

Fast Food Consumption and Snacking in Female Adolescents and Their Correlation With Hemoglobin Levels

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Abstract— Female adolescents are at high risk of anemia due to nutrient deficiencies and unhealthy lifestyle. Fast food consumption and snacking with high calories, carbohydrates and fat are very common in adolescent daily life that can cause inflammation by which macrophage infiltration into adipose tissues leading to hypertrophy and hyperplasia. This situation triggers the release of pro-inflammatory cytokines such as interleukin-6 (IL-6) which inhibits iron metabolism. Therefore, this study aimed to investigate the correlation of fast food consumption and snacking with hemoglobin (Hb) levels in female adolescents. This cross sectional research study was performed among 117 female adolescents of high and vocational schools in Karanganyar Regency, which were selected using the stratified random sampling. Data of fast food consumption and snacking were collected using the Food Frequency Questionnaire (FFQ), and hemoglobin levels were determined using a hematology analyzer. To test data normality, we used the Kolmogorov-Smirnov test. The Spearman rank was used to analyze individual correlation of variables with Hb levels, and all together variables were analyzed using a multiple linear regression test. A total of 17.1 % female adolescents suffered from anemia. Fast food consumption ($r = -3.47$; $p = 0.001$) significantly correlated with Hb levels but not for snacking ($r = -1.44$; $p = 0.152$). In conclusion, fast food consumption negatively correlates with Hb levels in female adolescents while snacking does not. Education of healthy nutrition is required for prevention of anemia in female adolescents.

Keywords— *Fast food consumption, snacking, hemoglobin levels, female adolescents*

I. INTRODUCTION

Adolescent is a transition period between childhood and adulthood life that is characterized by biological, psychological and social changes. Environmental, genetic and epigenetic factors play important roles in adolescent health [1]. Nutrition, which is one of the environmental factors, has the strongest effect on the human body, and chronic insufficiency of nutrition intake leads to metabolic disorders, including anemia [2].

Female adolescents, for instance, are more susceptible to get iron deficiency anemia (IDA) than male adolescents due

to blood loss during their regular menstrual cycles [3], which has negative impacts on their health. In short time, female adolescents with IDA generally have poorer academic performance than healthy female adolescents [4].

When they become pregnant, IDA can cause bleeding, high blood pressure, low birth weight and intra uterine growth retardation [5].

World Health Organization says that 50% anemia cases worldwide are due to iron deficiency, which are more predominantly found in developing countries (30-48%) than in developed countries (4.3-20%) [6]. The prevalence of anemia in India is much higher by 45% than those of anemia in Jamaica (25%) and Indonesia (30%) [7]. Based on the data of Basic Health Research in Indonesia, the prevalence of anemia among female adolescents increased in the last decade from 19.7% in 2007 to 22.2% in 2013[8]. Five years later, the national prevalence of anemia increased by more than 100% (48.9%), whereas anemia prevalence in Central Java and Karanganyar was 57.1% and 56.8% respectively. The proportion of anemia in Indonesia is estimated to increase in 2020 [9].

A number of factors contribute to the prevalence of anemia in female adolescents such as some nutrient deficiencies including iron intake, acute and chronic inflammations, and increased iron loss from the body during menstruation [10]. Unhealthy eating behavior and habits such as snacking and fast food consumption, which consist of low micronutrients, especially iron, high calorie and fat and high salt, also result in increase of anemia prevalence [11], [12]. Moreover, excessive nutrient intake is strongly associated with inflammation, which is characterized by macrophage infiltration into adipose tissues, leading to adipose hypertrophy and hyperplasia [13]. These molecular changes induce hyper secretion of pro-inflammatory cytokines such as IL-6, which inhibits iron metabolism and affects the hemoglobin (Hb) levels [13], [14]. Thus, the aim of this study was to evaluate the correlation of fast food consumption and snacking with hemoglobin levels in female adolescents.

II. MATERIAL AND METHOD

This research study was an analytic observational study with cross sectional design. Its population was female adolescents who were in years X-XI of senior and vocational high schools in Colomadu, Matesih, and Jumapolo districts, Karanganyar

Regency in March 2020. Stratified random sampling was used to determine research samples and we got 117 female adolescents. Inclusion criteria for this study were female adolescents who aged 15-18 years, lived in Karanganyar Regency, and signed the informed consent whilst female adolescents who got menstruation and had a history of blood disorders such as malaria infection were excluded.

Body weight digital scales and microtoice were used to measure body weight and height of research participants respectively. Data of fast food consumption and snacking were collected using the Food Frequency Questionnaire (FFQ) that contained checklist sheets of > 30 types of fast food and snacks commonly consumed by adolescents for a couple months before. Hemoglobin levels were tested using the hematology analyzer at the Clinical Laboratories in Surakarta city and Colomadu, Matesih, and Jumapolo Community Health Centers.

Collected data in this study were analyzed using the SPSS program, version 24. Data normality was then evaluated using the Kolmogorov-Smirnov test. Numerical and categorical data were presented as mean ± standard deviation and percentage. Correlation of individual variable with hemoglobin level was analyzed using the Spearman test and multivariate linear regression test was used to analyze all variables with Hb levels. The protocol of this study was approved by the Health Research Ethics Committee (KEPK), Faculty of Medicine, Universitas Sebelas Maret, Surakarta (No.033/UN27.06.6.1/KEPK/EC/2020).

III. RESULT

TABLE I. CHARACTERISTICS OF RESEARCH PARTICIPANTS

Variable	Total (n: 117)%	Mean±SD
Hemoglobin Level		
Non anemia ≥ 12 mg/dL	97(82.9)	13.19±1.34
Anemia < 12 mg/dl	20(17.1)	
Age		
15 years old	47(40.2)	15.89±0.90
16 years old	43(36.8)	
17 years old	20 (17.1)	
18 years old	7 (6)	
Father education		
Elementary school	25 (21.4)	2.30±0.86
Secondary school	38 (32.5)	
High School/vocational	48 (41)	
University	6 (5.1)	
Mother education		
Elementary school	33(28.2)	2.16±0.92
Secondary school	40(34.2)	
High School/vocational	36(30.8)	
University	8 (6.8)	
BMI/age		
Underweight	4(3.4)	-0.01±1.22
Normal	87(74.4)	
Overweight	20(17.1)	
Obese	6(5.1)	

Physical activity		
High	14(12)	1,545±1198.84
Moderate	90(76.9)	
Low	13(11.1)	
Pocket money		
≤ 10,000 IDR	74(63.2%)	11,965.8±5705.3
> 10,000 IDR	43(36.8%)	

Most of female adolescents (82.9%) had normal hemoglobin level (≥ 12 mg/dL) with the average of 13.19 ± 1.34 mg/dL. The age of female adolescents ranged from 15 to 18 years old with the average age of 13.19 ± 1.34 years old. The latest educations of parents, fathers and mothers, were mostly high school (41%) and middle school (34.2%) respectively. The nutritional status of the subjects was mostly normal (74.4%), had overweight and obesity status of 17.1% and 5.1%. Adolescent physical activity was mostly moderate (76.9%) with an average of 1545 ± 1198.84 (Table 1). In Table 2, the frequency of fast food (r = -2.07; p = 0.025) and snacks (r = -0.87; p = 0.350) with Hb levels. Table 3 showed the linear regression test for the frequency of fast food and snacks with hemoglobin levels.

TABLE II. SPEARMAN CORRELATION OF FAST FOOD CONSUMPTION AND SNACKING WITH Hb LEVELS

Variable	Min	Max	Mean±SD	r	p
Fast food consumption	30	215	92.34±34.07	-2.07	0.025
Snacking	10	190	91.79±31.93	-0.87	0.350

* p < 0.05 significance

TABLE III. REGRESSION LINEAR ANALYSIS OF FAST FOOD CONSUMPTION AND SNACKING WITH Hb LEVELS

Variable	b	t	sig	β**
Fast Food consumption	-0.13	-3.474	0.001	-0.319
Snacking Food	-0.006	-1.443	0.152	-0.131

R square = 0,186
p (sig) = 0.000
n observations = 117
b* = Unstandardized coefficients
β ** = standardized coefficients

IV. DISCUSSION

The frequency of fast food consumption can be determined by seeing how frequent the subjects consume fast food. According to Sharkey et al., fast food can be described as low cost, large portion and high-energy, and high-fat foods [15], whereas fast foods more likely contain low micronutrients and fiber [16]. The frequency of fast food consumption had a high variance in all research subjects as indicated by the difference in the minimum and maximum levels and the deviation standard of frequency of fast food consumption by ±38% of the overall mean (Table 1).

The results of correlation test using Spearman indicated that there was a negative relationship (inversely proportional) between the frequency of fast food consumption and hemoglobin (Hb) levels in female adolescents (r=-2.07; p=0.025). This means that the higher the frequency of fast food consumption was, the lower the Hb level would be. Conversely, the lower the frequency of fast food consumption was, the closer Hb level to normal would be (Table 2). Such results were in line with those of previous researches, in which the majority of research subjects

consuming fast food had low hemoglobin levels with the p -value = 0.009 [17].

Fast food is usually higher in calories, sugar, gluten, and sodium. Adolescent habits in consuming fast food can interfere with nutrient absorption. Fast foods such as pasta, instant noodles, burgers, and bread and wheat pizza contain high levels of phytate which interfere with absorption of nutrients such as iron, calcium found in meat, fish, and fruits [18]. The results of the frequency score of fast food shows that most of the subjects consumed instant noodles, fried rice, fried noodles. Fast food has a low nutrient such as fiber and vitamins with a high number of calories that will affect fat adipocytes in the body to inflammation. Fiber is a source of vitamins such as Vitamin C and Vitamin B12 found in vegetables. Previous studies found an association between Vitamin C and Vitamin B12 with hemoglobin levels [19]. Other researches stated that low Hb levels can be due to decreased Vitamin C due to interference of iron absorption [20].

In addition, parental education level factor had an effect on the availability of food. Most subjects had parental education level, especially maternal education level of middle school (Table 1). Other researches showed that parental education level had a relationship with anemia, that is, mothers have broader information. Higher maternal education level has been shown to lead to increased knowledge about children's health and nutritional quality [21].

A high frequency of fast food consumption can lead to excessive nutrient that causes inflammation. Inflammation that occurs in an individual with excessive nutrient or obesity affects the concentration of ferritin and high adiposity [22]. This condition triggers the formation of pro-inflammatory cytokines such as interleukin-6 (IL-6) which inhibits iron metabolism [13].

Snacking can be defined as consuming high-calorie foods between regular meals [23]–[25]. Snacks are associated with energy-dense foods with poor nutrients, high in sodium, sugar, and fat such as cakes, sweet drinks, chiki balls, packaged biscuits and chips [26]–[28].

The frequency of snacking had a high variance in all research subjects as shown by the difference between the minimum and maximum levels and the standard deviation of the frequency of snacking by $\pm 35\%$ of the overall mean (Table 3) which was not much different from the frequency of fast food consumption (Table 2).

Based on Table 5, the results of correlation test using Spearman indicated that there was not a relationship between the frequency of snacking and the hemoglobin (Hb) levels in female adolescents ($p < 0.05$). The finding was similar to that of Sari and Mulyani, that there was no correlation between the contribution of snacks and the Hb levels in female adolescents in Tangerang [29]. This can be due to the possibility that the types of snacks consumed by adolescents do not meet the needs of iron intake, and many types of snacks can inhibit iron absorption in the body such as the consumption of packaged tea and consumption of packaged snacks which contain more additives than the nutrients needed by adolescents. In addition, it can be related to allowance where most subjects received an allowance of \leq

Rp10,000 or more than half (63.2%) (Table 1), so that the subjects preferred purchasing heavy meals to buying snacks that are less filling. Other causes affecting low hemoglobin levels were the monthly menstrual cycle, insufficient iron intake, and inadequate iron absorption.

V. CONCLUSION

The result of the determinant coefficient (R square) was 0.186, meaning that the frequency of fast food and snacks had a contribution to the hemoglobin level of 18.6%. In addition, many factors contributed to blood hemoglobin such as intake and other external factors. As for the limitations of this study, we did not do the calculation of nutrients from the amount of fast food and snacks consumed by teenagers.

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