

# The Effect of Lifestyle Modification Program on Growth Parameters and Mood Status among Adolescent Girls Having Anemia

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## ABSTRACT

**Context:** Anemia is a significant public health problem that persists worldwide, not only among pregnant women and young children but also among adolescent girls contributing to high maternal and perinatal mortality and morbidity in the future life.

**Aim:** The study was conducted to assess the effect of lifestyle modification programs on growth parameters and mood status among adolescent girls with anemia.

**Methods:** A Quasi-experimental study design utilized at one preparatory school and one secondary school affiliated to Shebein Elkom town-Menoufia governorate. One hundred thirty-two adolescent girls were included in this study. This study's four tools used to collect data are the socio-demographic Structured Interview questionnaire, growth parameters measurement scales, Hemoglobin level measurement scale, and Kutcher Adolescent Depression Scale (KADS).

**Results:** The study population was adolescent girls whose mean age was  $14.10 \pm 1.15$  years; the main findings of this study revealed that adolescents with mild anemia pre-intervention (74.2%) fall to 5.30% and 4.50% in the post and follow up intervention, respectively. Also, adolescents with severe anemia pre-intervention (6.80%) ultimately improved because none of the participants had severe anemia in the post and follow-up intervention. Adolescents underweight pre-intervention (23.5%) have standard weight post-intervention and at follow-up test 43.9 % and 47.7 % respectively. High statistically significant differences were found between pre, post, and follow-up tests regarding adolescents' mood status, in which the number of affected adolescents has fallen from 93.2% to 34.1% at post-intervention and 32.6% at follow-up.

**Conclusion:** Based on the findings of the present study, it can conclude that the dietary modification program has a better effect on the improvement of anemia, mood status, and growth parameters of the studied adolescent girls. The study recommended that all adolescent girls urgently adhere to a healthy lifestyle modification regarding their dietary regimen to prevent and manage iron deficiency anemia and promote mood stability and growth and development.

**Keywords:** Lifestyle, Growth Parameters, Mood Status, and Anemia

## 1. Introduction

One of the most common and widespread public health problems in the world today is anemia. In the Eastern Mediterranean region, 149 million people are estimated to be anemic according to WHO criteria. Iron deficiency anemia is the most common type of nutritional deficiency affecting two billion people globally. It has a profound negative impact on psychological and physical development, behavior, working performance, and learning capacity (Soliman, Azmi, & El-Sied, 2007).

Adolescence is a significant period of human growth and maturation when unprecedented changes occur, and adult patterns are established (Brabin & Brabin, 1992). Increasing nutritional needs at this juncture relate to the fact that adolescents gain up to 50% of their adult weight, more than 20% of their adult height, and 50% of their adult skeletal mass during this period (Anil, Akhilesh, Niket & Ashwin, 2018). The iron needs are high in adolescent girls because of the increased requirements for expansion of blood volume associated with the adolescent growth spurt

and the onset of menstruation. During the adolescent growth spurt, the risk of iron deficiency anemia reappears for both boys and girls. Adolescent girls are a particularly vulnerable group as their iron requirements and their losses from the body are high. 25-50% of girls worldwide become anemic by reaching menarche (Dallman, 1992).

According to the epidemiological data collected from multiple countries by the World Health Organization (WHO), Iron deficiency is the most widespread form of malnutrition among women and children, including adolescents, worldwide. The prevalence of anemia is disproportionately high in developing countries (World Health Organization, 2017) due to poverty, inadequate diet, certain diseases, pregnancy/lactation at a young age, and poor access to health services. Iron deficiency anemia is defined at the cutoff points of Serum Iron less than 30 mcg/dl and TIBC more than 470 mcg/dl. The severity of anemia graded as Mild (10-12g/dl), Moderate (7-10gm/dl), and Severe (<7gm/dl) (Odeh, 2006).

Anemia causes weak motor and mental performance in children, impaired cognitive development, poor concentration, and low work productivity. There are several symptoms like easy fatigability, breathlessness on exertion,

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lassitude, dizziness, headache, tinnitus, vertigo-like symptoms. It also causes some psychiatric symptoms like irritability, sleep disturbance, anorexia, and unstable mood. It is observed that anemia affects almost all of the body systems, which impaired children growth and development (Keskin, et al., 2005)

In children, anemia compromises physical growth and mental development (Kotecha, Patel, & Nirupam, 2000). Iron deficiency anemia's most severe and long-term complications alter children's growth and development, such as weight loss, short stature, reduced body mass index, and improper maturation. Besides, it produces irritable and unstable mood status that affects their daily life (LeBlanc, Almudevar, Brooks, & Kutcher, 2002). Unfortunately, Iron deficiency anemia is a public health problem that required urgent interventions.

Lifestyle modification has recently been seen to have better effects in preventing and managing anemia among adolescents. One such lifestyle approach focuses on achieving energy balance (or energy deficit for weight loss), eating healthy fats, consuming more fruits and vegetables, choosing whole grain-containing foods, decreasing junky food intake, increasing daily physical activity, and improving mood, and reducing the risk for chronic disease. Research indicates that adolescents will be well on the way to adopting a healthy lifestyle (Wister, Loewen, Kennedy, & Singer, 2015).

## 2. Significance of the study

Iron deficiency anemia is the most common type of anemia related to malnutrition worldwide. It represents a significant problem in developing countries, especially in Egypt. These deficiencies affect women, infants, and children. Poor eating habits play a major role in developing iron-deficiency anemia, which is an important indicator of poor health status. Children and adolescents are at increased risk of developing iron deficiency anemia because of their increased demand for iron during growth and pupetry.

Globally, iron deficiency anemia ranks number 9 among 26 risk factors included in the Global Burden of Disease (GBD) 2000 and accounts for 841,000 deaths and 35,057,000 disability-adjusted life years lost. Africa and parts of Asia bear 71% of the global mortality burden and 65% of the disability-adjusted life years lost (WHO, 2001; and Stoltzfus, 2003). The overall prevalence rate of anemia among women in the reproductive age of 15-49 y was 29.2

% in Egypt (El-Zanaty & Way, 2001).

Also, most anemic mothers have mild anemia (35.13 %). This result indicates that the prevalence of anemia in preschool, school-age children, and the remaining sibling for both sexes is high, ranging from 49.48%– 100%, representing a public health problem of high severity in Egypt (Soliman, Azmi, & El-Sied, 2007). Iron deficiency anemia has severe complications for the children's growth and development also on their mood stability. Although few programs for anemia control have targeted adolescent girls worldwide, unfortunately, it has not been given priority. For this reason, the present study was conducted to assess

the effect of lifestyle modification programs on growth parameters and mood status among adolescents having anemia.

## 3. Aim of the study

The study was conducted to assess the effect of lifestyle modification programs on growth parameters and mood status among adolescent girls with anemia.

### 3.1. Research hypotheses

- Adolescent girls who will receive a lifestyle modification program will have better growth parameters on the posttest than the pretest.
- Adolescent girls who will receive a lifestyle modification program will have improved posttest mood compared to pretest.

## 4. Subjects & Methods

### 4.1. Research design

A quasi-experimental research design (pre and posttest) was utilized in this study.

### 4.2. Research setting

The study was conducted at two schools. One preparatory school (Hussein Ghorab preparatory school) and one secondary school (the girls' secondary school). The two mentioned settings were randomly selected in Shebein Elkom town, Menoufia governorate, Egypt, considering sample size and criteria for sample selection.

### 4.3. Subjects

A purposive sample of 132 student girls was included under the following criteria.

#### Inclusion criteria

- Adolescent girls of the age group 12–19yrs.
- Adolescents with a hemoglobin level less than 12g/dl.
- Serum Iron and Total Iron Binding Capacity (TIBC) suggest iron deficiency anemia (Serum Iron less than 30 mcg/dl and TIBC more than 470 mcg/dl).
- Adolescent girls who free from any other health problems and willing to participate in the study included

#### Exclusion criteria

- Adolescent girls who suffer from any other health problem rather than iron deficiency anemia excluded.

The sample size was calculated using the Epi Info (2000) program based on a review of past literature and prevalence rate of phenomena; the sample size was calculated at power 80% and Confidence level 95% by the following equation:

$$n = \frac{[DEFF * Np(1-p)]}{[(d^2/Z^2) * (N_{adj}) + p*(1-p)]}$$

(n) = Sample Size

DEFF = Design effect (for cluster surveys-DEFF): (1.5)

d= confidence level (95%)

N = Population size

P = margin of error (0.05).

So the total sample size was 132 participants.

#### 4.4. Tools of the study

The following instruments used:

##### 4.4.1. Socio-demographic Structured Interview

It was developed by the researcher and divided into two parts. Part one is concerned with the socio-demographic characteristics of the studied adolescent girls. It includes data about studied adolescent girls, such as age, grade, level of education, kind of housing, size of the house, number of rooms, occupation of father and mother, and income.

Part two is concerned with dietary history. It was in the form of an interview questionnaire. It was used to collect data about adolescent girls' dietary habits. It includes the number of meals per day, regularity of main meal, types of food intake, favorite food, eating with family members, time of eating, and eating between meals.

##### 4.4.2. Growth Parameters Measurement Scales

It includes the accurate estimation of weights, height using its standardized scales. Secondly, plotting it on standardized charts adopted by WHO, than body mass index calculated for weight and height according to the age of each adolescent. A measurement between the 5th and 85th percentile on the BMI-for-age charts is considered healthy. According to the BMI-for-age charts, the 50th percentile, the midrange for BMIs for a given age, for girls, the range is between 18.7 and 21.3. However, this measurement is not the same as the current average BMI for adolescents, as the data used for these charts dates from 1963 to 1994. For example, the average BMI for an 18-year-old was 22 in the 1980s but increased to 24.5 by the year 2000, according to a study published in the *Journal of Adolescent Health* in 2012 (*World Health Organization, 2006*).

##### 4.4.3. Hemoglobin Level Measurement Scale

It includes measurement of Hemoglobin level for all studied girls. All subjects were assessed for the presence of anemia using WHO criteria. A peripheral blood smear (PBS) examination was carried out in subjects with hemoglobin less than 12g/dl. Serum Iron and Total Iron Binding Capacity (TIBC) estimated in studied subjects with PBS suggestive of Iron deficiency anemia. Hemoglobin estimation has done using the cyanmethemoglobin method to confirm Iron deficiency. All participants were divided according to their results into three categories: severe anemia Hb level (< 7 g/dl), moderate anemia Hb level (7-10gm/dl), mild anemia Hb level (10-12g/dl). So the scoring system considered as follows: Severe anemia (3), Moderate anemia (2), and mild anemia (1).

##### 4.4.4. Kutcher Adolescent Depression Scale (KADS)

It was developed by *Kutcher, LeBlanc, Almudevar, and Brooks (2002)*, and it is a self-report scale designed explicitly to diagnose and assess the severity of adolescent

depression and evaluate their mood status. It includes 16-items, for example, (Low mood, sadness, and feeling down, depressed, just cannot be bothered, Irritable, losing temper easily). There are no validated diagnostic categories associated with ranges of scores. All scores were assessed relative to an individual patient's baseline score (higher scores indicating worsening depression, lower scores suggesting possible improvement in adolescents' depressed mood).

The scoring system is a 4-point Likert scale ranging from hardly ever to all of the time. The scoring considers hardly ever as not affected mood estimated with (1 score). Affected mood estimated as most of the time (2 scores), and much of the time (3 scores), and all of the time (4 scores). The total score of mood status assessment ranged from 26-130. Score from 26–104 considered as (mood not affected). Score from 105–130 was considered (mood affected)

#### 4.5. Procedures

The reliability of the instruments computed using the split-half method ( $r=0.88$ ). This method was used to assess the homogeneity of the tools. Five experts reviewed tools in pediatric nursing and psychiatric health nursing (two pediatric nursing experts and two experts in psychiatric health nursing, and one expert in pediatrics). They examine the tool for relevance, comprehensiveness, and clarity.

Data collected from February 1, 2018, to the end of August 2018. Official permission to carry out the study was obtained from the director of the two mentioned settings after submitting an official letter from the Dean of the Faculty of Nursing - Menoufia University. The letter was explaining the purposes of the study and methods of data collection.

For ethical considerations, oral and written consent was obtained from student girls to share in the study. Therefore, the nature of the study, objectives, its importance, safety, and confidentiality explained. All subjects informed that participation in the study is voluntary, no name included in the questionnaire sheet, anonymity, and confidentiality of each participant protected by allocating a code number to the questionnaire sheet. Subjects were informed that the content of the tool would be used for the research purpose only.

A pilot study was carried out on 13 student girls (10% of the total sample) to test the clarity and applicability of the tools and the feasibility of the research process. No modifications have been done. So, the pilot study sample was included in the total sample of the study.

An initial interview started by introducing the researcher to the students, then explaining the study's purpose to gain their cooperation. The researcher assessed the bio-socio-demographics, including adolescents' characteristics and the dietary habits of the adolescents. Nutritional status and growth parameters using the WHO standard for weights, heights, BMI by using growth parameters measurement scales.

The researchers were assessing anemia through accurate measurement of Hemoglobin levels for all

adolescent students. Moreover, obtained arterial blood samples for each adolescent girl to measure Hb levels, Serum Iron, and Total Iron Binding Capacity (TIBC). All blood smears sent to a specialized laboratory to confirm the diagnosis of iron deficiency anemia. Then the researchers diagnosed anemia using the WHO definitions for anemia (age, gender, and altitude specific) less than 10mg, using Hemoglobin level measurement scale. The mood status of adolescent girls assessed using Kutcher Adolescent Depression Scale.

The implementation phase based on the philosophy of the intervention is that of a self-directed, self-controlled eating plan to enhance a series of activities that ultimately become part of everyday life. Participants encourage self-monitor fruit/vegetable and grain intake, which helps them make appropriate food choices high in iron content and meet nutrition goals. The researcher divided all participants into five groups. Each group contains 27 adolescent students who informed that they would receive six scientific sessions regarding (diet modification) program.

Each session includes information and activities that reflect both nutritional and behavioral principles. Participants also receive individual contacts and can participate in peer-led sessions to provide additional support and enhance adherence. The Education training session ran three times per week, 60 minutes for each session. During the six scientific sessions, they recommended following the diet modification principles accurately, and they will also receive self-practice exercise training once a week for six months. The program is divided into three sections. The first and second educational session concerned with the definition and sign, symptoms, full description, and complications of iron deficiency anemia.

The program emphasized the importance of increasing healthy food consumption containing a high level of iron, avoiding excessive drinks of high caffeine content such as (coffee, soft drinks, and tea). Also, avoid drinking milk and milk products immediately after meals, which enriches iron content to improve iron absorption. Particular food, including fresh vegetables and fruits, whole grain cereals, fresh fruit juice containing Vit. C, meat, liver were also encouraged (sessions three and four). The researcher provided an accurate illustration of students' adherence to healthy food consumption and their practices of proper daily exercise. Evaluation of their accurate recording of daily food intake with guided feedback also emphasized during sessions five and six.

Group activity training ran four times for 20 minutes each session regarding proper food choices divided on three times daily, and useful daily exercise was enhanced. Adolescents contacted by phone and asked about their self-practice activity at home. So that the research assistants could evaluate the participants' understanding and practices of dietary behaviors as prescribed by the diet modification program and stimulate their motivation to practice these behaviors continuously.

The adolescent participants were asked to perform daily self-evaluation concerning their healthy food consumption and adherence to recommended diet regimen and daily exercise. Self-evaluation helps the individual accurately perform activities as prescribed concerning diet modification programs and gives them confidence in self-control, enhancing their mood status. Adolescents should have confidence that they understand and having healthy lifestyle behaviors that essential for their health.

Scientific colorful brochures regarding anemia and its management gave to each participant. Also, all of the scientific sessions illustrated through PowerPoint presentations and videos assisted teaching. Reassessment for Hemoglobin Level, mood status, and growth parameters were done post-intervention immediately for each adolescent girl using the same instruments (posttest). Follow-up was done after three months using the same instruments (follow-up test).

#### 4.6. Data analysis

Data collected, tabulated, statistically analyzed using an IBM personal computer with Statistical Package of Social Science (SPSS) version 22 (SPSS, Inc., Chicago, Illinois, USA). Where the following statistics were applied:

- Descriptive statistics, in which quantitative data presented in the form of the mean ( $\bar{X}$ ), standard deviation (SD), range, and qualitative data presented in the form of numbers and percentages.
- Analytical statistics include the following significant tests. Chi-square test ( $\chi^2$ ) was used to study the association between two qualitative variables. The Fischer-exact test was used for 2 x 2 tables when the expected cell count of more than 25% was less than 5, and p-value < 0.05 was considered significant. McNemar's test assesses the significance of the difference between two correlated proportions, such as might be found in the case where the two proportions are based on the same sample of subjects or matched-pair samples. Paired T-Test is a test of significance used for comparison between two related groups having quantitative variables. Pearson's correlation (r) is a test used to measure the association between quantitative variables. Also, the effect size was used to measure the effectiveness of the diet modification program on dependent variables (growth parameters & mood). It considered as follow:

Effect size	Cohen's D
Small	0.20
Medium	0.50
Large	0.80

#### 5. Results

Table 1 shows the socio-demographic characters of the studied group. The highest percentage of the sample (50.8%) of the sample were in the age group of >16:19 years old and, also, more than half of the sample (50.8%) had a secondary level of education. This table also shows that all samples were residents in urban areas.

Table 2 reveals the dietary habits of the studied sample. This table shows that more than one-third of the sample consumed only two meals daily, and lunch was the main meal 36.4%, 39.4% respectively. More than half of the sample was sometimes regular with the main meal (53.0%) and 43.2% of the sample sometimes eat and drink between meals. Also, 49.2% preferred to eat carbohydrates, and only 10.6% and 6.10% preferred vegetables and fruits, respectively, while 39.4% of the sample has not preferred proteins. 75.0% of the sample preferred to eat with their families. Also, 54.5% and 55.6% respectively of the sample showed difficulty during eating, and the primary cause was mood disturbance.

Table 3 shows the hemoglobin level of the studied group at pre, post, and follow-up intervention. This table shows that adolescents with mild anemia pre-intervention 74.2% fall to 5.30% and 4.50% in the post and follow-up intervention. Also, adolescents with severe anemia pre-intervention 6.80% improved in the post and follow-up intervention.

Table 4 shows the growth parameter of the studied group in pre, post, and follow-up intervention: Highly statistically significant differences were found between pre, post, and follow-up tests regarding weight and BMI. 43.9% and 47.7% of the studied group have standard weight post-intervention and at follow-up test respectively compared with 23.5% pre-intervention.

Table 5 describes the mood status of the studied group in pre, post, and follow-up intervention: Highly statistically significant differences were found between pre, post, and follow-up tests regarding the mood status of the studied group. The number of affected adolescents was diminished from 93.2% to 34.1% and 32.6% respectively.

Table 6 shows the relation between dietary habits and mood status among the studied group post-intervention. A highly statistically significant difference was found between dietary habits and mood status among the studied group post-intervention. 31.0% and 33.3% of not affected adolescents and have better mood statuses have three and four meals daily. Also, 31.0%, 49.4%, 33.3%, 100%, and 48.3% of them have lunch as the main meal, have a regular main meal, their favorite food is proteins, eating with a family member, and their time of eating is the noon respectively.

Table 7 represents the relation between mood status and growth parameters of the studied group post-intervention: A highly statistically differences found between mood status and growth parameters (namely weight and body mass index) of the studied group post-intervention. 77.0% of adolescents with non-affected moods, their weight is ranged 56-80 kg. Also, 60.9% of them have a healthy weight.

Figure 1 illustrates the correlation between hemoglobin level and mood status post-intervention. A positive correlation was found between hemoglobin level and mood status post-intervention where ( $r$  equals 0.250).

Figure 2 demonstrates the effect size of dietary modification program on the studied group's mood status and growth parameters. Cohen's  $D$  for intervention on mood status equals 8.11, which means large effect size. Cohen's  $D$  for intervention on growth parameter equals 8.62 this also means large effect size. It, fortunately, indicates that the dietary modification program was highly effective for improvement in mood status and growth parameters of the studied adolescents.

**Table (1): Frequency and percentage distribution of socio-demographic characters of the studied group (n=132).**

Socio-demographic characters	No.	%
<b>Age</b>		
12-16	65	49.2
>16-19	67	50.8
<b>Gender</b>		
Female	132	100
<b>Educational level</b>		
Preparatory	65	49.2
Secondary	67	50.8
<b>Residence</b>		
Urban	132	100
Rural	0	0.00
<b>Number of siblings</b>		
One	19	14.4
Two	36	27.3
Three	16	12.1
Four	31	23.5
Other	30	22.7
<b>Birth order</b>		
First	14	10.6
Second	29	22.0
Third	38	28.8
Fourth	35	26.5
Others	16	12.1

**Table (2): Frequency and percn tage distribution of the studied adolescent girls’ dietary habits (n=132).**

Dietary habits variables	No.	%
<b>Number of meals</b>		
One	28	21.2
Two	48	36.4
Three	27	20.5
Four	29	22.0
<b>Main meal</b>		
Breakfast	23	17.4
Lunch	52	39.4
Dinner	37	28.0
No	20	15.2
<b>The regularity of themain meal</b>		
Usually	43	32.6
Sometimes	70	53.0
Never	19	14.4
<b>Drinking or eatingbetween meal</b>		
Yes	47	35.6
Sometimes	57	43.2
No	28	21.2
<b>Favorite food</b>		
Protein	29	22.0
Carbohydrates	65	49.2
Milk product	16	12.1
Vegetables	14	10.6
Fruits	8	6.10
<b>Non-favorite food</b>		
Protein	52	39.4
Carbohydrates	32	24.2
Milk product	31	23.5
Vegetables	13	9.80
Fruits	4	3.00
<b>Eating with familymembers</b>		
Yes	99	75.0
No	33	25.0
<b>Time of eating</b>		
In the morning	10	7.60
At noon	67	50.8
At night	39	29.5
At three times	16	12.1
<b>Difficulties duringeating</b>		
Yes	72	54.5
No	60	45.5
<b>Causes of difficultiesduring eating</b>		
Stomach pain	16	22.2
Gum and toothache	16	22.2
Mood disturbance	40	55.6

**Table (3): Hemoglobin level of the studied group at pre, post, and follow-up intervention (N =132).**

Hemoglobin level	Pre-intervention		Post-intervention		Follow-up		McNemar test	p-value
	No.	%	No.	%	No.	%		
Mild anemia (Hb 10 - <12 mg/dl)	98	74.2	7	5.30	6	4.50	218.3	P1:<0.001*
Moderate (Hb7 - < 10 mg /dl )	20	15.2	0	0.00	0	0.00	221.9	P2: <0.001*
Severe (Hb< 7 mg /dl)	9	6.80	0	0.00	0	0.00		

\*High significance P1: Comparison between pre and post-intervention, P2: Comparison between pre-intervention and follow up

**Table (4): Comparison of growth parameters of the studied group at pre, post, and follow-up intervention regarding (N =132).**

Growth Parameters	Pre-intervention		Post-intervention		Follow up		McNemar test	P-value	
	No.	%	No.	%	No.	%			
<b>Weight</b>	30 – 55	85	64.4	43	32.6	41	31.1	33.9	P1:<0.001**
	56 – 80	35	26.5	82	62.1	86	65.2		
	Up to 80	12	9.10	7	5.30	5	3.70	39.7	P2:<0.001**
<b>Height</b>	130 – 150	75	56.8	75	56.8	75	56.8	---	----
	151 – 171	49	37.1	49	37.1	49	37.1		
	Up to 172	8	6.10	8	6.10	8	6.10		
<b>BMI</b>	Underweight	63	47.7	49	37.1	48	36.4	13.1	P1:0.004**
	Normal weight	31	23.5	58	43.9	63	47.7		
	Overweight	7	5.30	3	2.30	2	1.50		
	Obese	31	23.5	22	16.7	19	14.4		

\*\*High significant p1: Comparison between pre and post-intervention

P2: Comparison between pre-intervention and follow up

**Table (5): mood status of the studied group at pre, post, and follow-up intervention (N =132).**

Mood status	Pre-intervention		Post-intervention		Follow-up		McNemar test	p-value
	No.	%	No.	%	No.	%		
Affected (26 –104)	123	93.2	45	34.1	43	32.6	99.5	P1:<0.001**
Not affected (105-130)	9	6.80	87	65.9	89	67.4	103.8	P2:<0.001**

\*\*High significant P1: Comparison between pre and post-intervention P2: Comparison between pre-intervention and follow up

**Table (6): Relation between dietary habits and mood status among the studied group post-intervention (N =132).**

Dietary habits	Mood status		X <sup>2</sup>	P-value	
	Affected (N=45)	Not affected (N=87)			
	N (%)	N (%)			
<b>Number of meals</b>	One	20(44.4)	8(9.20)	53.2	0.001**
	Two	25(55.6)	23(26.4)		
	Three	0(0.00)	27(31.0)		
	Four	0(0.00)	29(33.3)		
<b>Main meal</b>	Breakfast	0(0.00)	23(26.4)	17.8	0.001**
	Lunch	25(55.6)	27(31.0)		
	Dinner	15(33.3)	22(25.3)		
<b>The regularity of the main meal</b>	No	5(11.1)	15(17.3)	39.3	0.001**
	Usually	0(0.00)	43(49.4)		
	Sometimes	40(88.9)	30(34.5)		
<b>Drinking or eating between meal</b>	Never	3(6.70)	14(16.1)	19.6	0.001**
	Yes	23	24		
	Sometimes	22	35		
<b>Favorite food</b>	No	0	28	70.3	0.001**
	Protein	0(0.00)	29(33.3)		
	Carbohydrate	45(100)	20(23.0)		
	Milk product	0(0.00)	16(18.4)		
	Vegetables	0(0.00)	14(16.1)		
<b>Eating with family members</b>	Fruits	0(0.00)	8(9.20)	85.1	0.001**
	Yes	12(26.7)	87(100)		
	No	33(73.3)	0(0.00)		
<b>Time of eating</b>	In the morning	5(11.1)	5(5.70)	10.0	0.018*
	At noon	25(55.6)	42(48.3)		
	At night	15(33.3)	24(27.6)		
	At three times	0(0.00)	16(18.4)		

\*Statistically significant \*\*Highly significant

Table (7): Relation between mood status and growth parameters of the studied group post-intervention (N =132).

Growth Parameters	Mood status				X <sup>2</sup>	P-value	
	Affected (N=45)		Not affected (N=87)				
	No.	%	No.	%			
Weight	30 – 55	23	51.1	20	23.0	29.8	0.001*
	56 – 80	15	33.3	67	77.0		
	Up to 80	7	15.6	0	0.00		
Height	130 – 150	29	64.4	46	52.9	3.61	0.164
	151 – 171	12	26.7	37	42.5		
	Up to 172	4	8.90	4	4.60		
BMI	Underweight	15	33.3	34	39.1	65.3	0.001*
	Normal weight	5	11.1	53	60.9		
	Overweight	3	6.70	0	0.00		
	Obese	22	48.9	0	0.00		

\*High significant

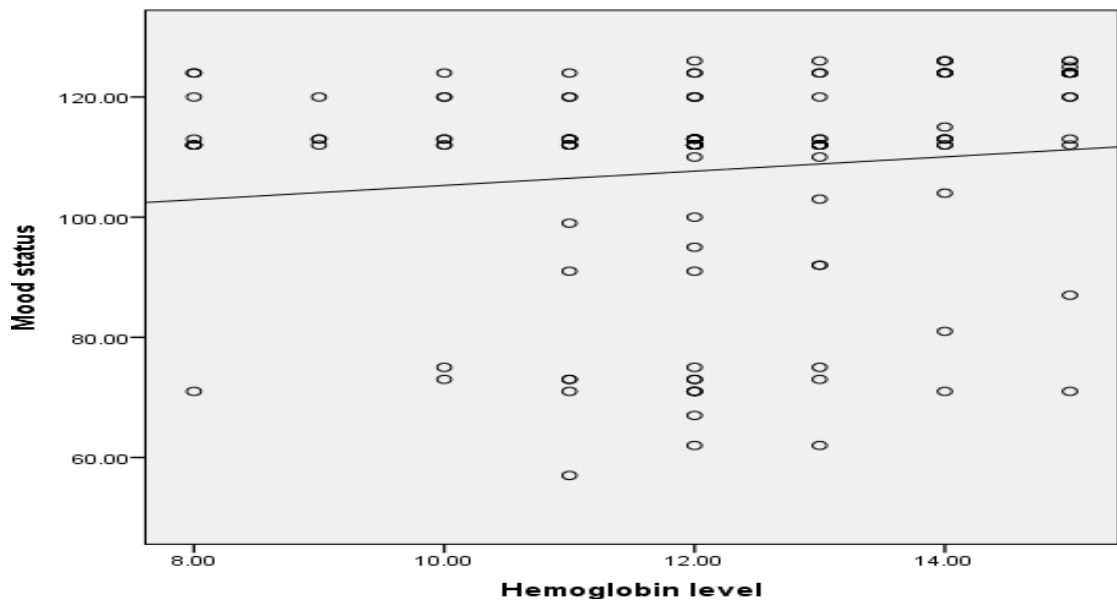


Figure (1): Correlation between hemoglobin level and mood status post-intervention

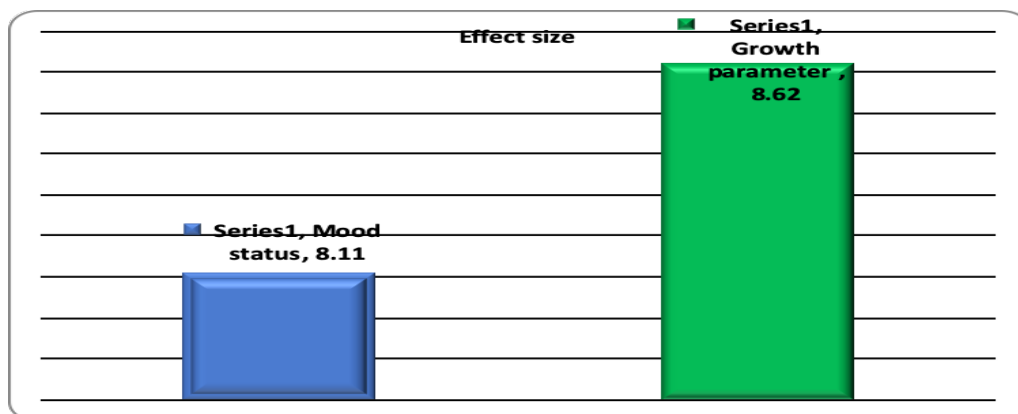


Figure (2): Effect size of dietary modification program on the studied group's mood status and growth parameters.



## 6. Discussion

The World Bank estimates that one-half of the world's population suffers from malnutrition, and two million people suffer from diseases related to iron, iodine, and vitamin A deficiency. These deficiencies affect women, infants, and children, especially those of developing countries. Poor eating habits play a significant role in developing iron deficiency anemia that is an essential indicator of poor health status. Children and adolescents are at increased risk of developing iron deficiency anemia because of their increased demand for iron during growth and puppetry. In most cases, they are undiagnosed because of irregular, far visiting health clinics, doctors, and hospitals (Soliman, Azmi, & El-Sied, 2007).

The current study hypothesized that adolescents who received the dietary modification program would have better growth parameters and mood status on the posttest compared to the pretest. Accordingly, the significant findings of this study will be discussed. Therefore, the relationship between dietary modification programs and previously mentioned dependent variables would be the basis of this discussion. However, this section will discuss the findings of this study in terms of interpretation agreement and disagreement with other studies and the researcher's interpretation.

Regarding the characteristics of the studied adolescent girls, the result of the present study indicated that the total number of adolescents were 132. All of them were females, the majority of them residing in urban areas. The majority of participants were in the age group 16-19 years old. Half of them were in preparatory education, and the other half were in secondary education. This result was in line with (Moonsarnand, & Sumpowthong, 2016), who conducted a study about "Anemia and Iron Deficiency in Adolescent School Girls in Kavar Urban Area" and mentioned that iron deficiency anemia is much higher among females and the most common age ranged from 12-18 years old. Besides, (Badura, 1986) who researched anemia among adolescent school girls and young adults. They found that iron deficiency anemia is much higher among females their age ranged 11- 19 years old.

Concerning dietary habits of adolescent girls, the result of the present study revealed that more than one-third of the sample consumed only two meals daily, and lunch was the main meal. More than half of the sample was regular with the main meal; less than half eat and drink between meals. Also, about half preferred to eat carbohydrates, and only one-tenth and less than one-tenth preferred vegetables and fruits. Also, one-third of the sample did not prefer proteins. The majority of the sample preferred to eat with their families. Besides, 54.5% and 55.6%, respectively, showed difficulty eating, and the primary cause was mood disturbance. This result agrees with (LeBlanc, Almudevar, Brooks, & Kutcher, 2002), who conducted a study entitled "Dietary Habits among Adolescent Girls and Their Association with Parental Educational Levels." They reported that most participants (48.4%) skipped breakfast while only a few (8.3%) skipped lunch. Almost 67.4 percent of the girls have expressed that they consumed enough bread and cereals daily, and only 2.1 percent have

expressed that bread and cereals are not a part of the daily diet.

Also, these findings are consistent with the study conducted by (World Bank Group, 2008) and Ramzi, et al., (2011), who studied the prevalence of anemia among adolescents and reported that the consumption of fruits and vegetables among adolescents was at least ( $\leq 5$  serving) daily. The present study's findings also agreed with (Anil, Akhilesh, Niket, & Ashwin, 2018), who reported that, Eating disorders commonly emerge during adolescence and young adulthood. Most eating disorders affect females more commonly than males. Eating disorders are detrimental to health and often co-exist with depression, anxiety, and substance misuse.

Regarding the hemoglobin level of the studied group in pre, post, and follow-up intervention, The present study revealed that high significant statistical differences were found between pre, post, and follow-up intervention regarding the hemoglobin level of the studied group where the majority of adolescents having anemia in pre-intervention were improved and become healthy, in the post and follow up intervention.

On the other hand, this finding was in agreement with (Manijeh, Rosemary, Jafar, & Ahdieh, 2013), who conducted a study entitled " anemia and iron deficiency among school adolescents: burden, severity, and determinant factors in southwest Ethiopia" and reported that among anemic adolescents, the proportion of anemic participants was high (83.9%) in pretest and fell to reach (3.2%) posttest after receiving recommended diet intervention.

This finding was inconsistent with (Zhag, 2012), who conducted a study entitled " Hemoglobin concentrations and associated factors in adolescents from Recife, Brazil" and reported that the prevalence of anemia in adolescents in Recife represents a public health problem at a mild level, since the percentage falls within the range 5%-19%. This finding is due to the lack of healthy food consumption and awareness of the importance of healthy lifestyle nutritional habits. The cause for this variation of improvement pre and after intervention in the present study might be the increased adherence of adolescent participants to diet modification program and their willingness to improve.

There were highly statistically significant differences between pre, post, and follow-up intervention concerning the growth parameter of the studied group in pre, post, and follow-up tests regarding weight and BMI. The majority of the studied group has a healthy weight in the post and follow-up intervention, respectively, compared with less than one-third of the studied sample in pre-intervention.

These results disagree with (Erinosho, Moser, Oh, Nebeling, & Yaroch., 2007) who conducted a study entitled " study of anemia among adolescent school girls and young adults" and mentioned that age and BMI were not significantly related with anemia. This finding may be due to the different genetic and nutritional factors between the countries, and many adolescents show alteration in their BMI, but their weight significantly improved in the posttest. It may also be due to failure to take corrective measures for anemia and iron deficiency in girls before entering adolescence and the additional requirements for growth and

development during puberty. Also, the other losses during menstruation all lead us to provide diet modification intervention for adolescent girls urgently.

Regarding the mood status of the studied group, the current results revealed highly statistically significant differences between pre, post, and follow-up tests regarding their mood status. The number of affected adolescents was diminished significantly in posttest and follow-up tests, respectively. This result was supported by (WHO, 2018), who conducted a study entitled "A randomized controlled trial of dietary improvement for adults with major depression" and found that participants reported that those who adhered more closely to the dietary program experienced the most significant benefit to their depression symptoms.

Also, the current study findings were consistent with (Soliman, Azmi, & El-Sied, 2007), who studied "Adolescent Nutrition" and reported that adolescence is a unique intervention point in the life-cycle. Adolescents are in intense need of proper nutrition to prevent or delay adult-onset diet-related illnesses and enhance their mood stability.

The present study's findings illustrated that highly statistically significant differences were found between dietary habits and mood status among the studied group post-intervention. About one-third of no affected adolescents and who have better mood status have three and four meals daily. Also, they have lunch as the main meal, have a regular main meal, their favorite food is proteins, prefer eating with family members, and their time of eating is the noon respectively. These findings came in the same line with (Elisângela et al., 2014), who reported a significant association between a healthy diet and lower depression with effect sizes ranging from small to medium.

Furthermore, this result was consistent with (Melkam, Tilahun, Wondimagegn, Yaregal, & Lealem, 2015), who indicated a significant association between healthy diet and mood stability among adolescents females post-diet modification intervention. Also, (Elisângela, Lilian, Ilma, & Alcides, 2014) found that a healthy diet predicted depression two years later, but that depression at baseline did not predict healthy diet consumption two years later. However, this finding contrasts with (Yooli & Bongseog, 2017), who reported no association between a healthy diet and mental health three years later.

Regarding the relation between mood status and growth parameters of the studied group post-intervention, the current study's findings show highly statistically significant differences between mood status and growth parameters of the studied group post-intervention. The majority of adolescents who have not affected mood their weight ranged between (56-80 kg). Also, 60.9% of them were of average weight. These findings agreed with (Felic, et al. 2017), who reported that girls demonstrated a higher risk of depression when their BMI was higher or lower than average.

On the other hand, this finding disagreed with (Brooks et al., 2002). They conducted a study entitled "Body Mass Index, Body Weight Perception, and Depressed Mood in Korean Adolescents" and reported that underweight or overweight adolescents showed a lower risk for depressed mood than those who had a healthy BMI.

Concerning the correlation between hemoglobin level and mood status post-intervention, the result of the present study revealed that there was a positive correlation between hemoglobin level and mood status post-intervention where ( $r$  equals 0.250). This finding reflects the improvement in adolescents' Hb. their mood status also improved. This result was congruent with (Jacka, et al. 2010), who studied "Relation of anemia and depressive mood among adolescents" and reported that higher hemoglobin levels found in those with current depressive or anxiety disorders after socio-demographic adjustment and both higher and lower hemoglobin levels found in persons with higher depression and anxiety severity. However, after full adjustment for socio-demographics, disease indicators, and lifestyle, associations were no longer significant.

In the same line (Oddy et al., 2009) conducted a study entitled "Nutritional aspects of depression in adolescents" and found that iron deficiency anemia is associated with depression, apathy, and fatigue, affecting adolescent girls and women childbearing age. Fatigue, lethargy, and depression can all be symptoms of iron deficiency, which has led to studies investigating the relationship between circulating levels of iron and depression.

Concerning the effect size of the dietary modification program on mood status and growth parameters of the studied group, fortunately, the result of the present study indicated that the dietary modification program was highly effective for the improvement of mood status and growth parameters of the studied adolescents. Despite the importance of the topic, we found relatively few studies that examined diet and mood status in adolescents. This result was congruent with (Cortese, 2009) conducted study entitled "A prospective study of diet quality and mental health in adolescents" reported that dietary and nutritional improvements offer the potential for inexpensive, safe, and acceptable interventions and treatment for adolescent depression as well as supporting healthy upbringing and well-being of adolescents.

## 7. Conclusion

Based on the present study's findings, fortunately, the dietary modification program has a better effect on mood status and growth parameters of the studied adolescents having anemia.

## 8. Recommendations

The findings of the study suggest that:

- All adolescents should urgently adhere to a healthy lifestyle
- diet modification regimen to properly prevent and manage iron deficiency anemia.
- Also, for promoting growth, development, and mood stability,
- Allowing children to grow healthier through an iron supplementation program should be emphasized at an earlier age, thus reducing health expenditure in the future.
- Awareness sessions on healthy eating for adolescents and their parents should be implemented in schools, social media, and national organizations.

- A national plan should be developed by the Ministry of Education and the Ministry of Health involvement of governmental and non-governmental organizations toward adolescents. Include three essential areas; Quality of life, psychology, and nutrition, through Health education programs.
- Apply continuous psychosocial screening measures and support programs for all adolescents with mood disturbance.

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