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Prevalence and Factors Associated with Anemia in Children Aged 12-24 Months In Darul Imarah Sub-District Aceh Besar District

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Abstract: This study was aimed to determine the prevalence and factors affecting the anemia status of children aged 12-24 months in Darul Imarah Sub-district, Aceh Besar District. Sample was selected using stratified random sampling technique with proportional allocation. The classification was based on pre-prosperous household/ prosperous I (Jeumpet village = 56 people), prosperous II (Lambheu village = 40 people) and prosperous III (Geugajah village = 45 people) which stood as each layer. Minimum sample size was 102 children aged 12-24 months. Children's characteristics, socioeconomic status of the family, nutrition and health knowledge of the mothers, feeding practices and history of diarrhea and upper respiratory tract infection (URTI) were measured by using a structured questionnaire. Food consumption was measured through a 24 h recall method. Anthropometric nutritional status was measured by weight-for-age index (WAZ) and length-for-age (LAZ). Hb level was measured by Hemocue 201$^+$ tool. Based on the results of the current study, the anemia prevalence among children aged 12-24 months in Darul Imarah Sub-district, Aceh Besar District was categorized as severe nutrition and public health problem (68.6%). Based on the overall results of regression analysis, the dominant variables affecting anemia status of children were Fe adequacy level (PE = 0.017; R = 0.117), energy adequacy level (PE = -0.013; R = 0.029), length of education of the father (PE = 0.126; R = 0.033), income per capita (PE = -0.657; R = 0.040) and father's age (PE = -0.020; R = 0.022). Among these five factors, iron adequacy level contributed greatly to the occurrence of anemia in children aged 12-24 months (11.7%). It is thus concluded that high prevalence of anemia in Darul Imarah Sub-district, Aceh Besar District requires special attention from the local government to plan or make policies regarding treatment or prevention program of anemia problem in children under two years, especially in the age group of 12-24 months. There is a need to increase the knowledge and practice about the appropriate child feeding practices, especially the consumption of various plant and animal food sources, as well as iron rich foods.

Key words: Children, 12-24 months, anemia, hemoglobin (Hb), Indonesia

INTRODUCTION

Anemia is a common nutrition problem caused by iron (Fe) deficiency and often called as iron-deficiency anemia (WHO, 2008). Iron is needed to form hemoglobin (Hb) which serves to carry oxygen from lungs to all body tissues. If the production of Hb decreases as a result of iron deficiency, it results in reduced level of Hb in blood, thus leading to anemia (World Bank, 2006).

Anemia in children under two years of age is one of common nutritional and public health problems in Indonesia nowadays. Previous reports have shown that anemia prevalence in children under five years of age in Indonesia was 67.8%, (in), 53.7% (in) and 73.7% (in) in Aceh, Sikka and Merauke districts (WVI, 2009). Surveys in four districts of Aceh Province (West Aceh, Aceh Besar, Aceh Jaya and Banda Aceh) showed that the highest prevalence of anemia (77%) was found in the group of children aged 11-24 months (Ahmad *et al*., 2010). The anemia prevalence in children under two years of age reached 78.3% in Darul Imarah Sub-district (Aceh Besar District) and because of such higher prevalence, it was included in severe public health problem category according to WHO (2008).

An increased prevalence of anemia in children under two years of age could be influenced by various factors. Studies reading this have been done with various variables. Previous studies have stated that the determinants of anemia in children under two years were birth weight, maternal factors, food pattern practices (Domellof and Hernell, 2002); early introduction to milk, exclusive breastfeeding over the age of 6 months (Meizen-Derr *et al*., 2006); partial breastfeeding in children under 6 months of age, the delay in complementary feeding introduction and providing the food deficient in iron (Soh *et al*., 2004). Other factors among socioeconomic characteristics of the family that have higher chances of

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causing anemia in children aged 6-59 months were younger maternal age, low parental education, current breast-feeding, smoking fathers, having more than four family members and lower weekly household expenditure per capita (Semba *et al*., 2010).

High prevalence of anemia among children under five years of age is considered as a serious public health problem which will have adverse effects for future generations. Review results by McGregor and Ani (2001) stated that the impact of iron deficiency and anemia in the first two years of life were associated with decreased cognitive, motor and mental development of the children. The evaluated longitudinal observational studies consistently showed that children who suffered from anemia in early childhood period would have lower cognitive development, motor development and educational achievement in their middle childhood period. This would give rise to various socioeconomic problems in the future if not addressed promptly and anticipated properly (Lozoff, 2007).

Thus, the high prevalence of anemia and the magnitude of the factors affecting it were the reasons for undertaking the present study. The aim of this study was to determine the prevalence and dominant factors affecting the anemia status of children aged 12-24 months in Darul Imarah Sub-district, Aceh Besar District.

MATERIALS AND METHODS

Subjects and sampling: The study was conducted on children aged 12-24 months in Darul Imarah Sub-district, Aceh Besar District. The target population were the chosen targets who met the criteria i.e. born at term (≥37 weeks), not in the state of severe pain, lived with their mothers and willing to participate. Sample was part of the planned target population which was randomly selected using stratified random sampling technique with proportional allocation. The classification was based on pre-prosperous household/prosperous I (Jeumpet village = 56 people), prosperous II (Lambheu village = 40 people) and prosperous III (Geugajah village = 45 people) which stood as each layer/level. Minimum sample size was 102 children aged 12-24 months.

Socioeconomic characteristics of children: Data of socioeconomic characteristics of the family (father's and mother's education as well as occupation, family size, number of children and income per capita) and children under two years (age, gender and birth weight) were obtained by interview using questionnaire.

Nutrition and health knowledge of mothers: Data of nutrition and health knowledge of the mothers were obtained by interview using a questionnaire. After that, every correct answer for the given question was given score "1" and the wrong answer was given "zero" score. Therefore, nutrition knowledge score ranged from 0-15. Thereafter, the score was categorized as good (>80%), moderate (60-80%) and low (<60%).

Feeding practice: Feeding practice was asked through interview to the mothers/care givers using a questionnaire. Feeding practice aspects that were assessed include breast-feeding history, provision of complementary feeding, practice of good hygiene and proper food handling, responsive feeding and feeding when the child was sick (WHO, 2002). Feeding practice was then classified into three categories, namely poor (<60%), moderate (60-80%) and good (>80%).

Nutrient intake: Nutrient intake data of children were collected using 24 h food recall. Food frequency questionnaire (FFQ) was used to ensure the quality of food consumption data, that was to assess the frequency of consumption of animal source foods (e.g. beef, poultry, fish, egg and milk) and food that inhibited iron absorption (e.g. tea). Parameters calculated were energy (Kcal), protein (g), iron (mg), vitamin C (mg) and vitamin A (g). Adequacy level of vitamin and mineral was classified as follows: deficient (< 77% RDA) and adequate (≥77% RDA) (Gibson, 2005).

Nutrition status: Nutrition status assessment of children was calculated with measurement of anthropometric indicators (weight, body length and age) using WHO international reference. Anthropometric 2005 software was used to calculate weight-for-age Z-scores (WAZ) and length-for-age Z-scores (LAZ). Body weight was measured by digital scales that had been calibrated beforehand, while body length was measured by length board. Each sample was measured twice.

Health status: Children's health status was determined from history of upper respiratory tract infection (URTI) and diarrhea in the last two weeks. URTI was determined based on the symptoms of cough, cold and fever. Diarrhea was determined based on the symptoms of defecate in dilute form more than three times a day.

Anemia status: Blood samples of the children were collected from the tip of ring finger by a medic. Blood drops were put in micro cuvette to determine Hb level. Measurement of Hb level was determined by Hemocue system (201^{+}). According to WHO, Hemocue method is comparable with Cyanmethemoglobin method, in terms of validation and reliability. Anemia status of the children aged 12-24 months was defined as Hb level <11 g/dL.

Statistical analysis: Data were analyzed using Microsoft Excel 2013, SPSS version 16.0 for Windows and SAS version 9.1 for Windows. Statistical analysis performed was descriptive analysis and multiple linear regression

using stepwise method where the dominant variable affecting anemia status of children was variable with significance level ($p>0.05$).

RESULTS

Sample size in this study was 102 children aged 12-24 months who lived in Darul Imarah Sub-district, Aceh Besar District. Means of various variables studied have been shown in Table 1. Anemia prevalence was 68.6% and Hb level ranged from 7.0-12.4 g/dL with an average of 10.0±1.3 g/dL. There was a tendency of boys (75%) to have higher anemia prevalence compared to girls (63.8%). Average age of children in both groups was 17 months and birth weight of the children with anemia was slightly higher (3105.9 g) than those without anemia (3065.6 g). There was a tendency of higher anemia prevalence in children aged 19-24 months (70.6%) compared to children aged 12-18 months (67.8%).

Mean of education length of fathers in children aged 12 = 24 months with anemia (11.6 years) was lower than non-anemic children (12.5%) while education length of mothers in both groups were the same (12.4 years). Number of family members in both groups classified as small family size (≤4 people) with average number of children in the household was one child. Most fathers worked as non-peasant labor (service labor) and civil servants while mothers were mostly housewives. Household income per capita were lower in anemic children (IDR 697 372/capita/month) than non-anemic children (IDR 775 468/capita/month).

In general, nutrition and health knowledge of mothers in both groups were relatively low. However, the average score of mother's nutrition and health knowledge was lower in anemic children (54%) than non-anemic children (57%). Meanwhile, feeding practices applied by mothers/care givers were moderate. Mean score of feeding practices in non-anemic children was higher (64.5%) than anemic children (63.4%).

Consumption of energy, protein, iron, vitamin A and vitamin C in both groups were still lower than RDA for children aged 1-3 years, i.e., 1125 Kcal (energy), 26 g (protein), 7 mg (iron), 400 mg (vitamin A) and 40 mg (vitamin C) (Kemenkes, 2013). In general, energy adequacy level was in mild deficit category; protein and vitamin A were adequate; iron and vitamin C were deficient in both groups. However, the mean of adequacy level of protein, iron, vitamin A and vitamin C in anemic children under two years were lower than non-anemic children, except for energy adequacy level. Animal source foods rarely consumed by both the groups were beef and chicken/poultry. Consumption of milk and eggs were higher in non-anemic than anemic children. Consumption of tea, a type of inhibitor foods, was also examined in this study. Tea consumption was rare in both groups because it was not necessarily consumed twice a week and the amount of consumption was also little. In general, nutrition status in both groups was categorized as good based on WAZ index and normal based on LAZ index. However, there was a greater tendency of anemia in children with moderate malnutrition, moderate stunting and severe stunting.

In general, history of URTI by 51% and diarrhea by 45.1% had been experienced by children aged 12-24 months in the last two week of the study date. Average duration of URTI was 3 days and diarrhea was 2.7 days. However, duration of URTI and diarrhea experienced by non-anemic children was slightly longer than the anemic children. Children aged 12-24 months, whether they were suffering from URTI and diarrhea or not in the last two weeks, had a greater tendency of anemia.

Factors which were expected to affect anemia status of children aged 12-24 months were analyzed using multiple linear regression with independent variables as follows: characteristics of children, socio-economic characteristics of the family, nutrition and health knowledge of the mothers, feeding practices and children's history of health (nutrition status, history of URTI and diarrhea). Based on multiple regression analysis, Fe and energy adequacy level, father's education length, income per capita and age of the father had significant effect on anemia status simultaneously. The dominant variables affecting anemia status have been presented in Table 2. Coefficient of determination was 0.241 (Table 2) which meant that 24.1% of the diversity of anemia status or Hb level of children aged 12-24 months could be explained by those variables, while the rest of it (75.9%) could be explained by other factors such as iron status and its absorption in the body. However, those factors were not inspected in this study. Once entered into the regression model, it showed that Fe adequacy level, energy adequacy level, education length of the father and income per capita were respectively accounted for 11.7, 2.9, 3.3 and 4% of anemia status of children aged 12-24 months.

DISCUSSION

According to Gibson (2005), age and gender are important factors that determine Hb level. In the first six months of life, Hb level of males were lower than females. Likewise, Soh *et al.* (2004) stated that boys had a faster growth rate than girls. According to Soetjiningsih and Ranuh (2013), boys were more often sick and more active so they required higher nutrition intakes than girls. These results differ from the study of Riyadi (2002) which showed that anemia prevalence in children aged 6-24 months was higher in girls than boys.

According to Gunnarsson *et al.* (2004), younger children (aged 6-12 months) had better iron stores than the older ones (aged 12-24 months). Further, Vendt *et al.* (2007) reported that infants with low birth weight were at risk of iron deficiency and iron-deficiency anemia in 9-12 months in Estonia. There was no significant effect of age and gender on anemia status in the present study. This might

Table 1: Mean and standard deviation (SD) of study variables

	Anemic (n = 70)	Non-anemic (n = 32)
Variable	Mean±SD	
Hb level (g/dL)	9.4±0.9	11.6±0.5
Age of children (months)	17.0±3.8	17.0±3.4
Mother's age (years)	29.6±5.1	29.1±6.1
Father's age (years)	34.5±5.8	34.5±5.8
Father's education (years)	11.6±2.3	12.5±2.2
Mother's education (years)	12.4±3.1	12.4±2.4
Family size (person)	4.1±1.0	4.2±1.0
Income per capita (IDR/capita/month)	697372.5±505538.5	775468.8±596591.2
Number of children under five (per person)	1.3±0.5	1.3±0.4
Nutrition and health knowledge of mothers (%)	54.0±14	57.0±20
Feeding practice (%)	64.5±11.0	63.5±11.0
Energy consumption (Kcal)	583.9±159.5	617.2±166.0
Protein (g)	16.8±6.1	19.8±6.3
Iron/Fe (mg)	2.9±2.1	4.4±2.1
Vitamin A (µg)	339.6±155.9	376.2±154.4
Vitamin C (g)	13.8±11.2	18.4±10.1
Energy adequacy level (%)	78.4±23.2	77.8±19.4
Protein adequacy level (%)	95.8±33.7	107.6±32.0
Fe adequacy level (%)	41.6±29.7	62.9±30.5
Vitamin A adequacy level (%)	89.4±41.0	99.0±40.6
Vitamin C adequacy level (%)	34.5±28.0	45.9±25.2
Chicken (times/week)	0.4±0.8	0.5±0.9
Beef/lamb (times/week)	0.1±0.2	0.1±0.4
Fish (times/week)	13.0±7.6	12.3±8.6
Eggs (times/week)	5.7±4.5	12.3±8.6
Milk (times/week)	11.4±15.7	20.3±15.1
Tea (times/week)	1.7±2.6	1.3±2.6
WAZ	-1.3±1.3	0.6±1.4
LAZ	-1.8±1.8	0.4±1.7
Duration of URTI (days)	2.7±1.3	3.6±2.4
Duration of diarrhea (days)	2.6±1.3	3.0±1.7

Table 2: Dominant variables affecting the status of anemia

Variable	Parameter estimate	Partial r-square	p-value
Intercept	8.341		
Fe adequacy level	0.017	0.117	0.000**
Energy adequacy level	-0.013	0.029	0.069*
Education length of the father	0.126	0.033	0.049**
Income per capita	-0.657	0.040	0.027**
Age of the father	-0.020	0.022	0.093*

Linear regression, *p<0.1; **p<0.05

be caused by little variation in age distribution of children aged between 12-24 months.

Fe adequacy level had significant positive effect on anemia status of children aged 12-24 months. This meant that there was a tendency that lower the Fe adequacy level, higher the anemia status of children. Iron intake in this study came from breast-feeding and complementary feeding, particularly milk, which were thought to contribute greatly in providing iron. Average consumption of milk was 23.5 g/day, so it contributed 1.9 mg iron approximately per day. According to Saragih (2007), iron intake had a strong association with Hb than its association with calorie and protein intake. Infants with iron intake below 70% RDA were experiencing anemia 3.5 times higher than infants with iron intake above 70% RDA. Iron intake would affect iron level in the body which was indicated by Hb level (Wegmuller *et al*., 2006). Iron is needed to form Hb its function is to carry oxygen from lungs to all body tissues (World Bank, 2006). Increased level of Hb due to intake of high bioavailability iron was found in children aged 6-23 months in Brazil (Osorio *et al*., 2004).

Energy adequacy level had significant negative effect on anemia status of children aged 12-24 months. Behavior of consumption of animal source foods, such as meat and poultry had not become a part of people's daily menu in Aceh (Kemalawaty, 1999). Their consumption was dominated by food sources of carbohydrate that contributed more in energy intake but low in iron which was needed in the synthesis of Hb. In general, the processing of daily menu for children was mostly done by sauteing and deep-frying. Thus, it was alleged that energy source was mostly contributed by the oil/fat.

Education length of the father had significant positive effect on the anemia status of children aged 12-24 months. This meant that there was a tendency that lower the father's education, higher the anemia status of the children. These results were rarely found in other studies (Onyemaobi and Onimawo, 2011); (Kikanfunda *et al*., 2009) which stated that low education of the mothers was significantly associated with anemia incidence in children under five years of age in Uganda and Nigeria. Meanwhile, the results of this study indicated that father's education was no less important than the mother's education. This might be due to father's education that contributed to his knowledge in meeting the need of food and health of the children. In addition to the mother, the father also had a major role in decision making of daily food consumption of the family members. This current study results were consistent with the study by Cahyaningdiah (2001) who reported that there was a significant association between father's education level and anemia in children aged 5-7 months in Indramayu.

Income per capita had significant negative effect on anemia status. This might be due to an increase in income were preferred for non-food expenditures so that the reduction of food expenditure, especially for animal source foods which was a good source of iron. These results were confirmed by Kemalawaty (1999) who stated that the nominal value of expenditure per capita per month for animal source foods in Aceh Province was only Rp 12 663. Proportion of expenditure for animal source foods to total expenditure amounted to only 13.9%. This proportion was considered low for consumption of animal source foods. Furthermore, based on data, the consumption of animal source foods was still low in which poultry consumption was 2.6 times/month and beef consumption was 0.6 times/month only. According to Sulistyoningsih (2011), high income that was not accompanied by adequate nutrition knowledge would cause a person to be very consumptive in terms of his own diet, so that the selection of food was based more on taste than its nutritional aspects.

Age of the father had significant negative effect on anemia status of children aged 12-24 months. The higher the age of the father, higher was the anemia status of the children. This might be due to the association between the increasing of age and the time allocation of the father for child care and the ability to absorb the knowledge. Higher age of the father caused him to have a great opportunity to have low knowledge because most of fathers who did not complete primary school education or only had education until primary school in this study were largely spread in the age group of above 32 years.

Other factors that did not affect the anemia status of children aged 12-24 months were gender; age; nutrition and health knowledge of the mother; adequacy level of protein, vitamin C, vitamin A; nutrition status and history of URTI and diarrhea. Gamble *et al*. (2004) stated that either iron or vitamin A was risk factor of anemia. In addition to iron, the presence of vitamin C in diet will provide acidic conditions to facilitate reduction of ferric iron (non-heme) into ferrous (heme) that is more easily absorbed by the small intestine. Food menu in Indonesia doesn't consider good food combination oftentimes, which consists of a mixture of iron source from animal and plant source foods, as well as other nutrients such as vitamin C that can help iron absorption in the body (Almatsier, 2006).

Protein is the main source of iron in the diet. However, different types of protein will provide different form of nutrients as well. Animal protein provides iron in heme form that is absorbed more easily by the body, while plant protein provides iron in the form of non-heme which is more difficult to absorb. Protein intake of children in this study was expected to be derived mostly from plant sources.

No significant association between nutrition and health knowledge of the mother with anemia status of children aged 12-24 months was probably caused by the lack of knowledge about nutrition and health, especially the knowledge related to anemia. In addition, it might also be due to the mother's behavior which was not conducive in improving the nutrition intakes of the children. Mothers who did not know about children's food diversification contributed to anemia in children in Uganda (Kikanfunda *et al*., 2009).

Feeding practices measured in this study might be too general to describe the effect on anemia status of children aged 12-24 months. In addition, the relatively uniform diet in children led to a lack of association between feeding practices and the anemia status. According to Sivan *et al*. (2010), feeding practices in the form of lack of interaction between mothers and their children in feeding associated with the incidence of anemia in their children.

According to Hay *et al*. (2004), children with history of fever at the time of blood sampling showed no significant association with anemia prevalence. However, a history of fever in a month or a week before blood sampling could increase ferritin level and decrease Hb level in children aged 6-24 months in Norwegian. Study by Osorio *et al*. (2004) showed that diarrhea in the last two weeks could lower Hb level or increase the incidence of anemia. The magnitude of prevalence of URTI and diarrhea experienced by children in this study might be caused by flooding in some parts of the study area a week before data collection and it could also be caused by the rainy season. Rainy season and flood season were conditions that make one vulnerable to disease outbreaks and viruses.

There was no association between nutrition status based on WAZ and LAZ with anemia status of children. However, correlation test showed a positive correlation between nutrition status based on WAZ with anemia status of children aged 12-24 months. Chronic macronutrients malnutrition can be a potential predictor of micronutrient

deficiency, including iron deficiency (Almatsier, 2006). Doloksaribu (2005) reported that there was a significant association between nutrition status based on LAZ with the incidence of anemia in children aged 12-23 months in 7 provinces of Indonesia.

Conclusion: Anemia prevalence among children aged 12-24 months in Darul Imarah Sub-district, Aceh Besar District was categorized as severe nutrition and public health problem (68.6%). Based on regression analysis, the dominant variables affecting anemia status of children were Fe adequacy level (PE = 0.017; R = 0.117), energy adequacy level (PE = -0.013; R = 0.029), father's education (PE = 0.126; R = 0.033), income per capita (PE = -0.657; R = 0.040) and age of the father (PE = -0.020; R = 0.022). Among these five factors, iron adequacy level had a greater contribution (11.7%) to anemia status of children.

High prevalence of anemia in Darul Imarah Sub-district, Aceh Besar District requires special attention from the local government to plan or make policies regarding treatment or prevention program of anemia problem in children under two years, especially in the age group of 12-24 months. There is a need to increase the knowledge and practice about the appropriate child feeding practices, especially the consumption of various plant and animal food sources, as well as iron rich foods. Feeding practices in children under two years is important because they are still passive consumers in which the food consumed is dependent on what is provided by their mothers or care givers.

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