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Integrating NHE along with Supplementation of IFA alone and with Multiple Micronutrient to improve the nutritional status and Hemoglobin levels of under privileged school-going adolescents (10-19 yrs) of Urban Vadodara

ANNIE KURUVILLA
Associate Professor
Department of Foods and Nutrition, Faculty of Family and Community Sciences,
The Maharaja Sayajirao University of Baroda, Vadodara (Gujarat) India
(Email: apnaatul@hotmail.com)

ABSTRACT

The nutritional requirements of adolescents are influenced primarily by the normal events of puberty and the simultaneous spurt of growth. Adolescence is a unique period of development of physiologic, psychosocial, and cognitive levels, all of which impact on the nutritional needs of the adolescent. Thus, the present study was designed keeping in view the increased nutritional needs of the adolescents and the broad objective of the study was Integrating NHE along with Supplementation of IFA alone and with Multiple Micronutrient to improve the nutritional status and Hemoglobin levels of underprivileged school-going adolescents (10-19 yrs) of Urban Vadodara. The study was divided into 3 phases. Phase 1 To assess the nutritional status of adolescents in terms of blood parameters and anthropometric measurements. Phase II Supplement adolescents(10-19 years) with IFA and Multiple Micronutrient tablets for a period of 4 months and provide Nutrition Health Education. Phase III Assess the impact of supplementation on nutritional status of the sample population and Nutrition Health Education on the overall knowledge and nutrition behaviours. Two schools of urban Vadodara were selected in which adolescents (10-19 yrs) of low socio economic status were studied. A total of 124 subjects were enrolled for the study out of which only 96 subjects were taken for the present study due to lack of consent from parents. The sample was divided into three groups-two experimental groups and one control group based on Stratified Random Sampling. An intervention period of 4 months was carried out. One experimental group was supplemented with IFA alone, other was given IFA along with Multiple Micronutrient, while third was control group. The entire study sample was given Nutrition Health Eduation. Baseline Data was collected on Background information, Socio economic status, and Biochemical estimations. The findings are presented in this paper.

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Key Words : NHE, Adolescents, IFA

INTRODUCTION

Adolescence, the second decade of life, is a period in which an individual undergoes major physical and psychological changes. Alongside this, there are enormous changes in the person's social interactions and relationships. Adolescence is a time of opportunity, but also one of risk. It presents a window of opportunity to set the stage for healthy and productive adulthood and to reduce the likelihood of problems in the years that lie ahead. At the same time, it is a period when health problems that have serious immediate consequences can occur or when problem behaviours that could have serious adverse effects on health in the future are initiated. Consistent with WHO's aims and comparative advantage, the WHO Department of Child and Adolescent Health and Development (WHO/CAH) contributes to the goal of improving adolescent heath in two main ways: by recommending comprehensive, multisectoral and evidence-informed adolescent health approaches; and by delineating and supporting the critical contribution of the health sector, including the leadership role of health ministries. One in every five people in the world is an adolescent, and 85% of them live in developing countries. Nearly two thirds of premature deaths and one third of the total disease burden in adults are associated with conditions or behaviors that began in youth, including tobacco use, lack of physical activity, unprotected sex or exposure to violence. Promoting healthy practices during adolescence, and efforts that better protect this age group from risks will ensure longer, more productive lives for many. Food habits that are seen more frequently among teens than other age groups include irregular consumption of meals, excessive snacking, eating away from home, (especially fast food venues), dieting and meal skipping. Many factors contribute to these behaviors, including decreasing influence of family and increasing influence of peers on food and health choices, increasing exposure to media, increasing prevalence of employment outside the home, greater discretionary spending capacity, and increasing responsibilities, leaving less time for teens to eat meals with their families (Stang *et al.*, 2000). Under nutrition is a lack of food energy and nutrients. It can be divided into PEM and micronutrient deficiencies. But in real life they generally go together. It includes being underweight for one's age, too short for one's age (stunted), dangerously thin for one's height (wasted) and deficient in vitamins and minerals (micronutrient malnutrition) (UNICEF, 2006).

By altering dietary behaviours, nutrition interventions during adolescence have the potential of affecting children at that time and later in life. The majority of interventions implemented in the teen years have occurred in schools, but other intervention sites have included after-school programs, summer camps, community centers, libraries, and grocery stores. Programs with successful outcomes have tended to be behaviorally based, using theories for the developmental framework; included an environmental component; delivered an adequate number of lessons; and emphasized developmentally appropriate strategies.

Behavior change is probably the major controversy in nutrition education and in the evaluation of nutrition education programs. The real measure of effective nutrition education is a change not in knowledge or attitude, but in behavior, as well as maintenance of existing desirable behaviors. Such alterations in any area are difficult to achieve.

Evaluation must be part of all nutritional endeavors, with measureable objectives constructed to determine the effectiveness of the programs. Depending on resources and facilities, methods of evaluation will vary. WHO, Regional Office for the South-East Asia, 2006 states that so far, most of the interventions have either focused on children aged 0-5 yrs or on pregnant women, and, to some extent on lactating women. However, not much attention has been paid to adolescents by nutrition related programs in developing countries. Adolescents are in the progress of establishing responsibility for their own health related behaviors, including diet. It is therefore, an appropriate time for health promotion programs based on documented relationships between behavior in this age group. Adolescents can and should take responsibility for their nutrition and the long-term responsibility for their nutrition and the long-term repercussions on health.

Specific objectives:

1. To study the socio-economic status of the subjects.
2. To measure the growth pattern of adolescents in terms of anthropometric measurements.
3. To assess the prevalence of anemia in the subjects (10-19 yrs) by estimating Hb and CBC parameters.
4. To study the impact of supplementation of IFA alone and with Multiple Micronutrient for four months on the Hemoglobin levels of the subjects.
5. To assess the impact of Nutrition Heath Education on the subjects.

METHODOLOGY

The present study was undertaken to integrate NHE along with Supplementation of IFA alone and with Multiple Micronutrient to improve the nutritional status and Hemoglobin levels of underprivileged school-going adolescents (10-19 yrs) of Urban Vadodara.

The study was carried out in three phases

Phase I: Situational analysis.

To determine the Nutritional Status and prevalence of anemia in underprivileged adolescent boys and girls aged 10-19 yrs of Urban Vadodara, Gujarat state.

Phase II: Intervention period for 4 months :

1. To supplement Iron Folic Acid tablets and IFA+MMN twice weekly with deworming tablet *i.e.* Albendazole once at the beginning.
2. Planning and implementing Nutrition Health Education and twice weekly IFA supplementation

Phase III: Impact evaluation :

To conduct and study the impact of Supplementation and Nutrition Health Education.

Experimental design :

Two schools from urban Vadodara were purposively selected based on the following

criteria:

1. Their willingness to participate in the study
2. Adolescents should belong to the low economic strata of the society
3. Their past history of non consumption of IFA tablets in the last two years.

A pre-post experimental design was used to fulfill the objectives of the study. The study was conducted in three phases and both qualitative and quantitative methods of data collection were used in each phase.

The supplementation of IFA (100mg of elemental iron and 0.5 mg of folic acid) and Polyvitamin Tablets (2500 IU of Eq. to Vitamin A, 200 IU of Cholecalciferol, 2 mg of Thiamine Hydrochloride, 2 mg Riboflavin, 1 mg of Calcium Pantothenate, 25 mg of Niacinamide and 50 mg of Ascorbic Acid) twice weekly with deworming tablets (Albendazole – 400 mg) once at the beginning was done and the details are given below:

Supplement	Manufacturing date	Expiry date	Batch No.
E- Folifer	03.2010	02.2012	00308
Polyvitamin	11.2010	04.2012	F638L007

The polyvitamin supplement was given for analysis of 2 major nutrient and the results were:

– Ascorbic acid by titrimetric method: 143 mg
– Vitamin A by carr price method: 2000 IU

All the anthropometric measurements were taken in triplets for individual subjects and average of the three readings was finally recorded. Anthropometric measurements such as height, weight, body mass index (BMI), were recorded using standard procedures.

Self-administered semi- structured questionnaire was given under supervision and guidance to elicit information.

RESULTS AND DISCUSSION

Baseline data :

The study consisted of 96 subjects out of which 52 were boys and 44 girls in the age group of 10-18 years. Most subjects (56.3%) were in their mid adolescence (13-15 years). Girls (72.7%) following more vegetarianism than boys (53.8%). These adolescents lived mostly in nuclear families (77.3%) because they belonged to urban slums and their grandparents lived in the village. Rest of the subjects (22.7%) lived in joint families(Table 1).

Socio-demographic profile of the subjects :

Salient observations that emerged from the socio demographic data in Table:2 were as follows:

– Subjects mainly lived in pucca houses (57.3%), while very few lived in kutcha houses. Majority of them had toilet facility (88.5%).

– More number of the mothers of subjects were illiterate as compared to the fathers. Approximately 31% of the mothers and fathers had completed primary education.

– Many fathers (38.5%) were in service, while half of the mothers (39.6%) were

Table 1 : Background information of the subjects (N=96)

Variables	Category	Boys	Per cent	Girls	Percent	Total	Per cent
Age of	10	7	13.5	9	20.5	16	16.7
respondents	11	4	7.7	4	9.1	8	8.3
(yrs.)	12	5	9.6	9	20.5	14	14.6
	13	7	13.5	9	20.5	16	16.7
	14	14	26.9	2	4.5	16	16.7
	15	7	13.5	5	11.4	12	12.5
	16	4	7.7	2	4.5	6	6.3
	17	3	5.8	4	9.1	7	7.3
	18	1	1.9	0	0	1	1.0
	10-12	16	30.8	22	50.1	28	29.2
	13-15	28	53.9	16	36.4	54	56.3
	16-18	8	15.4	6	15.4	14	14.6
	Total	52	100.0	44	100.0	96	100.0
Religion	Hindu	41	78.8	43	97.7	84	87.5
	Muslim	5	9.6	0	0	5	5.2
	Christian	2	3.8	0	0	2	2.1
	Sikh	4	7.7	1	2.3	5	5.2
	Total	52	100.0	44	100.0	96	100.0
Birth order	1^{st}	16	30.8	15	34.1	31	32.3
	2^{nd}	17	32.7	13	29.5	30	31.3
	3^{rd}	14	26.9	12	27.3	26	27.1
	4^{th}	4	7.7	2	4.5	6	6.3
	5^{th}	1	1.9	1	2.3	2	2.1
	6^{th} and higher	0	0	1	2.3	1	1.0
	Total	52	100.0	44	100.0	96	100.0
Type of family	Joint	16	30.8	10	22.7	26	27.1
	Nuclear	36	69.2	34	77.3	70	72.9
	Total	52	100.0	44	100.0	96	100.0
Type of diet	Vegetarian	28	53.8	32	72.7	60	62.5
	Ovovegetarian	6	11.5	6	13.6	12	12.5
	Non Vegetarian	18	34.6	6	13.6	24	25.0
	Total	52	100.0	44	100.0	96	100.0

working.

Only about half the girls (45.5%) had attained menarche.The average age of menarche was between 13-15 years (Table 3). Menarche, which is the onset of menses, is considered the hallmark of puberty among females. It occurs at 12.4 years in the average female (Kraus and Mahan, 2008).The present result shows that their pubertal growth was delayed probably due to low nutritional status. Low iron stores throughout childhood may contribute to a delayed menarche and impaired immune response (Barbin and Barbin, 1992 and, Beaton *et al*).

Table 2 : Socio economic status of the subjects

Variable	Category	Boys	Per cent	Girls	Per cent	Total	Percent
Type of house	Kutcha	1	1.9	3	6.8	4	4.2
	Semi kutcha	2	3.8	4	9.1	6	6.3
	Pucca	29	55.8	26	59.1	55	57.3
	Semi pucca	20	38.5	11	25.0	31	32.3
	Total	52	100.0	44	100.0	96	100.0
Toilet in house	Yes	45	86.5	40	90.9	85	88.5
	No	7	13.5	4	9.1	11	11.5
	Total	52	100.0	44	100.0	96	100.0
If no,	Community toilet	2	3.8	2	4.5	4	-
	Field	5	9.6	2	4.5	7	-
	Total	7	13.5	4	9.1	11	-
Father's	Illiterate	8	15.4	2	4.5	10	10.4
education	Till 7^{th}	10	19.2	19	43.2	29	30.2
	Till 10^{th}	15	28.8	10	22.7	25	26.0
	Till 12^{th}	1	1.9	4	9.1	5	5.2
	College	6	11.5	3	6.8	9	9.4
	Don't know	12	23.1	6	13.6	18	18.8
	Total	52	100.0	44	100.0	96	100.0
Father's	Wage labourer	12	23.1	14	31.8	26	27.1
occupation	Service	20	38.5	17	38.6	37	38.5
	Business	8	15.4	6	13.6	14	14.6
	Driver	5	9.6	3	6.8	8	8.3
	Cultivation	1	1.9	1	2.3	2	2.1
	Don't know	6	11.5	3	6.8	9	9.4
	Total	52	100.0	44	100.0	96	100.0
Mother's	Illiterate	13	25.0	8	18.2	21	21.9
education	Till 7^{th}	13	25.0	17	38.6	30	31.3
	Till 10^{th}	10	19.2	10	22.7	20	20.8
	Till 12^{th}	1	1.9	0	0.0	1	1.0
	College	3	5.8	1	2.3	4	4.2
	Don't know	12	23.1	8	18.2	20	20.8
	Total	52	100.0	44	100.0	96	100.0
Mother's	Wage labourer	2	3.8	1	2.3	3	3.1
occupation	Service	3	5.8	0	0.0	3	3.1
	House wife	26	50.0	24	54.5	50	52.1
	Maid	16	30.8	15	34.1	31	32.3
	Cultivation	1	1.9	0	0.0	1	1.0
	Don't know	4	7.7	4	9.1	8	8.3
	Total	52	100.0	44	100.0	96	100.0

Table 3 : Age at which Menarche attained (n=20)

Age group	Age of subject (yrs.)	Total no. of Girls	No. of girls not attained Menarche	No. of girls attained Menarche	%
Early adolescence	10-12 yr	22	14	8	40
Mid adolescence	13-15 yr	16	6	10	50
Late adolescence	16-18 yr	6	4	2	10
Total	10-19 yr	44	24	20	100

Anthropometric data:

Anthropometric data was analyzed according to both WHO 2007 and CDC 2000 standards. A comparison of the two was also done.

Mild stunting was more prevalent in late adolescence in both boys (50%) and girls (33.3%). The prevalence of stunting in boys and girls and overall was 12% (WHO 2007) In boys, maximum stunting was seen in mid adolescence (5.8%), whereas, in girls it was observed in early adolescence(7.5%).However, in the present study, stunting was not highly prevalent as 88% of the subjects came under normal height category according to WHO 2007 standards (Table 4).

Table 4 : Prevalence of stunting

Sex	Age (Yrs.)	WHO 2007						CDC 2000					
		n	Stunted (<-2SD)		Normal (<-2SD)		Total	n	Stunted (<-2SD)		Normal (<-2SD)		Total
			n	%	n	%	%		n	%	n	%	%
Boys	10-12	16	1	1.9	15	28.8	30.8	16	1	1.9	15	28.8	30.8
	13-15	28	3	5.8	25	48.1	53.8	28	3	5.8	25	48.1	53.8
	16-19	8	2	3.8	6	11.5	15.4	8	2	3.8	6	11.5	15.4
	Total	52	6	11.5	46	88.5	100.0	52	6	11.5	46	88.5	100.0
Girls	10-12	20	3	7.5	17	42.5	50.0	20	1	2.6	19	48.7	51.3
	13-15	14	2	5	12	30	35.0	13	2	5.1	11	28.2	33.3
	16-19	6	0	0	6	15	15.0	6	0	0.0	6	15.4	15.4
	Total	40	5	12.5	35	87.5	100.0	39	3	7.7	36	92.3	100.0
Total	10-12	36	4	4.3	32	34.8	39.1	36	2	2.2	34	37.4	39.6
	13-15	42	5	5.4	37	40.2	45.7	41	5	5.5	36	39.6	45.1
	16-19	14	2	2.2	12	13.0	15.2	14	2	2.2	12	13.2	15.4
	Total	92	11	12.0	81	88.0	100.0	91	9	9.9	82	90.1	100.0

The overall prevalence of underweight was higher in boys (28.8%) than in girls. The total prevalence of underweight was 24.2%. Among boys, underweight was more in mid-adolescents (13.5%) whereas in girls it was seen in early adolescents(12.8%)(Table 5).Studies were also carried out on stunting and underweight among rural adolescents in Nepal (Bisai *et al.*, 2011).

According to the BMI calculations, undernutrition was more seen among boys(38.5%) than girls according to WHO 2007 standards(Table 6).Mid-adolescent boys(19.2%) and early adolescent girls(15%) were more under nourished. The nutritional status which is often poor during early life gets worsened as the adolescent growth spurt occurs (Senapati

Table 5 : Prevalence of underweight

Sex	Age (Yrs.)	CDC 2000					Total %
		n	Normal (>-2SD)		Underweight (<-2SD)		
			N	%	N	%	
Boy	10-12	16	12	23.1	4	7.7	30.8
	13-15	28	21	40.4	7	13.5	53.8
	16-18	8	4	7.7	4	7.7	15.4
	Total	52	37	71.2	15	28.8	100.0
Girl	10-12	20	15	38.5	5	12.8	51.3
	13-15	13	11	28.2	2	5.1	33.3
	16-18	6	5	12.8	1	2.6	15.4
	Total	39	31	79.5	8	20.5	100.0
Total	10-12	36	27	29.7	9	9.9	39.6
	13-15	41	33	36.3	8	8.8	45.1
	16-18	14	9	9.9	5	5.5	15.4
	Total	91	69	75.8	22	24.2	100.0

Table 6 : Prevalence of under nutrition

Sex	Age (Yrs.)	WHO 2007						CDC 2000					
		n	Undernourished		Normal		Total	n	Undernourished		Normal		Total
			n	%	n	%	%		N	%	N	%	%
Boys	10-12	16	4	7.7	12	23.1	30.8	16	5	9.6	11	21.2	30.8
	13-15	28	10	19.2	18	34.6	53.8	28	11	21.2	17	32.7	53.8
	16-19	8	6	11.5	2	3.8	15.4	8	6	11.5	2	3.8	15.4
	Total	52	20	38.5	32	61.5	100.0	52	22	42.3	30	57.7	100.0
Girls	10-12	20	6	15	14	35	50	20	6	15.4	14	35.9	51.3
	13-15	14	2	5	12	30	35	13	2	5.1	11	28.2	33.3
	16-19	6	1	2.5	5	12.5	15	6	1	2.6	5	12.8	15.4
	Total	40	9	22.5	31	77.5	100	39	9	23.1	30	76.9	100.0
Total	10-12	36	10	10.9	26	28.3	39.1	36	11	10.9	25	28.3	39.1
	13-15	42	12	13.0	30	32.6	45.7	41	13	13.0	28	32.6	45.7
	16-19	14	7	7.6	7	7.6	15.2	14	7	7.6	7	7.6	15.2
	Total	92	29	31.5	63	68.5	100.0	91	31	31.5	60	68.5	100.0

et al., 1990).

In another study carried out by Das and Bisai (2009), the overall (age-sex combined) rate of undernutrition was 28.6% among studied population. The study revealed that rate of undernutrition was significantly higher among boys (37.6%) than girls (19.4%) counterpart which is similar to the results obtained in the present study.

Prevalence of anemia:

Prevalence of anemia was 72.9% out of which 34.4% were boys and 38.5% were girls revealing that girls were more anemic than boys (Table 7). No one suffered from severe

anemia among both boys and girls. Among boys, most of the anemic subjects were in their early adolescence, while maximum percentage of anemic girls were in their mid adolescence. It was also noted that mid adolescence was the age at which they attained menarche which could be a contributing factor in the depleted blood haemoglobin levels. The prevalence of anemia among adolescent school girls was 21.4% in Western Iran (Akramipour *et al.*, 2008 and Verma *et al.,* 2004)

Table 7 : Prevalence of anemia

Sex	Normal		Anemic		Chi square
	n	%	n	%	
Boys	19	19.8	33	34.4	5.136*
Girls	7	7.3	37	38.5	
Total	26	27.1	70	72.9	

Several studies have been reported on anemia and its consequences (Rawat *et al.*, 2011; Deshmukh *et al.*, 2008; Baral and Onta, 2009; Leenstra *et al.*, 2003 and Toteja *et al*., 2006).

KAP:

Most children considered themselves to be healthy. They also considered their height to be normal. Most of the subjects had no knowledge about malnutrition, anemia and hemoglobin. The hygiene practices of the children were good as all washed hands after using toilet and also took a bath regularly. Their clothes were also washed frequently.

Dietary intake:

The dietary intake of nutrients was low as compared to the RDA in all the subjects except in the case of fats where the consumption exceeded RDA levels (104%- 200%). β-carotene consumption was very low in both boys and girls, while girls, apart from the little consumption of β-carotene, the intake of iron was also less

From FFQ, wheat was consumed daily, while bajra, which is an iron rich cereal, was consumed very less by the subjects. Highest number of subjects were in the category of never consuming the GLVs.

Impact of intervention :

The total subjects in the present study were randomly divided into three groups and they were given twice weekly supplementation for 4 months with NHE.

– The first group was administered IFA tablets (100mg of elemental iron and 0.5 mg of folic acid)- Experimental Group I

– The second group was given IFA and MMN tablets (Polyvitamin Tablets; 2500 IU of Eq. to Vitamin A, 200 IU of Cholecalciferol, 2mg of Thiamine Hydrochloride, 2 mg Riboflavin, 1 mg of Calcium Pantothenate, 25 mg of Niacinamide and 50 mg of Ascorbic Acid) – Experimental Group II

– The third was the Control group which was given IFA placebo – Control Group

Anthropometric measurements were taken at the end of the supplementation period.

The number of stunted individuals remained the same post intervention for boys, girls and total subjects.However, the number of underweight subjects decreased post intervention with the number of underweight girls (20.5%) reducing to half the number (10.3%) post intervention (Table 8).Similarly, according to BAZ, the percentage of undernourished subjects also reduced after intervention. While previously there were 31% undernourished subjects,

Table 8: Impact of Intervention sex-wise on Anthropometric Indices (CDC 2000)

	N	Nutritional status	Pre (n)	Pre (%)	Post (n)	Post (%)	Chi square
HAZ							
Boys	52	Normal	46	88.5	46	88.5	
		Stunted	6	11.5	6	11.5	
Girls	39	Normal	36	92.3	36	92.3	0.4^{NS}
		Stunted	3	7.7	3	7.7	
Total	91	Normal	82	90.1	82	90.1	
		Stunted	9	9.9	9	9.9	
WAZ							
Boys	52	Normal	37	71.2	41	78.8	
		Underweight	15	28.8	11	21.2	
Girls	39	Normal	31	79.5	35	89.7	0.8^{NS}
		Underweight	8	20.5	4	10.3	
	91	Normal	68	74.7	76	83.5	
Total		Underweight	23	25.3	15	16.5	
BAZ							
Boys	52	Normal	30	57.7	37	71.2	
		Undernourished	22	42.3	15	28.8	
Girls	39	Normal	30	76.9	34	87.2	3.7^{NS}
		Undernourished	9	23.1	5	12.8	
Total	91	Normal	60	65.9	71	78.0	
		Undernourished	31	34.1	20	22.0	

NS=Non-significant; *Significant at p <0.05

their percentage reduced to 22% after the intervention.

Table 9 shows the change in the anemic status after the supplementation. In all the experimental groups there was an increase in post mean hemoglobin levels (Table 10). The difference in the mean haemoglobin levels was 0.59 g/dl in the IFA group, 0.77g/dl in IFA with MMN group and 0.46g/dl in the Control group. Differences were significant in both Experimental groups 1 and 2, while it was not significant in the control group. The impact of IFA with MMN on Hb level was more prominently seen to affect the girls (difference in mean was 0.91 g/dl) than the boys. In boys, however, the impact on Hb was the same in both IFA and IFA+MMN group with a difference in mean of 0.67 g/dl. A study among rural adolescent girls in Bangladesh confirms similar results (Ahmed *et al.*, 2010).

Very few studies have been reported onthe combined effect of multiple micronutrient and iron supplementation (Tarun *et al.*, 2008).

Vitamin A exerts an influence on the metabolic activity of iron, and hence haemoglobin

Table 9 : Change in anemic status

Sex	Age	N	Normal		Anemic	
			Pre	Post	Pre	Post
Boys	10-12	16	3	6	13	10
	13-15	26	12	19	14	7
	16-18	8	3	7	5	1
	Total	50	18 (36)	32 (64)	32 (64)	18 (36)
Girls	10-12	22	5	6	17	16
	13-15	14	1	3	13	11
	16-18	6	1	4	5	2
	Total	42	7 (16.7)	13 (31)	35 (83.3)	29 (69)
Total	10-12	38	8	12	30	26
	13-15	40	13	22	27	18
	16-18	14	4	11	10	3
	Total	92	25 (27.2)	45 (48.9)	67 (72.8)	47 (51.1)

Table 10 : Mean of blood parameters of subjects sex-wise in three groups after intervention

Subjects	Mean ± SE		
	Experimental 1	Experimental 2	Control
Boys			
Hb Initial	11.52 ± .30	11.82 ± .24	12.01 ± .29
Hb Final	12.19 ± 0.26	12.49 ± .31	12.63 ± .34
Difference	0.67	0.67	0.62
Paired 't'	3.47*	3.97*	1.78^{NS}
Girls			
Hb Initial	10.78 ± .21	10.65 ± 0.38	11.68 ± .35
Hb Final	11.31 ± .25	11.56 ± 0.34	12.13 ± .29
Difference	0.53	0.91	0.46
Paired 't'	3.03*	5.19*	0.76^{NS}
Total			
Hb Initial	11.12 ± .19	11.35 ± .23	11.68 ± .23
Hb Final	11.71 ± .19	12.12 ± .24	12.13 ± .26
Difference	0.59	0.77	0.46
Paired 't'	4.63*	6.22*	1.93^{NS}

NS=Non-significant; *Significant at $p < 0.05$

formation (Meija, 1992). In the MMN given to the subjects, 2500 IU of Vitamin A was present. The girls with lowest serum retinol level had lower Hb and serum ferritin levels, indicating that marginal vitamin A status might compromise iron metabolism and hence Hb formation. An association of lower serum retinol with lower iron indices, including Hb, has also been reported in children (Bloem *et al.*, 1989), adolescent girls (Ahmed *et al.*, 1996), and in pregnant women (Suharno *et al.*, 1992).

Evaluation of NHE intervention reveals that all the NHE sessions had a significant impact on the knowledge of the subjects as evaluated by the Score for NHE. Pre Score

Table 11 : Impact of NHE intervention

Topic of NHE	Pre Mean Score ± SE	Post Mean Score ± SE	t	df	Level of significance
Importance of supplementation	5.5 ± .2	7.3 ± .2	9.1	57	.000
Diet and healthy eating	7.2 ± 0.2	8.1 ± 0.1	6.5	92	.000
Vitamins	5.4 ± 0.1	6.9 ± 0.2	7.7	90	.000
Minerals	4.5 ± 0.2	6.1 ± 0.2	9.4	88	.000
Anemia	4.9 ± 0.1	7.8 ± 0.1	13.1	83	.000
Sanitation and hygiene	6.7 ± 0.1	7.3 ± 0.1	5.7	88	.000
Addictive behaviors	6.5 ± 0.2	7.9 ± 0.2	9.0	87	.000
Puberty and early marriage	4.1 ± 0.2	6.6 ± 0.2	13.2	71	.000

Mean was highest in Diet and healthy eating Practices (7.2), while maximum change in mean from pre to post occurred in Anemia (Table 11). A study by Kochar among rural adolescent girls of Kurukshetra also reported significant improvement in knowledge an attitude of the females.

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