

RELATIONSHIP BETWEEN KNOWLEDGE, NUTRITIONAL ADEQUACY LEVEL, TEA DRINKING HABITS AND NUTRITIONAL STATUS WITH ANEMIA AMONG ADOLESCENT GIRLS IN SMK PRATAMA MULYA KARAWANG

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Abstract

Introduction: Adolescent is a nation's future asset that is prone to nutritional problems. One of the nutritional problem in adolescent is anemia. Anemia is a condition when the hemoglobin level is below normal limits. Currently, anemia among adolescent is still a health problem both globally and in Indonesia. Anemia has a negative impact on adolescents, including reducing concentration in learning, reducing work productivity, and disrupting the body's defense system. Furthermore, anemia is one of the indirect factors that cause maternal death. The prevalence of anemia among adolescent in Karawang Regency, especially at SMK Pratama Mulya Karawang is still quite high (53.3%), so it is necessary to do further research on the factors that influence the incidence of anemia among adolescent girls. This study aims to determine the relationship between knowledge, nutritional adequacy level, tea drinking habits, and nutritional status with incidence of adolescent girls anemia in SMK Pratama Mulya Karawang.

Method: This study use a quantitative observational research with a cross sectional design. The minimum number of samples in this study was 65 people. Anemia data was collected using biochemical measurements of hemoglobin levels, knowledge data using a knowledge questionnaire, nutritional intake data and tea drinking habits were carried out by interviewing using the SQ-FFQ form, while nutritional status data was measured by anthropometric measurements.

Results: The results showed that there was a significant relationship between energy adequacy levels, protein adequacy levels, iron adequacy levels, and vitamin C adequacy levels with the incidence of anemia and there was no significant relationship between knowledge, vitamin B12 adequacy levels, tea drinking habits and nutritional status with the incidence of anemia in adolescent girls.

Conclusion: Nutritional adequacy level is related to the incident of anemia among adolescent girls in SMK Pratama Mulya Karawang

Keywords: Adolescent, Anemia, Nutritional Adequacy Level

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INTRODUCTION

Adolescent is an asset as the nation's successor. Adolescents are vulnerable to nutritional problems, one of which is anemia. Anemia is a condition when the number of erythrocytes that function to transport oxygen is not sufficient to meet the needs of oxygen in the body which is characterized by hemoglobin levels <12 g/dl (WHO, 2011). Hemoglobin is a protein that contains iron and is found in erythrocytes. Hemoglobin functions as a carrier of oxygen from the lungs to be distributed throughout the body and as a carrier of carbon dioxide back to the lungs (Amalia & Tjiptaningrum, 2016).

Anemia is still a health problem both globally and also in Indonesia. According to WHO, the global prevalence of anemia in 2011 was 29% in women aged 15-49 years (WHO, 2015). The prevalence of anemia in women in Indonesia in the age group 15-24 years is 18.4% (Kemenkes RI, 2013). Meanwhile in West Java, the prevalence of anemia is 45.5% (R. Agustina et al., 2020). Meanwhile, the prevalence of anemia in adolescent girls at SMK Pratama Mulya Karawang is 53.3%.

Anemia has a negative impact on adolescents, including impaired learning ability, decreased ability to work and physical activity and disruption of the body's defense system (Masrizal, 2007). Research conducted by Simanjuntak shows that there is a relationship between hemoglobin levels and student achievement (Simanjuntak, 2018). Furthermore, anemia is one of the indirect causes of maternal death. The

maternal mortality rate in the world during 2000-2017 was around 38% (WHO, 2019). Meanwhile, the maternal mortality rate in Indonesia is 305 per 100,000 live births (Kemenkes RI, 2019).

Factors that can affect the occurrence of anemia in adolescents, there is knowledge. Research conducted by Gebreyesus et al showed that adolescents who had never heard of anemia were 1.5x more likely to develop anemia compared to adolescents who had knowledge of anemia (Gebreyesus et al., 2019). In addition, factors that influence anemia in adolescent girls are the level of adequacy of various nutrients. Research conducted by Engidaw et al in 2018 in Ethiopia showed that there was a relationship between consumption of food sources of Fe and the incidence of anemia (Engidaw et al., 2018). The results of a study conducted by Kaimudin et al, in Kendari in 2017 showed that the proportion of anemia was higher in subjects with insufficient Vitamin C intake (55.3%) compared to subjects with sufficient Vitamin C intake (Kaimudin et al., 2017). Research conducted by Saptyasih et al at SMP Negeri 2 Tawangharjo, Grobogan Regency, showed that high vitamin B12 intake can be higher the hemoglobin level (Saptyasih et al., 2016).

Other influencing factors include tea drinking habits and nutritional status. Suni's research concluded that the more often you drink tea, the lower your hemoglobin level will be (Suni, 2016). Research conducted by Muhayati and Ratnawati at SMA Negeri 97 Jakarta showed that there was a significant relationship between nutritional status and the incidence of anemia (Muhayati & Ratnawati, 2019). Based on this background, a study is needed to determine the relationship between knowledge, nutritional adequacy levels, and nutritional status with the incidence of anemia in adolescent girls at SMK Pratama Mulya Karawang because the results of a preliminary study conducted in April 2021 by measuring Hb levels of 13 female students showed that the prevalence of anemia in SMK Pratama Mulya Karawang is 53.3% higher than the prevalence in other schools, in West Java and nationally. It is intended that this research can be used as consideration for making anemia prevention and control programs in schools so that students can compete with other schools in achieving achievements.

The purpose of this study was to determine the relationship between knowledge, nutritional adequacy level, tea drinking habits and nutritional status with the incidence of anemia in adolescent girls at SMK Pratama Mulya Karawang.

METHOD

This study uses an observational quantitative research design with cross sectional research methods. This research was conducted in February-August 2021 at SMK Pratama Mulya Karawang. The population in this study were all female students in grades 10 and 11 totaling 149 people. The sample in this study was 130 people who were calculated using the Lemeshow formula based on previous research with inclusion criteria, namely aged 15-18 years and had menstruated for 3 cycles with exclusion criteria the subject was menstruating at the time of data collection. The method of determining the sample uses probability sampling with cluster random sampling technique.

The variables studied included anemia, knowledge, nutritional adequacy level, tea drinking habits and nutritional status. Data collection techniques using primary data and secondary data. Primary data were collected directly by the researcher using a questionnaire for the knowledge variable, nutritional adequacy level variable and tea drinking habits variable collected using the SQ-FFQ form, nutritional status variable collected with measurement weight using digital scales and height using microtoise, and then there is will calculate using BMI/A index. Meanwhile, variable of anemia collected by measurement of hemoglobin levels taken from the capillaries at the fingertips with a hemoglobinometer digital assisted by health workers. Data analysis used univariate and bivariate data analysis. Respondent in this study had signed an informed consent before taking data. This research has received ethical approval from the Health Research Ethics Commission of Muhammadiyah University Prof. DR. HAMKA with the number 03/21.04/0961.

RESULTS

Respondent Characteristics

The following is the result of a univariate analysis of respondents' characteristics including age, class, father's occupation, mother's occupation, father's education, mother's education which can be seen in Table 1.

Table 1. Respondent Characteristics

Characteristics	n	%
Age		
15 th years	25	19,2
16 th years	53	40,8
17 th years	46	35,4
18 th years	6	4,6
Class		
10 th grade	59	45,4
11 th grade	71	54,6
Father's Occupation		
Unemployment	10	7,7
Employee	21	16,2
Entrepreneur	20	15,4
Laborer	70	63,8
Honorary Staff	1	0,8
Farmer	5	3,8
Dead	3	2,3
Mother's Occupation		
Housewife	107	82,3
Employee	5	3,8
Entrepreneur	8	6,2
Laborer	9	6,9
Farmer	1	0,8
Father's Education		
Not complete Primary School	14	10,8
Primary School	64	49,2
Junior High School	24	18,5
Senior High School	28	21,5
Mother's Education		
Not complete Primary School	19	14,6
Primary School	65	50
Junior High School	33	25,4
Senior High School	13	10

The age of the respondents was calculated by subtracting the date of measurement when the study was conducted with the date of birth of each respondent. Based on the table above, the most respondents were at the age of 16 years, namely 40.8% and the least at the age of 18 years (4.6%). Meanwhile, respondents aged 15 years and 17 years were 19.2% and 35.4%, respectively. More respondents came from grade 11 (54.6%) compared to grade 10 (45.4%). The selection of grades 10 and 11 is based on the age of the students in the class that are included in the category of late teens, aged 15-18 years. In addition, it is also based on the availability of the school to make students of grade 10 and grade 11 as research subjects because grade 12 at the time of the research had already taken the Final Exam so they were no longer active in school at SMK Pramata Mulya Karawang.

Most of the respondents' fathers work as laborers as much as 63.8% while the respondents' mothers are mostly housewives (82.3%). Meanwhile, almost half of the respondent's father's education finished elementary school and only 21.5% graduated from high school. Meanwhile, the majority of respondents' mothers have graduated from elementary school (50%) and only 10% have graduated from high school. SMK Pratama Mulya Karawang is located in a rural area so that most of the parents' education is not too high.

Univariate Analysis Results

Table 2. Univariate Analysis Results

Variabel	n	%	Median	Min-Max
Anemia				
Yes	43	33,1	13,2	9,4 – 18
No	87	66,9		
Knowledge				
Low	40	30,8	72,22	33,33 – 100
Medium	62	47,7		
High	28	21,5		
Energy Adequacy Level				
Deficient	15	11,5	2249,95	1520,8 – 2988,5
Sufficient	57	43,8		
Excessive	58	44,6		
Protein Adequacy Level				
Deficient	38	29,2	71,60	31,30 – 845
Sufficient	28	21,5		
Excessive	64	49,2		
Fe Adequacy Level				
Deficient	57	43,8	12,85	4,1 – 32,8
Sufficient	73	56,2		
Vit. C Adequacy Level				
Deficient	68	52,3	55,4	1,1 – 609,8
Sufficient	62	47,7		
Vit. B12 Adequacy Level				
Deficient	6	4,6	21,7	0,1 – 84,44
Sufficient	124	95,4		
Tea Drinking Habits				
Often	46	35,4	9,46	0 – 86,5
Don't Often	84	64,6		
Nutritional Status				
Undernutrition	13	10		
Normal	96	73,8		
Overnutrition	21	16,2		

Determination of anemia is done by measuring hemoglobin levels, if the hemoglobin concentration in adolescent girls is <12 g/dl, then the female adolescents are included in the category of anemia. Based on table 2. above, it can be seen that the proportion of anemia in adolescent girls in SMK Pratama Mulya is 33.1%. According to WHO, the category of anemia problems in adolescent girls at SMK Pratama Mulya Karawang is included in the moderate category of public health problems. Anemia is considered a public health problem if the proportion is above 5% (WHO, 2008). The median value of hemoglobin levels in adolescent girls is 13.2 g/dl with the lowest hemoglobin level being 9.4 g/dl and the highest being 18 g/dl.

Knowledge is information about anemia and nutrients related to anemia. Knowledge of adolescent girls was measured using a questionnaire containing 27 questions about anemia. Based on table 2. above, it can be seen that the proportion of respondents' knowledge is more in the medium category (47.7%) than in the low category (21.5%) and in the high category (21.5%). The median value of the respondent's knowledge score is 72.22 with the smallest value of 33.33 and the largest value of 100. The results of the univariate analysis of each question indicate that many respondents answered correctly on the question items regarding the definition of anemia, the factors that cause anemia, signs and symptoms anemia, and the effects of anemia. Meanwhile, respondents still answered incorrectly on questions about foods that contain iron, the benefits of Vitamin C for iron absorption, and treatment of anemia.

Energy Adequacy Level is the average energy intake obtained from the respondent's food and beverage consumption compared to the RDA in percent. The respondent's energy intake was measured using the SQ-FFQ form for one month and then calculated using the Nutrisurvey application and then compared with the needs of young women based on the RDA. In table 2. above it can be seen that the proportion of energy adequacy levels in young women at SMK Pratama Mulya Karawang in the sufficient category (43.8%) is almost the same as the energy adequacy level in the excessive category (44.6%). Meanwhile, the energy adequacy level in the deficient category has the smallest proportion of 11.5%. The average energy intake of

respondents is around 2242 Kcal with a standard deviation of about 427 Kcal. When compared with the RDA for women aged 13-15 years and aged 16-18 years, the average energy intake of respondents is still above the RDA. This is because respondents often consume snacks, such as seblak, sausage, cilok, fish balls, basreng, and Cireng which contribute more calories so that the respondent's energy intake is higher when compared to the RDA.

Protein Adequacy Level is the average protein intake obtained from the respondent's food and beverage consumption compared to the RDA in percent. The respondent's protein intake was measured using the SQ-FFQ form for one month and then calculated by the Nutrisurvey application and then compared with the needs of young women based on the RDA. Based on table 2. above, it can be seen that the proportion of protein adequacy levels in adolescent girls at SMK Pratama Mulya Karawang is mostly included in the excessive category (49.2%). While the other 29.2% are included in the deficient category. The median value of protein intake in respondents was 71.4 grams of protein per day with the lowest intake of 31.3 grams and the highest of 113.2 grams per day. When compared with the RDA (65 grams per day), the respondents' protein intake was higher than the RDA for women aged 13-18 years. The respondents' protein intake, apart from being obtained from vegetable and animal side dishes, was also obtained from snacks that they often consumed, such as seblak snacks, fish balls, sausages, nuggets, and egg rolls. This resulted in the respondent's protein intake being more in the excess category.

Iron Adequacy Level is the average iron intake obtained from food consumed by respondents compared to the RDA in percent. The respondent's iron intake was measured using the SQ-FFQ form for one month and then calculated by the Nutrisurvey application and then compared with the needs of young women based on the RDA. Based on table 2. above shows that the proportion of respondents have a sufficient level of iron adequacy (56.2%). This is because most of the respondents often eat eggs every day. As is known that eggs are one of the foods that contain iron. In 100 grams of chicken eggs contain iron as much as 3 mg. The median value of the respondents' iron intake was 12.85 mg of iron per day with the lowest intake of 4.1 mg and the highest of 32.8 mg of iron per day. When compared with the RDA for women aged 13-18 years, the respondents' iron intake is still below the RDA, which is 15 mg of iron per day. This is because respondents rarely consume iron-rich foods such as liver and beef, so that respondents' iron intake is still below the RDA.

Vitamin C Adequacy Level is the average intake of Vitamin C obtained from everything consumed by respondents compared to the RDA in percent. Vitamin C intake of respondents was measured using the SQ-FFQ form for one month and then calculated using the Nutrisurvey application and then compared with the needs of young women based on the RDA. Based on Table 2. above, it can be concluded that the proportion of respondents with insufficient and sufficient levels of Vitamin C adequacy is almost the same, namely 52.3% and 47.7%, respectively. The median value of Vitamin C consumed by respondents was 55.4 mg of Vitamin C per day with the lowest intake of 1.1 mg and the maximum of 609.8 mg. When compared to the RDA, the daily requirement of Vitamin C for women aged 13-15 years is 65 mg and aged 16-18 years is 75 mg, the respondents' Vitamin C intake is still below the RDA. This is because most respondents rarely eat fruit, including fruits that contain Vitamin C. In addition, only a small proportion of respondents take Vitamin C supplements so that the respondents' Vitamin C intake is still below the RDA.

The level of Vitamin B12 Adequacy is the average intake of Vitamin B12 obtained from what respondents consume compared to the RDA in percent. Vitamin B12 intake of respondents was measured using the SQ-FFQ form for one month and then calculated using the Nutrisurvey application and then compared with the needs of young women based on the RDA. Based on Table 2. above, it can be concluded that most of the respondents have adequate levels of Vitamin B12 (95.4%). The median value of vitamin B12 intake of respondents per day was 21.7 mcg with the lowest intake of 0.1 mcg and the highest 84.44 mcg. When compared with the RDA, the need for Vitamin B12 in women aged 13-18 years is 4 mcg, so the respondents' Vitamin B12 intake has met the daily requirement based on the RDA. This is because respondents often consume sources of Vitamin B12 found in animal side dishes such as eggs, milk and other processed products.

Tea drinking habits were measured by the habit of consuming tea every day to see the tannin content in tea expressed in milligrams. Based on table 2. above, it can be concluded that the proportion of respondents is more in those who do not often drink tea (64.6%) than those who often drink tea (35.4%). The median value of tannin levels consumed by respondents was 9.46 mg with the lowest value being 0 mg or not

drinking tea at all and the highest being 86.5 mg.

Nutritional status was obtained by measuring the respondent's weight and height and then calculated using the WHO Antro Plus software using the BMI/A index. Based on table 2. above, it can be concluded that most of the respondents have good nutritional status (73.8%) while the other 16.2% have more nutritional status and 10% have less nutritional status. When compared with the prevalence of adolescents with poor nutritional status in West Java, the proportion of adolescents with less nutritional status is higher than the province of West Java, which is 4.68% (Kemenkes RI, 2018). While the proportion of adolescent nutrition is lower than the results of Riskesdas in West Java in 2018.

Bivariate Analysis Results

Tabel 3. Hasil Analisis Bivariat

Variabel	Anemia				Total		P Value	OR 95% CI
	Yes		No		N	%		
	n	%	n	%				
Knowledge								
Insufficient	32	31,4	70	68,6	102	100	0,574	
Good	11	39,3	17	60,7	28	100		
Energy Adequacy Level								
Deficient	10	66,7	5	33,3	15	100	0,007*	4,97
Sufficient	33	28,7	82	71,3	115	100		
Protein Adequacy Level								
Deficient	23	62,2	14	37,8	37	100	0,000*	5,99
Sufficient	20	21,5	73	78,5	93	100		
Iron Adequacy Level								
Deficient	37	64,9	20	35,1	57	100	0,000*	20,6
Sufficient	6	8,2	67	91,8	73	100		
Vit. C Adequacy Level								
Deficient	31	45,6	37	54,4	68	100	0,003*	3,49
Sufficient	12	19,4	50	80,6	62	100		
Vit. B12 Adequacy Level								
Deficient	2	33,3	4	66,7	6	100	1,000	
Sufficient	41	33,1	83	66,9	124	100		
Tea Drinking Habits								
Often	17	37,0	29	63,0	46	100	0,251	
Not Often	26	31,0	58	69,0	84	100		
Nutritional Status								
Undernutrition	3	23,1	10	76,9	13	100	0,543	
Good Nutrition	40	34,2	77	65,8	117	100		

Based on table 3. above, it can be seen that the proportion of anemia is more common in respondents with good knowledge (39.3%) compared to respondents who have insufficient knowledge (31.4%). The results of data analysis using the Chi Square test showed that there was no significant relationship between knowledge and the incidence of anemia in adolescent girls at SMK Pratama Mulya Karawang with p value = 0.574 (p value > 0.05).

The proportion of anemia was more found in respondents with deficient energy adequacy level (66.7%) compared to respondents with sufficient energy sufficiency level (28.7%). The results of the bivariate analysis using the Fisher's Exact Test showed that there was a significant relationship between the level of energy adequacy and the incidence of anemia in adolescent girls at SMK Pratama Mulya Karawang with p value = 0.007 (p value <0.05). Respondents with a level of energy sufficiency deficient, 5 times more at risk of experiencing anemia compared to respondents with a level of energy adequacy of sufficient-more (OR = 4.97).

The table above shows that the proportion of anemia is more in respondents with deficient protein adequacy level (62.2%) than in respondents with sufficient protein adequacy level (21.5%). The results of

the bivariate analysis using the Chi Square test showed that there was a significant relationship between the level of protein adequacy and the incidence of anemia in adolescent girls at SMK Pratama Mulya Karawang with p value = 0.000 (p value < 0.05). Respondents with a protein adequacy level deficient, 6 times more risk of experiencing anemia compared to respondents with a sufficient level of protein adequacy (OR = 5.99).

The proportion of anemia was more in respondents with a low level of iron adequacy (64.9%) compared to respondents with a sufficient level of iron adequacy (8.2%). The results of the bivariate analysis using the Chi Square test showed that there was a significant relationship between the level of iron adequacy and the incidence of anemia in adolescents at SMK Pratama Mulya Karawang with p value = 0.000 (p value < 0.05). Respondents with a insufficient level of iron deficiency were 20 times more likely to experience anemia than respondents with sufficient iron levels (OR = 20.6).

Based on the table above, it shows that the proportion of anemia is more in respondents with insufficient levels of Vitamin C (45.6%) than respondents with sufficient levels of Vitamin C (19.4%). The results of the bivariate analysis using the Chi Square test showed that there was a significant relationship between the level of vitamin C adequacy and the incidence of anemia in adolescent girls at SMK Pratama Mulya Karawang with p value = 0.003 (p value < 0.05). Respondents with adequate levels of Vitamin C less than 3.5 times more risk of experiencing anemia compared to respondents with sufficient levels of Vitamin C sufficient (OR = 3.49).

The proportion of respondents who experience anemia in respondents with insufficient levels of Vitamin B12 adequacy (33.3%) is almost the same as respondents with sufficient levels of Vitamin B12 sufficiency (33.1%). Most of the respondents with insufficient levels of Vitamin B12 did not experience anemia. The results of the bivariate analysis using the Fisher's Exact Test showed that there was no significant relationship between the level of vitamin B12 adequacy and the incidence of anemia in adolescents at SMK Pratama Mulya Karawang with p value = 1,000 (p value > 0.05). The table above shows that respondents who frequently drink tea do not experience anemia (63.0%) compared to those who experience anemia (37.0%). The results of the bivariate analysis using the Chi Square test showed that there was no significant relationship between tea drinking habits and the incidence of anemia in adolescent girls at SMK Pratama Mulya Karawang with p value = 0.251 (p value > 0.05). However, based on the cross tabulation table above, it can be seen that respondents who often drink tea have a tendency to experience anemia compared to respondents who rarely drink tea.

Most of the respondents with poor nutritional status did not experience anemia (76.9%). The proportion of respondents who have poor nutritional status and do not experience anemia is higher than respondents who have anemia (23.1%). The results of bivariate analysis using the Fisher's Exact Test showed that there was no significant relationship between nutritional status and the incidence of anemia in adolescent girls at SMK Pratama Mulya Karawang with p value = 0.543 (p value > 0.05).

DISCUSSION

Relation Between Knowledge with Anemia

Knowledge is information about anemia and nutrients that play a role in the occurrence of anemia. Knowledge of adolescent girls was measured using a questionnaire containing 27 questions about anemia. Based on the results of this study, it can be concluded that there is no significant relationship between knowledge and the incidence of anemia in adolescent girls at SMK Pratama Mulya Karawang ($p = 0.574$). This is because knowledge is not a direct cause of nutritional problems, one of which is anemia. There are direct factors that can cause anemia, one of which is nutrient intake. Thus, knowledge does not have a significant relationship with the occurrence of anemia in adolescent girls at SMK Pratama Mulya Karawang.

The results of this study are in line with research conducted by Suryani, et al in Bengkulu City which showed that there was no relationship between knowledge and the incidence of anemia. Although adolescents already have knowledge about anemia, they do not necessarily apply it in their daily lives (Suryani et al., 2015). This study also shows that respondents who have good knowledge about anemia can still experience anemia because they have not practiced what they know in their daily lives. So, they only know and do not have the awareness and concern to implement a healthy lifestyle to avoid anemia.

The results of this study are also in accordance with research by Agustina and Fridayanti (2017) which

concluded that there was no significant relationship between knowledge and the incidence of anemia with p value = 0.223 (Agustina & Fridayanti, 2017). However, this study is inversely proportional to the research conducted by Safitri and Maharani (2019) which showed that there was a relationship between knowledge and the incidence of anemia (p value = 0.035). Nutrition knowledge in adolescents is the result of knowing that is obtained by sensing. Knowledge of nutrition in adolescents will affect the perception of adolescents about nutrition. In addition, good nutritional knowledge can be used as a provision for teenagers to choose nutritious foods. Good adolescent knowledge allows adolescents to choose nutritious foods so as to avoid anemia (Safitri & Maharani, 2019).

Relation Energy Adequacy Level and Anemia

Based on this research shows that there is a significant relationship between the level of energy adequacy with the incidence of anemia in adolescents in SMK Pratama Mulya Karawang ($p = 0.000$). The results of statistical analysis showed that the value of OR = 4.97 which means that respondents with a level of energy sufficiency less than 5 times more at risk of experiencing anemia compared to respondents with a sufficient level of energy sufficiency and more. The results of this study are in line with research conducted by Junengsi and Yuliasari (2017) which showed that there was a relationship between energy intake and the incidence of anemia (p value = 0.001). The risk of anemia will be higher in those with less energy intake, which is influenced by purchasing power and food availability in the household. Energy intake is a determinant of a person's nutritional status, lack of energy will be at risk of experiencing various diseases, one of which is anemia (Junengsih & Yuliasari, 2017).

The food triguna describes the three functions of food, namely as a source of energy, building blocks, and regulator. Energy sources come from carbohydrates and fats. Proteins act as building blocks, while vitamins and minerals act as regulators. If the energy obtained from carbohydrates and fats is insufficient, then the protein reserves will be remodeled into energy, as a result, protein which is one of the components of hemoglobin cannot carry out its duties properly to transport oxygen in the blood so that it can cause anemia. Therefore, the level of energy sufficiency has a significant relationship with the incidence of anemia. However, this study is inversely proportional to the research by Restuti and Susindra in 2016 which showed that there was no relationship between energy intake and the incidence of anemia in adolescents with p value = 0.36 (Restuti & Susindra, 2016).

Relation Protein Adequacy Level and Anemia

Proteins are molecules consisting of amino acids that have important biological functions such as functioning as neurotransmitters, hormones and helping the growth and maintenance of the body. In addition, protein is also a component of hemoglobin which functions to transport oxygen (Wildman & Medeiros, 2014). Protein Adequacy Level is the average protein intake obtained from the respondent's food and beverage consumption compared to the RDA in percent. The respondent's protein intake was measured using the SQ-FFQ form for one month and then calculated by the Nutrisurvey application and then compared with the needs of young women based on the RDA. Based on this study concluded that there is a significant relationship between the level of protein adequacy with the incidence of anemia in adolescent girls in SMK Pratama Mulya Karawang ($p = 0.000$). The results of statistical analysis showed that the value of OR = 5.99 which indicates that respondents with a protein adequacy level of less than 6 times more at risk of experiencing anemia compared to respondents with a sufficient level of protein adequacy and more.

The results of this study are in line with research conducted by Farinendya et.al (2019) which stated that there was a significant relationship between the level of protein adequacy and the incidence of anemia in adolescents (p value = 0.031). Transport of iron for the formation of hemoglobin assisted by protein. If protein intake is less, it will result in impaired iron transport resulting in anemia (Farinendya et al., 2019). In this study, respondents with a low level of protein adequacy rarely consumed a variety of protein sources. Respondents only consumed one or two types of protein sources in insufficient amounts. So that both in terms of quality and quantity of protein have not been met and resulted in respondents lacking protein which over time will affect hemoglobin levels because protein is one of the molecules that make up hemoglobin. Low hemoglobin levels can cause anemia because oxygen transport in the tissues is disrupted.

The results of this study are in line with the theory that protein is a component of hemoglobin and also

plays a role in the absorption of iron in the body which is needed for the formation of hemoglobin. Protein deficiency can cause iron absorption to be inhibited so that the formation of hemoglobin is not optimal. As a result, the level of hemoglobin in the body becomes low so that this situation causes anemia. However, this study is inversely proportional to the results of a study conducted by Pratama et.al (2020) in Banjarmasin which stated that there was no relationship between protein intake and anemia in adolescent girls with a p value of 0.084 (Pratama et al., 2020).

Relation Iron Adequacy Level and Anemia

Iron is one of the most abundant micro-minerals in the body that functions as a carrier of oxygen from the lungs to be circulated to the tissues (Almatsier, 2010). The results of this study indicate that there is a significant relationship between the level of iron adequacy and the incidence of anemia in adolescent girls at SMK Pratama Mulya Karawang ($p = 0.000$). The results of statistical analysis showed that the OR = 20.6, which means that respondents with a sufficient level of iron deficiency were 20.6 times more at risk of developing anemia than respondents with a sufficient level of iron adequacy.

This study is in line with the results of research by Emilia (2019) which concluded that there was a significant relationship between iron intake and the incidence of anemia in adolescent girls (p value = 0.001). The lack of iron intake was caused by the respondents consuming less side dishes containing protein (Emilia, 2019). In this study, based on the results of food intake interviews using the SQ-FFQ form for a period of one month, it showed that respondents with a low level of iron adequacy rarely consumed animal protein foods as sources of iron such as liver and red meat. Respondents more often consume eggs which have lower iron content when compared to liver and beef. As a result, iron intake has not been able to meet the needs so that the level of iron adequacy becomes less.

Lack of iron intake causes iron stores in the body (ferritin) to be broken down in order to meet the iron needs for the formation of hemoglobin. However, if this situation continues, iron reserves in the body will be depleted. Inadequate intake of iron from food and iron reserves in the body that have been depleted cause the process of hemoglobin formation to be hampered, as a result, hemoglobin levels in the blood decrease and anemia occurs.

This study is also in accordance with the results of Junengsih and Yuliasari's study at SMU 98 East Jakarta which showed a relationship between iron intake and the incidence of anemia (p value = 0.001) (Junengsih & Yuliasari, 2017). However, this study is in contrast to the research of Permatasari et al (2020) which showed that there was no relationship between iron intake and the incidence of anemia in adolescent girls with p value = 0.28 (Permatasari et al., 2020).

Relation Vitamin C Adequacy Level and Anemia

Vitamin C plays a significant role in iron absorption, among others, it can increase iron absorption by helping to convert ferrous form of iron to ferrous form which is easier for the body to absorb than the ferrous form (Wildman & Medeiros, 2014). This study states that there is a significant relationship between the level of vitamin C adequacy and the incidence of anemia in adolescent girls at SMK Pratama Mulya Karawang ($p = 0.003$). The results of statistical analysis showed that respondents with an adequate level of Vitamin C was 3.5 times more at risk of experiencing anemia compared to respondents with sufficient levels of Vitamin C. This is evidenced by the value of OR = 3.49.

The results of this study are in line with research conducted by Chayu (2019) which showed that there was a relationship between Vitamin C intake and hemoglobin levels (p value = 0.001). Hemoglobin levels will be higher in respondents who have a high intake of Vitamin C (Chayu, 2019). In this study, respondents with sufficient levels of Vitamin C rarely consumed vegetables and fruits which are sources of Vitamin C. Respondents rarely consumed fruits that are sources of Vitamin C which have high Vitamin C content, such as oranges and guavas.

Vitamin C is one of the essential molecules needed to form erythrocytes in the body. Vitamin C can prevent the synthesis of hemosiderin which can bind iron needed by the body. In addition, Vitamin C can also help iron absorption by converting ferric iron into ferrous so that it is more easily absorbed in the small intestine. Absorption of non-heme iron will be more optimal if it is assisted by the presence of Vitamin C. Thus, adequate intake of Vitamin C can help the absorption of iron which can prevent anemia (Elba et al., 2021).

The results of this study are also in line with the results of Monica's (2019) study at SMAN Rambatan Tanah Datar Regency which showed that there was a significant relationship between Vitamin C intake and the incidence of anemia (p value = 0.000). Anemia is more common in respondents with insufficient Vitamin C intake (80.5%) compared to respondents with sufficient Vitamin C intake (11.1%) (Monica, 2019). However, this study is inversely proportional to the results conducted by Thamrin and Masnilawati (2021) who concluded that there was no relationship between vitamin C intake and the incidence of anemia (p value = 0.757) (Thamrin & Masnilawati, 2021).

Relation Vitamin B12 Adequacy Level and Anemia

This study concludes that there is no significant relationship between the level of vitamin B12 adequacy and the incidence of anemia in adolescent girls at SMK Pratama Mulya Karawang (p = 1,000). This is because in this study, respondents who had sufficient levels of Vitamin B12 and experienced anemia based on the results of the SQ-FFQ mostly had insufficient levels of iron, protein, and Vitamin C. So, even though the respondent's intake of Vitamin B12 is sufficient, they are still at risk of anemia because the intake of iron, protein, and Vitamin C affects the occurrence of anemia. In addition, in the formation of hemoglobin, Vitamin B12 plays a role in converting folate into an active form for hemoglobin synthesis, so that anemia can be caused by other factors such as folic acid which were not studied in this study.

The results of this study are also in line with the research conducted by Desriani and Tina (2018) which stated that there was no effect between the level of vitamin B12 intake and the incidence of anemia (p value = 0.211). Insufficient intake of Vitamin B12 is caused by a lack of consumption of food sources of Vitamin B12. Vitamin B12 along with folic acid plays a role in metabolic processes in the body, one of which is the formation of DNA. In addition, Vitamin B12 also functions to activate folic acid in the body, so vitamin B12 deficiency is also at risk for folic acid deficiency (Desriani & Tina, 2018). In this study, respondents with sufficient levels of Vitamin B12 rarely consumed food sources of Vitamin B12, such as milk, liver, kidneys, meat, fish, and shellfish. Most respondents only consume dairy products in the form of sweetened condensed milk.

This study is also in line with the results of a study conducted by Triyonate (2015) which said that there was no relationship between vitamin B12 intake and the incidence of anemia (p value = 0.122) (Triyonate, 2015). However, this study is inversely proportional to the research conducted by Saptyasih et al (2016) which stated that there was a relationship between Vitamin B12 intake and the incidence of anemia with p value = 0.000 (Saptyasih et al., 2016).

Relation Tea Drinking Habits and Anemia

Tea is a drink made from the young leaves of the tea plant which is brewed with hot water (Layuk & Layuk, 2018). Tea contains polyphenolic compounds called tannins (Wildman & Medeiros, 2014). Tea drinking habits were measured by the habit of consuming tea every day to see the tannin content in tea expressed in milligrams. This study concludes that there is no significant relationship between the habit of drinking tea with the incidence of anemia in adolescent girls at SMK Pratama Mulya Karawang (p value = 0.251). However, there is a tendency that respondents who frequently consume tea are more likely to experience anemia compared to respondents who do not consume tea often. This is because the measurement of tannin levels for the tea drinking habit variable in this study is not valid because it only looks at the tannin content based on the type of tea.

This study is in line with the results of research conducted by Utomo (2013) which states that there is no significant relationship between tea drinking habits and the incidence of anemia in adolescent girls (p value = 0.455) (Utomo, 2013). In this study, the measurement of tea drinking habits only used tannin levels based on the type of tea, namely black tea and green tea. In addition, the habit of drinking tea in this study did not pay attention to the time of consuming tea, whether it was after eating or before eating and only counted the amount of tea consumed. One of the limitations of this study is that it does not consider the thickness of the tea, the brewing temperature and the time of brewing the tea that affect the tannin levels in tea, so the possibility that there is no significant relationship between tea drinking habits can be caused by the results of measurements of tannin levels that are not valid, which is one of the reasons for this. shortcomings in this study.

The results of this study are also similar to those of Resmana (2015) which showed that there was no

relationship between tea drinking habits and the incidence of anemia (p value = 0.147). The habit of drinking tea after eating can be an inhibitor of iron absorption in the body. This is because tea contains tannins that can bind to iron in the gastrointestinal tract to form components that are difficult to absorb by the body (Resmana, 2015). As a result, the body lacks iron because iron is wasted with feces. Lack of iron in the body causes the formation of hemoglobin to be disrupted so that hemoglobin levels become low. This condition, if it persists, causes anemia. However, the results of this study are inversely proportional to the research conducted by Nababan (2016) which concluded that there was a relationship between tea drinking habits and the incidence of anemia (p value = 0.032) (Nababan & S, 2016).

Relation Nutritional Status and Anemia

Nutritional status is a description of a person's adequacy in consuming nutrients in the past and can be interpreted as the result of the accumulation of previous food consumption (Supariasa et al, 2002). Nutritional status was obtained by measuring the respondent's height and weight and then calculated using the WHO Antro Plus software using the BMI/U index. The results of this study concluded that there was no significant relationship between nutritional status and the incidence of anemia in adolescent girls at SMK Pratama Mulya Karawang ($p=0.543$). In this study, the proportion of respondents who experienced anemia was more common in respondents with good nutritional status and more than respondents with poor nutritional status. Respondents who have good nutritional status mostly have less intake of protein, iron, and vitamin C. So, even though they already have good nutritional status, respondents are still at risk of anemia because the intake of protein, iron, and vitamin C is less associated with anemia.

This study is in line with the research of Indartanti and Kartini (2014) which concluded that there was no significant relationship between nutritional status and the incidence of anemia in adolescent girls (p value = 0.289). Intake of macronutrients, such as protein, fat and carbohydrates more affects nutritional status based on the BMI/A (Indartanti & Kartini, 2014) index. In this study, more respondents were included in the good nutritional status (73.8%). Nutritional status describes a person's intake in the past. Intake is reflected in the nutritional status based on the BMI/A index, namely the intake of macronutrients, while anemia is a condition caused by a micronutrient deficiency, namely iron or often referred to as hidden hunger because the micronutrient deficiency cannot be seen. directly with nutritional status (fat/thin).

This study is also in line with the results of research by Sya'bani and Sumarmi (2016) which showed that there was no significant relationship between nutritional status and the incidence of anemia (p value = 0.44). Respondents with poor nutritional status are at risk of lack of iron reserves in the body (Sya'bani & Sumarmi, 2016). In this study, the proportion of respondents who experienced anemia was higher in respondents with good nutritional status and more than respondents with poor nutritional status. This is because the food intake of respondents with good nutritional status is not necessarily diverse so that it cannot meet the nutritional needs, especially micronutrients. Respondents in this study consumed more food sources of carbohydrates, protein and fat. While most of the respondents rarely eat vegetables and fruits which are sources of micronutrients. Although the source of iron comes from animal foods which are also a source of protein, the absorption of iron in the body requires Vitamin C which is abundant in vegetables and fruits. So, even though the intake is good, it does not guarantee the variety of foods needed by the body can be met.

This study is also in line with research conducted by Adiyani et al (2018) which concluded that there was no significant relationship between nutritional status and the incidence of anemia (p value = 1,000). Nutritional status based on BMI/A index is not influenced by micronutrient intake because the energy content of micronutrients is very small (Adiyani et al., 2018). However, this study is in contrast to research conducted by Triwinarni et al (2017) which states that there is a relationship between nutritional status based on BMI/A with the incidence of anemia in high school students. Underweight teens are 1.5 times more likely to develop anemia (Triwinarni et al., 2017).

CONCLUSION

The results of this study indicate that there is a significant relationship between the level of energy adequacy, the level of protein adequacy, the level of adequacy of vitamin C and the level of adequacy of Iron with the incidence of anemia in adolescent girls at SMK Pratama Mulya Karawang. The level of nutritional adequacy can be met by eating a variety of foods in accordance with the principles of balanced

nutrition. Therefore, it is very important to fulfill nutritional needs by eating a variety of foods to prevent anemia in young women.

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REFERENCE

- Adiyani, K., Heriyani, F., & Rosida, L. 2018. Hubungan Status Gizi Dengan Kejadian Anemia Pada Remaja Putri Di Sma PGRI 4 Banjarmasin. *Homeostasis*, 1(1):1–7.
- Agustina, E. E., & Fridayanti, W. 2017. Determinan Risiko Kejadian Anemia pada Remaja Putri berdasarkan Jenjang Pendidikan di Kabupaten Kebumen. *Jurnal Ilmiah Kebidanan*, 8(1):57–70.
- Agustina, R., Nadiya, K., El Andini, A., Setianingsih, A. A., Sadariskar, A. A., Prafiyanti, E., Wirawan, F., Karyadi, E., & Raut, M. K. 2020. Associations Of Meal Patterning, Dietary Quality And Diversity With Anemia And Overweight-Obesity Among Indonesian Schoolgoing Adolescent Girls In West Java. *PLoS ONE*, 15(4):1–19. <https://doi.org/10.1371/journal.pone.0231519>
- Amalia, A., & Tjiptaningrum, A. 2016. Diagnosis dan Tatalaksana Anemia Defisiensi Besi Diagnosis and Management of Iron Deficiency Anemia. *Majority*, 5(5): 1–4.
- Chayu, A. I. D. 2019. Hubungan Asupan Vitamin C, Vitamin B12, Asam Folat dengan Kadar Hb Remaja Putri Kelas VIII di SMP Negeri 3 Lubuk Pakam. Politeknik Kesehatan Medan.
- Desriani, P., & Tina, L. 2018. Pengaruh Tingkat Asupan Zat Besi, Vitamin B12 Dan Asam Folat Terhadap Kejadian Anemia Pada Wanita Usia Subur Di Wilayah Kerja Puskesmas Abeli Kota Kendari Tahun 2017. *Jurnal Ilmiah Mahasiswa Kesehatan Masyarakat*, 3(4).
- Elba, F., Daryanti, E., Gumilang, L., & Nurjannah, T. A. 2021. Correlation Between Consumption of Protein and Vitamin C Among Children Aged 12-24 Months with Anemia in the South Sumedang District. *KnE Life Sciences*, 2021, 220–227. <https://doi.org/10.18502/cls.v6i1.8606>
- Emilia. 2019. Hubungan Asupan Zat Besi dengan Status Anemia pada Santri Putridi Pondok Pesantren Hidayatussalikin Air Itam Kota Pangkalpinang Tahun 2017 The Relationship between Iron Intake and Anemia on Female Students At Hidayatussalikin Islamic Boarding School in Air. *Jurnal Kesehatan Poltekkes Kemenkes RI Pangkalpinang*, 7(2): 64–69.
- Engidaw, M. T., Wassie, M. M., & Teferra, A. S. 2018. Anemia and associated factors among adolescent girls living in Aw-Barre refugee camp, Somali regional state, Southeast Ethiopia. *PLoS ONE*, 13(10): 1–12. <https://doi.org/10.1371/journal.pone.0205381>
- Farinendya, A., Muniroh, L., & Buanasita, A. 2019. Hubungan Tingkat Kecukupan Zat Gizi Dan Siklus Menstruasi Dengan Anemia Pada Remaja Putri The Correlation of Nutrition Adequacy Level and Menstrual Cycle with Anemia Among Adolescent Girls. *Amerta Nutrition*, 3(4): 298–304. <https://doi.org/10.2473/amnt.v3i4.2019>.
- Gebreyesus, S. H., Endris, B. S., Beyene, G. T., Farah, A. M., Elias, F., & Bekele, H. N. 2019. Anaemia among adolescent girls in three districts in Ethiopia. *BMC Public Health*, 19(1): 1–11. <https://doi.org/10.1186/s12889-019-6422-0>
- Indartanti, D., & Kartini, A. 2014. Hubungan Status Gizi dengan Kejadian Anemia pada Remaja Putri. *Journal of Nutrition College*, 3(2): 33–39.
- Junengsih, & Yuliasari. 2017. Hubungan Asupan Zat Besi Dengan Kejadian Anemia Pada Remaja Putri Smu 98 Di Jakarta Timur. *Jurnal Ilmu Dan Teknologi Kesehatan*, 5(1): 55–65. <https://doi.org/10.32668/jitek.v5i1.68>
- Kaimudin, N., Lestari, H., & Afa, J. 2017. Skrining Dan Determinan Kejadian Anemia Pada Remaja Putri Sma Negeri 3 Kendari Tahun 2017. *Jurnal Ilmiah Mahasiswa Kesehatan Masyarakat Unsyiah*, 2(6): 1–10.
- Kemenkes RI. 2013. Laporan Nasional Riset Kesehatan Dasar. In *Kementerian Kesehatan RI*. <https://doi.org/10.1517/13543784.7.5.803>
- Kemenkes RI. 2018. *Risikedas Laporan Provinsi Jawa Barat*.
- Kemenkes RI. 2019. Profil Kesehatan Indonesia Tahun 2019. In *Kementerian Kesehatan Republik Indonesia*

(Vol. 42, Issue 4).

- Layuk, P., & Layuk, S. 2018. Komponen Bioaktif dalam Teh dan Manfaat untuk Kesehatan. *Balai Besar Pengkajian Dan Pengembangan Teknologi Pertanian*, 226–234.
- Masrizal. 2007. Anemia defisiensi besi. *Jurnal Kesehatan Masyarakat*, II(1): 140–145.
- Monica, D. 2019. *Faktor-Faktor Yang Berhubungan Dengan Kejadian Anemia Pada Remaja Putri Kelas XI di SMA N 1 Rambatan Kabupaten Tanah Datar Tahun 2019 TAHUN 2019*. Politeknik Kesehatan Kemenkes Padang.
- Nababan, L., & S, N. W. 2016. Hubungan Minum Teh Mahasiswi Kebidanan dengan Kejadian Anemia pada Mahasiswi Kebidanan Akademi Kesehatan Sapta Bakti Bengkulu. *Jurnal Kebidanan Besurek*, 1(2): 167–171.
- Permatasari, T., Briawan, D., & Madanijah, S. 2020. Hubungan Asupan Zat Besi Dengan Status Anemia. *PREPOTIF Jurnal Kesehatan Masyarakat*, 4.
- Pratama, F. N., Noor, M. S., & Heriyani, F. 2020. Hubungan Asupan Protein Dan Zat Besi Dengan Kejadian Anemia Pada Remaja Putri Di Smpn 18 Banjarmasin. *Homeostasis*, 3(1): 43–48.
- Resmana, R. 2015. Hubungan Tingkat Konsumsi Makanan dan Kebiasaan Minum Teh dengan Kejadian Anemia Defisiensi Zat Besi pada Ibu Hamil. *Healthy Journal*, III(1): 9–19.
- Restuti, A. N., & Susindra, Y. 2016. Hubungan antara Asupan Zat Gizi dan Status Gizi dengan Kejadian Anemia pada Remaja Putri di SMK Mahfilud Durror II Jelbuk. *Seminar Hasil Penelitian Dan Pengabdian Masyarakat Dana BOPTN Tahun 2016*, 74–80.
- Safitri, & Maharani, S. 2019. Hubungan Pengetahuan Gizi Terhadap Kejadian Anemia pada Remaja Putri di SMP Negeri 13 Kota Jambi. *Jurnal Akademika Baiturrahim*, 8(2): 261–266.
- Saptyasih, A. R. N., Widajanti, L., & Nugraheni, S. A. 2016. Hubungan Asupan Zat Besi, Asam Folat, Vitamin B12, dan Vitamin C dengan Kadar Hemoglobin Siswa di SMP Negeri 2 Tawangharjo Kabupaten Grobogan. *Jurnal Kesehatan Masyarakat*, 4(4): 521–528.
- Simanjuntak, J. 2018. Hubungan Kadar Hemoglobin Pada Remaja Putri Dengan Hasil Belajar Di Mts Assalam Wilayah Kerjapuskesmas Rimbo Bujang Ii Tahun 2018. *Scientia Journal*, 7(2): 61–66.
- Suni, S. R. 2016. Hubungan Kebiasaan Minum Teh dan Pengetahuan Gizi dengan Kadar Hemoglobin pada Siswi di SMK Negeri 1 Sukoharjo Kabupaten Sukoharjo [Universitas Muhammadiyah Surakarta]. In *Publikasi Karya Ilmiah*. http://eprints.ums.ac.id/46035/19/Naskah_Publikasi.pdf
- Suryani, D., Hafiani, R., & Junita, R. 2015. Analisis Pola Makan Dan Anemia Gizi Besi Pada Remaja Putri Kota Bengkulu. *Jurnal Kesehatan Masyarakat Andalas*, 10(1): 11–18. <https://doi.org/10.24893/jkma.v10i1.157>
- Sya'bani, I. R. N., & Sumarmi, S. 2016. Hubungan Status Gizi dengan Kejadian Anemia pada Santriwati di Pondok Pesantren Darul Ulum Peterongan Jombang. *Jurnal Keperawatan Muhammadiyah*, 1(1).
- Thamrin, H., & Masnilawati, A. 2021. Hubungan antara Pengetahuan, Tingkat Konsumsi Protein, Zat Besi, dan Vitamin C dengan Kadar Hemoglobin pada Mahasiswi Kebidanan. *Jurnal Penelitian Kesehatan Suara Forikes*, 12(April): 30–33.
- Triwinarni, C., Ninuk, T., Hartini, S., & Susilo, J. 2017. Hubungan Status Gizi dengan Kejadian Anemia Gizi Besi (AGB) pada Siswi SMA di Kecamatan Pakem. *Jurnal Nutrisia*, 19(1): 61–67.
- Triyonate, E. M. 2015. *Faktor Determinan Anemia pada Wanita Dewasa Usia 23-35 Tahun*. Universitas Diponegoro.
- Utomo, G. D. P. 2013. Hubungan Antara Asupan Protein, Vitamin C, dan Kebiasaan Minum Teh dengan Kejadian Anemia Pada Remaja Putri di SMA Negeri 1 Mojolaban, Kabupaten Sukoharjo Jawa Tengah. In *Universitas Muhammadiyah Surakarta*. Universitas Muhammadiyah Surakarta.
- WHO. 2008. *Worldwide prevalence of anaemia 1993-2005* (B. de Benoist, E. McLean, & M. Cogswell (eds.)). http://whqlibdoc.who.int/publications/2008/9789241596657_eng.pdf
- WHO. 2011. Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. *Geneva, Switzerland: World Health Organization*, 1–6. <https://doi.org/2011>
- WHO. 2015. The global prevalence of anaemia in 2011. In *Who*. www.who.int
- Wildman, R. E. C., & Medeiros, D. M. 2014. Advanced Human Nutrition. In *Advanced Human Nutrition* (fourth edi). Jones & Bartlett Learning. <https://doi.org/10.1201/b16554>