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Is Iron Deficiency Anemia still Becoming Community Health Problem in Urban Area?

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Abstract

BACKGROUND: Iron deficiency anemia is one of the common public health problems that found in various countries, including Indonesia. The incidence of iron deficiency anemia does not only occur in rural areas but also in urban areas. Iron deficiency that occurs in adolescent girls with or without anemia has a negative impact on immune function, growth, and physical and mental development.

AIM: The purpose of the study was to determine the incidence of anemia in adolescent girls in urban areas.

PATIENTS AND METHODS: This study was an observational study with a cross-sectional design. The research subjects were 52 young women aged 15–25 years living in the city of Semarang, Central Java. The subject will be taken a blood sample to check the complete blood profile and iron status, namely, serum ferritin, serum iron, and serum TIBC (total iron binding capacity). Research data analysis was carried out using SPSS Ver.16. normality test using Kolmogorov–Smirnov correlation test using Spearman rank.

RESULTS: The prevalence of iron deficiency anemia among female adolescents in urban areas in this study was 13.4% while adolescent girls who experienced iron deficiency without anemia were 13.4%.

CONCLUSION: Iron deficiency anemia can occur in urban areas with a prevalence > 5%.

Introduction

Iron deficiency anemia occurs at all stages of the life cycle but adolescents are a group that vulnerable. Growth spurt, hormonal changes, malnutrition, and starting of menstrual periods in girls are major causes in this period [1]. Anemia is defined as a decrease in the absolute number of red blood cells in the blood circulation. Iron deficiency anemia is the most common type of anemia that can be found in society [2]. Nutritional status which is influenced by dietary patterns, socio-economic status (education and income), environment and health status are risk factor that cause iron deficiency anemia especially in developing countries and rural areas [3]. The low socio-economic status of the community will have an impact on the wrong diet causing low iron intake from food and lack of sanitation and environmental hygiene.

Iron deficiency can have irreversible negative impact on the physical and mental development of children and adolescents. Late nutrition treatment for iron deficiency that given after critical period lead to irreversible developmental and growth delay [4]. In children and adolescents, iron deficiency with or without anemia can interfere with learning concentration and growth problems and have an impact on decreased immunity so that it is more susceptible to infectious diseases [5]. In preparation for maternal period young girls need more iron to prevent deficiency before pregnancy. If daily iron dietary requirements are not met, it will have an impact on the birth of the baby, including premature birth, abnormal, low birth weight, and even maternal mortality [6], [7].

Adolescents who live in rural areas are more prone to develop iron deficiency anemia. Adolescent from rural areas were almost 4 times more likely to be anemic than their urban counterpart [8]. Iron deficiency anemia among adolescents in rural areas is associated with low socio-economic status and poor environmental hygiene and sanitation. Higher socio-economic status leads to the lower prevalence of iron deficiency and anemia in Korean adolescent girls. This may be due to the fact that higher socio-economic individuals

consume more food that contain of iron [9]. Kothari *et al.* (2019) from their study also conclude that children those living in rural areas and those having mother with low education have higher risk suffering anemia. This study also show that children those live in environment that having bad sanitation also having high prevalence of anemia [10].

People who live in urban areas tend to having higher socio-economic status, and good environmental, hygiene, and sanitation than rural areas. The prevalence of iron deficiency anemia incidence among adolescent's girls in urban area should not be a major health problem. This study wants to know how the incidence of iron deficiency anemia that may occur in urban areas with all these conditions is a preliminary study.

Materials and Methods

This study used an observational method with a cross-sectional design which was conducted during September-November 2020 in Miroto and Tembalang district, Semarang City. Initial screening was carried out on 160 adolescents girl aged 15–25 years in the Miroto Community Health Center and Diponegoro University in Tembalang district. Most of the samples refused to take blood so that only 52 respondents were found willing to have their blood drawn as evidenced by having signed the Informed Consent. The inclusion criteria for the participants in this study were adolescents girl aged 15–25 years in healthy condition and not in menstrual periods.

Vital sign participants include blood pressure and body temperature were checked and blood sample were collected to examined blood profiles, serum iron (Fe), serum ferritin, and serum TIBC. Research subjects were also asked to fill out a short-form FFQ (SFFFQ) questionnaire regarding their daily diet [11]. The complete blood profile examination was checked using a hematology analyzer Sysmex XS 800i. Examination of serum iron using Thermo Fisher Scientific reagent and analyzed with Indiko Analyzer, serum ferritin assay using Vidas ferritin reagent, and analyzed with Biomeraux mini Vidas. TIBC serum was determined by unsaturated iron binding capacity reagent kit Cobas and analyzed with C311 Cobas. Cutoff point for hemoglobin was 12 mg/dL, 65–175 ug/dL for iron serum level, ferritin level was 9.3–159 ng/mL, and TIBC was 135–392 ug/dL.

Data were analyzed with SPSS Ver.16. Descriptive analysis was carried out, normality test using Kolmogorov–Simonov and continued with correlation analysis using Spearman test. This research has received ethical clearance from the Health Research Ethics Commission (KEPK), Faculty of Medicine, Diponegoro University No.162/EC/KEPK/FK-UNDIP/VII/2020.

Results

Table 1 shows the characteristics of the participants in this study who had a mean age of 20.57 ± 2.38 years. Participant in this study was in healthy condition with mean normal blood pressure of 111/75 mg/dL and mean body temperature 36.3 ± 0.37°C. The mean hemoglobin (Hb) levels participant was 12.73 ± 1.19 mg/dL.

Table 1: Characteristic participants

No	Participant characteristic	Mean ± SD	Median (Min-Max)
1	Age (years)	20.57 ± 2.38	21 ± (15–25)
2	Temperature (°C)	36.3 ± 0.37	36.3 (35.7–36.9)
3	Sistolic blood pressure (mmHg)	111.37 ± 10.79	111 (83–132)
4	Diastolic blood pressure (mmHg)	75.94 ± 9.52	76 (56–116)
5	Hb (mg/dl)	12.73 ± 1.19	12.8 (9.8–12.1)
6	Hematocryte (%)	37.9 ± 2.7	37.6 (33.3–43)
7	Leukocyte (10^3/uL)	7.42 ± 1.81	1.80 (3.6–18.4)
8	Trombocyte (10^3/uL)	305.47 ± 61.8	285 (217–525)
9	Eritrocyte count (10^6/uL)	4.67 ± 0.19	4.62 (3.86–5.89)
10	RDW (%)	13.8 ± 1.7	13.2 (11.9–21.4)
11	MCV (fL)	80.75 ± 8.85	81.6 (37.6–92.9)
12	MCH (pg)	28.5 ± 8.3	69 (16.6–83.7)
13	MCHC (g/dL)	33.3 ± 1.8	33.5 (23.5–36)
14	Fe (ug/dL)	59.26 ± 3.39	47.5 (14.1–160.7)
15	Ferritin Serum (ng/mL)	43.8 ± 2.97	27.06 (2.15–219)
16	TIBC (ug/dL)	360 ± 68.49	349 (235–593)

Table 2 shows that from 52 participants in this study, 37 people have normal hemoglobin level (≥12 mg./dL) and 15 people are having low hemoglobin level < 12 mg/dL. Iron status participants in this study include serum iron, serum ferritin, and TIBC (total iron binding capacity). Participants who had serum iron levels less than the reference value were 35 people (67%), 12 people (15.4%) had serum ferritin below normal values, and 15 people (25%) had increased serum TIBC.

Table 2: Iron profile participants

	Normal	Low
Hemoglobin (Hb) mg/dL	37	15
Serum Iron (Fe) (ug/dL)	18	34
Ferritin (ng/mL)	40	12
	Normal	High
TIBC (ug/dL)	37	15

Table 3 show that there are seven participants who had iron deficiency anemia, five participants who had Iron Deficiency Erythropoiesis Iron Deficiency Erythropoiesis, and two people who had iron depletion. Table 4 shows that hemoglobin as first parameter seen in blood count significantly correlate with all others hematological parameters. Serum iron correlates with all the iron deficiency anemia parameters, ferritin and TIBC. Red blood cell and MCV are two parameters in

Table 3: In this study show prevalence iron deficiency in this study

Iron deficiency	Participants
Stage I (iron depletion)	2
Stage II (iron deficiency erythropoiesis)	5
Stage III (iron deficiency anemia)	7

Table 4: Spearman test of hematological parameters for iron deficiency anemia

Parameter	Hb	Ht	RBC	MCV	MCH	MCHC	Serum Fe	Serum Feritin	TIBC
Hb	-	0.000	0.000	0.080	0.000	0.000	0.000	0.001	0.023
Ht	0.000	-	0.000	0.099	0.003	0.000	0.001	0.008	0.052
RBC	0.000	0.000	-	0.000	0.003	0.303	0.966	0.964	0.599
MCV	0.080	0.099	0.000	-	0.000	0.046	0.029	0.170	0.560
MCH	0.000	0.003	0.003	0.000	-	0.000	0.000	0.005	0.143
MCHC	0.000	0.000	0.303	0.046	0.000	-	0.000	0.000	0.036
Serum Fe	0.000	0.001	0.966	0.029	0.000	0.000	-	0.000	0.000
Serum Feritin	0.001	0.008	0.964	0.170	0.005	0.000	0.000	-	0.000
TIBC	0.023	0.052	0.599	0.560	0.143	0.036	0.000	0.000	-

Significant if P < 0.05.

complete blood count for erythrocyte profile that not correlate with serum iron significantly. This condition also appears for correlation between ferritin and the erythrocyte profiles in complete blood count.

Figure 1 shows that 55.8% of the respondents consumed red meat 1–3 serving/week, 11.5% consumed red meat more than 3 serving/week and the remaining 33.7% ate red meat. Respondents who consumed food from legumes 1–3 serving/week were 48%, while respondents who consumed bean and nuts more than 3 serving/week were 13.5% and the remaining 38.5% of respondents never consumed food from bean and nuts. As many as 76.9% of respondents consumed fish and seafood with a frequency of 1–3 serving/week, 15.4% of respondents never or rarely consumed fish or seafood in 1 week and the remaining 7.7% consumed fish and seafood more than 3 serving a week.

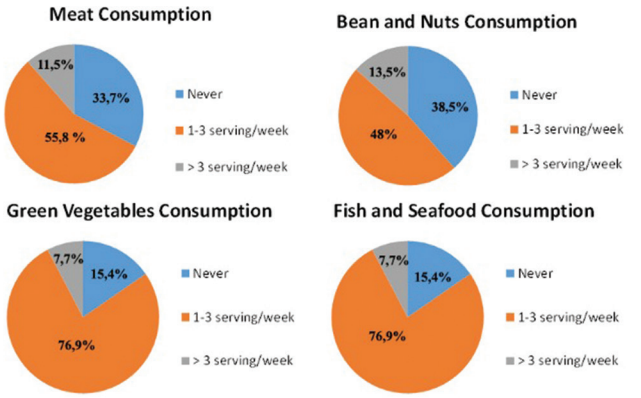

Figure 1: Consumption food source of iron subject a) Meat; b) Bean and Nuts; c) Green vegetable; d) Fish and seafood

Discussion

Analysis prevalence anemia iron deficiency is very needed. Nowadays iron deficiency anemia is not a problem experienced by people in rural areas, however, urban communities also experience this problem. Indonesia Basic Health Research in 2013 showed that anemia in adolescent girls was 37.1% which actually increased to 48.9% in Riskesdas 2018, with the proportion of anemia in the 15–24 years and 25–34 years age groups. Result of this study is expected to be a consideration for determining the appropriate solution to reduce the prevalence of anemia in adolescent girls in urban areas according to the possible causes of iron deficiency anemia.

Result from this study, participants who had anemia with hemoglobin level below normal (<12 mg/dL) were 15 people. Blood hemoglobin level below normal (<12 mg/dl) does not always indicate the occurrence of iron deficiency anemia (WHO 2011). There were eight participants who experienced anemia but not accompanied by a decrease in one or the three indicators of iron status such as serum ferritin, serum iron. Lower hemoglobin levels that is not accompanied by a decrease in serum ferritin indicates the occurrence of non-iron deficiency anemia. The decrease in hemoglobin may be due to deficiencies of other nutrients besides iron, such as lack of intake of protein which is also a component of iron, deficiency of B12, or folic acid, or there is an inflammatory reaction due to certain infections [12], [13], [14].

Iron deficiency anemia is determined by a decrease in hemoglobin levels and changes in iron status include serum iron, serum ferritin, and TIBC (total iron binding capacity). Normal iron levels in the blood are around 65–175 ug/dL and in this study there are 34 participants who had serum iron level below this range and seven participants showed a decrease in serum iron; however, there was no decrease in serum ferritin, and an increase in TIBC. Serum iron level can change rapidly each day and between days. Decline serum iron level without being followed serum ferritin and hemoglobin reduction can indicate a disturbance in iron absorption, one of which is caused by an inflammatory process or inflammation in response to an infectious or traumatic disease [15].

Due to this study limitations, we did not analyze inflammatory factors or other factors that cause iron malabsorption but, according to the inclusion criteria of this study, the subject was confirmed to be in good health when attending this study. This low serum iron level is probably caused by a lack of iron intake from the food consumed. Based on the results of a questionnaire regarding diet, most of the subjects tended to consume less green vegetables and processed meat, which are foods that contain lots of iron.

Ferritin is a protein in the body and functions to bind iron stored in the body. Ferritin is found in the liver, spleen, skeletal muscle, and bone marrow. The ferritin found in the blood is generally not too much, the amount

of this protein in the blood can show how much iron is stored in the body [16]. Normal serum ferritin level is 9.3–159 ng/mL, if the ferritin test results are low, that means iron in the body is at a low level and the body is deficient in iron. Conversely, if the ferritin test results are higher than normal levels, it means too much iron is stored in the body. TIBC (Total Iron Binding Capacity) in the blood indicates the amount of transferrin, which is an iron-binding protein [16]. Normal TIBC levels are in the range 135–392 ug/dL and will increase in cases of iron deficiency anemia.

Iron deficiency is divided into three stages, namely the mildest first stage (iron depletion), the second stage (called iron deficiency erythropoiesis), and the third stage is called iron deficiency anemia [17]. Stage I iron deficiency characterized by reduced serum ferritin; however, other components such as total iron binding capacity (TIBC), serum iron (Fe), saturation transferrin, RDW, MCV, hemoglobin, and blood cell morphology are still within normal limits. From this study, of the 52 participants there are two respondents were in Stage I iron deficiency. Stage I iron deficiency is indicates there is negative iron homeostasis affecting iron depletion and decrease iron storage.

Second stage iron deficiency characterized by decrease in serum ferritin, serum iron, transferrin saturation and iron in empty bone marrow, but TIBC level increase while other components are still normal, and is called iron deficiency erythropoiesis. Result from this study, from 52 participants, there is five people in this stage iron deficiency. The second stage, also referred to as “iron deficiency,” is characterized by a phase of erythropoiesis. Iron is depleted, but anemia is not yet present, although biochemical abnormalities reflect its inability to produce hemoglobin normally.

The third stage is called iron deficiency anemia. Iron deficiency anemia is a severe stage of iron deficiency characterized by decreased serum ferritin and hemoglobin levels and all other components will also undergo changes such as the morphological picture of hypochromic microcytic blood cells, while RDW and TIBC increase. The third stage is characterized by a reduction in iron delivery to the bone marrow, reducing both hemoglobin synthesis and content in erythrocyte precursor cells. The damage in flicted on the body increases as the concentration of available iron diminishes [18]. Based on complete blood analysis and iron status examination, a total of 7 subjects (13.4%) had iron deficiency anemia.

Hemoglobin level is hematological parameters that significantly correlate ($p < 0.05$) with all others parameters in iron deficiency. This result is accordance with previous study and literature that state that hemoglobin level will decrease in iron deficiency anemia stage three or severe stage [18]. Decreasing hemoglobin level indicates iron deficiency anemia where iron reserves in the body have been depleted as seen from a decrease in serum iron, ferritin and an increase in TIBC and the body has decreased the number of erythrocyte production seen from blood profiles such as MCV, MCH, and MCHC. Decreased hemoglobin levels are not sufficient to establish a diagnosis of iron deficiency anemia. Another parameter that needs to be considered is the serum ferritin level which is an indicator of iron stores in the body, decreasing hemoglobin level which is not followed by decrease serum ferritin indicates that the anemia is not iron deficiency anemia [19]. The results of correlation analysis also showed a significant correlation of serum ferritin with other hematological parameters in iron deficiency anemia except erythrocyte count and MCV. Hemoglobin and Ferritin serum are the best predictor for iron deficiency anemia in this study.

From this study, we find that iron deficiency anemia among adolescents girls still becoming major health problem in Semarang City with prevalence incidence 13.4% higher than 5% from the World Health Organization (WHO) recommendation even though urban areas having higher socio-economic status with good environmental hygiene and sanitation. Iron deficiency anemia among adolescent’s girls caused by inadequate iron intake from daily food. Adolescents tend to consume less diverse foods and unhealthy dietary patterns such as skip meal and picky eaters.

Conclusion

Iron deficiency anemia still becoming major health problem among adolescents girls in urban areas with prevalence incidence >5%. Even though urban areas have higher socio-economic status, and good hygiene, environmental sanitation. Further research is needed with a wider sample and area coverage.

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