Factors Associated with Iodine Deficiency Disorders (IDD) in Elementary School 4 Krebet, Ponorogo, East Java

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Abstract: One of the problems being faced in Ponorogo district is the phenomenon of Idiot Village. One of the villages known by the nickname is the Krebet Village in Jambon sub-district. Jambon is an endemic area due to Iodine Deficiency Disorders (IDD). The purpose of this study is to examine the factors associated with IDD in Elementary School 4 Krebet. This cross-sectional study was conducted from February to June 2016. The population is all students in Elementary School 4 Krebet. The total sample was 72 students. IDD status was identified using the palpation. Salt iodine content was measured using the iodine test. The frequency of food consumption from outside the village (FFCO) was collected by a food frequency questionnaire. Energy and protein intake were assessed using food recall. Nutritional status was measured using a height for age (HFA) index. The results of multiple logistic regression tests showed that significant factors associated with the incidence of IDD were iodine salt content (OR=8.7; p=0.003), protein intake level (OR=6.7; p=0.004), and FFCO (OR=5.8; p=0.009). It is very important for the Government of the Ponorogo Regency to ensure that used salt truly contains iodine.

1 INTRODUCTION

Iodine deficiency (ID) causes poor school performance, decreased resistance to infection, lack of physical strength of children (WHO, 2013), preventable mental retardation (Egli et al., 2004), and inhibits the socio-economic growth of the nation in general (Andersson, Karumbunathan and Zimmermann, 2012).

The most vulnerable groups to ID are school children and pregnant women, compared to other population segments (Benoist et al., 2008). According to the International Council for Control of Iodine Deficiency Disorders (ICCIDD), there were 32 countries with iodine deficiency in 2011, declined from 54 countries in 2003 (World Health Organization, 2013).

Iodine Deficiency Disorders (IDD) is still a public health problem in Indonesia. National prevalence was still above 5% in 2010 and varied between provinces. There were still found sub-districts with a prevalence of IDD above 30%. It was estimated that around 18.16 million people live in moderate and severe endemic areas, and 39.24 million people live in mild endemic areas (National Institute of Health Research and Development, 2010).

According to the Basic Health Research 2013., urine iodine concentration (UIC) with a risk of iodine deficiency among children aged 6-12 years as 14.9µg/L. Classified as endemic when it is observed that population suffering from goiter enlargement with the following classification, severe if the Total Goiter Rate/TGR is or greater than 30%, moderate if TGR ranges from 20% to 29.9%, mild if TGR ranges from 5 to 19.9%, and non-endemic if TGR is less than 5% (Ministry of Health, 2001).

Based on the result of the IDD survey in East Java, it was found that TGR as 24.8%, classified as mild endemic. One of the endemic areas in East Java is Ponorogo Regency, it has a TGR of 12.27%. (East Java Provincial Health Office, 2009).

Nutrition mapping 2008, which was conducted in Ponorogo Regency to a sample of 6300 elementary school children using the palpation, found that 9.7% of children with grade I goiter, and 0.9% of children with grade II goiter, as a result, Total Goiter Rate (TGR) is 10.6% (Ponorogo Regency Health Office, 2010).

One of the endemic areas in the Ponorogo Regency is Jambon Sub-district. The population in

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Jambon suffering from IDD as 315 people, the most are found in Krebet and Sidoharjo Village (Ponorogo Regency Health Office, 2015). Sidoharjo Village is located at the end of Jambon Sub-district and is area expansion from Krebet Village since September 2007.

Sidoharjo Village is often known as the idiot village. Out of 6257 total population of Sidoharjo Village, approximately 249 people have mental disabilities. It is caused by many factors, including the location of the village on the slopes of the limestone mountains with barren land so that it only can be planted cassava as a staple food that is daily consumed. Second, the lack of iodine content, even none, contained in the salt consumed every day (Ponorogo Regency Health Office, 2014).

Elementary School 4 Krebet is a public primary school located in Dusun Sidowayah, Sidoharjo Village, Jambon Sub-district, Ponorogo Regency. This school accepts all children either normal or with special needs. Although the Ministry of Health has developed regulations and guidelines for the availability of iodized salt, IDD prevalence is still a significant public health problem. Therefore, this study aims to examine factors related to IDD among school children in Elementary School 4 Krebet, Sidoharjo Village, Jambon, Ponorogo, East Java.

2 METHOD

2.1 Study Design, Time and Location

A school-based cross-sectional study was conducted in Elementary School 4 Krebet, Dusun Sidowayah, Sidoharjo Village, Jambon Sub-District, from February to June 2016. The sub-district is found in Ponorogo Regency, 20 km from the Ponorogo City. The village, which is located at the end of Jambon Sub-district, is area expansion from Krebet Village since September 2007. Sidoharjo Village is located at an altitude of 325 meters above sea level, in a barren land and gets an average rainfall of 2000-2500 mm once a year, with temperatures of 21-23ºC (Ponorogo Regency Health Office,2014).

2.2 Sampling Procedure

The sample size was calculated by G-Power software 3.1.9.2 considering the following assumptions: 50% expected prevalence of IDD, a 5% error margin and at a 95% confidence level. After adding a non-response rate of 10%, a sample size of 72 was obtained. To select study participants, this study used a systematic sampling technique. The number of children from each class was divided by the total number of samples to get the sampling fraction. In addition, the total number of children who meet the criteria chosen from each class was proportional to the population size.

Study participants should meet the inclusion and exclusion criteria. The inclusion criteria are the child has lived in the village at least for the last year and able to communicate. The exclusion criteria are the child consumed iodine supplement for the last six months and not present during data collection.

2.3 Data Collection and Procedure

The palpation method of the thyroid gland indicates the enlargement, surface, and consistency of the thyroid (Benoist et al., 2008). The palpation was performed by trained health officers to assess the size of the thyroid gland. According to the WHO criteria, goiter was clinically defined: grade-0 when there is no palpable goiter and categorized as not suffering from IDD, grade-1 when there is palpable and visible goiter with extended neck, and grade-2 when visible goiter with the head in normal position is found (WHO, UNICEF, ICCIDD, 2001). In this study, grade-1 and grade-2 were categorized as suffering from IDD.

To specify the iodine content of salt, the enumerators took the used salt for cooking at the participant home. Iodine test was used to assess the iodine content of the salt. Compared with the chart color, the iodine content of salt was ensured. Iodine concentration in salt is classified eligible or meet the requirement when ranging between 30-80 ppm and ineligible when less than 30 ppm (Ministry of Health, 2001).

Information on food frequency from outside the village was collected using a 30 items-Food Frequency Questionnaire (FFQ). The questionnaire was completed in the presence of skilled enumerators. The tool was previously developed and validated in a preliminary study. Each sample was asked to answer the details of food in the considerations column. At first, the reported answer in FFQ was changed to a frequency score. Score 50 when consumed more than once a day, score 25 when consumed once a day, score 15 for four to six times a week, score 10 for two to three times a week, score 1 when consumed once a week, and score 0 when never consumed. Then, the total score from each sample was divided by total sample to find the average score, the average is 316.27. Classified to frequently consumed when the sample's score is or greater than the average score and infrequently consumed when the sample's score is less than the average score (Nadimin, 2011).

Energy and protein intake level was collected by a 24-hour food recall to record the information of all foods and beverages consumed by study participant for two in consecutive days. Energy and protein intake level was measured by percentage to the Recommended Dietary Allowance (RDA) 2013. Good when the intake level is or greater than 80% RDA and poor when the level is less than 80% RDA.

The used nutritional status is the Height for Age (HFA) index, which is used to identify chronic malnutrition. Z-score was calculated by WHO Anthroplus software. Classified to stunted when the HFA index is below -2SD value of z-scores and normal when the index is or above -2SD (World Health Organization, 2015).

2.4 Data Analysis

Frequencies and proportions were used to describe variables as descriptive statistics. A bivariate analysis using the chi-square test was used to show the crude odds ratio of each independent variable on IDD (grade I and II of a goiter). In multivariate analysis, multiple logistic regression was applied using a backward method to overcome the presence of multicollinearity (Santoso et. al., 2005). With the backward method, the best model is obtained by eliminating insignificant variables. With a corresponding 95% confidence interval, crude odds ratio and adjusted odds ratio were calculated to exhibit the power of the relationship. A p-value of <0.05 was chosen to assert statistical significance.

3 RESULTS

More than half (51.4%) of the children were male and aged ranging between 11-16 years. Nearly half (41.7%) of the children were stunted and had IDD (grade 1 and 2 goiter). About three-fourth (76.4%) of the children had poor energy intake levels. More than half (56.9%) of children had poor protein intake levels. Almost one-third (27.8%) of the household used ineligible iodized salt. About two-thirds (63.9%) of children infrequently consumed food from outside the village (Table 1).

The proportion of children who frequently consumed food from outside the village in the last week as following, most (94.4%) of them frequently consumed rice and 76.4% ate tempeh and tofu, followed by egg (65.3%) as their common animal food source, then vegetables (46.9 %) and banana (36.1 %) as the major fruit source. About one-third (30.5%) of them frequently ate chicken. However, the consumption of animal food products was low, in which 17.0, and 9.7 %, respectively of children ate dairy products and meat such as beef (Figure 1).

The prevalence of goiter was 41.7 %, in which about 33.4 and 8.3 %, were found with grade 1 and grade 2 goiter, respectively. The result of the bivariate logistic regression analysis showed that energy and protein intake level, iodine concentration in salt and frequency of food consumption from outside the village were significantly associated with IDD. In the multivariate logistic regression analysis, protein intake level, iodine concentration in salt and frequency of food consumption from outside the village remained significantly associated with IDD. The odds of IDD among children with poor protein intake level 6.7 times [AOR = 6.7; 95% CI: 1.8, 24.7] higher as compared to children with good protein intake level. Those used ineligible salt 8.7 times [AOR = 8.7; 95% CI: 2.1, 35.7] higher as compared to those used eligible iodized salt. Likewise, the likelihood of IDD among children infrequently consumed food from outside the village was 5.9 times [AOR = 5.9; 95% CI: 1.5, 22.3] higher than that of frequent counterparts (Table 2).

4 DISCUSSION

In this study, the prevalence of IDD or goiter was 41.7%, showed that there is a severe public health problem. According to the World Health Organization (WHO), the total goiter rate above 5% reflects a public health problem (World Health Organization, 2001).

This study also showed that the application of iodized salt (72.2%) was lower than the WHO recommendation (>90%) (World Health Organization, 2013). Iodine concentration in salt was found as the most dominant associated factor to IDD [AOR = 8.7; 95% CI: 2.1, 35.7]. It is known that the provision of iodine intake through daily consumption of salt is the most commonly used method. It has proven its success and has been recommended by WHO and UNICEF. To accelerate the achievement of IDD elimination, an agreement was reached that iodized salt is the best tool to increase iodine consumption in the effort to eliminate IDD problems (WHO, UNICEF, ICCIDD, 2001).

Table 1: Characteristics of school children in Elementary School 4 Krebet, Jambon sub-district, Ponorogo, East Java, 2016.

Characteristics	Frequency	Percent
Sex		
Male	37	51.4
Female	35	48.6
Age (in years)		
5-10	35	48.6
11-16	37	51.4
Nutritional status (height for age)		
Normal (-2SD to +2SD)	42	58.3
Stunted (<-2SD)	30	41.7
Energy intake level		
Good (≥ 80% RDA)	17	23.6
Poor (<80% RDA)	55	76.4
Protein intake level		
Good (≥ 80% RDA)	31	43.1
Poor (<80% RDA)	41	56.9
Iodine concentration in salt		
Eligible (30-80 ppm)	52	72.2
Ineligible (< 30 ppm)	20	27.8
Frequency of food consumption from outside the village		
Frequent(≥ mean score)	26	36.1
Infrequent (<mean score)	46	63.9
Iodine Deficiency Disorders (IDD)		
Yes (grade I and II goiter)	30	41.7
No (grade 0)	42	58.3

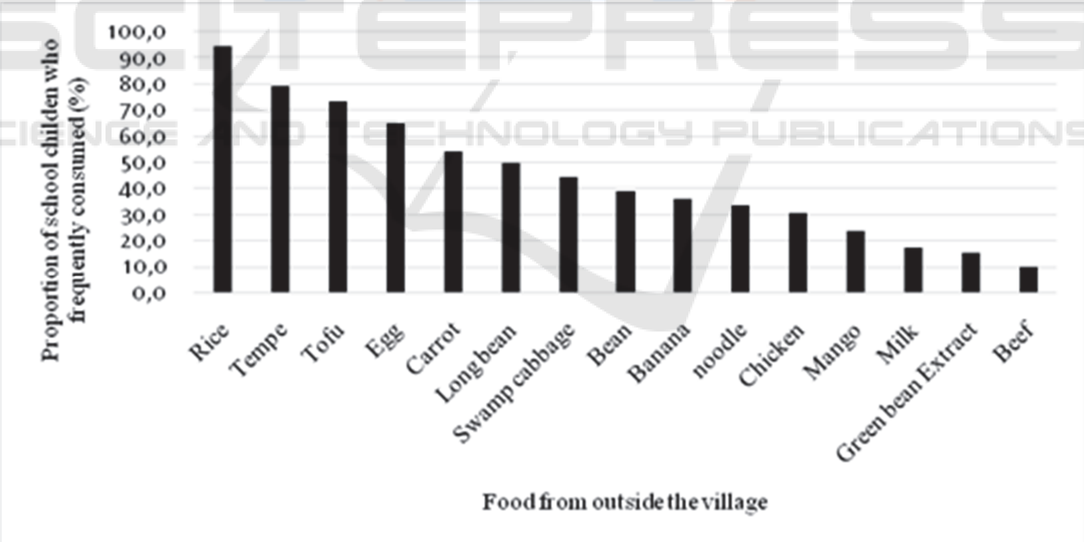

Figure 1: Proportion of respondents frequently consumed food from outside the village in the last week.

The majority of children have poor energy and protein intake levels. Poor energy intake causes protein anabolism to produce energy and inhibit the metabolism of the thyroid hormone (Hetzel, 1989). Poor protein intake level among children is a significantly associated factor to IDD [AOR = 6.7; 95% CI: 1.8, 24.7]. Based on the dietary survey in this study, the common dietary protein sources are tempeh and tofu. Animal sources were not frequently consumed because it is expensive and the traditional market is far away.

According to Sauberlich (1999), protein deficiency inhibits the production of thyroid hormones, both triiodothyronine (T3) and thyroxine (T4) are bound to serum proteins. In the production of thyroid hormone, the initial step is the merger of

Table 2: Factors associated with iodine deficiency disorder/IDD (grade 1 and 2 goiters) among school children in Elementary School 4 Krebet, Jambon Sub-District, Ponorogo Regency, East Java, 2016 (n =72).

Charactersitic	Iodine deficiency disorders		COR[1] (95 % CI)	AOR[2] (95 % CI)
	Yes	No		
Nutritional status				
Stunted	10	20	0.5 (0.1, 2.5)	
Normal	20	22	1	
Energy intake level				
Poor	27	28	4.5 (1.3, 9.6)*	
Good	3	14	1	
Protein intake level				
Poor	23	18	4.4 (1.9, 25.1)*	6.7 (1.8, 24.7)*
Good	7	24	1	1
Iodine concentration in salt				
Ineligible	14	6	5.2 (2.2, 35.8)*	8.7 (2.1, 35.7)*
Eligible	16	36	1	1
Frequency of food consumption from outside the village				
Infrequent	25	21	5.0 (1.6, 22.6)*	5.9 (1.5, 22.3)*
Frequent	5	21	1	1

*$p < 0.05$, [1]Crude Odds Ratio, [2]Adjusted Odds Ratio

iodide into a large protein. In a state of decreased protein will cause total hormone levels to decrease. A decrease in released hormones from the thyroid gland (especially T4) will cause feedback barriers in the pituitary gland to produce Thyroid Stimulating Hormone (TSH). The role of protein is also to neutralize the effect of thiocyanate (Brody, 1993).

The frequency of food consumption from outside the village was observed as a significantly associated factor [AOR =5.9; 95% CI: 1.5, 22.3]. Iodine content in the soil used in agriculture associated with the incidence of iodine deficiency. Serious deficiencies still take place in certain regions, even though iodine supplementation programs have been able to combat iodine deficiency in many regions of the world (Brody, 1993).

As located in the highlands, Sidoharjo village has a lack of food diversity. In order to get other foodstuffs than local foodstuffs commonly grown, they should go to traditional markets in other regions. In addition, the large amount of local food that commonly can be planted and grown have goitrogenic substances such as spinach, cassava, cabbage, and corn.

As research by Ningtyas et al., (2014), another cause of iodine deficiency disorders (IDD) in Jember Regency that was identified is the thiocyanate goitrogenic factor. Papaya leaves, cassava leaves, cabbage, and bamboo shoot are vegetables with goitrogenic substances that were consumed daily.

The consumption of foods containing goitrogens aggravates the development of goiter among children with iodine deficiency (Brody, 1993). Goitrogens are substances interfering with the incorporation of iodine into a protein in the thyroid gland thus disrupt the production of thyroid hormones.

Lack of food diversity consumed in Sidoharjo causes a lack of nutrients intake such as selenium that is important for thyroid metabolism. The deiodinases are enzymes containing selenium that are important for the activation of thyroid hormones. These enzymes catalyze the deiodination of T4 and produce the active form of thyroid hormone (T3) to the bloodstream (Brody, 1993).

The study has some limitations. First, this study used only school children as respondents. Second, the study used a cross-sectional design thus the results may not demonstrate the causality.

5 CONCLUSIONS

The prevalence of iodine deficiency disorders was high, showing a severe public health problem. The application of iodized salt in this study was lower than the WHO recommendation. Moreover, The dominant associated factor of IDD was ineligible iodized salt. Hence, there is a necessity to strengthen the application of salt iodization by the Government of the Ponorogo Regency and concern must be directed to schoolchildren to eradicate IDD efficiently.

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REFERENCES

Andersson, M., Karumbunathan, V., Zimmermann, MB.,2012. Global iodine status in 2011 and trends over the past decade. *J Nutr*.,142(4):744–50.

National Institute of Health Research and Development, 2010.*Basic Health Research Report2010*. Jakarta: Indonesian Ministry of Health.

National Institute of Health Research and Development, 2013.*Basic Health Research Report2013*. Jakarta: Indonesian Ministry of Health.

Benoist, B., McLean, E., Andersson, M., Rogers, L., 2008. Iodine deficiency in 2007: global progress since 2003. *Food Nutr Bull*., 29(3):195–202.

Brody, T., 1993. *Nutritional Biochemistry*, Academic Press. San Diego, Orlando, Second Edition.

Ministry of Health, 2001.*Guidelines for Implementing Iodized Salt Monitoring at the Community Level*. Jakarta: Indonesian Ministry of Health.

East Java Provincial Health Office, 2009. *East Java Province Health Profile, 2009.* Surabaya: East Java Provincial Health Office.

Ponorogo Regency Health Office, 2014. *Profile of Sidoharjo Village, JambonSub-District, Ponorogo Regency*. Ponorogo Regency: Ponorogo Regency Health Office.

Ponorogo Regency Health Office, 2010. *IDD Issues in Ponorogo Regency*.Ponorogo Regency: Ponorogo Regency Health Office.

Ponorogo Regency Health Office, 2015. *Overview of Eradicating Iodine Deficiency Disorder Problems in PonorogoRegency 2015.* Ponorogo Regency: Ponorogo Regency Health Office.

Egli, I. M., Allen, H., El Bahi, T., Andersson, M., De Benoist, B., 2004. *Iodine status worldwide: WHO global database on iodine deficiency*, World Health Organization. Geneva

Hetzel, B. S.,1989. *An Overview of the Prevention and Control of Iodine Deficiency Disorder*. In: Hetzel, J.T. Dunn and J. B. Stanbury (ed), New York: Elsevier Science Publisher, pp. 7-29

Nadimin, 2011. Diet Pattern, Physical Activity and Nutritional Status among South Sulawesi Provincial Health Office Staffs. *Media GiziPangan*, 11(1).

Ningtyas, F. W., Asdie, A.H., Julia, M., Prabandari, Y.S., 2014. Local Wisdom Exploration of Community in Goitrogenic Food Consumption to Iodium Deficiency Disorder. *JurnalKesehatanMasyarakatNasional, 8(7).*

Santoso, P. B., *et al.*, 2005. *Statistical Analysis with Microsoft Excel and SPSS.* ANDI Publisher. Yogyakarta.

Sauberlich, H. E., 1999. *Assessment of Nutritional Status,* CRC Press. New York. Second Edition

WHO, UNICEF, ICCIDD, 2001. *Assessment of iodine deficiency disorders and monitoring their elimination: a guide for programme managers*, WHO/NHD/01.1. Geneva

World Health Organization, 2013. *Urinary iodine concentrations for determining iodine status deficiency in populations. Vitamin and Mineral Nutrition Information System*, WHO. Geneva

World Health Organization, 2015. *Global Database on Child Growth and Malnutrition*. Available at: https://www.who.int/nutgrowthdb/en/. [Accessed 25September 2019).