

Daily Consumption of Fruits and Vegetables Has Different Correlations With Haemoglobin Levels in Young Women at Karanganyar Regency

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Abstract— Indonesia still encounters a nutritional problem since the morbidity rate of anemia in young women has increased in the last few years. Iron deficiency is the most common cause of anemia in susceptible age groups especially in young women. Based on the results of Basic Health Research in Indonesia, low daily intake of fruits and vegetables commonly occurs in Indonesian people. This study therefore aimed to investigate the correlation of fruit and vegetable consumptions with hemoglobin (Hb) levels in young women. A cross sectional study was performed to 117 young women who studied at senior and vocational high schools in Karanganyar Regency. They were selected by using a stratified random sampling. Data of fruit and vegetable consumptions were collected through a Semi Quantitative-Food Frequency Questionnaire (SQ-FFQ) while Hb levels were measured by using a hematology analyzer. Data of other factors that influenced Hb levels were obtained by using questionnaires and anthropometric measurement. Spearman and multiple linear regression tests were used to analyze correlation of fruit and vegetable consumptions and confounding factors with Hb levels. The p-value of <0.05 was considered as a statistical significance. Anemia was found in 17.1% young women. Most young women had inadequate fruit consumption whereas 52.1% had adequate vegetable consumption. Fruit consumption ($b = 0.002$; $p = 0.740$) did not correlate with Hb levels while a positive correlation with Hb level was observed in vegetable consumption ($b = 0.006$; $p < 0.001$). In conclusion, daily consumption of fruits and vegetables has different correlations with Hb levels in young women.

Keywords— Fruit and vegetable consumption, Hemoglobin level, Anemia, Young women

I. INTRODUCTION

Many countries in the world have come across anemia for long time periods, in which the prevalence of anemia tended to increase in the last five years [1] In Indonesia for instance, the prevalence of anemia increased from 37.1% in 2013 to 48.9% in 2018 and is likely to increase in 2023. In addition, 84.6% of anemic cases are found in the 15-24 year age group including young women [2]. Beside the morbidity rate, anemia in young women also has negative impacts on physical health such as weakness, fatigue, less concentration,

and reduced physical activity, causing decreases of life quality and work productivity [3,4].

There are many factors that contribute to anemia, but the most common is due to iron deficiency. Low daily intake of fruits and vegetables is thought to be an important factor which may increase iron deficiency in Indonesia. According to the data of the Basic Health Research in Indonesia (2018), most Indonesian people (95.5%) had low consumption of fruits and vegetables [2]. However, it is surprising because fruits and vegetables are easily grown and found in all areas in Indonesia [5].

Beside iron and carotenoids, fruits and vegetables are rich in vitamin C. The presence of vitamin C helps absorb ferric iron from fruits and vegetables by removing the interaction with tannin, phytate, and oxalate [6,7]. Some studies have shown that adequate consumption of fruits and vegetables has contradictory effects on iron bioavailability. In this sense, one side said that there was a positive correlation of daily consumption of fruits and vegetables with serum iron level, but the other side said no correlation [7-9] Therefore, this study aimed to assess the correlation of fruit and vegetable consumption with Hb levels in young women.

II. MATERIAL AND METHOD

This cross-sectional research study was performed at Karanganyar Regency from February to March 2020. Population of this study was young women who studied at high and vocational schools in Colomadu, Jumapolo, and Matesih districts, based on their highest prevalence of anemia in the Karanganyar Regency in 2018. Young women were selected using a stratified random sampling method with the criteria as follows: they were aged 15-18 years old and lived in those districts at least 6 months. The selected young women were excluded from this study when they had menstruation and blood disorders such as thalassemia, worm infection, and malaria. After research participants agreed to participate to this study, they then signed the informed consent. The protocol of this study was also approved by

The Health Research Ethic Committee of Dr. Moewardi General Hospital, Surakarta (No. 102 / I / HREC / 2020).

According to the Indonesian recommended dietary allowance, adolescents (13-18 year old) should daily consumed fruits and vegetables at least 400 g / person / day that consists of 150g fruits and 250 g vegetables. If they consumed less than 400 g/day, it would be classified "less" and vice versa [10]. Data of those intakes were obtained using the SQ-FFQ. Blood samples were taken from the venous lower arms of research participants, and Hb levels were measured using a hematology analyzer at Health Laboratories in Surakarta City, Jumapolo, or Matesih Community Health Centers. Adolescent Hb levels were ≥ 12 g/dL were categorized as "non-anemic" [11]. Confounding factors in this study such as physical activity, menstrual length, and parent income were collected using the international physical activity and open questionnaires, and body mass index (BMI) for age respectively. The physical activity of research participants was classified into low (<600 metabolic equivalent of tasks or METs), medium (600-2999 METs), and high (≥ 3000 METs) categories [12]. Meanwhile, menstrual length was categorized into abnormal (>7 days/ cycle) and normal (≤ 7 days/cycle) and classification of parent income was based on minimum regional wage (MRW) in Karanganyar Regency (1.989 million IDR)[13]. The BMI/age was then determined using the Z score method and was classified into thin (- 3 SD to <- 2 SD), normal (-2 SD to +1 SD), overweight (+ 1 SD to +2 SD), and obese (>+2 SD)[14].

Collected data in this study were analyzed using the Statistical Product and Service Solutions (SPSS) program, Version 21. Numeric and categorical data were presented as mean \pm standard deviation (SD), and frequency and percentage respectively. Data normality was then verified using the Kolmogorov-Smirnov test, and the correlations of fruit and vegetable consumption and the confounding factors with Hb levels were assessed using the Rank Spearman test. Finally, regression coefficients of those variables against Hb levels were analyzed using the multiple linear regression test, and the significant correlation was set up at the p-value < 0.05.

III. RESULT

General characteristics and daily consumption of fruits and vegetables in young women who took part in this study were indicated in Table 1. In general, young women had normal characteristics except fruit consumption and parent income. The average age of young women was 15.8 \pm 0.73 years old, and 17.1% among them had anemia. Inadequate consumption of fruits was observed in 86.3% young women but 52.1% young women daily consumed adequate vegetables. Furthermore, more than half of parent's young women had low monthly income.

TABLE I. GENERAL CHARACTERISTICS AND DAILY CONSUMPTION OF FRUITS AND VEGETABLES IN YOUNG WOMEN PARTICIPATING IN THIS STUDY

Variable	Mean \pm SD	Frequency (%)
Age (years)	15.8 \pm 0.73	
Hb Levels (g / dl)	13.32 \pm 1.69	
Anemic (<12 g/dL)		20(17.1)

Non-anemic (>12 g/dL)		97(82.9)
Fruit consumption (g/ day)	111.56 \pm 27.30	
Inadequate (<150 g/person/day)		101(86.3)
Adequate (>150 g/person/ day)		16(13.7)
Vegetable consumption (g/day)	252.77 \pm 110.12	
Inadequate (<250 g/person/day)		56(47.9)
Adequate (>250 g/person/ day)		61(52.1)
Fruits + vegetables (g/ day)	364.32 \pm 119.69	
Inadequate (<400 g/person/day)		79(67.5)
Adequate (>400 g/person/ day)		38(32.5)
Physical activity (METs)	1558.1 \pm 1350	
Low (<600 METs)		32(27.4)
Medium (600-2999 METs)		67(57.3)
High (>3000 METs)		18(15.4)
Menstrual length (days)	6.33 \pm 1.12	
Abnormal (>7 days/cycle)		9(7.7)
Normal (≤ 7 days/cycle)		108(92.3)
BMI for Age (z-score)	-0.23 \pm 1.23	
Thin (-3 SD to <-2 SD)		14(12)
Normal (-2 SD to +1 SD)		94(80.3)
Overweight (+1 SD to +2 SD)		2(1.7)
Obese (>+2 SD)		7(6)
Parent income (million rupiah)	1.865 \pm 1.1154	
< MRW (million IDR)		77(56.4)
\geq MRW (million IDR)		51(43.6)

TABLE II. THE AVERAGE CONSUMPTION OF FRUITS AND VEGETABLES IN ANEMIC AND NON-ANEMIC YOUNG WOMEN

Hb levels	N	Daily Consumption		
		Fruits (g/day)	Vegetables (g/day)	Fruits + Vegetables (g/day)
Anemia (<12 g/dL)	20	100.77 \pm 22.93	159.79 \pm 79.12	260.57 \pm 89.81
Non-anemia (≥ 12 g/dL)	97	113.78 \pm 27.69	271.94 \pm 106.02	385.71 \pm 114.04

Table 2 showed that daily consumption of fruits, vegetables or combination in anemic young women was lower than daily consumption of fruits, vegetables or combination in non-anemic young women. However, young women with anemia daily consumed fruits slightly different from those with non- anemia (100.77 vs. 113.78 g/day).

TABLE III. THE CORRELATIONS OF FRUIT AND VEGETABLE CONSUMPTIONS AND CONFOUNDING FACTORS WITH Hb LEVELS IN YOUNG WOMEN

Variable	r	p
Independent variable		
Fruit consumption	0.188	0.042
Vegetable consumption	0.399	< 0.001
Confounding factors		
Physical activity	0.038	0.687
Menstrual length	-0.23	0.013
BMI for Age	0.156	0.094
Parent income	0.12	0.199

In order to assess independent correlations of fruit and vegetable consumptions and confounding factors with Hb levels, the Spearman test was carried out. Table 3 showed that fruit and vegetable consumptions and menstrual length had significant correlations with Hb levels. Daily fruit consumption (r = 0.188; p = 0.042) and daily vegetable consumption (r = 0.399; p < 0.001) positively correlated with Hb levels while a negative correlation was for menstrual length (r = -0.23; p = 0.013).

The next statistical analysis used the multiple linier regression test for evaluating the correlation of all factors

together with Hb levels. Only daily consumption of vegetables positively correlated with Hb level after adjustment with physical activity, menstrual length, BMI for age, and parent income (Table 4). Meanwhile, changes of Hb levels in young women were also influenced by the length of menstruation.

TABLE IV. THE MULTIVARIATE ANALYSIS OF FRUIT AND VEGETABLE CONSUMPTIONS AND CONFOUNDING FACTORS WITH Hb LEVELS IN YOUNG WOMEN

Variables	b*	t	sig	β**
Constant	12.738	12.338	0.000	
Fruit consumption	0.002	0.333	0.740	0.029
Vegetable consumption	0.006	4.785	<0.001	0.404
Physical activity	0.000	1.243	0.216	0.103
Menstrual length	-0.249	-2.039	0.044	-0.172
BMI / Age	0.172	1.567	0.12	0.131
Parent income	0.171	1.413	0.161	0.118
R square = 0.264 F = 6.587 p (sig) = 0.000				
n observations = 117				
b * = Unstandardized coefficients				
β ** = standardized coefficients				

IV. DISCUSSION

Adequate intake of fruits and vegetables is one of the healthy diet components to keep normal human body functions, based on Balanced Nutrition Message 2014, at least 150 g/person/day and 250 g/person/day respectively [10]. However, most young women in this study only consumed approximately 111.56 g/day fruits. In addition, all young women with anemia had low consumption of fruits and vegetables, which could be influenced by several factors such as parent income [15]. A previous study has showed that higher parent income correlates to higher amount of fruit consumption in young women [16].

It is not surprised that fruit consumption did not correlate to Hb levels ($b = 0.002$; 95% CI = -0.008 to 0.012 ; $p > 0.05$) in young women since 86.3% among them had a low fruit consumption. For young women with anemia, daily consumption of fresh fruits perhaps affect the iron absorption [8]. From our finding, vegetable consumption slightly increases Hb levels in young women as well ($b = 0.006$; 95% CI = 0.003 - 0.008 ; $p < 0.05$) because the proportion of vegetable consumption between young women with anemia and young women without anemia is slightly difference (47.9 vs. 52.1%). Secondly, vegetables are rich ferric iron that requires the presence of vitamin C to convert into ferro iron [17-19]. Therefore, it will need longer time to increase Hb levels than daily consumption of meat and dairy products. Vegetables also contain carotenoids as a precursor of vitamin A formation in the human body that help the iron absorption in the small intestine through mobilization of iron from ferritin into all body tissues [20]. Another study has reported that vitamin A activates the expression of ferroportin 1 in cells *Caco-2*, which causes iron to pass through the intestinal cell membrane and increasing iron absorption [21]. A similar study reveals that consumption of spinach for 7 days increases the mean Hb levels from 12.80 g/dL to 13.18 g/dL [22].

Menstrual duration in this study was found to have a negative correlation with Hb levels ($b = -0.249$; 95% CI = -0.49 to -0.007 ; $p < 0.05$). This finding is in line with the

theory that regular menstruation can cause iron loss [23]. Our study supports a previous research study that adolescent girls with menstrual periods ≥ 5 days have 2.4 higher risk of developing anemia compared to those with the menstrual periods < 5 days [15]. Altogether, consumption of fruits and vegetables and confounding factors significantly influence Hb levels by 26.4% and many other factors contribute to Hb levels such as daily intake of protein and heme-rich foods.

V. CONCLUSION

Daily consumption of vegetables positively correlates with Hb level in young women at Karanganyar Regency but that of fruits does not. This finding suggests that regular consumption of vegetables plays an important role for preventing iron deficiency anemia in consideration of menstrual length of every young woman. Moreover, we aware that our study just used limited number of research participants so that we could not generalize our result to Indonesian population. In future, we will recruit a large number of research participants to complete our study and involve other factors that contribute to Hb production.

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