). Complementary foods thus need to be nutrient dense, particularly in the micronutrients, including iron, zinc and calcium (micronutrients of interest to this study), that are critical for growth and development but whose intake is often limited in the diets of older infants and young children in low and middle-income countries (Dewey & Brown, 2003; Kimmons et al., 2005). For this reason, the WHO recommends the use of complementary foods using local indigenous ingredients, as well as the use of fortified complementary foods (PAHO & WHO, 2003).

Given limited stomach capacity, crucial brain development occurring during the first two years of life, and the establishment of food preferences early on in childhood (Luque et al., 2018), it is essential that foods fed to older infants and young children are high quality, nutrient dense and are low in added saturated fat, trans-fatty acids, free sugars, and salt (Ventura & Worobey, 2013). With the increasing demand for commercially produced foods, including CPCF, it is essential that CPCF are of optimal quality (containing the necessary nutrients) and are appropriately promoted so as not to undermine breastfeeding or the inclusion of other complementary foods. Product labelling, a form of marketing promotion, is essential to provide the consumer with necessary information on product use, health, safety and nutrient levels (CFIA, 2011).

Appropriate labelling of CPCF is necessary for correct use of products and in order not to undermine optimal breastfeeding practices by, for example, encouraging their early introduction or recommending an excessive daily ration that interferes with continued breastfeeding (Quinn et al., 2010).

Recommendation 3 of the WHO Guidance, that forms part of WHA 69.9, indicates that '*Foods for infants and young children that are not products that function as breast-milk substitutes should be promoted only if they meet all the relevant national, regional, and global standards for composition, safety, quality and nutrient levels and are in line with national dietary guidelines*' (WHO, 2016).

The WHO recommendation further encourages the use of nutrient profile models (NPM) to guide decisions on which foods are inappropriate for promotion.

Nutrient profiling entails evaluation of food items according to their composition to prevent disease or promote health and has been widely used as a guide to restrict or promote products particularly those marketed to children (WHO, 2010). While global guidance and standards for CPCF are numerous (Appendix 1), there are no Cambodian regulations governing the composition and nutrient content of CPCF, although some regulations/standards provide limited labelling requirements for CPCF and for pre-packaged foods in general (Appendix 2).

Despite the improvement in nutrition outcomes in Cambodian infants and young children in past years, much remains to be done. Strong political commitment and leadership needs to be demonstrated and national legislation is required to direct what constitutes appropriate composition, safety, quality, nutrient levels, labelling and promotion of CPCF for older infants and young children Such political commitment and efforts will also have to withstand strong opposition from the private sector that continues to threaten the protection and promotion of optimal young child feeding, in particular breastfeeding.

4. RESEARCH SIGNIFICANCE

The study is expected to have policy significance at both the national and global level. The findings can be used to assist Cambodian policy makers, regulators and stakeholders in better understanding current composition, nutrient content, nutrient content claims and related labelling practices of locally available CPCF as against relevant national regulations as well as WHA 69.9 guidelines and global standards. The findings could facilitate the identification of areas where improved/updated/new policies, regulations, standards and monitoring might be required in order to optimally promote and protect breastfeeding and complementary feeding practices and thus lead to improved nutrition outcomes.

At the global level, the research findings provide global IYCF stakeholders with insights into the application of, and compliance with, relevant recommendations of the WHO Guidance on ending the inappropriate promotion of foods for infants and young children (part of WHA 69.9) in a LMICs in Southeast Asia.

5. AIM AND OBJECTIVES

5.1 AIM

To assess, and for a sub-sample of products also validate, the nutrition composition, nutrient content, nutrient content claims and related labelling practices as declared on the labels of CPCF sold in Khsach Kandal District, Kandal Province, Cambodia against global guidance and standards and relevant aspects of national legislation.

5.2 OBJECTIVES

1. To assess selected labelling practices (serving size; number of servings per day; daily ration; age of introduction; nutrient content claims) of CPCF sold in the Khsach Kandal District against global (Codex Alimentarius and WHO) guidance and standards and relevant aspects of national legislation.
2. To assess the nutrition composition and nutrient content, as declared in the ingredient list and nutritional information of the labels, of CPCF sold in the Khsach Kandal District against global (Codex Alimentarius and WHO) guidance and standards and relevant aspects of national legislation.
3. To compare the content of selected nutrients, as determined by laboratory assessment, of a sub-sample of each category of the most commonly available CPCF sold in the Khsach Kandal District to their declared nutritional information.

6. METHODOLOGY

6.1 STUDY DESIGN

In this cross-sectional survey, CPCF purchased in Khsach Kandal District, Kandal Province, Cambodia was subject to label assessment (and a sub-sample subject to laboratory analysis) to determine adherence to global standards and guidance and relevant aspects of national legislation regarding ingredient list, nutritional information, nutrient content claims and related labelling practices.

6.2 SAMPLING STRATEGY

6.2.1 Identifying and Purchasing CPCF for Label Analyses

Sampling of communes

There is a total of 18 communes in Khsach Kandal District, of which 3 were observed to be 'more urban' in terms of infrastructure, size and/or population by the Helen Keller Cambodia Unhealthy Foods Study team[9] in early 2020, despite all communes having 'rural commune' status.

The 3 'more urban' communes (Preaek Ta Meak, Vihear Suork and Svay Chrum) were purposively selected for inclusion in the study as it was anticipated (from the results of a store scoping exercise[10]) that several baby stores as well as other small stores carrying CPCF would be found in these communes.

[9]This team conducted a census towards the ARCH 3 Cambodia survey titled 'Consumption of unhealthy commercial foods/beverages and nutritional status during the complementary feeding period: a cohort study among young children in rural/peri-urban Kandal, Cambodia' (hereafter referred to as 'the Cambodia Unhealthy Foods Study').

[10] The Helen Keller Cambodia Labelling Study Team performed a store scoping exercise to identify the distribution channels e.g., large stores (chain or independent grocery stores, baby stores and pharmacies) and small stores (chain or independent corner/convenience stores, small grocery stores, small pharmacies and kiosks) through which CPCF are sold to the general public in the Khsach Kandal district in preparation for the study.

In addition, 6 of the 15 'more rural' communes were selected as follows:

- The 3 'more rural' communes with the greatest population of children under 1 year of age (Preaek Ampil, Puk Ruessei and Sanlung) were purposively selected for inclusion in the study. This selection was based on data from a census conducted in the Khsach Kandal District in January - February 2020 as part of the Cambodia Unhealthy Foods Study (see Table 1).
- To give the remaining 12 'more rural' communes an equal probability of being included in the study, 3 communes were randomly selected (Preaek Luong, Bak Dav and Roka Chonlueng) using a true random number generator (www.random.org).

A total of 9 (50%) of the 18 communes in the Khsach Kandal District were included in the study. These 9 communes are home to 58% of all children under 1 year of age in the district (Table 1).

Table 1: Number of children under 1 year of age per commune from a census conducted in the Khsach Kandal District in January - February 2020

Communes in the Khsach Kandal District	**Number (percentage) of children under 1-year of age**
Vihear Suork	319 (11%)
Puk Ruessei	256 (9%)
Preaek Ta Meak	254 (9%)
Sanlung	215 (7%)
Preaek Ampil	203 (7%)
Preaek Ta kov	202 (7%)
Preah Prasab	184 (6%)
Chey Thum	159 (6%)
Roka Chonlueng	139 (5%)
Sithor	138 (5%)
Svay Romiet	125 (4%)
Kaoh Chouram	119 (4%)
Kaoh Oknha Tei	116 (4%)
Preaek Luong	108 (4%)
Svay Chrum	103 (4%)
Kampong Chamlang	94 (3%)
Bak Dav	85 (3%)
Ta Aek	64 (2%)
Total	**2883 (100%)**

	Communes selected for study

Locating and selecting stores

For each of the communes selected, field workers visited the village considered to be the most commercially developed (likely to have the most stores) in its commune, commencing at the village chief's home/office. Using printed village maps previously obtained for the Cambodia Unhealthy Foods Study, the village chief assisted field workers in identifying the main commercial road/roads in the village. From there the field workers went to the identified roads and located all stores selling baby goods (e.g., baby stores), medicines (e.g., pharmacies), or commercially produced foods (e.g., grocers, corner/convenience stores and kiosks) along each road within the village boundaries. Each of these store types encountered were checked for CPCF, and all unique CPCF were purchased. A census was taken of all stores visited, gathering the store names, locations, store type and whether CPCF were found at the store. A total of 188 stores were visited, of which 13% (n=25) sold CPCF.

Purchasing CPCF

In the 25 stores visited that sold CPCF, 69 unique CPCF products that met the definition of a CPCF (Box 1) were found for sale. One of each product was purchased from the first store at which it was encountered for a desk review of the label. Products carrying the same brand name but different sub-brands, descriptive names, age recommendations, age categories or made by different manufacturers were treated as a unique product and purchased. Different flavors (but not different package sizes/containers) of the same product were also treated as a unique product (since their nutrient content could vary) and purchased. CPCF that are beverages or condiments are excluded from the study and therefore were not purchased.

Where single-serving and multi-serving packages of the same product were available, the single-serving package was purchased. Where different sizes of multi-serving packages only were available at the same store, the smallest package was purchased. Data on product availability was captured in each of the stores visited.

Box 1. Definition of CPCF used in this study

Commercially produced complementary foods (CPCF) are all (local and imported) commercially produced foods and beverages that are specifically marketed as suitable for feeding older infants and young children if they meet at least one of the following criteria:

1. are recommended for introduction at an age of less than 3 years.
2. are labelled with the word's 'baby', 'infant', 'toddler', 'young child', or synonym.
3. have a label with an image of a child who appears to be younger than 3 years of age or who is feeding with a bottle; or
4. are in any other way presented as being suitable for children under the age of 3 years. (WHO, 2016; WHO, 2017a).

The following categories of CPCF, if encountered, were included in the study:

1. Cereal-based infant cereals/porridges/meals, instant/requires cooking
   (e.g., instant cereals; porridges; pasta/noodle meals or soups; meals with cereal, protein source and/or vegetables).
2. Cereal-based infant snacks
   (e.g., biscuits; rusks; crackers; puffs).
3. Dairy/fruit-based snacks
   (e.g., freeze-dried fruit; freeze-dried fruit and yoghurt melts).
4. Ready-to-eat foods – shelf-stable
   (e.g., shelf-stable jars/pouches/tubs, which may include cereal, pasta, meat, poultry, fish, dairy, eggs, fruits, and/or vegetables)
5. Ready-to-eat foods – refrigerated/frozen
   (e.g., yoghurts, refrigerated meals, which may include cereal, pasta, meat, poultry, fish, dairy, eggs, fruits, and/or vegetables)
6. Infant pudding
   (e.g., instant milk/gelatine pudding).
7. Other
   (e.g., shredded meat/fish/poultry; cereal/root vegetable/legume/fruit flours).

6.2.2 Selecting and purchasing CPCF for laboratory analysis

Selecting CPCF for laboratory analysis

At the end of the product purchasing/data collection phase of the study, a sub-sample of 12 of the most commonly available shelf-stable CPCF identified in the stores visited were purposively selected and additional units of the selected products purchased for laboratory analysis. Using frequency tables, the 7 most commonly available cereal-based infant cereals/porridges/meals and the 5 most commonly available cereal-based infant snacks were selected to achieve a total of 12 CPCF across all categories. CPCF were excluded from the selection process if the product: required refrigeration; did not provide the required nutrition information in English or Khmer; was not fortified with vitamins and/or minerals; was a flavour variant of another product already selected for laboratory analysis. All 12 products selected for laboratory analysis were imported as no shelf-stable CPCF produced by Cambodian companies were found in the stores visited.

Selecting stores for purchase of CPCF for laboratory analysis

A total of 10 stores, 7 in the Khsach Kandal District and 3 in Phnom Penh, were visited to purchase CPCF for laboratory analysis. A purposive sample of 7 stores (2 pharmacies, 2 food stores and 3 baby stores) in 3 communes in the Khsach Kandal District were selected from the list of 25 stores selling CPCF that was compiled during the first purchasing phase of the study. For each of the products selected for laboratory analysis, the aim was to purchase the product from at least 2 stores (where possible from different communes). As the selected stores did not have sufficient units of 5 of the selected products, 3 additional baby stores in Phnom Penh[11] were visited and the outstanding units purchased where available.

Selecting and purchasing CPCF

Six units of each product were purchased in order to provide the laboratory with sufficient amount of product for analysis, and to ensure that a representative sample of product from across various batches was obtained for the pooled/composite laboratory analysis. For one cereal-based infant cereal/porridge, only 3 units were found and purchased after visiting the 10 stores and so the product was excluded, resulting in a total of 11 products for laboratory analysis. As far as possible, units for each product were purchased from a minimum of 2 stores.

For 2 products found in only 1 store (after visiting all 10 stores), the product was over-purchased from the store where the product was found (i.e., all the units were purchased at one store). The units of 6 products were purchased from 2 stores, and the units of the remaining 3 products from 3 stores.

As far as possible, units of different batch numbers/lot numbers were purchased to ensure maximum representation of the samples. Only products with a minimum of a four-month shelf-life were purchased. A total of 11 products (6 units per product, 66 units in total) were prepared for delivery to the laboratory as per the specifications provided by the laboratory.

[11] Stores in Phnom Penh were visited to purchase outstanding units of CPCF for the sake of convenience (the field-worders reside in Phnom Penh) and to reduce time spent in the field during the COVID-19 pandemic.

6.3 DATA CAPTURING

Label Information

The labels of the 69 purchased CPCF products meeting study definitions, as well as all units of the 11 CPCF re-purchased for lab analysis, were photographed or scanned and images uploaded to a central digital folder. Photographing and scanning was done according to the standard operating procedure (SOP) used by Pereira et al. (2016) and Sweet et al. (2016), for photographing CPCF product labels.

Only labels with some/all label information in English or Khmer (the official language of Cambodia) were analysed. As a result, one product with no English or Khmer on the label was excluded, resulting in a total sample of 68 products. Labels in Khmer were translated into English (unless accompanying English text was provided) and 10% of the translated products were back translated to check for quality.

In cases where stickers providing label information in Khmer were stuck onto English product labels, data was extracted from the Khmer sticker. If English text provided additional required information not found on the sticker, this data was also extracted provided the relevant text was visible without the removal of the sticker. Where conflicting information was presented on the sticker versus the label, researchers deferred to the information provided in Khmer as it was assumed that this was the consumer's preferred language.

One researcher carried out data extraction by entering all relevant information from the product labels into Microsoft Excel datasheets, including: the ingredient list; the declaration of nutrition information (both in dry weight[12], and reconstituted form where applicable) per serving, per 100g and as percentage of RDA (or whichever reference value is used on the label) if provided; serving size; number of servings/day; daily ration; age of introduction; and nutrient content claims, as well as the date the product was purchased. Extracted data underwent a 10% error check where 10% of all labels' extracted information were checked against the actual label images. If the error rate was more than 5% then all extracted data would have to be re-checked, corrected, and a second 10% error check would be carried out until the error rate was acceptable below 5%. After the initial 10% error check took place, the error rate was found to be 0.86% and therefore there was no need to conduct a second 10% error check. Any discrepancies picked up during the error check were corrected and applied throughout the data set.

For the 11 products re-purchased and sent for laboratory analysis, the extracted data from each of the 6 units purchased per product were compared to ensure that all units of the same product provided identical information.

Label information from the data extraction database was then used to complete checklists that draw on relevant Codex and WHO guidance and standards and national regulations. The checklists were completed independently by two researchers for each product. All checklist results were then compared, and any discrepancies resolved between the two researchers. Where consensus could not be reached between the two researchers, the final decision was taken by a third researcher.

[12] Dry weight = Product as it is found within the package, not reconstituted.

Laboratory analysis of sub-sample of products

The 66 units (6 units per 11 products) of CPCF re-purchased for laboratory analysis were coded, relevant information captured into an Excel database and then sent to the internationally recognized laboratory (compliant with International Standard ISO/IEC 17025:2017) selected and contracted for analysis of energy content and nutrient content. A composite sample was created by the laboratory by combining all 6 units of each product for one final sample of each of the 11 products to undergo laboratory analysis. As per the nutrients of interest to the study, the product contents that were analysed included: energy, protein, total sugar, total carbohydrate, total fat, saturated fat, iron, zinc, calcium and sodium. Results were provided by the lab per 100g of non-reconstituted/ready-to-eat product.

6.4 DATA ANALYSIS

The data were cleaned and then assessed against national and global checklists.

The two checklists were developed to carry out objective 1 and 2 of the study. The global checklist (GC) was developed using relevant Codex and WHO global guidance and standards for CPCF (Appendix 1), and the national checklist (NC) using relevant aspects of national legislation (Appendix 2). Each product was assessed against both checklists and according to its designated CPCF category. Table 2 presents the categories of CPCF included in this study against the CPCF categories used in Codex standard/guidelines and Cambodian regulations, while Appendix 3 provides the number of products per category (study and Codex categories).

Global Checklist: The current Codex standards/guidelines for foods for infants and young children, namely canned baby food[13] (CBF), processed cereal-based food[14] (PCF) and formulated complementary food[15] (FCF), were used as the categories for the GC. Four of the study's CPCF categories (dairy/fruit-based snacks, ready-to-eat foods – refrigerated/frozen, infant puddings and 'other - shredded meat/ fish/ poultry; cereal/ root vegetable/ legume/ fruit flours[16]') are covered by general, but not category-specific, Codex standards/guidelines (see table 2). The GC consists of 15 general questions pertaining to all CPCF, plus additional questions that are category-specific: 3 questions for CBF; 13 questions for PCF; and 11 questions for FCF. For each result presented in the body of this report, the related checklist question number is provided. The GC, with results for the 68 products assessed and references to global guidance and standards for each question, can be found in Appendix 5.

As per Codex requirements, ready-for-use products were assessed for their nutrient content as sold, while products that require reconstitution were assessed as prepared according to the instructions of the manufacturer, except for formulated complementary food (FCF) where products were assessed as per the dry product. Where a product's preparation instructions recommended reconstitution with water, the product was assessed as reconstituted with water. Where preparation instructions recommend reconstitution with milk only, the product was assessed as reconstituted with the milk type specified (see Appendix 4 for decision tree of milk type for product reconstitution).

[13] Standard for canned baby foods, CODEX STAN 73-1981.

[14] Standard for processed cereal-based foods for infants and young children, CODEX STAN 74-1981.

[15] Guidelines on formulated complementary foods for older infants and young children, CAC/GL 08-1991.

[16] Cereal flours do not fit into any of the four product categories covered by the Codex standard for processed cereal-based foods for infants and young children (CODEX STAN 74-1981) as they require cooking. The standard only makes allowance for pasta products to require cooking, while the same allowance is not made for products consisting of cereals that have to be prepared with water or milk (instant cereals/ porridges).

Products that recommended reconstitution with water or milk were assessed: as reconstituted with water for all Codex related questions as this is the closest form to the inherent content of the product; and, as reconstituted with milk for WHO questions where energy/nutrient levels were assessed against maximum thresholds. For checklist questions that assessed nutrient content against maximum and/or minimum thresholds, all manufacturer-recommended options for reconstitution were considered with regards to recommended liquid for reconstitution (milk or water), portion size and number of portions per day, as applicable.

National Checklist: Relevant Cambodian regulations pertain to all pre-packaged foods or CPCF in general (they do not set specific requirements for different categories of CPCF) and thus all products were assessed against all questions. The national checklist (NC) consists of 12 questions, and the NC along with results for the 68 products assessed and references to the relevant Cambodian regulations for each question, can be found in Appendix 6.

Table 2: ARCH 3 Study and CODEX standard/guideline's CPCF categories.

ARCH 3 study CPCF categories	**CODEX standard/guideline's CPCF categories**	
1. Cereal-based infant cereals/ porridges/ meals, instant/ requires cooking (e.g., instant cereals; porridges; pasta/ noodle meals or soups; meals with cereal, protein source and/ or vegetables).	PCF (b) - Cereals requiring reconstitution with milk/ other nutritious liquids;	FCF - *All products fortified with vitamins and/or minerals.*
	PCF (c) - Cereals with added high protein food, requiring reconstitution with water;	
	PCF (d) - Pasta (cooked in boiling water);	
2. Cereal-based infant snacks (e.g., biscuits; rusks; crackers; puffs).	PCF (e) - Rusks and biscuits	
3. Dairy/ fruit-based snacks (e.g., freeze-dried fruit; freeze-dried fruit and yoghurt melts).	*No category specific, only general, Codex standards/ guidelines apply.*	
4. Ready-to-eat foods – shelf stable (e.g., shelf-stable jars/ pouches/ tubs, which may include cereal, pasta, meat, poultry, fish, dairy, eggs, fruits, and/ or vegetables)	CBF (a) 'Canned' baby food, fruit products /dessert products based on fruit	
	CBF (b) 'Canned' baby food, other	
5. Ready-to-eat foods – refrigerated/frozen (e.g., yoghurts, refrigerated meals, which may include cereal, pasta, meat, poultry, fish, dairy, eggs, fruits, and/or vegetables).	*No category specific, only general, Codex standards/ guidelines apply.*	
6. Infant pudding (instant milk/ gelatine pudding).	*No category specific, only general, Codex standards/ guidelines apply.*	
7. Other (shredded meat/ fish/ poultry; cereal/ root vegetable/ legume/ fruit flours).	*No category specific, only general, Codex standards/ guidelines apply.*	

CBF – Canned baby Food (Standard for Canned Baby Foods (CODEX STAN 73-1981)); CM – Main Complementary Meal; CS – Complementary Snack; FCF – Fortified Complementary Food (Guidelines on Formulated Complementary Foods for Older Infants and Young Children (CAC/GL 08-1991)); PCF – Processed Cereal-based Food (Standard for Processed Cereal-based Foods for Infants and Young Children (CODEX STAN 74-1981)).

	PCF – Processed Cereal-based Food
	CBF – Canned baby Food
	FCF – Fortified Complementary Food

The checklists assessed CPCF in relation to the label's nutrient content claims and general labelling practices for objective 1; and information contained in the ingredient list and nutrition information table for objective 2.

Objective 1: *To assess selected labelling practices (serving size; number of servings per day; daily ration; age of introduction; nutrient content claims[17]) of CPCF sold in the Khsach Kandal District against global guidance (Codex Alimentarius and WHO) and standards and relevant aspects of national legislation.*

- The presence and/or appropriateness of a serving size, number of servings/day, daily ration and age of introduction on product labels was determined using the GC.
- It was determined whether nutrient content claims were made on the label for nutrients of interest.

Objective 2: *To assess the composition and nutrient content, as declared in the ingredient list and nutritional information of the labels, of CPCF sold in the Khsach Kandal District against global (Codex Alimentarius and WHO) guidance and standards and relevant aspects of national legislation.*

- Using descriptive statistics, the presence of additives, added flavourings and added vitamins/minerals, as determined using the ingredient list, were reported, as well as the specific names of emulsifiers, flavourings, and forms of vitamins/minerals of interest.
- Declared nutrient content assessed using the global checklist and national checklist included: energy, protein, total fat, saturated fat, total sugar and micronutrients of interest, namely sodium, iron, zinc and calcium per 100g; per serving; and as percentage of Recommended Dietary Allowance, (RDA) where applicable.
- For products that provided nutrient content as a percentage of RDA without also providing the nutrient content by weight, the latter was calculated using a method based on a 2019 study by Dreyfuss et al. The reported percentage of RDA of the nutrient in one recommended serving (as listed on the product label) was multiplied by the RDA for the product's recommended age of use. If no recommended age was provided on the label, the nutrient content by weight could not be calculated. When the product's recommended age of use spanned more than one age category for the specified country's RDA (e.g., 6-24), the average of the RDA values from the two age categories was used to calculate the nutrient content. The specific country RDA used for this calculation was determined by the information reported on the product label.
- All applicable components of relevant national legislation that are only available in Khmer were translated into English by the Helen Keller team before being used.

Objective 3: *To compare the content of selected nutrients, as determined by laboratory assessment, of a sub-sample, of each category of the most commonly available CPCF* sold in the Khsach Kandal District *to their declared nutritional information.*

- Energy (kJ), micronutrients of interest (iron, zinc, calcium, riboflavin), free and total sugar, total fat, saturated fat, and sodium per serving and per 100g of each CPCF retrieved from the laboratory was compared to the declared nutritional information on the label (using dry weight where appropriate).
- Using the laboratory results, it was assessed whether nutrient content claims related to the nutrient of interests on the product label complied with the Codex standards for such claims. This was a hypothetical case as claims are not permitted by Codex on CPCF.

[17] Nutrient Content Claim: ***Nutrient content claim*** is a nutrition claim that describes the level of a nutrient contained in a food. (Examples: "source of calcium"; "high in fibre and low in fat".) Codex Alimentarius: Nutrition and Health Claims, CAC/GL 23-1997.

7. RESULTS

7.1 Description of stores encountered and visited in Khsach Kandal District

Table 3 presents the number of each store type found and visited by field workers along the main commercial roads of the most commercially developed village in each of the 9 communes selected, as well as the number of each store type that was found to sell CPCF. Of the stores visited (n=188), the majority were food stores (85%, n=160) followed by pharmacies (12%, n=23) and a small number of baby stores (3%, n=5). All baby stores encountered in Khsach Kandal sold CPCF, while only a small percentage of pharmacies and food stores sold CPCF (Table 3). Vihear Suork Cheung and Preaek Ta Meak, villages in the largest and third largest communes in number of infants below 1 year of age (table 1), were the villages with the greatest number of stores selling CPCF (Table 3). Roka Chongleung which holds 5% of the province's infants under 1 year of age (table 1) had no stores selling CPCF.

Table 3: Number of stores visited and selling CPCF per store type in each commune in Khsach Kandal.

	Commune (Village)	**Food store**		**Pharmacy**		**Baby Store**		**All stores**	
		Visited	**With CPCF**	**Visited**	**With CPCF**	**Visited**	**With CPCF**	**Visited**	**With CPCF**
1	Preaek Ta Meak (Preaek Ta Meak)	18	1	6	1	3	3	27	5
2	Vihear Suork (Vihear Suork Cheung)	14	3	8	1	1	1	23	5
3	Sanlung (Sanlung)	16	4	2	0	0	0	18	4
4	Preaek Ampil (Preaek Krabau Ti Muoy)	22	2	1	1	0	0	23	3
5	Preaek Luong (Preaek Ta Tep)	22	2	2	0	0	0	24	2
6	Svay Chrum (Svay Chrum)	22	2	1	0	0	0	23	2
7	Bak Dav (Preaek Chruk)	18	1	1	0	1	1	20	2
8	Puk Ruessei (Puk Ruessei Kandal)	13	1	1	1	0	0	14	2
9	Roka Chonlueng (Roka Ti Pir)	15	0	1	0	0	0	16	0
		160	**16 (10%)**	**23**	**4 (17%)**	**5**	**5 (100%)**	**188**	**25 (13%)**

7.2 Description of commercially produced complementary foods

Sixty-nine (n=69) CPCF were purchased in the Khsach Kandal District over a 3-week period in July to August of 2020, of which 1 CPCF was excluded as none of the label information was provided in either of the study languages (English and Khmer). The final dataset included 68 CPCF. Most products were imported (n=62, 91%) and only 6 (9%) were locally manufactured, representing a total of 16 identified manufacturers (15 international, 1 local), as presented in Table 4. Two products did not identify their manufacturer but provided an international (Taiwanese) address on the label.

Three international companies (Gerber Products Co., Guangzhou Yong Want Foods Ltd. and Nestle Manufacturing (Malaysia) Sdn. Bhd.) and 1 local company (Angkor Dairy Products Co. Ltd.) produced the largest number of products (Table 4). Sixteen brands were represented with the most common

brands being Gerber followed by Want-Want, Milna and Nestlé (Table 4). Over two-thirds (n=43, 69%) of international products were imported from Asian countries, while 18% (n=11) were from the United States of America, 11% (n=7) from Europe and 2% (n=1) from Australia.

Table 4: Brands and manufacturers of CPCF sold in Khsach Kandal District, Cambodia (n=68).

Brand	Manufacturer	International or national manufacturer	No. of products by manufacturer and percentage by brand.
Gerber	Gerber Products Co.	International	10
		Subtotal	10 (15%)
Want-Want	Guangzhou Yong Want Foods Ltd.	International	8
Hot-Kid		International	2
		Subtotal	10 (15%)
Milna	PT. Sanghiang Perkasa (Kalbe)	International	5
	PT. Seasonal Supplies Indonesia for PT Sangiang Perkasa (Kalbe)	International	3
		Subtotal	8 (12%)
Nestlé	Nestle Manufacturing (Malaysia) Sdn. Bhd.	International	7
		Subtotal	7 (10%)
Angkormilk	Angkor Dairy Products Co. Ltd.	National	6
		Subtotal	6 (9%)
Apple Monkey	Healthy Foods Co. Ltd.	International	5
		Subtotal	5 (7%)
Dana Milk	Dana Dairy Group Ltd.	International	4
		Subtotal	4 (6%)
Promina	PT. Indofood CBP Sukses Makmur Tbk.	International	3
	PT. Makindo Perdana for PT. Indofood CBP Sukses Makmur Tbk.	International	1
		Subtotal	4 (6%)
France Lait	Manufactured in Belgium for Regilait, France	International	3
		Subtotal	3 (4%)
Namchow	Namchow (Thailand) Ltd.	International	3
		Subtotal	3 (4%)
Peachy	Peachy Village Co. Ltd.	International	3
		Subtotal	3 (4%)
Little Bio Organic	Manufacturer unknown	International	2
		Subtotal	2 (3%)
Organics Happy Baby	Happy Family Brands	International	1
		Subtotal	1 (1.5%)
LiF, Love'in Farm	International Dairy Product Joint Stock Company (IDP)	International	1
		Subtotal	1 (1.5%)
AFC Nutrition	Mondelez Kinh Do Vietnam Joint Stock Company	International	1
		Subtotal	1 (1.5%)
		Imported products	62 (91%)
		Locally manufactured products	6 (9%)
		Grand total	**68**

Table 5 shows the characteristics of products as well as the CPCF categories included in this study. Aside from the 7 yoghurts, all products included in the study were shelf stable (Table 5). All products presented label information in Khmer, English, or both. Just under half of the products (44%, n=30) did not provide any label information in Khmer. Additional languages (Thai, Mandarin, Bahasa Indonesia, French, Vietnamese, Arabic and Burmese) were found on 68% of the products (n=46). The most common category of CPCF was cereal-based infant snacks, followed by cereal-based infant cereals/porridges/meals and yoghurts (Table 5). Nearly three-quarters (72%, n=49) of the products listed vitamins and/or minerals in the ingredient list and were thus considered to be fortified. The most commonly recommended age of use provided on CPCF labels was '6 months and above' (46%, n=31), with 62% (n=42) of products recommended for older infants and young children[18], 22% (n=15) for young children only, and 15% (n=10) for older infants only. Almost two-thirds (65%, n=44) of the CPCF were ready-to-eat, while the remaining products (cereal-based cereals/porridge/meals) required the addition of a liquid, of which the majority recommended reconstituting the products with water (Table 5). Of the 5 products that recommended reconstitution with milk/water or milk, 4 products did not specify the type of milk to be used, 1 product implied the use of reconstituted milk powder or formula, and none of the products recommended the use of breastmilk.

Table 5: Characteristics of CPCF sold in Khsach Kandal District, Cambodia (n=68).

Characteristic	Number of products (percentage of products)
Recommended age of use	
4 months and above	3 (4%)
6 months and above	31 (46%)
6-12 months	7 (10%)
8 months and above	8 (12%)
8-12 months	3 (4%)
12 months and above	12 (18%)
24 months and above	3 (4%)
Age recommendation not provided	1 (2%)
Fortification with vitamins and/or minerals	
Fortified products	49 (72%)
Non-fortified products	19 (28%)
CPCF Study Category	
Cereal-based infant snacks (e.g., biscuits, crackers, puffs)	37 (54%)
Cereal-based infant meals - instant/requires cooking (e.g., cereals, porridges, meals, rice cereal, soup)	24 (35%)
Ready-to-eat foods – refrigerated/frozen (e.g., yoghurt)	7 (10%)
Infant pudding - instant milk/gelatine pudding	0 (0%)
Other (e.g., shredded poultry and cereal/root vegetable/fruit/ legume flour	0 (0%)
Ready-to-eat foods – shelf-stable (e.g., jars/pouches)	0 (0%)
Storage	
Shelf stable	61 (90%)
Fresh/frozen	7 (10%)

[18] The term older infants means persons from the 6th month and not more than 12 months of age. The term young children means persons from the age of 12 months up to the age of three years (36 months). Codex Alimentarius: Guidelines on formulated complementary foods for older infants and young children, CAC/GL 08-1991.

Language	
Khmer/other language combination	38 (56%)
English/other (not Khmer) language combination	16 (23%)
English only	14 (21%)
Khmer only	0
Preparation type	
Ready-to-eat	44 (65%)
Instant – add water	19 (28%)
Instant – add water or milk	4 (6%)
Instant – add milk	1 (1%)

7.3 CPCF checklist results

None of the products complied with all relevant global or national checklist questions.

7.3.1 Selected labelling practices (serving size; number of servings per day; daily ration; age of introduction) of CPCF sold in the Khsach Kandal District.

7.3.1.1 Age related recommendations & statements

Nearly all products (94%, n=64) provided a recommended age of introduction of 6 months of age or older, as required by global guidelines, while 3 products (4%) provided an age recommendation of less than 6 months (two Little Bio cereal products and one Dana Milk product). One product did not provide an age recommendation (GC – 1. General B1).

National regulations require CPCF labels to include a warning related to the health hazards of introducing CPCF before six months of age[19]. Only 7% (n=5) of products provided a complete warning in one of the study languages[20]. Almost a quarter (21%, n=14) provided a partial warning by stating that the product should not be introduced before 6 months but did not make mention of this being a health hazard or stated the health hazard of early introduction of CPCF without providing the age of introduction (6 months).

Nearly three-quarters (72%, n=49) of products did not provide the required warning (NC -1. Gen B3). In addition to this warning, national regulations require CPCF labels to state that the product shall only be used on the advice of a health worker[21]. Only 12% (n=8) of products provided this message in full in one of the study languages. Two (3%) provided a partial message that recommends consulting a health professional but without stipulating that this is required before using the product. The majority of products (85%, n=58) did not provide the message (NC -1. Gen B4).

[19] The Sub-decree on Marketing of Products for Infant and Young Child Feeding (Regulation 133 A Nor Kra Bor, 18 November 2005) does not specifically require this label message to be provided in Khmer.
[20] Study languages included English and Khmer.
[21] The Sub-decree on Marketing of Products for Infant and Young Child Feeding (Regulation 133 A Nor Kra Bor, 18 November 2005) does not specifically require this label message to be provided in Khmer.

National regulations also require that CPCF labels provide a statement regarding the superiority of exclusive breastfeeding for the first 6 months of age and sustained breastfeeding until the child reaches the age of 2 years or beyond[22]. Seven products (10%) provided this message in full, while the remaining products provided either a partial message (18%, n=12) or no message (72%, n=49) in one of the study languages (NC -1. Gen B1).

7.3.1.2 Serving size and daily ration

Most products (90%, n=61) provided a serving size on the label, while only 3 products (4%) did not. Four products (6%) provided a serving size that could not be used as it was not in the study languages (GC – 1. General B2).

Global guidelines for FCF require that, when prepared according to the instructions, they constitute a serving size of between 10 and 50g. Of the 49 FCF, five products (10%) did not provide sufficient information to determine and assess the reconstituted/ ready-to-eat serving size (GC – 9. FCF. B1.1).

Of the 44 FCF that provided a serving size, only 7% (n=3) had a serving size within the recommended range (all were cereal-based snack foods and described as baby biscuits), while 82% (n=36) had a serving size falling outside the recommended range, and 11% (n=5) were cereal-based infant cereals/porridges with insufficient information to calculate the products' reconstituted serving size. Almost one third (32%, n=14) had a serving size below 10g (ranging from 3 to 7g), all of which were cereal-based snack foods in a ready-to-eat form and described as biscuits, crackers or baked snacks. Half (50%, n=22) had a serving size above 50g (ranging from 100g to 250g), which included all cereal-based infant cereals/porridges for which sufficient information was provided to calculate prepared serving size (43%, n=19) and yoghurts (7%, n=3).

Only 12% (n=8) of all products provided a proposed daily ration (or a recommended number of servings per day) in addition to a serving size, as recommended by global guidance (GC – 1.GEN B3), while nearly ninety percent of products (88%, n=60) did not.

7.3.1.3 Compulsory messages

In addition to the compulsory age-related messages (see section 3.3.1.1), national regulations require CPCF labels to carry 3 additional messages related to their safe and appropriate use.

CPCF labels are required to provide a warning with the words 'Important Notice' of the health hazards of inappropriate use of the product[23].

While no product provided the full warning, a small percentage of products (n=7, 10%) provided a partial message that included a warning of the health hazards of inappropriate use but omitted the required words 'Important Notice'. Ninety percent (n=61) of products did not provide the required warning in one of the study languages (NC -1. Gen B2).

CPCF labels are required by national regulations to provide instructions for appropriate preparation and use of the product in the local language, Khmer (NC -1. Gen B5, 5.1). Labels were assessed based on the presence or absence of preparation and use instructions; the appropriateness of the preparation method/suggested usage of the product provided by the manufacturer was not assessed.

[22] The Sub-decree on Marketing of Products for Infant and Young Child Feeding (Regulation 133 A Nor Kra Bor, 18 November 2005) does not specifically require this label message to be provided in Khmer.
[23] The Sub-decree on Marketing of Products for Infant and Young Child Feeding (Regulation 133 A Nor Kra Bor, 18 November 2005) does not specifically require this label message to be provided in Khmer.

For the purposes of this study, use instructions included recommendations regarding how much and/or how frequently to feed the child (daily ration, number of servings per day and/or serving size provided outside of the nutrition information table).

Such instructions might be provided on the label as text or as a 'feeding table'. Preparation instructions included information on the correct way to prepare the product, for example heating, cooking, reconstituting or serving directly from the packaging. Nearly half (47%, n=32) of the products provided instructions for appropriate use, while nearly seventy percent (68%, n=46) of products provided instructions for appropriate preparation, and an additional 21% (n=14) provided partial preparation instructions (preparation method was implied, but not directly stated). National regulations require that the preparation and use instructions be in Khmer. Of the products that provided instructions for appropriate use, two thirds (66%, n=21/32) provided them in Khmer, while just under half (48%, n=29/60) that provided instructions for appropriate preparation provided them in Khmer (NC -1. Gen B5, 5.1; B6, 6.1).

7.3.2 Composition and nutrient content, as declared in the ingredient list and nutritional information of the labels, of CPCF sold in the Khsach Kandal District.

7.3.2.1 Composition

While Codex exempts single ingredient foods from providing an ingredient list, Cambodian regulations require an ingredient list, in Khmer, on all product labels (GC – General A. 1.1; NC – General A.1, A1.1). All CPCF products provided an ingredient list, however less than a third (31%, n=21) provided the list in Khmer.

a. Vitamins, minerals, flavourings and additives

Table 6 displays the number and percentage of fortified products within each CPCF category and shows the frequency with which all CPCF were fortified with vitamins and minerals of interest to this study (calcium, iron, zinc, vitamin C). All cereal-based cereals/porridges/meals were fortified with vitamins and/or minerals, compared to 59% (n=22) of cereal-based infant snacks and 43% (n=3) of yoghurts marketed for young children.

Table 6: Fortified CPCF characteristics.

CPCF product categories	**Total number of fortified products per product category (percentage of CPCF category)**
Cereal-based infant cereals/porridge/meals (n=24)	24 (100%)
Cereal-based infant snacks (n=37)	22 (59%)
Yoghurts (n=7)	3 (43%)
Total products (n=68)	**49 (72%)**
Vitamins / Minerals of interest (n=68)	**Total number of CPCF* fortified with vit/min (percentage of CPCF)**
Iron	28 (41%)
Calcium	23 (34%)
Vitamin C	19 (28%)
Zinc	11 (16%)

*Products that only stated 'vitamin/minerals premix' in the ingredient list, without explicitly stating the specific vitamins or minerals included in the premix, were excluded.

Of the vitamins and minerals of interest to this study, products most commonly contained iron (41%, n=28), followed by calcium (34%, n=23), vitamin C (28%, n=19) and zinc (15%, n=11). A total of 8 products that listed iron in the ingredient list did not specify the form of iron used.

Almost two-thirds (64%, n=18) of products fortified with iron were fortified with a globally recommended form of iron (ferric pyrophosphate, electrolytic iron, or ferrous fumarate), and only 2 products were fortified with another form of iron (Table 7) (GC – A. 2.1). Over two-thirds (68%, n=19) of the products fortified with iron also contained added vitamin C, which is recommended to aid iron absorption.

Eight (35%) of the 23 products fortified with calcium did not specify the form of calcium, however, the remainder were fortified with a globally recommended form of calcium. All products fortified with zinc provided the form and made use of a globally recommended form of zinc.

Table 7: Form of iron used in CPCF fortified with iron (n=28).

Form of iron	Total number of products (percentage of products)
Ferric pyrophosphate	9 (32%)
Electrolytic iron	8 (29%)
Not specified	8 (29%)
Other (non-recommended form)	2 (7%)
Ferrous fumarate	1 (3%)

Nearly three-quarters (74%, n=50) of CPCF contained at least 1 additive according to their ingredient list.[24] Of interest in this study was the presence of emulsifiers and flavourings. Emulsifiers were present in 41% (n=28) and flavourings in 56% (n=38) of CPCF (Table 8). The most common emulsifiers were lecithins (soy, sunflower, or unspecified) found in 25% (n=17) of products, followed by acetylated distarch adipate (10%, n=7) and mono- and diglycerides of fatty acids (10%, n=7).

All emulsifiers listed as ingredients in the CPCF included in this study are permitted by Codex as food additives for processed cereal-based foods, canned baby foods and formulated complementary foods (Codex Alimentarius, 1981a; Codex Alimentarius, 1981b; Codex Alimentarius, 1991). There is no Cambodian regulation regarding the use of additives in complementary foods.

Fruit flavourings (e.g., blueberry, strawberry and apple) were the most common flavourings (29%, n=20), followed by non-specific flavourings (e.g., nature identical flavours, natural flavours and artificial flavours) (19%, n=13) and 'dessert/sweet snack' flavourings (e.g., vanillin and vanilla) (10%, n=7). Less than 5% of products had savoury flavourings such as vegetable flavourings (4%, n=3), savoury dairy flavourings (3%, n=2) or yeast extract (1%, n=1) while only 1% of products contained more 'neutral' flavourings such as cinnamon (n=1). Cereal-based infant snacks were most likely to have added flavouring (62%, n=23/37), followed by cereal-based infant cereal/porridge/meals (50%, n=12/24), and yoghurt (43%, n=3/7).

[24] Cambodian Standard on the Labelling of Pre-packaged Food (CS 001:2000) does not require pre-packaged foods to declare certain additives (e.g., processing aids, preservatives and colours) in their ingredient lists. As such, the number of products in this study containing additives may be higher than what was assessed using the additives declared in ingredient lists.

Table 8: Frequency of emulsifiers and flavourings in CPCF (n=68).

Ingredient	Total number of products (percentage of products)
Emulsifiers:	28 (41%)
Lecithin:	17 (25%)
Soy	7
Unspecified	6
Sunflower	4
Acetylated distarch adipate	7 (10%)
Mono- and diglycerides of fatty acids	7 (10%)
Pectin	4 (6%)
Vegetable emulsifier	3 (4%)
Disodium phosphate	1 (1%)
Flavourings	38 (56%)
Fruit flavourings:	20 (29%)
Blueberry, natural / NFS* / organic extract	5
Strawberry, natural / NFS / synthetic	4
Apple, natural	3
Banana, natural	2
Fruit, natural / NFS	2
Kiwi, natural	1
Mango, natural	1
Orange	1
Pomegranate, natural	1
Non-specific flavourings:	13 (19%)
Nature identical flavour	7
Natural flavour	3
Artificial/ synthetic flavour	3
Dessert/Sweet snack flavourings:	7 (10%)
Vanillin	5
Vanilla, natural / synthetic	2
Vegetable flavourings:	3 (4%)
Carrot extract, purple	1
Garlic, natural	1
Onion, fried, artificial	1
Dairy flavourings, savoury:	2 (3%)
Cheese, cheddar, natural	1
Sour cream, natural	1
Cinnamon, natural	1 (1%)
Dairy flavourings, sweet:	1 (1%)
Milk	1
Yeast extract, autolysed	1 (1%)

*Not further specified.

Table 9 shows that almost all (92%, n=35) products that contained flavourings also contained free sugars, whereas 87% (n=26) of products with no flavourings contained free sugars. Furthermore, 97% (n=30) of products with sweet flavourings contained free sugars, whereas 71% (n=5) of products with savoury flavourings contained free sugars.

Table 9: CPCF by flavourings category with and without free sugar (n=68).

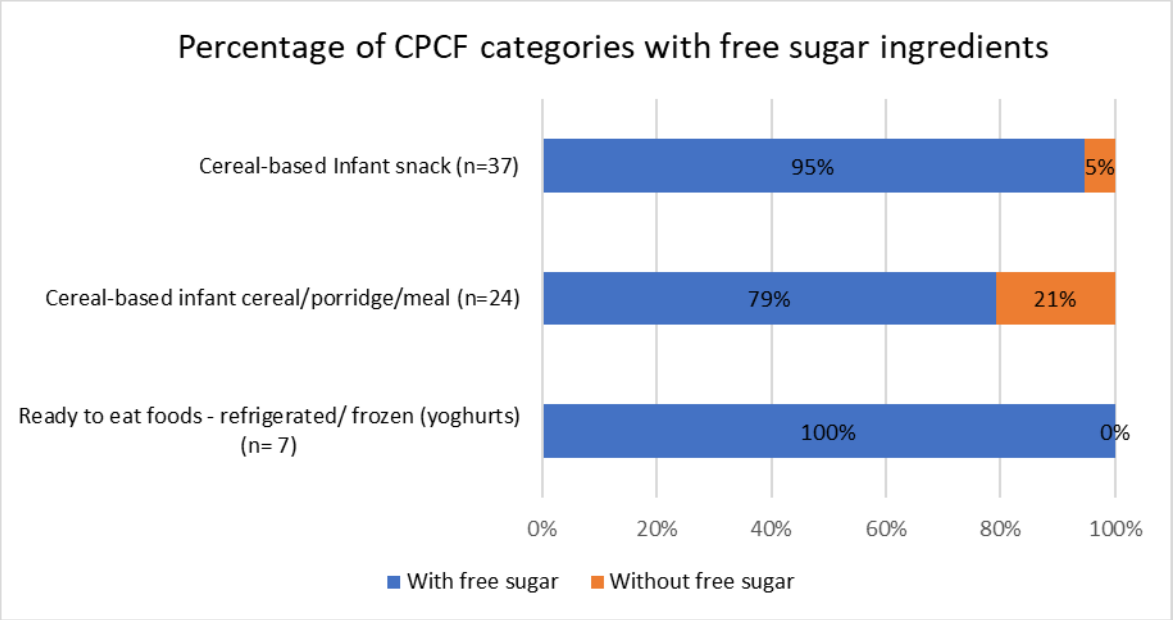
Flavourings category*	Total number of products (percentage of products)	Number of products per flavourings category with free sugar (percentage of product per flavourings category)	Number of products per flavourings category without free sugar (percentage of product per flavourings category)
All flavourings	38 (56%)	35 (92%)	3 (8%)
Sweet	31 (46%)	30 (97%)	1 (3%)
Savoury	7 (10%)	5 (71%)	2 (29%)
No flavourings	30 (44%)	26 (87%)	4 (13%)

*Products with a combination of sweet and neutral flavourings (n=1) were classified as sweet. Products with a combination of sweet and savoury flavourings (fruit and vegetable flavourings) (n=1) and were classified as sweet.

b. Prohibited Ingredients

According to global guidelines, the addition of free sugars to CPCF should be avoided (GC - General A.3.1). Free sugar[25] ingredients were highly prevalent across all CPCF categories (Figure 1). CPCF with free sugar ingredients declared between 1 and 3 different free sugars; three-quarters (74%, n=45) declared 1 free sugar, almost a quarter (21%, n=13) declared 2, and 4% (n=3) declared 3 free sugars. The most common free sugars were cane sugar/ sucrose/ brown sugar (92%, n=56/61), followed by fruit concentrate/ fruit juice concentrate (11%, n=7/61) and fruit puree (8%, n=7/61) (Table 10). Other free sugars found were glucose (3%, n=2/61), honey (3%, n=2/61) and maltose syrup (2%, n=1/61).

Figure 1: Percentage of CPCF categories with free sugar ingredients (n=68).



[25] Free sugars include monosaccharaides, disaccharides, honey, syrups, fruit juice and/or fruit juice concentrate.

Table 10: Number of CPCF with free sugar ingredients (n=61).

Free sugars	Total number of products (% of products containing free sugar)
Cane Sugar/ sucrose/ brown sugar	56 (92%)
Fruit concentrate/ fruit juice concentrate	7 (11%)
Fruit puree	7 (8%)
Glucose	2 (3%)
Honey	2 (3%)
Maltose syrup	1 (2%)

Global guidance advises against the addition of salt to foods for infants and young children, however, 35% (n=24) of CPCF contained added salt. All the products that contained added salt were cereal-based infant snacks, both sweet and savoury varieties. Cereal-based infant cereal/porridge/meals and yoghurts did not contain any added salt (GC – General A.3.2).

All PCF and FCF are recommended not to contain hydrogenated oil and no product indicated this in the ingredient list (GC – PCF (All) A.1, GC – FCF – A.1).

7.3.2.2 Nutrient Content

Almost all products (90%, n=61) provided a declaration of nutrition information in one of the study languages[26], making it possible to assess their nutrient content. Seven products (10%) provided nutrition information in in a language other than the study languages and were therefore excluded from nutrient content assessment.

National regulations require that the declaration of nutrition information be provided in Khmer. Of the products that provided nutrition information in one of the study languages (GC – General C1), only one third (31%, n=19) provided it in Khmer (NC – C1, C1.1).

There is currently no national legislation regulating the nutrient content of CPCF. As a result, CPCF were assessed against the nutrient content requirements of global guidelines and standards only.

7.3.2.2.1 Global Guidelines

i. All CPCF: Energy per recommended daily ration versus energy intake from breastmilk

For products intended for older infants 6-8.9 months (n=49), 9-11.9 months (n=49), or young children 12-23.9 months (n=48), 80% (n=39), 84% (n=41), and 94% (n=45) of products, respectively, did not provide sufficient information (no daily ration/ recommended serving size combined with a recommended frequency of feeds per day provided) to determine if the manufacturer's recommended daily ration exceeded the PAHO/WHO recommended energy intake from complementary foods for a breastfed child.

For products marketed as suitable for older infants 6 to 8.9 months, the daily ration or single serving size recommended by the manufacturer of almost a quarter (20%, n=10/49) of the products exceeded the PAHO/WHO recommended daily energy intake for complementary foods for a breastfed child for one or all of the daily ration recommendations provided on the label.

[26] Study languages include English and Khmer.

This figure decreased to 6% (n=3) for products for the age category of 9 to 11.9 months and to 0% for products for the 12 to 23.9-month age category. None of the products for older infants 6 to 8.9 months, only 10% (n=5) of products marketed for older infants 9-11.9 months, and 6% (n=3) of products for young children 12-23.9 months, recommended a daily ration within the recommended energy intake from complementary foods for a breastfed child (GC – General C.2).

ii. Recommendations specific to CODEX standard/guideline's CPCF sub-categories

a) All processed cereal-based complementary food (PCF) (n=61)

The majority (83%, n=45/54) of PCF, for which nutrition information was available in one of the study languages, provided the recommended minimum energy density of 0.8kcal/g. Four products (7%) provided less than the recommended energy density, and 5 products (9%) did not provide sufficient information to calculate energy density (GC – PCF all C.1).

b) PCF requiring reconstitution with milk or other nutritious liquids[27] (n=3)

All products that, according to Codex, are required to be prepared with milk or other appropriate nutritious liquids (100%, n=3) met the requirement for lipids (≤ 3.3 g/100 kcal) and sodium (≤ 100 mg/100 kcal) when reconstituted according to the manufacturer's instructions[28] (GC – PCF(b) C.1.1, 2.1). Two products provided instructions on their label to reconstitute the product with water or milk, however according to Codex, these products should only be prepared with milk or other appropriate nutritious liquids.

c) PCF requiring reconstitution with water[29] (n=21)

Of the products that contained an added high protein food and therefore, according to Codex, require reconstitution with water only, all 18 had a protein content that was less than or equal to the required maximum protein limit of 5.5g/100kcal ((GC – PCF(c) C.1.1). All 18 of products met the recommended lipid (≤ 4.5 g/100 kcal), sodium (≤ 100 mg/100 kcal), and calcium (≥ 80mg/100kcal) requirements (GC – PCF(c) C.3.2). Two of the 18 products recommended reconstitution with either water or milk but were assessed based on reconstitution with water. Three products could not be assessed as they did not provide nutrition information in one of the study languages.

[27] Products consisting of cereals which are or have to be prepared for consumption with milk or other appropriate nutritious liquids (CODEX STAN 74-1981). For the purposes of this study, all such products that do not declare a high protein food (e.g., milk powder, meat, eggs, amino acids) in their ingredient list were categorised as 'PCF requiring reconstitution with milk or other nutritious liquids', regardless of whether preparation instructions recommended mixing with water/milk/other liquids.

[28] Two of the 3 PCF requiring reconstitution with milk or other nutritious liquids recommended reconstitution with water or milk. In such instances it was decided by the researchers that the assessments would be based on reconstitution with the lowest calorie option provided namely water. Thus, the results of this assessment may differ if the products were assessed as being reconstituted with milk.

[29] Cereals with an added high protein food which are or must be prepared for consumption with water or other appropriate protein-free liquid (CODEX STAN 74-1981). For the purposes of this study, all such products that declared a high protein food (e.g., milk powder, meat, eggs, amino acids) in their ingredient list were categorised as 'PCF requiring reconstitution with water', regardless of whether preparation instructions recommended mixing with water/milk/other liquids.

d) PCF: Biscuits and rusks (n=37)

The nutrient content recommendations for PCF biscuits and rusks were met by all 33 products for protein (≤ 5.5 g/100 kcal); by 79% (n=26/33) for lipid (≤ 3.3 g/100 kcal); and 91% (n=30/33) for sodium content (≤ 100 mg/100 kcal) (GC – PCF(e) C.1.1, 2.1, 3.1).

None of the rusks/biscuits were manufactured with the addition of milk and therefore were not assessed against the calcium recommendations (≥ 50 mg/100 kcal) for such products (GC – PCF(e) C.3.2). Four products could not be assessed as they did not provide nutrition information in one of the study languages.

e) Formulated complementary food (FCF) (n=49)

Macronutrients: Energy, protein, fat

Formulated complementary foods (defined as CPCF fortified with vitamins and/or minerals for the purposes of this study) have a specific set of nutritional recommendations according to Codex.

Of the 42 products that were fortified and provided nutrition information in one of the study languages, 83% (n=35) met the recommended energy density of ≥4 kcal/g on a dry weight basis (GC – FCF C1.1). Sixty-four percent (n=27) provided a protein percentage of total energy within the recommended range of 6-15% (GC – FCF C2.1). Only 29% (n=12) provided sufficient fat to meet the recommended minimum of 20% of total energy, while nearly three quarters (71%, n=30) fell short of the recommendation (GC – FCF C3.1). Almost 90% (n= 37) of the fortified CPCF, did not provide sufficient information on their linoleic acid content to assess for sufficiency against the recommendations (GC – FCF C3.2).

Micronutrients of interest: Calcium, Zinc, Iron

Codex recommends that a daily ration of fortified CPCF provide a minimum of 50% RNI for each added vitamin/mineral (GC – FCF C.4). Many products provided insufficient label information for assessment, with 60% (n=12/20) of products fortified with calcium, 73% (n=8/11) of products fortified with zinc, and 57% (n=16/28) of products fortified with iron lacking sufficient nutritional, serving size or daily ration information to undertake the necessary calculations.

Only 1 (5%) of the 20 products fortified with calcium provided at least 50% RNI for calcium and 2 (10%) provided at least 50% for one or more but not all possible daily rations recommended on the label. A quarter (n=5) of the products fortified with calcium fell short of the minimum requirement.

Cereal-based infant cereals/meals/porridges with an added high protein food are required to have a minimum calcium content of 80mg/100kcal, of which all 18 products met the requirement.

Of the 11 products fortified with zinc, just over a quarter (27%, n=3) provided at least 50% RNI for one or more but not all possible daily rations recommended on the label and none fully met the minimum requirement.

Of the 28 products fortified with iron, 32% (n=9) provided the minimum 50% RNI for iron (2.9mg/daily ration), while only 11% (n=3) provided at least 50% RNI for one or more but not all possible daily rations recommended on the label. None of the iron fortified products fell short of the minimum requirement. However, when assessed against the WHO recommendations that recommend substantially higher amounts of iron by age group (8-10mg/day for 6-12 months, and 5-7mg/day for 12-24 months) (GC – FCF C.4.3.1), none (0%, n=0/28) of the iron fortified products for the age category 6-12 months and only 4% (n=1/23) of the iron fortified products for the age category 12-24 months

provided a daily ration of iron within the recommended range. Nearly a third (29%, n= 8/28) of the iron fortified products recommended for 6-12 months of age provided less than the recommended range per daily ration. Of the iron fortified products intended for 12-24 months age group, 13% (n=3) products provided iron within the suggested range for one or more, but not all possible daily rations. Of the partially compliant products (n=3/23), all provided less than the recommended range per daily ration for at least one of the possible daily rations.

The Codex CPCF categories have differing nutrient content recommendations for each category of product, ranging between 1 and 10 nutrient content recommendations. Only processed cereal-based foods that required preparation with milk or other nutritious liquids and those that required preparation with water complied with all relevant nutrient content guidelines. None of the FCF complied with all relevant nutrient content guidelines (some were partially compliant but lacked some of the nutrient information required to complete the assessment).

7.3.3 Nutrient content claims of CPCF sold in Khsach Kandal District.

According to global guidelines, nutrition and health claims are not permitted for foods for infants and young children except where specifically provided for in relevant Codex standards or national legislation (CAC/GL 23-1997). Codex makes no provision for such claims and neither do Cambodian regulations.

This study assessed only the presence of nutrient content claims[30], as these are the most common claims made on these types of products. Of the 68 labels assessed for Cambodia, two thirds (66%, n=45) made a nutrient content claim. This is in direct contravention of Codex.

7.3.4 Comparison of the content of selected nutrients, as determined by laboratory assessment, of a sub-sample of each category of the most commonly available CPCF sold in the Khsach Kandal District to their declared nutritional information.

A total of 11 products were sent for laboratory analysis in September 2020. The nutrients analysed were energy, total fat, saturated fat, trans fat, carbohydrate, protein, sugar, sodium, calcium, iron and zinc. All 11 products were international brands and represented the cereal-based infant cereal/porridges/meals and cereal-based infant snacks CPCF categories.

Results from the laboratory analysis and declared energy and nutrient content for each product are provided in Appendix 7.

7.3.4.1 General comparison

The proportion of declared nutrient contents measured by laboratory analysis for the 11 products is presented in Table 11.

[30] According to Codex a nutrient content claim is a nutrition claim that describes the level of a nutrient contained in a food (Examples: “source of calcium”; “high in fibre and low in fat”).

Table 11: Proportion of declared nutrient content below or above 100% the value declared on the label, as measured by laboratory, of CPCF products.

Nutrient	Milna, Bubur Bayi (Baby Porridge) Chicken & corn soup	Milna, Bubur Bayi (Baby Porridge) Banana	Nestlé, Cerelac (Infant cereals with milk) Rice & soybeans	Nestlé, Cerelac, (Infant cereals) Wheat & honey	Nestlé Cerelac (Infant cereals with milk) Wheat with fish & spinach	France Lait Diastase, (My 1st cereals with milk)	Milna, (Baby Biscuit) Orange	Gerber Puffs (Cereal snack) Blueberry	AFC Nutrition (Crunchy Crackers) Vegetable flavour	Gerber, Lil 'Crunchies (Baked corn snack) Apple & sweet potato	Happy Baby Superfood Puffs (Organic grain snack) Purple carrot & blueberry
Energy kJ/100g	103%	100%	102%	100%	101%	99%	100%	109%	95%	101%	106%
Saturated Fat g/100g	NP	NP	92%	134%	NP	NP	NP	NP	77%	NP	250%
Trans fatty acid g/100g	571%	700%	10%	143%	NP	NP	NP	NP	NP	NP	143%
Total fat g/100g	109%	94%	100%	84%	102%	97%	99%	1610%	82%	80%	726%
Total carbohydrate g/100g	94%	93%	98%	95%	90%	93%	93%	92%	85%	71%	97%
Total Sugar g/100g	122%	195%	NP	NP	NP	NP	133%	100%	84%	NP	NP
Protein g/100g	130%	135%	135%	161%	142%	141%	174%	15600%	296%	23900%	9770%
Sodium mg/100g	91%	104%	95%	90%	129%	78%	92%	25100%	101%	89%	79000%
Calcium mg/100g	118%	116%	129%	97%	138%	93%	60%	NP	109%	NP	213%
Iron mg/100g	136%	106%	121%	135%	125%	88%	101%	126%	NP	138%	140%
Zinc mg/100g	102%	116%	158%	NP	170%	124%	81%	NP	NP	NP	207%

COLOUR CODING	
100%	
Above 100%	
Below 100%	
Not provided on the label	NP

Energy values were the most aligned between declared energy and those determined by laboratory assessment. The greatest variation between declared contents and laboratory measured value was observed in protein and sodium values. Laboratory-measured protein values ranged between 130% to 23900% of the declared amount. Laboratory-measured sodium value ranged between 78% to 79000% of the declared amount.

A large range was also observed in proportion of declared trans fatty acid contents as measured by laboratory - between 10% to 700% of the declared amount. All brands contained lower levels of total carbohydrate compared to their declared label content, ranging from 71% to 98% of the declared amount. Over half (55%) of products did not declare the total sugar content and of those that did, 60% (n=3/5) contained more sugar than was declared.

7.3.4.2 Assessment of a sample of CPCF's nutritional content, as determined by laboratory analysis, for their appropriateness for nutrient content claims.

All 11 products sent to the laboratory for assessment made nutrient content claims in either English or Khmer. The number of nutrient content claims made on a product label varied between 1 and 8 and a total of 35 nutrient content claims were made across the 11 product labels. Table 12 highlights the types and prevalence of nutrient content claims made on the labels of the assessed CPCF. Almost two-thirds (64%, n=7) made a nutrient content claim related to their vitamin and/or mineral content.

As the issue of the appropriateness of certain claims on complementary foods is under the global spotlight, it was deemed valuable to assess the nutrient content claims for the nutrients assessed by laboratory analysis against Codex standards. Although Codex currently does not permit nutrient content claims on foods for infants and young children, unless specifically permitted in national legislation, Codex does permit specific nutrient content claims that meet set criteria on foods for the general population. The Codex permitted nutrient content claims for vitamins and minerals are 'Source' and 'High' and to make these claims products must contain 15% and 30% of the nutrient reference value (NRV) per 100g for solid food, respectively. The laboratory assessed products that made nutrient content claims were assessed against these Codex standards. Only 11% (n=4) of the total 35 nutrient content claims made complied with the Codex Guidelines for the use of Nutrition and Health Claims (CAC/GL 23-1997) for the general population.

Nutrient content claims (as with all nutrition and health claims) are not permitted under Cambodian legislation, so all the products making such claims in this study contravene Cambodian legislation.

Table 12: Type and prevalence of nutrient content claims made on the labels of CPCF sent to the laboratory for analysis and their compliance with the Codex Guidelines for the use of Nutrition and Health Claims (CAC/GL 23-1997) for foods for the general population.

Nutrient content claim	**Number (% of products) making the claim (n=11)**	**Number (% of total claims made) making the claim (n=35)**	**Claim wording in accordance with Codex permitted wording* Yes / No**
Fatty acid content claims			
Omega 3	2 (18%)	2 (6%)	No
Omega 6	2 (18%)	2 (6%)	No
Contains DHA	1 (9%)	1 (3%)	No
X mg DHA per serving	1 (9%)	1 (3%)	No
Per serving contains AA (X mg) and DHA (X mg)	1 (9%)	1 (3%)	No
Mineral content claims			
Iron+	2 (18%)	2 (6%)	No
High iron	1 (9%)	1 (3%)	Yes
Zinc+	2 (18%)	2 (6%)	No
Vitamin content claims			
High calcium	2 (18%)	2 (6%)	Yes
Product fortified with calcium	1 (9%)	1 (3%)	No
Vitamin A	4 (36%)	4 (11%)	No
Vitamin C	2 (18%)	2 (6%)	No
High vitamin C	1 (9%)	1 (3%)	Yes
High vitamin D	1 (9%)	1 (3%)	Yes
Vitamin E	1 (9%)	1 (3%)	No
Vitamin B_{12} as %DV	1 (9%)	1 (3%)	No
Antioxidant vitamins C and E as %DV	1 (9%)	1 (3%)	No

Vitamin and mineral content claims			
X vitamins and/or X minerals	7 (64%)	7 (20%)	No
X essential vitamins and/or minerals	1 (9%)	1 (3%)	No
Other content claims			
X mg choline per serving	1 (9%)	1 (3%)	No
Product fortified with fibre	1 (9%)	1 (3%)	No

* Codex does not permit claims on foods for infants and young children, but this study assessed whether the wording used for nutrient content claims found on these products followed the Codex standard for such claims on products for the general population.

In the absence of relevant Codex standards providing guidance on nutrient content claims for foods used during the complementary feeding period, the research considered a hypothetical case. The 4 nutrient content claims worded according to the Codex guidelines were assessed (using the laboratory analysis results) against the existing Codex Guidelines for Nutrient Content Claims. The findings are shown in Table 13.

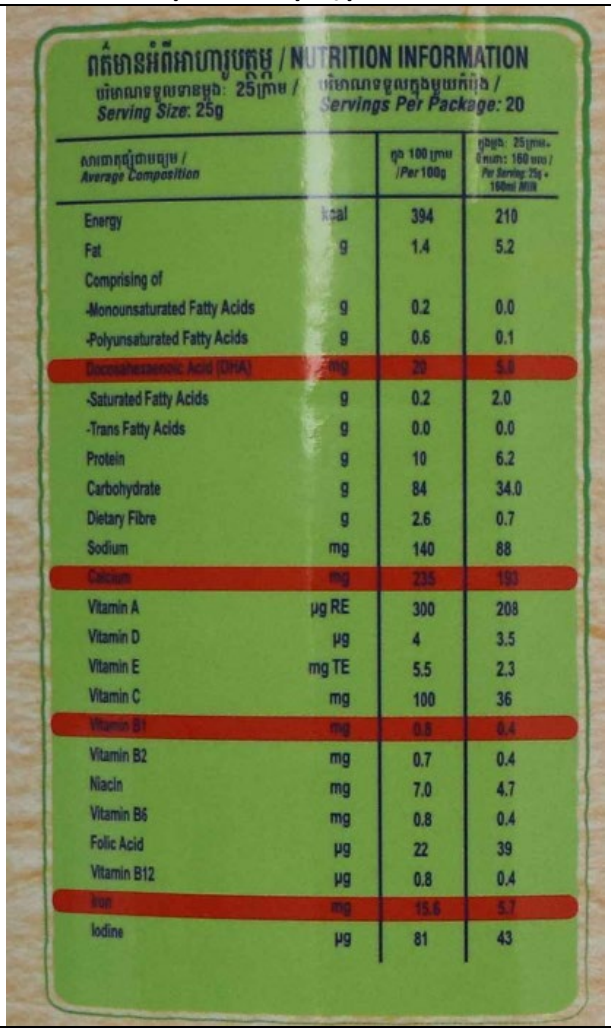
Table 13: Nutrient content claims made on product labels sent to the laboratory for analysis of selected nutrients assessed against the Codex Guidelines for use of Nutrition and Health Claims for the general population (CAC/GL 23-1997). Note: Not specific to older infants and young children.

CODEX GUIDELINES NUTRIENT CONTENT CLAIMS FOR NUTRIENTS ASSESSED BY LABORATORY ANALYSIS	
1 product made the claim 'High in iron'	This claim was substantiated.
2 products made the claim 'High in calcium'	1 of the claims was substantiated.
	1 of the claims did not meet the required level of calcium.
1 product made the claim 'High in Vitamin C'	This claim was substantiated.
1 product made the claim 'High in vitamin D'	This claim was substantiated.

Further qualitative analysis was undertaken in comparing the nutrient content claims made on the labels of all the products sent to the laboratory for analysis with the ingredients list information and the nutrition information provided. The findings reveal a number of discrepancies that could be misleading or question the accuracy of the nutrient claims made, these include:

1. The number of vitamins and/or minerals in the nutrient content claim do not match the number declared in the ingredients list. For example, the claim states '10 vitamins and 5 minerals' while a count of the vitamins and minerals named in the ingredients list is 12 vitamins and 4 minerals.
2. Specific nutrients for which a content claim is made are not named in the ingredients list. For example, the claim states 'Zinc+' but zinc is not named in the ingredients list while other minerals are.
3. The vitamins/minerals named in the content claim and those included in the nutrition information provided do not match. For example, the claim states '13 vitamins and minerals' yet the nutritional information is provided for 14 vitamins and minerals.
4. In some cases, nutrients not generally considered as vitamins (e.g., biotin, choline, inositol) have to be counted when referring to the ingredients list, in order to reach the number claimed.
5. The nutrition information highlights certain vitamins and minerals that are not mentioned in the nutrient content claims being made. For example, Figure 2 shows a product that makes nutrient content claims through images and words for iron, vitamin A, vitamin C and zinc, yet in the nutrition information table highlights DHA, calcium, vitamin B_6 and iron.

Figure 2: Discrepancy between nutrient content claims made on a product label and the nutrients highlighted in the nutrition information.

Nutrient content claims made for iron+ / Vitamin A + C	**Nutritional information declaration highlights the nutrient DHA / Calcium / B_6 / Iron**
	

8. DISCUSSION AND RECOMMENDATIONS

8.1 Main Findings

The aim of this study was to assess, and for a sub-sample of products also validate, the composition, nutrient content, nutrient content claims and related labelling practices as declared on the label of CPCF sold in Khsach Kandal District, Cambodia, against global guidance and standards and relevant aspects of national legislation.

None of the 68 products assessed using the global checklist complied with all relevant Codex standards/guidelines and WHO guidance.

There are no Cambodian regulations governing the composition and nutrient content of CPCF, while there are regulations/standards providing limited labelling requirements for CPCF, and for pre-packaged foods in general (see Appendix 2). The national checklist enabled an assessment of CPCF against these relevant national regulations.

None of the products complied with all relevant national requirements for labelling, indicating that CPCF manufacturers wishing to continue marketing their products in Cambodia will need to improve their labelling practices to meet the standards set by existing regulations. The Cambodian Government should monitor and strictly enforce existing regulations to ensure compliance and should also pass legislation that comprehensively regulates the composition and nutrient content, as well as the labelling of CPCF that is in line with global standards and guidance.

The CPCF assessed in this study failed to comply with all relevant national requirements and global guidance and therefore fall short of the WHO guidance prerequisites for appropriate product promotion. These products thus fail to sufficiently protect, promote and support optimal older infant and young child feeding/nutrition in Cambodia.

8.2 Labelling practices

8.2.1 Age related recommendations & statements

Six percent of CPCF labels included in this study failed to provide an appropriate age recommendation (with 1 product neglecting to provide any age recommendation and 3 products recommending an age of introduction less than 6 months of age), compared to 16% of the CPCF labels assessed in a recent Indonesian study (Helen Keller, 2021), 35% in a South African study (Sweet et al., 2013), and 13.6%–38.6% in a four-country study – Cambodia, Nepal, Senegal and Tanzania (Sweet et al., 2016). Providing an appropriate recommended age of introduction, in line with global and national standards, of 6 months or above on CPCF labels is one of the keyways manufacturers can help caregivers select products that are appropriate for their child's age. It is also essential for protecting optimal breastfeeding practices by reducing the risk of early introduction of complementary foods. CPCF purchased in 2020 for this study in the Khsach Kandal District fared much better against age recommendation requirements than CPCF purchased in Phnom Penh, Cambodia in 2013, where 30% of products provided no age recommendation and 9% of products provided an age recommendation below 6 months. As a peri-urban area, the products in Khsach Kandal likely do not represent all products available in Cambodia. Assessment of additional CPCF available in other urban localities, particularly Phnom Penh, would be beneficial to understand the total Cambodia CPCF landscape, and to confirm whether age recommendations provided on CPCF labels have improved over the last 8 years, as the results from this study may imply.

The CPCF labels performed poorly against the Cambodian Sub-decree on Marketing of Products for Infant and Young Child Feeding (Regulation 133 A Nor Kra Bor, 18 November 2005, referred to hereafter as Sub-decree 133) requirement that they provide a warning regarding the health hazards of introducing CPCF before six months of age[31]. Only 7% of products provide the complete warning in one of the study languages[32].

[31] The Sub-decree on Marketing of Products for Infant and Young Child Feeding (Regulation 133 A Nor Kra Bor, 18 November 2005) does not specifically require this label message to be provided in Khmer.
[32] Study languages included English and Khmer.

Similarly, only 12% of labels provided the required statement that the product shall only be used on the advice of a health worker[33], and only 10% of labels provided a complete statement regarding the superiority of exclusive breastfeeding for the first 6 months and sustained breastfeeding until the child reaches the age of 2 years old or beyond[34].

While the Cambodian Ministry of Health (MOH) is commended for developing guidelines to improve the implementation, monitoring and enforcement of Sub-decree 133 (Ministry of Health, 2015), a sample standard label, applying the requirements of Article 9 of Sub-decree 133, is supplied for infant formula/follow-on formula only.

Specific recommendations:

- It is recommended that the MOH and other stakeholder ministries update this document to include a sample standard label for CPCF that is in line with global standards and guidance, and to ensure that all CPCF labels conform to this standard before they are marketed in Cambodia.

8.2.2 Serving size & daily ration

While only 10% of CPCF labels failed to provide a serving size in one of the study languages[35], the majority (88%) failed to provide a proposed daily ration (or a recommended number of servings per day) in addition to a serving size, as recommended by global guidance. This finding is consistent with the results of other studies that showed that the majority of CPCF assessed in Indonesia, South Africa, Cambodia, Nepal, Senegal and Tanzania did not provide sufficient information to calculate a daily ration, leaving the consumer to decide on the appropriate use of the product (Helen Keller, 2021, Sweet et al., 2013; Sweet et al., 2016). Failure to provide a serving size and daily ration (or recommended number of servings per day) on the label of CPCF increases the risk of their inappropriate use (under/overconsumption).

The majority of fortified products did not comply with the 10-50g serving size (of the product when prepared according to the instructions) recommended by the Codex Guidelines on Formulated Complementary Foods for Older Infants and Young Children (Codex Alimentarius, 1991). Most fortified cereal-based snack foods had a serving size below 10g, while all cereal-based infant cereals/porridges (for which sufficient information was provided to calculate prepared serving size) and yoghurts had prepared serving sizes exceeding 50g, ranging from 200 – 500% of the maximum serving size threshold. Of the products that provided an appropriate serving size, all were cereal-based snack foods in a ready-to-eat form. Similar results were found in an Indonesian study where many fortified cereal-based snack foods had a serving size below 10g, while cereal-based infant cereals/porridges/meals, instant puddings, RTE infant foods and rusks/cereal puffs requiring the addition of milk/water had prepared serving sizes exceeding 50g, ranging from 122 – 582% of the maximum serving size threshold. Of the products that provided an appropriate serving size, all were described as biscuits or rusks in the ready-to-eat form (Helen Keller, 2021).

[33] The Sub-decree on Marketing of Products for Infant and Young Child Feeding (Regulation 133 A Nor Kra Bor, 18 November 2005) does not specifically require this label message to be provided in Khmer.
[34] The Sub-decree on Marketing of Products for Infant and Young Child Feeding (Regulation 133 A Nor Kra Bor, 18 November 2005) does not specifically require this label message to be provided in Khmer.
[35] Study languages included English and Khmer.

It would appear that that there are different interpretations of the Codex text related to serving size, specifically whether it refers to the dry weight or the reconstituted/ready-to-eat weight of the product. It is recommended that Codex provide formal clarification on this issue. As such, no clear conclusions or recommendations can be made related to fortified CPCF's compliance with the Codex serving size recommendation.

Specific recommendations:

- Cambodian regulations should be updated to specifically require that CPCF labels provide an appropriate serving size, daily ration and recommended number of servings a day, in line with global guidance and standards.

8.2.3 Compulsory Messages

Of the labelling requirements of Sub-decree 133 pertaining to appropriate preparation and use, none of the products provided the required warning against inappropriate use of the product, and 69% and 57% of products did not provide (in Khmer or at all) instructions for appropriate use and instructions for appropriate preparation, respectively.

Failure to provide clear instructions on the safe and appropriate use of CPCF can undermine the nutritional status of the child by increasing the risk of inappropriate use of the product. Attention to hygienic practices during food preparation and feeding is critical for prevention of gastrointestinal illness, while appropriate food consistency, as well as meal frequency and energy density, are important for meeting the older infant and young child's energy and nutrient requirements without displacing breastmilk (PAHO & WHO, 2003). While clear definitions for preparation and use instructions were developed for the purposes of this study, Cambodian regulations do not provide such definitions, nor do they state what constitutes 'appropriate' preparation and use of CPCF.

Specific recommendations:

- Clarity as to what information is required on CPCF product labels, giving due consideration to the different categories of CPCF, would remove ambiguity for manufacturers and provide measurable standards needed for monitoring and enforcement of national regulations.

Recommendations related to CPCF labelling practices:

Policy/Regulatory environment:

1. Update CPCF labelling regulations/guidelines to be in line with global standards and guidance, including age related recommendations and statements; the provision of clear feeding instructions (specifically including appropriate serving size, daily ration and recommended number of servings a day); and compulsory warnings and instructions regarding preparation and use.
2. Update guidelines to improve the implementation, monitoring and enforcement of Sub-decree 133 (Ministry of Health, 2015) by including a sample standard label for CPCF that is in line with global standards and guidance, and to ensure that all CPCF labels conform to this standard before they are marketed in Cambodia.
3. Monitor and enforce current labelling regulations and standards to ensure that CPCF provide required labelling information in Khmer.

CPCF Manufacturers:

1. Ensure that CPCF comply with existing Cambodian CPCF labelling regulations (Sub-decree 133, 2005, Article 9) and global guidance and standards.
2. Ensure that CPCF comply with the Cambodian standard for Labelling of Pre-packaged Food (CS 001:2000, section 4.3 and 8.2) as well as the Law on the Management of Quality and Safety of Products and Services (No. 126 CL, 26 June 2000, chapter 2, article 3), which require all pre-packaged foods to provide an ingredient list, declaration of nutrition information and instructions for appropriate preparation and use in Khmer.

Recommendations for future research:

1. As this study only assesses CPCF purchased in a peri-urban area of Khsach Kandal District, assessment of the labelling practices of additional CPCF available in other urban localities, particularly Phnom Penh, would be beneficial to understand the larger Cambodia CPCF landscape.

8.3 Composition

8.3.1 Fortification with vitamins and minerals

Nearly three-quarters (72%) of CPCF in this study were fortified with one or more vitamins and/or minerals, however less than half of the CPCF named vitamins and minerals of interest to this study in their ingredients list (iron - 41%; calcium - 34%; vitamin C - 28%; and zinc - 15%). These findings are generally lower than CPCF assessed in another Southeast Asian LMIC, Indonesia (iron - 58%; calcium - 50%; zinc - 28%; and vitamin C - 18%) (Helen Keller, 2021), and for iron higher than commercially produced complementary cereals assessed in Germany (iron - 26%; and zinc - 14%) (Therurich et al., 2020).

Fortified CPCF, together with continued breastfeeding and culturally appropriate local family foods, can play an important role in filling the nutrient gaps in the diets of older infants and young children (WHO 2003, PAHO & WHO 2003).

As is required for all CPCF, fortified CPCF should also meet all relevant global, regional and national standards for nutrient levels and composition, safety and quality (WHO, 2003; WHO, 2017a).

In a country such as Cambodia, where the majority of 6–24-month-olds do not receive the minimum acceptable diet due to poor dietary diversity (Som et al., 2018; NIS, 2015), strategies to improve the quality of the complementary diet, including mandatory fortification of suitable CPCF with key nutrients, should be implemented. Micronutrients, particularly iron and zinc, are essential for optimal physical, neurological, cognitive, and immune system growth and development during the first years of life (Finn et al., 2017).

Close to half (49%) of the fortified CPCF in this study were cereal-based cereals/porridges/meals, with all products in this category being fortified. These findings are similar to a study in Indonesia (Helen Keller, 2021) where all cereal-based cereals/porridges/meals were fortified with vitamins and/or minerals and represented 61% of all fortified CPCF in the study. High levels of fortification of processed cereal-based CPCF were similarly found in 80% and 88% of products purchased in the capital cities of five African and five Asian countries, respectively (Gibbs et al., 2011).

For fortification to be effective, manufacturers must use fortificants that are well absorbed without affecting the sensory properties of foods (WHO & FAO 2006). In this study, close to a third of products fortified with iron and calcium (29% and 35% respectively) did not specify in the ingredient list the form of fortificant used, making it impossible to rule out the use of poorly bioavailable fortificants, while all products fortified with zinc provided the form used. Studies of many CPCF sold in Asia, Africa and Europe (Gibbs et al., 2011; Roos et al., 2013) found that most CPCF did not specify the form of the fortificant, particularly iron, zinc and calcium. A study on iron content in CPCF in Bandung City, Indonesia, found that these foods are often reported to be iron fortified but with less than recommended amounts or suboptimal forms of iron (Dreyfuss et al., 2019).

As was found by Theurich et al., (2020), those products that did provide the form of the fortificant in the ingredient list were generally found to use appropriate forms of iron and zinc (and in our study, also calcium) as recommended in the WHO/FAO Guidelines on Food Fortification with Micronutrients (WHO & FAO 2006). In the interests of transparency, CPCF fortified with iron, calcium or zinc should be required to provide the form of fortificant used in the label's ingredient list.

Specific recommendations:

- While voluntary fortification with vitamins/minerals is common practice in CPCF sold in Cambodia, regulations requiring the mandatory fortification of CPCF with micronutrients of public health importance for Cambodian infants and young children, including the use and declaration of globally recommended forms and levels of fortificants, are necessary to ensure that CPCF successfully contribute towards filling existing micronutrient gaps.

8.3.2 Emulsifiers

This research confirms the findings of studies conducted in Brazil (Teixeira, 2018) and Indonesia (Helen Keller, 2021) that food additives, including emulsifiers such as lecithin, are commonly added to foods for older infants and young children.

Emulsifiers are food additives that form or maintain a uniform emulsion of two or more phases of food (Codex Alimentarius, 1989). Their use in food production is widespread, providing uniform consistency, a pleasant mouth feel, and improved taste and aesthetics (Cox et al., 2020).

Recent studies have however raised concerns regarding the possible role of permitted emulsifiers in the increased societal incidence of inflammatory bowel disease, metabolic syndrome and other chronic inflammatory diseases (Roberts et al., 2013; Chassaing et al., 2015; Chassaing et al., 2017). Proposed mechanisms by which emulsifiers may contribute to gut and metabolic disease development include alterations to the gut microbiota, intestinal mucus layer, increased bacterial translocation and associated inflammatory response (Partridge et al., 2019). However, the available evidence is limited to mostly animal and in-vivo studies involving a small number of emulsifiers, while little is known about the health effects of chronic exposure to other common emulsifiers. Additionally, there is little information on the occurrence and concentration of emulsifiers in processed foods, making it difficult to estimate exposure (Cox et al., 2020).

Of the three emulsifiers (carrageenan, polysorbate 80, and carboxymethylcellulose) that have been investigated for adverse effects on metabolic syndrome and gastrointestinal disease at doses feasible for chronic daily exposure (Bhattacharyya et al., 2017; Chassaing et al., 2015; Chassaing et al., 2017), none were present in the ingredients list of CPCF in this study.

Whilst regulatory bodies may define limits as to the amounts of additives that can be added to food products, food labels are not required to provide information on the amount of additive in the product, making it difficult to estimate actual dietary intake of emulsifiers (Halmos et al., 2019).

Concerns have also been raised regarding inadequacy of the regulation and oversight of many food additives; the paucity of data on the health effects of food additives on older infants and young children considering that this age group is particularly vulnerable to the effects of these compounds, and in some cases the disproportionate exposure to additives among low-income populations (Trasande et al., 2018).

Specific recommendation:

- Our results show that emulsifiers are commonly added to CPCF, and therefore support the call for studies into the safety of emulsifiers permitted for foods in general, and particularly for foods for older infants and young children. Such research requires information on the concentration of emulsifiers in commercially produced foods, and thus transparency and co-operation on the part of manufacturers.
- It is recommended that the Cambodian government pass legislation regulating the composition of CPCF, including permitted additives and their concentrations, that is in line with global standards and guidance.

8.3.3 Flavourings

More than half (56%) of the products in this study contained added flavourings, and sweet flavourings were found to be far more common than savoury flavourings. These findings are similar to an Indonesian study (Helen Keller, 2021) where 44% of CPCF contained added flavourings (predominantly sweet). Global standards/guidelines permit the use of natural fruit extracts for processed cereal-based complementary food and formulated complementary foods, while vanilla extract, ethyl vanillin and vanillin are permitted for use in canned baby food, processed cereal-based complementary food and formulated complementary foods (Codex Alimentarius, 1981a; Codex Alimentarius, 1981b; Codex Alimentarius, 1991). There is no Cambodian legislation regulating the composition of CPCF, including permitted flavourings. Artificial and nature identical flavourings, as well as vegetable flavourings, dairy flavourings, and other added flavourings were named in the ingredient list of products in this study, despite not being provided for in global guidance.

Food preferences are formed in early life and track into childhood and beyond, making the complementary feeding period an important window for exposure to nutritious foods and flavour variety/preferences.

Early exposure to certain tastes can potentially result in children choosing healthier diets as they grow and therefore contribute to the prevention of non-communicable diseases, including obesity later in life (De Cosmi et al., 2017). A study following European children from age 1 to 8 years showed that dietary patterns are established between 1 and 2 years of age and track into mid-childhood, with a dietary pattern characterized by added sugars, unhealthy fats, and poor consumption of fish and olive oil being the most stable throughout childhood (Luque et al., 2018). A systematic review by Ambrosini (2014) concluded that dietary patterns that are high in energy-dense, high-fat, and low-fibre foods predispose young people to later overweight and obesity.

Children have an innate preference for sweet, umami, and salty foods, while bitter and sour foods, such as some vegetables, are innately rejected (Beauchamp & Mennella, 2009). These preferences are at odds with an environment overloaded with sweet-tasting, unhealthy foods that place them at risk of excessive weight gain but can be overcome by modulating early flavour experiences during gestation, breastfeeding, and the complementary feeding period (Forestell, 2017).

A review of experimental studies found that repeated exposure (between 6 and 15 times) to new or disliked foods that occurs in a positive, supportive environment can promote the acceptance of and eventually a preference for those foods (Ventura & Worobey, 2013).

For example, one study demonstrated that early exposure to a rotation of vegetable flavours first added to milk and then to cereal increased the intake and liking of these vegetables (Hetherington et al., 2015). Such experiences set the stage for later food choices and are important in establishing life-long food habits (Beauchamp, 2009).

There is a need for educational interventions in the complementary stage that focus on the introduction of core foods such as vegetables and fruits as well as the avoidance of discretionary, low-quality foods at early ages (Luque et al., 2018).

In the light of the global research, the findings of this study and a similar study conducted in Indonesia (Helen Keller, 2021) lead to asking whether it is appropriate that the majority (82% and 80% respectively) of CPCF with added flavourings made use of sweet flavourings, therefore targeting the innate preferences of older infants and young children, regardless of whether such flavourings are permitted by global standards/guidance for use in CPCF.

It is of concern that exposures to flavourings such as vanilla, caramel and chocolate during the complementary feeding period could predispose older infants and young children to preferring such flavours throughout life - flavours that are typically used in poor nutritional quality foods such as desserts, sweet snacks, and sugary cereals (Helen Keller, 2021).

While CPCF with sweet flavourings almost always contained free sugar, 71% of the CPCF with savoury flavourings also contained free sugars, compared to 77% in an Indonesian study (Helen Keller, 2021). Products that appear to be offering the opportunity to expose older infants and young children to vegetable or other savoury flavours in most cases also contain added sugar for sweetness, thus potentially misleading the consumer as to their true taste. This is especially concerning considering that CPCF manufacturers commonly feature messages on CPCF labels promoting the products' appeal to older infants or young children, including 'taste messages', such as "unique veggie and fruit combination to delight tiny taste buds" (Harris et al., 2016). Additionally, by familiarising children with sweetened versions of foods that are not inherently sweet, such as yoghurt or cereal, they develop an expectation that such foods should taste sweet (Sullivan & Birch, 1990). Offering complementary foods without added sugars and salt is important not only for short-term health but also to set the older infant and young child's threshold for sweet and salty tastes at lower levels later in life (Agostini et al., 2008) and to avoid later enhanced acceptance of such tastes (Forestell, 2017).

Specific recommendations:

- Further research is recommended to determine the impact of exposure of older infants and young children to predominantly sweet flavourings in CPCF on food choices/preferences in later childhood and adulthood.
- Manufacturers should avoid misleading the consumer as to the true taste (e.g., sweet or savoury) of CPCF.

8.3.4 Salt / Sodium

According to WHO guidance, salt should not be added to foods for infants and young children (WHO, 2016), yet over a third (35%) of CPCF in our study contained added salt, these were all cereal-based infant snacks. A study conducted in Indonesia similarly found that of the 23% of CPCF with added salt; the majority (80%) were cereal-based infant snacks (Helen Keller, 2021).

Diets high in sodium are associated with non-communicable diseases such as hypertension, renal diseases and cardiovascular diseases in childhood as well as adulthood (Yang et al., 2012; Lawlor & Smith, 2005). For this reason, WHA Resolution 66.10 set the global target for the general population to reduce salt intake by 30% by 2025 (WHA, 2013).

In adult foods, salt is often added to improve the taste of the food, however, as with the development of sweet-taste preference, increased exposure to salty foods during infancy can lead to an increased acceptance and preference for salt rich foods and thus also to unhealthy food choices during childhood and adulthood (Liem, 2017).

Global guidelines not only recommend against the addition of salt to CPCF in general and to fruit and dessert-based canned baby foods specifically, but for some Codex CPCF categories (canned baby foods and processed cereal-based CPCF) they also set maximum sodium levels (Codex Alimentarius, 1981a; Codex Alimentarius, 1981b). For both categories of processed cereal-based cereals/porridges (that require reconstitution with milk or with water), all products met the recommended sodium limit, while for processed cereal-based biscuits and rusks, 9% had a sodium content that exceeded the recommended maximum limit.

Specific recommendations:

- Global guidance that salt should not be added to CPCF is not being applied to cereal-based infant snacks, an especially problematic CPCF category.
- National regulations prohibiting the addition of salt to all CPCF are needed to enforce global guidance.

8.3.5 Sugar

Despite WHA resolution 69.9 guidance that free sugars should not be added to CPCF, nearly all (90%) products in this study listed free sugars in their ingredient list, ranging between 1 and 3 sugars per product. This is higher than the 70% of CPCF sold in the United States of America found to contain at least 1 added sugar (Maalouf et al., 2017), and the 74% of CPCF sold in Bandung, Indonesia that contained between 1 and 4 free sugars (Helen Keller, 2021).

High-sugar food for general consumption is associated with low-nutrient, energy-dense products that contribute to the development of non-communicable diseases such as diabetes, hypertension, overweight and obesity (Morenga et al., 2013). It is recommended that high-sugar foods be avoided from an early age as they are known to alter the gut microbiome and contribute to underlying inflammation in non-communicable diseases (Satokari, 2020), dental caries (Ruottinen et al., 2004) and can lead to sweet-taste preferences later in life (De Cosmi et al., 2016). The number of overweight children under five has increased from 3% to 7% in Southeast Asia between 2000 and 2013 (WHO, 2014). A German study showed that older infants who consumed a larger proportion of CPCF as part of their diet had a higher total sugar intake than older infants who consumed less CPCF and may be predisposed to higher added sugar intake later in childhood (Foterek et al., 2016).

A study by Harris et al. (2016) in the United States of America showed that half of snacks for older infants and the majority (83%) of snacks for young children, such as cookies, cereal bars, puffs and fruit snacks, contained added sweeteners, while this study found that nearly all (95%) of cereal-based infant snacks contained at least one free sugar. All yoghurts in the current study (n=7) declared free sugar ingredients. Dairy products such as yoghurts are often recommended as snacks for older infants and children due to their beneficial nutritional content, particularly protein and calcium, and their positive effect on growth and bone development (Rizzoli, 2014).

However, the added- and high-sugar content of yoghurts affects their overall healthfulness, making them unsuitable to be marketed for infants and young children.

The most common free sugars were cane sugar/ sucrose/ brown sugar (92%), followed by fruit concentrate/ fruit juice concentrate (11%) and fruit puree (8%). These findings are nearly identical to the findings of a study conducted in Indonesia, where 93% of products contained cane sugar/ sucrose/ brown sugar, 8% contained fruit concentrate/fruit juice concentrate, and 7% fruit puree (Helen Keller, 2021). Maalouf et al. (2017) similarly found in the United States of America that the top three sources of added sugar included fruit juice concentrate, sugar and cane.

A study on complementary foods by Garcia et al. (2016) suggests that total sugar is often higher in products with added fruit and vegetables and that these fruit and vegetables and their derivatives (including juice and dried forms) are likely added as sweetening agents.

An Australian study by Devenish et al. (2019) found that the largest single contributing source of free sugar to the young child's diet was CPCF (26.6%). Despite home-made, nutritious complementary foods being strongly recommended (WHO, 2003), the global market for convenience CPCF is growing (Euromonitor 2016). It is therefore essential that the Cambodian government implements the global standards/guidance on free sugars.

Global and national efforts to decrease sugar intake in adults are being made to address increasing rates of overweight, obesity and non-communicable diseases. However, greater attention must be given to the critical complementary feeding stage, during which lifelong taste preferences are being formed and bodily development is largely still taking place.

Currently there are no Cambodian regulations governing the composition of CPCF and thus no limitations placed on the addition free sugar to these products. This study reveals that in the absence of such regulations, CPCF manufacturers do not abide by global guidance/standards.

Specific recommendations:

- National regulations prohibiting the addition of free sugars to all CPCF are needed to enforce global guidance.

Recommendations related to CPCF composition:

Policy/Regulatory environment:

1. Develop national regulations/standards for CPCF composition in line with latest global guidelines and standards, including:
   a) Permitted additives and their concentrations
   b) Prohibiting the addition of salt and sugar.
2. Legislate the mandatory fortification of CPCF sold in Cambodia with micronutrients of public health importance at recommended levels and in recommended forms, in line with global guidance and standards.
3. Once established, ensure that regulations/standards are monitored and enforced.

CPCF Manufacturers:

1. When fortifying CPCF with vitamins/minerals:
   a) Ensure that the level and form of fortificant used is in line with global guidance and standards and with nutrient gaps identified in the target age group;
   b) Declare the form of the fortificant used in the ingredient list**.**
2. Transparency regarding the concentration of emulsifiers in CPCF when called upon by governments/other interested parties.

3. Avoid misleading consumers as to the true taste (e.g., sweet or savoury) of CPCF. 4. Avoid the addition of salt and sugar to CPCF, in line with global guidance.
Recommendations for future research: 1. Further research is recommended regarding: a) The use and safety of emulsifiers in CPCF. b) The impact of exposure of older infants and young children to predominantly sweet flavourings in CPCF on food choices/preferences in later childhood and adulthood.

8.4 Nutrient Content

As there is no national legislation regulating the nutrient content of CPCF, the onus falls on manufacturers to adhere to global standards and guidelines. However, only national legislation can be enforced.

Specific recommendations:

- It is important that the Cambodian government develop national regulations/ standards for the nutrient content of CPCF based on existing global standards and guidelines that can be adapted to address the specific needs of the country's older infants and young children.

8.4.1 Energy

Between 80% and 94% of CPCF in this study did not provide enough information to determine if a daily ration of the product exceeded the recommended energy intake for complementary foods for the breastfed child.

This confirms the findings of studies conducted in South Africa, Senegal, Nepal, Tanzania as well as Cambodia where few CPCF provided sufficient information to calculate the energy contribution of a daily ration of the product (Sweet et al., 2013; Sweet et al., 2016). The study conducted in Cambodia in 2016 found, similar to this study, that the majority of CPCF (between 81% and 89%) provided inadequate label information to determine the energy contribution of a daily ration of the product (Sweet et al., 2016), whereas a recent study conducted in Indonesia found around half of CPCF (between 40% and 56%) provided inadequate information to determine the energy contribution of a daily ration of the product (Helen Keller, 2021). Considering their limited gastric capacity and high energy requirements for growth and development, in addition to continued breastfeeding, older infants and young children must receive complementary foods that are sufficiently energy-dense (Dewey & Brown, 2003). It is however essential that the energy provided by complementary foods does not exceed recommended limits and encroach on the energy that should be provided by breastmilk together with breastmilk's provision of nutrients and immune properties.

CPCF labels should recommend daily rations and serving sizes that provide energy within the daily requirements for breastfed children, as excessive consumption may displace continued breastfeeding as well as other locally available and appropriate foods (WHO, 2017b; Quinn et al., 2010). It is concerning to note that the majority of CPCF labels do not provide sufficient information regarding the appropriate use of the product. Where the required information is provided, it is even more concerning to note the practice of providing daily rations that promote excessive energy intake thus impinging upon continued breastfeeding and dietary diversity and contributing to excessive energy intakes.

This study found that over 80% of processed cereal-based foods and fortified CPCF met or surpassed the Codex recommended minimum energy density for processed cereal-based foods for infants and young children and formulated complementary foods for older infants and young children (Codex Alimentarius, 1981b; Codex Alimentarius, 1991). These findings are similar to those of a labelling study conducted in Indonesia (Helen Keller, 2021), while a similar study undertaken in Rwanda found that most of the processed cereal-based foods for older infants and young children did not comply with Codex energy density recommendations (Grosshaguaer et al., 2020).

Specific recommendations:

- Cambodian regulations should be updated to specifically require that CPCF labels provide an appropriate serving size, daily ration and recommended number of servings a day, that provide energy within the daily requirements for breastfed children in line with global guidance and standards.

8.4.2 Protein

All processed cereal-based cereals/porridges with added high protein and processed cereal-based biscuits/rusks complied with the maximum Codex protein recommendations for their respective categories. Codex does not provide a minimum protein content level and so products cannot be assessed to determine protein sufficiency. Formulated complementary foods are however required by Codex to ensure that the protein content is within a range of 6-15% of total energy (Codex Alimentarius, 1991). In this study, just under two thirds (64%) of fortified complementary foods complied with this requirement. This is similar to the findings in a labelling study carried out in Indonesia where all processed cereal-based cereals/porridges with added high protein and processed cereal-based biscuits/rusks complied with the maximum Codex protein recommendations and 63% of fortified CPCF provided a protein percentage of energy within range (Helen Keller, 2021).

While protein is essential to muscle building and proper bodily function, only between 50% and 86% of infants and young children in Cambodia consume animal source protein (meat, fish and poultry) and few consume legumes, nuts and dairy products (NIS, 2015). Therefore, protein sufficiency in CPCF products may be an important route to ensure adequate protein intakes among older infants and young children.

Specific recommendations:

- All fortified CPCF should provide sufficient amounts of protein in line with global Codex standards and guidelines.

8.4.3 Fat

All cereal-based infant cereals/porridges and biscuits/rusks had a fat content below or equal to the maximum limit set by Codex (Codex Alimentarius, 1981). However, 71% of fortified CPCF did not contain sufficient fat to meet the Codex requirement that fat must account for at least 20% of total energy (Codex Alimentarius, 1991). Few products declared linoleic acid content, making it impossible to assess the content in 90% of fortified CPCF. As there is no minimum fat requirement for all CPCF, and large numbers of products have inadequate label information, it is uncertain whether these products have an adequate fat and linoleic acid content to meet older infant and young child dietary requirements. This is problematic in making an overall assessment of the nutritional adequacy of CPCF.

Appropriate quantities of healthy fats / lipids in the diet can contribute significantly to meeting the high energy requirements of older infants and young children, while also promoting optimal physiological functioning and lipid-soluble vitamin uptake (Dewey & Brown, 2003; Uauy & Castillo, 2003). Good quality, healthy fats such as mono- and polyunsaturated fatty acids in the older infant and young child's diet can support normal neurological, metabolic and immunological development (Uauy & Castillo, 2003). Equally, excess fat, as well as the intake of unhealthy fats during early life, can displace the appropriate intake of other nutrients by increasing early satiety, and promote processes that lead to systemic inflammation and non-communicable diseases (Bauer & Waldrop, 2009).

Specific recommendations:

- All fortified CPCF should provide sufficient fat, in line with global Codex standards and guidelines.

8.4.4 Iron, Zinc & Calcium

Of the micronutrients of interest to this study, CPCF were most commonly fortified with iron (41%), followed by calcium (34%) and zinc (16%). Codex only places zinc, calcium and iron content requirements on fortified CPCF with added iron, calcium and zinc (Codex Alimentarius, 1991), and calcium requirements for biscuits that are manufactured with the addition of milk.

In the current study, none of the rusks/biscuits were manufactured with the addition of milk and therefore were not assessed against the calcium recommendation.

Zinc

Compared to iron and calcium, zinc was the least commonly used fortificant, and products fortified with zinc were least likely to contain sufficient nutritional, serving size and/or daily ration information to undertake the necessary calculations to assess for adequate zinc content. Of the products that could be assessed, none met the minimum zinc requirement for all possible daily rations recommended on the label. Low levels of zinc fortification and inadequate zinc content in CPCF were also found in CPCF studies in West-Africa and Germany (Dimaria et al., 2018; Theurich et al., 2020).

A study undertaken in Africa and Asia also found that cereal-based CPCF do not comply with the micronutrient, including zinc, content recommendations of the WHO (Gibbs et al., 2011). Our finding differs to a similar study conducted in Indonesia where 50% of fortified CPCF met global recommendations for zinc content (Helen Keller, 2021).

In a country where stunting affects a third of children under 5 and 65% of infant and young children experience zinc deficiency (NIS, 2015), ensuring that diets of older infants and young children provide sufficient zinc is crucial.

Specific recommendations:

- It is essential that all CPCF fortified with zinc should meet the global recommendations for zinc content, and their labels should provide adequate information to allow for the assessment against these recommendations.

Calcium

All processed cereal-based cereals/porridges with added high protein food (in this study all contained added milk powder) provided a minimum of 80mg/100kcal as required by Codex (Codex Alimentarius, 1981b). Of the products that were fortified with calcium, 60% of products provided insufficient information to calculate the calcium contributed by a daily ration of the product, and a further 35% failed to provide at least 50% RNI for calcium for all possible daily rations recommended on the label, as recommended by Codex (Codex Alimentarius, 1991).

Dietary calcium plays an essential role in the development of strong bones and teeth during early childhood, particularly the first 12 months, setting up calcium stores and bone density for adulthood and after (Koo & Warren., 2003).

Specific recommendations:

- It is essential that all CPCF fortified with calcium should meet the global recommendations for calcium content, and their labels should provide adequate information to allow for the assessment against these recommendations.

Iron

Three-quarters (75%) of CPCF products fortified with iron that could be assessed provided a minimum of 50% of the iron RNI in the daily ration, as recommended by the Codex Guidelines on Formulated Complementary Foods for Older Infants and Young Children (Codex Alimentarius, 1991). This is less than the 93% rate found in Indonesia (Helen Keller, 2021).

A study conducted in Ghana found that all CPCF provided at least 70% of the RNI provided by the FAO/WHO for iron (Abizari et al., 2017), unlike a German study that found that none of the products studied contained sufficient iron based on their percentage contribution of daily reference value (Theurich et al., 2020).

When assessing CPCF against the higher age group-specific WHO recommendations for the iron content of fortified complementary foods (WHO, 2005), it was found that none of the products for the age category 6-12 months and only 1 product for the 12-24 months age group provided iron within the daily ration recommended range for all possible daily rations.

Our study found that around a third of CPCF provided iron at levels outside of the WHO recommended range per daily ration, with 29% of products for 6–12-months providing too little iron, and 29% of products for 12-24-months providing too much iron.

This may be due to the fact that many products recommend an age range that includes both older infants and young children, without providing age-specific feeding recommendations. Iron fortified products intended for 12-24 months of age that partially complied with the WHO recommendations all provided less than the recommended iron range for at least one of the possible daily rations recommended.

Specific recommendations:

- The product labels of CPCF that are recommended for both older infants and young children should provide serving sizes and recommended number of servings per day/daily rations that are age-specific and will result in appropriate energy, macro- and micronutrient intake.

Recommendations related to CPCF nutrient content:
Policy/Regulatory environment: 1. Develop national regulations/standards for CPCF nutrient content in line with global guidelines and standards and adapted to address the specific needs of Cambodia's older infants and young children.
CPCF Manufacturers: 1. Ensure that CPCF comply with global (Codex Alimentarius and WHO) guidance and standards on nutrient content. 2. Provide adequate label information (nutrient content, serving size, daily ration, recommended number of servings a day) to facilitate assessment of the adequacy of CPCF nutrient content.

8.5 Nutrient content claims

The Codex Guidelines for Use of Nutrition and Health Claims (CAC/GL 23-1997) and WHA Resolution 63.23 (2010) specifically prohibit the use of nutrition claims (that encompass nutrient content claims) on foods for infants and young children, unless specifically provided for in relevant Codex standards or national legislation (Codex Alimentarius, 1997; WHA, 2010). Cambodian legislation does not specifically cover claims. Therefore, the two-thirds of CPCF in this study that were found to carry nutrient content claims can be considered to contravene Codex and WHA 69.9.

As it is globally recognised that national regulations may permit claims dependant on the national context, there may be room for national governments to allow specific nutrient content claims (e.g., nutrient content claims related to micronutrients of public health concern such as 'source of iron') if the product is appropriate for promotion for IYC, as defined in WHA resolution 69.9.

It has been shown that the majority of claims on food labels in stores in the United States are classified as nutrient content claims and research has shown that such claims are likely to attract caregivers to the product (Harris et al., 2011). A study in Ghana found that 29.7% of mothers stated that commercial infant cereals helped growth and development and 9.4% believed that they provide sufficient nutrients for older infants and young children. Although the research does not specifically identify how these beliefs originated, they refer to 'strong media marketing' (Abizari et al., 2017). These findings highlight that nutrition claims are noticed by and considered important to mothers. Thus, nutrient content claims on food labels can potentially function as both a public health tool and a promotional tool.

When considering the possible public health value of specific nutrient content claims, it should be noted that the WHO guidance under recommendation 3 makes two clear recommendations.

The first is that "*Foods for infants and young children that are not products that function as breast-milk substitutes should be promoted only if they meet all the relevant national, regional and global standards for composition, safety, quality and nutrient levels and are in line with national dietary guidelines*" and the second states that *"… Nutrient profile models should be developed and utilized to guide decisions on which foods are inappropriate for promotion*" (WHA, 2016). It is clear that only nutrient content claims on CPCF that are in line with national dietary guidelines and/or perform well against a relevant nutrient profiling model should be permitted for use on CPCF. This is important to curb the use of nutrient content claims that do not support country level nutrition priorities or that create a healthy 'halo effect' for products that are high in 'unhealthy' nutrients.

Specific recommendations:

- The Cambodian government should evaluate the potential appropriateness and value of permitting appropriate CPCF to carry specific nutrient content claims for micronutrients of public health concern in line with national dietary guidance and regulate accordingly. Equally, prohibited nutrition and health claims should be specified in national regulations.

8.6 Label declaration versus laboratory analysis

The WHO and UNICEF Strategy for infant and young child feeding states that after 6 months of exclusive breastfeeding, *"… low-cost complementary foods, prepared with locally available ingredients using suitable small-scale production technologies in community settings, can help to meet the nutritional needs of older infants and young children*" (WHO, 2003). This means that there is global recognition of a role for CPCF in the diets of older infants and young children in assisting them to meet their nutritional requirements, providing that they are safe and nutritionally adequate.

According to the website of market research company Allied Market Research, the global baby food market was valued at $67.3 billion in 2019 and the Asia-Pacific region (which includes Cambodia) held the highest market share of 40% and is expected to reach $96.3 billion by 2027 growing at a CAGR of 6.0% from 2021 to 2027 (Allied Market Research, 2020). Another market research company, Prescient & Strategic Intelligence notes on its website that the "*6-12 months category held the largest market share in terms of revenue.*" (Prescient & Strategic Intelligence, 2021). No specific sales and value figures could be found for Cambodia without purchasing the baby food market reports of any of the market research companies.

The accuracy of the information provided on the labels of food products for older infants and young children is important to provide caregivers with information that can influence their selection of CPCF and that will ultimately affect the nutritional status of this vulnerable group. As there is increasing availability, marketing, and use of CPCF, it is critical that the information provided on the label of CPCF is accurate and correctly reflects its composition.

8.6.1 General composition: Label declaration versus laboratory analysis

The study findings show that very few of the declared nutrient content levels on the labels of the products, in the sub-sample sent to the laboratory, matched the amount found on analysis for those nutrients that were assessed (energy, total fat, saturated fat, trans fat, carbohydrate, protein, sugar, sodium, calcium, iron and zinc).

According to global guidance, CPCF should not contain trans-fatty acids, as consumption of trans-fatty acids has been linked to systemic inflammation, health diseases and diabetes mellitus among other conditions (Bauer & Waldrop, 2009). It is concerning to find that of the 5 products that declared trans-fat on the label, 4 contained significantly more than that declared (143% - 700%).

Sodium and sugar are other nutrients of concern which global guidance recommends be limited in the diets of older infants and young children. Five products contained more sodium than was declared and two of those had laboratory values 79000% and 25100% of that provided on the label. With regards to sugar, a significant number (55%) did not provide sugar information, and for the products that did, 60% contained more sugar than was declared on the label.

Protein also showed large discrepancies, ranging from 130% to 23900% of the declared values.

Such inaccuracies can be misleading especially when they make products appear healthier than they are. Regulation is required to both limit 'unhealthy' nutrients and provide tolerance levels for label declaration deviations.

For the micronutrients assessed, almost all had a higher actual content, per laboratory assessment, than what was declared on the product label. As a positive, this indicates that fortification taking place is sufficient, but it is also potentially concerning as some of the overages were well above 100% (101% - 213%). As micronutrient deficiencies remain common amongst this age group of children, it is critical that more products are fortified with the micronutrients of public health concern. However, it is also important that products are fortified appropriately and that the level of micronutrients in the product correspond with what is declared on the product label.

These findings also highlight the importance of using actual laboratory analyses nutrient values when considering the role played by CPCF in the diets of older infants and young children. A study in Viet Nam by Tuan et al. (2017), that made use of the WHO standardized 24-hour recall questionnaire for infant and young child feeding and specific questions to mothers about the consumption of CPCF, found that when CPCF were included in the diets of older infants and young children, population-level estimates of dietary quality (minimum dietary diversity and minimum meal frequency) were higher than when CPCF were omitted. The study however did not assess the actual nutrient content of the CPCF, only the listed ingredients, and while appearing to improve diets (based on broad indicators), detailed analysis of the CPCF might find that this is not the case. It should be noted that Tuan et al. stated that more detailed research is required to fully understand the role of CPCF in meeting the dietary needs of older infants and young children.

The discrepancies between actual nutrient content and label declaration (both above and below) are not uncommon and have been reported in other CPCF studies (Grosshagauer et al., 2020; Masters et al., 2017). Unless manufacturers are accountable for ensuring accurate labelling and fortification, caregivers and researchers cannot rely on the label information of products when researching, developing guidance or selecting products for appropriateness and healthfulness of CPCF.

Specific recommendations:

- The Cambodian government should consider making fortification of CPCF, with specific micronutrients of public health concern, mandatory and should provide guidance on the amounts to be added and prescribe acceptable tolerance levels for label declaration deviations.
- Manufacturers must ensure that the amounts of nutrients declared on the product label correspond with the amounts assessed on laboratory analysis in order to ensure that CPCF labels can be trusted to provide honest and valuable information.

8.6.2 Nutrient content claims

A detailed analysis of the 11 products sent to the laboratory for assessment revealed that all 11 product labels included between 1 and 8 nutrient content claims. Almost two thirds (64%) made a nutrient content claim related to vitamins and minerals, yet few gave any indication as to the level of micronutrient.

Although Codex does not permit claims on foods for infants and young children, they do permit specific nutrient content claims, that meet set criteria, on foods for the general population. Codex has begun work on developing NRVs for older infants and young children and the value of certain nutrient content claims on products for these children is a current topic of interest in LMIC.

Therefore, as a theoretical exercise, the laboratory assessed products that made nutrient content claims were assessed against the Codex standard for the general population (Codex Alimentarius, 1997). Few used the Codex prescribed wording for permitted nutrient content claims and only 11% of the total 35 nutrient content claims complied with the Codex criteria.

The accuracy of the nutrition information provided on the labels of products becomes even more consequential when nutrient content claims are made, as such claims are specifically used to inform the caregiver of beneficial properties of the specific product, sometimes over other equivalent products. It is thus essential that the claimed and declared nutrient content of products are both matched by the actual composition of the product and meet the requirements for making such claims, so that consumers can make informed choices and are not misled by manufacturers.

In this study, 3 of the 4 nutrient content claims, that were worded according to the existing Codex Guidelines for Nutrient Content Claims and could be assessed, contained sufficient amounts of the micronutrient to substantiate the claim. However, further qualitative analysis of the ingredients list and nutrition information revealed a number of discrepancies that could be misleading and question the accuracy of the nutrient content claims made on the products.

The WHO has recognised that fortification of complementary foods is a possible strategy for addressing iron deficiency in this age group (WHO. 2017a). However, for CPCF to have a role in older infant and young child feeding, it is important that the levels of fortification are optimal, that the label declarations are accurate and that nutrient content claims are truthful and do not mislead the consumer. This is in addition to ensuring the quality of the manufactured food to ensure safety and avoid contamination.

The results of this study indicate, as was concluded by Masters et al. (2017), that the potential for CPCF to meet older infants and young children's nutrient needs cannot be fulfilled until consumers can trust them to have high and uniform content of macronutrients and micronutrients.

This study's results call into question the trustworthiness of the nutrition information provided by a sample of CPCF and highlight that inaccurate nutrition information labelling can result in products appearing healthier than they are.

Recommendations related to nutrient content claims and nutrient content versus label declaration:

Policy/Regulatory environment:

1. Develop national regulations/standards for CPCF in line with latest global guidelines/ standards and national dietary guidance, including:
   a) Mandatory fortification with micronutrients of public health importance at recommended levels and in recommended forms;
   b) Declaration of nutrition information on product labels;
   c) Tolerance levels for label declaration deviations;
   d) Permitted and prohibited nutrition and health claims.
2. Develop dietary guidelines for older infants and young children and develop/ adopt a relevant nutrient profiling model to determine whether CPCF available for sale are appropriate for promotion.
3. Consider the appropriateness of nutrient content claims on CPCF, for micronutrients of public health concern, and regulate accordingly.

CPCF Manufacturers: 1. Ensure that CPCF comply with global guidance and standards on nutrition information label declarations and nutrient content claims. 2. Manufacturers must provide comprehensive label information pertaining to ingredients and nutrition information to avoid potentially misleading consumers.
Civil society: 1. Be aware of the misleading practices and lack of regulatory enforcement related to foods for older infants and young children. Expose manufacturers that do not protect, promote and support optimal older infant and young child health, thereby putting the future of individuals, communities and countries at risk and hold governments accountable for regulatory enforcement.

8.7 Study Limitations

- The study made use of information provided on CPCF product labels and not actual values for the first 2 objectives. This is not always reliable as seen in objective 3.
- The study was limited to the information provided on the CPCF labels and was unable to determine whether the products complied with nutritional content if the label nutrition information was absent.
- The study only included products available for sale in the Khsach Kandal District, Kandal Province so is unlikely to include all CPCF available in Cambodia especially in the more urban Phnom Penh.
- The study only included label information provided in Khmer and English. Information provided in an additional language may have contained components of assessment.

9. CONCLUSION

Optimal infant and young child feeding is in the global and national spotlight. This is because it is recognised that a window of opportunity exists during the first 1000 days of life when appropriate early nutrition interventions can help prevent malnutrition in children and establish positive dietary habits that can carry on into adulthood – impacting individuals and economies.

The WHO states that optimal infant and young child feeding includes exclusive breastfeeding from birth to 6 months, with appropriate complementary feeding and continued breastfeeding thereafter. Appropriate complementary feeding involves providing adequate amounts, frequency, variety, and consistency of foods that meet the growing child's nutritional needs when breastmilk alone is no longer sufficient.

Complementary foods can be home-prepared but are now often also commercially produced. Latest WHO Guidance states that '*Foods for infants and young children that are not products that function as breast-milk substitutes should be promoted only if they meet all the relevant national, regional and global standards for composition, safety, quality and nutrient levels and are in line with national dietary guidelines*.' Commercially produced complementary foods (CPCF) vary widely in quality.

While it is useful to assess the performance of CPCF against the requirements of all relevant global guidance/standards, manufacturers can only be held legally accountable for their practices by national legal measures, such as national regulations/standards.

Only a small number of labelling requirements relevant to CPCF exist in present Cambodian regulations, however there are currently no Cambodian regulations/standards that specifically and comprehensively govern the composition, nutrient content and labelling (including appropriate nutrient content claims) of CPCF as assessed in this study.

It is recommended that the Cambodian government use the national checklist developed for this study to assess whether available CPCF products are compliant with current national regulations and standards and are therefore permitted to be on the market. It is important to note that due to the limited scope of the existing Cambodian CPCF regulations, ensuring that products are compliant will not provide sufficient protection against the negative practices reported in this study. In order to address these practices, it is essential that the Cambodian government urgently develop national CPCF regulations/standards that comprehensively prescribe acceptable composition, nutrient content and labelling practices. As a first step, it is recommended that the Cambodian government review how the national checklist differs from the global checklist used in this study to determine the changes required to bring national regulations and standards in line with global standards and guidance.

Nutrient profiling is the science of classifying or ranking foods according to their nutritional composition for reasons related to preventing disease and promoting health and can be incorporated by governments into policy to improve the overall nutritional quality of diets (WHO, 2015). As recommended by WHO guidance (WHO, 2017b), a nutrient profiling model for foods for older infants and young children should be developed and utilized to guide decisions on which foods are inappropriate for promotion. A comprehensive nutrient profiling model provides a clear output - categorizing a product as appropriate or inappropriate for promotion, based on its composition, and providing national governments with the option to permit only CPCF categorized as appropriate to make relevant and measurable nutrient content claims that potentially assist in addressing micronutrient deficiencies of national concern.

While a nutrient profiling model for CPCF in Cambodia or the Southeast Asia region does not yet exist, WHO Europe has recently drafted a nutrient profiling model to assess the nutritional quality of CPCF marketed in the European region and to assess if labelling practices are in line with WHO recommendations (WHO, 2019). This model could be adapted for use in the Asia region, including the addition of micronutrient content evaluation given deficiencies in the region, and piloted in contexts such as Cambodia.

Strong, unambiguous, and enforced national regulation is required to ensure appropriate composition, nutrient content, labelling and promotion of products specifically targeted at the vulnerable age group of 6-36 months of age. Without such regulations and enforcement to hold manufacturers accountable, progress addressing the high rates of undernutrition and micronutrient deficiencies in Cambodia will be limited.

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11. APPENDICES

Appendix 1:

Global Guidelines and Standards Relevant to the Nutrient Composition and Labelling of Commercially Produced Complementary Foods

Publishing Body	Title
CODEX[1]	Standard for Processed Cereal-based Foods for Infants and Young Children, CODEX STAN 74-1981.
CODEX	Standard for Canned Baby Foods, CODEX STAN 73-1981.
CODEX	Guidelines on Formulated Complementary Foods for Older Infants and Young Children, CAC/GL 8-1991.
CODEX	General Standard for The Labelling of Prepackaged Foods, CODEX STAN 1-1985.
CODEX	Guidelines on Nutrition Labelling, CAC/GL 2-1985.
CODEX	Guidelines for Use of Nutrition and Health Claims, CAC/GL 23-1997.*
CODEX	Advisory Lists of Nutrient Compounds for Use in Foods for Special Dietary Uses Intended for Infants and Children, CAC/GL 10-1979.
WHO[2]/FAO[3]	Vitamins and Mineral Requirements in Human Nutrition. 2nd Edition. (2004)
WHO/FAO	Guidelines on food fortification with micronutrients. (2006)
PAHO[5]/WHO	Guiding Principles for Complementary Feeding of the Breastfed Child. (2005)
WHO	International Code of Marketing of Breast-milk Substitutes (WHO, 1981) and subsequent relevant World Health Assembly (WHA) resolutions **
WHO	Global Strategy for Infant and Young Child Feeding. (2003)
WHO	Guiding Principles for Feeding Non-Breastfed Children 6-24 Months of Age. (2005)
WHO	Guidance on ending the inappropriate promotion of foods for infants and young children. (2016)

[1] Codex Alimentarius; [2] Food and Agriculture Organization of the United Nations; [3] World Health Organization; [4] Institute of Medicine; [5]Pan-American Health Organization;

*This guideline was used to determine that claims should be dealt with in the CPCF National Checklist.

** The principles of the Code and subsequent relevant WHA resolutions as applied to CPCF by 'Using the Code of Marketing of Breast-milk Substitutes to Guide the Marketing of Complementary Foods to Protect Optimal Infant Feeding Practices.' (Quinn et al., 2010).

Appendix 2:

National Instruments Regulating the Nutrient Composition and Labelling of Commercially Produced Complementary Foods (Cambodia)

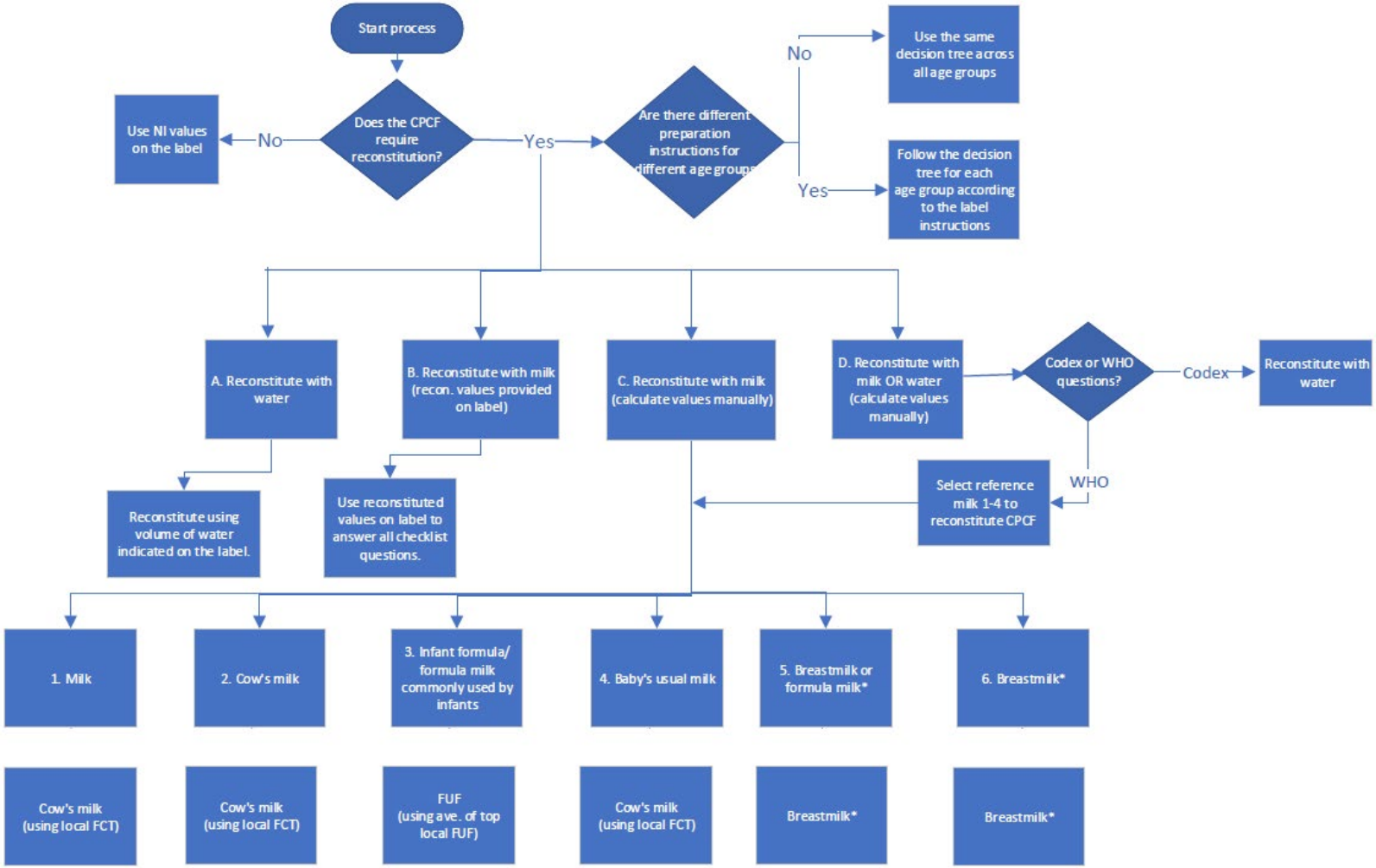
Regulation of the:	Regulation No.	Title of Regulation
Ministry of Health	No 061, August 2007	Joint Prakas on Implementation of Sub-Decree on Marketing of Products for Infant and Young Child Feeding
Royal Government of Cambodia	133 A Nor Kra Bor, 18 November 2005	Sub-decree on Marketing of Products for Infant and Young Child Feeding
Royal Government of Cambodia	No. 126 CL, 26 June 2000	The Law on the Management of Quality and Safety of Products and Services
Ministry of Industry, Mines and Energy	No. 1045, 28 December 2000	Prakas on Cambodian Standard CS 001-2000 Labelling of Food Product
Body	**Standard No.**	**Title of Standard**
Industrial Standards Bureau of Cambodia	CS 001:2000	The Labelling of Pre-packaged Food
Guideline of the:	**Date:**	**Title of Guideline**
Ministry of Health	December 2015	Guidelines for the Review of the Content of Advertising, Promotion and Promotional Materials of Products for Infant and Young Child Feeding & Implementation, Monitoring, and Enforcement of Sub-Decree 133 and Joint Prakas 061

Appendix 3: ARCH 3 Study and CODEX standard/guideline's CPCF categories.

ARCH 3 study CPCF categories	**CODEX standard/guideline's CPCF categories**	
1. Cereal-based infant cereals/ porridges/ meals, instant/ requires cooking (e.g., instant cereals; porridges; pasta/ noodle meals or soups; meals with cereal, protein source and/ or vegetables). n=24	PCF (b) - Cereals requiring reconstitution with milk/ other nutritious liquids n=3;	FCF - A*ll products fortified with vitamins and/or minerals.* n=49
	PCF (c) - Cereals with added high protein food, requiring reconstitution with water n=21;	
	PCF (d) - Pasta (cooked in boiling water); n=0;	
2. Cereal-based infant snacks (e.g., biscuits; rusks; crackers; puffs). n=37	PCF (e) - Rusks and biscuits n=37	
3. Dairy/ fruit-based snacks (e.g., freeze-dried fruit; freeze-dried fruit and yoghurt melts). n=0	*No category specific, only general, Codex standards/ guidelines apply.*	
4. Ready-to-eat foods – shelf stable (e.g., shelf-stable jars/ pouches/ tubs, which may include cereal, pasta, meat, poultry, fish, dairy, eggs, fruits, and/ or vegetables) n=0	CBF (a) 'Canned' baby food, fruit products /dessert products based on fruit n=0;	
	CBF (b) 'Canned' baby food, other n=0	
5. Ready-to-eat foods – refrigerated/frozen (e.g., yoghurts, refrigerated meals, which may include cereal, pasta, meat, poultry, fish, dairy, eggs, fruits, and/or vegetables). n=7	*No category specific, only general, Codex standards/ guidelines apply.*	
6. Infant pudding (instant milk/ gelatine pudding). n=0	*No category specific, only general, Codex standards/ guidelines apply.*	
7. Other (shredded meat/ fish/ poultry; root vegetable/ legume flours). n=0	*No category specific, only general, Codex standards/ guidelines apply.*	

CBF – Canned baby Food (Standard for Canned Baby Foods (CODEX STAN 73-1981)); CM – Main Complementary Meal; CS – Complementary Snack; FCF – Fortified Complementary Food (Guidelines on Formulated Complementary Foods for Older Infants and Young Children (CAC/GL 08-1991)); PCF – Processed Cereal-based Food (Standard for Processed Cereal-based Foods for Infants and Young Children (CODEX STAN 74-1981)).

Appendix 4: Decision tree of milk type for product reconstitution



* CPCF reconstituted with breastmilk will be excluded from the WHO question on energy provided per daily ration.
Abbreviations: CPCF - commercially produced complementary food; NI - nutritional information; WHO - World Health Organisation; FCT - food composition table; FUF - follow-up formula

Appendix 5: Global checklist (n=68)

Results of the Cambodia CPCF Global Labelling Checklist (n=68)								
Ref No.	***Question***	***Number of labels assessed against question (n)***	***Possible Answers***	***Criteria for selecting answer***	***Reference for Question***	***Number of labels (Number of labels excl. 'NA' or 'Not used')***	***Percentage of labels***	***Percentage of labels excl. 'NA' and 'Not used'***
All CPCF (n=68)								
A.	**INGREDIENTS LIST**	**68**						
1	**General**							
1.1	Is an ingredient list provided?		Yes[a]	An ingredient list is provided.	General Standard for The Labelling of Prepackaged Foods. CODEX STAN 1-1985 (2018) (Section 4.2.1)	68	100%	
			No	No ingredient list is provided.		0	0%	
			NA	Single ingredient food.		0	0%	
2	**Fortificants of Interest**							
2.1	Is the product fortified with an appropriate form of Iron?		Yes[a]	Ferrous sulfate, ferrous fumarate, encapsulated ferrous sulfate/fumerate, electrolytic iron or ferric pyrophosphate.	Guidelines on food fortification with micronutrients (WHO, 2006).	18	26%	64%
			No	Any other form of iron.		2	3%	7%
			NA	Not fortified with iron/iron not named in ingredient list.		40	59%	
			Insufficient information	The form of iron is not provided.		8	12%	29%
						(28 fortified with iron)		
2.1.1	For products fortified with iron, is vitamin C added?		Yes[a]	For a product fortified with iron, Vit C appears in ingredient list.	Guidelines on food fortification with micronutrients (WHO, 2006).	19	28%	68%
			No	For a product fortified with iron, neither Vit C nor a vitamin premix appears in the ingredient list.		9	13%	32%
			NA	Not fortified with iron/iron not named in ingredient list.		40	59%	

			Insufficient information	For a product fortified with iron, only a vitamin premix listed (not individual micronutrients).		0	0%	0%
						(28 fortified with iron)		
2.2	Is the product fortified with an appropriate form of Calcium?		Yes[a]	One of the following calcium salts: carbonate, chloride, citrate, gluconate, glycerophosphate, lactate, mono-, di- and tribasic phosphates, hydroxide and oxide.	Guidelines on food fortification with micronutrients (WHO, 2006).	15	22%	65%
			No	Any other form of calcium.		0	0%	0%
			NA	Not fortified with calcium/calcium not named in ingredient list.		45	66%	
			Insufficient information	The form of calcium is not provided.		8	12%	35%
						(23 fortified with calcium)		
2.3	Is the product fortified with an appropriate form of Zinc?		Yes[a]	One of the following Zinc salts: sulfate, chloride, gluconate, and oxide.	Guidelines on food fortification with micronutrients (WHO, 2006).	11	16%	100%
			No	Any other form of zinc.		0	0%	0%
			NA	Not fortified with zinc/zinc not named in ingredient list.		57	84%	
			Insufficient information	The form of zinc is not provided.		0	0%	0%
						(11 fortified with zinc)		
3	**Prohibited Ingredients**							
3.1	Does the product contain free sugars?		Yes	Contains monosaccharides, disaccharides, honey, syrups, fruit juice and/or fruit juice concentrate.	Guidance on ending the inappropriate promotion of foods for infants and young	61	90%	

			No[a]	Does not contain monosaccherides, disaccherides, honey, syrups, fruit juice or fruit juice concentrate.	children (WHO, 2016) (Recommendation 3)	7	10%	
3.2	Does the product contain added salt?		Yes	Salt/sodium appears in the ingredient list.	Guidance on ending the inappropriate promotion of foods for infants and young children (WHO, 2016) (Recommendation 3)	24	35%	
			No[a]	Salt/sodium does not appear in the ingredient list.		44	65%	
B	**LABELLING PRACTICES**	**68**						
1	Does the product label specify a recommended age of introduction that is 6 or more months of age?		Yes[a]	Recommended age of introduction is 6 months of age (180 days/the 7th month of life) or later.	WHA resolution 39.28 (1986); WHA resolution 49.15 (1996); Gobal Strategy for IYCF (WHO 2003); Quinnn, et al. 2010. (Section 3.1, p 13-14; Section 4, p.23) Codex guidelines on formulated complementary foods for older infants and young children (CAC/GL-8-1991); Codex standard for processed cereal-based foods for infants and young children (Codex/STAN 074-1981)	64	94%	
			No	Recommended age of introduction is less than 6 months of age (180 days/the 7th month of life).		3	4%	
			Not provided	The label does not specify an age of introduction.		1	1%	
2	Does the product label provide a serving size?		Yes[a]		Codex guidelines on formulated complementary foods for older infants and young children (CAC/GL-8-1991, revised in 2013); Codex standard for processed cereal-based foods for infants and young children (Codex/STAN 074-1981, revised in 2006); Codex standard for canned baby foods (CODEX STAN 73-1981)	61	90%	95%
			No	No serving size.		3	4%	5%
			Not used	Serving size provided in a language other than the study languages		4	6%	
						(64 usable labels)		

3	Does the product label provide a proposed daily ration (in addition to a serving size) or can the daily ration be calculated?		Yes[a]	Label provides BOTH of the following: A proposed daily ration/recommended number of servings per day; AND Serving size.	Codex 1991; Quinn, et al. 2010 (Section 3.1, p.15; Section 4, p. 24)	8	12%	12%
			No	Label provides ONE/NONE of the following: A proposed daily ration/recommended number of servings per day; OR Serving size.		60	88%	88%
C	**NUTRITION INFORMATION**							
1	Does the product label provide a declaration of nutrition information?	68	Yes[a]		Guidelines on Nutrition Labelling (CAC/GL 2-1985), section 3.1.2	61	90%	100%
			No	No declaration of nutrition information.		0	0%	0%
			Not used	Nutrition information provided in a language other than the study languages.		7	10%	
2	Does the daily ration (or a recommended serving size combined with a recommended frequency of feeds per day) included on the product label exceed the recommended energy intake from complementary foods for a breastfed child provided below? For products where an age of introduction is not provided, answer the question for all age categories.	61[b]			PAHO/WHO 2003; Quinn, et al. 2010 (Section 3.1; p. 13-15; Section 4, p.24)			
2.1	6–8.9 months: 837kJ/day (200 Kcal/day)		Yes	Greater than.		7	11%	14%
			Partial	In the case of more than one daily ration being recommended on the label, one or more but not all possible daily rations are less than or equal to.		3	5%	6%
			No[a]	Less than or equal to.		0	0%	0%

			Insufficient information	No daily ration (nor a recommended serving size combined with a recommended frequency of feeds per day) provided.		39	64%	80%
			NA	Product not recommended for this age group (age of introduction from 9 months or older).		12	20%	
						(49 Products within this age group)		
2.2	9–11.9 months: 1255kJ/day(300Kcal/day)		Yes	Greater than.		0	0%	0%
			Partial	In the case of more than one daily ration being recommended on the label, one or more but not all possible daily rations are less than or equal to.		3	5%	6%
			No[a]	Less than or equal to.		5	8%	10%
			Insufficient information	No daily ration (nor a recommended serving size combined with a recommended frequency of feeds per day) provided.		41	67%	84%
			NA	Product not recommended for this age group (age of introduction from 12 months or older).		12	20%	
						(49 Products within this age group)		
2.3	12–23.9 months: 2301kJ/day (550 Kcal/day)		Yes	Greater than.		0	0%	0%
			Partial	In the case of more than one daily ration being recommended on the label, one or more but not all possible daily rations are less than or equal to.		0	0%	0%
			No[a]	Less than or equal to.		3	5%	6%

			Insufficient information	No daily ration (nor a recommended serving size combined with a recommended frequency of feeds per day) provided.		45	74%	94%
			NA	Product not recommended for this age group (age of introduction from 2 years or older).		13	21%	
						(48 Products within this age group)		
D	**NUTRIENT CONTENT CLAIMS**							
1.	Does the product label make any nutrient content claims?		Yes		CODEX Guidelines for Use of Nutrition and Health Claims (CAC/GL 23-1997); WHA Resolution 63.23 (2010)	45	66%	
			No[a]			23	34%	
PROCESSED CEREAL-BASED FOODS (ALL) (n=61)								
A	**INGREDIENT LIST**	**61**						
1.	Does the label state that the product contains partially hydrogenated fats?		Yes	1 or more oils with the descriptor 'partially hydrogenated' are listed in the ingredients list.	CODEX STAN 74-1981, section 3.12	0	0%	
			No[a]	No oils with the descriptor 'partially hydrogenated' are listed in the ingredients list.		61	100%	
C	**NUTRITION INFORMATION**	**54[b]**						
1.	Is the energy density of the product ≥3.3 kJ/g (0.8 kcal/g)?		Yes[a]	Energy density ≥3.3 kJ/g (0.8 kcal/g).	CODEX STAN 74-1981, section 3.2	45	83%	
			Partial	Energy density ≥3.3 kJ/g (0.8 kcal/g) for one but not all of the product's recommended age groups.		0	0%	
			No	Energy density <3.3 kJ/g (0.8 kcal/g).		4	7%	
			Insufficient information	Energy content not provided.		5	9%	
PROCESSED CEREAL-BASED FOODS (PREPARE WITH MILK) (n=3)								

C	NUTRITION INFORMATION	3						
1.1	Do lipids contribute ≤0.8 g /100 kJ (3.3 g/100 kcal)?		Yes[a]	Lipids ≤0.8 g /100 kJ (3.3 g/100 kcal).	CODEX STAN 74-1981, section 3.5.2	3	100%	
			Partial	Lipids ≤0.8 g /100 kJ (3.3 g/100 kcal) for one but not all of the product's recommended age groups.		0	0%	
			No	Lipids >0.8 g /100 kJ (3.3 g/100 kcal).		0	0%	
			Insufficient information	Lipid content not provided.		0	0%	
2.1	Is the sodium content ≤24 mg/100 kJ (100 mg/100 kcal) of the ready-to-eat product?		Yes[a]	Sodium ≤24 mg/100 kJ (100 mg/100 kcal).	CODEX STAN 74-1981, section 3.6.1	3	100%	
			Partial	Sodium ≤24 mg/100 kJ (100 mg/100 kcal) for one but not all of the product's recommended age groups.		0	0%	
			No	Sodium >24 mg/100 kJ (100 mg/100 kcal).		0	0%	
			Insufficient information	Sodium content not provided.		0	0%	
PROCESSED CEREAL-BASED FOODS (PREPARE WITH WATER) (n=21)								
C	**NUTRITION INFORMATION**	**18[c]**						
1.1	Is the protein content ≤1.3 g/100 kJ (5.5 g/100 kcal)?		Yes[a]	Protein ≤1.3 g/100 kJ (5.5 g/100 kcal).	CODEX STAN 74-1981, section 3.3.2	18	100%	
			No	Protein >1.3 g/100 kJ (5.5 g/100 kcal).		0	0%	
			Insufficient information	Protein content not provided.		0	0%	
2.1	Do lipids contribute ≤1.1g/100 kJ (4.5 g/100 kcal)?		Yes[a]	Lipids ≤1.1g/100 kJ (4.5 g/100 kcal).	CODEX STAN 74-1981, section 3.5.1	18	100%	
			No	Lipids >1.1g/100 kJ (4.5 g/100 kcal).		0	0%	
			Insufficient information	Lipid content not provided.		0	0%	

3.1	Is the sodium content ≤24 mg/100 kJ (100 mg/100 kcal) of the ready-to-eat product?		Yes[a]	Sodium ≤24 mg/100 kJ (100 mg/100 kcal).	CODEX STAN 74-1981, section 3.6.1	18	100%	
			No	Sodium >24 mg/100 kJ (100 mg/100 kcal).		0	0%	
			Insufficient information	Sodium content not provided.		0	0%	
3.2	Is the calcium content ≥20 mg/100 kJ (80 mg/100 kcal)?		Yes[a]	Calcium ≥20 mg/100 kJ (80 mg/100 kcal).	CODEX STAN 74-1981, section 3.6.2	18	100%	
			No	Calcium <20 mg/100 kJ (80 mg/100 kcal).		0	0%	
			Insufficient information	Calcium content not provided.		0	0%	
PROCESSED CEREAL-BASED FOODS (RUSKS AND BISCUITS) (n=37)								
C	**NUTRITION INFORMATION**	**33[d]**						
1.1	Is the protein content ≤1.3 g/100 kJ (5.5 g/100 kcal)?		Yes[a]	Protein ≤1.3 g/100 kJ (5.5 g/100 kcal).	CODEX STAN 74-1981, section 3.3.2	33	100%	
			No	Protein >1.3 g/100 kJ (5.5 g/100 kcal).		0	0%	
			Insufficient information	Protein content not provided.		0	0%	
2.1	Do lipids contribute ≤0.8 g /100 kJ (3.3 g/100 kcal)?		Yes[a]	Lipids ≤0.8 g /100 kJ (3.3 g/100 kcal).	CODEX STAN 74-1981, section 3.5.2	26	79%	
			No	Lipids >0.8 g /100 kJ (3.3 g/100 kcal).		7	21%	
			Insufficient information	Lipid content not provided.		0	0%	
3.1	Is the sodium content ≤24 mg/100 kJ (100 mg/100 kcal) of the ready-to-eat product?		Yes[a]	Sodium ≤24 mg/100 kJ (100 mg/100 kcal).	CODEX STAN 74-1981, section 3.6.1	30	91%	
			No	Sodium >24 mg/100 kJ (100 mg/100 kcal).		0	0%	
			Insufficient information	Sodium content not provided.		3	9%	
3.2	For products manufactured with the addition of milk and presented as such, is the calcium content ≥12 mg/100 kJ (50 mg/100 kcal)?		Yes[a]	Calcium ≥20 mg/100 kJ (80 mg/100 kcal).	CODEX STAN 74-1981, section 3.6.3	0	0%	
			No	Calcium <20 mg/100 kJ (80 mg/100 kcal).		0	0%	

			Insufficient information	Calcium content not provided.		0	0%	
			NA	Product not manufactured with the addition of milk and presented as such.		33	100%	
						(0 Biscuits/ rusks with milk)		
FORMULATED COMPLEMENTARY FOODS (FORTIFIED CPCF) (n=49)								
A	**INGREDIENT LIST**	**49**						
1.	Does the label state that the product contains partially hydrogenated fats?		Yes	1 or more oils with the descriptor 'partially hydrogenated' are listed in the ingredients list.	CAC/GL 8-1991, section 4.1.5.2	0	0%	
			No[a]	No oils with the descriptor 'partially hydrogenated' are listed in the ingredients list.		49	100%	
B	**LABELLING PRACTICES**	**44[e]**						
1.1	Is a serving of the product, when prepared according to the instructions, within the following limits: 10 - 50g?		Yes[a]	1 serving = 10 - 50g.	CAC/GL 8-1991, section 6.1.3	3	7%	
			No	1 serving <10g or > 50g.		36	82%	
			Insufficient Information	Reconstituted serving size could not be determine due to insufficient information provided.		5	11%	
C	**NUTRITION INFORMATION**	**42[b]**						
1.1	Is the energy density of the product ≥4 kcal/g on dry weight basis?		Yes[a]	Energy density ≥4 kcal/g.	CAC/GL 8-1991, section 6.2.3	35	83%	
			No	Energy density <4 kcal/g.		7	17%	
			Insufficient information	Energy content not provided; information not available on a dry weight basis.		0	0%	
2.1	Does protein account for 6-15% of the total energy from the product?		Yes[a]	Energy from protein between 6-15% TE.	CAC/GL 8-1991, section 6.3.5	27	64%	
			No	Energy from protein <6% or >15% TE.		15	36%	
			Insufficient information	Protein content not provided.		0	0%	
3.1			Yes[a]	Energy from fat ≥20% TE.	CAC/GL 8-1991, section 6.4.1	12	29%	

	Does fat account for ≥20% of the total energy from the product?		No	Energy from fat <20% TE.		30	71%	
			Insufficient information	Fat content not provided.		0	0%	
3.2	Is the linoleic acid content ≥333 mg/100 kcal or 1.6 g/100 g dry product?		Yes[a]	Linoleic acid content ≥333 mg/100 kcal or 1.6 g/100g.	CAC/GL 8-1991, section 6.4.2	2	5%	
			No	Linoleic acid content <333 mg/100 kcal or 1.6 g/100g.		3	7%	
			Insufficient information	Linoleic acid content not provided.		37	88%	
4.1	Does a daily ration of the product provide ≥50% RNI for calcium		Yes[a]	Calcium ≥ 250mg/daily ration of product.	CAC/GL 8-1991, section 6.6.1.3	1	2%	5%
			Partial	In the case of more than one daily ration being recommended on the label, one or more but not all possible daily rations of the product provide ≥ 250mg calcium.		2	5%	10%
			No	Calcium < 250mg/daily ration of product.		5	12%	25%
			Insufficient information	Calcium content/serving size/daily ration not provided.		12	29%	60%
			NA	No calcium listed in ingredient list OR only vitamin premix listed.		22	52%	
						(20 fortified with calcium)		
4.2	Does a daily ration of the product provide ≥50% RNI for zinc?		Yes[a]	Zinc ≥ 2.05mg/daily ration of product.	CAC/GL 8-1991, section 6.6.1.3	0	0%	0%
			Partial	In the case of more than one daily ration being recommended on the label, one or more but not all possible daily rations of the product provide ≥ 2.05mg zinc.		3	7%	27%
			No	Zinc < 2.05mg/daily ration of product.		0	0%	0%

			Insufficient information	Zinc content/serving size/daily ration not provided.		8	19%	73%
			NA	No zinc listed in ingredient list OR only vitamin premix listed.		31	74%	
						(11 fortified with zinc)		
4.3	Does a daily ration of the product provide ≥50% RNI for iron?		Yes[a]	Iron ≥ 2.9mg/daily ration of product	CAC/GL 8-1991, section 6.6.1.3	9	21%	32%
			Partial	In the case of more than one daily ration being recommended on the label, one or more but not all possible daily rations of the product provide ≥ 2.9mg iron.		3	7%	11%
			No	Iron < 2.9mg/daily ration of product.		0	0%	0%
			Insufficient information	Iron content/serving size/daily ration not provided.		16	38%	57%
			NA	No iron listed in ingredient list OR only vitamin premix listed.		14	33%	
						(28 fortified with iron)		
4.3.1a	Daily ration is within the following limit: 8-10 mg/d at 6-12 month		Yes[a]	Iron 8 - 10 mg/daily ration.	Guiding principles for feeding non-breastfed children 6-24 months of age (WHO, 2005)	0	0%	0%
			Partial	In the case of more than one daily ration being recommended on the label, one or more but not all possible daily rations of the product provide 8 - 10 mg of iron.		0	0%	0%
			No	Iron < 8mg or > 10mg per daily ration.		8	19%	29%
			Insufficient information	Iron content/serving size/daily ration not provided.		20	48%	71%
			NA	Recommended age of introduction ≥12 months / No iron listed in ingredient list OR only vitamin premix listed.		14	33%	

						(28 fortified with iron and within age group)		
4.3.1.b	Daily ration is within the following limit: 5-7 mg/d at 12-24 months		Yes[a]	Iron 5 - 7 mg/daily ration.	Guiding principles for feeding non-breastfed children 6-24 months of age (WHO, 2005)	1	2%	4%
			Partial	In the case of more than one daily ration being recommended on the label, one or more but not all possible daily rations of the product provide 5 - 7 mg of iron.		3	7%	13%
			No	Iron < 5mg or > 7mg per daily ration.		0	0%	0%
			Insufficient information	Iron content/serving size/daily ration not provided.		19	45%	83%
			NA	Recommended age of introduction <12 months / No iron listed in ingredient list OR only vitamin premix listed.		19	45%	
						(23 fortified with iron and within age group)		

[a] Answer indicating compliance with CODEX Standard/Guideline.

[b]Products where the nutrition information was not used (n=7) were not assessed against this question.

[c]Products where the nutrition information was not used (n=3) were not assessed against this question.

[d] Products where the nutrition information was not used (n=4) were not assessed against this question.

[e]Products where serving size information was not provided (n=5) were not assessed against this question.

Appendix 6: National checklist (n=68)

Results of the Cambodia CPCF National Labelling Checklist (n=68)							
Ref No.	***Question***	***Possible Answers***	***Criteria for selecting answer***	***Reference for Question***	***Number of labels (Number of labels excl. 'NA' or 'Not used')***	***Percentage of labels***	***Percentage of labels excl. 'NA' and 'Not used'***
A	**INGREDIENTS LIST**						
1	Is an ingredient list provided?	Yes*	Ingredient list provided in English/ Khmer	CS 001:2000, section 4.3; No. 126 CL, 2000, chapter 2 article 3	68	100%	
		No	No ingredient list; OR Ingredient list provided in a language other than English/ Khmer.		0	0%	
		NA	Single ingredient food.		0	0%	
1.1	Is the ingredient list provided in Khmer?	Yes*		CS 001:2000, section 8.2; No. 126 CL, 26 June 2000, chapter 2 article 3	21	31%	
		No			47	69%	
		Not assessed	Answer to A.1 is 'No' or 'NA'.		0	0%	
B	**LABELLING PRACTICES**						
1	Does the label provide a statement of the superiority of exclusive breast-feeding for the first six months and sustained breast-feeding until the child reaches two years old or beyond? E.g. *"Only breast milk during your child's first six months and continued breastfeeding from 6 months to at least 2 years of age or beyond is the normal and safe way."*	Yes*	A message including the following concepts is provided in English/Khmer: (a) exclusive; breastfeeding; first 6 months; and (b) sustained/continued; breastfeeding; up to two years or beyond.	Sub-decree 133, 2005, Article 9b. Example: Guideline, Annex 1.	7	10%	
		Partial	A message including (a) or (b), as above.		12	18%	
		No	Incomplete message (a) and/or (b); OR No message; OR		49	72%	

			Message provided in a language other than English/ Khmer.				
2	Does the label provide a warning with the words "Important Notice" of the health hazards of inappropriate use of the designated products? E.g. *"IMPORTANT NOTICE: The unnecessary or improper use of this product may be dangerous to your child's health and development."*	Yes*	The label provides the following in English/ Khmer: (a) the words "Important notice"; AND (b) a warning of the health hazards/consequences of inappropriate use of the product.	Sub-decree 133, 2005, Article 9d. Example: Guideline, Annex 1.	0	0%	
		Partial	The label provides a warning of the health hazards/consequences of inappropriate use of the product. The words "Important notice" are NOT provided.		7	10%	
		No	A warning is provided without associated health hazards/consequences; OR No warning; OR Warning provided in a language other than English/ Khmer.		61	90%	
3	Does the label provide a warning regarding the health hazards of introducing the product before six months of age? E.g. *"It is dangerous to give this product before your child reaches six months of age."*	Yes*	The label provides a warning regarding the health hazards of introducing the product/complementary foods (or words of similar meaning) before six months of age in English/ Khmer.	Sub-decree 133, 2005, Article 9e. Example: Guideline, Annex 1, adapted.	5	7%	
		Partial	(a) The label states that the product/complementary foods (or words of similar meaning) should not be introduced before six months of age, but no information is provided regarding the health hazards associated with early introduction; OR (b) The label states that the		14	21%	

			product should not be introduced before the 'recommended age' (or similar), and elsewhere on the label recommends introduction from 6 months.				
		No	No warning; OR Warning provided in a language other than English/ Khmer.		49	72%	
4	Does the label state that the product shall be used only on the advice of a health worker? E.g. *"The use of this product should only be upon the advice of a trained health worker."*	Yes*	A statement is provided in English/ Khmer.	Sub-decree 133, 2005, Article 9e.	8	12%	
		Partial	Label recommends consulting a health professional without stipulating that this is required before using the product.		2	3%	
		No	No statement; OR Statement provided in a language other than English/Khmer.		58	85%	
5	Does the label provide instructions for appropriate use of the product?	Yes*	The label provides instructions in English/Khmer containing at least one of the following: (a) Daily ration; (b) No. of servings per day; or (c) serving size (outside of the nutrition information table).	Sub-decree 133, 2005, article 9c; No. 126 CL, 2000, chapter 2 article 3; CS 001:2000, section 4.3 and 8.2	32	47%	
		No	No instructions; OR Instructions provided in a language other than English/ Khmer.		36	53%	
5.1	Are the instructions for appropriate use of the product provided in Khmer?	Yes*	The label provides instructions in English/Khmer.		21	31%	66%
		No	No instructions; OR Instructions provided in a language other than English/ Khmer.		11	16%	34%
		Not assessed	Answer to B.5 is 'No'.		36	53%	

6	Does the label provide instructions for the appropriate preparation of the product?	Yes*	The label provides instructions in English/ Khmer on the correct way to prepare the food, for example heating, cooking, reconstituting or serving as is.	Sub-decree 133, 2005, article 9c; No. 126 CL, 2000, chapter 2 article 3; CS 001:2000, section 4.3 and 8.2	46	68%	
		Partial	Preparation of the product is implied, but not directly stated.		14	21%	
		No	No instructions; OR Instructions provided in a language other than English/ Khmer.		8	12%	
6.1	Are the instructions for appropriate preparation of the product provided in Khmer?	Yes*			29	43%	48%
		No			31	46%	52%
		Not assessed	Answer to B.6 is 'No'.		8	12%	
C	**NUTRITION INFORMATION**						
1	Does the label provide a declaration of nutrition information?	Yes*	Declaration of nutrition information provided in English/ Khmer.	No. 126 CL, 2000, chapter 2 article 3	61	90%	
		No	No declaration; OR Declaration provided in a language other than English/ Khmer.		7	10%	
1.1	Is the declaration of nutrition information provided in Khmer?	Yes*			19	28%	31%
		No			42	62%	69%
		Not assessed	Answer to C.1 is 'No'.		7	10%	

Appendix 7: Comparison of nutrient values per product: Declared label value and laboratory measured values.

Product	Milna, Bubur Bayi (Baby porridge) Chicken & corn soup		Milna, Bubur Bayi (Baby Porridge) Banana		Nestle, Cerelac (Infant cereals with milk) Rice & soybeans		Nestle, Cerelac (Infant cereals) Wheat & honey		Nestle, Cerelac (Infant cereals with milk) Wheat, fish & spinach		France Lait, Diastase, My 1st cereals with milk	
Nutrient	**Declared label value**	**Laboratory value**	**Declared label value**	**Laboratory value**	**Declared label value**	**Laboratory value**	**Declared label value**	**Laboratory value**	**Declared label value**	**Laboratory value**	**Declared label value**	**Laboratory value**
Energy Cal/100g	400.00	412.00	425.00	423.00	415.00	425.00	394.00	395.00	424.60	428.00	403.00	405.00
Energy kJ/100g	1673.60	1723.81	1778.20	1769.83	1736.36	1778.20	1648.50	1652.68	1777.00	1790.75	1704.00	1694.52
Saturated fat g/100g	NP	2.69	NP	3.17	2.60	2.40	0.20	0.27	NP	4.00	NP	2.57
Trans fatty acid g/100g	0.007	0.04	0.007	0.05	0.10	0.01	0.007	0.01	NP	0.02	NP	0.04
Total fat g/100g	7.50	8.16	10.00	9.42	9.00	9.03	1.40	1.17	9.80	10.00	7.00	6.76
Total carbohydrate g/100g	72.50	68.50	72.50	67.50	67.00	65.70	84.00	79.90	68.60	61.90	69.80	64.80
Total sugar g/100g	12.50	15.30	12.50	24.40	NP	22.50	NP	28.60	NP	23.40	NP	31.60
Protein g/100g	12.50	16.20	12.50	16.90	15.00	20.20	10.00	16.10	16.00	22.70	15.00	21.10
Sodium mg/100g	300.00	274.00	225.00	235.00	150.00	142.00	140.00	126.00	240.00	309.00	188.00	147.00
Calcium mg/100g	437.50	517.00	468.75	543.00	420.00	540.00	235.00	228.00	370.00	511.00	720.00	667.00
Iron mg/100g	16.63	22.60	16.63	17.60	10.00	12.10	15.60	21.10	10.00	12.50	5.50	4.84
Zinc mg/100g	6.00	6.12	5.63	6.54	2.50	3.96	.	0.73	2.00	3.40	5.50	6.82

Product	Milna, (Baby Biscuit) Orange		Gerber Puffs (Cereal snack) Blueberry		AFC Nutrition (Crunchy Crackers) Vegetable flavour		Gerber Lil 'Crunchies (Baked corn snack) Apple & sweet potato		Happy Baby Superfood Puffs (Organic grain snack) Purple carrot & blueberry	
Nutrient	**Declared label value**	**Laboratory value**	**Declared label value**	**Laboratory value**	**Declared label value**	**Laboratory value**	**Declared label value**	**Laboratory value**	**Declared label value**	**Laboratory value**
Energy Cal/100g	409.09	411.00	357.14	391.00	509.00	484.00	500.00	505.00	357.14	379.00
Energy kJ/100g	1711.64	1719.62	1494.29	1635.94	2129.66	2025.06	2092.00	2112.92	1494.29	1585.74
Saturated fat g/100g	.	311.00	.	0.41	11.00	8.50	.	2.03	0.10	0.25
Trans fatty acid g/100g	.	0.02	.	0.01	.	0.13	.	0.04	0.007	0.01
Total fat g/100g	6.82	6.72	0.10	1.61	24.30	20.00	28.57	22.80	0.10	0.73
Total carbohydrate g/100g	77.27	71.80	85.71	78.60	65.70	55.60	71.43	51.00	85.71	83.30
Total sugar g/100g	22.73	30.30	14.29	14.30	12.20	10.30	.	6.40	.	4.90
Protein g/100g	9.09	15.80	0.10	15.60	6.92	20.50	0.10	23.90	0.10	9.77
Sodium mg/100g	22.73	20.80	0.10	25.10	469.00	473.00	71.43	63.70	0.10	79.00
Calcium mg/100g	568.18	340.00	.	24.10	265.00	288.00	.	15.60	285.71	608.00
Iron mg/100g	9.20	9.60	20.00	25.20	.	0.68	24.29	33.40	12.86	18.00
Zinc mg/100g	9.55	7.72	.	2.48	.	0.32	.	0.77	2.86	5.90