

▪ **Basic Research****Iron Deficiency Anemia: Evidence Based Prevention Program among Primary School Students according to 100 Million Health Initiative**

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Abstract

Despite national and international initiatives to eliminate health challenges, Iron Deficiency Anemia (IDA) still a major wellbeing concern in underdeveloped nations; a project of 100 million health initiative was started to detect non-communicable disorders such IDA early. **Aim:** This study aimed to evaluate the effect of evidence-based iron deficiency anemia prevention program among primary school students according to 100 million health initiative. **Research design:** A quasi-experimental design was employed in this study. **Setting:** Seven Benha City Governmental Primary Schools served as research sites from the 108 schools that distributed into 7 sectors; one school was chosen at random from each sector. **Sample:** 190 primary school students were chosen using a systematic random selection. **Tools of data collection:** There were 3 tools employed. **I:** A structured interviewing questionnaire that asked about: (a) school students' demographics, (b) family history, medical conditions and the girls' menstrual history; and c) their knowledge regarding iron deficiency anemia and 100 million health initiative. **II:** Practices of primary school students regarding prevention of iron deficiency anemia. **III:** Attitude scale for IDA prevention. **Results:** Before the program was implemented, 4.2% of school students had average knowledge about IDA and the 100 million health initiative, which improved to 77.9% after the program was implemented; 8.9% of them had satisfactory practices regarding IDA prevention, which improved to 64.2% after the program was implemented; and 7.4% of them had a positive attitude regarding prevention of IDA before the program was implemented, which improved to 77.4% after the program was implemented. **Conclusion:** Evidence-based iron deficiency anemia prevention program significantly improved the knowledge, practices, and attitudes of primary school students'. **Recommendations:** Continuing evidence-based iron deficiency anemia prevention program for primary school students to increase their knowledge and practices to prevent iron deficiency anemia.

Keywords: Evidence-based iron deficiency anemia prevention program, 100 million health initiative, primary school students.

Introduction:

The school years are a time of rapid physical and mental development. It spans the years 6–12, when childhood development is most active. It is essential for increasing the body's nutritional reserves to support adolescent growth. As children grow, their bodies require more nutrition. School-aged children's nutritional status and physical development are considered crucial since they represent the general well-being of the community. At every stage of life, but especially in the early years, healthy eating is also a predictor of wellbeing, mental and physical development (*Saavedra & Prentice, 2023*).

Anemia is a condition when there are not enough red blood cells or their ability to deliver oxygen. to fulfill physiological requirements that differ by gender, attitude, and well-being, affects about 2 billion individuals globally, or a third of the global populace. It is also a significant public health concern in poorer nations., as between one-third and half of pediatrics in nearly all developing nations suffer from anemia. Iron deficiency, a leading cause of anemia, is listed by the World Wellbeing Organization as one of the top 10 risk factors for "lost years of wellbeing life" in developing nations in 2020 reports (*Elsbay et al., 2023*).

Iron deficiency is the most common haematologic illness in pediatrics and is regarded as a systemic ailment with numerous repercussions. Up to 11% of pediatrics were found to be iron deficient in recent investigations on the incidence of IDA in the United States. When haemoglobin concentrations fall below ideal ranges, IDA develops. In poor nations, IDA afflicted more than 45% of pediatrics under the age of five. Additionally, due to inadequate food intake in relation to high iron requirements associated with rapid growth, primary school students are vulnerable to dietary iron insufficiency (*El-Shafie et al., 2024*).

Iron Deficiency Anemia (IDA) can be induced by many causes, including poverty, inadequate intake, as a result of inadequate knowledge of dietary choices, a high consumption of iron-deficient foods, elevated needs, inadequate absorption, mineral excesses, or containments. The primary non-nutritional cause is blood loss, especially in developing nations where parasitic gastrointestinal disorders can induce blood loss.. High diets of sugar and fat are also frequently linked to low intakes of iron. Children of school age, particularly those in primary school, are more susceptible to anemia, especially a lack of iron. Low IQ, poor school performance, diminished labor capacities, poor psychomotor development, adverse long-term impacts on the central nervous system, and a lower quality of life are all consequences of anemia in school-age children. (*Ibrahim et al., 2022*).

According to *Ruegg (2020)*, an initiative is an action plan that is proposed by government agencies and associations to solve societal challenges and is developed into both short-term and long-term development initiatives. Health initiatives are regarded as one of the emerging approaches in the field of development that help strengthen the well-being system in developing nations by combating diseases, particularly in those countries. In light of this, President Abdel Fattah ElSisi announced a number of initiatives and a wellbeing reform package on September 18, 2018. The "100 million Health " initiative was one of the Ministry of Health (MOH) programs to address wellbeing risks in all of Egypt's governorates. It screened 50 million Egyptians for the virus's risks and treated 1.2 million individuals who had Hepatitis C and Non-Communicable Diseases (NCDs) like blood pressure, diabetes, anemia, and obesity in an effort to lower the number of deaths from these conditions. It also gave many citizens the chance to check on their wellbeing (*Orabi & El Sabbagh, 2023*).

A 100 million health initiative was launched to improve early detection and lower NCDs like anemia for millions of Egyptians, as these diseases account for 70% of fatalities in Egypt. **(The Arab Republic of Egypt Presidency, 2020)**. The Ministry of health and Population reports that 10,837,000 primary school students were screened for anemia, obesity, and stunting during the 2021–2022 school year. According to the government, screening around 15 million Egyptian and non-Egyptian students at 29,444 Egyptian private and public primary schools is the year's objective **(Egypt Today Staff, 2022)**.

The best practice options that each community may use are evidence-based preventative program. Additionally, evidence-based programs guarantee that prevention strategies and initiatives are harmless. Pediatric primary care physicians understand the value of evidence-based practice in the clinical setting. There are now many clinical practice guidelines that provide evidence-based understanding for the prevention and treatment of childhood anemia, varying in strength and quality **(Prevention Action Alliance, 2022)**.

The causes, risk factors, signs, symptoms, prevention, and management of IDA should all be thoroughly understood by Community Health Nurses (CHNs). A CHN conducts a thorough evaluation to determine the extent of IDA by well-being surveys, routine screening, and research. A CHN should be aware of the role, sources, and daily requirements of iron in the diet. Based on the information acquired, CHN assists in the formulation and implementation of the national nutritional anaemic prophylaxis program and attempts to identify the contributory variables that cause iron deficiency anemia **(Puckree, 2023)**.

By creating policies, strategies, and procedures for the delivery of school wellbeing services at the student level, school health nurses play a critical role in the prevention of IDA. By optimising the health and wellbeing of school-age students, school health nurses improve the educational process. Students with IDA are assessed, cared for, implemented, and evaluated by the school nurse using the nursing process. The school nurse leads the school in putting safety measures in place for children to avoid IDA. The school nurse educates community members, staff, and families on the causes, symptoms, and effects of IDA. In addition to screening and referring students, the school health nurse is crucial in the early detection of IDA. As a health educator, the school health nurse is essential to the prevention and management of IDA by raising awareness of good eating practices and educating medical professionals about iron-rich foods, which are a crucial preventative and therapeutic strategy for IDA **(Shafik et al., 2022)**.

Significance of the research:

The most common nutritional deficit worldwide is IDA. According to earlier research, anemia is a serious public health issue in Egypt, particularly for school-age students. It affects 30–40% of students. 43% of Egyptians with low socioeconomic status were found to have IDA, the most common cause of anemia. The frequency of IDA was 12% among children aged 6 to 12 in the Qena governorate, but it was found to be greater in the Elmenofya governorate, where it was 29% among school students **(Sedky et al., 2021)**. Bettering the health and well-being of the populace is also a modern political objective, as seen by the massive "100 million healthy lives" campaign, which entails collecting blood samples and weighing and measuring millions of Egyptians. Anemia affects a large number of Egyptians, according to the 100 million health project. Geographical location, gender, and socioeconomic level can all affect the occurrence of anemia. Anemia is one of the primary causes of several NCDs. Consequently, avoiding it can help reduce NCDs, which can help achieve the Sustainable Development Goals of 2030.

(Mabrouk et al., 2022).

Aim of study:

This study aimed to evaluate the effect of evidence-based iron deficiency anemia prevention program among primary school students according to 100 million health initiative.

Research hypothesis:

Evidence based iron deficiency anemia prevention program will raise knowledge, enhance practices, and modify the attitude of primary school students.

Subject and Methods**Research design:**

This research was conducted using a quasi-experimental design.

Setting:

Taha Hussein, Huda Sharawi, Abd el Menem Reyad, Ebn Khaldon, El Imam Mohammed Abdu, El Thowra, and Anas Ebn Malek are the seven Governmental Primary Schools in Benha City where the study was conducted. There were 108 schools total, with one school chosen at random from each of the seven sectors.

Sample:

1980 primary school students from the aforementioned locations who are enrolled in the six grades and agree to participate in the study were chosen via a systematic random sampling technique.. Every tenth student was chosen to participate in the sample after the beginning point was chosen at random from a list of students with serial numbers. A total of 190 primary school students were chosen.

Tools for data collection:

Three research tools were utilized to obtain the data:

Tool I: A structured interviewing questionnaire:

It was written in 3 parts in simple, intelligible Arabic and was created by researchers utilizing a literature review.

First part: Primary school students' demographics, including age, gender, location of residence, parents' educational level, fathers' employment status, mothers' employment status, and family monthly income, were included, along with their academic performance as documented in their school records.

Second part: Included the following:

A. Primary school students' medical and family history, such as having a family history of IDA and experiencing any health issues.

B. Girls' menstrual history, including if they are menstruating, when they menarche, how often they menstruate, how long they menstruate each day, any related pains, and how often they change their pads each day.

Third part: Included knowledge about iron deficiency anemia adapted from **Nr, (2023)** and 100 million health initiatives. Ten multiple-choice, closed-ended questions about the meaning, causes, high-risk students, symptoms, diagnosis, treatment, complications, IDA preventive measures, and the aim and services of the 100 million health initiative were included in this part.

Scoring system:**Total knowledge= 20 points**

The students' knowledge score was calculated as follows: 0 for not knowing the answer, 1 for accurate incomplete answers, and 2 for correct complete answers. The item scores were added together, and the result was divided by the total number of items to determine the mean score. A percentage score was created from these scores. If the total knowledge score was greater than >75% (> 15 points), it was deemed good; if it was between 50% and 75% (10–15 points), it was deemed average; and if it was less than <50% (<10 points), it was deemed poor.

Tool II: Primary school students' practices regarding prevention of iron deficiency anemia and was divided into 3 parts:

First part: Included reported practices of students at primary school regarding prevention of iron deficiency anemia. It consisted of 26 items and categorized into four main dimensions as: Nutrition (9 items), follow up and treatment (7 items), prevention and treatment of parasitic worms' infestation (7 items). and exercise and rest (3 items).

Second part: Students blood test and stool analysis assessment sheet; it was used to measure HB and serum ferritin concentration and detection of parasitic diseases during routine screening test which was carried out by school health insurance.

Third part: An observational checklist used to assess primary school students' anthropometric measures and BMI. There are 14 steps total—5 for height measurement, 6 for weight measurement, and 3 for BMI measurement adopted from Niedzwiecki et al. (2020).

Scoring system:**Total practices= 40 points**

There are 2 options to each question in the reported practice tool: Done and not done. Each of these received a score of 1,0 respectively. The level score was calculated by dividing the total item scores by the total number of items, and a percent score was developed from these scores. If the practice score was sixty percent or more (≥ 24 points), it was deemed satisfactory; if it was less than sixty percent (< 24 points), it was deemed unsatisfactory.

Tool III: Agustina et al. (2021) provided the scale to measure primary school students' attitudes on IDA prevention. A 3-point Likert scale with 3 categories—Agree, Uncertain, and Disagree was rendered in Arabic which included (10 points).

Scoring system:**Total attitudes= 20 points**

The scores of the attitude scale for agree, uncertain and disagree were 2, 1, and 0 respectively. If the overall attitude score was 60% or more (≥ 12 points), it was deemed positive; if it was less than 60% (< 12 points), it was deemed negative.

Validity:

To determine the content relevance of the tools, five community health nursing staff members from Benha University's Faculty of Nursing were chosen to assess their content validity, relevance, completeness, understanding, and application.

According to the experts, the tools were deemed dependable after their opinions on the design, structure, and order of the questions were solicited and all of their input was taken

into consideration.

Reliability:

By giving the identical instruments to the same sample in the same conditions, the researchers employed reliability for tools to confirm the internal consistency of the instruments. Cronbach's alpha coefficient was used to assess each tool item's internal consistency dependability. The dependability scores for knowledge, practices, and attitude were 0.896, 0.727, and 0.786, respectively. This demonstrates how highly reliable the research aids are.

Ethical consideration:

All ethical concerns were addressed, and the study received approval from Benha University's Faculty of Nursing's Ethical Research Committee. (Code: REC-CHN-P.56). Prior to conducting the interview, each primary school student gave their verbal consent and received a brief explanation of the purpose of the research. Additionally, they were told that all data gathered would be kept confidential and used exclusively for the research. The forms did not ask for names in order to preserve anonymity and secrecy. Participants were also informed that they might leave the research at any time and without explanation.

Pilot study:

A pilot study was carried out on 10% (N=19) of the studied school students in the previously mentioned settings to assess the research tools' suitability and clarity for completing the research. Based on the pilot research's results, the required modifications were made before data collection began by eliminating items that were superfluous or duplicate. School students who took part in pilot research were included in the full research sample.

Evidence based iron deficiency anemia prevention program:

Four phases were used to carry out the current research.

1. **Assessment phase:** After conducting a thorough analysis of pertinent literature, the researchers developed the program. It was modified and amended in light of the pre-assessment instruments' findings. Prior to the program's implementation, the researchers visited the selected settings to ensure their cooperation by outlining the purpose and nature of the research and going over the work plan.
2. **Development phase:** The program was developed based on the pre-program assessment's actual results.

An objective of the program: Was to evaluate the effect of evidence-based iron deficiency anemia prevention program among primary school students according to 100 million health initiative.

Contents of program: included the definition, causes, high-risk student, symptoms, diagnosis, treatment, complication, iron deficiency anemia prevention strategies, and the purpose and offerings of the 100 million health initiative.

- Practices for prevention of iron deficiency anemia which include nutrition, follow up & treatment, prevention and treatment of parasitic worms' infestation and exercise & rest.
- Practices for demonstration of anthropometric measurements and BMI.
- Students' academic accomplishments, which were gathered from their school records, were used to evaluate their performance in class. Haemoglobin and serum ferritin

concentrations were measured in blood samples. An insurance laboratory technician collected blood samples from every primary school student during the school day. Haemoglobin levels below 11.7 g/dL were deemed anemia. The following standards were used to determine the IDA degrees: When the serum ferritin concentration was less than 10 µg/L, it was deemed iron depletion, and when it was less than 10 µg/L, it was considered IDA. IDA, iron deficiency, iron depletion, and anemia were determined using the standards set forth by the World Health Organization (**WHO, 2001**). Additionally, a stool sample was taken from each student, and an insurance laboratory technician analysed it to check for parasite infestation. Students' school health records provided information on their haemoglobin levels and stool analyses.

Teaching methods:

Every student used the same instructional methods and content from an evidence-based IDA prevention program, including lectures, brainstorming sessions, discussions, demonstrations, and re-demonstrations.

Teaching aids: Particularly for the sessions, appropriate instructional resources were developed including booklets, videos, colored posters, and real equipment.

3.Implementation phase: For the first term, data was collected from mid-October 2023 to mid-December 2023, and for the second term, data was collected from mid-February 2024 to mid-April 2024. The researchers were accessible from 9 a.m. to 12 p.m. on Sundays and Mondays. After giving pupils a thorough and straightforward assessment of the study's purpose and methodology, the school student who met the requirements was requested to participate. The student who accepted was then questioned utilizing the questionnaire sheet. Each student interview took between thirty and forty-five minutes. The teaching module was created with the knowledge and practice levels of the students in mind. This curriculum consists of six sessions., (3 theoretical and 3 practical) were offered. Each took thirty to forty-five minutes. The goals of the previous session and the upcoming one were summarized at the start of each one. During program sessions, learning was enhanced through inspiration, reinforcement, and discussion. Every student worked together with the researchers.

4. Evaluation phase:

By contrasting the knowledge, practices, and attitudes of primary school students prior to and during the adoption of an evidence-based IDA prevention program, the efficacy of this program was evaluated. The pre-test and post-test questionnaires utilized in this assessment were identical in format.

Statistical analysis:

The Statistical Package for Social Science (SPSS) version 25 was utilized to analyze the data. To represent numerical data, the mean, standard deviation (SD), and range were used. To convey the qualitative data, percentages and frequencies were used. The chi-square test, Pearson correlation coefficient test, and paired t-test were employed. Smaller than 0.05 p-values were considered significant.

Results:

Table (1): reveals that 58.9% of the students in the study, who were between the ages of 11 and 12, had a mean of 11.41 ± 0.49 , were female in 54.7% of cases, and 60% of them resided in cities. Additionally, according to the statistics, 74.7% of the fathers of pupils are working, and 51% have completed secondary school. In terms of their moms' educational attainment,

49.5% of them are unemployed, and 63.7% have only a basic education. 82.1% of the pupils in the study had insufficient monthly household income.

Table (2): Illustrates that; 55.3% of the studied students had family history of iron deficiency anemia. 82.1%, 66.8% and 57.8% of them suffered from headache, dizziness or felt dizzy, especially when standing, digestive system diseases and respiratory system problems (dyspnea - tonsillitis - sore throat) respectively. Regarding to menstrual history, 47.9% of female students had menstruation from ≥ 12 years (52.7%), 54.9% of them their menstrual cycle was irregular, 89% of them their menstruation remains ≥ 7 days, 68.1% of them suffered from severe pain during it and 59.3% of them changed 3 pads/ day daily.

Table (3): illustrates that every aspect of the students' understanding of iron deficiency anemia and 100 million health initiative before and after program implementation were highly statistically significant differences ($p < 0.001$) except on high-risk students for iron deficiency anemia, there was statistically significant differences ($P \leq 0.05$).

Figure (1): Clears that; 4.2% of the studied students had average total knowledge before the implementation of the program which improved to 77.9% after the implementation of the program, while 92.1% of them had poor total knowledge preprogram implementation and reduced to 0.5% post program implementation.

Table (4): Clarifies that; the mean score of total students' reported practices regarding prevention of iron deficiency anemia before program implementation was 9.19 ± 5.76 and improved to 19.32 ± 8.59 after program implementation. Also, there were highly statistically significant differences in students' reported practices regarding prevention of iron deficiency anemia post program implementation ($p < 0.001$) except on exercise and rest, there were statistically significant differences ($P \leq 0.05$).

Figure (2): Demonstrates that; 8.9% of the studied students had satisfactory total reported practices regarding prevention of iron deficiency anemia before program implementation which improved to 64.2% after program implementation, while 91.1% of them had unsatisfactory total reported practices before implementation of program compared by 35.3% after implementation of the program.

Table (5): Shows that; 79.5% of the studied students had anemia pre program implementation and this percentage decreased to 26.8% post program implementation (after three months), while 83.7% of them had positive parasitic worms preprogram implementation and decreased to 28.4% post program implementation (after three months) and 36.3% of them were obese preprogram implementation and decreased to 19.5% post program implementation (after three months).

Figure (3): Reveals that; 70.0% and 38.8% of not anemic students had normal weight and positive parasitic stool test while 49% of obesity and 79.5% positive parasitic stool test result were among non-anemic students preprogram to be improved to 90.0% of normal weight and 100.0% negative stool test among not anemic students besides, (54.0% & 60.0%, respectively) among anemic student post program implementation.

Figure (4): Illustrates that 59.6% of students who had satisfactory level of achievement preprogram were anemic and 59% with excellent achievement were not anemic pre program, moreover, during post program period (47.1% of anemic students had satisfactory achievement while 61.2% of not anemic students had an excellent level with a significant difference between both groups during pre and post periods.

Table (6): Reveals that; there were statistically significant differences between all items of the studied students' attitude about prevention of iron deficiency anemia pre and post program implementation ($P \leq 0.05$) except on pay attention not to consume drinks and foods such as tea and coffee with foods that contain iron because they interfere with its absorption and it was important to exercise and got enough sleep from 6-8 hours daily respectively, there were highly statistically significant differences ($p < 0.001$).

Figure (5): Demonstrates that; 7.4% of the studied students had positive total attitudes regarding prevention of iron deficiency anemia before program implementation which progressed to 77.4% after program implementation, while 92.6% of them had negative total attitude regarding prevention of iron deficiency anemia before program implementation compared by 22.6% after program implementation

Table (7): Shows that; there were highly positive statistically significant correlations between the studied students' knowledge, practices and attitudes regarding prevention of iron deficiency anemia before and after implementation of the program.

Table (1): Distribution of the studied students regarding their demographic characteristics (n= 190)

Demographic Characteristics	No.=190	
	(No.)	%
Age		
- 11-<12	112	58.9
- ≥ 12	78	41.1
Mean \pm SD	11.41 \pm 0.49	
Gender		
-Male	86	45.3
-Female	104	54.7
Residence		
-Urban	114	60.0
-Rural	76	40.0
Fathers' level of education		
- Can't read and write	6	3.2
- Basic education	58	30.5
- Secondary education	97	51.0
- High level of education	29	15.3
Fathers' job		
- Employed	142	74.7
- Retired	22	11.6
- Unemployed	26	13.7
Mothers' level of education		
- Can't read and write	4	2.1
- Basic education	121	63.7
- Secondary education	29	15.3
- High level of education	36	18.9
Mothers' job		
- Employed	69	36.3
- Retired	27	14.2
- Unemployed	94	49.5
Family monthly income		
- Enough	34	17.9
- Not enough	156	82.1

Table (2): Distribution of the studied students according to their health history (n=190).

Items	No.=190	
	No.	%
(Family history)		
Presence of family history of iron deficiency anemia		
-Yes	105	55.3
-No	85	44.7
#Suffering from any health problems:		
-Headache, dizziness or feeling dizzy, especially when standing	156	82.1
-Respiratory system problems (dyspnea - tonsillitis - sore throat)	110	57.8
-Urinary system problems (frequent urination - burning in urine)	54	28.4
-Digestive system diseases	127	66.8
-Endocrine diseases such as (diabetes mellitus – sluggish thyroid activity)	4	2.1
-Recurrence of infectious and parasitic diseases	2	1.0
(Menstrual history of female students)		
Having menstruation	91	47.9
-Yes	99	52.1
-No		
Age during menarche (n=91)		
-≤ 11 years	43	47.3
- ≥12 years	48	52.7
Regularity of menstruation (n=91)		
-Regular	41	45.1
-Irregular	50	54.9
Duration of menstruation in each cycle(n=91)		
- 3-<5 days	10	11.0
- 5-<7 days	0	0.0
- ≥ 7 days	81	89.0
Presence of severe pain associated with menstruation (n=91)		
-Yes	62	68.1
-No	29	31.9
Frequency of changing pads used daily(n=91)		
-1-2 pads/ day	37	40.7
-3 pads/ day	54	59.3

(#) Answers are not mutually exclusive

Table (3): Distribution of the studied students' knowledge regarding iron deficiency anemia and 100 million health initiative pre and post program implementation (n=190).

Knowledge Items	Response	Preprogram implementation		post program implementation		χ^2 (p value)
		No.	%	No.	%	
Meaning of IDA	Correct complete	5	2.6	189	99.5	37.196 <0.001**
	Correct incomplete	117	61.6	0	0.0	
	Don't know	68	35.8	1	0.5	
Causes of IDA	Correct complete	27	14.3	153	80.5	38.206 <0.001**
	Correct incomplete	119	62.6	37	19.5	
	Don't know	44	23.1	0	0.0	
High -risk students for IDA	Correct complete	125	65.8	171	90.0	10.978 0.004*
	Correct incomplete	52	27.4	19	10.0	
	Don't know	13	6.8	0	0.0	
Symptoms of IDA	Correct complete	5	2.6	63	33.2	143.946 <0.001**
	Correct incomplete	85	44.8	126	66.3	
	Don't know	100	52.6	1	0.5	
Diagnosis of IDA	Correct complete	8	4.2	11	5.8	127.919 <0.001**
	Correct incomplete	111	58.4	178	93.7	
	Don't know	71	37.4	1	0.5	
Treatment of IDA	Correct complete	46	24.2	35	18.4	70.057 <0.001**
	Correct incomplete	49	25.8	154	81.1	
	Don't know	95	50.0	1	0.5	
Complications of IDA	Correct complete	10	5.3	23	12.1	89.155 <0.001**
	Correct incomplete	47	24.7	167	87.9	
	Don't know	133	70.0	0	0.0	
Preventive measures of IDA	Correct complete	4	2.1	150	78.9	61.992 <0.001**
	Correct incomplete	11	5.8	32	16.9	
	Don't know	175	92.1	8	4.2	
Aim of 100 million health initiative	Correct complete	7	3.7	159	83.7	34.407 <0.001**
	Correct incomplete	8	4.2	30	15.8	
	Don't know	175	92.1	1	0.5	
Services of 100 million health initiative	Correct complete	7	3.7	159	83.7	34.407 <0.001**
	Correct incomplete	8	4.2	30	15.8	
	Don't know	175	92.1	1	0.5	

(*) Statistically Significant at ≤ 0.05 (**) Highly statistically Significant at ≤ 0.001

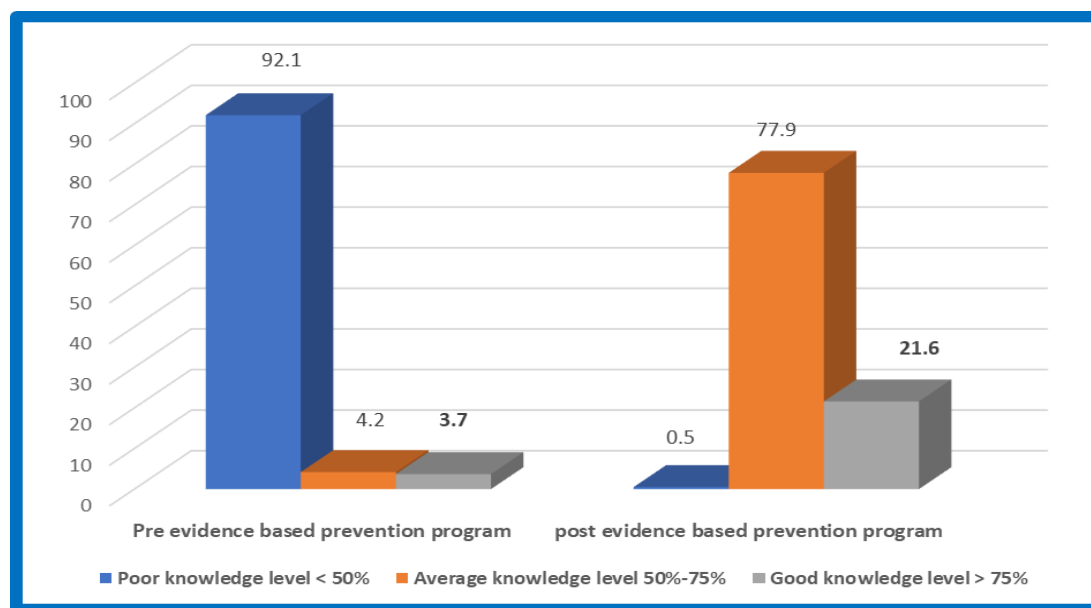


Figure (1): Percentage distribution of the studied students regarding their total knowledge about IDA and 100 million health initiative pre and post program implementation (n=190).

(**) Highly statistically Significant at ≤ 0.001

Table (4): Mean scores of school students' reported practices regarding prevention of IDA between pre and post program implementation (n=190).

Practices dimensions	Max score	Pre-program	Post program	% of mean post program	Ranking of practices	T test (p value)
		Mean \pm SD	Mean \pm SD			
Nutrition	9	4.27 \pm 4.92	6.37 \pm 3.27	70.7%	2	T=-4.684 <0.001**
Follow up and treatment	7	0.79 \pm 1.77	4.42 \pm 3.34	63.1%	3	T=-11.448 <0.001**
Prevention and treatment of parasitic worms' infestation	7	2.57 \pm 1.14	6.60 \pm 1.59	94.2%	1	T=-30.092 <0.001**
Exercise and rest	3	1.53 \pm 0.98	1.89 \pm 0.98	63.0%	4	T=-2.317 0.022*
Total score	26	9.19 \pm 5.76	19.32 \pm 8.59	-		T=-12.135 <0.001**

(*) Statistically Significant at ≤ 0.05 (**) Highly statistically Significant at ≤ 0.001

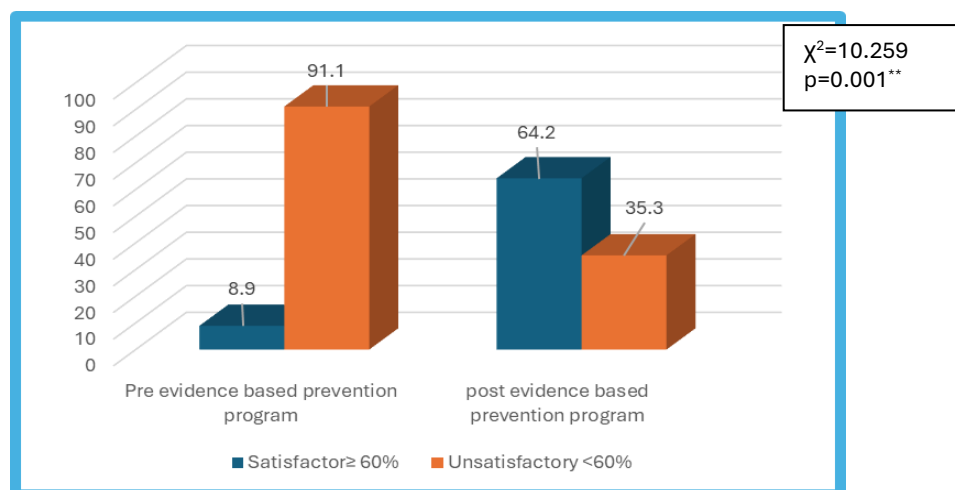


Figure (2): Percentage distribution of the studied students regarding their total reported practices regarding prevention of IDA pre and post program implementation (n=190).

(**) Highly Statistically Significant at ≤ 0.001

Table (5): Distribution of the studied students regarding their demonstration of laboratory tests and anthropometric measurements pre and post program implementation (after 3 months) (n=190).

Clinical outcomes	pre – program implementation		post program implementation (after 3 months)		χ^2 (p value)
	No.	%	No.	%	
(laboratory tests)					
Blood test					
- Anemic	151	79.5	51	26.8	9.538 0.049*
-Not anemic	39	20.5	139	73.2	
Stool test					
-Negative	31	16.3	136	71.6	15.092 0.005*
-Positive parasitic worms	159	83.7	54	28.4	
(anthropometric measures)					
BMI (body mass index)					
-Normal weight	74	38.9	143	75.2	26.019 <0.001**
-Obese	69	36.3	37	19.5	
- Under weight	47	24.8	10	5.3	

(*) Statistically Significant at ≤ 0.05 (**) Highly statistically Significant at ≤ 0.001

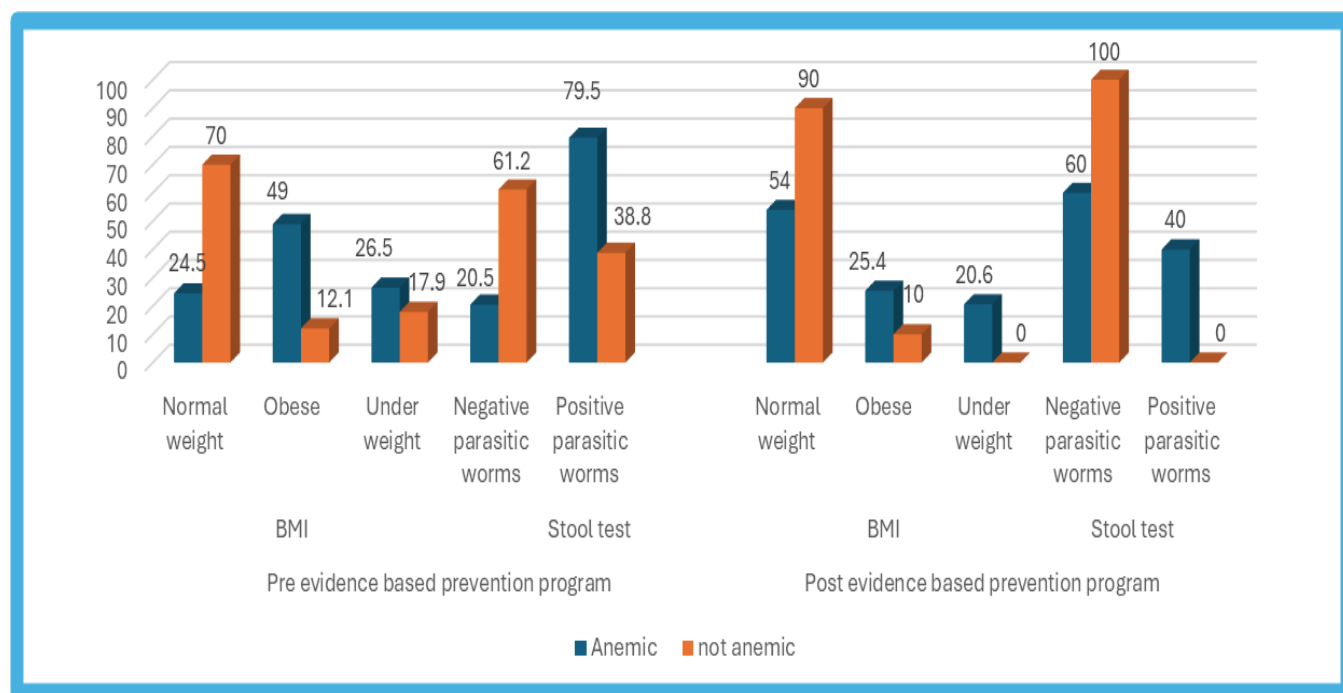


Figure (3): Percentage distribution of primary school students' clinical outcomes according to their blood test results for anemia pre and post program implementation (n=190).

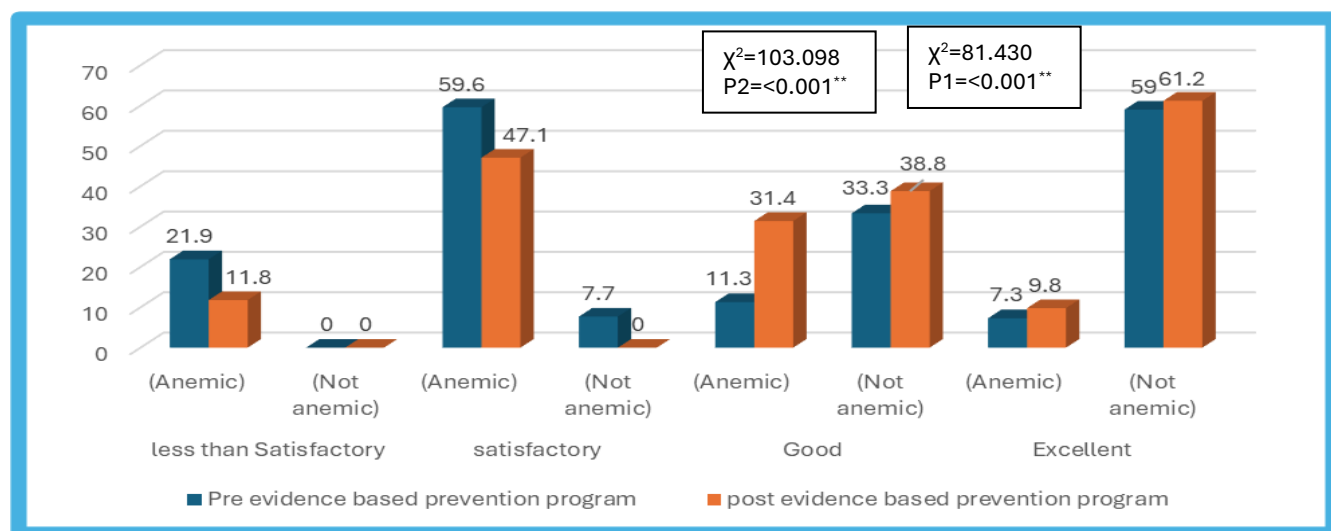


Figure (4): Differences between primary school students' academic achievement according to their blood test results for anemia pre and post program implementation (n=190).

(**) Highly statistically significant $p \leq 0.001$

P1 difference between presence of anemia and academic achievement pre program

Table (6): Distribution of the studied students' attitude regarding prevention of IDA pre and post program implementation (n=190).

Attitudes Items	Response	Pre-program implementation		Post program implementation		χ^2 (p value)
		No.	%	No.	%	
Realize the possibility of having IDA	Agree	11	5.8	184	96.8	7.031 0.030*
	Uncertain	90	47.4	6	3.2	
	Disagree	89	46.8	0	0.0	
Perceive the extent of my risk of developing IDA due to physical and mental development	Agree	6	3.2	175	92.1	7.753 0.021*
	Uncertain	87	45.8	15	7.9	
	Disagree	97	51.0	0	0.0	
Pay attention to eat foods rich in iron	Agree	0	0.0	15	7.9	6.508 0.039*
	Uncertain	11	5.8	122	64.2	
	Disagree	179	94.2	53	27.9	
Feel responsible when reduce the purchase of canned foods	Agree	10	5.3	182	95.8	12.218 0.002*
	Uncertain	45	23.7	8	4.2	
	Disagree	135	71.0	0	0.0	
Try to remind mother to put lemon with foods that contain iron	Agree	6	3.2	156	82.1	7.992 0.018*
	Uncertain	41	21.6	34	17.9	
	Disagree	143	75.2	0	0.0	
Pay attention not to consume drinks and foods such as tea and coffee with foods that contain iron because they interfere with its absorption	Agree	117	61.6	182	95.8	13.386 <0.001**
	Uncertain	73	38.4	8	4.2	
	Disagree	0	0.0	0	0.0	
It is important to drink enough water daily	Agree	79	41.6	99	52.1	5.332 0.021*
	Uncertain	111	58.4	91	47.9	
	Disagree	0	0.0	0	0.0	
It is important to exercise and get enough sleep from 6-8 hours daily	Agree	116	61.1	181	95.3	14.810 <0.001**
	Uncertain	74	38.9	9	4.7	
	Disagree	0	0.0	0	0.0	
Realize that anemia caused grades to decline	Agree	7	3.7	186	97.9	12.791 0.002*
	Uncertain	137	72.1	4	2.1	
	Disagree	46	24.2	0	0.0	
Realize that IDA caused growth to lag behind peers when did not adhere to the diet healthy rich in iron	Agree	7	3.7	182	95.8	8.376 0.015*
	Uncertain	28	14.7	8	4.2	
	Disagree	155	81.6	0	0.0	

(N.A) Not applicable (*) Statistically Significant at ≤ 0.05 (**) Highly statistically Significant at ≤ 0.001

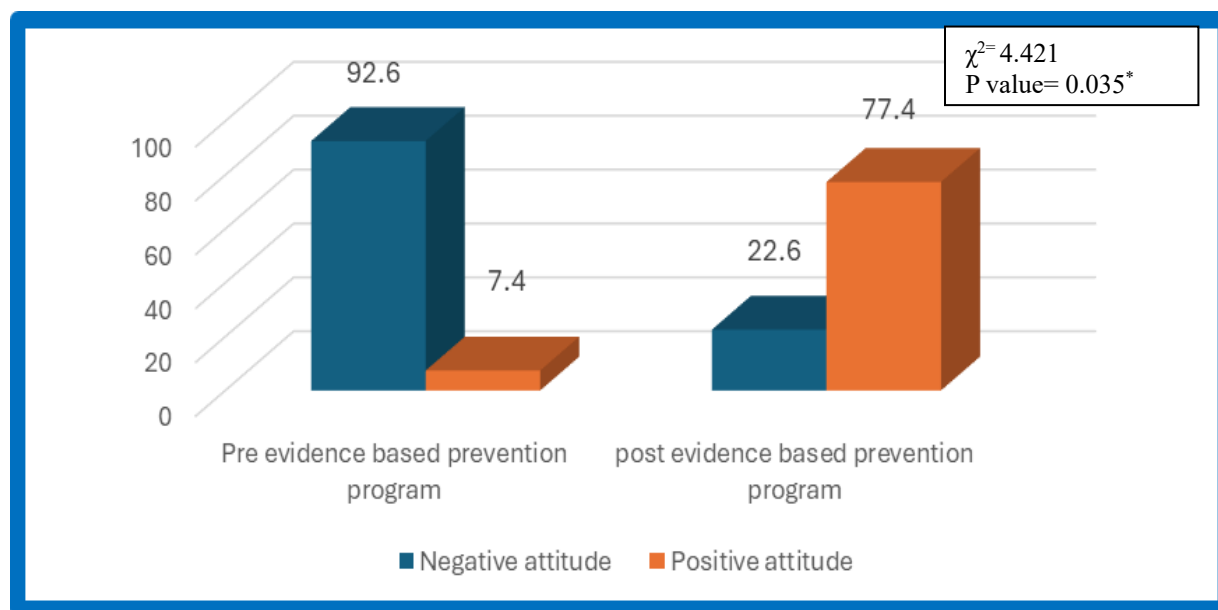


Figure (5): Percentage distribution of the studied students regarding their total attitudes regarding prevention of IDA pre and post program implementation (n=190).

(*) Statistically Significant at ≤ 0.05

Table (7): Correlation matrix between school students' total knowledge, total practices, and total attitudes regarding prevention of IDA pre and post program implementation (n=190).

Variables	Total knowledge score			
	Pre-program		Post program	
	R	P value	r	P value
Total practices	0.224	0.002*	0.602	<0.001**
Total attitude	0.574	<0.001**	0.367	<0.001**

(*) Statistically Significant at ≤ 0.05

** Highly statistically significant $p \leq 0.001$

Discussion:

IDA is a widespread and dangerous health issue that affects children in primary school all around the world. This stage of development is crucial because it affects social, physical, and cognitive development. among Egypt, the 100 Million Health Initiative is a comprehensive public health campaign that aims to address a number of health conditions, including IDA among children in primary school (**Mabrouk *et al.*, 2022**).

The aim of this study was to evaluate the effect of evidence-based iron deficiency anemia prevention program among primary school students according to 100 million health initiative. It was anticipated that an evidence-based IDA preventive program would be a successful strategy for IDA preventive demonstrated a notable improvement in the knowledge, practice, and attitudes of primary school students.

According to the demographic characteristics of studied primary school students, the study revealed that more than half of the studied students aged 11–<12 years with mean age was 11.41 ± 0.49 , this result was in accordance with the study carried out by **Shafik et al.(2022)**, about “Assessment of Primary School Students Knowledge, Practices and Health Beliefs regarding Prevention of Iron Deficiency Anemia” (n=300 students) which was conducted at 3 mixed primary schools in the Beni Suef Governorate, the research found that, the majority (86.7%) of their primary school students aged 11-12 years with mean age was 11.34 ± 0.91 . The inclusion of this age group is highly relevant, as the onset of puberty increases nutritional demands, particularly for iron, making them more susceptible to iron deficiency anemia. Also, more than half of them were females, less than two thirds of them lived in urban areas (urban children might have way better get to iron-fortified nourishments and healthcare administrations, whereas rural children may confront higher rates of parasitic contaminations due to sanitation challenges) and more than half of them, their fathers’ education was secondary, slightly three quarters of them, their fathers employed and less than two thirds of them, their mothers’ education was basic education and less than half of them, their mothers employed and the majority of them hadn’t enough family monthly income. **From the researchers' point of view**, parental education, particularly fathers, is often linked to household socioeconomic status and health literacy. Low education levels may contribute to a lack of awareness about the importance of nutrition and healthcare. Also, these findings were in contrast with the study carried out by **Mabrouk et al.(2022)** in their study about “Iron Deficiency Anemia in Primary School Children in Beni-Suef (Prevalence and Clinical Spectrum)”, Egypt (N=1000) and showed that less than half of their participants were females (45%), about two thirds of the studied students had highly educated mothers (65.5%) and more than half of them were rural inhabitants (55%). **From the researchers' point of view**; both sex inclusion equally necessary. Females aligns with the higher prevalence of anemia in this group due to physiological factors such as menstruation. However, boys in this age group also experience rapid growth, requiring higher iron intake. Low family income could be a basic factor contributing to insufficient diets, poor living conditions, and limited access to healthcare. These financial obstructions make iron deficiency prevention programs, such as free supplementation, school nourishing programs, and public education campaigns, essential.

In terms of female students' menstrual histories, the study showed that among female students less than half of them had begun menstruating, with more than half started menstruation from 12 years and reported irregular menstruation respectively. Also, majority of them had longer cycles of 7 days. These findings aligned with another study about, "Assessment of knowledge, Attitudes, and Practices regarding Menstrual Hygiene Management among Adolescent School girls (10–19 Years)," which carried by **Yogesh et al. (2023)** and found that 361 adolescent schoolgirls in the Saurashtra region of Gujarat, aged 10–19, experienced menarche between the ages of 12 and 15 (53%) and that most of them had menses for seven days. These findings were in close agreement with those of their research. This may be because girls who menstruate are more likely to acquire anemia because of the monthly blood loss they experience, especially when coupled with inadequate food intake. Iron deficiency can also be made worse by heavy or protracted menstruation (**Malcolm, 2023**).

Concerning students' knowledge about iron deficiency anemia pre and post program implementation, the current study revealed highly significant improvements ($p < 0.001$) in students' knowledge regarding all items of iron deficiency anemia and 100 million health initiative. The data strongly supports the effectiveness of the evidence-based prevention

program in enhancing students' knowledge about iron deficiency anemia and 100 million health initiative. This aligns closely with the findings of **Raut et al. (2024)** who carried study about "Effect of Nutrition Education Intervention on Nutrition knowledge, Attitude, and Diet Quality among School-age Adolescents," and involved 226 students between the ages of 12 and 19 from 2 private schools in the Banepa municipality of Nepal, are in close agreement with this. When compared to the control group, the mean nutrition knowledge score ($n = 113$) significantly improved after the intervention was put into place, reaching 1.80. This finding was also consistent with another research conducted by **Sharif et al. (2020)** on seventy-six adolescents regarding the Effectiveness of A school-based Intervention on Knowledge, Attitude, and Practices on Health Lifestyle and Body Composition in Malaysian adolescents, Malaysia. The research found that the adolescents' scores were significantly higher after the educational intervention than they were before. According to studies, a combination of effective teaching techniques, active learning tactics, and well-structured, evidence-based information leads to understanding gain. Students are more likely to remember and use the material in their everyday life if the program is more engaging and relatable.

According to students' mean health practices regarding prevention of IDA pre and post implementation of evidence-based preventive program, The current research made it clear that, with the exception of exercise and relaxation, where there were statistically significant changes ($P \leq 0.05$), there were very statistically significant differences in students' stated habits for preventive of IDA post program implementation ($p < 0.001$). This indicates that the evidence-based preventive program significantly and favourably improved primary school students' IDA preventive practices. However, the differences were statistically significant but not very significant when it came to rest and exercise. **From the researchers' point of view,** in contrast to food improvements, altering relaxation and exercise routines may call for greater motivation and lifestyle modifications, which may take longer. Additionally, it may have been difficult for students to fit exercise and enough rest into their routines due to constraints like school schedules, a lack of facilities, or personal preferences. Furthermore, the program might have had a bigger influence on nutrition-related behaviors if it had placed more emphasis on eating habits than on rest and exercise. The moms may place a higher priority on dietary modifications than on rest and exercise because they think these are more closely linked to IDA preventive. Initiatives and programs are therefore required to promote physical activity among school children. **Sari et al. (2022)** research, "The Effect of Mobile Health (m-Health) Education based on WINTER Application on knowledge, Attitude, and Practice (KAP) regarding Anemia among Female Students in A Rural Area of Indonesia," corroborated the research's findings. Following the implementation of the program, the practices of the 162 teenage girls in the intervention group and the 115 teenage girls in the control group improved. On the other hand, the participants' practices did not improve because of the little intervention period and their lack of enthusiasm in the research carried out by (**Sharif et al., 2020**).

Regarding to distribution of the studied students regarding their demonstration of laboratory tests and anthropometric measurements pre and post program implementation (after three months), The current study revealed that over three quarters of the students in the study had anemia prior to program implementation, and this percentage dropped to slightly higher levels one quarter post program implementation (three months later), This was in line with the research done by **Wiafe et al. (2023)**, on "The Effect of Nutrition Education and Counselling on Nutritional Status and Anemia among Early Adolescents." In this research, 137 adolescents between the ages of 10 and 14 participated in a randomized controlled trial at the Asante-Akim South Municipality in Ghana, and the results showed that the intervention group's rate of anemia decreased by a larger percentage

than the control group. This result lends credence to the idea that the program appears to have improved the health of the children. In order to improve iron absorption, participants were instructed to eat more foods high in iron (such as beans, meat, and eggs) and foods high in vitamin C. To maintain and advance our findings, dietary education in school curricula that informs parents and children about foods high in iron (such as meat, legumes, and leafy greens) is crucial.

Additionally, the majority of the students in the research had positive parasitic worms prior to the program's implementation, and this number dropped to just over a quarter following the program's adoption (3 months later). Reinfection rates were probably lowered by teaching students about hand washing, drinking clean water, and practicing personal hygiene. To reduce the spread of parasites, schools must immediately increase access to sanitary restrooms and handwashing facilities. Prior to the program's implementation, more than one-third of the research participants were obese; 3 months later, this number dropped to less than one-fifth. These results were comparable to those of **Sharif et al. (2020)**, who discovered that following the implementation of their educational program, the students' degree of obesity dropped.

The high pre-program prevalence of obesity, parasitic worms, and anemia, according to the researchers, was probably caused by a confluence of non-health lifestyle choices, inadequate hygiene, and poor diet. All 3 health concerns significantly decreased as a result of the program's successful handling of these problems through lifestyle changes, deworming treatments, nutrition education, and hygiene promotion. Future health and nutrition programs for additional school children could be developed using the interventions' efficacy as a model.

In accordance with the attitudes of the students regarding the preventive of ID pre and post-program implementation,, The current study found that, there were statistically significant differences between all of the items of the students' attitudes regarding preventive of IDA pre and post-program implementation ($P \leq 0.05$), with the exception of pay attention not to consume drinks and foods such as tea and coffee with foods that contain iron because they interfere with its absorption and it was important to exercise and get enough sleep from 6-8 hours daily respectively, there were highly statistically significant differences ($p < 0.001$). These results indicated that the program had a considerable effect on students' attitudes about IDA preventive. There are a few noteworthy outliers, though.

From the researchers' points of view, many possible factors lead to these different statistical significance level such as: Many students might have deep-rooted habits of drinking tea or coffee with meals, making it harder to change their behavior even after an educational program, also tea and coffee consumption was a common family or social practice, students might find it difficult to change, even if they understand the reasoning. Unlike dietary changes, exercise and sleep habits might be more manageable for students to adjust after receiving proper guidance. The educational program emphasized the benefits of exercise and sleep in a compelling way, leading to a stronger attitudinal shift. These study findings agreed with **Katageri, et al. (2023)**, in their study about "Impact of A school-based Nutrition Educational Intervention on Knowledge related to Iron Deficiency Anemia in Rural Karnataka, India: A mixed Methods Pre-Post Interventional Study" (n=45) They said that their participants emphasized positive results, such as changing their attitude.

Concerning the correlation matrix between primary school students' total knowledge, total practices, and total attitudes regarding prevention of iron deficiency anemia before and after program implementation, The results of the study showed that the students' knowledge, behaviors, and attitudes toward preventing iron deficiency anemia before and after the program's implementation were statistically significantly positively correlated.

These noteworthy associations between pre- and post-program knowledge, attitudes, and practices suggested that the program is successful in influencing health-related behaviors. The significance of well-designed health education programs in schools is further supported by the stronger association observed after the program, which indicates that students who learnt more also adopted health behaviors and improved attitudes.

These findings were in line with a study by **Pirzadeh (2020)**, who looked at the health beliefs and knowledge of 100 schoolchildren in Isfahan, Iran, about IDA. The study discovered a significant statistical correlation between the participants' total health beliefs scores and their total reported practices scores. The findings, however, contradicted those of **Shafik et al.'s** study from 2022, which found no statistically significant relationship between the overall knowledge scores and the total health beliefs scores.

Conclusion:

An evidence-based program for preventing iron deficiency anemia proved successful in increasing knowledge, improving health practices and changing attitude of school students regarding iron deficiency anemia. Prior to the program' implementation, most of the studied primary school students had poor knowledge regarding iron deficiency anemia and 100 million health initiative which decreased to the minority after program implementation. Minority of primary school students had satisfactory practices regarding prevention of iron deficiency anemia before program implementation which improved to less than two thirds after program implementation. Prior to the program's implementation, a minority of schoolchildren had a positive attitude about preventing iron deficiency anemia, and this attitude increased more than three quarters later.

Recommendations:

- Continuous evidence-based iron deficiency anemia prevention program for students in the schools to increase their knowledge and practices.
- Distribution of various educational pamphlets and brochures, including ones on iron deficiency anemia prevention, to students in the schools.
- Additional studies on a large probability sample among school students is recommended to achieve more generalization and avoid iron deficiency anemia and its complications.

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الملخص العربي**انيميا نقص الحديد: برنامج وقائي قائم على الأدلة بين طلاب المدارس الابتدائية وفقاً لمبادرة 100 مليون صحة**

مقدمه: على الرغم من المبادرات الوطنية والدولية للقضاء على التحديات الصحية، فإن انيميا نقص الحديد لا يزال يشكل مصدر قلق كبير في الدول النامية؛ وقد تم إطلاق مشروع مبادرة 100 مليون صحة للكشف المبكر عن الاضطرابات غير المعدية مثل مرض انيميا نقص الحديد.

الهدف: هدفت هذه الدراسة إلى تقييم أثر برنامج قائم على الأدلة للوقاية من انيميا نقص الحديد بين طلاب المرحلة الابتدائية، وفقاً لمبادرة 100 مليون صحة.

التصميم: استُخدم تصميم شبه تجريبي في هذه الدراسة. الموقع: استُخدمت سبع مدارس ابتدائية حكومية بمدينة بنها كمواقع بحثية من بين 108 مدرسة موزعة على 7 قطاعات؛ حيث اختيرت مدرسة واحدة عشوائياً من كل قطاع. وتم اختيار 190 طالباً من طلاب المرحلة الابتدائية بطريقة عشوائية منتظمة.

النتائج: 4.2% من الطلاب كانوا لديهم متوسط معلومات عن أنيميا نقص الحديد ومبادرة 100 مليون صحة قبل تطبيق البرنامج وقد تحسن هذا إلى 77.9% بعد تطبيق البرنامج؛ 8.9% منهم لديهم ممارسات مرضية فيما يتعلق بالوقاية من انيميا نقص الحديد، والتي تحسنت إلى 64.2% بعد تطبيق البرنامج؛ و 7.4% منهم لديهم سلوك إيجابي تجاه الوقاية من انيميا نقص الحديد قبل تطبيق البرنامج، والذي تحسن إلى 77.4% بعد تطبيق البرنامج.

الخلاصة والتوصيات: أدى برنامج الوقاية من انيميا نقص الحديد القائم على الأدلة إلى تحسين معلومات طلاب المدارس الابتدائية وممارساتهم وسلوكهم بشكل ملحوظ. التوصيات: مواصلة برنامج الوقاية من انيميا نقص الحديد القائم على الأدلة لطلاب المدارس الابتدائية لزيادة معلوماتهم وممارساتهم للوقاية من انيميا نقص الحديد.