Deficient Nutrient Intake from Complementary Foods among Infants Aged 6–11 Months in Rural Areas of Yogyakarta

Heni Hendriyani[1,2], Toto Sudargo[3], Umi Fahmida[4], Siti Helmyati[3],
Susetyowati[3] and Wardina Humayrah[5]

[1] *Doctoral Program Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada,
Yogyakarta 55281, Indonesia*
[2] *Nutrition Department, Health Polytechnic of Semarang, Semarang 50192 Central Java, Indonesia*
[3] *Nutrition and Health Program, Faculty of Medicine, Public Health and Nursing,
Universitas Gadjah Mada, Yogyakarta 55281, Indonesia*
[4] *Southeast Asian Ministers of Education Organization Regional Center for Food and Nutrition
(SEAMEO-RECFON) - Pusat Kajian Gizi Regional (PKGR) Universitas Indonesia, Jakarta, Indonesia*
[5] *Nutrition Study Program, Faculty of Food Technology and Health, Sahid University,
Jakarta 12870 Indonesia*

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Summary   Nutrition education message that is developed based on linear programming could help arrange complementary feeding recommendations (CFR) using locally available food to improve infants' nutrient adequacy. This study examined deficient nutrients to optimize complementary feeding for infants. Data were collected from the Health District Office of Yogyakarta province that consisted of 91 breastfed infants aged 6–11 mo old. Their dietary intake was assessed by quantitative 24-h recall and data were processed using the software Nutrisurvey, MS Excell, and Optifood. Meat, fish, eggs, fruit, legumes, nuts, and seeds were infrequently consumed. Intakes of Fe and Zn could not fully reach the Recommended Nutrient Intake (RNIs), while the vitamins C, B6, folate, B12, and A could achieve 100% of RNIs by using optimized food pattern. Local foods that could be used to help improve the nutrients, except for Fe and Zn. The CFR were as follow: continue breastfeeding frequently; feed quality protein source food such as 3 servings/wk of all type of eggs and liver, 5 servings/wk of locally available flesh of fish; provide 2 servings/wk of enriched/fortified baby porridge; offer plant protein foods (legumes, nuts or seeds) 2 servings/wk including 1 serving/wk of mung bean porridge. Locally available foods had potential to improve diet quality of infants aged 6–11 mo, providing that the consumption frequency is increased. Consumption of food sources for Fe and Zn needs to be improved in terms of both portion and frequency.
Key Words   children 6–11 mo, complementary feeding, linear programming, Optifood

Health and nutritional status of children especially malnutrition is still important issues to be tackled in Indonesia. Despite of many programs that have been in place to handle stunting and undernutrition, their prevalence remains high. Basic health research data (*1*), the latest survey of basic health data run by Ministry of Health Indonesia, revealed that the proportion of undernutrition, stunting and wasting in this age group were 11.4%, 30% and 11.7% respectively.

SEANUTS study showed that stunting prevalence is higher in rural areas (approximately 25% in urban areas and approximately 39% in rural areas) (*2*). Basic health research data (*1*) showed similar pattern that the prevalence of stunting was higher in rural areas (32.8%) than urban areas (27.4%).

Feeding practice has a significant role for children' growth. The importance of complementary feeding practice among children 6 mo above along with breast-

milk in morbidity and malnutrition reduction has been widely recognized (*3*). Literature study conducted by Blaney et al. (*4*) regarding complementary feeding practices in Indonesia showed that the practice among mothers who have children aged 6 mo above was still not optimal. Some aspects that were indicated as determinant factors include dietary diversity, responsive feeding, iron source food consumption and food hygiene both in preparation and feeding practice (*4*).

Total diet survey in Indonesia 2014 showed that more than half of the children aged 0–59 mo (55.7%) had lower mean energy intake compare to their recommended daily allowance (RDA) for Indonesian (*5*). However, protein intake in this group was more than the RDA (36.8% and 25.5 gr) respectively. Mean protein intake children at urban areas (39.2%) was higher than at rural areas (34.4%). In addition, mean carbohydrate intake in this age group was higher in urban areas compare to rural areas (153.7 gr vs 142.1 gr) (*5*).

The identification of adequate food-based feeding rec-

E-mail: hendriyaniheni74@gmail.com

ommendations that takes into account locally available foods and address gaps in nutrient availability needs serious effort (6). Sustainable diet, which addresses the consumption of foods with lower water and carbon footprints, promotes the use of food biodiversity including traditional and local foods with their nutritionally rich species and varieties, and can play a role in enhance food security throughout the world has been a focus recently (7). In obtaining a sustainable diet and offers a solution to address malnutrition in poor rural areas, enhanced consumption of local foods is one important note. Local food is defined as "a locally or regionally produced agricultural food product is less than 400 miles from its origin or within the state which it was produced" (8). Local food systems can provide many advantages for the communities in terms of local economic development, food and nutrition issues and environment (8). Meanwhile, local people's areas are often related with high biological diversity, and they have their own value culture and traditional knowledge which need to be developed to construct good nutrition program (9). A study conducted by Fahmida et al. in 2015 suggests that nutrition education and behavior-change communication with CFR messages have the potential to influence food choice toward more nutritious foods in rural Lombok Indonesia (10).

Rapid modifications in consistency, amount and variety of complementary foods of the Infant and Young Child (IYC) diet as an infant ages make the development of Complementary Food Recommendation (CFR) to improve nutrient adequacy more difficult. Even though the World Health Organization have developed general IYC feeding guidelines that can be applied in all countries, it is essential to adjust these to be locally relevant (11). Optifood, a new software, which uses linear programming analysis, was developed to enable the development of context-specific and realistic CFR for adoption by caregivers (6). Optifood can accurately specify the extent to which these can supply nutritionally adequate diets for the whole population as well as delivers information on the best combinations of local foods to optimize nutrient intakes. The advantages using optifood is it can identify specific local context CFR that include actual dietary practices, possible gaps between intakes and requirements for specific nutrients, and local food availability. The Optifood-resultant CFR can also diverge considerably between age groups within a population area since the analyses used to identify CFR are based on 24 h dietary recall data demonstrating food intakes specific to certain age groups (i.e. 6–8, 9–11 and 12–23 mo) and the dietary patterns across these age groups can be different.

This study was carried out to identify the realistic combination of local foods within the constraints of actual dietary patterns that would meet or come as close as possible to meeting the nutrient needs of the target population since its potential to promote sustainable diet through local food consumption. The aims of the study were to evaluate whether the current diet of children between 6–11 mo in the study area was suffi-

cient, identify nutrient gaps "problem nutrients" and to develop appropriate complementary feeding recommendation (CFR) within the constraints of the normal local dietary patterns. Special region of Yogyakarta was chosen as the study area. Some health indicators in Yogyakarta are better than national indicators. Based on basic health research 2018 it is known that the prevalence of stunting among young children aged 6–23 mo was 20.5%, lesser than national prevalence (29.9%) (3). Meanwhile, the prevalence of wasting in this region was 8.1%, while national prevalence was 11.7% (1).

MATERIALS AND METHODS

Study site, design, and subjects. This study was conducted in Special Region of Yogyakarta Region as a part of national survey on nutrition assessment and food consumption run by Ministry of Health Indonesia. Population of the national survey was children aged 0–59 mo and study participants for this study were all children aged 6 to 11 mo in rural areas of Kulon Progo, Bantul and Sleman Districts. Data collection was conducted from Mei to June 2017.

Data collection.

Socio-demographic characteristics of the subjects. Socio-demographic characteristics were obtained using a questionnaire collected through face-to-face interviews with the mothers.

Anthropometry. In obtaining anthropometric data, the body weight of the children was measured using the digital scale precision±0.1 kg; Seca 813) with the child minimally clothed. Recumbent length was measured using length board with precision ±0.1 cm. Enumerators were trained to take anthropometric measurements and they were standardized by the Ministry of Health team. Anthropometric data were analyzed using the WHO Anthro Software (version 2.0.4) to calculate the children's Z-scores for length-for-age (LAZ), weight-for-length (WLZ) and weight-for-age (WAZ). The children were categorized as stunted, wasted or underweight if their LAZ, WLZ and WAZ were less than -2 SD and as severely stunted, wasted or underweight if the respective Z-scores were less than -3 SD according to the World Health Organization.

Food consumption pattern. The dietary intakes of the children were assessed using single 24-h (without serving size estimates) dietary recall. Data from dietary assessment were used to describe the median and range of food consumption patterns in 7 d. Food serving sizes were estimated by asking the mother to estimate the amount of foods consumed in local cups or utensils, and the estimated amounts were weighed using the real food models. This single 24-h recall was used also for obtaining information on the frequency of foods and beverages consumed within the 24 h. Mothers were interviewed to get the list of all foods and beverages consumed by the child the previous day. Information was also collected on the time of consumption.

Food composition database. The Indonesia food composition database MoH Indonesia 2017 was applied for all nutrients except vitamin B6 and B12 in (12). Data

for vitamin B6 and B12 that nutrients were imputed mainly from the Cohort Baduta food composition database (SEAMEO RECFON 2017), Australia, New Zealand, and United States Department of Agriculture food composition databases by matching the foods using key nutrients as described by Gibson (*13*).

Preparation of linear programming (LP) model parameters. The dietary assessment data from survey were used to set the LP model parameters and processed in Microsoft Excel 2007. The model parameters consist of a list of foods consumed by the subjects (from 1 d 24-h recall dietary assessment methods), a median serving size for each food (g/d for consumers only), the number of servings per week for individual foods, food groups and food subgroups (Table 1 and 2). This study used method from the previous study by Skau et al. to define model parameters for weekly food-consumption patterns, for food groups, and food subgroups (*14*).

The range in weekly food pattern consumption frequencies (minimum, average and maximum) was defined as the 5th, 50th and 95th percentile of the frequency distribution for each food item, food group and subgroup. For nutrient-dense foods for which the 90th percentile value was 0 (i.e. <10% of children consumed it), the maximum frequency of consumption was defined at 95th percentile with the aim to promote consumption of these nutrient-dense foods. These LP parameters were used to set up the LP models for the analyses in the WHO Optifood software (version 4.04). The twelve nutrients were analyzed in Optifood: protein, Ca, vitamin C, thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12, vitamin A, Fe, and Zn. The mean body weight of subject population i.e. 8.4 kg was used in the LP models to calculate the average energy requirements for the infants (6–11 mo old) based on the WHO/FAO energy requirements. This study used the average breast milk intake of 541 g/d for 6-to11-mo-olds based on WHO recommendation 1998.

Development of complementary feeding recommendations (CFR). The CFR could be established with WHO Optifood in four analytical modules according to Daelmans et al. (*6*). The model parameters were checked in module I, and all analysis were carried out in modules II and III. There were two nutritionally best diets which represented in the module II analysis. The 'food pattern best diet' was defined by the average of food patterns of target population's while the 'no food pattern best diet' was defined as the food pattern which deviate from the average food patterns while still remaining within the observed food pattern ranges. Then, in the module III analysis, the diets that had the lowest and the highest nutrient contents were first delivered without CFR to provide baseline levels for comparison. The lowest nutrient contents were nutrients minimized to identify the worst-case scenarios whereas the highest were nutrients maximized to identify the best-case scenarios. Further analysis in module III specify the worst-case scenario nutrient levels, for each alternative CFR tested.

The CFR were set up based on problem nutrients (PN) of the subject population's. The PN is assigned if the

Table 1. Foods consumed by 6 to 11 mo-old rural infants, the number of infants consuming them, and median serving sizes.

Food items	n	Serving size (g)
Staple		
Rice, white steamed	34	35 (10–100)
Rice, white porridge	27	50 (10–160)
Rice, white raw	3	8 (6–38)
Soft rice	23	100 (10–150)
Rice, flour	7	15 (5–50)
Fortified instant baby's cereal	20	30 (25–60)
Animal protein		
Chicken egg, raw	9	30 (10–60)
Chicken egg, fried	11	25 (10–60)
Chicken egg, yolk	4	24 (20–33)
Duck egg	1	20 (10–20)
Chicken meat, raw	12	10 (10–25)
Chicken meat, grilled	2	25 (20–30)
Chicken liver, raw	3	11 (10–25)
Chicken nugget	2	58 (10–105)
Cat fish, raw	5	25 (20–30)
Fresh fish, raw	5	20 (10–20)
Sausage, cooked	3	10 (10–10)
Meat ball, cooked	4	10 (5–20)
Plant protein		
Tofu, raw	9	25 (10–50)
Tofu, fried	2	33 (25–40)
Tempeh, raw	3	25 (13–25)
Tempeh, fried	5	28 (10–50)
Mung bean, raw	1	10 (10–10)
Mung bean extract	7	40 (20–50)
Red bean, raw	1	10 (10–10)
Fruits		
Avocado	4	63 (50–75)
Banana (ambon)	11	50 (10–150)
Banana (mas)	8	29 (5–50)
Watermelon	2	55 (10–100)
Mango	2	45 (45–50)
Papaya	13	50 (25–150)
Orange	22	40 (10–100)
Guava	2	38 (25–50)
Vegetables		
Cauliflower, raw	5	10 (3–25)
Baby corn, raw	7	9 (2–16)
Spinach, raw	15	15 (5–33)
Bean, raw	2	10 (9–10)
Cabbage, raw	2	11 (6–15)
Carrot, raw	51	10 (3–30)
Broccoli, raw	38	10 (5–30)
Yellow pumpkin, raw	2	18 (10–25)
Tomato, raw	2	10 (5–10)
Potatoes, raw	9	10 (5–10)
Snack		
Biscuit non fortified	58	18 (5–30)
Bread, sweet	6	25 (10–30)
Cassava, boiled	3	16 (10–35)
Condiment		
Honey	2	5 (5–5)
Palm sugar	5	5 (5–10)
Sugar	7	10 (2–10)
Palm oil	15	3 (1–5)

Table 2. Serving sizes (consumers only) and upper constraint level (maximum serving per week) for modelled food items (medians and ranges).

Nutrient-dense foods included in the model	Serving size (g/d)		Upper constraint (serving/wk)
	Median	Range	
Cereal			
Rice	50	10–160	15
Enriched fortified grain product (instant cereal)	30	25–60	2
Meat Fish Egg			
Egg (chicken/duck)	30	10–60	2
Organ meat			
Chicken liver	11	10–25	2
Fish without bones			
cat fish	25	20–30	2
Legumes Nuts Seeds			
Nuts seeds	40	20–50	1
Unsweetened product (Mung bean)			
Vegetables			
Dark green leaf			
Spinach	15	5–33	6
Broccoli	10	5–30	15
Carrot	10	3–30	18
Fruits			
Papaya	50	25–150	3
Banana	50	10–150	2
Orange	40	10–100	3

nutrients did not achieve 100% of their RNI in the model in Module III which had the upper tail of the model nutrient intake distribution. Besides that, it was necessary to define the dietary adequacy (DA) which showed by ≤65% of its RNI in the "worst-case scenario" in Module III which had the lower tail of the modeled nutrient intake distribution. The DA was accepted percentage of the population at risk of an inadequate nutrient intake. The CFR was evaluated if the DA for each nutrient was set if the nutrient level >65% of RNI in the 'worst-case scenario' (minimized).

Nutrient dense food (NDF) was identified on the basis of the food patterns of the best diets in module II to formulate alternative sets of CFR in the module III analyses. The NDF were selected based on PN of the target population. Each set of CFR was described as the number of daily servings per week to be consumed of individual food groups, subgroups, food items or combinations of them. The set of CFR that achieved >40% of RNI in the 'worst-case scenario' with the simple combination was selected as the final set of CFR.

RESULTS

General characteristic of the target group

Ninety-one recall data from children aged 6–11 mo were obtained. There were 49 male and 42 female children with the mean age of 9.4 mo. The average weight and length of the children were 8.4±1.71 kg and 71.3±5.77 cm. The prevalence of stunting was 17%,

of underweight 9%, and wasting 8%. There were 37% infants who have insufficient energy intake and 30.7% insufficient protein intake.

Food patterns

The reported consumed foods were 65 different types of food items. Of those, 9% reported foods were excluded from the linear program models as those foods were either condiments, rarely consumed foods, or not of high nutrient value. Rice was the most common foods consumed. The most frequent animal protein food was chicken egg (26.3%), followed by chicken meat (15.4%). Fish was consumed only by 11% of the children. More than 50% of the children consumed vegetables and fruits (Table 1).

Food frequency, food serving sizes, and food patterns

There were 45 foods of which 6 were staples, 5 were plant protein foods, 9 were animal protein foods, 8 were fruits, 9 were vegetables, and 7 were snack and condiment foods consumed by the infants (Table 2). Rice, fortified baby's cereals, orange, carrots, broccoli, and unfortified biscuits were consumed by more than 20% of children. Tempe and tofu as cheap plant protein source foods and available in any area were consumed by less than 20% of the infants. Orange, carrot and broccoli were vegetables and fruits mostly consumed by >20% of the infants. Fish was consumed by a small number of the infants.

The serving size varied, from as small as 3 g per eating occasion for palm oil to 100 g per eating occasion for rice (Table 1). Although both rice and fortified cereal were often consumed, rice was consumed in larger amounts, i.e. 100 g/d of rice vs. 30 g/d dry weight (60 g/d wet weight) of fortified cereal. The serving sizes for animal and plant protein source foods were similar (range, 10–60 g/serving). The serving sizes of fruits ranged from 29 to 63 g; much larger than vegetables of 9–18 g per serving.

The Optifood analysis figured out that meat, fish, eggs, fruit, legumes, nuts, and seeds were infrequently consumed. The infants generally consumed 2–3 staples/d and 1–2 snacks/d. Vegetables consumption exceeded meat, fish and eggs consumption. Legumes, nuts and seeds and fruits consumption was low (Table 2).

Subgroups sources of nutrients

Among food subgroups, breast milk was the main nutrient source food for fifteen nutrients followed by whole or refined enriched/fortified cereals and products, (11 nutrients) (Table 3). Animal protein source foods that provided more than 5% of nutrients were egg and organ meat (9 and 7 nutrients respectively), whilst plant protein source foods were nuts, seed and unsweetened products (9 nutrients).

Problem nutrients

Figure 1 showed that intakes of Fe and Zn could not fully reach the Recommended Nutrient Intake (RNIs), while the vitamins C, B6, folate, B12, and A could achieve 100% of RNIs by using optimized food pattern. Calcium, Zn, riboflavin, niacin, and Fe were identified as 'problem nutrients' in the two best diets (i.e. nutrient level in the two best diets is <100% RNI) (Table 3, best

diets: first two rows). Zinc and Fe were 'absolute problem nutrients' (i.e. nutrient level in the best-case scenario diet without a CFR is <100% RNI) (Table 3, best-case scenario without a CFR). Figures 1 and 2 showed the percentage in graph.

The 'no food pattern best diet' covered almost all of nutrients RNI's except iron and zinc so that the alterna-

tive CFR should be done. After all the alternative sets of CFR were generated and compared on the basis of their worst-case scenario nutrient levels in module III, the final sets of CFR selected could cover iron and zinc close to 50% of RNI (Table 4). However, this final alternative CFR did not meet 65% of RNI for others nutrients. Yet, this final alternative CFR was chosen as the most promising CFR because of the realistic and simple combination increasing the likelihood for optimal achievement by target population.

Recommended frequency and portion sizes of the final complementary feeding recommendations formulated for infants aged 6–11 mo old in rural Districts of Yogyakarta Province, Indonesia include:

1. Breast-feed daily on demand
2. Had at least 3 main meals in a day
3. Feed animal protein at least every alternate day, including
   a. At least 3 servings/wk of all type of eggs
   b. At least 5 servings/wk of fish without bone
   c. At least 3 servings/wk of liver
4. Feed plant protein (legumes, nuts or seeds) at least 2 servings/wk, including
   a. At least 1 serving/wk of mung bean porridge
5. At least 2 servings/wk of whole or refined enriched/fortified cereals and products

Recommended minimum portion size/meal:
1 serving of chicken liver=25 g (cooked weight)
1 serving of fish without bone=100 g (fried weight)
1 serving of eggs=50 g (boiled weight)

Table 3. Food subgroups providing >5% of nutrients in the NFP diet of breastfed children.

| Food subgroups	Numbers of nutrients
Breastmilk	15
Enriched/fortified grains and products, whole or refined	11
Eggs	9
Nuts, seeds, and unsweetened products	9
Organ meat	7
Refined grains and products, unenriched/unfortified	8
Vitamin A source dark green leafy vegetables	5
Fish without bones	5
Vitamin A source fruit	4
Vitamin C-rich vegetables	4
Other fruit	2
Fluid or powdered milk (non-fortified)	2
Vitamin C-rich fruit	2
Vitamin A source other vegetables	1
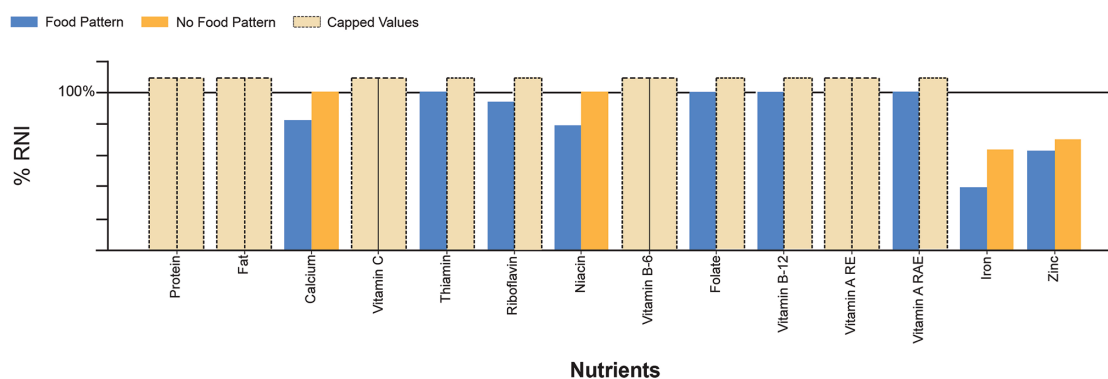
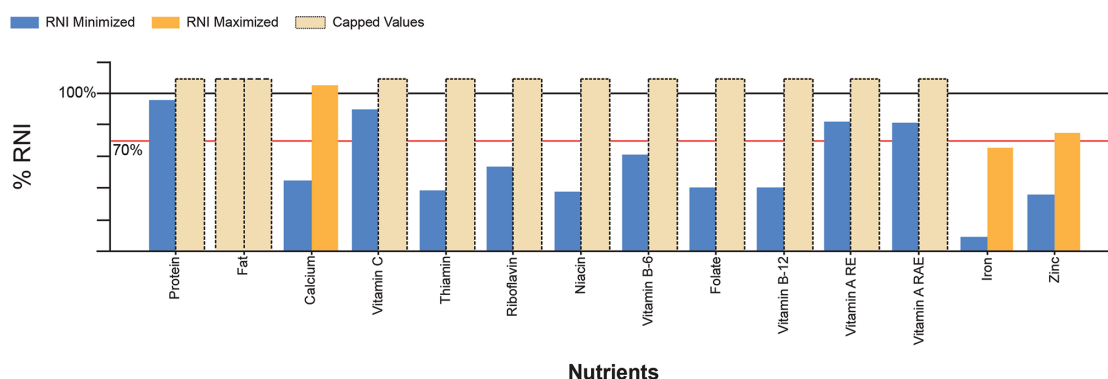Fig. 1.   Percentage of RNI achievement for each nutrient of two best diets.

Fig. 2.   Worst and best scenario diet.

Table 4. Comparisons of nutrient levels and minimized costs of the two best diets (module II), worst-case and best-case scenario diets without complementary feeding recommendations (CFR) (module III), and alternative sets of CFR tested (module III; worst-case scenarios only).

Analysis	Achievement of nutrients (% RNI)											
	Protein	Fe	Zn	Ca	Vit. B1	Folate	Vit C	Vit B2	Vit B3	Vit B6	Vit B12	Vit A (RAE)
Best diet (food pattern)	131.7	39.6	63	82.5	79.6	100	154.8	100	93.8	140.1	100	100
Best diet (no-food pattern)	172.4	63.6	70.2	100	100	158.7	284.2	148.9	130.2	160.7	230.4	170
Best-case scenario without CFR	194.7	65.1	74.8	105	136.2	207.2	314.6	180.6	147.5	404.4	295.1	200.1
Worst-case scenario without CFR	95.1	8.4	35.3	44.4	36.9	39.4	88.9	37.6	53.2	60.7	40.2	81.3
Alternative sets of CFR tested (worst-case scenarios only)												
CFR1*	174.4	42.3	61.6	81.4	88.3	81.1	153.1	107	105.8	203	192.6	123.5
CFR2	170	44.6	60.6	74.2	95.7	83.2	173.2	115.2	107	208.8	195.4	107.8
CFR3	171.3	44.3	60.7	75.2	95.5	75.4	161.5	113.9	106.6	208	195.2	107.6
CFR4	168.4	43.7	57.2	71.9	93	80.8	150.1	102.6	103.6	197	178.9	101.1
CFR5	175.3	42.9	61.1	70.9	86.3	131.6	157.2	115.6	104.9	205.2	192.8	107.5

RNI, recommended nutrient intake; vit, vitamin.

CFR1*: instant fortified baby porridge 2 servings/wk; eggs 3 servings/wk; fish without bone 5 servings/wk; liver 3 servings/wk; legumes, nuts & seeds 2 servings/wk; mung beans porridge 1 serving/wk.

CFR2: fruits6; vitamin a source dark green leafy vegetables 6 servings/wk; fortified biscuits 3 servings/wk; instant fortified baby porridge 2 servings/wk; animal protein sources 5 servings/wk; eggs 3 servings/wk; fish without bone 5 servings/wk; legumes, nuts & seeds 2 servings/wk; mung beans porridge 1 serving/wk.

CFR3: vitamin a source dark green leafy vegetables 6 servings/wk; fortified biscuits 3 servings/wk; instant fortified baby porridge 2 servings/wk; animal protein sources 5 servings/wk; eggs 3 servings/wk; fish without bone 5 servings/wk; legumes, nuts & seeds 2 servings/wk; mung beans porridge 1 serving/wk.

CFR4: vitamin a source dark green leafy vegetables 6 servings/wk; fortified biscuits 3 servings/wk; instant fortified baby porridge 2 servings/wk; eggs 3 servings/wk; fish without bone 5 servings/wk; liver 3 servings/wk.

CFR5: vitamin a source dark green leafy vegetables 6 servings/wk; eggs 3 servings/wk; fish without bone 5 servings/wk; liver 3 servings/wk; legumes, nuts & seeds 2 servings/wk; mung beans porridge 1 serving/wk.

1 serving of mung bean porridge=50 g (cooked weight)
1 serving of instant fortified porridge=60 g (wet powder weight)
1 serving of rice porridge=50 g (cooked weight)

DISCUSSION

This study described current feeding patterns as well as its modifications to increase the weekly consumption of specific, nutrient-dense foods to ensure dietary adequacy among 6–11 mo-old breastfed infants from rural Yogyakarta, Indonesia. Breastfed infants were identified as those who was breastfed in the observation day. This could result in underestimation of the number of breastfed children. It is considered that there would still be gaps in the intake adequacy for several nutrients, even when the CFR were adopted. Such gaps were aimed to be the lowest by taking into account the types, frequency and portion sizes of foods consumed in the existing dietary patterns.

The current analysis shows that additional modifications to the diet are essential to achieve nutritional adequacy of the diet. Such interventions might include provision of fortified foods, specifically those that are fortified with zinc and iron, or home fortification strategies (i.e. micronutrient powders). This modification is necessary as the food sources of micronutrients, such as animal-source foods were consumed less in both in quantity and quality. Studies promoting the use of local foods confirmed that food-based approaches could increase the micronutrient content of diets, yet they might not ensure dietary adequacy for all nutrients, especially iron, zinc, and calcium (14–16). Some strategies which combine the local foods with micronutrient supplementation or fortified foods can be developed 14–16) and these strategies should be coupled with well-designed behavior change intervention to be successful 15, 16). The need for effective nutrition education to achieve positive changes in individual or family diets and in practices is more pronounced than ever (17). For nutrition education intervention to be successful, the capability of nutritionist in performing nutrition education and counseling, and to assess, analyze and take appropriate actions to address individual, patients,

or family food and nutrition problems has to be increased (*18*).

Optifood's approach in developing context-specific recommendations for individual target populations means that analysis occurs in isolation for each age-based target group due to differences in food patterns and RNI. This type of analysis would assist the promotion and adoption of a single set of practices for the duration of the complementary feeding period by caregivers as opposed to recommending new foods or practices.

As the recommendation of local foods was formed based on the most frequently consumed foods and within the observed frequency of servings, the study could give valuable information for health workers in designing complementary food message. Furthermore, the recommendation of food groups or subgroups was chosen instead of specific food items to facilitate ease in implementation. This study also recognized several important food sources for the diet of children aged 6–11 mo, which could be promoted through agricultural interventions, such as increasing production and accessibility.

There are some challenges foreseen in the implementation and adoption of the developed local-specific CFR. Firstly, the recommendations were developed at their high constraint levels, which were at their high number of servings per week from food/food sub group according to the target groups' dietary patterns with the purpose of ensuring the nutritional adequacy. Secondly, to ensure the diet provide ≥70% of all micronutrient RNIs, the recommendation should come up with numbers of CFR and set at their highest constraint (*16*). FANTA (*16*) also stated that recommendation to include animal-source foods in the diet make diet become more expensive, and hinder affordability.

CONCLUSION

This study showed that locally available foods had potentials to improve diet quality of infants aged 6–11 mo, provided that the consumption frequency be increased. As iron and zinc remained deficient, the fortified/enriched food source for iron and zinc is needed.

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