

# Effect of Empowerment Program on the Blood Indicators of iron Deficiency Anemia in Teenage Girls

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## Abstract:

**Background:** More than 30% of the world's population are suffering from anemia, most of which are of iron deficiency type. Anemia as a chronic disease requires behavioral and lifestyle adjustments. Since the school environment is the best and most prepared place to improve the level of public health and considering the importance of this disease in teenage girls as future mothers, the present research was conducted with the aim of investigating the effect of empowerment program on the blood indicators of iron deficiency anemia in teenage girls.

**Methods:** Teenage girls between 15-18 years of age with similar socioeconomic background were recruited from two high schools in Tehran/Iran for the study. They were all screened and categorized into two groups depending on their hematological indicators of iron deficiency anemia. The intervention group participated in 8 group empowerment sessions for 2 months, while the control group did not attend.

**Results:** Before the intervention, there was no significant difference in the mean score of hematological indicators in teenagers between the test and control groups ( $P > 0.005$ ). Except for Hb, HCT, MCHC, the mean scores of serum ferritin, TIBC, MCV, and MCH in teenagers of the experimental group before and after the intervention had a significant difference ( $P < 0.005$ ) while in the control group, there was no change in any of these indicators.

**Conclusions:** The lifestyle change program with nutritional modification should be adopted with the participation of parents and integrated into comprehensive empowerment programs to target iron deficiency anemia among adolescents at different levels in Iran.

**Key words:** teenagers; girls; empowerment; iron deficiency; anemia

## Introduction

Anemia is a decrease in the volume or concentration of hemoglobin(Hb) below the level that exists in healthy people according to gender (<120g/l in women and <140g/l in men) (1). Iron deficiency anemia (IDA) is the most common nutritional deficiency in the world(2). According to national statistics, about 20% of all Iranian women of reproductive age suffer from iron deficiency (ID)(3). ID without anemia represents a moderate depletion of iron stores, without a reduction in Hb concentration(4). IDA is a subtype of anemia, resulting from chronic, inadequate iron supply or increased iron losses, leading to a reduction in concentrations of reticulocytes(Ret), hemoglobin(Hb), hematocrit(HCT), as well as storage iron markers such as serum ferritin(SF) and transferrin saturation (TSAT) (5).

One of the most common causes of ID is acute blood loss, such as that which occurs in gastrointestinal (GI) bleeding, trauma, surgery, and postpartum bleeding(6). Other causes include malnutrition, decreased iron absorption, celiac disease, use of erythropoietin-stimulating agents (ESAs), chronic illness, gastric bypass surgery, and congenital ID, parasitic diseases, and heavy menstrual bleeding(5, 7). The prevalence of IDA in girls increases after puberty due to monthly bleeding and a growth spurt. These girls suffer from severe ID after marriage and after pregnancy(8). Inadequate iron reserves before pregnancy are the main cause of ID during pregnancy, and even in mild stages, it leads to increased infant and maternal mortality, intrauterine growth retardation, risk of low birth weight (>2500 grams), and premature birth in pregnant

women(9). Obviously, in the severe stages of deficiency, anemia appears as a serious problem in sufferers(10). Thus, the health of this age group is at risk.

Currently, in some countries, screening programs for early detection of ID and the resulting anemia are carried out in at-risk populations such as children and women(11, 12). Research shows that consumption of foods containing iron, following a proper nutritional pattern along with the administration of iron supplements, can reduce the occurrence of anemia in children and women(11, 13). Therefore, considering the high prevalence of iron deficiency anemia in society and its importance, especially in women of childbearing age, interventions to empower this group of society in order to improve nutrition-oriented health behaviors seem necessary.

Empowerment is a simple and positive concept that refers to the possibilities and abilities of people and their surroundings, in order to identify problems, inadequacies, and interventions(14). Empowerment is one of the accessible goals in terms of public health, where people try to improve their health by actively participating and making decisions(15). Since the disease is very common in teenage girls as future mothers and causes severe complications, the present study was conducted with the aim of investigating the effect of the empowerment program on the blood indicators of iron deficiency anemia in teenage girls.

## Methods

This research is a semi-experimental study. Using Pocak's formula and Gigi's table, and the results of the same article, with 95% confidence and 80% test power, and considering the attrition rate, the required number of samples was determined to be 60 samples in two groups(16).

$$n = \frac{(z_{1-\alpha/2} + z_{1-\beta})^2 (s_1^2 + s_2^2)}{(\bar{x}_1 - \bar{x}_2)^2} = \frac{(1.96 + 0.84)^2 (0.65^2 + 0.6^2)}{(3/72 - 4/2)^2} = 26 \cong 30 \Rightarrow 30 \times 2 = 60$$

The criteria for entering the study were: teenage girls between 15-18 years, having hemoglobin less than 12 grams per deciliter (g/dl) and serum ferritin less than 15 mg per deciliter (mg/dl) (17), not suffering from infectious and parasitic diseases, not under medication or special diet, desire to participate in the research, have a specific address and phone number for follow-up.

The exclusion criteria were: getting sick during the intervention, not attending training sessions.

First, the project was approved by the research council and medical ethics committee of Tarbiat Modares University. Then, the researcher, with a letter of introduction, went to two girls' high schools in Tehran, which were randomly assigned to two control and test groups.

After the necessary coordination with high school officials, an introductory meeting was held to explain the goals of the plan to the girls and their parents. The intervention method, the right to enter and exit the study, and the confidentiality of the data were explained, and written consent was obtained from all participants.

Students who had symptoms of IDA or were sure of having it were asked to go to a laboratory center where the accuracy of its devices had been checked for a blood test.

On a certain day, 5 cc of blood was taken from each sample, fasting at a specific time (8-10 am). Cell counting was done by the Colter T890 machine, and iron and transferrin saturation index (TSAT) were measured by the calorimetric method using Pars Azmoun kits and biochemistry RA-1000 autoanalyzer, and the ELISA method and antibody kit were used to measure ferritin.

After the blood test, in both schools, 30 students with the necessary indicators of anemia (Hb less than 12 g/dL and SF less than 15 µg/dL, transferrin saturation index (TSAT) or transferrin saturation percentage less than 10% and TIBC more than 400 (µg/dL) were randomly included in the study.

After that, the students in the test group were divided into 5 groups of 6 people. 8 educational sessions were held with the aim of empowering teenagers (increasing knowledge, self-efficacy, self-control, self-esteem) in the form of group discussions, about ways to prevent anemia, such as choosing a diet rich in iron and vitamin C, how to properly cook and prepare food, how washing hands properly, and how to clean vegetables.

At the end of each training session, the teenagers were given educational content in the form of educational cards and they were asked to teach all the content to their mothers. Considering that there is a possibility that the mothers were not empowered through the education of the teenager and studying the educational card, they were invited to the school to discuss the contents that the teenager taught them and what they learned from the educational card during 1-2 sessions. In this way, the researcher found out how successful the students were in transferring educational materials. Finally, 3 months after the start of the intervention, blood tests were taken from the students in the same laboratory.

Data analysis was done using SPSS<sub>16</sub> statistical software using descriptive and analytical statistics, paired t-test, and independent t-test.

## Results

The comparison of the mean indicators of IDA before the intervention between the test and control groups with the independent t-test did not show any significant difference ( $P > 0.05$ ), and the two groups were the same. However, the comparison of the mean indicators of iron deficiency anemia, except for Hb, HCT, and MCHC, after the intervention in the test and control groups showed a significant difference ( $P \leq 0.05$ ).

Also, the comparison of the mean indices of Hb, HCT, and MCHC in adolescents under the study before and after the intervention in the experimental and control groups did not show a significant difference with the paired t-test. The comparison of the mean indicators of IDA in adolescents before and after the intervention in the test group shows a significant difference with the paired t-test, and the changes were positive and significant ( $P \leq 0.05$ ). But there was no significant difference in any of the Iron deficiency hematological indicators in the control group ( $P > 0.05$ ) (Table 1). It should be noted that although Hb, HCT, and MCHC indicators increased in the test group after the intervention, these changes are not significant.

Variable	Time	Test M ± Sd	Control M ± Sd	P-value
Hemoglobin (g/dl)	Before	10.0 ± 87.68	10.0 ± 88.67	*P=0.940
	After	10.0 ± 95.57	10.0 ± 88.65	*P=0.639
		**P=0.136	**P=0.740	
Hematocrit (%)	Before	35.0 ± 02.65	35.0 ± 05.64	*P=0.891
	After	35.0 ± 13.56	35.0 ± 06.63	*P=0.676
		**P=0.084	**P=0.743	
MCV (fl)	Before	79.2 ± 80.07	79.2 ± 74.18	*P=0.925
	After	82.1 ± 20.92	79.2 ± 70.13	*P=0.000

		**P=0.000	**P=0.468	
<b>MCH (Pg)</b>	Before	24.1±54.24	24.1±57.21	*P=0.941
	After	25.1±16.03	24.1±58.25	*P=0.05
		**P=0.000	**P=0.884	
<b>MCHC (g/dl)</b>	Before	31.1±02.38	31.1±03.45	*P=0.961
	After	31.1±17.21	31.1±02.41	*P=0.642
		**P=0.247	**P=0.667	
<b>serum iron (mg/dl)</b>	Before	41.4±92.46	41.4±94.68	*P=0.983
	After	54.1±69.61	42.4±91.58	*P=0.000
		**P=0.000	**P=0.262	
<b>serum ferritin (ng/ml)</b>	Before	12.1±51.48	12.1±67.52	*P=0.670
	After	16.1±98.09	12.1±73.41	*P=0.000
		**P=0.000	**P=0.260	
<b>TIBC (mg/dl)</b>	Before	453.33±55.55	452.32±93.78	*P=0.951
	After	342.14±77.18	451.32±13.03	*P=0.000
		**P=0.000	**P=0.93	
<b>Transferrin saturation percentage (%)</b>	Before	9.1±34.57	9.1±35.58	*P=0.972
	After	15.0±98.76	9.1±59.47	*P=0.000
		**P=0.000	**P=0.211	
* <i>Independent t-test</i>				
** <i>Paired t-test</i>				

**Table 1:** Comparison of laboratory indicators of iron deficiency anemia in two groups before and after the intervention

## Discussion

Since many diseases in children, such as obesity, iron deficiency anemia, constipation, diabetes, etc., are caused by unhealthy family lifestyles, parents' cooperation plays a very important role in controlling and preventing them(18, 19). For this reason, in this study, it was tried to have parents accompany the teenager in the empowerment sessions so that the change in the lifestyle pattern in nutrition happens in the whole family. As the results of this study showed, the comparison of values of mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH) before and after the intervention was significant. Also, according to the statistical test comparing the average values of serum iron (SI), serum ferritin (SF), and total iron binding capacity (TIBC), the percentage of transferrin saturation (TSAT) before and after the intervention was significant, while there was no significant difference in any of the indicators in the control group. not seen. As a result, it can be concluded that the educational intervention during 8 two-month sessions was able to influence the specific blood indicators of iron deficiency by empowering the adolescent and an active member of the family by modifying the diet and health principles, and we saw an increase in body iron reserves in the test group.

In a study, Prentice et al, (2017) showed that changing dietary habits and using foods rich in iron is a suitable solution for improving indicators in people with anemia(20). In a study on elementary school girls in Zahedan city, Irandegani et al, (2019) showed that educational intervention based on nutrition during 2 months can have a positive and significant effect on Hb, HCT, and SF(21). Although Hb and HCT did not change in the present study, other specific indicators of IDA improved. Maybe the reason is the age of the students. In other words, the girls in the present study were at the age of menarche, which may be the reason for the unchanged hemoglobin and hematocrit.

Gosdin et al.(2022) showed in a study that taking iron tablets for 37 weeks causes significant changes in the hemoglobin and hematocrit status of teenage girls(22). Although no changes were seen in Hb and HCT in the current study, instead of using pills, we used a change in the diet rich in iron and vitamin C, and maybe that's why only the change in iron and ferritin storage was achieved. The results of the study by Skolmowska et al, (2022) also showed that nutrition education for female students, although due to the short duration, did not have a significant effect on the reduction of anemia, but it had a positive effect on the amount of total

iron and homogenized iron(23) which is in line with the findings of the present study.

In line with the results of the present study, Ahmadpour et al.,(2017) and Parvin et al.,(2021) showed that face-to-face training had an effect on the knowledge, attitude, and performance of female students regarding the prevention of iron deficiency anemia(24, 25). In the present study, by conducting group discussions and practical exercises, it was made to increase the awareness of teenagers about iron deficiency anemia. Empowerment sessions were such that the students could practically prepare a diet rich in iron and vitamins according to their needs. Based on the positive changes made in specific blood indicators of iron deficiency, it can be said that after 8 sessions of empowerment, the knowledge and performance of teenagers regarding anemia has increased. Therefore, it can be hoped that by improving the performance, an important step will be taken in the direction of preventing anemia caused by iron deficiency and improving the health of female students who are future mothers.

## Conclusion

According to the improvement of the iron deficiency blood indicators of the studied subjects, it can be concluded that the family-oriented empowerment model has a favorable effect by increasing the ability of students and mothers to modify the dietary pattern in the third level prevention. It is suggested that this study be carried out on different age and gender groups that are exposed to iron deficiency and with a larger number of participants and over a longer period of time. Among the limitations of the current research, we can point out the difference in personal characteristics and mental and psychological conditions of adolescents in response to the intervention and its effect, the effect of environmental and individual factors on their understanding of the family-centered empowerment model.

## Competing interests

There is no conflict of interest between the authors of this article.

## Ethics approval and consent to participate

This research was conducted in accordance with the Declaration of Helsinki in 1995 (as revised in Brazil in 2013). The code of ethics was obtained from the Biological Committee of the Ministry of Health and the necessary permits were obtained from the officials (number 52/3528). Before starting the research, the researcher introduced herself to the

teenagers and mothers and explained how to conduct the research. Regarding the confidentiality of their personal information and the right to withdraw freely from the study at any time, they were assured. An informed consent form was obtained from all teenagers and mothers. The researcher emphasized that no financial burden will be imposed on the participants. Also, in terms of respecting the ethical issues of the research, after the completion of the intervention, all educational issues about iron deficiency anemia were taught to teenagers and their mothers in the control group. An educational booklet was given to them.

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## List of abbreviations

%= percentage

ESAs: erythropoietin stimulating agents

fl:femtoliters

g/dl: grams per deciliter

g/l: grams per liter

Hb: hemoglobin

HCT: hematocrit

ID: iron deficiency

IDA: Iron deficiency anemia

MCH: mean corpuscular hemoglobin

MCHC: mean corpuscular hemoglobin concentration

MCHC: mean corpuscular hemoglobin concentration

MCV: mean corpuscular volume

mg/dl: miligrams per deciliter

ng/mL: Nanograms per millilitre

P= Pvalue

Pg: picograms

Ret: reticulocytes

SF: serum ferritin

SI: serum iron

TIBC: total iron binding capacity

TSAT: transferrin saturation

TSAT: transferrin saturation index

## Data availability statement:

The data sets analyzed in this study are not publicly available because the privacy of the samples may be compromised. But they are available from the corresponding author (FSSNR) upon reasonable request.

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## Conflict of interests:

There is no conflict of interest between the authors of this article.

## Ethical approval:

This article is a part of the nursing master's thesis with approval number 52/3528 of the Faculty of Medical Sciences of Tarbiat Modares University.

## Patient consent statement:

Verbal and written consent was obtained from teenagers and their mothers.

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