ORIGINAL RESEARCH

CURRENT DEVELOPMENTS IN NUTRITION

Maternal and Pediatric Nutrition

Problem Nutrients and Food-Based Recommendations for Pregnant Women and Under-Five Children in High-Stunting Districts in Indonesia

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ABSTRACT

Background: Stunting and anemia in pregnant women and under-five children remain a challenge in developing countries, including Indonesia. One of the significant contributors to these problems is inadequate nutrient intake.

Objectives: The aim of the study was to identify, using a linear programming (LP) approach, problem nutrients and optimized food-based recommendations for under-five children and pregnant women in 10 stunting-prioritized districts in Indonesia.

Methods: LP analysis was done using the Optifood tool on dietary data collected using single 24-h dietary recall in the National Monitoring of Nutrient Consumption (*Pemantauan Konsumsi Gizi*), conducted by the Ministry of Health from 10 stunting-prioritized districts in Indonesia. Problem nutrients and nutrient-dense foods were identified, and all alternative food-based recommendations or complementary feeding recommendations were compared to identify which recommendation will best contribute to fulfill dietary adequacy.

Results: The number of problem nutrients in each district ranged from 0 to 7 nutrients for under-five children and 1 to 6 nutrients for pregnant women. The top 3 problem nutrients were: iron, zinc, and folate (for children aged 6–11 mo); zinc, folate, and calcium (for 12–23-mo-olds and 24–35-mo-olds); folate, zinc, and vitamin C/riboflavin (for 36–59-mo-olds); and iron, folate, and calcium (for pregnant women). The findings showed that problem nutrients identified using LP were in line with nutritional problems in under-five children (stunting and anemia) and pregnant women (anemia). Food-based recommendations (FBRs)/complementary feeding recommendations were developed that best meet dietary adequacy for the nutrients.

Conclusions: Despite the similarity in stunting prevalence across the districts, there was variation in number and types of problem nutrients. The developed FBRs that promoted nutrient-dense foods suited to the problem nutrients in each area need to be promoted to improve nutrient intakes of under-five children and pregnant women in these areas with high stunting prevalence. *Curr Dev Nutr* 2022;6:nzac028.

Keywords: complementary feeding recommendation, food-based recommendation, Indonesia, linear programming, pregnant women, problem nutrients, stunting, under-five children

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Abbreviations used: CFR, complementary feeding recommendation; FBR, food-based recommendation; FIF, fortified infant food; IFA, iron folic acid; LP, linear programming; MMS, multiple micronutrient supplementation; RNI, recommended nutrient intake.

Key messages:

- Problem nutrients identified using linear programming in pregnant women and under-five children in 10 stunting-priority districts in Indonesia varied in terms of number and type.
- The top 3 problem nutrients were iron, zinc, and folate (in children aged 6–11 mo); zinc, folate, and calcium (age groups 12–23 mo and 24–35 mo); folate, zinc, and vitamin C/riboflavin (age group 36–59 mo); and iron, folate, and calcium (pregnant women). These problem nutrients were in line with nutritional problems in under-five children (stunting and anemia) and pregnant women (anemia).
- The developed food-based and complementary feeding recommendations, which are in line with the specific problem nutrients, target a group's food pattern and promote the locally available nutrient-dense foods that should be incorporated into health promotion strategies for stunting prevention.

Introduction

To reduce stunting in under-five children, in 2017 the government of Indonesia announced stunting reduction as a national priority and identified 100 villages in 10 districts as stunting-prioritized districts. These 10 districts were selected based on number and prevalence of stunting in under-five children and the poverty rate.

Inadequate nutrient intakes are important determinants of child stunting and maternal anemia. Locally available nutrient-dense foods have been emphasized by the WHO/UNICEF Global Strategy for Infant and Young Child Feeding as well as Indonesia's Balanced Nutrition Guideline to improve nutrition adequacy (1). Feasible, accessible, and locally contextual food-based recommendations (FBRs), including complementary feeding recommendations (CFRs), which are compatible with specific problem nutrients and nutrient-dense foods in the area are important to achieve adequate nutrient intakes. Indonesia has a diverse population with differences in food patterns and food availability, and this difference can affect adequacy of nutrients from locally available foods. Linear programming (LP)–based software called Optifood, developed by the WHO, can be used to identify local-specific problem nutrients and develop feasible and affordable local-specific FBRs to reduce child stunting and maternal anemia (2, 3).

The aim of the study was to identify, using an LP approach, problem nutrients and optimized food-based recommendations in under-five children and pregnant women

in 10 stunting-prioritized districts in Indonesia.

Methods

LP analysis using the Optifood tool was used based on dietary data collected using single 24-h dietary recall from 10 stunting-prioritized districts in Indonesia in the National Monitoring of Nutrient Consumption (*Pemantauan Konsumsi Gizi*) conducted by the Ministry of Health. The total number of participants in this study was 3577, consisting of children aged 6–11 mo ($n = 366$), 12–23 mo ($n = 754$), 24–35 mo ($n = 572$), 36–59 mo ($n = 749$), and pregnant women in their second and third trimesters ($n = 1201$). Details of the number of subjects with dietary recall data by district and age group are given in **Table 1**.

LP analysis was done as described by Ferguson et al. (4) using Optifood software. Prior to LP analyses data cleaning was done by a team, who were all nutritionists trained in Optifood. The analysis was performed for 5 age groups based on the Recommended Nutrient Intake (RNI) for children aged 6–11 mo, 12–23 mo, 24–35 mo, and 36–59 mo, and pregnant women. Food pattern as the maximum number of servings per week was estimated by using the approach used previously, that is, 1, 2, 3, 4, 5, 6, or 7 when 0–5%, 6–12%, 13–22%, 23–34%, 35–47%, 48–65%, and 66–100%, respectively, of the children or pregnant women consumed the food (5). Weekly consumption of food items, food subgroups, and food groups (the "food pattern," i.e., 5th, 50th, and 95th percentiles of frequency of consumption per week) and median portion of food items among those who consumed (i.e., the "portion") were used as constraints in LP. The Indonesian food composition table was used (www.panganku.org), and for missing nutrients values were imputed using data from neighboring countries after adjusting to match the water content of the Indonesian food items.

TABLE 1 Number of subjects with dietary recall data and number of food items used in linear programming analysis, by district and age group

		Number of subjects						Number of foods				
	District	6–11 mo	12–23 mo	24–35 mo	36–59 mo	Total under-five	Total pregnant women	6–11 mo	12–23 mo	24–35 mo	36–59 mo	Pregnant women
1.	Brebes	30	94	59	75	258	153	41	70	80	100	143
2.	Cianjur	35	49	44	65	193	216	34	95	111	140	149
3.	Gorontalo	34	74	61	76	245	47	25	43	42	58	54
4.	Ketapang	42	75	51	84	252	100	36	79	74	99	111
5.	Lampung Tengah	41	95	56	84	276	286	56	106	92	118	171
6.	Lanny Jaya	25	66	77	93	261	16	28	36	32	29	20
7.	Lombok Tengah	38	85	56	67	246	108	35	88	107	116	121
8.	Maluku Tengah	35	74	44	56	209	21	29	53	49	59	52
9.	Pemalang	41	74	70	67	252	223	69	96	121	123	140
10.	Rokan Hulu	45	68	54	82	249	31	41	70	80	100	78
	Total	366	754	572	749	2441	1201					

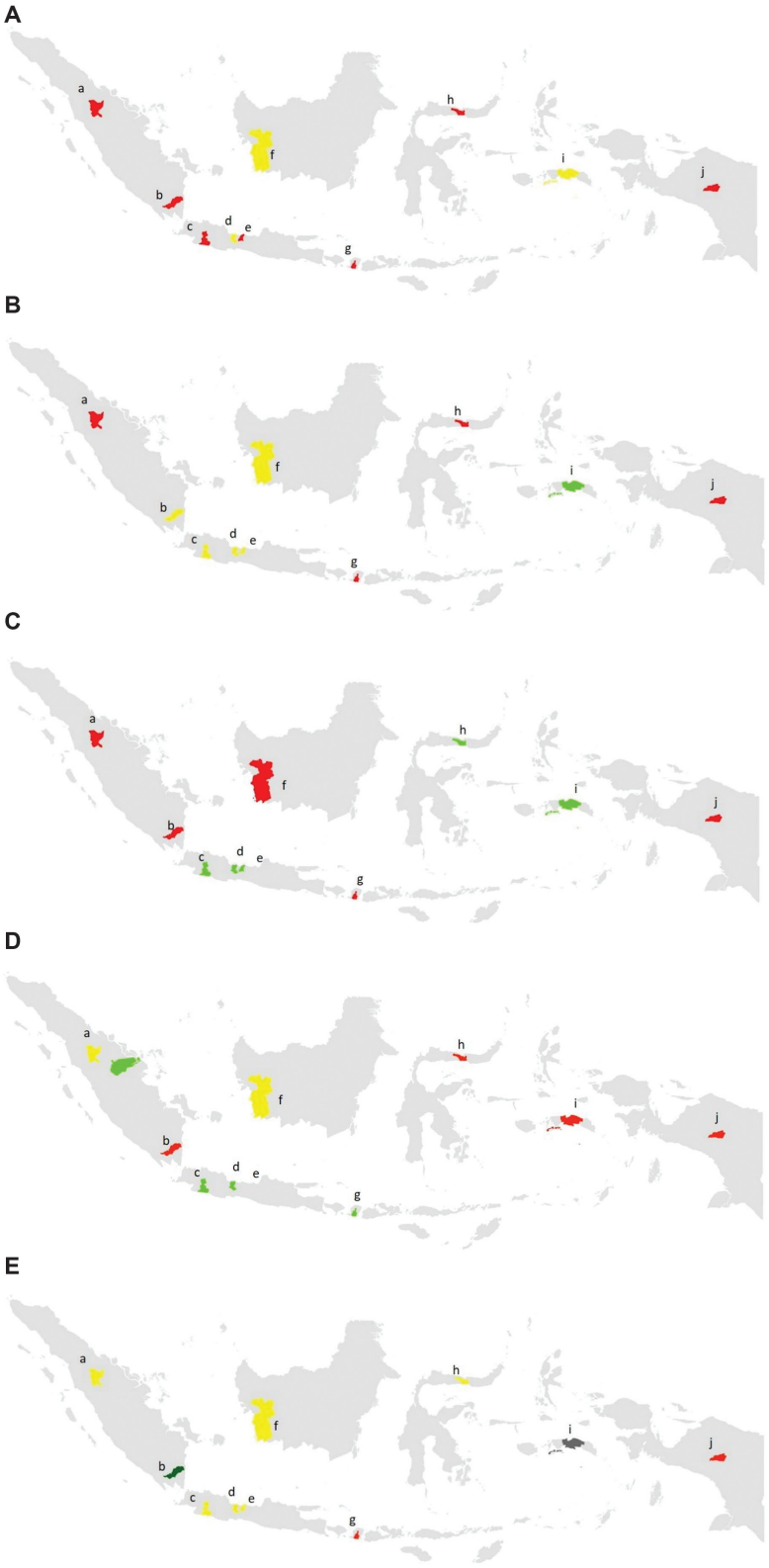

FIGURE 1 Number of problem nutrients in the 10 stunting-prioritized districts, by age group. The A–E refer to age groups: (A) 6–11 mo infants, (B) 12–23 mo, (C) 24–35 mo, (D) 36–59 mo, and 282 (E) pregnant women. The a–j refer to the district/province: (a) Rokan Hulu—RIAU, (b) Lampung Tengah— LAMPUNG, (c) Cianjur—WEST JAVA, (d) Brebes—CENTRAL JAVA, (e) Pemalang—CENTRAL JAVA, (f) Ketapang—WEST KALIMANTAN, (g) Lombok Tengah—WEST NUSA TENGGARA, (h) Gorontalo—GORONTALO, (i) Maluku Tengah—MALUKU, and (j) Lanny Jaya—PAPUA (Red: 3 or more problem nutrients Yellow: 1-2 problem nutrient(s) Green: no problem nutrient identified).

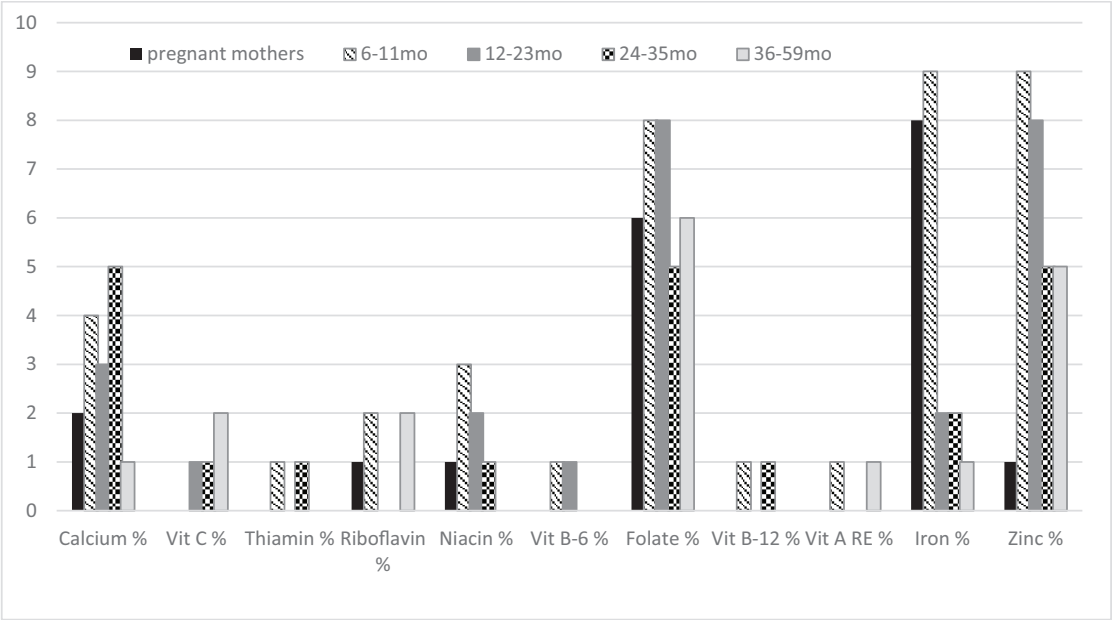

FIGURE 2 Number of districts with identified problem nutrients by age groups. RE, retinol equivalent, Vit, vitamin.

A problem nutrient was defined as a nutrient that did not meet 100% of the RNI based on FAO-RNI in the 2-best-diets Non Food Pattern in Optifood software, which is a nutritionally best diet derived from the deviation of the population's average food pattern while remaining within the minimum and maximum food pattern range (Optifood module 2). Subsequently, the analysis in module 3 was done to determine the worst-case scenario (diet generated with the minimized nutrient contents) and the best-case scenario (diet generated with the maximized nutrient contents). Problem nutrients were categorized into partial (i.e., meeting 100% RNI in the best-case scenario) or absolute (i.e., <100% RNI in the best-case scenario). Additionally, dietary inadequacy (i.e., cannot meet the estimated average requirement, or <65% of RNI in the worst-case scenario) was also assessed (Optifood module3, minimized diet). The Indonesian food composition database was used (www.panganku.org) and for missing nutrients values from neighboring countries were borrowed using water adjustment.

Based on the problem nutrients, nutrient-dense food subgroups and food items were identified, defined as those whose intake contributed ≥5% of the total intake for the problem nutrients. Alternative FBRs and CFRs were compared, which included different combinations of food subgroups and/or food items. The optimized FBR/CFR was selected from the alternative FBRs/CFRs based on their greatest number of nutrients that fulfilled the dietary adequacy (≥65% RNI in minimized or worst-case scenario).

Results

Most problem nutrients were found in the youngest children, aged 6–11 mo. In this age group 7 of 10 districts had ≥3 problem nutrients, which was more than in the older groups (i.e., 4–5 districts). In pregnant women, of 9 districts only 2 had ≥3 problem nutrients (**Figure 1**). On the other hand, the number of districts with no problem nutrients was 1 district in each of the 12–23-mo and 24–35-mo groups, 4 districts in the 36–59-mo group, but none in the youngest 6–11-mo group. Amongst the 10 districts, the average numbers of food items in pregnant women and under-five age groups were lowest in Lanny Jaya, Papua (20 and 28 food items, respectively) and highest in Lampung Tengah for pregnant women (171 food items) and Cianjur for under-five children (140 food items).

The number of problem nutrients in each district ranged from 0 to 7 nutrients for under-five children and from 1 to 6 nutrients for pregnant women. In under-five children the top 3 problem nutrients were: iron, zinc, and folate (6–11 mo); zinc, folate, and calcium (12–23 mo and 24–35 mo); and folate, zinc, and vitamin C/riboflavin (36–59 mo). In pregnant women, the top 3 problem nutrients were iron, folate, and calcium (**Figure 2**, **Table 2**). Table 2 shows that most 6–11-mo FBRs/CFRs included animal protein source foods and dark-green leafy vegetables, whereas most 12–23-mo and 24–25-mo FBRs/CFRs included dark-green leafy vegetables. Dairy products, including fortified ones, were more often included in the 36–59-mo FBRs/CFRs. At least half of the FBRs/CFRs in each age group in under-five children included fortified and unfortified bakery products.

An iron folic acid (IFA) tablet was added to each FBR for pregnant women in all districts. The number of messages specifying nutrient-dense food subgroup(s) and/or food item(s) varied across age groups ranging from 1 message (Lombok Tengah; 12–23 mo) to 11 messages (Ketapang and Lampung Tengah; 36–59 mo).

Discussion

The findings showed that problem nutrients identified using LP were iron, zinc, and folate in children aged 6–11 mo; zinc, folate, and

TABLE 2 Results of the 2-best diets, worst-case scenario and optimized FBRs (as percentage RNIs) for children aged 6–11 mo, 12–23 mo, 24–35 mo, and 36–59 mo and pregnant women in 10 stunting-priority districts[1]

No.	District	Analysis	<100% RNI	<65% RNI	Calcium %	Vit C %	Thiamin %	Riboflavin %	Niacin %	Vit B-6 %	Folate %	Vit B-12 %	Vit A RE %	Iron %	Zinc %
Children aged 6–11 mo															
1	Brebes	Optimized diets—FP	—	—	95.7	140.8	104.2	111	91.3	168	75.8	1187.4	112.8	1638	61.4
		Optimized diets—no FP	2	—	109	211.9	130.8	172.4	117.3	198.5	106.9	1231.3	254.9	61.2	75.4
		Worst-case scenario	—	9	51.1	88.9	51.8	58.8	40.8	33.5	34.6	39.2	81.6	10.9	31.6
		Optimized CFR: MFE6, Egg3, ChickenLiver1, FishwoBones3, SoybeanTempe3	—	0	110.5	74.2	126.3	167.1	116.3	175	70.6	80.2	133.9	65.9	82.9
2	Cianjur	Optimized diets—FP	—	—	79.7	125.3	115.8	110.6	81	100	59.3	100	138	24.8	35.1
		Optimized diets—no FP	3	—	110.1	205	134.6	154.8	112.7	160.7	84.2	131.4	180	41.9	58.1
		Worst-case scenario—	—	8	61.1	88.9	68.7	52.7	49.8	27.2	34.6	39.3	81.5	14.8	23.8
		Optimized CFR: MFE7, ProcessedMeat3, ChickenLiver1, Veg14, DGLV4, SoybeanProducts2, Fruits7, Bakery7		2	131.8	109.8	134.8	138.3	129.6	166.2	86.5	57.9	186.7	53.4	69.2
3	Gorontalo	Optimized diets—FP	—	—	119.8	118.6	179.2	130.5	159.3	322.8	21.3	1526.4	23.8	72.5	56.2
		Optimized diets—no FP	4	—	122.6	118.6	214.7	104.3	308.4	428.4	20.9	1065.7	36.7	70.1	64.8
		Worst-case scenario	—	3	103.6	91.1	163	103.1	112.7	263.9	11.7	1065.7	12.3	66.2	51.8
		Optimized CFR: MFE9, Egg4, ChickenLiver1, DGLV6	—	0	164	99.4	135.5	203.9	142.7	171.6	71.8	155.4	141.7	72.8	94.8
4	Ketapang	Optimized diets—FP	—	—	89.8	145.9	116.3	142.4	135	89.8	145.9	116.3	100	184.3	49.1
		Optimized diets—no FP	1	—	100	207.7	124.2	186	147.8	100	207.7	124.2	156.8	240.1	75.6
		Worst-case scenario	—	3	65.9	89.2	79.5	122.8	122.1	65.9	89.2	79.5	60.6	46.9	34.1
		Optimized CFR: MFE14, FishwoBones3, Egg4, Veg14, DGLV5, Fruits4		0	125.1	110.3	121.3	148.8	122.2	152.3	70.7	116.6	257.2	69	83.2
5	Lampung Tengah	Optimized diets—FP	—	—	96.8	120.3	105.8	90.5	72.4	92	41.2	649.4	125.6	31.9	40.1
		Optimized diets—no FP	6	—	100.4	123.9	110.2	92.6	74.9	95.4	42.2	650.2	130.8	33.2	41.2
		Worst-case scenario	—	7	72.9	88.9	78.6	52.2	52.8	27.9	34.1	39.3	81.5	17.2	24.2
		Optimized CFR: Veg21, DGLV7, MFE10, FishwoBones5, Soybean3, Orange1, Bakery7, FortiSweetenedBakery4		2	150.4	101.8	146.1	113.8	118.1	129.4	72.6	54.5	192.2	59.3	80.6
6	Lanny Jaya	Optimized diets—FP	—	—	90.6	130.2	101.2	95.6	95.9	115	48.7	43.3	98	17	20.5
		Optimized diets—no FP	5	—	98.8	228.4	152.1	121.1	102.4	181.6	69.3	44.6	139	18.5	24.8
		Worst-case scenario	—	8	64.1	89.2	66.8	56.1	47.7	27.7	33.8	39.2	81.5	6.9	12.8
		Optimized CFR: Fruits3, GreenBean2, SoyProduct2, DGLV7, PumpkinLeaves4, SweetPotatoLeaves3, Chicken3, Egg4, SweetbakeFor2		3	126.7	84.3	119.5	137.7	103.7	117.6	64.2	50	107.3	57.2	70.5

(*Continued*)

TABLE 2 (*Continued*)

No.	District	Analysis	<100% RNI	<65% RNI	Calcium %	Vit C %	Thiamin %	Riboflavin %	Niacin %	Vit B-6 %	Folate %	Vit B-12 %	Vit A RE %	Iron %	Zinc %
7	Lombok Tengah	Optimized diets—FP	—	—	38.5	74.4	44.2	95.1	33.8	96.5	43	103.1	370.9	32	42.5
		Optimized diets—no FP	6	-	69.2	104.5	65.1	112.3	73.3	100	70.4	167.1	157.1	79.4	54.5
		Worst-case scenario	—	9	30.5	71.6	30.3	43.4	20.6	20.9	33.2	55.1	72.4	10.5	22.1
		Optimized CFR: Veg9, DGLV4, SweetLeaveBush1, MFE7, ChickenLiver1, Bakery7	—	0	206.4	136.1	155	221.6	126.5	231.4	65.3	132.3	241.1	93.6	103
8	Maluku Tengah	Optimized diets—FP	—	—	98.3	135.4	102.1	102.9	98.2	130.2	53.1	100	99.1	34.5	52.9
		Optimized diets—no FP	2	—	133.6	243.8	133.7	210.5	101	158.6	73.7	791.7	187.9	67.3	100.2
		Worst-case scenario	—	8	61.1	88.9	65.9	55.6	46.4	24.1	33.7	39.2	81.6	16.6	27.1
		Optimized CFR: Egg6, DGLV7, VitAotherVeg6	—	2	173.5	101.9	122.2	137.8	91.8	161.1	58.1	59.9	119.6	75.3	80.3
9	Pemalang	Optimized diets—FP	—	—	125.2	211.3	136.7	149.1	118.2	262.9	61.8	146	154.7	51.9	54.7
		Optimized diets—no FP	3	—	122.7	209.6	142.2	171	138.8	260.6	95.3	907	257.2	59	74.9
		Worst-case scenario	—	6	62	91.5	62.6	78.2	70	69.7	33.4	39.2	81.5	20.9	41.7
		Optimized CFR: MFE6, ChickenLiver1, Egg3, DGLV10, VitAOtherVeg10, SoybeanProduct4, Mungbean2	—	0	165.4	122.5	142.8	177.7	141.1	271.3	72	83.4	160.3	79.9	102.7
10	Rokan Hulu	Optimized diets—FP	—	—	84	125.2	96.4	75.2	80.6	88.2	60.2	104.2	98	27.1	36.6
		Optimized diets—no FP	6	—	97.5	134.9	112.8	92.6	99.2	120.7	64.4	100	115.6	37.4	48.8
		Worst-case scenario	—	7	67.4	88.9	72.1	52.4	50.6	28	33.9	39.3	81.5	16.4	24.1
		Optimized CFR: Egg2, ChickenLiver4, DGLV4, VitAotherveg10, Legumes4, Fruits3, Unforti-fiedSweetenedBakery7	—	1	125.3	71.4	126	173.1	89.2	124.2	77.1	152.9	271.7	70.7	57.6
Children aged 12–23 mo															
1	Brebes	Optimized diets—FP	—	—	98.8	218.5	94.9	124.2	120.4	163	50.6	606.1	256.8	100.3 18	63.3
		Optimized diets—no FP	1	—	100	182	124.9	182.2	127.5	139.8	100	1128.2	204.4	138.7	98.1
		Worst-case scenario	—	9	63.2	89	58.6	57.4	39.9	43.5	26.2	32.9	85	37.7	47.4
		Optimized CFR: SoybeanTempe7, MFE10, ChickenLiver1, Unforti-fiedSweetenedBakery3, VitAOtherVeg14, DGLV3	—	0	76.5	126	145.4	214.1	130.3	174.2	76.4	152.8	274.7	116.1	131.4

(*Continued*)

TABLE 2 (*Continued*)

No.	District	Analysis	<100% RNI	<65% RNI	Calcium %	Vit C %	Thiamin %	Riboflavin %	Niacin %	Vit B-6 %	Folate %	Vit B-12 %	Vit A RE %	Iron %	Zinc %
2	Cianjur	Optimized diets—FP	—	—	85.6	145.1	105	157.1	94.4	81.7	46.5	1102.5	158.3	95.3	57.4
		Optimized diets— no FP	2	—	104.7	172.9	134.6	216.5	120.4	104.8	91.1	943.4	252.3	143.5	86.2
		Worst-case scenario —	—	8	63.2	81.2	64.6	65.6	43.8	26.5	19.3	32	75.7	47.7	30.5
		Optimized CFR: Fruits7, MungBean3, Legumes10, Bakeryproducts7	—	0	89.4	105	141.1	190.9	125.6	116.9	65.6	122.1	194.7	107.8	103.7
3	Gorontalo	Optimized diets—FP	—	—	107.9	24.7	334.5	82.6	580.5	482.6	33.5	1411.7	74.4	79.7	74.8
		Optimized diets— no FP	4	—	111.6	50.5	354.8	100	600.2	548.6	75	1295.2	109	84.1	80.3
		Worst-case scenario	—	5	99.4	14.5	272.3	41.4	391.1	338.2	18.8	98.3	46.7	68	54.3
		Optimized CFR: Bakeryproducts5, DGLV7, SoybeanProducts4, MungBean3	—	0	109.3	108	226.8	266.9	173.4	328.7	68.1	244.4	196.6	193.6	290.5
4	Ketapang	Optimized diets—FP	—	—	89.7	119.5	103.2	113.9	142.4	100	45.6	527.4	358.7	101.8	73.2
		Optimized diets—no FP	2	—	100	161.9	120.4	136.5	135.2	148.9	62.4	1293.6	443.8	124.2	95.2
		Worst-case scenario	—	8	64.8	81.2	67	52.2	46.7	29.2	17.4	33.4	74.7	50	36
		Optimized CFR: Bakery7, Fruit7, Mungbean4, Veg12, DGLV5, Egg7, MFE14, CookingOil14	—	0	71.3	101.2	149.2	100.6	82.5	155.3	66.3	75.7	201.2	131.7	77.8
5	Lampung Tengah	Optimized diets—FP	—	—	103.2	165.5	109.7	152	134.5	140.8	60.4	1567.5	399.9	110.7	79.6
		Optimized diets—no FP	2	—	100	141.6	124.3	157.9	139.5	140.8	69	1587.3	389.6	123.2	94.6
		Worst-case scenario	—	7	70.5	81.2	73.3	47.6	51.9	24.9	17.5	30.1	74.6	51.8	27.3
		Optimized CFR: Unfortibakery10, Mungbean4, MFE14, OrganMeat2, Veg21, DGLV14	—	0	83.4	112.1	121.6	109.3	84.2	107	61.3	262.3	389.3	100.9	85.6
6	Lanny Jaya	Optimized diets—FP	—	—	85.5	121.9	134.8	112.7	167.8	124.8	47.8	795	122.3	134.7	61.9
		Optimized diets— no FP	3	—	91.2	107.8	141.2	125.9	155.4	114.1	52.6	1342.8	125.9	139.5	71.1
		Worst-case scenario	—	8	63	1	87.3	25.9	67.7	35.5	3.1	12.4	2.7	70.2	29.8
		Optimized CFR: MFE7, Egg2, Chicken2, Sweetpotatowhite7, Corn1, DGLV7, Sweetpotatoleaves4	—	2	82.3	188.2	197.5	129.4	120.2	143.3	42	59.8	125	96.7	91.8

(*Continued*)

TABLE 2 (*Continued*)

No.	District	Analysis	<100% RNI	<65% RNI	Calcium %	Vit C %	Thiamin %	Riboflavin %	Niacin %	Vit B-6 %	Folate %	Vit B-12 %	Vit A RE %	Iron %	Zinc %
7	Lombok Tengah	Optimized diets—FP	—	—	78.3	204.8	148.3	74.5	80.4	100.6	38.4	476.6	95.4	38.5	24.2
		Optimized diets—no FP	5	—	87.8	281.2	173.2	102.3	88.5	133.1	51.4	477.5	130.7	43.8	28
		Worst-case scenario	—	5	75.7	159.5	126.9	64.9	71.1	88.4	33	34.8	86	33.7	21.9
		Optimized CFR: DGLV7	—	0	84.7	129.2	138.6	180.8	124.3	115.1	81.5	86.2	125.9	125.8	145.6
8	Maluku Tengah	Optimized diets—FP	—	—	101.2	121.2	117.8	110.7	100	113.3	34.8	1538.5	103	113.9	70.8
		Optimized diets—no FP	0	—	111.4	229.3	164.1	133.3	251.9	328.5	110.1	100	279	132.2	100
		Worst-case scenario	—	7	70.5	88.9	71.7	50	43.4	22.5	18.5	31.6	81.6	46.8	32
		Optimized CFR: Egg14, FishEgg2, SweetenedBakeryFortified2, DGLV14, WaterSpinach4	—	0	89.7	134.5	132.2	174.3	103.7	158.3	65.1	124.7	226.8	135.3	123.3
9	Pemalang	Optimized diets—FP	—	—	111.3	147	103.2	126.4	100	119.6	45.9	190.7	260.8	92.5	55
		Optimized diets—no FP	1	—	100	161.6	166.2	177.7	156.2	158.2	93.8	1049.6	305	130.4	100
		Worst-case scenario	—	8	63.1	81.2	71.2	53.4	53.2	26.6	19.2	30.9	74.9	52	35.2
		Optimized CFR: FishwoBones7, ChickenLiver1, SoybeanProducts3, Mungbean4, Veg21, DGLV12, BakeryProducts7	—	0	84.3	112	176.7	168.9	149.9	151.4	66.7	169.9	216.3	130.8	136.7
10	Rokan Hulu	Optimized diets—FP	—	—	90	114	100	124.5	66.6	72	30	3832	142.2	109.5	60.5
		Optimized diets—no FP	3	—	100	145.3	115	141	101.2	85.5	50.6	3830	188.1	139.9	78.7
		Worst-case scenario	—	4	73.4	81.3	81.3	67.4	49.2	34.1	19.9	75.4	83.1	67.5	35.4
		Optimized CFR: Bakeryproducts7, Mungbean1, DGLV7, WaterSpinach 3, Fruits3	—	0	96.4	108.2	150.2	176.7	134.7	119.3	70.2	124.8	156.6	131.6	138.7
Children aged 24–35 mo															
1	Brebes	Optimized diets—FP	—	—	258.5	136.8	100	198.7	166.7	189.3	154	132.9	100	145 20	228.8
		Optimized diets—no FP	0	—	313.8	119.7	83.9	100	113.6	140.1	155.9	125	68.6	159.6	104.1
		Worst-case scenario	—	10	195.5	79.5	32.9	0.1	54.5	25.6	29.3	38.6	2.4	5.2	4.3
		Optimized FBR: DGLV4, VitAOtherVeg10, VitCFruits1	—	0	86.6	93.1	148.1	201.1	194.2	155.4	84.1	87.1	174.3	131.8	149.3
2	Cianjur	Optimized diets—FP	—	—	200	100	120.3	100	143.7	100	116	101.7	140.9	100	100
		Optimized diets—no FP	0	—	254.7	88	115.8	83.6	124.1	100	104.1	615.8	72.7	1343.3	153.4
		Worst-case scenario	—	12	138.7	31	39.6	0.1	63	9.1	35.2	11.7	1	3	0
		Optimized FBR: MFE14, Egg7, MungBean3, SoyProducts4, Veg10, DGLV5, Fruits14, BakeryProducts10	—	0	106.6	76.1	174.4	161.9	176.8	161.8	83.3	95.8	180.1	147.4	149.2

(*Continued*)

TABLE 2 (*Continued*)

No.	District	Analysis	<100% RNI	<65% RNI	Calcium %	Vit C %	Thiamin %	Riboflavin %	Niacin %	Vit B-6 %	Folate %	Vit B-12 %	Vit A RE %	Iron %	Zinc %
3	Gorontalo	Optimized diets—FP	—	—	149.9	134.8	112	217.5	170.4	205	100	190	100	233.7	232.3
		Optimized diets—no FP	0	—	286.8	115.2	151	269.8	186	283.4	143.5	153.4	60.4	1377.8	245.5
		Worst-case scenario	—	8	141.5	51.3	77.2	0.9	90.8	41.3	66.7	32.8	3.4	21.8	44.3
		Optimized FBR: WaterSpinach7, Bakery7, Fruits5	—	1	100.5	81.9	248.8	162.2	528.6	439.1	62.2	128.6	237	170.7	175.8
4	Ketapang	Optimized diets—FP	—	—	230.5	74	94.8	57.4	122.9	81.1	106.4	100	28.4	177	113.9
		Optimized diets—no FP	3	—	293.9	100	99.6	91.7	149.1	100	216.6	204.8	43.4	1160.3	158.2
		Worst-case scenario	—	10	154.2	41.4	52.9	0.1	84.8	17.2	48.5	21.1	2.5	10	3
		Optimized FBR: MFE13, FishwoBones7, Egg7, DGLV5, Fruits7, Legumes5, SoybeanProducts2, Bakery6	—	1	74.4	80.2	172.2	125.5	130.3	161.6	45.4	142.1	182.5	141.7	112.7
5	Lampung Tengah	Optimized diets—FP	—	—	245.4	84.8	85.5	121.9	134.8	112.7	167.8	124.8	47.8	795	122.3
		Optimized diets—no FP	3	—	254	94.3	91.2	107.8	141.2	125.9	155.4	114.1	52.6	1342.8	125.9
		Worst-case scenario	—	9	185.6	51	63	1	87.3	25.9	67.7	35.5	3.1	12.4	2.7
		Optimized FBR: Veg21, DGLV7, BroadBeans1, Legume7, MFE21, FishwoBones7, Egg5, Bakery14, Fruits7, VitCFruit1	—	1	72.3	68.9	140.7	115.4	121.1	93.5	44.2	79.7	74.2	120.6	98.2
6	Lanny Jaya	Optimized diets—FP	—	—	151.6	41.5	85.2	343	252.4	96.6	109.8	181.7	31.3	8.8	100
		Optimized diets—no FP	4	—	132.2	48.6	81.1	492.7	276.3	100	109.3	228.9	43.7	9.5	152.4
		Worst-case scenario	—	7	119.1	39.6	68	284.4	204.5	56	84.7	155.8	25.3	6.3	16.2
		Optimized FBR: DGLV10, Sweetpotatoleaves7, MFE7, Chicken2, Egg2, Sweetpotatowhite14, VitCFruits1	—	2	75.8	571	411.5	148.5	120.9	350.1	51.4	35.7	70.2	108.7	73.1
7	Lombok Tengah	Optimized diets—FP	—	—	162.2	173.9	38.5	74.4	44.2	95.1	33.8	96.5	43	103.1	370.9
		Optimized diets—no FP	4	—	191.8	114	69.2	104.5	65.1	112.3	73.3	100	70.4	167.1	157.1
		Worst-case scenario	—	9	86.1	98.3	30.5	71.6	30.3	43.4	20.6	20.9	33.2	55.1	72.4
		Optimized FBR: MFE14, Egg7, Veg17, DGLV7, Fruits12	—	0	78.7	80.3	151.8	168	186.9	148.8	68.6	67.1	82.3	167.4	126.2

(*Continued*)

TABLE 2 (*Continued*)

No.	District	Analysis	<100% RNI	<65% RNI	Calcium %	Vit C %	Thiamin %	Riboflavin %	Niacin %	Vit B-6 %	Folate %	Vit B-12 %	Vit A RE %	Iron %	Zinc %
8	Maluku Tengah	Optimized diets—FP	—	—	192.8	100	116.2	264.8	154.5	227.7	115	252	100	1350.7	243.2
		Optimized diets—no FP	2	—	340.1	88.7	104.7	120	169.6	154.2	272.8	306.4	39.9	4695.6	122.2
		Worst-case scenario	—	10	165.6	29.3	55.2	0.6	91.8	31.1	53.6	28.5	2	24.2	5.2
		Optimized FBR: DGLV7, FishwoBones14, Egg7, Bakery4, Waterspinach6	—	2	65.1	15.5	141.8	140.5	98.8	104.1	63.2	76.3	85.9	126.2	76.4
9	Pemalang	Optimized diets—FP	—	—	176.8	165.7	61	100	148.5	110.7	112.6	129.5	67.1	182.9	184.9
		Optimized diets— o FP	0	—	216	138.8	100	121.8	183.1	146.8	177.4	175.2	100	103.6	308.9
		Worst-case scenario	—	11	87.5	70.8	15	0.1	34.2	6.5	12.5	9.6	0.5	2.6	0
		Optimized FBR: MFE21, Egg7, FishwoBones10, Legumes14, Veg21, DGLV14, DairyProducts10, Fruits14	—	0	68.9	73.7	173	198.5	198.3	232.2	81.3	210.5	219.1	145.8	181.7
10	Rokan Hulu	Optimized diets—FP	—	—	259.4	100	70.9	99	111	100	131.2	100	17	670.2	100
		Optimized diets—no FP	2	—	320.3	100	89.2	100	121.4	139.4	100	100.8	29.8	2685.5	117.7
		Worst-case scenario	—	12	156.1	44.9	33.4	0.1	56.7	15.9	31.4	13.5	1	4.1	0
		Optimized FBR: Veg12, DGLV7, SoyProducts4, Mungbean3, Fruits6	—	1	101.3	82.3	176.9	158	170.1	157.7	60.4	97.1	132.3	140.5	119.9
Children aged 36–59 mo															
1	Brebes	Optimized diets—FP	—	—	242.0	132.9	90.8	158.4	119.2	113.4	128.1	135.9	39.3	1377.222	124.7
		Optimized diets—no FP	0	—	255.7	128.0	100.0	255.7	162.8	202.2	153.7	159.3	100.0	117.5	100.0
		Worst-case scenario	—	11	146.5	59.8	45.3	0.1	62.6	13.2	28.8	18.6	1.0	3.7	0.2
		Optimized FBR: Legumes14, Eggs7, ChickenLiver1, DarkGreenLeafyVeg7, VitAOtherVeg14, FortiMilk7, Bakery7	—	4	50.7	64.7	118.1	147.7	82.5	76.7	35.1	127.8	210.3	88.6	54.4
2	Cianjur	Optimized diets—FP	—	—	277.8	100	94.4	100	125	100	141	101.8	56.1	544.8	93.6
		Optimized diets—no FP	0	—	206.9	108.3	100	164.2	155.8	106.8	112.8	100	100	100	153
		Worst-case scenario	—	10	143.5	41.2	39.2	0.1	72.9	11.6	37.3	13.7	1.2	2.9	0
		Optimized FBR: MFE14, Eggs7, FishwoBones5, Legumes10, Veg14, DGLV4, Bakery14, Fruits10	—	1	43.3	72.8	166.6	151.8	151.6	137.3		123.1	108.6	122.3	76.6

(*Continued*)

TABLE 2 (*Continued*)

No.	District	Analysis	<100% RNI	<65% RNI	Calcium %	Vit C %	Thiamin %	Riboflavin %	Niacin %	Vit B-6 %	Folate %	Vit B-12 %	Vit A RE %	Iron %	Zinc %
3	Gorontalo	Optimized diets—FP	—	—	272	68	89.3	30.4	166.1	56.3	237.4	181.6	19.9	313.4	66.4
		Optimized diets—no FP	5	—	315.1	75.7	103	65.7	187.3	92.1	257.9	206.3	39.8	345.8	90.7
		Worst-case scenario	—	9	179.6	22.1	71.5	3.9	107.7	19.7	62.4	28.2	4.9	5.2	1.3
		Optimized FBR: MFE14, Egg1, SoybeanProducts2, DGLV2, Fruit3, Bakery4, Dairy5	—	5	56.5	27.6	154.1	64.7	220.2	170.6	18.2	73	77.5	85.7	61.3
4	Ketapang	Optimized diets—FP	—	—	301.4	97.4	100	80.2	185.6	153.1	179.3	142	23.4	5257.4	99.8
		Optimized diets—no FP	1	—	338	100	122.3	117.7	219.4	181.2	265	221.2	61.9	5907.6	119.9
		Worst-case scenario	—	8	198.4	62.7	66.6	0.6	100.4	43.2	52.2	57.8	5	72.4	17.1
		Optimized FBR: Veg17, MFE17, FishwoBones7, Egg7, Legumes7, Nuts3, Fruits6, Bakery7, FortifiedBakery2, Dairy7, SmallFishwithBones3	—	2	53.4	112.2	187.1	140.4	143.8	247.4	57.6	215.1	217.3	142	102.4
5	Lampung Tengah	Optimized diets—FP	—	—	307.1	77.7	100.6	62.1	137.5	132.1	109.5	916	37.6	1936.6	100
		Optimized diets—no FP	3	—	329.4	93.3	101.4	82.8	156.1	126.6	141.6	125.2	53	1756.7	128.1
		Worst-case scenario	—	10	206.1	49.2	63.2	0.1	95.7	28.4	45.2	36.8	2.5	23.1	4.6
		Optimized FBR: MFE17, Eggs7, FishwoBones5, SmallShrimp1, Veg21, DGLV9, Legumes9, SoybeanProducts5, Fruits14, Bakery5, NutSeedsUnsweetened-Product3	—	1	69.2	92.9	143.4	140.6	127.2	501.7	48.1	277.8	160.7	111.7	67.7
6	Lanny Jaya	Optimized diets—FP	—	—	117.7	45.8	84.7	889.5	370.4	116.5	95.6	316.7	58.7	270.3	263.3
		Optimized diets—no FP	3	—	102.1	44.4	87	1004.8	408.3	148	100.6	375.5	63.8	269.9	357.4
		Worst-case scenario	—	6	65.2	28.9	69.7	544.2	281.9	69.2	75	218.9	30.3	7.5	30.4
		Optimized FBR: Sweetpotatowhite14, DGLV10, Sweetpotatoleaves7, Pumpkinleaves3, MFE6, Egg2, Chicken2	—	4	48.8	740.3	443.1	163.7	96.3	407.8	61.9	35.1	88.6	81	55
7	Lombok Tengah	Optimized diets—FP	—	—	417.3	119.5	93.9	52.7	141.1	195.2	193.8	171	71.8	264.8	105.6
		Optimized diets—no FP	0	—	399.6	119.4	100	194.3	176.2	204.4	208.4	200.3	100	252.9	196.9
		Worst-case scenario	—	3	357.5	96.5	78.2	25	123	153.4	153.9	131.4	48.4	174.5	49.8
		Optimized FBR: Veg17, DGLV5, Fruits10, FortiMilk5, Bakery4	—	2	56.2	78.7	146.3	171.8	182	161.8	63.1	169.9	98.1	124.2	112.4

(*Continued*)

TABLE 2 (*Continued*)

No.	District	Analysis	<100% RNI	<65% RNI	Calcium %	Vit C %	Thiamin %	Riboflavin %	Niacin %	Vit B-6 %	Folate %	Vit B-12 %	Vit A RE %	Iron %	Zinc %
8	Maluku Tengah	Optimized diets—FP	—	—	361.4	61.1	101.7	100	170.5	68.6	294.2	423.5	37.2	789.3	105.2
		Optimized diets—no FP	2	—	345.5	67.3	101.4	115.8	191.3	82.2	320.2	474	61.6	775.9	125.1
		Worst-case scenario	—	9	173.6	20.3	73.3	0.1	102.8	20.1	60.9	25.3	4.5	8	0.4
		Optimized FBR: Fishwithoutbones14, Eggs7, FishEgg3, DGLV7, Waterspinach4, Cassavaleaves3, Sweetpotatowhite1	—	2	67.9	41.5	186.1	115.5	186.6	189.6	44.6	118.4	117.1	100.8	77.3
9	Pemalang	Optimized diets—FP	—	—	268.9	105.8	100	95	153.9	112.5	136.4	100	41.8	222.7	100
		Optimized diets—no FP	0	—	300.1	100	100	177.8	189	148.7	153.8	135.4	100	141.2	150.2
		Worst-case scenario	—	12	102	34	38.7	0.1	57.5	7.8	28.3	10.2	0.7	2.5	0
		Optimized FBR: MFE21, FishwoBones7, Egg10, Legumes14, Veg21, DGLV7, Fruits14, VitCFruit3, DairyProducts14	—	1	73.1	109.8	159.2	189.7	146.1	157	61	243.1	158.4	118.2	94
10	Rokan Hulu	Optimized diets—FP	—	—	274.8	123.3	75.2	56.6	154.3	157.5	134.9	100	27.7	2239.2	146.2
		Optimized diets—no FP	1	—	307.8	105.1	100	116.4	180.1	173.9	147.5	130.9	44.7	3429.6	170.7
		Worst-case scenario	—	9	175.1	88.1	47	0.2	80.1	35.8	36.2	40.4	1.8	25.8	4.9
		Optimized FBR: FortiMilk4, DairyProducts10, Legumes9, Mungbean1, Bakery10, Papaya2, MFE21, Egg7, Veg17, DGLV10, VitAOtherVeg2	—	1	68.3	82.9	156.3	171	116.5	126.4	41.2	155.4	188.8	112.1	83.3
Pregnant women															
1	Brebes	Optimized diets—FP	—	—	134.3	115.2	92.4	228.1	142.2	163.0	156.3	148.9	63.7	100.024	180.0
		Optimized diets—no FP	0	—	147.1	100.0	164.5	292.8	212.0	240.4	153.1	173.4	100.0	745.4	269.1
		Worst-case scenario	—	12	54.4	43.4	40.2	0.1	67.4	20.0	38.5	22.3	8.6	2.7	1.6
		Optimized FBR: Fishwobones4, Egg7, Milkfish2, Tempe7, DGLV9, VitAFruits4, Milk3, IFAtablet7	—	1	66.4	79.6	83.6	74.3	79.5	49.2	97.8	92.5	112.7	199.1	65.1
2	Cianjur	Optimized diets—FP	—	—	103.2	101.6	69.4	145.2	111.4	69.1	109.4	93.5	45.6	713.9	262.4
		Optimized diets—no FP	1	—	117.4	100	100	180.2	132.6	125.7	111.3	105.1	72.4	1554.4	374
		Worst-case scenario	—	11	67.5	55.9	45.2	0.1	66.8	21	44.3	24.4	4.7	7.2	1.2

(*Continued*)

TABLE 2 (*Continued*)

No.	District	Analysis	<100% RNI	<65% RNI	Calcium %	Vit C %	Thiamin %	Riboflavin %	Niacin %	Vit B-6 %	Folate %	Vit B-12 %	Vit A RE %	Iron %	Zinc %
		Optimized FBR: Soyproducts7, DGLV6, VitAotherveg14, Egg7, ChickenLiver1, IFAtablet7	—	0	77.5	128.1	114.2	98.6	97.4	74.1	107.2	152.1	135.6	194.8	98.4
3	Gorontalo	Optimized diets—FP	—	—	180.4	60.4	135.6	69.9	215	237.4	335.5	171.3	11.8	566.7	237.8
		Optimized diets—no FP	2	—	187.7	75.9	138.4	100	725.6	295.5	692.3	413.2	32.9	574.7	295.3
		Worst-case scenario	—	7	109.6	31	75.1	17.9	108.7	33.7	86.5	50	7	77.8	45.3
		Optimized FBR: Fishwobones7, Egg2, DGLV10, SoyProducts2, Mungbean1, VitCFruits2, Banana2, FortifiedMilk2, IFAtablet7	—	1	85.1	72.4	125	57.4	159.5	109.5	87.3	88.2	109.5	192.9	95.8
4	Ketapang	Optimized diets—FP	—	—	132.7	93.8	75.8	89.8	120.5	85	144.6	100	23.4	673.5	117.2
		Optimized diets—no FP	1	—	146.8	100	100	167.2	128.5	100	136.3	164.8	33.5	781.4	260.8
		Worst-case scenario	—	7	109.4	76.8	59.9	7.7	95.3	43.1	99.7	60.6	12.4	113.2	14.7
		Optimized FBR: DGLV9, SweetLeaveBush2, Waterspinach3, ChickenLiver2, IFAtablet7	—	0	65.2	101.3	118	87.8	115	73.4	93.5	184.5	130	189.2	77
5	Lampung Tengah	Optimized diets—FP	—	—	95.8	99	327.9	99	549.4	135.4	191.8	208	94.8	260	171
		Optimized diets—no FP	1	—	56.7	100	255.1	106	155.8	100	123.8	1476.7	119.2	2226.3	171.8
		Worst-case scenario	—	12	55.8	13.6	35.1	0	66.1	21	47.4	26	0.3	7.4	1
		Optimized FBR: Soyproducts12, EndelLegume1, DGLV9, SweetLeaveBush4, waterspinach3, SmallFishwithBones1, Egg7, VitCrichFruit4, IFAtablet7	—	1	69	95.4	90.3	94.8	77.7	52.3	107.8	66.4	91	194.1	90.7
6	Lanny Jaya	Optimized diets—FP	—	—	66.6	62.3	89.1	417.5	191	84.1	78.1	96.3	17	100	220.2
		Optimized diets—no FP	6	—	68.8	66	90.2	417.6	183.7	87.4	80.1	100	18	245.1	270
		Worst-case scenario	—	9	63.5	56.7	72.6	262.4	159.4	52.4	63.6	80.6	11.4	4.8	33
		Optimized FBR: MFE10, Egg7, DGLV14, WhiteSweetPotato4, OrangeSweetPotato5, IFAtablet7	—	2	78.5	234.4	145.3	83.6	68.2	81.5	75.8	32.7	147.3	183.4	45.3

(*Continued*)

TABLE 2 (*Continued*)

No.	District	Analysis	<100% RNI	<65% RNI	Calcium %	Vit C %	Thiamin %	Riboflavin %	Niacin %	Vit B-6 %	Folate %	Vit B-12 %	Vit A RE %	Iron %	Zinc %
7	Lombok Tengah	Optimized diets—FP	—	—	111	81.2	72.3	101.9	105.2	109.2	130	94.1	56.4	752.4	699.9
		Optimized diets—no FP	3	—	107.5	86.4	99.5	155.5	134.3	133.4	126.6	100	92.1	897.6	761.4
		Worst-case scenario	—	11	77.3	46.2	60.8	6.8	77.2	33	53.8	30.8	13.5	6.3	8.6
		Optimized FBR: WaterSpinach4, SoyProducts7, ChickenLiver1, FishwoBones4, Nuts3, IFAtablet7	—	0	77.1	164.2	110.9	106.5	120.1	85.5	132.5	195	171.4	203.3	96.9
8	Maluku Tengah	Optimized diets—FP	—	—	108.5	283.9	105.1	83.9	110.9	100.3	45.6	198	204.5	42.6	127.6
		Optimized diets—no FP	2	—	117.1	334	117.2	100	109.4	100	54.3	209.2	246.9	55.1	139.2
		Worst-case scenario	—	7	73.8	33.4	90	48.7	82.9	62.9	19.4	64.2	43.4	30.4	80.9
		Optimized FBR: CassavaLeave4, MatelambonLeave2, SoyProducts7, FishwoBones7, — Egg4, IFAtablet7	—	3	80.5	159.4	91.6	53.6	84.5	62.9	100.7	64.3	124.3	191	93.9
9	Pemalang	Optimized diets—FP	—	—	131.6	120.6	81.4	146.8	141.4	139.7	149	124.1	60.6	139.2	152.2
		Optimized diets—no FP	0	—	141.9	103	100	169.6	166.1	179.1	145.4	113.3	100	181	230
		Worst-case scenario	—	7	94	93.3	49.2	7.8	97.4	69.7	93.1	48.3	26	19.8	13.3
		Optimized FBR: WaterSpinach4, SweetBakeryFortified3, ChickLiver1, FortifiedMilk3, IFAtablet7	—	2	59.1	32.1	114.3	102.9	107.7	65.5	102.5	92.6	135.6	205.4	117.1
10	Rokan Hulu	Optimized diets—FP	—	—	116.4	105.5	98.5	284.4	128.8	90.3	101.8	176.6	39.9	789.5	287.4
		Optimized diets—no FP	1	—	121.3	100	108.5	303	162.9	144.4	113.8	148	77.9	912.6	353.2
		Worst-case scenario	—	9	81.2	71.8	55	11.8	100.2	42.8	63	37.4	16.1	21.8	15.1
		Optimized FBR: Egg7, Tuna3, DGLV10, WaterSpinach4, VitCFruit1, VitAFruit2, FortifiedMilk2, IFAtablet7	—	2	67.9	129.3	99.6	70.6	104.8	62.9	102.7	54.3	158	190.8	80

[1]Optimized diets—FP is the best diet closest to the target group's average food patterns (median frequency per week of the food group; module 2 Optifood). Optimized diets—no FP is the best diet that can deviate from the target group's average food patterns but remains within the upper and lower range (corresponding to the 5th to 95th percentiles of the target group's frequency per week of each food group). Problem nutrient is identified from the Optimized diet—no FP, whereby the nutrient cannot fulfill 100% of the RNI (module 2 Optifood). Worst-case scenario: minimized percentage RNI for each nutrient generated from population diet to test whether the respective nutrient will achieve the minimum nutrient adequacy (>65% of the RNI; module 3 Optifood). Optimized FBR/CFR: the selected FBR/CFR among the alternative FBRs/CFRs based on their greatest number of nutrients that fulfilled the dietary adequacy (≥65% RNI in minimized or worst-case scenario). The codes under optimized FBRs were the nutrient-dense food items, sub-groups or groups followed by recommended portions per week, e.g. Egg3 means eggs are recommended to be consumed 3 servings per week. CFR, complementary feeding recommendation; DGLV, dark-green leafy vegetables; FBR, food-based recommendation; FishwoBone, fish without bone; FP, food pattern; IFA, iron and folic acid; MFE, meat, fish, poultry, eggs; RE, retinol equivalent, RNI, recommended nutrient intake; Vit, vitamin.

calcium in those aged 12–23 mo and 24–35 mo; folate, zinc, and vitamin C in those aged 36–59 mo; and iron, folate, and calcium in pregnant women. Most of the top 3 problem nutrients across the age groups were consistent with the key nutrients that play roles in stunting and anemia. In addition, despite the similarity in stunting prevalence across the districts, there was variation in number and type of problem nutrients.

Our finding is in line with a recent review of 15 observational studies, which found that calcium, iron, and zinc were the typical problem nutrients from complementary feeding diets of 6–23-mo-old children in Africa, Asia, and Latin America (3). The review also reported inadequacy of energy, vitamin A, thiamin, riboflavin, niacin, folate, and vitamin C in some studies, which was also found in our study.

As expected, we found that within each district the youngest children (6–11 mo old) had more problem nutrients than the older children. In 6–11-mo-old children, 7 of 10 districts had ≥3 problem nutrients, compared with only 4–5 districts in the older children. Previous studies have also found that younger children (6–8 mo) have less diverse foods, as well as more dietary inadequacy and nutrient gaps (3, 6–9). However 5 districts for 24–35-mo-old children and 4 districts for 36–59-mo-old children had ≥3 problem nutrients, suggesting that despite more diverse diets (following the food basket of the family) the intakes were inadequate compared with the requirements.

Among the 10 districts, food patterns varied greatly as reflected by the number of food items identified in the food intake data. The average number of food items in the 5 age groups was lowest in Lanny Jaya, Papua (20 food items) and highest in Lampung Tengah, Lampung (171 food items). These correspond to the number of problem nutrients (4.2 compared with 0.6) as well as the average nutrient gaps of the problem nutrients (40% compared with 11% from 100% RNI in 2 best diet no-FP). Our findings showed that the districts with a limited number of food items consumed had more problem nutrients (4–6 problem nutrients) compared with districts with more food items consumed (0–1 problem nutrient).

The findings also highlighted the importance of ensuring adequate nutrient intakes for the pregnant women, because this enables more feasible and timely intervention to prevent stunting. The typical problem nutrients in pregnant women in these 10 districts were iron, folate, and calcium. This finding supports the IFA and calcium supplementation program currently in place for pregnant women in Indonesia in accordance with WHO recommendations (10, 11). Based on the average percentage RNI in the worst-case scenario and comparing with adequacy level (estimated average requirement, or 65% of RNI) besides iron and folate (28% and 61% of RNI, respectively) we also found gaps in vitamins A, B-12, and C (22–50% of RNI). Because recent meta-analyses demonstrated that multiple micronutrient supplementation (MMS) can reduce the risks of preterm birth, low birth weight, and small for gestational age in comparison with IFA alone (12), our findings suggest that MMS should be considered given the nutrient gap in multiple micronutrients that still exists even after the FBRs are optimized.

In our LP analysis fortified infant cereals were part of the LP inputs because they were identified in the dietary data of the 6–23-mo-old children in all districts and therefore were included in the LP analysis. Although fortified infant products and formula given the actual dietary intake of respondents were included in mathematical modeling, there were still nutrient gaps between optimized nutrient intake and the nutrient requirements. Our previous LP study identified that when fortified foods were taken out from the complementary feeding diet of the 6–23-mo-old children from low socioeconomic households, more problem nutrients were identified compared with the children from the middle socioeconomic group (13), which signifies the importance of nutrient-dense foods for under-two children. However, recent findings from Indonesia also showed that fortified infant foods (FIFs), although increasing micronutrient intakes also reduced dietary diversity of under-two children because of mothers' overreliance on FIFs (14). FBRs/CFRs are derived from the existing food pattern because this ensures the availability and accessibility of the foods in the population. Therefore, promoting locally available micronutrient-rich foods based on FBR/CFR messages can be a potential solution to ensure nutrient adequacy while at the same time ensuring dietary diversity. Simple processing of foods rich in iron, zinc, and calcium, and folate-rich foods, such as dried/powder forms of liver, fish, anchovy, mungbean, and moringa leaf, can be a potential intervention because it significantly increases the nutrient density in the diet of infants and under-five children. The Comprehensive Nutrient Gap Assessment also identified liver, small fish (anchovy), and eggs as the best food sources with regards to micronutrient density to fill the potential micronutrient gaps (iron, zinc, vitamin A, vitamin B-12, folate, and calcium) in countries in South Asia (15).

Several limitations are identified in this study. First, the use of 1-d 24-h dietary recall could not capture the actual food pattern of the population as well as the 7-d dietary assessment. Second, the quality of field data collection was not fully within our control because we did our analysis using secondary data. Finally, given the variation in the number of available samples between age groups across districts (25–95 children; 16–234 pregnant women) the representativeness of the findings varied by district. Despite the above constraints, to our knowledge, this is the first study to represent different food patterns among different cultures across Indonesia and showed variations in problem nutrients across areas with a similar nutritional problem, namely stunting.

In conclusion, current dietary intake practices in under-five children and pregnant women in 10 stunting-prioritized districts cannot meet the nutrient requirements, especially for iron, zinc, folate, and calcium. Despite the similarity in stunting prevalence across the districts, there was variation in number and types of problem nutrients. The CFRs and FBRs developed in this study should be incorporated into health promotion messages to promote these local-specific FBRs and CFRs to pregnant women and under-five children. Their effectiveness in improving nutrient intakes and eventually nutritional status should also be evaluated.

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