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Prevalence and Risk Factors of Inadequate Micronutrient Intake among Children Aged 6-23 Months in Indonesia

Prevalensi dan Faktor Risiko Ketidakcukupan Asupan Zat Gizi Mikro Anak Usia 6-23 Bulan di Indonesia

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ABSTRACT

Background: Poor quality and quantity are the main factors that contribute to the increasing inadequacy of micronutrients intake such as Iron, Calcium, Zinc, Vitamins A, and C since the complementary food was introduced at 6 months of infant's age.
Objectives: To analyze the prevalence and risk factors of inadequate micronutrients intake among children aged 6-23 months in Indonesia.
Methods: A cross-sectional study used Individual Food Consumption Survey 2014 data from Indonesian Health Study and Development Agency involving 1575 children aged 6-23 months as the total subjects. Minimum Dietary Diversity (MDD) was measured by eight food groups for children under two years old. The prevalence of inadequate micronutrients intake used the probability approach. Binary logistic regression was used as a multivariate test to determine the risk factors of inadequate micronutrients intake.
Results: The highest prevalence of inadequate micronutrients intake was vitamin C, while the lowest was zinc, with overall inadequate multiple micronutrients intake being 61.9%. About 57.7% and 15.9% of subjects were low in energy intake and achieved the MDD, respectively. Lived in rural area [OR=1.37(95%CI:1.06-1.77)], low education mother [OR=1.71(95%CI:1.32-2.22)], low energy intake [OR=6.22(95%CI:4.84-7.99)] and not achieved MDD [OR=4.84(95%CI:3.47-6.75)] were more likely to have inadequate micronutrients intake, while not consuming breast milk were less likely to have inadequate micronutrients intake in children [OR=0.55(95%CI:0.43-0.71)].
Conclusions: Almost two-thirds of subjects were inadequate in overall multiple micronutrients. Low energy intake and not achieved MDD were the highest risk of inadequate micronutrients intake of subjects, instead of low mother education and living in rural areas.

ABSTRAK

Latar Belakang: *Rendahnya kualitas dan kuantitas pangan merupakan faktor utama yang berkontribusi terhadap ketidakcukupan asupan zat gizi mikro yaitu zat besi, kalsium, seng, vitamin A, dan C saat makanan pendamping diperkenalkan pada bayi berusia 6 bulan.*
Tujuan: *Menganalisis prevalensi dan faktor risiko ketidakcukupan asupan zat gizi mikro pada anak usia 6-23 bulan di Indonesia.*
Metode: *Desain penelitian yaitu studi potong lintang menggunakan data Survei Konsumsi Makanan Indonesia tahun 2014 dari Badan Penelitian dan Pengembangan Kesehatan Republik Indonesia dengan melibatkan 1.575 anak usia 6-23 bulan. Minimum Dietary Diversity (MDD) diukur dengan delapan kelompok pangan untuk anak di bawah dua tahun. Prevalensi ketidakcukupan asupan zat gizi mikro menggunakan pendekatan probabilitas. Regresi logistik biner digunakan saat uji multivariat untuk menentukan faktor risiko ketidakcukupan asupan zat gizi mikro.*
Hasil: *Prevalensi ketidakcukupan asupan zat gizi mikro tertinggi adalah vitamin C, sedangkan yang terendah adalah seng. Sebanyak 61,9% subjek mengalami ketidakcukupan keseluruhan asupan zat gizi mikro. Sekitar 57,7% dan 15,9% subjek memiliki asupan energi rendah dan sudah mencapai MDD. Tinggal di daerah pedesaan [OR=1,37 (95%CI:1,06-1,77)], Ibu berpendidikan rendah [OR=1,71 (95%CI:1,32-2,22)], asupan energi rendah [OR=6.22 (95%CI:4,84 -7,99)], dan tidak tercapai MDD [OR=4,84 (95%CI:3,47-6,75)] lebih berisiko memiliki ketidakcukupan asupan zat gizi mikro pada subjek, sedangkan*

tidak mengkonsumsi ASI lebih kecil kemungkinannya untuk memiliki ketidakcukupan asupan zat gizi mikro pada anak [OR=0,55 (95%CI:0,43-0,71)].
Kesimpulan: *Hampir dua pertiga dari subjek mengalami ketidakcukupan keseluruhan asupan zat gizi mikro. Asupan energi yang rendah dan tidak tercapai MDD merupakan risiko tertinggi dari ketidakcukupan asupan zat gizi mikro subjek dibandingkan dengan pendidikan Ibu yang rendah dan tinggal di pedesaan.*

Kata kunci: *Anak usia 6-23 bulan, Asupan energi, Keragaman pangan, Ketidakcukupan asupan, Zat gizi mikro*

INTRODUCTION

The first thousand days of life is a critical periods due to optimal growth and development. If this time is not used effectively, it will result in impaired physical growth and metabolic issues in the body due to malnutrition. Indonesia's prevalence of underweight in children under five is 17.7%, including a moderate problem, while the prevalence of stunting is almost a big problem, which is 29.9%[1]. This malnutrition is the consequence of inadequate nutrients intake and will cause economic and productivity losses if not tackled[2].

Inadequacy of iron, zinc, calcium, vitamin A, and vitamin C intake still become nutritional problems among children under two years old In Indonesia when complementary food is introduced[3,4]. The average of adequate iron, zinc, and calcium intake in children under two years old in Indonesia was below 75%. Compared to Bangladesh, about more than half of toddlers were inadequate in several micronutrients intake[5], the data in Indonesia were not available yet.

Breast milk only meets half of the infant's energy requirement aged 6-11 months and one-third of the energy requirement for children aged 12-23 months[6]. The gap of micronutrients adequacy such as energy (60%), protein (40%), iron (90%), and vitamin A (20%) occurred if the average breast milk intake was 550 ml/day for 12-23 months of age[7]. A good food quantity and quality can be provided to fill the gap.

Several previous studies stated that dietary diversity was an influential factor for micronutrients adequacy [5,8].In 2017, about 52.8% of children under two years old in Indonesia achieved Minimum Dietary Diversity (MDD). The quality of food consumption was low in animal source food, legumes and nuts, vegetables, and fruits[9]. However, that study used the qualitative data instead of quantitative data. Related study in Bangladesh found that low food intake and low dietary diversity were determinants of micronutrients adequacy in children under five years old[5]. Poor quality and quantity of food consumption were the main contributors to increasing food insecurity, malnutrition, and other health problems[10]. Socioeconomic factors such as low income, low education, and large family members will also have an impact on difficulties in obtaining and providing the food to meet nutritional needs[11]. Thus, this study aimed to analyze the prevalence and risk factors of inadequate micronutrients intake among children aged 6-23 months in Indonesia. It will be beneficial for policy making and intervention planning program to improve micronutrients intake on children aged 6-23 months.

METHODS

A cross-sectional design study was used with the secondary data from Individual Food Consumption Survey (SKMI 2014), Indonesian Health Study and Development Agency. The total population of children aged 6-23 months in Indonesia was 2061. The exclusion criteria were Recommended Dietary Allowance (RDA) >400%, energy intake <0.3 BMR or >3.0 BMR, nutritional status (WAZ) ≤-6.0 SD or ≥+5.0 SD, and incomplete data. After cleaning the data, the total subjects were 1575, consisting of children aged 6-23 months in Indonesia.

The independent variables were age, sex, nutritional status, breastfeeding status, residence area, economic status, parents' occupation, parents' education, mother's age, family size, food consumption (energy intake and MDD). Nutritional status was determined in weight age z-score (WAZ) with three categories such as underweight (< -2 SD), normal weight (-2 SD to +1 SD), risk of overweight (>+1 SD)[12] and processed by WHO-Anthro. Data on food consumption were collected with 1x24 hour for all subjects and 2x24 hours for 7% of subjects. Nutrients intake data were adjusted for intra- and inter-individual variance[13]. Nutrients intake such as energy, calcium, iron, zinc, vitamin A (retinol and β carotene), and vitamin C were from breast milk and complementary food. The amount of breast milk was estimated from ml/kg of body weight[14]. This study used breast milk's nutrient content of developing country[15] and Indonesia Food Composition Table 2017 for complementary food. Energy Estimated Requirements (EER) calculated for individual energy requirement based on age and body weight[16]. The prevalence of inadequate energy intake used Estimated Average Requirements (EAR) fixed cut-off as the proportion of the intake below requirement[13].

Minimum Dietary Diversity (MDD) was used to assess the dietary diversity of children under two years old through 1x24 hours of food recall. The eight food groups consisted of breast milk, grains, root and tubers, legumes and nuts, dairy product, meat/fish/poultry/organ meat, eggs, vitamin A-rich fruit and vegetable, other fruits and vegetable. If the subjects ate five or more food groups with minimum consumed ≥10 grams, it is considered to meet the MDD[17].

Inadequate micronutrients intake data were used for the outcome variable. If the inadequacy of overall micronutrients was less than 50%, it is considered as low and 50% or more as high. The prevalence of inadequate micronutrients intake was obtained by probability of inadequacy[5,13,18]. It assessed the probability of population at risk in inadequate intake, which the intake is below EAR[13]. Estimated micronutrients requirement used a basic formula of Recommended Dietary Allowance (RDA)[16]. A particular case for determining the probability of iron inadequacy used table The Institute of Medicie (IOM) 1-5[19]. The prevalence of inadequate micronutrients intake was calculated by multiplying the probability of

micronutrients inadequacy by 100. The overall prevalence of inadequate micronutrients intake was obtained by averaging the five micronutrients.

Subject characteristics, breastfeeding status, social-economy characteristic, dietary diversity, the prevalence of inadequacy were analyzed by descriptive analysis [frequency, proportion (%)]. Bivariate analysis used Chi-Square, Mann-Whitney, and Kruskall-Walis test to analyze the differences of inadequate micronutrients intake and independent variables ($p<0.05$). The variables of bivariate analysis with p-value <0.05 or <0.25 were included in multivariate analysis. Risk factors of inadequate micronutrients intake used binary logistic regression (backward elimination method) with 95% of confidence interval.

RESULTS AND DISCUSSION

Distribution of Subject Characteristics

Table 1 shows more than two-thirds of subjects experienced high inadequacy of micronutrients intake. More than 90% of subjects were aged 12-23 months. The distribution of boys and girls tended to be more in boys. Almost one-fourth of subjects were underweight based on WAZ indicator. According to the WHO, percentage of underweight between 20-29% was said to be high level of nutritional problem[20]. The latest report of the Indonesia Ministry of Health stated that 17.7% children under 5 years old suffered under-nutrition[1]. Children who are malnourished in childhood will impact on impaired physic, mental, and cognitive development, so it might reduce the productivity and work capacity on the future[21].

Half of the subjects consumed breast milk during the last 24 hours, with the median amount of 593 ml/days (6-11 months) and 432 ml/days (12-23 months). Meanwhile, high inadequacy of micronutrients intake occurred in consuming breast milk group rather than not consuming. According to a report from the Indonesia Ministry of Health[1], 84.9% of children over 6 months were still breastfed. The proportion decreases until children aged 23 months by 56.8%. It can be explained by consumption of complementary food will more dominate than breast milk consumption. Overall, inadequacy of micronutrients intake was not different in age and sex of the child, which reflects the homogeneous condition between both variables, while nutritional status and breastfeeding status were significantly different.

Table 1. Distribution of subject characteristics based on inadequate micronutrients intake

Subjects Characteristics		Inadequacy of Micronutrients Intake (%)			P-value
		Low	High	Total	
All subjects		512 (32.5)	1063 (67.5)	1575 (100)	
[1]Age (months)	6-11	18 (3.5)	46 (4.3)	64 (4.10)	0.445
	12-23	494 (96.5)	1017 (95.7)	1511 (95.9)	
[2]Sex	Girls	246 (48.0)	515 (48.4)	761 (48.3)	0.881
	Boys	266 (52.0)	548 (51.6)	814 (51.7)	
[3]Nutritional status	Risk of overweight	78 (15.2)	99 (9.3)	177 (11.2)	0.000*
	Normal body weight	344 (67.2)	704 (66.2)	1048 (66.5)	
	Underweight	90 (17.6)	260 (24.5)	350 (22.2)	
[1]Breastfeeding status	Consume	230 (44.9)	568 (53.4)	798 (50.7)	0.002*
	Not consume	282 (55.1)	495 (46.6)	777 (49.3)	

[1]Mann-Whitney Test; [2]Chi-Square Test; [3]Kruskall-Wallis Test;*p<0.05

Distribution of Socioeconomic Characteristics

Geographical location could impact to food consumption, food availability, and food access[10]. According to Table 2, most subjects were living in rural compared to urban. It also found that the percentage of subjects who experienced high inadequacy of micronutrients intake was more in rural, while the subjects with low inadequacy micronutrients intake were more in urban areas. A similar result in Ghana found the children who lived in rural had lower nutrient intake and poor anthropometric indicator such as body weight and body height than children who lived in urban[22]. There was a research in Ethiopia stated that the populations who lived in central city tended to have easier access of healthcare, thus more information about health and nutrition could be received[23].

Socio-economic factors such as low income, low education, and large family size will impact to having difficulty in food obtaining and processing to meet nutritional needs[11]. As we can see in Table 2, the majority of family economic status was on medium level and more than one-third of subjects were on lower level. Income reflects to family economic status, if the income was low, it might affect to poor allocation for food in family[24]. The table also shows the lowest category of socioeconomic status in family occurred to having high inadequacy of micronutrients intake. The majority of the families had five or more people and 70% of them had mother's age less than 35 years old. Five or more members of family is included in a large family[25]. Larger family members will affect the family's nutritional intake. Food distribution per member tends to decrease as the number of family members increases[26]. Unfortunately, in this research there was no significant difference in micronutrients inadequacy based on family size and mother's age.

More than half of parents' education was at the low level defined as graduated from junior high school or less. Parental education, especially from mother, had a significant role in stimulating the growth and nutritional status of children[26]. Most mothers were not working and half of the fathers worked in the

agriculture sector. Individuals with higher education tend to have better jobs and purchasing power, so the food was easier to access[27]. It is also found in Table 2, the subjects whose parents were in low education, not working mothers, and father's occupation in agricultural sector were significantly different and more likely to have a high inadequacy of micronutrients intake.

Table 2. Distribution of social-economic characteristics based on inadequate micronutrients intake

Socioeconomic Characteristics		Inadequacy of Micronutrients Intake (%)			P-value
		Low	High	Total	
[1]Residence of area	Urban	287 (56.1)	408 (38.4)	695 (44.1)	0.000*
	Rural	225 (43.9)	655 (61.6)	880 (55.9)	
[3]Family socioeconomic status	High	142 (27.7)	178 (16.7)	32 (20.3)	0.000*
	Middle	223 (43.6)	425 (40.0)	648 (41.1)	
	Low	147 (28.7)	460 (43.3)	607 (38.5)	
[1]Family size (people)	<5	222 (43.4)	419 (39.4)	641 (40.7)	0.136
	≥5	290 (56.6)	644 (60.6)	934 (59.3)	
[1]Mother's age	≥35 years	157 (30.7)	311 (29.3)	468 (29.7)	0.567
	<35 years	355 (69.3)	752 (70.7)	1107 (70.3)	
[3]Mother's occupation	Government employee	56 (10.9)	65 (6.1)	121 (7.7)	0.000*
	Entrepreneur/Private employee	79 (15.4)	105 (9.9)	184 (11.7)	
	Agricultural Sector	44 (8.6)	184 (17.3)	228 (14.5)	
	Not working	333 (65.0)	709 (66.7)	1042 (66.2)	
[3]Father's occupation	Government employee	77 (15.0))	110 (10.3)	187 (11.9)	0.000*
	Entrepreneur/Private employee	224 (43.8)	349 (32.8)	573 (36.4)	
	Agricultural Sector	205 (40.0)	588 (55.3)	793 (50.3)	
	Not working	6 (1.2)	16 (1.0)	22 (1.4)	
[1]Mother's education	High	247 (48.2))	299 (28.1)	546 (34.7)	0.000*
	Low	265 (51.8)	764 (71.9)	1029 (65.3)	
[1]Father's education	High	259 (50.6)	371 (349)	630 (40.0)	
	Low	253 (49.4)	692 (65.1)	945 (60.0)	0.000*

[1]Mann-Whitney Test; [2]Chi-Square Test; [3]Kruskall-Wallis Test;*p<0.05

Prevalence of Inadequate Micronutrients Intake

About 57.7% of children had inadequate energy intake (Table 3). Similar results in another study found about more than 50% of toddlers in Indonesia had energy intake below RDA[28]. Insufficiency of energy intake in long period will cause some metabolic problem due to its function to support the growth, development, and physical activity of children[29]. A research in Surabaya found that inadequate energy intake had higher risk to stunting rather than protein, iron, and zinc intake in children under two years old[30]. This indicated the importance of giving attention to infant and young children energy intake. Improper feeding practices can also contribute in insufficient energy intake[31].

The highest to the lowest prevalence of inadequate micronutrients intake was vitamin C, calcium, iron, vitamin A, zinc. A previous study in Indonesia which used SEANUTS data showed the average adequacy levels of vitamin A, vitamin C, calcium, iron, and zinc in children aged 6-23 months in Indonesia were <75%[31]. Proportions of iron and vitamin C intake were 41% and 80% using RDA as comparison in children aged 12-23 months in Indonesia[33]. Compared to this study, prevalence of inadequate zinc and calcium intake was lower than in South Ethiopia[31]. The same results are found in this study, micronutrients such as calcium, iron and zinc have been identified as a nutritional problem after the introduction of complementary foods[3,4].

Table 3. Prevalence of inadequate energy and micronutrients intake of children aged 6-23 months

Nutrients	EAR		Median Intake	Prevalence of Inadequacy (%)
	6-11 months	12-23 months		
[1]Energy (kkal)	727	756	706	57.7
Iron (mg)	9.2	5.8	2.3	61.9
Zinc (mg)	2.0	2.0	2.3	40.5
Calcium (mg)	225	542	252	74.4
Vitamin A (RE)	286	286	322	42.2
Vitamin C (mg)	42	33	17	90.5
Overall Micronutrients	-	-	-	61.9

[1]Median Energy Estimated Requirement (EER)
[2]Probability of iron intake used Table 1-5 IOM p. 701

[3]EAR was estimated by RDA = EAR + 2SD

Prevalence of inadequate calcium intake was still high. Calcium source food of this research was milk, meanwhile the median calcium intake was only 254 mg but the requirement was 542 mg in children aged 12-23 months. Prevalence of inadequate iron intake was more than 60%. Inadequate iron intake between child probably correlates with the quantity and quality of iron intake[4]. Zinc was the lowest prevalence of inadequate micronutrients intake due to the high contribution of the most consumed food group such as grain, root and tubers, dairy product, and meats food group (Table 4). Other study found that children under five years old had 7.8 bigger risk to stunting when zinc intake was low[30]. In children under five years old, in stunting group with not appropriate motor development has greatest proportion of low zinc adequacy intake[34]. Thus, inadequacy in zinc intake has been found to affect children's development.

The prevalence of inadequate vitamin C intake was the highest. The high inadequacy of micronutrients intake occurred due to subjects who did not consume vitamin A-rich fruit and vegetable and others were in the lowest economic level and mothers with low education. A research in children under two years old in Brazil with a high level of mother's education and household income found it would be high in food consumption such as fruits, vegetables, meat, organ meat, and eggs[35]. Unfortunately, low economic status will be more difficult to afford those foods due to high prices. Low vitamin C intake will have a consequence to the immune system due to antioxidants having a role in the immune system and tissue damage [19]. The result of prevalence of inadequate vitamin A intake was 42.2%. This result was higher than previous study in Jakarta, which stated that 19.3% children aged 12-23 months had inadequate vitamin A intake[4]. That was due to consumption of vitamin A-rich fruits and vegetables was only 31.9%, meanwhile in Jakarta it was higher, about half of children consumed this food group.

Overall, about 62 out of 100 children under two years old were experienced in crucial inadequate multiple micronutrients intake in the first thousand days of life and had a risk of deficiency. There was a research conducted in toddlers in Bangladesh which had a similar method in which the prevalence was higher than this study (57%)[5] and children aged 9-23 months in Nepal (52%)[18].

Minimum Dietary Diversity (MDD)

In this study, only 15.9% of subjects met the MDD. It was lower proportion than a study conducted in Indonesia using Demography Health Survey 2017 data. About 47.2% of children did not meet the MDD[9]. That research was using qualitative data rather than quantitative data as in this study with 10 grams of minimum consumption. Also different gap years of analysis might cause increasing dietary diversity over years.

The highest proportion of dietary diversity score was three food groups (33.2%) with a combination of grains, roots and tubers, milk and products, and meat/fish/poultry/organ meat. The proportion of subjects with five dietary diversity scores was only 12.6%, while no one had eight scores of dietary diversity (data not shown).

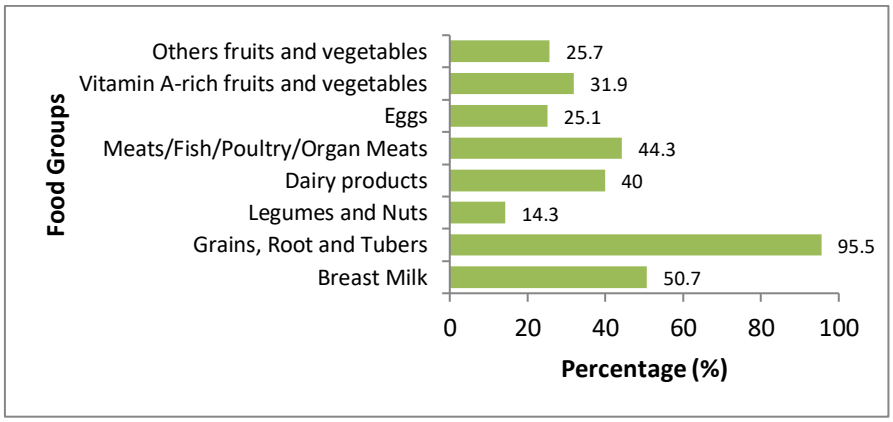

Figure 1. Percentage of food group consumption

Based on Figure 1, more than 95% of subjects consumed grains, root and tubers especially rice as their staple food, similar with the study conducted in Indonesia population[9]. However, more than half of the subjects consumed less energy than was recommended (Table 4). Even though almost all subjects consumed rice, the average rice consumption only contributed to about one-third of the energy requirements. Meanwhile, insufficient energy intake was associated with stunting in toddlers in Surabaya City, Indonesia[30]. White rice was a common food source of energy, but colored rice was more recommended due to its higher vitamin A, iron, and zinc content[36].

Based on Table 4, rice was also the main source of iron for the subjects. Although the rice was the predominant source of iron in the subject's total intake, it was included in plant-based food with low nutrient bioavailability[36]. Consumption of legumes and nuts such as tofu and tempeh also contributed to the subject's iron intake, while the proportion was low.

Grains, root, tubers and dairy products food group had a great contributor for zinc intake of subjects, about more than 30%. Thus, the prevalence of

inadequate zinc intake was the lowest among the other micronutrients observed (Table 3). About 40% of subjects consumed dairy products which was formula milk. More than 50% of subject's calcium intake was from formula milk. However, just consuming milk was not enough to meet the calcium requirements of children. A study found formula milk in toddlers was revealed to significantly contribute to their nutrient intake in Bandung City[37] and Sidoarjo District[38], Indonesia, and also was the primary sources of iron and zinc for children aged 6-23 months in urban China[39].

Table 4. Contribution of Food Group Consumption Based on Micronutrients Intake

Food Group	Contribution of Micronutrients Intake (%)					
	Energy	Calcium	Iron	Zinc	Vitamin C	Vitamin A
Grains, root and tubers	34.5	22.1	7.8	41.2	32.2	4.9
Legumes and nuts	1.8	4.5	2.8	9.4	5.0	0.2
Dairy products	17.7	28.1	53.5	5.8	34.7	6.2
Meat/Fish/Poultry/Organ Meat	6.3	15.4	3.9	11.2	9.0	0.0
Eggs	3.9	9.0	1.8	11.4	0.3	0.0
Vitamin A- rich fruits and vegetables	0.3	0.5	1.3	2.8	1.1	7.0
Other fruits and vegetables	0.7	0.8	1.7	13.9	0.8	12.6
Breast Milk	34.7	19.6	27.2	4.3	16.8	69.1

In this study, chicken meat consumption was higher in the urban area, meanwhile in rural area it was *tongkol* and *kembung* fish. However, the animal source food had low contribution in all micronutrients intake of subjects. Eggs became a low contributor of the iron intake of subjects. Eggs were a rich source of protein and zinc with affordable prices and easy to serve[37]. Animal-derived foods like meats, fish, milk, eggs, and poultry, have higher levels of vitamins A, B12, riboflavin, calcium, iron, and zinc than plant-based foods. These foods contained higher nutrient density to counter micronutrients deficiencies like iron, zinc, and calcium[3]. Those nutrients were difficult to obtain in sufficient amounts if plant-based sources only were used[37,40].

Animal organs such as chicken liver can be a good and affordable source of iron. However, in this study almost no one consumed chicken liver. A study in rural Sidoarjo District, Indonesia found only a few children who consume organ meats group[38].There was a perception about the foods that they are not commonly consumed and not healthy for the Indonesian. Thus, education and socialization is important to straighten out the perception of consuming organ food[36].

Inadequate vitamin C intake was the highest among the other nutrients. Breast milk was the highest contributor to vitamin C intake rather from complementary food especially from vitamin A-rich fruit and vegetable and others food groups which were <9.0%. The sources of vitamin A intake of subjects were also from breast milk. As the children are growing up, macro- and micronutrients from breast milk will have low contribution to nutrient intake of children, and it must be fulfilled from the foods[7]. The contribution of consuming the vitamin A-rich fruit and vegetable food group in total intake of vitamin A was 18.6%. The type of food consumed was like carrots, spinach, and papaya. Although those items were generally a source of vitamin A, the amount consumed was insufficient[41].

Risk Factors of Inadequate Micronutrients Intake

The multivariate test showed the children who lived in rural areas were about 1.37 times more likely to have inadequate micronutrients intake. It could be explained by the subjects' nutritional status, which was underweight and had the lowest family economic status. A comparable study in Indonesia discovered that people who lived in cities had better nutrient intake than those in rural areas[32]. In Ethiopia, where the population lived in central cities, they tended to have easier access to healthcare and information about child feeding practices[23].

Not consuming breast milk was less likely, about 45%, to have inadequate micronutrients intake due to the energy and micronutrients intake tend to be higher in the not consume breast milk group and similar to previous studies[5]. The high inadequate micronutrients intake occurred in subjects who consumed breast milk instead of not consumed. In general, children who consume breast milk will consume less food than breast milk[42]. Most mothers with children aged 6 to 11 months were primarily concerned with breastfeeding; therefore, they were unaware of the necessity in improving dietary amounts and types of foods[9]. Majority of formula milk was fortified with vitamins and minerals based on children's requirements. This could explain why not consuming breast milk reduced the risk of having inadequate micronutrients intake. Breast milk was still the best food for children under two years old due to immune modulator substances for a child's immune systems and high bioavailability. Achieving the optimal consumption of breast milk could reduce mortality about 6% and 13% of giving the appropriate complementary food[7].

Low mother education was about 1.71 times more likely to have inadequate micronutrients intake in children compared to high mother education. Parental education, especially from the mother, was influential in stimulating children's growth and nutritional status[26]. In this study, most low education mothers had children low in dietary diversity and energy intake. The role of mother's education was also potential to determine the mother's knowledge about child feeding practices in providing the quantity and quality of foods in children under two years old in Bangladesh[8].

Table 5. Risk factors of inadequate micronutrients intake among children aged 6-23 months

Independent Variables		Inadequacy of Micronutrients Intake			
		Low	High	OR (95%CI)	P-value
Residence Area	(0= Urban)	287 (56.1)	408 (38.4)		
	Rural	225 (43.9)	655 (61.6)	1.37 (1.05-1.77)	0.016*
Breastfeeding Status	(0= Consume)	230 (44.9)	568 (53.4)		
	Not consume	282 (55.1)	495 (46.6)	0.55 (0.43-0.71)	0.000*
Mother Education	(0=High)	247 (48.2)	299 (28.1)		0.000*
	Low	265 (51.8)	764 (71.9)	1.71 (1.32-2.32)	
Energy Intake	(0= ≥requirement)	373 (72.9)	293 (27.6)		0.000*
	<requirement	139 (27.1)	770 (72.4)	6.22 (4.84-7.99)	
MDD	(0=Achieved)	168 (32.8)	83 (7.8)		0.000*
	Not achieved	344 (67.2)	980 (92.2)	4.84 (3.47-6.75)	

*p<0.05, 95% Confidence Interval

Subjects who did not achieve the MDD were about 4.84 times more likely to have inadequate micronutrients intake. It is explained by more than 80% of subjects did not meet MDD and were low in animal, legumes and nuts, fruits and vegetables consumption. In line with other cross-sectional-study it found that not achieving MDD was more likely to have inadequate micronutrients intake in toddlers Bangladesh[5]. Study in Tanzania found that areas with a high prevalence of under nutrition can be reduced by increasing food diversity in complementary foods[40]. Not only in food quality, the food quantity reflected by energy intake below requirements was about 6.22 times more likely to have inadequate micronutrients intake in this study.

The risk of energy intake below requirement was the highest compared to dietary diversity factor in this study. Similar study found in toddlers of rural Bangladesh that the micronutrients inadequacy was explained by the low energy intake (r=0.51) and low dietary diversity (r=0.44)[5]. Also, the low energy intake contributed to inappropriate child feeding of children under two years old in Southern Ethiopia[31].The quantity and quality of foods must go simultaneously, increasing energy intake only by providing a greater amount of food without increasing the quality of dietary diversity will not significantly impact to achieve daily nutritional needs[10].

In this study, only 7% of subjects conducted the second recall. Nevertheless, repeated food recalls more than 2x24 hours is the best for estimating the usual intake of the subject[18]. Also, the causality effect between the independent variables and the outcome could not be explained in this cross-sectional study. Despite the limitation, this study was using EAR instead of RDA as the requirement, due to RDA having the probability of only 2-3% to identify the inadequate nutrient intake group[13]. The prevalence of inadequate micronutrients intake variable in children aged 6-23 months in Indonesia was limited. This study used quantitative data to determine the child dietary diversity, so it prevents misleading on classifying the child for consuming or not consuming the food groups. The sample size in this study was large enough due to national data level and the response rate until the final subjects was 76.4%. As a result, this study might be generalized and compared to related study in other countries.

CONCLUSIONS

Most subjects were dominantly low in energy intake and did not achieve the MDD. Calcium, iron, zinc, vitamin A, and vitamin C were still nutritional problems in the transition period between breastfeeding and complementary feeding in children aged 6-23 months. Almost two-thirds of subjects were inadequate in crucial micronutrients intake in the first thousand days of life. Energy intake below requirement, did not achieve MDD. Low education of mother, and living in rural area were more likely to have inadequate micronutrients intake, meanwhile not consuming breast milk was less likely to have inadequate micronutrients intake. Inadequate micronutrients intake could be improved by educating the mothers and caregivers about the food quantity and quality from breast milk and complementary food in infant and child feeding practice especially animal source food, legumes and nuts, fruits and vegetables food sources. Introducing and promoting local foods due to cheap, convenient, affordable, and nutritious foods is also important to meet their daily requirements

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CONFLICT OF INTEREST

All authors have no conflict of interest in this article

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