Research Article

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EFFECT OF NUTRITIONAL SUPPORT THERAPY ON LEVEL OF HEMOGLOBIN, VITAMIN C, IRON AND ITS IMPACT ON PHYSICAL WORK CAPACITY AND INTELLIGENCE AMONG ADOLESCENT GIRLS WITH IRON DEFICIENCY ANEMIA: A PILOT STUDY

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ABSTRACT

The nutritional support therapy was prepared from amla *(Phyllanthus emblica or Indian gooseberry)*, pumpkin leaves (*cucurbita pepo*) and jiggery. It was an experimental study conducted among adolescent girls between the age of 14-17 years with iron deficiency anemia. The aim of the study was to assess the effectiveness of intervention in enhancing the level of hemoglobin vitamin C and iron and its impact on the physical work capacity and intelligence. Amla and pumpkin leaves were extracted and Juice was mixed with jaggery syrup. It was administered to the adolescent girls with iron deficiency anemia, 30 ml/ day before lunch for a duration of two months. The estimation of level of hemoglobin by automatic hematology analyzer, iron by ferene method and vitamin c by HPLC method. Hardvard step test was applied to assess physical work capacity and culture fair intelligence non verbal test used to assess the intelligence. The result showed that statistically significant improvement in level of hemoglobin vitamin c and iron and it has significant effect on physical work capacity and intelligence. The intervention was very effective in enhancing the level of hemoglobin vitamin c and iron and also improving the physical work capacity and intelligence.

Keywords: Iron deficiency anemia, Adolescent girls, effectiveness, nutritional support therapy, hemoglobin, intelligence, physical work capacity.

INTRODUCTION

The adolescents are at high risk of iron deficiency and anaemia. WHO (2008) reported that worldwide mortality rate of iron deficiency anemia is more than 6 corers. In India there is a high prevalence rate of anemia among adolescent girls. UNICEF (2011) reported that in India there were 113 million adolescent girls between the age of 11 and 18 years and estimated more than half of the girls in India are anemic[1].

Amla is rich with vitamin C and which help to increase the Iron absorption. It is also called as Vitamin C power house. 100 gm of amla contains 1.02mg of iron and 600mg grams of vitamin C. Jaggery has a characteristic dark color due to the presence of high iron content in it. It is an excellent source of Iron and regular consumption of jaggery can help to improve the hemoglobin level. 100gm of raw jaggery contains iron 3mg. Various studies have revealed that raw pumpkin leaves juice was effective to increase the regeneration of hemoglobin. It is rich with vitamin C and Iron. 100 gm of pumpkin leaves contains 18% of Vitamin C and 12% of Iron. It is used for formation of hemoglobin. Recommended dietary requirements of iron in adolescence girl between the age 14 to 18 years is 15mg/day[2]. Hemoglobin is a complex protein found in red blood cells that contains an iron molecule. The main function of hemoglobin is to carry oxygen from the lungs to the body tissues, and to exchange the oxygen for carbon dioxide, and then carry the carbon dioxide back to the lungs and where it is exchanged for oxygen.

According to world health organization the hemoglobin level should be 12 g/dl for adolescent girls. When the hemoglobin level less than 12 g/dL is considered as anemia. Physical work capacity is reduced in iron deficiency anemia because the decrease in haemoglobin reduces the availability of oxygen to the tissues, which in turn affects the cardiac output. Further, the iron deficiency, changes in brain iron content and distribution, and in neurotransmitter function which may affect cognition. Anemia may produce scholastic under-achievement and behavioural disturbances in school children[3]. Iron absorption is significantly increased by the presence of vitamin C, also known as ascorbic acid. Vitamin C, also plays a vital role in the synthesis of red blood cells. Food iron is absorbed by the intestinal mucosa from two separate pools of heme and nonheme iron. Heme iron obtained from meat, is better absorbed than non-heme iron from plants and its absorption is influenced by other dietary intake such as vitamin C[4]. Vitamin C or ascorbic acid is a powerful enhancer of nonheme iron absorption and can reverse the inhibiting effect of substances such as tea and calcium/phosphate. Recommended dietary allowance for Vitamin C in adolescent girls is 65 mg. The present study is based on community resources. Since amla, jaggery and pumpkin leaves are locally available, cost effective can be easily stored and utilized by subject.

MATERIALS AND METHODS

Preparation of nutritional support therapy

The nutritional support therapy has prepared under the guidance of dietician and ayurvedic doctor. Amla Juice is prepared by slicing ½ Kg of fresh amla into small pieces and blended well. This pulp is mixed with ¼ litre of boiled and cooled water and use a sieve to strain it. Pumpkin leaves extract was prepared by place 2 medium sized leaves in a blender, add 50 ml of water, blended well and strain out the juice. Jaggery syrup was prepared by melting one Kg jaggery in 250 ml of water. Finally

add the amla (250 ml) and pumpkin (50 ml) leaves extract to the jaggery syrup.

Standardization of the nutritional support therapy

The standardization of amla and jaggery mixture supplemented with pumpkin leaves was done at "Bangalore Test house at Rajajinagar". The result of the test found that the acidity of the nutritional support therapy was 7.45, no alcohol content, Vitamin C 40% and presence of iron as Fe 101.27mg/kg.

Participants: The study was done in adolescent girls in the age group between 14-17 years studying at selected higher secondary school. A total of 20 adolescent girls (10 in experimental group) were taken from St.Lawrence International Public School, Bengaluru. The adolescent girls were selected by random sampling method based on the inclusion criteria. Informed consent and assent was obtained from the parents and verbal consent from participants. This study was approved by the Institutional Human Ethics Committee of Saveetha University, (011/01/2015/IEC/SU Dated 20/01/2015).

METHODOLOGY

Phase I: A prior permission was taken from the school authorities. Informed consent obtained from parents and verbal consent from participants. The purpose of the study was explained to adolescent girls and their parents. The screening test was conducted in two steps. Check list was used to assess the signs and symptoms of anemia with the score of 1-26. The second screening test adopted was sahlis method of measuring the level of haemoglobin as a confirmatory diagnostic investigation. The adolescent girls with mild and moderate anemia (Hb is 7-11.9 gm/dl) were selected as samples for the study.

Phase II: The structured questionnaire was used to collect demographic and clinical variables. The blood withdrawal procedure was explained in detail. Five ml of venous blood was collected and sent to the lab for the estimation of hemoglobin, vitamin C and iron.

Phase III: Non-verbal intelligence test was administered to the control and experimental subjects using Culture Fair Intelligence non verbal test. The test comprised of 4 sub-tests (Test 1 – series with 12 items, Test 2 – classification with 14 items, Test 3 – matrices with, 12 items, Test 4 – classification with 14 items. Time was monitored for each test by a stop watch and the entire test was completed within 15 minutes. Total items 46. The row scores were compared with the score given in the scoring table. Level of intelligence interpreted as very superior (130 and above, superior (120-129), high average (110-119), average (90-109), low average (80-89), borderline (70-79) and extremely low (69 and below).

Phase IV: Harvard step test was used to assess physical work capacity among adolescent girls in the control and experimental groups. Harvard step test was developed by Brouha et al (1943) and modified version was developed at Harvard university. Harvard step test was used to measure physical fitness and a person's ability to recover after a strenuous exercise. The test computes the capability to exercises continuously for extended intervals of time without tiring. The step test was well explained to all the participants. The test was conducted with help of a stop watch. A wooden stool was used with 33 cm height and 38 cm width for the study. The participants were advised to step up and down on the modified Harvard steps of 33cms height once every two seconds approximately 30 steps up per minute (30/min) followed by the whistle for 5 minutes. After 5 minutes whistle blows to stop stepping. Pulse was recorded at 1st, 3rd and 5th minute during the test. It was kept as PR1 (pulse rate 1)- 1 min after exercise, PR2 (pulse rate 2)- 3 min after exercise, PR3 (pulse rate 3)- 5 min after exercise. The physical fitness index was computed as *PFI= Duration of exercise in seconds X100/2 (Pulse 1+2+3).* The physical fitness index score was interpreted as excellent (>96), good (83-96), average (68-82), Low average (54-67) and poor (<54).

Phase V: nutritional support therapy was prepared from amla, jaggery and pumpkin leaves. The freshly prepared herbal extract was given to the adolescent girls in the experimental group. It was administered to the adolescent girls in a quantity of 30 ml per day prior to lunch for duration of 60 days the with the help of an ounce glass. It was administered during the short break before having the food between 10.30-10.45 am for the duration of 60 days from Monday to Saturday.

Phase VI: After 60 days, post-test was carried out with the same procedure.

Statistics

Parametric (Paired and Unpaired 't' test) was used to find out effectiveness of the intervention on level of hemoglobin, vitamin C and Iron. physical work capacity and intelligence were analyzed by both parametric and non parametric test (Wilcox on –signed rank test and Mann-Whitney 'U'-test).

RESULT

Table 1: Effectiveness of intervention on level of Hb, Vitamin C and Iron
N=20

Parameters	**Group**	**Mean±SE**	**Paired 't'-test**		**Unpaired 't' –test**	
			Con- pre test - post test	**Exp- pre test - post test**	**Con pre – exp pre**	**Con post - exp post**
Hemoglobin	Control pre test	9.96±0.48	t=0.907 p=0.388		t=0.517 p=0.611	t=3.21 p=0.005
	Control post test	9.84±0.51				
	Experimental pre test	9.62±0.45		t=8.27 p<0.001		
	Experimental post test	11.65±0.24				
Vitamin C	Control pre test	2.74±0.64	t=0.832 p=0.426		t=0.939 p=0.36	t=2.21 p=0.041
	Control post test	2.79±0.68				
	Experimental pre test	3.66±0.75		t=7.57 p<0.001		
	Experimental post test	5.25±0.88				
Iron	Control pre test	53.1±5.19	t=1.144 p=0.282		t=0.403 p=0.691	t=2.136 p=0.04
	Control post test	52.36±5.05				
	Experimental pre test	56.1±5.32		t=8.07 p<0.001		
	Experimental post test	67.6±5.03				

Table 2: Effectiveness of intervention on physical work capacity
N=20

Parameters	**Group**	**Mean±SE**	**Paired 't'-test**		**Unpaired 't' –test**	
			Con- pre test -post test	**Exp- pre test - post test**	**Con pre – exp pre**	**Con post -exp post**
Physical work capacity	Control pre test	66±2.72	t=0.238 p=0.818	t=5.971 p<0.001	t=0.258 p=0.799	t=5.85 p<0.001
	Control post test	65.5±2.65				
	Experimental pre test	64.9±3.28				
	Experimental post test	84.7±1.93				
Physical work capacity	Group	**Median (Q3-Q1)**	**Wilcox on –signed rank test**		**Mann-Whitney 'U-'test**	
			Con- pre test - post test	Exp- pre test - post test	Con pre – exp pre	Con post -exp post
	Control pre test	64 (73-60)	Z=0.156 p=0.876		Z=0.530 p=0.596	Z=3.557 p<0.001
	Control post test	63 (71-61)				
	Experimental pre test	61 (72-56)		Z=2.803 P=0.005		
	Experimental post test	84 (88-81)				

Table 3: Effectiveness of intervention on intelligence
N=20

Parameters	**Group**	**Mean±SE**	**Paired 't'-test**		**Unpaired 't' –test**	
			Con- pre test - post test	**Exp- pre test - post test**	**Con pre – exp pre**	**Con post -exp post**
Intelligence	Control pre test	87.6±3.09	t=1.829 p=0.1005	t=5.89 P<0.001	t=1.749 p=0.097	t=4.987 p<0.001
	Control post test	91.2±3.54				
	Experimental pre test	95.7±3.44				
	Experimental post test	112.1±2.23				
	Group	**Median (Q3-Q1)**	**Wilcox on –signed rank test**		**Mann-Whitney 'U-'test**	
			Con- pre test - post test	Exp- pre test - post test	Con pre – exp pre	Con post -exp post
	Control pre test	85 (92-80)	Z=1.81 p=0.07	Z=2.807 P=0.005	Z=1.668 p=0.095	Z=3.377 p<0.001
	Control post test	90 (100-82)				
	Experimental pre test	97.5 (104-84)				
	Experimental post test	113 (118-110)				

Table 1 represent the effectiveness of intervention on level of hemoglobin vitamin c and iron. The comparison of pre and post test level of hemoglobin, vitamin c and iron within control group using paired 't' test, 't' value obtained was 0.907 (p=0.388), 0.832, (p=0.426), 1.144, (p=0.282), respectively which were not found to be significant. The comparison of pre and post test level of hemoglobin, vitamin c and iron with in experimental group using paired 't' test and value obtained was 8.27, (p<0.001), 7.57, (p<0.001), 8.07, (p<0.001), respectively which were statistically significant. The comparison of pre test level of hemoglobin vitamin c and iron of control and experimental group using unpaired 't' test were 0.517 (p=0.611), 0.939 (p=0.36), 0.403 (p=0.691) respectively which were not significant. The comparison of post test level of hemoglobin, vitamin c and iron of control and experimental group using unpaired 't' test were 3.21 (p=0.005), 2.21 (p=0.041), 2.136 (p=0.04), which were statistically significant

Table 2 represent effectiveness of intervention on physical work capacity of adolescent girls with iron deficiency anemia. The comparison of pre and post test level of physical work capacity within experimental group using paired 't' test and the value obtained was t= 5.971 (p<0.001) and also Wilcox on – signed rank test value obtained was 2.803 (p=0.005) which was also significant but in control group it was not significant The comparison of post assessment level of physical work capacity and intelligence of control and experimental group using unpaired 't' test, and value obtained was t=5.85 (p<0.001) and Mann-Whitney 'U' test value was 3.577 (p<0.001) which was found to be highly significant but in the pre assessment it was not significant.

Table 3 represent the effectiveness of intervention on intelligence of adolescent girls with iron deficiency anemia. The comparison of pre and post test level of intelligence within the experimental group using paired 't' test was t=5.89 (p=<0.001) and using Wilcox on – signed rank test computed as z=2.807 (p=0.005) which was significant but in control group it was not significant. The comparison of post assessment level of intelligence of control and experimental group using unpaired 't' test and value obtained was t=4.987 (p<0.001) and Mann-Whitney 'U' test value was z=3.377 (p<0.001) but in pre assessment it was found to be not significant.

DISCUSSION

The effect of supplementation of iron and folic acid capsule on anemic girls revealed that increase in mean hemoglobin level was found three times higher in subjects of experimental group[5]. The present study proved that administration of nutritional support therapy for the duration of 2 months increased the hemoglobin and micronutrients level. The similar findings were supported by a study conducted in Bangalore, proved that anemia prevalence was reduced by giving gooseberry juice[6]. A positive impact of iron folate supplementation on physical work capacity and cognitive abilities of school children seen in Vadodara Inida[7].

Physical work capacity refers to the person's own capacity of carrying maximum work for a certain period with the normal pulse rate. The girls who were anaemic had lower scores of steps taken and higher the recovery time in comparison to non anaemic girls. Physical work capacity is reduced in Iron deficiency anemia because, the decrease in hemoglobin reduces the availability of oxygen to the tissues. The present study found that administration of nutritional support therapy for the duration 2 months improved the physical work capacity. It is supported by the study conducted on the impact of lotus stem along with Vitamin C for the adolescent girls with iron deficiency anemia shown a significant improvement in physical work capacity while compared to anaemic control group. The food based iron supplementation had shown satisfactory results in increasing hemoglobin (Hb) levels and physical work capacity[8].

Efficiency of a multiple micronutrient (vitamin A, B, C, iron, zine and iodine) food supplement on the nutrition status of school children and its effect on cognition proved that there was a significant improvement in the experimental group in hemoglobin[9]. The present study proved that there was improved intelligence level after the administration of intervention. This study is in tune with study conducted on cognitive functions in young women showed a significant improvement in cognitive score after iron supplementation[10].

CONCLUSION

This study revealed that adolescent girls who are at risk for iron deficiency anemia will benefited from intake of nutritional support therapy regularly the iron deficiency anemia has impact on level of physical work capacity and intelligence. The nutritional support therapy rich with iron and vitamin C for three months showed increase in the level of haemoglobin vitamin C, iron. Similarly, it has the beneficial effects in positively changing physical work capacity and intelligence among adolescent girls with iron deficiency anemia. Over all study resulted in highly significant improvement in all parameters than other conventional treatment in reducing iron deficiency anemia among adolescent girls.

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