

Effects of yoghurt on haemoglobin levels as a preventive measure against anaemia in adolescents

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Abstract. Anaemia is a highly prevalent global health issue, affecting approximately 37% of the population. In lower-income countries, the incidence of anaemia among teenage girls is exceptionally high, with around 53.7% of all adolescents affected. The administration of yoghurt enriched with probiotics and long-chain inulin demonstrated the most favourable outcomes regarding iron supplementation, bioavailability, and antioxidant activity. This study aims to assess yoghurt's efficacy in improving teenagers' haemoglobin levels. This study employed an experimental approach, utilizing a one-group pretest-posttest design and purposeful sampling of 48 adolescents with anaemia. This treatment group consisted of two groups: group A, which was administered blood supplement tablets (FEE) Group B with yoghurt administration, and group C, which served as the control group without any treatment. Each individual received a daily allocation of 200 ml of yoghurt for two weeks. Before and after yoghurt feeding, haemoglobin levels of the adolescents were checked. The Hb level of adolescents before consumption was found to be 12.6 gr/dl on average, while the Hb level of adolescents who consumed Fe tablets and yoghurt after consumption was 13.1 gr/dl on average. T-test analysis showed a statistically significant difference in haemoglobin levels in adolescents before and after yoghurt consumption. Yoghurt consumption was shown to increase haemoglobin (Hb) levels in adolescents, leading to the conclusion that yoghurt consumption has a positive impact on Hb levels.

1. Introduction

Anaemia in adolescents can result in decreased immunity, concentration, learning achievement, adolescent fitness and productivity. Anaemia is an extreme health problem worldwide with a prevalence of 37%, most of which occurs in people in lower-income countries such as Southeast



Asia and Africa. According to the World Health Organization (WHO), the incidence of anaemia among adolescent girls in lower-income countries is around 53.7% of all adolescent girls [1]. The results of the Riskesdas [2] showed that the prevalence of anaemia in Indonesia was 23.7% with a proportion of 22.7% in urban areas and 25.0% in rural areas and 23.9% of women. Based on age groups, anaemia sufferers at the age of 15-24 years were 32.0%, and in adolescent girls and women of childbearing age 13-49 years were 22.7% each [3]. The prevalence of anaemia in West Sumatra Province among women was 29.8%. According to data obtained from the West Sumatra Provincial Health Office in 2018 regarding the screening of all junior and senior high school students in districts and cities within West Sumatra Province, there were 5,270 junior and senior high school students who were netted, including 3,837 adolescent girls and 1,433 adolescent boys [4].

The most common cause of anaemia is nutrient deficiency. The underlying causes of nitric anaemia include inadequate intake, inadequate absorption, increased nutrient losses, and excessive demand. Iron deficiency is the most common nutritional deficiency in both higher-income and lower-income countries. A blood supplementation programme for adolescents has been launched which has a national target. However, in the field, the provision of blood supplementation tablets focuses more on pregnant women. This is why the incidence of anaemia in adolescent girls is still high. In addition, some things that can cause anaemia include poor nutrient intake, menstruation, infectious diseases, and lack of knowledge [5].

One method that is now gaining attention to overcome anaemia is the use of probiotics such as yoghurt. Yoghurt contains good bacteria that can help increase iron absorption in the body. Lactic acid-forming bacteria, including lactobacilli, are thought to increase dietary iron bioavailability through several mechanisms such as lowering gut pH [6], shifting gut microbiota metabolism and metabolite formation [6,7,8], and enhancing anti-inflammatory immunomodulation [9]. In addition, probiotics can also be involved in mineral metabolism (calcium (Ca), iron (Fe), magnesium (Mg), selenium (Se), potassium (K), copper (Cu), zinc (Zn), etc.), which facilitates their absorption [10]. Research shows that the level of minerals in the human body is mainly related to their intake from food. At the same time, the function of the human body is not only related to the amount of minerals but also the proportion and percentage of their absorption [11]. This suggests that probiotics may affect mineral absorption in the body. Some types of probiotics have been found to increase the absorption of certain minerals, while others may inhibit or have no effect on mineral absorption [12,13,14].

Plain (Cimory) yoghurt containing long-chain inulin showed the best effect in terms of iron supplementation, bioavailability, and antioxidant activity. This formula may be a potential new iron supplement and a good functional food candidate. Based on the phenomenon and description above, this article aims to find out about the Effectiveness of Yoghurt on the increase of haemoglobin in adolescent girls.

2. Materials and Methods

The population of respondents in this study were all female adolescents of the DIII Midwifery Study Program, Faculty of Vocational Studies in 2021 and 2022, namely 64 respondents, while the sampling technique was *purposive sampling*, namely 48 samples who experienced anaemia.

2.1 Characteristic respondents

Univariate analysis to describe each variable studied. The variables studied were knowledge and attitude of adolescents about 'Anaemia'.

2.2 Blood Haemoglobin Level Analysis

Haemoglobin test can be done by pricking the fingertip (finger prick). Blood is then tested directly with a digital haemoglobinometer (Easy Touch GCHb) with a sensitivity of 89.4% and specificity of 63.6%.

2.3 Statistical Analysis

Bivariate analysis to see the difference between before and after anaemia. Because the data were normally distributed (pvalue>0.05), the Paired T test was conducted.

2.4 Ethical research

The Ethics Committee of the Medical Faculty of Andalas University authorized the ethics clearance (No: 552/UN.16.2/KEP-FK/2024). Written informed consent was obtained from all subjects before to the study after they received information about the procedures.

3. Result and Discussion

3.1 Characteristic Responden

From the univariate results related to respondent data collection by looking at age, body mass index and Hb levels before starting treatment. The results of this study can be seen in the following table.

Table 1. Frequency Distribution of Respondent Characteristics

Characteristics Responden	F	Persentase (%)
Age		
20 Years	12	28,5%
21 Years	14	29,1%
22 Years	11	22,9%
23 Years	11	22,9%
Total	48	100%
BMI		
Very thin	8	16,6%
Skinny	12	28,5%
Normal	19	42,2%
Fat	9	18,7%
Total	48	100%
Hb Before		
10,3-10,9 gr/dl	9	18,7%
11,3-11,9 gr/dl	19	42,2%
12-12,9 gr/dl	12	28,5%
13-13,7 gr/dl	4	8,3%
14-14,2 gr/dl	4	8,3%
Total	48	100%

The frequency distribution of respondent characteristics based on age found that the age range of respondents was 20-23 years. Based on BMI, it was found that a small proportion of female students (16.6%) had a very thin BMI, (28.5%) had a thin BMI, a small proportion of female students (18.7%) had a fat BMI and most female students (42.2%) had a normal BMI. Based on Hb before hemoglobin levels were obtained 10.3-10.9 gr/dl as many as 9 people

(18.7%), hemoglobin levels 11.3-11.9 gr/dl as many as 19 people (42.2%), hemoglobin levels 12-12.9 gr/dl as many as 12 people (28.5%), hemoglobin levels 13-13.7 gr/dl as many as 4 people (8.3%), and hemoglobin levels 14-14.2 gr/dl as many as 4 people (8.3%). The normal Hb level in adolescent girls is >12g/dl. Adolescent girls will be said to suffer from anaemia if the Hb level is <12g/dl [15].

3.2 Haemoglobin Levels

Table 2. Mean haemoglobin levels before and after treatment

Treatment		Average	Sd	P value
Group A	Pretest	11,6	,93986	0,002
	Posttest	12,5	,83680	
Group B	Pretest	12,6	,90365	0,002
	Posttest	13,1	,79444	
Control	Pretest	11,1	,32602	0,498
	Posttest	11,1	,20207	

In table 2 it can be seen that in group A with the administration of blood supplement tablets (Fe) there was an increase in Hb levels as well as group B with the administration of yogurt it is known that there was also an increase from before and after administration for the respondent's Hb levels. Based on the results of the study, it can be seen that in the group before being given blood supplement tablets treatment, the mean value of haemoglobin levels was 11.6 standard deviation ,92986 and after treatment there was an increase in haemoglobin levels to 12.5 standard deviation ,83680 with a *p-value* of 0,002<0.05 which means there is a difference between before and after treatment. While in the group before being given yoghurt, the average value was 12.6 standard deviation ,90365 and after being given the treatment there was an increase in haemoglobin levels to 13.1 standard ,79444 with a *p-value* of 0.002 <0.05 which means there is a difference between before and after treatment. And in the control group, it was found that there was no increase and decrease, namely haemoglobin before the average value of 11.1 standard deviation ,32602 and haemoglobin after the average value of 11.1 standard deviation ,20207 with a *p-value* of ,498>0.05, which means that there was no effect on the control group.

The results of this study are in line with research conducted by Mutmainnah [16] that adolescent girls at Pondok Pesantren Miftahul Khoer Tasikmalaya before giving Fe tablets all adolescents experienced anaemia with a mild category of 28 people (100%), The test results of changes in Hb levels obtained a t value of -13.031 with a significance level (*pvalue*) of 0.000, which means that there is an effect of giving Fe tablets on changes in Hb levels in adolescent girls.

The increase in blood Hb levels after yogurt administration is related to the effect of probiotics contained in yoghurt on iron absorption in the intestine, this is due to the presence of *Lactobacillus* and *Bifidobacterium* as a starter in making yogurt where these two bacteria can change the pH of the intestine to become more acidic, which plays an important role in increasing the solubility of non-heme iron (iron from plant sources). With increased solubility, iron is more easily absorbed by the body. The study by Vorheid et al. [17] showed that consumption of probiotic yoghurt was able to increase iron absorption in iron-deficient experimental animals, thereby increasing their Hb levels. These acidic conditions may help maintain the stability of iron in the form of ferric ions (Fe²⁺), which are more easily absorbed by

the intestinal mucosa. Research by Rusu et al. [18] showed that lactic acid from yoghurt can reduce the binding of iron by anti-nutrient compounds (such as phytates), which usually inhibit iron absorption.

One way in which GM can interact with minerals is by producing enzymes that can break down complex minerals, making them more accessible to the host for absorption [19]. A lack of beneficial bacteria in the gut can lead to decreased phytase production, resulting in decreased mineral absorption [20]. In addition, the effect of consuming foods containing probiotics can also inhibit inflammation due to the antiinflammatory properties of probiotics. Inflammatory conditions in the gut can inhibit iron absorption. By reducing inflammation, probiotics can help optimise iron absorption and, in turn, increase haemoglobin levels. Markowiak & Śliżewska [21] showed that consumption of probiotics in yoghurt can reduce gastrointestinal inflammation and support a healthy environment for iron absorption. Consumption of yogurt with probiotic content in daily life for 14 days can increase blood haemoglobin levels in adolescent girls with an increase from 12.6 to 13.1 g/dl.

4. Conclusion

Consumption of yogurt and blood supplement (Fe) tablets had an effect on haemoglobin levels before and after being given to adolescents. Consumption of yogurt with probiotic content in daily life for 14 days can increase blood haemoglobin levels in adolescent girls with an increase from 12.6 to 13.1 g/dl.

Reference

- [1]. World Health Organization 2018 Global Nutrition Targets 2025. Anaemia Policy Brief
- [2]. Kementerian Kesehatan Republik Indonesia 2018 *Laporan Nasional Risetdas 2018*. Jakarta: Kementerian Kesehatan RI
- [3]. Mayasari N, Devita H & Utami A 2022 The Relationship of Knowledge About Anemia with Anemia Status in Adolescent Women in SMA N 07 Padang. *Jurnal Ibu Dan Anak*, **10** (2), 82-87.
- [4]. Badan Penelitian dan Pengembangan Kesehatan Kementrian Kesehatan RI 2018 Riset kesehatan dasar provinsi Sumatera Barat tahun 2018. *Laporan Risetdas Nasional 2018*. 2018. **131** p
- [5]. Sholicha C A and Muniroh L 2019 Correlation Between Intake of Iron, Protein, Vitamin C and Menstruation Pattern with Haemoglobin Concentration among Adolescent Girl in Senior High School 1 Manyar Gresik. *Media Gizi Indonesia*. **14**, 2 (Jul. 2019), 147–153.
- [6]. Hoppe M, Onning G, Hulthen L 2017 Freeze-dried *Lactobacillus plantarum* 299v increases iron absorption in young females-Double isotope sequential single-blind studies in menstruating women. *PLoS ONE*. **12** :e0189141.
- [7]. Mack D R, Ahrne S, Hyde L, Wei S, Hollingsworth M A 2003 Extracellular MUC3 mucin secretion follows adherence of *Lactobacillus* strains to intestinal epithelial cells in vitro. *Gut*. **52** 827–833
- [8]. Gonzalez A, Gálvez N, Martín J, Reyes F, Pérez-Victoria I, Dominguez-Vera J M 2017 Identification of the key excreted molecule by *Lactobacillus fermentum* related to host iron absorption. *Food Chem*. **228** 374–380
- [9]. Wells J M 2011 Immunomodulatory mechanisms of lactobacilli. *Microb. Cell Fact*. **10** (Suppl. S1): S17

- [10]. Czajeczny D, Kabzińska-Milewska K, Wójciak R W 2021 Bifidobacterium Lactis Bs01 and Lactobacillus Acidophilus La02 Supplementation May Change the Mineral Balance in Healthy Young Women. *Journal of Elementology*. **26**(4):849–859
- [11]. Weyh C, Krüger K, Peeling P, Castell L 2022 The Role of Minerals in the Optimal Functioning of the Immune System. *Nutrients*. **14** (3) 1–15.
- [12]. Behera J, Ison J, Tyagi S C, Tyagi N 2020 The role of gut microbiota in bone homeostasis. *Bone*. **135** (January) doi: 10.1016/j.bone.2020.115317.
- [13]. Katarzyna S, Joanna S 2017 Association between the gut microbiota and mineral metabolism. *Jour. Scie of Food and Agri*. **28** (3) 303–325. doi: 10.1002/j.
- [14]. Scholz-Ahrens KE, Ade P, Marten B, Weber P, Timm W, Açil Y, Glüer C C 2007 Schrezenmeir J. Prebiotics, probiotics, and synbiotics affect mineral absorption, bone mineral content, and bone structure. *Journal of Nutrition*. **137** (3) doi: 10.1093/jn/137.3.838s.
- [15]. Proverawati A dan Siti A 2011 *Buku Ajar Gizi untuk Kebidanan*, Yogyakarta. Nuha Medika. Cetakan I
- [16]. Mutmainah E H, Mardiah S S, Astiriyani E 2018 Pengaruh Pemberian Tablet Fe Terhadap Perubahan Kadar Hb Pada remaja putri Di Pondok pesantren miftahul khoer Tasikmalaya Tahun 2018. *Jurnal Kesehatan Bidkemas*. **9** (2)
- [17]. Vonderheid S C, Tussing-Humphreys L, Park C, Pauls H, OjiNjideka Hemphill N, LaBomascus, B, McLeo, A, & Koenig M D 2019 A Systematic Review and Meta-Analysis on the Effects of Probiotic Species on Iron Absorption and Iron Status. *Nutrients*, **11** (12), 2938.
- [18]. Rusu I G, Suharoschi R, Vodnar D C, Pop C R, Socaci S A, Vulturar R, Istrati M, Moroşan I, Fărcaş A C, Kerezsi A D, Mureşan C I, & Pop O L 2020 Iron Supplementation Influence on the Gut Microbiota and Probiotic Intake Effect in Iron Deficiency-A Literature-Based Review. *Nutrients*, **12** (7) 1993
- [19]. Zhou D, Zhao Y, Li J, Ravichandran V, Wang L, Huang Q, Chen C, Ni H, Yin J 2021 Effects of Phytic Acid-Degrading Bacteria on Mineral Element Content in Mice. *Frontiers in Microbiology*. **12** (November) 1–10. doi: 10.3389/fmicb.2021.753195.
- [20]. Nath A, Molnár M A, Csighy A, Kőszegi K, Galambos I, Huszár K P, Koris A, Vatai G 2018 Biological activities of lactose-based prebiotics and symbiosis with probiotics on controlling osteoporosis, blood-lipid and glucose levels. *Medicina (Lithuania)* **54** (6) 1–28. doi: 10.3390/medicina54060098.
- [21]. Markowiak P & Śliżewska K 2017 Effects of Probiotics, Prebiotics, and Synbiotics on Human Health. *Nutrients*, **9** (9) 1021. <https://doi.org/10.3390/nu9091021>