Effect of Iron Supplementation, Vitamin A and Vitamin C to the Increase of Hemoglobin and Achievement of Elementary School Students in Barru Regency, 2014

Haeruddin[a*], Syamsu Khaldun[b] , Veni Hadju[c], Alimin Maidin[d] , Armyn Nurdin[e]

[a] *Doctoral Program, Lecturer of Public Health faculty of Indonesia Moslem University*

[b] *Faculty of Public Health, Indonesian Moslem University, Makassar Indonesia*

[c,d] *Faculty of Public Health, Hasanuddin University, Makassar Indonesia*

[e] *Medical Faculty, Hasanuddin University, Makassar Indonesia*

Abstract

The prevalence rates of anemia in children nationwide reached 17.6% in 2011 and the prevalence of underweight in the Barru Regency was 16.5%. This study aims to determine the effect of iron supplementation, combinations of iron, vitamins A and C to the increase the hemoglobin levels and indices elementary school students learning achievement. This research method using a purely experimental design Randomized Double Blind of pre-post test design, research subjects are elementary school students with a sample of 96 students, that were randomly divided into three treatment groups. Results showed no significant increase in hemoglobin levels in each treatment group Fe (11.44 ± 0.43, being 12.34 ± 0.61, p = 0.00); Fe combination of vitamin A and vitamin C (11.53 ± 0.51, being 14.05 ± 0.12, p = 0.00 and the controls (11.60 ± 0.63 to 11.80 ± 0.28 p = 0.08). On the GPA elementary school students after the intervention there was a significant emphasis on the level of ignorance among others Fe treatment groups (2.91 ± 0.69, being 2.09 ± 0.53, p = 0.004); Fe combination of vitamin A and vitamin C (2.44 ± 0.87, to 1.41 ± 0.49, p = 0.004) and the control does not change the mean $\pm$ SD of 3.19 ± 0.93, and p = 0.92.

Keywords: supplementation of iron; multivitamins; academic achievement; school pupils.

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* Corresponding author.

1. Introduction

The nutritional status of children is one of the indicators that describe the level of welfare of a country. The prevalence rates of anemia in children nationwide in 2011 reached 17.6% prevalence of underweight in children 6-14 years for the city of Makassar (15.5%), Barru (16.5%) and Tanatoraja (16.8%) higher than in South Sulawesi (15.5%) and Indonesia (13.3%) [1]. The researchers stated that malnutrition in children is caused by multi factorial aspects. According to [2], the problem of child nutrition principally influenced by four factors: genetic, behavioral health, health and environmental programs. In children under five due to VAD (Vitamin A deficiency) will have an impact on the increase in morbidity and mortality, susceptible to infectious diseases such as diarrhea, pneumonia, pneumonia, and eventually death. Other consequences are very serious impact of VAD is night blindness and other manifestations of xeropthalmia including corneal damage and blindness [3]. Most of the causes of anemia in Indonesia is the lack of iron is needed for the formation of hemoglobin, so-called "iron deficiency anemia" [1, 4].

Efforts to reduce the prevalence of anemia, reference [5] says that complementary foods fortified with iron can increase iron consumption and reducing the prevalence of anemia in children 6-24 months. Complementary food fortification with micronutrient supplements can be received well and has a positive effect on iron status of infants in Ghana [3]. Increased consumption by traditional food development and fortification (using powders, crushable tablets, or fat-based products) [6]. Nutrition treatment is determined by the quality and quantity of intake of nutrients sat. Local gift weaning improved the formula can produce weight gain and body length were significant in infants 6-12 months when compared to children who were not given [7]. Similarly, school children and even affect learning achievement. N Sundari [8] suggests that the goal of learning achievement tests that reveal a person's success in learning.

Achievement test in the form of tests compiled in a planned manner to uncover the maximum individual perform in mastering the material or material that has been taught. Results of learning achievement tests may show high or low on student achievement. The learning achievement denoted by numbers or letters, as in graduate education as indicated by grade point average (GPA) scale 4. Meanwhile, according to [9], there are two kinds of successful learning outcomes, namely: (a) academic achievement indicated by the value in schools and (b) the economic benefits and quality of life after college. So this study assesses the effect of supplementation to increase hemoglobin levels and a GPA of elementary school children before and after the intervention at three elementary schools in the Barru Regency.

2. Materials and Methods

This research method is a purely experimental research using randomized double blind design. Subjects were elementary school students grade 3-5 were aged 9-12 years from three elementary schools selected. The number of samples, all students grade 3 to grade 5 with 96 elementary school students were divided into three intervention groups, consisting of a group of Fe and Fe + Vit A + Vit C called Fe combination and control groups. The treatment group received a supplement in advance before given worming with consideration to be free of worm infection disease that can affect the formation of hemoglobin concentration.

The treatment is given for 6 months. For student achievement were given extra lessons in the three treatment groups were then evaluated the beginning, middle and end of semester.

3. Results

Table 1: Characteristics of Primary School Students by Group

Variable	Kontrol	Fe	Fe + Vit C + Vit A	Total
	n(32)	n(32)	n(32)	n(96)
Sex				
Male	20(40,0)	12(24,0)	18(36,0)	50(52,1)
Female	12(26,1)	20(43,5)	14(30,4)	46(47,9)
Age (Y)				
9 Sex				
Male	4(25,0)	8(50,0)	4(25,0)	16(16,7)
Female	0(0,0)	10(71,4)	4(28,6)	14(14,6)
Total	4(13,3)	18(60,0)	8(26,7)	30(31,3)
10 Sex				
Male	9(34,6)	4(15,4)	13(50,0)	26(27,1)
Female	9(37,5)	8(33,3)	7 (29,2)	24(25,0)
Total	18(36,0)	12(24,0)	20(40,0)	50(52,1)
11 Sex				
Male	7(87,5)	0(0,00)	1(12,5)	8 (8,3)
Female	3(37,5)	2(25,0)	3(37,5)	8 (8,3)
Total	10(62,3)	2(12,5)	4(25,0)	16(16,7)

Overview of research sites located in the district and taken from rural areas who have family history descendants of the same respondents that elementary students in the school is a clump family certainly very high homogeneity of the respondents.

Table 1 presents the sex of each intervention group, in general, male were 50 (52.1%). Percentage of age are generally in the age group of 9 years were 30 (31.3%), in the age group 10 years were 50 (52.1%) and the age group of 11 years in general as much as 16 (16.7%). As can be seen in Table 1. Then, In table 2 shows the initial Hb level before intervention with an average value of 11.52 ± 0.52 g / ml. There is no average difference between treatment groups were statistically significant with a P value = $0.08 > \alpha = 0.05$. Furthermore, the measurement end of the study found the average value of 12.73 ± 0.34 g / ml Hb levels after intervention. There is an average difference between treatment groups were statistically significant with p = 0.000 <0.05.

Overview of the results of these studies showed that all three groups a chance to increase the rate of Hb levels but greater opportunities in the group given supplements of iron and iron supplementation combination of vitamin A + vitamin C compared to the control group in a span of 6 (six) months. As it can be seen in table 2 below.

Table 2: Hb before and after in each intervention group

| Variabel	Before	P	After	P
Fe n(32)	11,44±0,43		12,34±0,61	
Fe+ Vit C +				
Vit A n(32)	11,53±0,51	0,08	14,05±0,12	0,000
Kontrol n(32)	11,60±0,63		11,80±0,28	
Total (n=96)	11,52±0,52		12,73±0,34	

Table 3 describes the test results obtained prior to intervention mean $\pm$ SD values of Hb in the group of iron supplements by 11.44 ± 0.43 and the mean $\pm$ SD hemoglobin levels in the combination group iron supplements of vitamin A and vitamin C amounted to 11.53 ± 0.51 while the mean $\pm$ SD hemoglobin levels in the control group of 11.60 ± 0.63 to 0.08 p. value > α 0,05 so these results do not have significant differences in each group with the level of 95%.

The test results obtained after intervention mean $\pm$ SD values of Hb group iron supplements at 12.36 ± 0.61 and the mean $\pm$ SD Hb groups iron supplementation combined vitamin A and vitamin C amounted to 14.05 ± 0.12, while the average $\pm$ SD Hb control group of 11.80 ± 0.28 to 0.00 p. value < α 0,05.

These results there are significant differences in each group. More can be seen in Table 3 below; To see the effect of supplementation graphically in the three treatment groups which supplement group Fe and Fe combined vitamin supplement group A + vitamin C as well as a control group against an average increase hemoglobin levels before and after the intervention can be seen in Figure 1.

Table 3: Comparison of the mean hemoglobin levels before and after intervention

Variable	Before	After	P1	Mean	P2
	(mean ±SD	(mean±SD)			
Fe	11,44±0,43	12,36±0,61		0,92	
Fe + Vit A Vit C	11,53±0,51	14,05±0,12	0,08	2,52	0,00
Control	11,60±0,63	11,80±0,28		0,20	
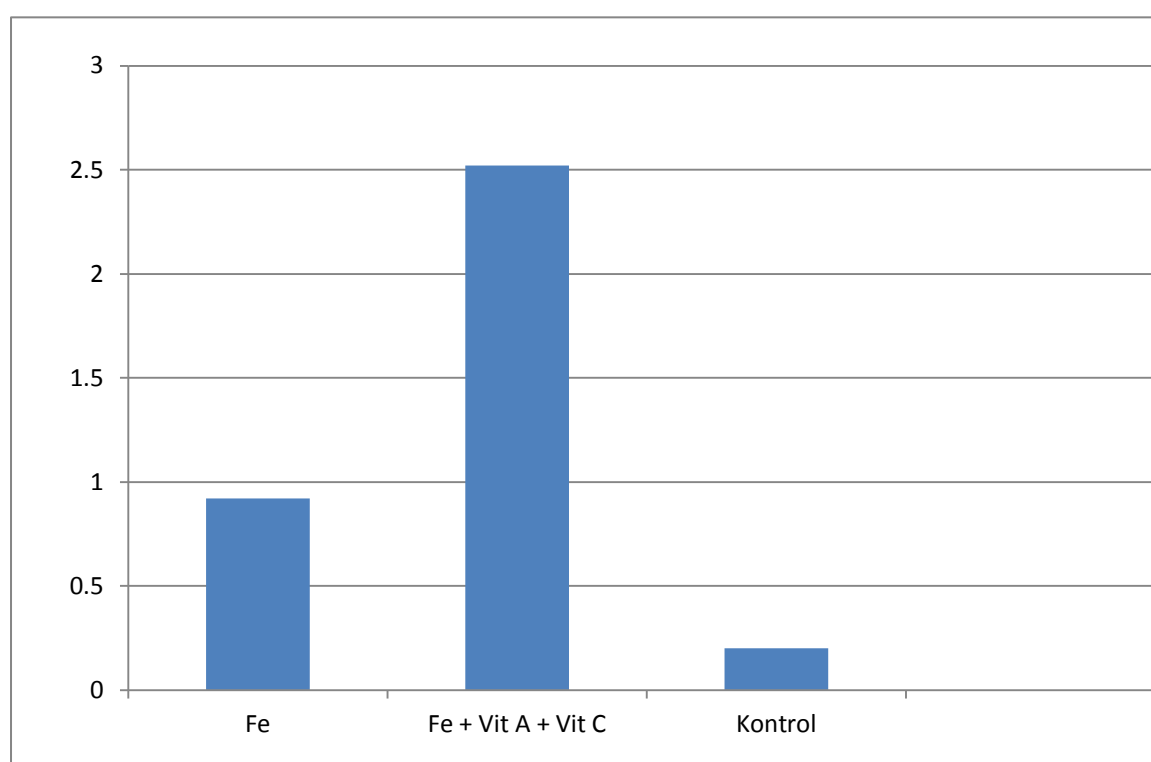
Figure 1: The increase of Hb level after intervention base on the group

Table 5 show that before the intervention there were no significant differences in each group, but after the intervention found a significant difference between the supplement and control Fe with an average difference - 0.53 and 0.00 P.value value as well as supplements Fe combination of vitamin A, and vitamin C than control the

value of the average difference -2.15 and 0.00 p.value further value in the table 5.

Table 5: The different mean of Hb Level before and after among the three groups intervention

Variable	Fe vs Control	P	Fe+A+C vs Kontrol	P	Fe vs Fe+A+c	P
	Difference		Difference		Difference	
Hb						
Before	0,28	0,09	0,19	0,25	-0,09	0,50
	(8,69 to 8,41)		(8,69 to 8,50)		(8,41 to 8,50)	
After	-0,53	0,00	-2,15	0,00	-1,62	0,00
	(8,88 to 9,41)		(8,88 to 11,03)		(9,41 to 11,03)	

On Table 6 shows a comparison of the frequency of GPA elementary school students before the intervention as much as 10.4% to the category of very satisfying, after supplementation for 6 months frequency very satisfactory GPA in the category increased by 25.0%. As can be seen in the following table.

GPA distribution each treatment group before the intervention suggests that GPA categorized as very satisfactory in the control group of 2.1%, in the group of Fe Modified by 3.1% while the Modified Fe combination vitamin A and vitamin C were 5.2% , End of the study after the intervention that the distribution of the GPA in each treatment groups: control group categorized as very satisfactory GPA of 2.1%, in the group by 3.1% Fe Fe while the combination of vitamin A + vitamin C with very satisfactory were 19 categories , 8% can further be seen in Table 7 below.

Table 8 shows the GPA at the beginning of the study with an average value of 2.85 ± 0.83. There is no average difference between treatment groups were statistically significant with p = 0.92> α = 0.05. Furthermore, the study found a GPA final measurement sample with an average value of 2.23 ± 0.65. There is an average difference between treatment groups were statistically significant with p = 0.004 <α = 0.05.

Table 5 show that before the intervention there were no significant differences in each group, but after the intervention found a significant difference between the supplement and control Fe with an average difference -0.53 and 0.00 P.value value as well as supplements Fe combination of vitamin A, and vitamin C than control the value of the average difference -2.15 and 0.00 p.value further value in the table 5.

Table 6: GPA Students before and after intervention

GPA	before	%	After	%
	n (96)		n (96)	
Very satisfied	10	10,4	24	25,0
Satisfied	16	16,7	41	42,7
Sufficient	49	51,0	16	16,7
Less	21	21,9	15	15,6
Total	96	100	96	100

Table 7a: Distribution of supplementation based GPA group before and after intervention inBarru elementary school

Suplementation	GPA (before) Total					GPA (after) Total				
	SM	M	C	K		SM	M	C	K	
Fe	3,1	0,0	27,1	3,1	33,3	3,1	24,0	6,2	0,0	33,3
Fe+A+C (combination)	5,2	11,5	13,5	3,1	33,3	19,8	13,5	0,0	0,0	33,3
Control	2,1	5,2	10,4	15,6	33,3	2,1	5,2	10,4	15,6	33,3
Total	10,4	16,7	51,0	21,9	100	25,0	42,7	16,7	15,6	100

Overview of the results of these studies showed that all three groups are likely to increase the GPA of elementary school children, but greater chances in the group given Fe combination of vitamin A and vitamin C than in the control group in a span of 6 months, as can be seen in Table 8.

4. Discussion

4.1 Effect of Fe, Fe combination of Vit A and Vitamin C to the increasing in school children Hb before and

after the intervention.

Results of the study describes the differences in average hemoglobin levels before the intervention obtained an average value of 11.52 ± 0.52 g / L with a value of $p = 0.08 > \alpha = 0.05$ means that before the intervention there were no differences in average between treatment groups significantly, while after intervention obtained an increase in the average value of Hb is 12.73 ± 0.34 g / ml with a value of $p = 0,000 < \alpha = 0.05$ means that after intervention mean there is a difference between treatment group significantly.

Table 7 b: Distribution of supplementation based GPA group before and after intervention in Barru elementary school.

Suplementation	GPA (before)					GPA (after)				
			Total					Total		
	SM	M	C	K		SM	M	C	K	
Fe	3,1	0,0	27,1	3,1	33,3	3,1	24,0	6,2	0,0	33,3
Fe+A+C (combination)	5,2	11,5	13,5	3,1	33,3	19,8	13,5	0,0	0,0	33,3
Control	2,1	5,2	10,4	15,6	33,3	2,1	5,2	10,4	15,6	33,3
Total	10,4	16,7	51,0	21,9	100	25,0	42,7	16,7	15,6	100

Table 8: Achievement index before and after intervention.

Variable	Before (mean±SD)	P	After (mean±SD)	P
Fe (n=32)	2,91±0,69		2,09±0,53	
Fe+A+C(n=32)	2,44±0,87	0,92	1,41±0,49	0,004
Control (n=32)	3,19±0,93		3,19±0,93	
Total (n=96)	**2,85±0,83**		**2,23±0,65**	

Overview of the results of these studies demonstrate that all three groups an opportunity to increase hemoglobin levels, but greater in the group given the opportunity modified Fe and Fe combination of vitamin A and vitamin C than in the control group in a span of 6 months. To determine the influence of each group before and after the intervention, the test results of the research conducted on each group before and after intervention with Anova statistical test, where the test results before intervention mean ± SD values obtained Hb Fe group amounted to 11.44 ± 0.43 and the mean ± SD Hb Fe group and the combination of Vit A Vit C amounted to 11.53 ± 0.51 while the mean ± SD Hb control group of 11.60 ± 0.63 with a value of 0.08 p.value > α of 0.05 means that the results of the study had no significant difference in each group with a 95% confidence level. The test results obtained after intervention mean ± SD values of Hb Fe group amounted to 12.34 ± 0.61 and the mean ± SD Hb Fe group and the combination of Vit A Vit C amounted to 14.05 ± 0.12 while the mean ± SD Hb the control group of 11.80 ± 0.28 with p. value 0,000 <α = 0.05 thus these results there are significant differences in each group. Advanced test results by comparing each group found a significant difference between the groups after intervention ie Fe controls with an average difference of 0.5 and 0.00 p. value as well as Fe combination of vitamin A and vitamin C than the control with an average difference of 2.25 and 0.00 p. value. Until it is assumed that there are differences in Hb levels were significantly between the groups of children who were given Fe and Fe combination of vitamin A and vitamin C compared with the group who were not given the supplement (control), so that 95% believed the difference of Hb levels in children given Fe and Fe a combination of vitamin A and vitamin C as well as control for 6 months among children of Barru Regency.

This research is in accordance with previous studies that there is a relationship between the consumption of food sources of Fe with high bioavabilitas with anemia status [10]. Likewise, if the consumption of Fe less, directly related to the incidence of anemia in children [11, 12]. Fe is needed by the body for many things: for the formation of hemoglobin cells, red blood cells in the bone marrow, offset a small amount of Fe that are constantly released by the body primarily through urine and menstrual blood, the formation of new hemoglobin in childhood and adolescence, as well as to compensate Fe lost due to bleeding and on lactation milk secretion [13]. Fe play an important role in the transport and use oxygen at oxidative energy production [14]. Vitamin C plays a role in the formation of substances between cells of various tissues, increase endurance, increase the phagocytic activity of white blood cells, increases iron absorption in the intestine as well as the transport of iron from transferrin in the blood to ferritin in the bone marrow, liver and spleen [3, 15]. Another study explained that vitamin C has a very important role in the absorption of iron, especially of non-haem iron.

Vitamin C can increase absorption of iron from food via complex formation of ferro-ascorbate. The combination of 200 mg of ascorbic acid with an iron salt can increase iron absorption by 25-50%. Bioavailability of iron from ferrous sulfate in combination with vitamin C [16, 17].

Furthermore, other nutrients that affect the formation of hemoglobin is Vitamin A. Vitamin A that has been consumed plays a role in the metabolism of iron stores in the body to synthesize hemoglobin [18, 19]. Other studies that the micronutrient-fortified biscuits such as vitamin A decline in the prevalence of anemia and improves iron status [20].

4.2 Supplements Influence toward Elementary Students GPA.

The results showed that the frequency GPA elementary school children before intervention supplements provide an overview GPA categorized as very satisfactory only reached 10.4%, after a given intervention, the GPA with a very satisfactory category increased by 25.0%. Continued chi-square test results of tests each group with a GPA supplement before the intervention illustrates that in the control group both before and after the change in value of interference does not give a GPA of 2.1% and the group Fe modifications provide a change to the category satisfactory GPA of 0 % to 24.0%, whereas in the group of modified Fe combination of vitamin A and vitamin C give change CPI score as much as 19.8% in the category of very satisfactory.

To determine the influence of each group before and after the intervention, the test results of the research conducted on each group before and after intervention with Anova statistical test, where the test results before intervention mean $\pm$ SD values obtained GPA by 2.91 $\pm$ Fe group 0.69 and the mean $\pm$ SD GPA Fe group combinations and Vit A Vit C of 2.44 $\pm$ 0.87 mean $\pm$ SD GPA while the control group of 3.19 $\pm$ 0.93 to 0.92 p. value> α 0 05 means that the results do not have significant differences in each group with a 95% confidence level. The test results after intervention mean $\pm$ SD values obtained Fe group GPA of 2.09 $\pm$ 0.53 and the mean $\pm$ SD GPA Fe group combinations and Vit A Vit C of 1.41 $\pm$ 0.49 GPA while the mean $\pm$ SD of the control group 3.19 $\pm$ 0.93 with p. value 0.004 <α = 0.05 thus these results there are significant differences in each group. Consumption of nutrients that are lacking in a long time could lead to a shortage of energy protein, which has the impact of lowering the quality of the physical and intellectual as well as lowered immune system which result in an increased risk of morbidity and mortality, especially in vulnerable populations' biology [21, 22]. conducted a comparison of learning achievement among children of primary school students with elementary school featured unseeded found that the average achievers have good nutritional status.

5. Conclusion

Increased levels of Hb at elementary school students are much better after being given the consumption of Fe combination of vitamin A and vitamin C than the group that consumed the supplement Fe and control, and so also to increase student achievement is much better GPA in the group that consumed Fe combination of vitamin A and vitamin C compared to the control group and Fe.

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