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DOI: [10.31965/infokes.Vol21Iss2.1028](https://doi.org/10.31965/infokes.Vol21Iss2.1028)Journal homepage: <http://jurnal.poltekkeskupang.ac.id/index.php/infokes>**RESEARCH****Open Access****Effect of Soybean Juice on the Increase in Hemoglobin Levels among Adolescent Girls****Nancy Oliy<sup>1a\*</sup>, Salman<sup>2b</sup>, Wenny Ino Ischak<sup>3c</sup>, Iyam Manueke<sup>4d</sup>, Amelia Donsu<sup>4e</sup>, Siti Surya Indah Nurdin<sup>5f</sup>, Nurnaningsih Ali Abdul<sup>1g</sup>**<sup>1</sup> Department of Midwifery, Politeknik Kesehatan Kementerian Kesehatan Gorontalo, Gorontalo City, Gorontalo Province, Indonesia<sup>2</sup> Department of Nutrition, Politeknik Kesehatan Kementerian Kesehatan Gorontalo, Gorontalo City, Gorontalo Province, Indonesia<sup>3</sup> Department of Nursing, Politeknik Kesehatan Kementerian Kesehatan Gorontalo, Gorontalo City, Gorontalo Province, Indonesia<sup>4</sup> Department of Midwifery, Politeknik Kesehatan Kementerian Kesehatan Manado, Manado City, North Sulawesi Province, Indonesia<sup>5</sup> Department of Midwifery, Universitas Muhammadiyah Gorontalo, Gorontalo City, Gorontalo Province, Indonesia<sup>a</sup> Email address: [oliinancy7@gmail.com](mailto:oliinancy7@gmail.com)<sup>b</sup> Email address: [slmnlukman@gmail.com](mailto:slmnlukman@gmail.com)<sup>c</sup> Email address: [wennyischak@gmail.com](mailto:wennyischak@gmail.com)<sup>d</sup> Email address: [iyam.manueke@gmail.com](mailto:iyam.manueke@gmail.com)<sup>e</sup> Email address: [ameliyaksdonsu@gmail.com](mailto:ameliyaksdonsu@gmail.com)<sup>f</sup> Email address: [uyanurdin@gmail.com](mailto:uyanurdin@gmail.com)<sup>g</sup> Email address: [adekoabdul@gmail.com](mailto:adekoabdul@gmail.com)

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**Abstract**

The highest percentage of anemia occurs among adolescent girls, and one of the efforts to overcome such problem is iron supplementation along with iron-rich foods from animal sources such as red meat and marine products, as well as vegetable sources such as nuts. Soybean is a kind of iron-rich food which contains 8.0/100 g of iron. This study aims to observe the increase in hemoglobin levels after the administration of soybean juice among adolescent girls. This was a pre-experimental study with a one group pretest-posttest design. The populations consisted of 133 adolescent girls of VII and VIII graders with a sample size of 35 respondents who were selected by using purposive sampling technique. The respondents were given 250 ml of soybean juice for 21 consecutive days every morning. On the twenty-second day, the Hb levels of respondents were re-assessed (post-test). The blood sample taken was a capillary blood at the fingertip. The statistical test applied the Paired T-Test. The results revealed that hemoglobin levels of respondents who were given soybean juice increased by 12.06 g/dl with a difference of 1.62 g/dl. This study concluded that 250 ml soybean juice had an effect on the hemoglobin levels among adolescent girls. Adolescents are recommended to regularly consume iron-rich foods and beverages with various kinds of preparations such as soybean juice.

**Keywords:** Soybean juice, hemoglobin levels, adolescent girls, anemia.**\*Corresponding Author:**

Nancy Oliy

Department of Midwifery, Politeknik Kesehatan Kementerian Kesehatan Gorontalo, Gorontalo City, Gorontalo Province, Indonesia

Email: [oliinancy7@gmail.com](mailto:oliinancy7@gmail.com)

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## 1. INTRODUCTION

An increase in nutritional needs occurs in line with an increase in age of children, especially during the transition period from childhood to adolescence. Surely, several problems will also arise, one of which is nutritional problem. Anemia is a major problem, wherein the incidence is predicted to be 30% of the world community, especially in developing countries and mostly affects adolescents and pregnant women. Based on data derived from the Ministry of Health, 22.2% of nutritional anemia occurs among adolescents aged >15 years (Susanti et al., 2016).

Adolescent girls are one of the groups at risk for anemia with a greater risk than male adolescents due to monthly menstrual cycle and also unhealthy eating habits and patterns (lack of concern to nutritional content in foods consumed such as protein, carbohydrates, vitamins and minerals). The habit of consuming low-nutrient foods leads to insufficient intake of nutrients required for the synthesis process to form hemoglobin (Hb). Certain long lasting habit may cause a decrease in Hb levels followed by anemia (Safyanti & Andrafikar, 2018), (Suryani et al., 2017).

The most important event experienced by adolescent girls is the first menstrual cycle or so called menarche (Puspitasari, & Budiastuti, 2019), which lasts every month. Thus, adolescent girls become a group that has the potential to experience anemia, especially due to iron (Fe) deficiency (Permatasari, 2016). Anemia is a condition wherein the erythrocytes (red blood cells) count or the Hb concentration decrease beyond normal level. One of the causes of nutritional anemia is the lack of nutrients that function in the process of hemoglobin formation, which is caused by impaired absorption or poor consumption of nutrients required such as Fe, protein, and pyridoxine. Ascorbic acid affects the absorption and release of Fe from transferrin into body cells, and Alpha Tocopherol affects the erythrocyte membrane (Adriyani & Wirjatmadi, 2016).

The World Health Organization (WHO) explains that anemia is one of the most significant health problems, and WHO predicts the prevalence of anemia worldwide by two billion. The most significant trigger or cause of anemia in the world is iron (Fe) deficiency of around 50-80%. Therefore, it becomes the approach focal point often applied in substance-deficiency anemia (Masthalina et al., 2015). The 2018 Basic Health Research reported that the highest proportion of anemia was in the age group of 5-14 years (26.4 %), followed by the age group of 15-24 years (18.4% %) (Kementerian Kesehatan Republik Indonesia, 2018).

Data derived from the Gorontalo Provincial Health Office in 2019 revealed that 118 senior high school adolescent girls experienced anemia, mostly in one district in Gorontalo Province by 67 people (52%). Furthermore, 126 junior high school adolescent girls experienced anemia. Iron deficiency can lead to an adverse impact of a decrease in learning concentration, which further results in a decrease in learning achievement and work performance. Iron deficiency anemia may also causes a decrease in the body's resistance to infectious diseases, reduced body health, impaired growth, and a high risk in young marriage and pregnancy. Anemia is very influential issue for women, especially during pregnancy and childbirth since it may cause postpartum hemorrhage which may lead to maternal and/or neonatal mortality (Suryani & Sulastri, 2020).

In Indonesia, more than half of the population with anemia (57.1%) are adolescent girls and pregnant women of around 50.9% (Kementerian Kesehatan Republik Indonesia, 2018). Based on the data, it can be concluded that the highest percentage of anemia occurs among adolescent girls, and one of the efforts to overcome such problem is iron supplementation along with iron-rich foods from animal sources such as red meat and marine products, as well as vegetable sources such as nuts. Green beans and soybeans are types of beans with high iron content (Ekafitri & Isworo, 2014).

There are two kinds of anemia treatment, namely through pharmacological and non-pharmacological methods. Pharmacological treatment can be performed by taking one iron tablet every day during menstrual period. Meanwhile, non-pharmacological treatment can be performed by consuming iron-rich fruits and vegetables such as soybeans (Resmi & Setiani, 2020). Soybeans contain iron up to 8.0 mg per 100 grams, the majority of which is concentrated in the embryo and seed coat (Ekafitri & Isworo, 2014).

Soybeans contains protein and essential amino acids that are almost equivalent to the protein found in milk, eggs, and meat. In addition, anti-oxidants contained in soybeans can also prevent cancer. Minerals such as Ca, P, and Fe contained in soybeans also play a role in the body's metabolism (Ekafitri & Isworo, 2014), (Suryani & Sulastri, 2020). A previous study conducted by Lestari, et al proved that administration of 250 ml of soybean milk for 7 days was able to increase hemoglobin levels among students (Lestari et al., 2021). Furthermore, Astawan, et al explained that consumption of soybean tempeh had an effect on the increase in hemoglobin and erythrocyte levels among white rats (Astawan, 2019).

Based on several previously findings, the current study substituted soybean milk with soybean juice and increased the number of days of intervention to observe the effect of intervention on the increase in Hb levels. This study aims to analyse the effect of soybean juice on the increase in haemoglobin (Hb) levels among adolescent girls aged 12-14 years.

## 2. RESEARCH METHOD

This was a pre-experimental study with a one group pretest-posttest design. The study was conducted in one of the junior high schools in Bone Bolango Regency, Gorontalo Province. The populations consisted of 133 adolescent girls of VII and VIII graders with a sample size of 35 respondents who were selected by using purposive sampling technique based on inclusion and exclusion criteria. The inclusion criteria were Hb levels of <12 g/dl, permission from parents, were not having menstrual bleeding, not taking any supplements including Fe tablets, participated in the study from the beginning until the end. The exclusion criteria consisted of not following the complete intervention and experienced certain illness or disease. The data collection instrument used here was an observation sheet to record the Hb levels. Hb level assessment was performed using digital Easy Touch GCHb.

The study was conducted from January-March 2020 through the following steps: Before the intervention was applied, the authors provided clear information and asked the permission from parents as well as students' willingness by filling out an informed consent. The anemia status of the students was determined by assessing the Hb levels (Pre-test). Furthermore, 40 students of VII graders who met the inclusion criteria as respondents were selected. Respondents were administered with 250 ml of soybean juice. Soybean juice was made by the researchers and several enumerators distributed it to the respondents. The enumerators had tasks to distribute juice, assist the respondents to consume the juice, and record the findings on the observation sheet. The intervention was carried out among all respondents every morning for 21 consecutive days. 4 respondents could not continue consuming juice because they experienced menstruation during the intervention on the 4th and 10th days. In addition, 1 respondent did not continue intervention due to health problem. Thus, the final number of samples involved was 35 respondents. On the twenty-second day, the Hb levels of respondents were re-assessed (Post test). The blood sample taken was a capillary blood sample at the fingertip. The sampling was performed by skin puncture method, and Hb levels were assessed by Cyanmet Hb method.

The data obtained were further analyzed using SPSS 22 software. The frequency distribution and the characteristics of study subjects for each variable were analyzed using univariate test. Meanwhile, a bivariate analysis was conducted through a paired t-test.

The implementation of study protocols was based on approval letter provided by the Health Research Ethics Commission (KEPK) of Gorontalo Health Polytechnic number LB.01.01/KEPK/01/2020.

### 3. RESULTS AND DISCUSSION

**Table 1.** Characteristics of Respondents

Characteristic	Frequency	
	N	%
<b>Age</b>		
12 years old	12	34.29
13 years old	16	45.71
14 years old	5	14.29
15 years old	2	5.71

Table 1 presented that most of respondents were 13 years old as many as 16 adolescent girls (45.71%). 90% of adolescent girls experienced anemia at the age of less than 15 years. The result of previous study explained that adolescent girls aged <15 years had the potential to experience a higher risk of anemia than other age groups. Adolescent girls aged 13-15 years who have just experienced menstruation and have lost a lot of blood will be more susceptible to experience anemia. A study among female students conducted in Bogor revealed that the mean age of menarche was 13 years (Susanti et al., 2016).

An adolescent girl will be diagnosed with anemia if her erythrocyte count or Hb level is <12 g/dl. Adolescence is one of the factors of anemia. In fact, the need for iron increases along with the presence of menstruation and growth spurt. Moreover, adolescent girls are usually very concerned about body shape, so that many of them limit the amount of food consumed and undergo the wrong diet pattern (Permatasari, 2016), (Rusman, 2018).

**Table 2.** Distribution of Mean Hb Levels before and after soybean juice intervention.

Variable	Min	Max	Mean±SD (gr/dl)	Δ Change	p-value	CI Value	
						Lower	Upper
Hb levels before intervention	9.6	11.1	10.44 ±0.68	1.62± 0.67	0.001	1.631	1.193
Hb levels after intervention	11.3	12.9	12.06± 0.46				

Table 2 revealed an increase between before and after the administration of soybean juice. before the intervention of soybean juice, the mean Hb levels was 10.44 g/dl and increased to 12.06 g/dl with a difference of 1.62 g/dl after the administration of 250 ml of soybean juice for consecutive days. According to Farid (2022) the synthesis of Hb takes approximately 7-14 days to become mature and ready to be distributed throughout the body through red blood cells (erythrocytes). Hb is contained in erythrocytes, and has the same lifetime with erythrocytes of about 20 days (Farid et al., 2022).

The study findings showed that after the administration of soybean juice, the mean Hb levels increased from 10.44 g/dl to 12.06 g/dl with a difference between before and after intervention of 1.62 g/dl. Furthermore, the statistical test through the t-test obtained a p value of 0.001 ( $p < 0.05$ ). Thus, the null hypothesis ( $H_0$ ) was rejected, meaning that soybean juice was effective to increase the Hb Levels among adolescent girls.

Before soybeans were made into juice, they were processed through soaking, boiling and mashing to facilitate the absorption of nutrients (Winham et al., 2017). Beans also contain phytic acid which can inhibit the absorption of minerals such as Fe, Zn and Ca. The levels of phytic acid in nuts can be reduced by soaking them before processing. Moreover, the

digestibility of protein in nuts is only around 77% due to anti-nutritional factors, such as anti-trypsin and tannins, so that soaking should be performed before processing (Ekafitri & Isworo, 2014).

An increase in Hb levels after soybean juice intervention is related to the fact that soybeans have a fairly high level of dietary fiber as well as iron contents. 100 grams of soybeans contain 331 cal of calories, 34.9 grams of protein, 18.1 grams of fat, 227 mg of Ca, 585 mg of P, 8 mg of Fe, 34.8 grams of carbohydrates, 110 SI of vitamin A, 1.07 mg of vitamin B1, and 7.5 grams of water (Lestari et al., 2021).

The study findings are in line with a study conducted by Suryani which concluded that there were changes in Hb levels and oxygen saturation among adolescent girls after being given half a glass of soybeans (Suryani & Sulastrri, 2020). A similar finding was also found in a previous study which concluded that there was an increase in Hb levels among adolescents after the intervention of soybean milk for 7 days (Aulia, 2019). Furthermore, according to Cahyadi, soybeans have a high iron (Fe) content of 8.0 mg compared to green beans of only 6.7 mg. Such content is a substance that is required by the body, especially for the formation of erythrocytes (Retnorini et al., 2017).

In general, iron absorption in the body is in the form of ferrous ( $\text{Fe}^{2+}$ ), while soybeans contain iron in the form of ferric ( $\text{Fe}^{3+}$ ). The increase in Fe absorption can be supported by consuming ascorbic acid at the same time, since ascorbic acid can convert  $\text{Fe}^{3+}$  into  $\text{Fe}^{2+}$ . The amount of Fe in the body affects the formation of hemoglobin levels.<sup>(14)</sup> Another study revealed that there was a relationship between Fe intake and blood Hb levels among adolescent girls aged 12 to 25 years, which was due to the presence of iron (Fe) as the main element that functions in the blood formation process (Siallagan et al., 2016).

In the current study, it was found that after soybean juice intervention, there were still 2 respondents (3.3%) who did not experience an increase in Hb levels. Such finding can be due to difference in personal absorption process, which is influenced by the dietary regulator. After iron administration, the absorptive cells can be resistant to iron absorption for some time (Putri & Isnaeni, 2017).

Researchers also assumed that no increase in Hb levels can be caused by poor pattern of fruits and vegetables consumption, especially those containing iron (Fe) and vitamin C (ascorbic acid) (Olii, et al., 2022), (Suryani et al., 2017), and also due to frequent consumption of tea and milk that are known to inhibit the absorption of iron in the body. Therefore, to facilitate the absorption of Fe in the intestine, it is recommended to consume vitamin C (ascorbic acid)-rich foods such as dragon fruit, Ambon banana, oranges, and guava (Olii, 2020), ((Putri & Isnaeni, 2017), (Fitriani & Panggayuh, 2017). In addition, it is recommended to avoid the consumption of foods containing tannins, Ca, P, and phytic acid. Tannins and phytic acid may bind and inhibit the absorption of iron from food (Siallagan et al., 2016).

Another study conducted by Irianto also reveal similar finding that lack of iron was the most common cause of anemia in women. Iron (Fe) is needed to form erythrocytes. Adolescent girls need more iron than young man, so they need to consume iron-rich foods such as red meat, liver, fish, chicken, as well as vitamin C-rich foods which can help iron absorption (Yulianti et al., 2016), (Suryani et al., 2017).

Several efforts can be made to increase the Hb level of adolescent girls in order to reduce the incidence of anemia, namely by regularly consuming soybeans in various forms, one of which is juice (Olii, et al., 2022), (Nurhayatun et al., 2020), (Oktaviani et al., 2020), (Magfirah, 2019). It is also necessary to consume quality foods high in iron content such as red meat, liver, fish, chicken meat, green compounds, fruits, as well as vitamin C-rich foods which can help iron absorption (Sonawane, 2017), (Cia et al., 2021), (Hardimarta et al., 2018). Consuming 250 ml of soybean juice was found to be effective in increasing Hb levels. The outcome will be even more effective if it is taken together with Fe tablets.

#### 4. CONCLUSION

Administration of 250 ml of soybean juice for 21 consecutive days could increase hemoglobin levels among adolescent girls. Adolescent girls are recommended to regularly consume iron-rich foods and beverages with various kinds of preparations such as soybean juice. It is also recommended to conduct further study on the effect of consumption of soybeans along with vitamin C on Hb levels.

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