Since 2002

The Effectiveness of Iron-folic Acid Supplementation and Education Intervention to Hemoglobin Level, Knowledge, and Compliance among Adolescent Girls in Islamic Boarding School

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Abstract

BACKGROUND: Adolescent girls are at a high risk of iron deficiency anemia. Weekly iron-folic acid supplementation (WIFAS) is recommended to address anemia, but it is still ineffective to reduce the prevalence of anemia in Indonesia. Lack of knowledge and low adherence are the factors associated with the problem.

AIM: The study aimed to assess the effectiveness of education combined WIFAS intervention compared to WIFAS intervention and to identify the compliance of iron-folic acid tablets intake.

METHODS: A quasi-experimental study was carried out on November 2020–March 2021. By simple random sampling, a total of 135 adolescent girls in Islamic boarding schools in Semarang, Indonesia, were divided into two groups: WIFAS group only received WIFAS and the WIFAS+Education group received combination of WIFAS and education intervention for 16 weeks. Hemoglobin level was measured by Cyanmethemoglobin method. The knowledge and compliance were determined through the questionnaires. Mann–Whitney, Wilcoxon, and McNemar tests were performed to analyze the effect of intervention by SPSS 22 software.

RESULTS: Mean of Hb levels and knowledge scores before and after intervention in the WIFAS group were 13.38 g/dL and 13.08 g/dL (p = 0.055); and 79.08 and 76.21 (p = 0.93), respectively, meanwhile, in the WIFAS+Education group were 12.79 g/dL and 12.69 g/dL (p = 0.248); and 78.67 and 82.10 (p = 0.008), respectively. The increases of anemia prevalence both in the WIFAS group and the WIFAS + Education group were not statistically significant. There was no significant difference of the compliance both groups (p = 0.095).

CONCLUSIONS: Education intervention was effective to increase the knowledge regarding anemia and nutrition. The education intervention to trustees of Islamic boarding school is needed to increase the compliance of WIFAS, so it can improve the effectiveness of WIFAS among adolescent girls.

Introduction

Anemia is one of the public health problems globally [1]. One of the groups having high risk of anemia is adolescent girls [2]. Adolescents are individuals in 10–19 years age group [3]. Rapid growth, poor diet, and monthly blood loss due to menstruation are all factors contributing to iron deficiency in adolescent girls. The amount of iron reserves, the need for iron, and the synthesis of blood hemoglobin are all affected by these circumstances [4]. Adolescent girls are anemic if their blood hemoglobin level below than 12 g/dL [5]. Globally, the prevalence of anemia in adolescent girls is approximately 29% [1]. In Indonesia, the prevalence of anemia in the age of 15–24 years old increased from 18.4% in 2013 to 32% in 2018 based on Basic HealthResearch Report. The higher prevalence of anemia was found on female of 27.2% compared to male of 20.3% [6].

Anemia can be caused by various conditions, in which the most common is iron deficiency [1], [2].

The long-term effects of untreated iron deficiency anemia in adolescent girls will increase the risk of anemia during pregnancy and have a negative impact on fetal growth and development, pregnancy, and childbirth complications such as low birth weight, infant anemia, maternal and child mortality, stunting, and neurocognitive development [4], [7]. A study in the primary schoolchildren reported that anemic children compared to non-anemic had worse score in cognitive test [8].

To prevent and reduce anemia in adolescent girls, the World Health Organization (WHO) recommends the weekly iron and folic acid supplementation (WIFAS) program [5]. Several studies have found that WIFAS intervention can reduce the prevalence of anemia [9], [10]. According to the WHO recommendation, the Indonesian government makes effort to address the problem of anemia in adolescent girls aged 12–18 years with the supplementation of iron-folic acid tablets as much as one tablet per week throughout the year in the educational institutions [4]. Nevertheless, WIFAS program for adolescent girls

in Indonesia has not been effective in reducing the prevalence of anemia among adolescent girls.

Besides attending the public school, some of adolescent girls choose taking education in the Islamic boarding school. Studies in some regions of Indonesia expressed that the prevalence of anemia among female students in Islamic boarding school was high and ranged from 52.25% to 68.30% [11], [12], [13]. The level of compliance to the intake of iron-folic acid tablets is one of the factors contributing this problem, which only 1.4% of adolescent girls adhere to the consumption of 52 iron-folic acid (IFA) tablets during 1 school year [6]. Lack of knowledge is associated to low compliance of IFA supplementation [14]. Moreover, only few adolescent girls had good knowledge about nutrition anemia in the previous study [15]. A prior study reported that most of female students in Islamic boarding school have bad dietary habits [12]. Low food intake quality is the main factor of iron deficiency anemia [16].

It is important to carry out health and nutrition education to improve the knowledge regarding anemia among adolescent girls, so that, finally, it can combat anemia. Several studies in other countries acknowledged that the health education intervention has the impact on improving the knowledge regarding anemia among adolescent girls. For example, a quasi-experimental study with pre-posttest control group design was conducted in Jordan and another study with only pre-posttest one group was carried out in India [17], [18]. Providing nutrition education might greatly enhance the knowledge and hemoglobin level after 3 months of intervention in India [19]. Nevertheless, the study only gave the nutrition education without the WIFAS to the intervention group; meanwhile, the control group did not receive any intervention. Furthermore, studies assessing the impact of education intervention combined the WIFAS and identifying the compliance of WIFAS among adolescent girls have few reported in Indonesia, especially in Semarang. Hence, the study aimed to assess the effectiveness of WIFAS combined with education intervention regarding anemia nutrition and the importance of WIFAS compliance to hemoglobin concentration and knowledge among adolescent girls in Islamic boarding schools (compared to the only WIFAS without education intervention). The study also identified the compliance of WIFAS in adolescent girls.

Materials and Methods

Study design and setting

A quasi-experimental with pre-test and post-test control group design was conducted on November 2020 to March 2021 in Semarang city, Indonesia. The adolescent girls aged 12–18 years old living at Islamic boarding schools and willing to be participants in this study were selected by simple random sampling. Participants taking iron-folic acid tablets for the last 3 months, having pre-existing disease, or getting treatment such as intestinal worming, tuberculosis, or HIV/AIDS in the past 1 month were excluded from the study.

A total of 162 adolescent girls were eligible as participants and divided into two groups. Eighty participants were selected as WIFAS intervention group which they received WIFAS for 16 weeks. All participants received a total of 16 IFA tablets once at the beginning of the study and were educated to consume one tablet each week for 16 weeks. Each IFA tablet contained ferrous fumarate 91.27 mg and folic acid 0.8 mg. The other group of 82 participants got WIFAS combined education intervention for 16 weeks and was called WIFAS + Education intervention group. Topics of education intervention were about anemia, nutrition of anemia prevention, and the importance of consuming IFA tablets. Education intervention was delivered in 2 times: Immediately in the 1st week after distributing IFA tablets and 8 weeks later. In the first meeting class, a lecture for 60 min was delivered using visual aids (power point) followed by discussion. A lecture for 30 min was taken using booklet followed by discussion in the second meeting class. The booklet was given to participants to be read at any time.

After intervention, a total of 27 participants dropped out because they have left from Islamic boarding school. Hence, a total number of samples were 70 adolescent girls in the WIFAS + Education group and 65 in the WIFAS group. This number has met the minimum sample size of 65o; subjects in each group calculated by Lemeshow formula: The power of 80%, the significance level of 5%, difference of mean in the intervention group of 3.5, and difference of mean in the control group of 1.

Variables

The outcome variables of this study were hemoglobin (Hb) level and knowledge score. Hb level and knowledge score were collected before intervention and immediately after finished the intervention (16 weeks intervention). Hb level was measured through taking blood sample of the participants by medical laboratory professionals. By Cyanmethemoglobin method, the Hb level was in unit g/dL. Participants were categorized as anemic if Hb level <12 g/dL and non-anemic if Hb level ≥12 g/dL. Knowledge score was determined by a structured questionnaire consisting of 30 true and false questions and ranged from 0 to 100. The compliance of IFA supplementation was assessed by a questionnaire and confirmed by calculating the unconsumed IFA tablets. Participants who consumed 12–16 tablets were categorized as having good compliance, meanwhile, who spent less than 12 tablets were classified as having

less compliance. A pilot study was carried out to test the questionnaire to be easy to understand.

Data analysis

Data collected in this study were analyzed using software SPSS 22. By Kolmogorov–Smirnov test, data were abnormally distributed ($p < 0.05$). Wilcoxon test was employed to test the mean of Hb level and knowledge score before and after the intervention in each group. The Mann–Whitney U-test was performed to analyze the comparison of the difference (delta) in Hb levels and knowledge scores before and after the intervention, the difference of mean in Hb levels between two intervention groups, and the level of compliance between the WIFAS group and the WIFAS + Education group. McNemar test was used to observe the effectiveness of intervention to reduce the prevalence of anemia in each group. All statistical tests were significant at $p < 0.05$ at 95% confidence interval (CI).

Ethical consideration

The study was carried out after obtaining permission from the Ethics Committee of Faculty of Medicine, Universitas Diponegoro (Number 265/EC/KEPK/FK-UNDIP/XII/2020). Informed consent was given to the subject's parents through the trustees of the Islamic boarding school.

Results

Overall, 18.5% of adolescent girls at Islamic boarding schools in Semarang, Indonesia, were anemic at the baseline of the study. The median (minimum–maximum) age of the subjects was 17 (14–18) years old. The majority of participant's parents had low education level. Most of participants (74.8%) had a normal nutritional status (Table 1). The prevalence of anemia increased from 15.4% to 18.5% in the WIFAS group and from 21.4% to 25.7% in the WIFAS + Education group (Table 2).

Table 1: Characteristics of subjects

Variable	n (N = 135)	Percentage	Median (min-max)	Mean ± SD
Age			17 (14–18)	16.42 ± 1.075
Father's education level				
Low	69	51.1		
Moderate-high	66	48.9		
Mother's education level				
Low	78	57.8		
Moderate-high	57	42.2		
Nutritional status				
Underweight	2	1.5		
Normal	101	74.8		
Overweight	28	20.7		
Obesity	4	3		
Anemia status				
Anemic	25	18.5		
Non-anemic	110	81.5		

Table 2: Prevalence of anemia before and after intervention

Intervention groups	Before intervention n (%)	After intervention n (%)	p-value
WIFAS group (n = 65)			
Anemia	10 (15.4%)	12 (18.5%)	0.754[a]
Normal	55 (84.6%)	53 (81.5%)	
WIFAS+Education (n = 70)			
Anemia	15 (21.4%)	18 (25.7%)	0.508[a]
Normal	55 (78.6%)	52 (74.3%)	

[a]McNemar test.

Based on Table 3, Hb levels before intervention in the WIFAS group (13.38 ± 1.33 g/dl) and in the WIFAS+Education group (12.80 ± 1.36 g/dl) were significantly different ($p = 0.008$). After intervention, Hb levels between the WIFAS+Education group (12.69 ± 1.48) and WIFAS group (13.08 ± 1.35) were not statistically significant different ($p = 0.110$). There was no significant difference between Hb level before and after intervention in the WIFAS group ($p = 0.055$) neither WIFAS+Education group ($p = 0.248$). A decrease of mean Hb level (mean difference) before and after intervention showed no statistically significant difference ($p = 0.562$) between the WIFAS group (-0.30 ± 1.06 g/dl) and WIFAS+Education group (-0.10±0.87 g/dl). This showed that both of only WIFAS and WIFAS combined education intervention were not effective to increase hemoglobin level.

Table 3: Bivariate analysis of Hb level and knowledge in two groups

Variable	Intervention groups		
	WIFAS (n = 65) Mean ± SD (g/dL)	WIFAS+Education (n = 70) Mean ± SD (g/dL)	p value
Hemoglobin level			
Pre-intervention	13.38 ± 1.33	12.80 ± 1.36	0.008[*b]
Post-intervention	13.08 ± 1.35	12.69 ± 1.48	0.110[b]
Mean difference (post-pre)	-0.30 ± 1.06	-0.10 ± 0.87	0.562[b]
p value pre-post	0.055[a]	0.248[a]	
Knowledge score			
Pre-intervention	79.08 ± 9.1	78.67 ± 8.90	0.716[b]
Post-intervention	76.21 ± 8.89	82.10 ± 8.51	< 0.001[*b]
Mean difference (post-pre)	-2.87 ± 11.98	3.42 ± 10.21	0.001[*b]
p value pre-post	0.093[a]	0.008[*a]	

*Significant if P < 0.05 [a]Wilcoxon test [b]Mann–Whitney U-test

Knowledge scores in both of two groups, before intervention, were not significantly different ($p = 0.716$). There was a significant difference of knowledge score between the WIFAS+Education group (82.10 ± 8.51) and WIFAS group (76.21 ± 8.89), after intervention, at $p < 0.001$. The knowledge score in the WIFAS+Education group significantly increased from 78.67±8.90 to 82.10±8.51 ($p = 0.008$) after the intervention, whereas in the WIFAS group, the knowledge score decreased from 79.08±9.1 to 76.21±8.89 ($p = 0.093$). The mean difference (delta) of knowledge score between the WIFAS group and WIFAS+Education group was significantly different ($p = 0.001$). The education intervention was effective to increase the knowledge in the study.

Figure 1 describes the comparison of the compliance level to consuming IFA tablets between two groups (OR = 0.501, 95%CI = 0.221–1.137, $p = 0.095$). Overall, good compliance was found to be only 29.2% in the WIFAS group and 17.1% in the WIFAS + Education group (Table 3). During the consumption of IFA tablet, 16.8% of subjects in the WIFAS group and 25.7% in the

WIFAS+education group stated having adverse effects after consuming IFA tablet (Table 4). Nausea was the most common symptom followed by dizziness.
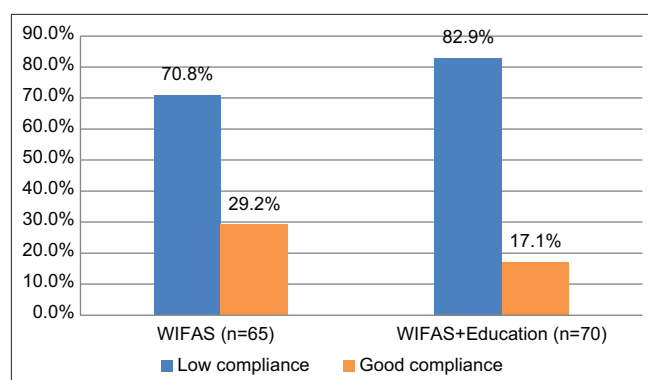

Figure 1: Comparison the compliance of IFA tablets intake between two groups

Discussion

Overall prevalence of anemia among adolescent girls of Islamic boarding schools in Semarang at the baseline and the end of the study was 18.5% and 22.2%, respectively. The prevalence in this study was much lower compared with studies conducted in other regions of Indonesia, in Islamic boarding school in West Java and East Java of 52.25% and 29.93%, respectively [11], [20]. However, its prevalence was higher compared with the prevalence of anemia on adolescent girls in public school aged 12–15 years of 19,6% [21]. These differences might be associated with the different of age groups and socioeconomic status. Socioeconomic status is acknowledged as the risk factor of anemia in adolescent girls [22].

Table 4: Side effects of consuming IFA tablet supplementation

Side effects	Intervention groups	
	WIFAS (N = 65)	WIFAS+Education (N = 70)
	n (%)	n (%)
No	54 (83.1)	52 (74.3)
Yes	11 (16.8)	18 (25.7)
Dizziness	4	9
Nausea	3	12
Constipation	0	3
Weakness	2	1
Black feces	1	0
Fatigue	1	0
Short menstrual cycle	3	0

One of the prevention and controlling anemia in adolescent girls is weekly iron-folic acid supplementation [23]. The decreasing of the prevalence of anemia from 25.1% to 19.6% has been proved with the WIFAS intervention to adolescent girls aged 10–19 years old during 1 school year [24]. The increase of Hb concentration of 0.2 g/dL after consuming 11–20 IFA tablets was noticed in other study in Ghana and the mean of Hb level increases of 1.21 g/dL after 3 months IFA supplementation intervention in Indian [24], [25]. However, this study revealed that the WIFAS interventions both of intervention groups were not effective to increase Hb level and to decrease the prevalence of anemia. It was in line with a previous study in Medan, Indonesia, which stated the mean of Hb level was not significantly different before and after IFA supplementation intervention [26]. The ineffectiveness of the WIFAS intervention may be related to the low compliance of IFA tablets intake in both groups. The compliance in the WIFAS+Education group was not significantly different compared to the only the WIFAS group. Although the education intervention was effective to increase the knowledge regarding the importance of WIFAS in this study, the education intervention rarely has the impact to change the behavior [27]. The behavior to adhere to iron supplementation contributed to the effectiveness of iron supplementation [28].

The low compliance of IFA supplementation was also found, in Ghana and Kenya to be at 26.2% and 32.7%, respectively [29], [30]. A decrease in the prevalence of anemia would not be achieved through the IFA supplementation program without good compliance [31]. Low compliance in the present study might be associated with lack of supervision to the intake of IFA tablet by the trustees in Islamic boarding school. Based on the interview to the subjects, forgetting to consume the IFA tablets was the most reason of low compliance. The participation of teacher to supervise the students in consuming IFA tablets and education to adolescent girls about the importance of consuming IFA tablets are the keys of the success of IFA supplementation program [32]. In Islamic boarding school, the trustee's role is important to influence the students in complying the WIFAS. It can be a key strategy to enhance the compliance of IFA supplementation and to combat anemia in adolescent girls.

The knowledge about nutrition also plays an important role in the prevention of anemia [18], [33]. Similar findings to the present study have acknowledged that nutrition education intervention could improve the knowledge [18], [19]. However, nutrition education intervention could not increase the Hb level in the present study. In accordance with the previous study in Iran, the nutritional knowledge score in the nutrition education group significantly increased than the control group, but there was no significant change in the Hb level between two groups [34]. Good knowledge can lead to an increase in good practice to prevent anemia [35]. However, this study found that the good knowledge about nutrition might not improve the behavior of good nutrition intake in adolescent girls. A prior study stated that female students at Islamic boarding school have low food intake because they are bored of the food that was provided by Islamic boarding school's trustee [36]. The menu served was less varied. The low intake of iron and protein-rich foods is at higher risk of having anemia [37].

The limitations of the study, first, were less of controlling of IFA tablets consumed by subjects in a

quasi-experimental study. Most of subjects did not take all of IFA tablets, so this study cannot describe the true effect of iron-folic acid supplementation on hemoglobin level. Further research is needed to control the compliance of IFA tablets intake in the intervention study to observe the exact effect of the WIFAS intervention. Second, the study did not investigate the other factors such as the food intake, which could contribute to the change of Hb level before and after intervention. Regardless these limitations, our study has a strength that is the pre-post with control group design could naturally measure the effect of intervention on the community. These findings also provide the information about the importance of education intervention and compliance of WIFAS for policymaker in addressing anemia among adolescent girls.

Conclusions

Education intervention was effective to increase knowledge regarding anemia and nutrition. However, both of WIFAS combined education and only WIFAS intervention were not effective to increase Hb level among adolescent girls. No increasing in Hb level after iron-folic acid supplementation might be associated with low compliance of consuming IFA tablets. It is important to involve the role of the trustees in Islamic boarding school to control the compliance of the student in consuming IFA supplementation. Further research to give the education intervention to trustees at Islamic boarding school is needed.

Acknowledgments

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