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**Difference in Haemoglobin Rates in Young Women  
Given Fe tablets with Fe tablets Vitamin C Combination in  
Lembeng Ketewel village**

**Kadek Dinda Putri Atmaja add all**

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**ABSTRACT**

Adolescent girls require high levels of iron due to their rapid growth and development. They are at high risk of anaemia because their nutritional needs exceed those of other age groups, and they are more physically active. This study aimed to determine the difference in haemoglobin levels between adolescent girls given iron tablets alone and those given iron tablets combined with vitamin C. The research used a quasi-experimental pre-posttest design with a control group. The study population consisted of adolescent girls aged 16–19 years. A total of 44 participants were divided into two groups: Treatment Group I (iron tablets), consisting of 22 participants, and Treatment Group II (iron tablets combined with vitamin C), consisting of 22 participants. Purposive sampling was used to select the participants. Statistical tests employed included the

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Paired t-test and the Independent t-test. The paired t-test in group I showed a p-value of 0.000 ( $p < 0.05$ ), indicating a significant difference in haemoglobin levels before and after the administration of iron tablets. The paired t-test in Treatment Group II showed a p-value of 0.000 ( $p < 0.05$ ), indicating a difference in haemoglobin levels before and after the administration of iron tablets combined with vitamin C.

**Keywords:** Haemoglobin Level ; Fe tablet; Vit C; adolescent girls.

**Keywords:** mosquito, aromatherapy candle, cancer, concentration, citronella

## **INTRODUCTION**

Indonesia is a developing country that still faces issues related to nutrition and health. One such issue that requires serious attention and intervention is anaemia. According to the World Health Organization (WHO), approximately two billion people worldwide suffer from anaemia,

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50% of whom have iron deficiency (WHO, 2011). The main risk factors for iron deficiency anaemia are low iron intake and high iron requirements (Nuraeni et. all.,2019). According to the WHO, adolescents are defined as individuals aged 10–19 years. Adolescence is a period of physical and mental growth and development (Suryani et all., 2017). Adolescent girls are at a higher risk of iron deficiency anaemia because their iron requirements exceed those of other age groups due to accelerated growth and increased physical activity (Rosanti et.all., 2022). Listiana's (2016) study found that iron deficiency anaemia is prevalent among adolescent girls in their first year of menstruation, affecting 27.50% of girls with an average age of first menstruation of thirteen years (Listiana,2016). Anaemia is characterised by a decrease in haemoglobin levels, and iron deficiency anaemia is one of the main causes. Anaemia is a condition in which haemoglobin levels are lower than normal. Iron deficiency anaemia occurs when the deficiency is severe enough to disrupt erythropoiesis and lead to anaemia. Normal haemoglobin (Hb) levels in adolescent girls are >12 g/dl (Kemenkes,2018). Anaemia causes oxygen deficiency because there is not enough haemoglobin to bind to oxygen, resulting in less oxygen being distributed around the body. This leads to reduced oxygen reaching the brain and muscles, resulting in impaired concentration and diminished physical endurance during activities. Consequently, the patient's overall physical endurance is affected (Kemenkes,2018). Bali is one of the Indonesian provinces with a high prevalence of anaemia. In 2019, the incidence of anaemia in Bali Province was 5.07%, increasing to 5.78% in

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2020. In Gianyar Regency, the incidence of anaemia among adolescent girls aged over 15 years was 19.4% (Pemkab Gianyar, 2018). However, the government's programme to address anaemia in adolescent girls focuses solely on distributing Iron-Folic Acid Tablets (IFAT). Consuming IFAT alone is not an effective way to increase haemoglobin levels because iron requires vitamin C to be absorbed optimally (Rista et.al,2018). Combining vitamin C with iron tablets increases the absorption of haem iron by up to four times by converting ferric iron into ferrous iron. This process occurs in the small intestine, where vitamin C forms an iron-ascorbate complex that remains soluble at the higher pH levels found in the duodenum. In addition, vitamin C inhibits the synthesis of haemosiderin, which is difficult to release when iron is required. Therefore, the risk of iron deficiency anaemia can be minimised (Kaimudin et.all,2017). This aligns with Qomariah's (2018) research, which found that taking iron tablets and vitamin C supplements increased haemoglobin levels by an average of 0.85 g/dl in adolescent girls after a 4-week intervention at the Muhammadiyah University of Mataram.

## **METHOD**

This type of research is classified as quasi-experimental research with a pre-posttest control group design. In this design, there are two groups, namely treatment group I and treatment group II, which are selected randomly (Sugiyono,2014). Treatment group I is given Fe tablet supplementation, while treatment group II is given Fe tablet supplementation combined with vitamin C. The population in this study consists of adolescent girls in Lembeng Village, Ketewel. The sample in this study consists of adolescent girls in Lembeng Village, Ketewel,

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aged 16–19 years. The sampling technique used was purposive sampling, with a sample size of 44 adolescent girls. The study was conducted by administering iron tablets to treatment group I at a dose of 1x per week and administering iron tablets to A combination of 250 mg of vitamin C was administered once a week to treatment group II. Univariate and bivariate analyses were performed on the data. Bivariate data analysis in this study was performed using the Shapiro–Wilk normality test. If the data were normally distributed, two statistical tests were performed: The paired t-test and the independent t-test.

## RESULTS

The characteristics of adolescent girls based on age are shown in Table 1. below:

**Table 1. Characteristics of adolescent girls**

No.	Age category	Frequency (people)	Percentage (%)
1.	16	12	27,27
2.	17	9	20,46
3.	18	9	20,46

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4.	19	14	31,81
Total		44	100

Table 1 shows that the most common age for the distribution of samples was 19 ( 31.81%).

**Table 2: Haemoglobin Levels Before Treatment**

haemoglobin level (g/dl)	treatment group I		treatment group II	
	N	%	N	%
Low (<12 g/dl)	7	31,8	4	18,2
Normal (12-16 g/dl)	15	68,2	18	81,8
Total	22	100	22	100

Table 2. shows. In treatment group I (iron tablets only), seven respondents (31.8%) had low haemoglobin levels, while 15 respondents (68.2%) had normal levels. In treatment group II (iron tablets

combined with vitamin C), four respondents (18.2%) had low haemoglobin levels, while 18 respondents (81.8%) had normal levels.

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**Table 3: Testing for Normality of Haemoglobin Levels Before and After Administration of Iron Tablets and Iron Tablets Combined with Vitamin C**

	Haemoglobin level before ( <i>p</i> )	Haemoglobin level aftere ( <i>p</i> )
Treatment group I (Fe)	0,244	0,056
Treatmen group II (Fe+Vit C)	0,425	0,059

*Shapiro-Wilk test ( $p \geq 0,05$ )*

Table 3. shows. The normality test of HB levels in groups I and II before and after treatment was normally distributed with  $p \geq 005$ .

**Table 4: Analysis of haemoglobin levels before and after treatment group I**

	N	Mean	Std. Deviation	Std. error Mean	<i>p</i>
Tablet Fe					
Hb level before	22	11.982	.2630	.0561	
Hb level aftere	22	12.509	.2893	.0617	0,000

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Paired T test ( $p < 0,05$ )

As shown in Table 4, the results of the paired t-test indicate that respondents in treatment group I, who were given iron (Fe) tablets, experienced an increase in haemoglobin levels. The results showed a p-value of 0.000 ( $p < 0.05$ ), with an average increase in haemoglobin levels of 0.527 mg/dl.

**Table 5: Analysis of haemoglobin levels before and after treatment group II**

		<i>N</i>	<i>Mean</i>	<i>Std. Deviation</i>	<i>Std. error Mean</i>	<i>p</i>
Tablet Fe + Vitamin C	Hb level before	22	12.659	.5861	.1250	0,000
	Hb level aftere	22	13.536	.4520	.0964	

Paired T test ( $p \leq 0,05$ )

As shown in Table 6, the results of the paired t-test indicate that respondents in treatment group II (who were given iron tablets combined with vitamin C) experienced an increase in haemoglobin levels. The p-value obtained was 0.000 ( $p < 0.05$ ), with an average increase in haemoglobin level of 0.904 mg/dL.

**Table 6: The analysis of differences in haemoglobin levels between treatment groups I and II.**

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		<i>N</i>	<i>Mean</i>	<i>Std. Deviation</i>	<i>Std. error Mean</i>	<i>p</i>
Haemoglobin Level After Intervention	Fe	22	12.509	.2893	.0617	0,000
	Fe + Vitamin C	22	13.536	.4520	.0964	

To see the effectiveness of using aromatherapy candles with citronella essential oil extract (*Cymbopogon nardus*) (*Cymbopogon nardus*) is calculated using the Schneider-Orelli formula proposed by Punter (1981) in (Inayah and Sukendra, 2019).

**Table 2. Test Results of Effectiveness of Aromatherapy Candles with Citronella Essential**  
Based on Table 7, the results of the independent t-test for the final haemoglobin group (after the intervention) showed a p-value of 0.000 ( $p < 0.05$ ), indicating an increase in haemoglobin levels of 1.027 mg/dL. Therefore, there was a significant difference in haemoglobin levels between treatment groups I and II.

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## **DISCUSSION**

The higher the concentration of citronella essential oil (*Cymbopogon nardus*) used in aromatherapy candles, the higher the effectiveness in causing mosquito mortality. This significant difference supports the hypothesis that citronella essential oil extract (*Cymbopogon nardus*) is effective as an active ingredient in mosquito control.

The results showed that soywax-based aromatherapy candles with the addition of citronella essential oil extract (*Cymbopogon nardus*) were able to cause mosquito death with different effectiveness at each concentration. The average mosquito mortality in the control group was only 1.00 head per replicate, while in the 5% treatment it increased to 2.83 heads, at 15% to 4.67 heads,

and at 25% it reached the highest average of 8.00 heads per replicate. The results of ANOVA and Post Hoc tests showed significant differences between treatment groups ( $p < 0.05$ ), which confirmed that the higher the concentration of citronella essential oil in aromatherapy candles, the higher the mosquito mortality rate obtained. This fact supports the research hypothesis that citronella is effectively used as an active ingredient for mosquito repellents in the form of aromatherapy candles.

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Previous studies also support this finding. Hilmarni et al. (2021) proved that citronella, clove, and kecombrang are effective as active ingredients in aromatherapy candles in repelling mosquitoes, although their effectiveness is not as high as chemical insecticides. Halim & Fitri (2020) explained that citronellal, citronellol, and geraniol in citronella have natural repellent and insecticidal activities, but the stability of the aroma needs to be improved with fixative substances so that the repellency lasts longer. The findings of this study are in line with the literature, that **Haemoglobin levels before and after the administration of iron tablets combined with vitamin C**. Based on haemoglobin level tests conducted using the Point-of-Care Testing (POCT) method on 22 adolescent girls in Treatment Group II, four adolescent girls (18.2%) were found to have low haemoglobin levels (below 12 g/dL). The study results showed that the average haemoglobin levels of adolescent girls in treatment group II changed after they took iron tablets combined with vitamin C for four weeks. A paired t-test revealed a p-value of 0.000 ( $p < 0.05$ ), indicating an average difference in haemoglobin levels of 0.904 mg/dL before and after the administration of iron tablets combined with vitamin C. This aligns with the findings of Andaruni and Nurbaety (2018), who found that administering iron tablets and vitamin C significantly increased haemoglobin levels in adolescent girls. Their study also found that vitamin C enhances the absorption of iron from plant-based (non-heme) sources. It is known that consuming 25–75 mg of vitamin C can increase the absorption of non-heme iron by up to four times. Vitamin C plays a role in iron absorption by reducing ferric iron to ferrous iron in the small intestine, making it easier to absorb. Vitamin C also enhances iron absorption from plant-based foods (non-heme). Consuming 25–75 mg of vitamin C can increase the absorption of non-heme iron fourfold (Pemkab.Gianyar, 2018).

**There was a difference in haemoglobin levels between treatment group I (iron tablets only) and treatment group II (iron tablets combined with vitamin C).** Based on the results of the independent t-test, there was a significant difference in haemoglobin levels between the two

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groups. The average haemoglobin level in treatment group I was 12.509 mg/dl, compared to 13.536 mg/dl in treatment group II. The average increase in haemoglobin level was 1.027 mg/dL. The p-value was 0.000 ( $p < 0.05$ ), meaning that  $H_0$  was rejected and  $H_1$  was accepted. This indicates a difference in haemoglobin levels between adolescent girls given iron tablets only and those given iron tablets combined with vitamin C. These findings are consistent with those of a study conducted on midwifery students, which also showed differences in haemoglobin level increases. The effect of haemoglobin levels on iron tablets and iron tablets combined with vitamin C (Briawan,2014). Vitamin C aids iron absorption by enhancing its absorption from food, and can help to overcome inhibition of iron absorption by phytates and tannins. It plays a role in forming soluble, easily absorbed iron-ascorbate complexes. Furthermore, vitamin C absorbs non-haem iron by converting ferric iron to ferrous iron in the small intestine, thereby facilitating absorption. Furthermore, vitamin C inhibits the formation of hemosiderin, a substance that is difficult to mobilise, thereby enabling iron to be easily released when needed (Astuti,2018). These findings are consistent with those of Wirawan et al. (2015), who showed that combining iron tablets with vitamin C resulted in a greater increase in haemoglobin levels than iron tablets alone (Susilo,2015). Iron is primarily absorbed in the duodenum and upper jejunum, where it can enter the bloodstream through the epithelial cells of the small intestine mucosa. When iron comes from an oral source, it is oxidised to  $Fe^{3+}$ , which requires an acidic gastrointestinal environment for absorption. Ascorbic acid, also known as vitamin C, plays a crucial role in creating a more acidic environment in the duodenum and jejunum, as well as preventing the oxidation of ferrous iron to ferric iron. By remaining in the ferrous form, absorption efficiency increases, as this form is easier to transport across the enterocyte cell membrane. Conversely, inhibitors such as alcohol, tannins and caffeine can reduce the efficiency with which iron is absorbed across all age groups. While some micronutrients other than vitamin C have been tested in non-pregnant women, they do not generally aid the absorption of ferric iron (Cahmbial,2013).

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## **CONCLUSIONS**

Based on the results of the study, it can be concluded that administering Fe tablets combined with vitamin C in Lembeng Village, Ketewel, resulted in differences in haemoglobin levels between treatment groups I and II, both before and after the test. This was determined by a paired t-test.

## **Conflict of Interest**

We declare that there is no conflict of interest in this research.

## **Acknowledgment**

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**CONFLICT OF INTEREST**

The author(s) declare that they have no conflict of interest.

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