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Short Communication

Estimates of the quality of complementary feeding among Vietnamese infants aged 6–23 months varied by how commercial baby cereals were classified in 24-h recalls

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Abstract

The World Health Organization's (WHO) standardized questionnaire for assessing infant and young child feeding practices does not include commercial baby cereals (CBC), which are derived from several food groups and are fortified with micronutrients. We examined how different scenarios for classifying CBC affect estimates of the quality of complementary feeding in children ages 6–23 months in Vietnam in 2014 ($n = 4811$). In addition to the WHO standardized 24-h recall questionnaire for infant and young child feeding, we asked mothers about the consumption of CBC. The five resulting scenarios were S1 – omitted CBC; S2 – CBC classified as grains; S3 – as grains and dairy; S4 – as grains, dairy and fruit/vegetables; and S5 – as grains, dairy, fruit/vegetables and any others. Including CBC resulted in 4–11 percentage points higher in the prevalence of children who were fed each of the six food groups compared with what was reported in the WHO standardized questionnaire. Minimum dietary diversity (% fed ≥ 4 out of the 7 food groups) was higher in S5 (90%) than in S1 (84%), S2 (84%), S3 (85%) and S4 (86%). Minimum acceptable diet was also higher in scenarios S5 (80%) than in S1 (74%), S2 (75%), S3 (75%) and S4 (77%). Consumption of iron-rich foods was 94% when CBC was accounted, which was higher than the alternative scenario (89%). In summary, when CBC were included, population-level estimates of dietary quality were higher than when CBC were omitted. Guidance is required from the WHO about how to account for the consumption of CBC when estimating the quality of complementary feeding.

Keywords: breast milk substitutes, commercial baby cereals, developing countries, infant and young child feeding (IYCF), Vietnam, WHO IYCF indicators.

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Introduction

In the early 2010s, about one-fourth of children less than 5 years of age worldwide were stunted; the prevalence of stunting was high in developing countries (~33%), east Africa (42%), west Africa (36%) and south-central Asia (36%) (Black *et al.* 2013; UNICEF 2015b). Every year, undernutrition causes 3.1 million child deaths (Black *et al.* 2013; UNICEF 2015b). Optimal complementary feeding practices are one of the core components to improve nutrition and health status of children in the first 1000 days from pregnancy to the second birthday (Dewey & Brown 2003; Lutter *et al.* 2011; Bhutta *et al.* 2013). In addition to breast

milk, infants aged 6 months or older should be fed with complementary foods that meet the minimum requirements of energy density, food consistency, meal frequency, diversity and micronutrients (World Health Organization – PAHO 2003; UNICEF 2015b). Estimation of nutrient and dietary intake for infants and young children is challenging, however, especially in population studies in low-income and middle-income countries due to lack of skilled data collectors and/or sufficient food composition tables to analyze dietary intake (Chavarro *et al.* 2009; Daelmans *et al.* 2009; Burrows *et al.* 2010).

To develop simple, valid and reliable indicators to track progress and guide investment to improve

nutrition and health during the first 2 years of life, the World Health Organization (WHO) in partnership with other organizations developed, pretested and released indicators for assessing infant and young child feeding (IYCF) practices in 2007 (Daelmans *et al.* 2009; World Health Organization & UNICEF 2010; Marriott *et al.* 2012). The revised indicators include four complementary feeding indicators: minimum meal frequency, minimum dietary diversity (MDD), minimum acceptable diet (MAD) and consumption of iron-rich or iron-fortified foods (IRF), which are assessed based on the foods eaten by the infant or young child during the previous day (Daelmans *et al.* 2009; World Health Organization & UNICEF 2010). These indicators have been used in large-scale nationally representative surveys worldwide, including the demographic and health surveys and UNICEF multiple indicator cluster surveys (Daelmans *et al.* 2009; Marriott *et al.* 2012; Senarath & Dibley 2012; Vietnam National Institute of Nutrition 2012; Menon *et al.* 2015; UNICEF 2015a).

The WHO standardized questionnaire to estimate these indicators, however, does not include commercial baby cereals (CBC), which are consumed by a large and increasing number of infants and young children in countries worldwide (Kersting *et al.* 1998; Fox *et al.* 2004; Huffman *et al.* 2014). For example, the consumption CBC was 22% in German infants in early 1990s (Kersting *et al.* 1998) and 81% in 7–8-month-olds US infants in 2002 (Fox *et al.* 2004). Data from demographic and health surveys conducted during 2005 and 2011 in low-income and middle-income countries showed a notable proportion of children ages 6–23 months consumed CBC on the day prior (31–37% in Southeast

Asian countries and 4–26% in East and West African countries) (Huffman *et al.* 2014). Data about dietary intake for US infants aged 6–11 months (NHANES 2005–2012) showed that commercial baby foods and ready-to-eat cereals contributed to 17% of energy, 16% of protein, 5% of fat, 21% of carbohydrate, 24% of folate and 46% of iron intake (Grimes *et al.* 2015). CBC typically are derived from a combination of grains, dairy, fruit, vegetables, animal foods and legumes and are usually fortified with micronutrients, including vitamins A, B group, C, zinc and iron. Consequently, the way to classify CBC might have potential effects on the prevalence of MDD and MAD. The objective of this study was to examine how different scenarios for classifying CBC affect estimates of the quality of complementary feeding in children ages 6–23 months in Vietnam.

Methods

Participants

Data were drawn from an endline household survey conducted in April and May 2014 through Alive & Thrive (A&T), an initiative to save lives, prevent illness and ensure healthy growth and development through improved breastfeeding and complementary feeding practices. In its first 5 years (2009–2014), A&T demonstrated that innovative approaches to improve feeding practices could be delivered with impact and at scale in three contexts: Bangladesh, Ethiopia and Vietnam. A&T is now supporting others to scale up nutrition in Burkina Faso, India and Southeast Asia. A&T is funded by the Bill & Melinda Gates Foundation and

Key messages

- The World Health Organization's (WHO) standardized questionnaire for assessing infant and young child feeding practices have been used worldwide. It, however, does not include commercial baby cereals (CBC), which are derived from several food groups and are fortified with micronutrients.
- When CBC were included in the standardized infant and young child feeding questionnaire and taken into account in the data analysis, population-level estimates of dietary quality were higher than when CBC were omitted.
- Guidance is required from the WHO about how to account for the consumption of CBC when estimating the quality of complementary feeding.

the Governments of Canada and Ireland (Alive & Thrive 2015; Baker *et al.* 2013).

For this analysis, we used data from 4811 children ages 6–23-month-olds who participated in the endline survey conducted in 11 provinces in Vietnam in 2014. Along with the baseline survey in 2011, this survey was intended to provide information for planning and tracking of progress for each province (Alive & Thrive 2015; Nam *et al.* 2014). The same sampling strategy was used for the both the baseline and endline surveys (Alive & Thrive 2015; Nam *et al.* 2014). Briefly, mothers were recruited using a three-stage cluster sampling technique that selected the following: (1) intervention and comparison districts; (2) primary sampling units (equivalent to an average-sized village) based on population-proportionate-to-size method; and (3) mother–child dyads using systematic sampling (Alive & Thrive 2015; Nam *et al.* 2014).

The survey was conducted by an independent research firm, the Institute of Social and Medical Studies in Hanoi, Vietnam. Data were collected via face-to-face interviews using a structured questionnaire that was developed by the A&T team and pretested several times in the field. The study protocol was approved by the Institutional Review Board of Institute of Social and Medical Studies and FHI 360. Written informed consent was obtained from all participants.

Common CBC consumed in Vietnam

There are five common brands of CBC consumed in Vietnam: Ridielac (Vinamilk), Cerelac (Nestlé), Nutri IQ (NutriFood), Heinz and HiPP (Supporting Information Table 1). The first three brands were available through the country, while the last two were available in big cities. The commonly claimed ingredients are grains, dairy, and fruit/vegetables/digestible fibre and animal foods. Four products of Nestlé contain a large amount of soybean powder. Only two products of HiPP brand include grains and vegetables and are fortified with thiamine. Nonetheless, in the instruction, mothers are instructed to either mix the product with fortified infant formula and sugar or cook with animal foods, vegetables, sugar and cooking oils. Except for the two HiPP products, all others are fortified with multivitamins and minerals, including iron and vitamin A.

Five scenarios for recoding CBC

In addition to the standardized questionnaire from the WHO (Daelmans *et al.* 2009; World Health Organization & UNICEF 2010), we asked mothers about the consumption of CBC from key manufacturers of CBC in Vietnam such as Vinamilk, Nestlé, NutriFood, Heinz and HiPP. We used standardized WHO definitions to evaluate minimum meal frequency, MDD, MAD and IRF (Daelmans *et al.* 2009; World Health Organization & UNICEF 2010), which are based on 24-h food recalls. Four indicators for complementary feeding practices for children ages 6–23 months were selected based on the revised WHO recommendations: (1) the proportion of children who received foods from four or more food groups (MDD); (2) the proportion of breastfed and non-breastfed children who received solid or semi-solid food, including milk feeds for non-breastfed children the minimum number of times or more (MMF); (3) the proportion of children who received a MAD, apart from breast milk (MAD); and (4) the proportion of children who consumed flesh foods or commercially fortified foods especially designed for infants and young children (consumption of IRF) (Daelmans *et al.* 2009; World Health Organization & UNICEF 2010).

Then, we estimated and compared the prevalence of these four indicators using five scenarios, four of which take into account the consumption of CBC: S1 – omitted CBC; S2 – CBC classified as grains; S3 – as grains and dairy; S4 – as grains, dairy and fruit/vegetables/fibre; and S5 – as grains, dairy, fruit/vegetables/fibre and any others. The order of our scenarios was matched with common ingredients of CBC in Vietnam stated in the Supporting Information Table 1. Baby food companies' claim, as listed in the labels, and most mothers believe that CBC can provide complete nutrients, including protein, fat, carbohydrates, vitamins and minerals. This is the basis for us to consider that feeding CBC can be considered feeding at least four food groups (S5) or meeting minimal dietary diversity. For IRF, we compared two scenarios, one of which takes into account the consumption of CBC as the consumption of an IRF and the other does not. Although IRF are recommended to be included as an IRF (Daelmans *et al.* 2009; World Health Organization & UNICEF 2010), the chance to underestimate the

consumption of IRF might be high if CBC items were not included in the questionnaire.

Statistical analysis

Analysis was performed using Stata 13.1 (Stata Inc., TX, USA). To visualize the size of difference, we compared and reported pairs with a difference of > 5 and > 10 percentage points. To test the statistic difference between pairs of scenarios, we constructed a McNemar's χ^2 test statistic, which is based on a within-dyad comparison between pairs of scenarios for each mother-child dyad, thus removing any variation among dyads and among clusters. For each scenario, because the member of the pair that included CBC items was more inclusive by design, the resultant

test statistic was simply the number of additional mother-child dyads in the more inclusive scenario, and a test statistic greater than three corresponded to a one-sided P -value less than 0.05. The findings showed that all McNemar's tests had a P -value of < 0.001. To provide a more conservative finding, we also use non-overlapping 95% confidence interval, derived from survey commands, to proxy for a statistical difference.

First, we compared the prevalence of consuming a select food group when CBC was taken into account and when it was not. Second, we compared the prevalence of MDD and MAD derived from various scenarios of accounting for CBC. Finally, we compared the prevalence of MDD and MAD in each economic quintile. The economic quintiles were derived from an economic score based on housing

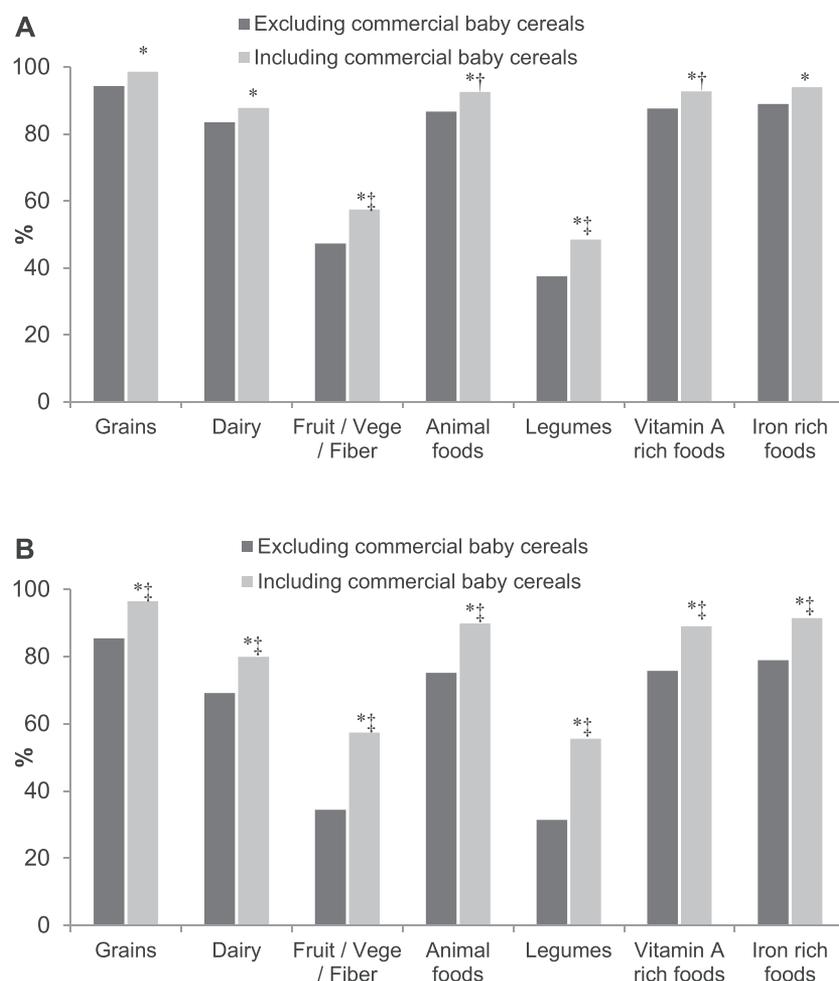


Fig. 1. Proportion of children fed with different food groups when feeding of baby cereals was taken into account in children ages 6–23 months (A) and children ages 6–11 months (B) (Alive & Thrive endline survey, 2014). Values are percentages, $n = 4811$. One-sided McNemar's χ^2 tests with P -value < 0.001 for all pairwise comparisons of scenarios for which baby cereal was and was not included. *, non-overlapping 95% confidence interval; †, absolute difference > 5 percentage points; ‡, absolute difference > 10 percentage points compared with not account for baby cereal.

condition and assets using a principal component analysis (Vyas & Kumaranayake 2006). In addition to providing data for children 6–23-month-olds to show the magnitude of the discrepancy with the WHO definition, we also provided a more in-depth analysis for children aged 6–11 months where most of the discrepancy occurred.

Results

The percentage of children who were fed CBC the previous day was 16.4% in children ages 6–23 months and 32.3% in children ages 6–11 months. Including CBC

resulted in 4–11 percentage points higher in the prevalence of children who were fed each of the six food groups compared with what was reported in the WHO standardized questionnaire (Fig. 1). The prevalence of children who consumed IRF was 94% when CBC were accounted, which was higher than the alternative scenario (89%; Fig. 1).

Minimum dietary diversity (percent fed ≥ 4 out of the seven food groups) was higher in S5 (90%) than in S1 (84%), S2 (84%), S3 (85%) and S4 (86%). Minimum acceptable diet was also higher in scenarios S5 (80%) than in S1 (74%), S2 (75%), S3 (75%) and S4 (77%; Fig. 2). The difference in the prevalence of both MDD and

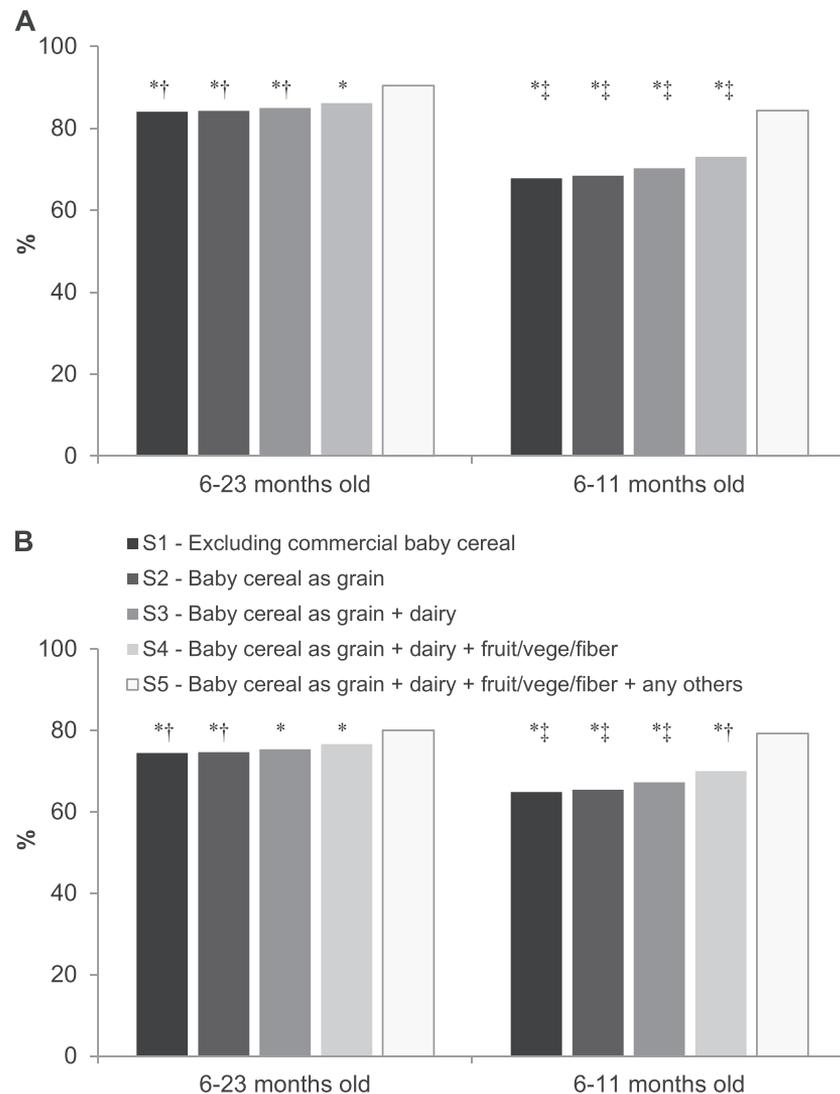


Fig. 2. Prevalence of minimum dietary diversity (A) and minimum acceptable diet (B) with different scenarios of grouping baby cereals with other food groups (Alive & Thrive endline survey, 2014). Values are percentages, $n = 4811$. One-sided McNemar's χ^2 tests with P -value < 0.001 for all pairwise comparisons. *, non-overlapping 95% confidence interval; †, absolute difference > 5 percentage points; ‡, absolute difference > 10 percentage points compared with S5.

MMF in different scenarios was driven mainly by infants ages 6–11 months, who consumed more CBC (Fig. 2).

The prevalence of MDD was higher in every quintile when accounting for consumption of CBC (S5 vs. S1), especially in infants ages 6–11 months. In addition, the difference in the prevalence in S5 and S1 was higher in poorer families (Fig. 3). A similar pattern was found in the prevalence of MAD (Fig. 4).

Discussion

As suggested by other authors (Jones *et al.* 2014; Pullum 2014; Reinbott *et al.* 2015), although the revised

WHO standardized questionnaire and indicators on IYCF practices (Daelmans *et al.* 2009; World Health Organization & UNICEF 2010) are widely used, we still need to improve them. Our study suggests that taking into account CBC were linked with a higher assessment of dietary quality.

Because CBC are a mixture of different food ingredients, each ingredient of CBC must be reported separately to have an unbiased estimate. It may be difficult for mothers to report accurately the ingredients of CBC, however, either because they do not know the ingredients or because they do not recall them. As a result, the nutritional value of the complementary foods given to a large proportion of infants and young children

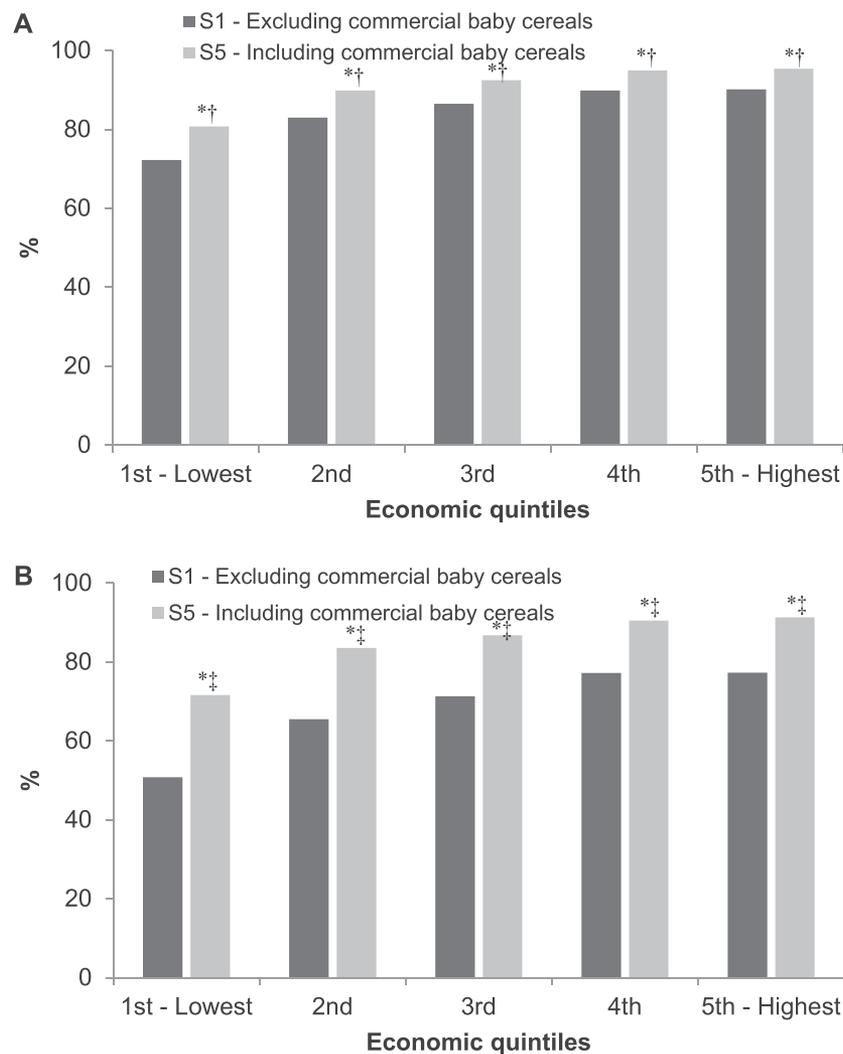


Fig. 3. The prevalence of minimum dietary diversity when commercial baby cereals were taken into account (S5) and when they were not (S1) in children ages 6–23 months (A) and children ages 6–11 months (B) (Alive & Thrive endline survey, 2014). Values are percentages, $n = 4,811$. One-sided McNemar's χ^2 tests with P -value < 0.001 for all pairwise comparisons. *, non-overlapping 95% confidence interval; †, absolute difference > 5 percentage points; ‡, absolute difference > 10 percentage points compared with not account for baby cereal.

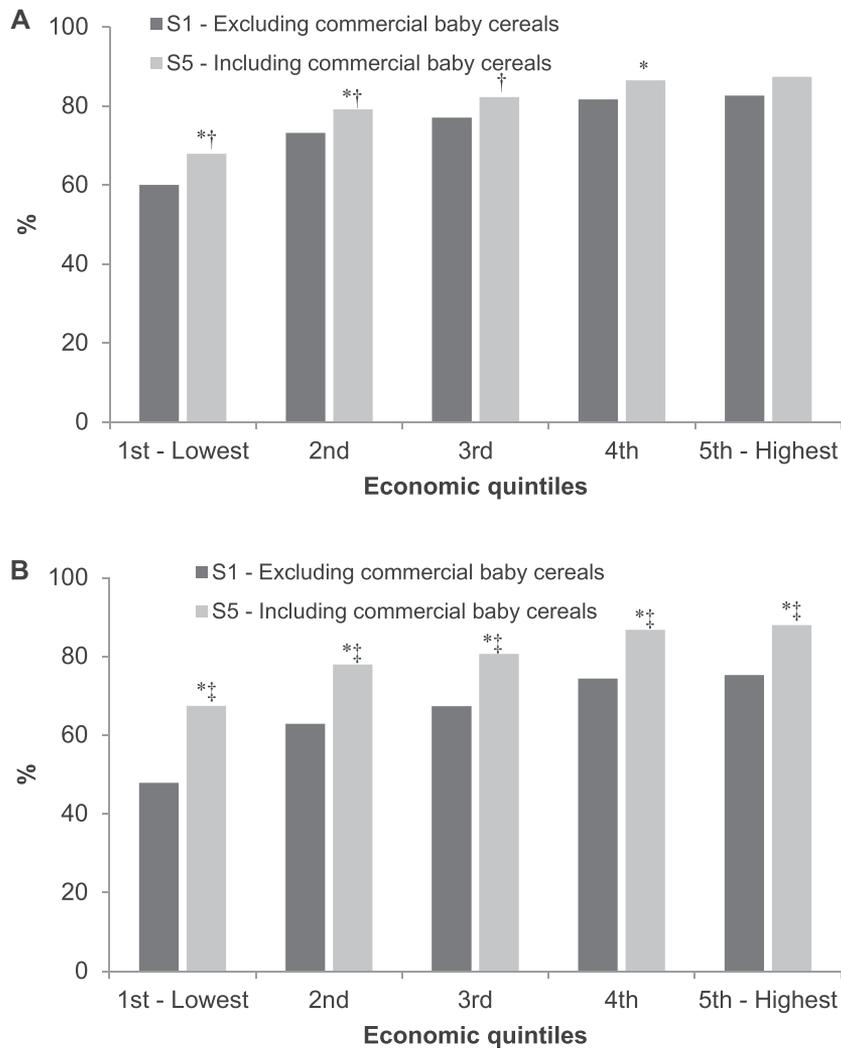


Fig. 4. The prevalence of minimum acceptable diet when commercial baby cereals were taken into account (S5) and when they were not (S1) in children ages 6–23 months (A) and children ages 6–11 months (B) (Alive & Thrive endline survey, 2014). Values are percentages, $n = 4811$. One-sided McNemar's χ^2 tests with P -value < 0.001 for all pairwise comparisons. *, non-overlapping 95% confidence interval; †, absolute difference > 5 percentage points; ‡, absolute difference > 10 percentage points compared with not account for baby cereal.

around the world may be substantially miscalculated. Our results demonstrate that taking into account CBC linked with significantly improved dietary quality (e.g. MDD, MAD and IRF), especially among lower-income families. Because CBC are typically sold and perceived as being a 'complete' source of nutrients for infant and young child growth and development, caregivers may reduce other foods to rely on CBC (Piwoz & Huffman 2015). Higher-income families are likely to have more diverse diets regardless of consuming CBC, while mothers from lower-income families might perceive that the infant has sufficient nutrients from CBC and minimize the consumption of other foods.

The sale of baby foods, including infant formulas and CBC, is increasing worldwide, especially in the Asia-

Pacific region (Euromonitor International 2008,, Euromonitor International 2011; Piwoz & Huffman 2015). The reasons behind this increase include (1) massive advertisements and promotion of CBC in developing markets; (2) value-added innovation claims (e.g. organic, hypoallergenic, soy-based products, fibre and prebiotic/probiotic); (3) government regulations on baby foods focusing on infant formula, but not other baby foods such as CBC; and (4) the potential of e-commerce models for selling baby foods in the Asia-Pacific region, especially in China, Indonesia and Vietnam (Piwoz & Huffman 2015). In addition, compared with homemade complementary foods, CBC are more convenient (e.g. time required for preparation and variety of tastes, products, brands and

manufacturers). The rising consumption of CBC in low-income and middle-income countries seems to be an inevitable trend (Euromonitor International 2008; Euromonitor International 2011; Piwoz & Huffman 2015). We found that 16.4% of our sample reported the consumption of CBC during the previous day, which is about 50% lower than that from Cambodia, the Philippines and Timor-Este (Huffman *et al.* 2014). In Vietnam, mothers and caregivers prefer and are recommended to make complementary foods from raw/fresh ingredients (e.g. vegetables, meat/fish/eggs and vegetable oil) for children aged 6–11 months (Alive & Thrive 2013). Porridge or rice is then typically prepared for those older than 12 months (Alive & Thrive 2013). Higher cost and/or lower availability of CBC than the homemade complementary foods might be another contributing reason, especially among those who live in rural areas.

The growing consumption of CBC as well as the limitation of the current WHO IYCF questionnaire underscores the need to revise dietary recall questionnaires to include CBC. In the context of Vietnam, (with possible application elsewhere), we propose the addition of two questions (Textbox 1) to the WHO questionnaire (World Health Organization & UNICEF 2010). One question is about the consumption of CBC that are typically fortified with multi-nutrients, including iron. Researchers should explore all commonly sold CBC in their study areas (e.g. our Supporting Information Table 1) and list them out in the questionnaire to facilitate the recall. If possible, a subset of the survey participants would be asked about individual products and

brands of CBC consumed the previous day. The information would guide the researchers on how to account for the consumption of CBC when estimating the quality of complementary feeding in infants and young children. To our knowledge, only the recent MICS – conducted in about 50 developing countries worldwide from 2014 to 2016 – integrated CBC into the IYCF module (UNICEF 2015a). In the analysis, MICS included CBC in the staple group (e.g. grains, roots and tubers or our S2), which underestimated both MDD and MAD. More research is required to determine the availability and amount of various ingredients of CBC by manufacturer, brand and country to support detailed instructions on how to account for these differences in the analysis could help maximize the ability to make comparisons across countries and regions. Also, further studies should be conducted to investigate if CBC can provide complete nutrients as claimed by food companies. If not, a global announcement is needed to correct this claim.

Because an infant might be fed a complementary food made from mixed locally made flour, another question about locally made complementary flours and their ingredients (e.g. rice, mung bean and lotus seed in Vietnam; Textbox 1) is needed. The interviewer or supervisor can then include the ingredient into appropriate food groups. Without the question, an interviewer might forget to prompt for and/or the interviewed mother might forget reporting about detail ingredients of the flour. The added question also helps to maximize the comparability of data from different surveys.

Textbox 1. Suggested additional questions for the World Health Organization's 24-h food recall questionnaire

Thinking about the time period from when (NAME) woke up yesterday morning until the time she or he woke up this morning, was (NAME) given any. . . *READ RESPONSES* . . . ?

Question	Code		
	Yes	No	DK
s. Commercial baby cereals such as (list of commonly available brands in the given countries)The list for Vietnam: Heinz, HiPP, Cerelac/Nestlé, Ridielac/Vinamilk, Gerber	1	0	8
t. Locally made complementary flour: What are the compositions of the flour? Specify _____	1 ¹	0	8

¹If the mother answered 'yes', the interviewer prompts about ingredients of the flour and what the mother put in the food. The interviewer marks appropriate items in the standardized questionnaire.

In conclusion, when CBC were included in the 24-h recall, population-level estimates of dietary quality were higher than when CBC were omitted. Our findings suggest the need of guidance about how to collect and account for information about the consumption of CBC when estimating the quality of complementary feeding practices.

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Conflicts of interest

None of the authors had a conflict of interest related to any part of this study or manuscript.

Contributions of authors

NTT: Designed the study, acquired data, analyzed and interpreted the data, and drafted a part of revised and finalized this manuscript; MW: Assisted in the analysis and interpretation of the results and draft a part of the manuscript, provided critical intellectual feedback to help revise the manuscript; NH: Designed the study, assisted in the analysis and interpretation of the results, provided critical intellectual feedback to help revise the manuscript. EAF: Advised in the analysis and interpretation of the results, provided critical intellectual feedback to help revise the manuscript. All authors have read and approved the final manuscript.

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Supporting information

Additional supporting information may be found in the online version of this article at the publisher's web site.