

THE RELATIONSHIP BETWEEN YODIUM AND ZINC INTAKE AND HEMOGLOBIN LEVELS IN ADOLESCENT WOMEN AT SMK PGRI 13 SURABAYA

Hubungan antara Asupan Yodium dan Zink dengan Kadar Hemoglobin pada Remaja Putri di SMK PGRI 13 Surabaya

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ABSTRACT

Lack of iodine and zinc intake in adolescents disrupted the metabolic process of iron in their bodies, leading to decreased hemoglobin levels in the blood and increasing the risk of anemia among adolescent girls. This study aimed to analyze the relationship between iodine and zinc intake and hemoglobin levels in adolescent girls at SMK PGRI 13 Surabaya. This research was a quantitative study with an analytic observational design. The research sample consisted of 104 respondents selected using Stratified Random Sampling. Data on iodine and zinc intake were collected using a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), and hemoglobin levels were measured digitally using the Point of Care Testing (POCT) method from capillary blood samples. Data analysis was performed using the Spearman Rank statistical test. The results showed that the average iodine intake was 63.68 mcg, and zinc intake was 4.24 mg, both classified as deficient. The average hemoglobin level was 12 g/dL. Spearman Rank test results indicated a significant relationship between iodine intake and hemoglobin levels (p -value = 0.032), and between zinc intake and hemoglobin levels (p -value = 0.030). The correlation coefficient values for iodine and zinc intake with hemoglobin levels were 0.210 and 0.213, respectively, indicating that the strength of the relationship between iodine and zinc intake and hemoglobin levels was weak.

Keyword : hemoglobin levels; intake; iodine; zinc

ABSTRAK

Kurangnya asupan yodium dan zink pada remaja mengakibatkan proses metabolisme zat besi dalam tubuh akan terganggu, menyebabkan kadar hemoglobin dalam darah berkurang sehingga berisiko mengalami anemia pada remaja putri. Penelitian ini bertujuan untuk menganalisis hubungan asupan yodium dan asupan zink dengan kadar hemoglobin pada remaja putri di SMK PGRI 13 Surabaya. Penelitian ini adalah penelitian kuantitatif dengan jenis penelitian observasional analitik. Sampel penelitian sebanyak 104 responden dengan menggunakan *Stratified Random Sampling*. Pengumpulan data asupan yodium dan zink pada penelitian ini menggunakan SQ-FFQ (*Semi Quantitative Food Frequency Questionnaire*) serta kadar hemoglobin diukur secara digital dengan metode POCT (*Point Of Care Testing*) dari darah kapiler. Analisis data yang digunakan pada penelitian ini yaitu uji statistik *Rank Spearman*. Hasil dari penelitian ini menunjukkan bahwa rata-rata asupan yodium 63.68 mcg, dan asupan zink 4.24 mg (keduanya tergolong kurang). Rata-rata kadar hemoglobin yaitu 12 gr/dL. Berdasarkan uji *Rank Spearman* menunjukkan adanya hubungan yang signifikan antara asupan yodium dengan kadar hemoglobin (p -value=0.032), terdapat hubungan yang



signifikan antara asupan zink dengan kadar hemoglobin ($p\text{-value}=0.030$). Hasil nilai koefisien korelasi pada asupan yodium dan zink dengan kadar hemoglobin sebesar 0.210 dan 0.213 artinya tingkat kekuatan hubungan antara asupan yodium dan zink dengan kadar hemoglobin adalah lemah.

Kata Kunci : asupan; kadar hemoglobin; yodium; zink

INTRODUCTION

Each stage of life has unique characteristics that distinguish it from other growth stages. Adolescence is characterized by many changes because it is a transitional phase between childhood and adulthood. These changes include physical, psychological, and mental changes (Diananda, 2019). These changes during adolescence can lead to several health problems, one of which is anemia. Anemia is a condition characterized by low hemoglobin (Hb) levels in the blood, namely less than 12 g/dL, which are insufficient to meet the body's needs (Swamilaksita, Amir, Suryani, & Livana, 2022).

The prevalence of anemia in Indonesia is among the highest in Southeast Asia, reaching 42%. Adolescent girls are more at risk of anemia than adolescent boys, with approximately 12% of boys and 23% of girls in Indonesia experiencing anemia (Marfiah, Putri, & Yolanda, 2023). In 2019, the global prevalence of anemia among women aged 15–49 years was 29.9%. Based

on Riskesdas 2018 data, the prevalence of anemia in Indonesia remains relatively high, with 48.8% of adolescents experiencing anemia, meaning that 3–4 out of 10 adolescents suffer from anemia. According to data from the East Java Provincial Health Office (2020), 42% of adolescent girls in East Java experienced anemia. Meanwhile, research conducted by Zanuba and Sumarmi (2023) found that approximately 39% of adolescents in Surabaya experienced anemia.

The causes of anemia among adolescents are complex and involve several factors. One of these factors is micronutrient deficiency, such as folic acid, vitamin A, vitamin D, iodine, and zinc. Iodine and zinc are minerals that can contribute to anemia when consumed inadequately. Although iodine intake does not directly cause anemia, iodine is necessary for the synthesis of healthy thyroid hormones. Thyroid hormones, such as thyroxine, play a role in regulating body metabolism. If thyroxine does not function optimally, iron metabolism may be disrupted. Therefore, iodine



deficiency can reduce thyroid hormone production, leading to decreased erythrocyte and hemoglobin production, which may be associated with anemia (Ginting et al., 2024). Zinc intake is also required by the body because it helps the absorption and utilization of iron. Zinc deficiency can inhibit iron absorption and reduce hemoglobin production in the blood. Although iodine and zinc are not directly related to hemoglobin levels, they can interfere with iron absorption and eventually lead to anemia.

Female students at SMK PGRI 13 Surabaya were selected as the research subjects because many students experienced anemia-related problems. Preliminary research conducted on April 19, 2024, involving 22 female students, showed that 11 students had decreased hemoglobin levels. Hemoglobin level is one of the indicators used to determine whether a person has anemia. Hemoglobin levels can be measured using an electrical Hb method. They can also be measured through laboratory examinations such as complete blood count (CBC), fecal Hb test, peripheral blood smear examination, and iron level tests. Hemoglobin is a multifunctional molecule involved in several functions, including

catalytic activity, nitric oxide metabolism, metabolic reprogramming, pH regulation, and maintaining redox balance (Clark, 2020). The general objective of this study was to analyze the relationship between iodine and zinc intake and hemoglobin levels among adolescent girls at SMK PGRI 13 Surabaya. The specific objectives were to identify iodine intake, zinc intake, and hemoglobin levels, as well as to analyze the relationship between iodine and zinc intake and hemoglobin levels among adolescent girls at SMK PGRI 13 Surabaya.

METHOD

Research Design, Location, and Time

This study used a quantitative analytic observational method with a cross-sectional study design, where the independent variables (iodine intake and zinc intake) and the dependent variable (hemoglobin levels) were measured simultaneously. The study was conducted at SMK PGRI 13 Surabaya from January 2024 to June 2025.

Sample

The population in this study consisted of 143 female students in grades XI and XII



at SMK PGRI 13 Surabaya. Sampling was conducted using probability sampling with Stratified Random Sampling, resulting in 104 respondents who met the inclusion criteria: able to communicate well, willing to participate in the study, aged 15–19 years, and already experiencing menstruation.

Data Collection

Data on iodine and zinc intake were collected through interviews using the SQ-FFQ questionnaire. The average daily intake in grams was calculated and analyzed using NutriSurvey software. According to the Indonesian Recommended Dietary Allowance (RDA), the daily requirement for iodine intake is 150 mcg/day, while zinc intake is 9 mg/day.

Hemoglobin levels were measured using the Point of Care Testing (POCT) method with the Fora 6 Plus Hb measuring device. The dependent variable scale was ratio.

Data Analysis

Respondent characteristics collected in this study included age, father's occupation, mother's occupation, father's education, and mother's education. The data

obtained were analyzed using IBM SPSS Statistics software. Univariate analysis was conducted to identify iodine intake, zinc intake, and hemoglobin levels. Bivariate analysis was used to determine the strength of the relationship between iodine and zinc intake and hemoglobin levels among adolescent girls. The statistical test used was Spearman Rank with p-value <0.05 indicating a significant relationship and p-value >0.05 indicating no significant relationship.

RESULTS AND DISCUSSION

Table 1. Frequency Distribution of Respondents Based on Characteristic

Characteristics	Total	
	n	%
Father's Occupation		
Private-sector employee	40	38.5
Self-employed	29	27.9
And others	35	33.7
Total	104	100
Mother's Occupation		
Private-sector employee	11	10.6
Self-employed	11	10.6
Housewife	54	51.9
And others	28	26.9
Total	104	100
Father's Education		
SD	11	10.6
SMP	13	12.5
SMA	45	43.3
S1	2	1.9
And others	33	31.7
Total	104	100
Pendidikan Ibu		
SD	14	13.5
SMP	16	15.4
SMA	46	44.2
S1	2	1.9
And others	26	25
Toatal	104	100



Univariate Analysis

Table 2. Univariate analysis

Variable	Minimum	Maximum	Mean	Cut-off
Iodine Intake (mcg)	1.9	387	63.68	150 mcg
Zinc Intake (mg)	1.1	20.6	4.24	9 mg
Hemoglobin Level (g/dL)	6.4	16.6	12.0 ± 1.9	12-15 g/dL

Respondent Characteristics

Based on the results, the majority of respondents were 16 years old (49%). Most fathers worked as private employees (38.5%), while most mothers were housewives (51.9%). The majority of fathers' educational background was senior high school (43.3%), and most mothers also had a senior high school education (44.2%).

Iodine Intake

Based on Table 2, the iodine intake of 104 respondents showed a minimum value of 1.9 mcg and a maximum value of 387 mcg, with a mean iodine intake of 63.68 mcg/day among adolescent girls. This finding indicated that the iodine intake of the participants was below the recommended dietary intake. The SQ-FFQ data also revealed that the consumption of marine fish, one of the primary dietary sources of iodine, was very low among the respondents. Marine fish and shrimp were rich sources of iodine

and protein and were highly recommended for increasing iodine intake. The low consumption of marine fish was a major factor contributing to inadequate daily iodine intake. In this study, the average iodine intake was 63.68 mcg/day, while the average iodine intake derived from marine fish consumption was only 2.9 mcg/day, indicating that the respondents' daily iodine intake was insufficient to meet nutritional requirements. These findings were consistent with the study conducted by Lei, Tao, and Xiao (2023), which reported that inadequate iodine intake in Macau was associated with low fish consumption among respondents. In their study, 424 respondents had an average iodine intake of 74.4 mcg/day, while the average iodine intake from marine fish consumption was only 0.2 mcg/day. This was attributed to insufficient iodine intake resulting from the low consumption of marine fish, which was considered a major dietary source of iodine.



Zinc Intake

The zinc intake of 104 respondents showed a minimum value of 1.1 mg and a maximum value of 20.6 mg, with a mean zinc intake of 4.24 mg/day among adolescent girls. This finding indicated that most of the adolescent girls in this study had inadequate zinc intake. Zinc deficiency was one of the most common forms of micronutrient malnutrition worldwide; however, it remained one of the least recognized forms of malnutrition. The symptoms of zinc deficiency were often nonspecific, and their severity varied depending on age, duration of deficiency, and the presence of other comorbid conditions (Lowe et al., 2024). In this study, the average zinc intake among adolescent girls was 4.24 mg/day. Based on the SQ-FFQ data, respondents consumed tofu and tempeh almost every day as their primary side dishes, whereas animal protein sources such as chicken meat were consumed only 2–3 times per week. In addition, many respondents reported disliking green leafy vegetables. These findings suggested that the inadequate zinc intake observed among adolescent girls might have been associated with a low consumption of zinc-rich foods. Plant-based protein sources such as tofu and

tempeh generally contain lower amounts of bioavailable zinc compared to animal-based foods. These findings were consistent with the study conducted by Ilmi et al. (2021), which reported that 22 respondents (91.7%) had inadequate zinc intake. Based on their dietary assessment data, adolescent girls consumed plant-based protein sources, such as tofu and tempeh, more frequently, while the consumption of animal-based side dishes was relatively low. This dietary pattern was considered a contributing factor to the insufficient zinc intake observed among the respondents.

Hemoglobin Level

The hemoglobin levels of 104 respondents showed a minimum value of 6.4 g/dL and a maximum value of 16.6 g/dL, with a mean hemoglobin level of 12.0 g/dL among adolescent girls at SMK PGRI 13 Surabaya. Low hemoglobin levels led to a condition known as anemia, in which individuals could experience fatigue, weakness, lethargy, increased heart rate, irregular heartbeat, and dizziness, thereby affecting their daily activities (Indriani, Zaddana, Nurdin, & Sitinjak, 2019). Low hemoglobin levels among adolescent girls were associated with



maternal education. Mothers played a crucial role in providing nutritious foods for their families; therefore, they had a significant influence on their children's nutritional status, which could subsequently affect the anemia status of family members, including adolescents. In this study, most respondents' mothers had completed senior high school education, accounting for 46 respondents (44.2%), while 16 respondents' mothers (15.4%) had completed junior high school education. These findings were consistent with the study conducted by Fentie, Wakayo, and Gizaw (2020), which found that 22.2% of mothers of adolescents had completed only primary school education, while 22.3% had attained secondary school education (grades 9–12). Their study demonstrated a significant association between low maternal educational attainment and a higher prevalence of anemia among adolescents. This finding suggested that maternal education influenced a mother's ability to provide nutritious foods and manage her children's health, which in turn affected adolescents' nutritional status and hemoglobin levels.

Relationship Between Iodine Intake and Hemoglobin Levels

Based on Table 3, the results showed that there was a significant relationship between iodine intake and hemoglobin levels. The correlation coefficient ($r = 0.210$) indicated a positive correlation with a weak strength of association. The positive direction of the correlation suggested that lower iodine intake was associated with lower hemoglobin levels among adolescent girls, thereby increasing the risk of anemia. Inadequate iodine intake could interfere with hemoglobin production and regulation in the body.

Table 3. Bivariate Analysis

Variable	Hemoglobin Level
Iodine Intake	$p = 0.032$ $r = 0.210$ $n = 104$
Zinc Intake	$p = 0.30$ $r = 0.213$ $n = 104$

A study conducted by Aparajita, Manas, and Santasmita (2022) reported a significant association between iodine deficiency and hemoglobin levels ($p = 0.0001 < 0.05$). The hypothyroid group (86.6%) was more likely to experience anemia than the euthyroid group (33.0%). Hypothyroidism was associated with anemia due to reduced erythrocyte proliferation and decreased iron



absorption, which could be exacerbated by menorrhagia (heavy menstrual bleeding). In this context, hypothyroidism caused by iodine deficiency could impair thyroid gland function because iodine was an essential component in the synthesis of thyroid hormones. When thyroid hormone production decreased, its role in regulating red blood cell production was disrupted. This condition could lead to anemia, particularly among adolescent girls (Berta et al., 2024).

Relationship Between Zinc Intake and Hemoglobin Levels

The results also showed a significant relationship between zinc intake and hemoglobin levels. The correlation coefficient ($r = 0.213$) indicated a positive correlation with a weak strength of association. This positive correlation suggested that lower zinc intake was associated with lower hemoglobin levels among adolescent girls, thereby increasing the risk of anemia. These findings were consistent with the study conducted by Marissa and Tri Hendarini (2021), which reported a significant relationship between zinc intake and the incidence of anemia among students at SMAN 1 Kampar Utara (p

$= 0.000 < 0.05$). The study found that 51.9% of respondents were anemic and had inadequate zinc intake. The low zinc intake was attributed to insufficient consumption of animal-source protein foods. In addition, some respondents experienced helminth infections and digestive disorders, which reduced the absorption of zinc as an essential nutrient and consequently contributed to lower hemoglobin levels.

Similarly, a study by Putri et al. (2023) reported a significant association between zinc intake and hemoglobin levels, with a p-value of 0.001 (< 0.05). Zinc plays several important physiological roles, including maintaining overall health and supporting iron metabolism, which is essential for hemoglobin synthesis. Zinc deficiency may result in decreased appetite and impaired immune function. Furthermore, inadequate zinc status may negatively affect iron utilization and hemoglobin formation, thereby increasing the risk of anemia.

CONCLUSION

Based on the findings of this study, it was concluded that there were significant relationships between iodine intake, zinc



intake, and hemoglobin levels among adolescent girls at SMK PGRI 13 Surabaya. The majority of the respondents had inadequate iodine and zinc intake, and most of the adolescent girls had hemoglobin levels below 12 g/dL, indicating a risk of anemia. Therefore, adolescent girls are encouraged to consume foods rich in iodine and zinc to help prevent the adverse effects associated with low hemoglobin levels and reduce the risk of anemia. Schools are expected to continuously monitor and promote healthy eating habits among adolescent girls, particularly the consumption of nutrient-rich foods that support optimal hemoglobin status. For future researchers interested in similar topics, it is recommended to further investigate factors other than dietary intake that may influence hemoglobin levels, such as nutritional knowledge, menstrual cycle characteristics, food allergies, and dietary restrictions. Exploring these factors may provide a more comprehensive understanding of the determinants of hemoglobin status among adolescent girls.

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