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Multi Micronutrient Supplement (MMS) Is Effective In Increasing Ferritin Levels In Female Adolescents In Gianyar Regency, Bali Province

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Abstract

Based on Riskesdas, 2018 shows that the prevalence of anemia in women of childbearing age (WUS) in Indonesia is 23.7% with anemia sufferers aged 5-14 years of 26.8%, anemia sufferers aged 15-24 years of 32.0%, anemia sufferers aged 25- 34 years of 15.1% and anemia sufferers aged 35-44 years of 16.7%. The prevalence of anemia in women of childbearing age (WUS) in Bali based on the 2013 Riskesdas results was 10.8 % . The World Health Organization (WHO) targets to reduce anemia by 50 percent by 2025 in women of reproductive age (WUS) aged 15-49 years. In Bali, research on the prevalence of anemia in adolescents, to the best of the knowledge of the authors, is still very minimal. According to the results of the study showed that 11.4 % of subjects experienced anemia. Subjects with energy and protein intake were in the less category, namely 37.1 % and 50%. The subject's intake of vitamins and micronutrients was still lacking, namely vitamin B2 of 72.9%, zinc 68.6%, iron 92.9%, and folic acid 90% and most of the subjects (68.6%) intake of vitamin C was included in the category good. This research is an epidemiological study of community nutrition conducted in Gianyar Regency, Bali Province from the first year from March to October 2021 and the second year from March to October 2022. The first year research method used a community trial with a Cross Sectional design with a sample size of 168 samples. The second year with a different subject design with a sample size of 86 samples consisting of 43 control groups and 43 treatment groups. Giving iron folate is effective in increasing hemoglobin levels and giving Multi Micronutrient Supplement (MMS) is effective in increasing ferritin levels in female adolescents in Gianyar Regency, Bali Province.

Keywords: Hb Levels; Ferritin Levels; Consumption Of Nutrients; Teenage Girl

INTRODUCTION

Anemia is a condition where the number of red blood cells or the amount of hemoglobin is below the reference standard value (FAO/WHO. 2002) . Hemoglobin is a protein compound that plays an important role in carrying oxygen throughout the body. One of the most common causes of anemia is iron deficiency, which is estimated to account for around 50% of all cases of anemia (Georgieff MK. 2020) . The condition of anemia caused by a lack of iron intake is often known as iron nutritional anemia. Anemia can occur at all phases of the life cycle. One of the groups at high risk for anemia is the adolescent group (age 10-19 years). Adolescence is a period of accelerated growth and development which causes an increase in the need for iron in the body. In young women, iron is also needed to replace iron during menstruation. In addition, early marriage and teenage pregnancy are other factors that increase the risk of anemia, especially in young women.

Based on research conducted by Rossita Denistikasari in 2016 it was found that most of the female students with insufficient intake of iron (Fe) and experienced anemia were 22 female students (84.6%) and female students with good iron intake and experienced anemia were 5 female students (41, 7%). Based on the results that have been tested, it is known that there is a relationship between intake of iron (Fe) and the incidence of anemia and there is a relationship between intake of iron (Fe) and the incidence of anemia in female students of SMK Bina Dhirgantara Karanganyar Flight (Denistikasari, 2016). To determine the effectiveness of giving iron folate and *Multi Micronutrient Supplement* (MMS) on hemoglobin levels and ferritin *levels* in female adolescents in Gianyar Regency, Bali Province.

RESEARCH METHODS

In the early stages of this research, this type of research will be carried out using an *observational* study with a *cross-sectional research design* , where the measurement of ferritin levels as the dependent variable is measured at the same time as the consumption of micronutrients as the independent variable. The next stage of research is planned to use research experimentation l with a different subject design (Pocock, 2008). This design is a parallel design , there are 2 sample groups, namely the Control Group and the Treatment Group. This research was conducted at high schools throughout Gianyar Regency in the Province of Bali in March - October 2022 with some considerations of the trend of nutritional problems from the PSG data for 2015-2017 found that the prevalence of stunting in Gianyar Regency had increased in 2017. The data is available in 2015 (15.8) , 2016 (13.6) and 2017 (22.5) while there is no data on anemia in adolescents. The population is female students in high schools throughout Gianyar Regency in the Province of Bali**.** The sample is part of the population, namely female high school students in all Gianyar districts in the province of Bali. The sample inclusion criteria were determined as follows: Status of female high school students who were selected as samples , aged 15-19 years, physically and mentally healthy, willing to become research subjects as evidenced by filling out *informed consent.* Exclusion criteria in this study were as follows: Not present at the beginning of the study, Suffering from illness during the study, Menstruating at the time of data collection, For some reason withdrew as a sample. Based on the above calculations, the minimum sample size in this study was 86 people. The sample was divided into two groups, namely the treatment group and the control group. The sampling technique in this study used a *non-probability random sampling technique* with *purposive sampling* . *Purposive sampling* is a sampling technique by selecting a sample from among the population according to what the researcher wants based on the objectives or problems in the study so that the sample can represent the characteristics of the population. The selected sample is female students who have Hb levels or ferritin levels less than normal/standard.

RESULTS AND DISCUSSION

Results

The sample in this study were high school students in the Gianyar District and high school students in Payangan District, Gianyar Regency. The sample in this study was selected female students of SMAN 1 Gianyar and female students of SMAN 1 Payangan as much as 86 person. When grouped by age most of the girls were 16 years old (44.2%), 17 years old 39.5%, 15 years old (11.6%), 18 years old (4.7%) in the control group. The treatment group was mostly 16 years old (55.8%), 15 years old 32.6%, 18 years old (9.3%), 17 years old (2.3%). For more details, it can be seen in table 1 below this.

Table 1
Sample Age Distribution

Age (Year)	Control		Treatment	
	n	%	n	%
15	5	11,6	14	32,6
16	19	44,2	24	55,8
17	17	39.5	1	2,3
18	2	4,7	4	9,3
	43	100	43	100

The average hemoglobin level in the control group was 12.67 mg/dl with a minimum value of 8.6 mg/dl and the highest was 15.1 mg/dl. After the intervention, the results were 12.96 mg/dl with a minimum value of 11.0 mg/dl and the highest was 15.1 mg/dl. The average hemoglobin level in the treatment group was 12.81 mg/dl with a minimum value of 10.3 mg/dl and the highest was 15.2 mg/dl. After the intervention, the results were 12.84 mg/dl with a minimum value of 11.0 mg/dl and the highest was 15.2 mg/dl

Table 2
Hb Levels Sample

Hb levels	Control				Treatment			
	Before		After		Before		After	
	n	%	n	%	n	%	n	%
Anemia	15	34,9	10	23,3	11	25,6	10	23,3
Not Anemia	28	65,1	33	76,7	32	76,7	33	76,7
	43	100	43	100	43	100	43	100

The results of statistical analysis using the *paired sample t test* in the control group showed a p> 0.05 meaning that there was no difference in Hb levels before and after the intervention in the control group. The same results were obtained in the treatment group where p> 0.05, which means that there was no difference in Hb levels before and after the intervention in the treatment group.

When viewed from the sample ferritin levels, the data obtained was that in the control group the lowest ferritin level was 2.6 µg/l and the highest was 173.6 µg/l with an average of 50.6 µg/l . Before the intervention in the control group the sample had a low ferritin level of 30.2 % and after the intervention it became 23.3%. Meanwhile, the samples with normal ferritin levels before the intervention were 69.8 % and after the intervention it was 76.7%. The sample ferritin content obtained from the data was that in the treatment group the lowest ferritin level was 6.4 µg/l and the highest was 375.2 µg/l with an average of 70.344 µg/l . Before the intervention in the sample treatment group, the ferritin level was low as much as 23.3 % and after the intervention it became 4.7%. Meanwhile, samples with normal ferritin levels before the intervention were 76.7 % and after the intervention it was 95.3%.

Table 3
Distribution of Sample Ferritin Levels

Ferritin levels	Control				Treatment			
	Before		After		Before		After	
	n	%	n	%	n	%	n	%
Low	13	30,2	10	23,3	10	23,3	2	4,7
Normal	30	69.8	33	76,7	33	76,7	41	95.3
	43	100	43	100	43	100	43	100

The results of statistical analysis using the *paired sample t test* in the control group showed p> 0.05, meaning that there was no difference in ferritin levels before and after the intervention in the control group. Whereas in the treatment group the same results were obtained where p> 0.05, which means there was no difference in ferritin levels before and after the intervention in the treatment group.

Measurement of nutrient consumption in the control group was seen from the consumption of macronutrients and micronutrients (Vitamin C, Folic acid, Zinc and Iron). The measurement results show that the average energy consumption of the sample is 1024.40 Kcal , where the lowest value is 308.20 Kcal and the highest is 2164.5 Kcal while the average consumption of protein is 38.99 Kcal and the average fat is 45.06 Kcal. While the average consumption of micronutrients, namely Vitamin C 23.79 mg, Folic acid 72.20 mg, Zinc 4.33 mg and Iron 11.22 mg .

Measuring the consumption of sample nutrients in the treatment group was seen from the consumption of macronutrients and micronutrients (Vitamin C, Folic acid, Zinc and Iron). The measurement results show that the average energy consumption of the sample is 1004.39 Kcal, where the lowest value is 226.20 Kcal and the highest is 2297.60 Kcal while the average consumption of protein is 35.07 grams and the average fat is 33.66 grams. While the average consumption of micronutrients, namely Vitamin C 27.34 mg, Folic acid 90.84 mg, Zinc 4.33 mg and Iron 3.54 mg. For clarity, the data can be seen in table 14

Table 4
Consumption of Sample Nutrients

Nutritional Substances	Control			Treatment		
	Min	max	Average	Min	max	Average
Energy	308,20	2164.50	1024,40	226,20	2297,60	1004,39
Proteins	8.40	79.90	38.99	10.70	70,80	35.07
Fat	5.00	403.60	45.06	6.00	88,80	33,66
KH	10.00	1330.00	154.85	31.70	269.30	137.55
Folic acid	3.60	215.90	72,20	12.80	494.60	90.84
VitC	20.00	124.90	23.79	17.00	163.30	27,34
Iron	2.90	231.00	11,22	1.60	11.00	3.54
Zinc	1.90	9.60	4,33	1.40	11.60	4,33

Discussion

In general, the purpose of this study was to determine differences in the administration of iron folate and *Multi-Miconutrient Supplement* t (MMS) on hemoglobin levels and ferritin *levels* in female adolescents in Gianyar Regency, Bali Province. In order to achieve this goal, there are several specific objectives, namely determining Hb levels in female adolescents before and after receiving iron folate, determining Ferritin levels in female adolescents before and after receiving *Multi Micronutrient Supplement* (MMS), determining the consumption of micronutrients in female adolescents who receive iron. folate and *Multi Micronutrient Supplement* (MMS), analyze differences in Hb levels in female adolescents before and after receiving iron folate, analyze differences in Ferritin levels in female adolescents before and after receiving *Multi Micronutrient Supplement* (MMS) and determine the effectiveness of iron folate and *Multi Micronutrient Supplement* (MMS) on hemoglobin levels and *ferritin levels* in female adolescents in Gianyar Regency, Bali Province.

MMS is a multi-micronutrient supplement whose formula contains 15 vitamins and minerals including Vitamins A, C, D, E, B1 (thiamine), B2 (riboflavin), B3 (niacin), B6, B12 and folic acid and Fe (iron). necessary for pregnant women during pregnancy. MMS is intended as a substitute for iron supplement tablets (blood supplement tablets only contain iron and folic acid). MMS contains 30 mg of iron (instead of 60 mg) for the following reasons: Iron absorption in multi-micronutrient supplement formulations is increased (compared to TTD) due to the addition of vitamin C, vitamin

A, and riboflavin, Lower iron content the dose is sufficient when taken regularly, because it can reduce side effects (eg, constipation). The addition of 60 mg of iron needs to be accompanied by at least 30 mg of zinc to avoid possible negative effects on iron absorption. The addition of iron can increase the total amount of metals, which may increase negative side effects. Almost all pregnant women experience mild or moderate anemia, which can be treated with 30 mg of iron.

The results showed that the prevalence of anemia in the control group before the intervention (given iron folate) was quite high , namely 34.9 % , while after the intervention it became 23.3%. These data indicate a decrease in the prevalence of anemia in the control group by 11.6 % . In the treatment group (given *Multi Micronutrient Supplement* (MMS) before the intervention 25.6 % and after the intervention decreased to 23.3%. Data in the treatment group showed that the administration of MMS reduced the prevalence of anemia by 2.3 % . This figure indicated that giving acid folate has been able to reduce the prevalence of anemia in young women in Gianyar Regency.The results of statistical analysis using the *paired sample t test* in the control group showed a result of p> 0.05 meaning that there was no difference in Hb levels before and after intervention in the control group.The same results were obtained in the treatment group where p> 0.05, which means there is no difference in Hb levels before and after the intervention in the treatment group

This shows a lower number than the research of Lukman Dwi Priyanto (2018) who found the incidence of anemia was 83.90% in female students with Madrasah Tsanawiyah education (MTs). There is no significant relationship between age, level of education and physical activity with the incidence of anemia in female students at the Poskestren Pondok Pesantren X Surabaya (Priyanto, 2018). This study also showed that there was a relationship between the age of the sample and the occurrence of anemia (p< 0.05) where the samples aged 16 and 17 experienced anemia.

The low ferritin level (<30 µg/ml) in the control group, before being given iron folate was 30.2 % of the samples and after being given iron folate the samples were in the low category (<30 µg/ml) to 23.3%. These data indicate a decrease in the number of samples with low ferritin levels of 6.9 % . Whereas in the treatment group before being given the *Multi Micronutrient Supplement* (MMS) the sample had low ferritin levels (<30 µg/ml) of 23.3% and after being given *the Multi Micronutrient Supplement* (MMS) it became 4.7%. In the treatment group there was a decrease in samples with low ferritin levels by 18.6 % . The results of statistical analysis using the *paired sample t test* in the control group showed p> 0.05, meaning that there was no difference in ferritin levels before and after the intervention in the control group. Whereas in the treatment group the same results were obtained where p> 0.05, which means there was no difference in ferritin levels before and after the intervention in the treatment group.

After statistical tests, it was found that there was no relationship between the incidence of anemia and ferritin levels in the samples. This is in accordance with Norashikin's study, 2006 with a study sample of 92 people where there was no relationship between hemoglobin levels and ferritin levels in blood donors in Malaysia ($r^2 = 0.05$) with an average serum ferritin level in the sample of 62.0 µg /l and an average Hb of 14.9

Energy is needed by teenagers for the body's metabolic processes. Lack of intake of energy nutrients is probably caused by the amount of intake that is less on part teenager Princess. dense activity school and no offset with adequate food intake. Consumption of nutrients, especially energy, showed low results, namely the average sample energy consumption was 59.1 % . This is the same as Agustina's research, 2018 that there is a significant relationship between the intake of energy nutrients, protein, iron, and menstrual patterns with the incidence of anemia in young women. Multivariate logistic regression analysis showed that the variable that most influenced the incidence of anemia in female adolescents was nutrient intake proteins.

Protein functions as a builder, regulator and fuel for the body's metabolism. Protein is a provider of amino acids which are components of all cells in the body. Transferrin and ferritin are types of

proteins that help transport and store iron. Lack of protein intake can result in low levels of hemoglobin which is a bond between globin and heme proteins. Low protein consumption can be caused because protein consumption is dominated by plant protein rather than animal protein, which should be balanced. Protein is used for the growth process and as an energy reserve if energy intake is lacking. Protein consumption is quite good even though it is still below 100%, namely 80.4% , while fat is quite low, namely 56.4%.

Consumption of macronutrients, especially iron, showed a very low sample consumption average of 55%, Vitamin C 39.2%, folic acid 31.7%. Iron is the main component of hemoglobin which functions to synthesize hemoglobin. Excess iron in the form of the protein ferritin is stored in the liver, bone marrow, spleen and muscles. An imbalance will occur if the iron stores are not sufficient for the formation of red blood cells, resulting in decreased serum ferritin and iron deficiency anemia occurs. Iron has an important role in the body, including helping hemoglobin to transport oxygen and helping various enzymes bind oxygen for the body's combustion/metabolic processes. The need for iron in adolescents increases from before adolescence by 0.7-0.9 mg Fe/day to 2.2 mg Fe/day, during heavy menstruation the need for Fe increases, the iron requirement for adolescents is 26 mg/day. The lack of iron intake, which mostly occurs in young girls, can be caused by the fact that most of the respondents did not consume Fe supplements because there was no distribution of blood-adding tablets from schools during the pandemic. Low knowledge about anemia can be a factor that might cause a lack of intake of nutrients with low iron content. Different results were shown in Adhisti's research (2011) in Agustina (2018) regarding the relationship between anthropometric status and nutritional intake with Hb and ferritin levels in female adolescents with the result that there was no significant relationship between nutritional intake and Hb levels and ferritin levels. Very low iron consumption causes anemia in young women in Gianyar Regency, Bali Province. If you look at the consumption of iron, it is quite good, although it is still below 100%, namely 74.25 % . The results of data collection regarding consumption did not differ much from several studies, as this was in line with Ghassani Putri's research, 2016 showing that there was no significant effect between intake of protein, iron, and vitamin C on serum ferritin levels ($p > 0.05$) in the category normal nutritional status. Iron intake was significantly and positively correlated with serum ferritin ($p< 0.05$) in overweight nutritional status. Based on the results of observations on 149 young women at SMPN 9 Cimahi, it was found that protein intake was insufficient by 43.6% and vitamin C intake was insufficient by 42.3%. Intake data was obtained using a questionnaire and Semi Quantitative Food frequency Questionnaire (SQ-FFQ) table (Susilowati, et al, 2018). Of the 71 students with an age range of 16-18 years who were observed at SMK Mahfilud Duror II, 50 people (70.4%) had a deficit protein intake and 68 people (95.8%) had a deficit of vitamin C intake. Intake data was obtained through the interview method and 2 x 24 hour food recall calculations. From the results of the recall interview it is known that female students at SMK Mahfilud Durror II often consume sweet tea and consume junk food almost every day in the form of sausages. (Restuti & Susindra, 2016) . Of the 70 young women who were observed at SMA Negeri 2 Purwokerto aged 15-17 years, it was found that 42 people (60%) had insufficient protein intake and 62 people (88.6%) had insufficient vitamin C intake. Intake data was obtained from an open questionnaire in the form of a food recall form (Sari, et al, 2016). The results of observations of 44 class X students at SMAN 4 Surabaya It was found that 13 people (59.1%) had insufficient protein intake and 19 people (86.3%) had insufficient vitamin C intake. The level of consumption is measured by food recall 2x24 hours with non-consecutive days (weekends and weekdays) (Sholihah, et al, 2019). In 202 students at SMP Negeri 22 Jambi City, it was found that 199 students (98.5%) had insufficient protein intake and 163 students (80.7%) ate less frequently. Intake data was obtained from a questionnaire (Isati & Hastono, 2016). Of the 100 young women observed at Pancur Batu Junior High School, Deli Serdang Regency, it was found that protein intake was insufficient by 44% and

vitamin C intake was insufficient by 85%. Intake data was obtained from an open questionnaire in the form of a 24-hour food recall form. The results of the recall interview revealed that female students at Pancur Batu Junior High School, Deli Serdang Regency, often ate rice as a staple food, animal dishes such as eggs and fish. The vegetable side dish that is often consumed is tempeh . The most consumed fruits are oranges and bananas. As well as frequently consuming meatballs, chicken noodles, fried foods, and donuts (Gultom, et al, 2020). The results of the 76 female students observed at SMK Negeri 1 Manggis revealed that 34 students (44.7%) had insufficient protein intake and 41 students (53.9%) had insufficient vitamin C intake. The frequency of eating less than three times a day was 23 people (30.3 %). Intake data was obtained using a questionnaire and the Semi Quantitative Food frequency Questionnaire (SQ-FFQ) table (Sari, 2018).

A recent Cochrane review, published in March 2019, found some advantages of multiple micronutrient supplements compared to iron and folic acid supplements alone. These advantages include: Reducing the number of babies born weighing < 2500 grams, Reducing the number of small babies based on gestational mass, Reducing the number of babies born at gestational age < 37 weeks. Nevertheless, multiple supplements were not found to provide any benefits or risks to maternal and infant mortality, anemia in third trimester pregnant women, abortion , the need for cesarean section , and congenital anomalies. Micronutrient supplementation is relatively safe for consumption because it has almost no side effects. Although Sudfelt, *et al* are concerned about the possibility of an increased risk of neonatal death in mothers taking micronutrient supplements.

CONCLUSION

1. The average Hb level for young women in Gianyar Regency, Bali Province, before getting iron folate was 12.805 g/dL and after getting iron folate was 12.835 g/dL
2. The average ferritin level of female adolescents in Gianyar Regency, Bali Province before receiving the *Multi Micronutrient Supplement* (MMS) was 60.62 and after receiving the *Multi Micronutrient Supplement* (MMS) was 82.2
3. The average consumption of micronutrients for young women who receive iron folate in Gianyar Regency, Bali Province is Vitamin C 27.3 mg, folic acid 90.84 mg, iron 3.54 mg and zinc 4.3 mg
4. The average consumption of micronutrients for young women who receive *Multi Micronutrient Supplement* (MMS) in Gianyar Regency, Bali Province is Vitamin C 23.78 mg, folic acid 72.84 mg, iron 11.22 mg and zinc 4.3 mg
5. There is no difference in Hb levels for female adolescents before and after receiving iron folate in Gianyar Regency, Bali Province
6. There is no difference in ferritin levels in female adolescents before and after receiving *Multi Micronutrient Supplement* (MMS) in Gianyar Regency, Bali Province
7. Giving iron folate is effective in increasing hemoglobin levels and giving Multi *Micronutrient Supplement* (MMS) is effective in increasing *ferritin levels* in female adolescents in Gianyar Regency, Bali Province.

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