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FOOD FORTIFICATION AND IRON DEFICIENCY ANAEMIA –SCHOOL MODEL APPROACH

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ABSTRACT

Food based approaches are gaining high potential for long lasting benefits in improving nutrition and serum iron status of adolescents. The study assessed the impact of nutrition education and intervention of a novel iron rich fortified beet-root extract on the packed cell volume(Haematocrit) and weight gain of adolescents. 80 study participants (Haemoglobin<9gm/dl) were randomly assigned to two study groups the intervention and control. 150ml of the fortified beetroot extract was served to each of the interventional subjects on every alternate days for three months (45days). Control group was served with a placebo. Nutrition education was given (n=80).Packed cell volume (Haematocrit) and weight gain were assessed. Students paired 't' test was performed to test the level of significance. Hypothesis was tested at 95 per cent confidence interval. The mean body weight improved significantly (t=3.42, p<.0001) in the intervention group (13-15yrs) with significant (t=18.8, p< .0001) impact in the mean Packed cell volume (16-18yrs). In conclusion fortified beet-root extract intervention had high impact on the body weight and packed cell volume of adolescents.

KEY WORDS; **Fortification, Iron deficiency anaemia ,Intervention, , Placebo**

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INTRODUCTION

Food-to-food fortification is recognized as an urgently needed and a more comprehensive strategy to combat micronutrient and iron deficiency anaemia.[1]It is estimated that Iron deficiency anaemia is the greatest nutritional problem in the adolescent stage. The overall nutrient needs are higher to support optimum growth and development. Iron is one nutrient that is particularly high in demand and requirement in this age group as is true for some adolescent girls who experience heavy blood loss. Iron deficiency can decrease appetite, and food intake leading to weight loss and deficiency. The hemoglobin count in most of the adolescent girls in india is less than the standard (12 g/deciliter) accepted worldwide.[2] In India widespread prevalence of anaemia in adolescent girls is gaining increased recognition. Adolescent girls are stated as important beneficiary group in national and state level nutrition policy.[3-4] This has resulted in various programmes to combat under nutrition and iron deficiency anaemia in recent years in this group. Though iron and folic acid supplementation remains the corner stone in treatment of anaemia nutrition education and food supplementation are long term measures in preventing the recurrence.[5] A change from pill to natural food is a difficult challenge but should be considered as the best and most natural solution for iron deficiency anaemia. Iron from plant sources have generally low –bioavailability but can be significantly enhanced by adding foods rich in vitamin-C.[6] The addition of certain vegetables or fruits containing ascorbic acid can double or triple iron absorption thereby counteracting the effects of the iron inhibitors. Each meal should preferably contain at least 25 mg of ascorbic acid and possibly more if the meal contains many inhibitors of iron absorption. The process of selecting the best food vehicle and iron source may appear simple but is actually a complex process that requires evaluation at every step.[7] Beet-root extract is possibly the best natural remedy for anaemia. Ferritin, a major form of endogenous iron in beet-root is a novel and natural alternative to iron supplementation. Haematocrit or packed cell volume measures the proportion of blood volume occupied by erythrocytes and is the most cost efficient and commonly used method to screen anaemia. The study was performed to find the prevalence of anaemia among adolescent (12-18yrs) girls and assess impact of nutrition education and supplementation of a novel iron rich fortified beet-root extract on the packed cell volume (Haematocrit) and body weight.

MATERIALS AND METHOD

The study was approved by the research committee of Sri Avinashilingam deemed university. Government-aided girls school of Chennai city was selected and designed to include eligible adolescent girls in the age group of 12 – 18 years. Consent was obtained from school authorities, students and parents. They were briefed about the supplemental study with fortified beetroot extract and collection of blood through letter and meetings.

SAMPLE SIZE

A randomised control trial was followed.118 adolescent students(12 – 18 yrs) were screened for baseline haemoglobin (cyanmethaemoglobin) with the help of trained biochemist. 98 adolescents were found to be anaemic (Haemoglobin<9gm/dl). The Inclusion criteria for the supplementation study consists of those willing to participate in the study with haemoglobin level≤ 9gm/dl. The exclusion criteria was those un willing to participate in the study, haemoglobin level≤ 5mg/dl and subjects allergic to beetroot extract. After several stages of inclusion and exclusion criteria 80 study participants were randomly assigned to two study groups. The intervention group 12 -15yrs (n=20), control 12 - 15yrs(n=20) and intervention group16 – 18yrs(n=20), control 16 – 18yrs(n=20). The participants were appraised of anaemia and the importance of fortified beetroot extract in combating anaemia through nutrition lecture.

PRODUCT DEVELOPMENT

Idea generation and screening of ideas were the initial step in product development using food-to-food fortification strategy. Beetroot extract provides 37 percent of natural daily requirement of folate and is the best natural remedy in treating anaemia.[8]After a series of trials using ingredients in various proportion the concept of the enriched product took shape.

Beetroot(fresh)
↓
Washed and cut to pieces (1kg)
↓ + Ginger(10gms)
Crushed(Food mixer)
↓
Pulp+Water(2lit)
w/v: 1:2
↓
Freshlimejuice(30ml) +sugar
↓ To prevent oxidation of vitamin C
add at the time of consumption

Fortified Beetroot Extract.

2000ml of extract contains 1000gms beetroot
100ml contains 50gms beetroot
150ml contains 75gms beetroot

INTERVENTION

Helminth infection is an important contribution to anaemia. The study participants were dewormed.150ml of beetroot extract was given to each of the intervention subject on every alternate days for three months(45days). In rare cases some people observe beeturia(red urine) after consumtion of beetroot in any form, while it is not a problem but an indicator of defect in iron metabolism.[9] The control group was served with a placebo containing fruit essence in water sweetened with sugar. Nutrition education was given to all the study participants(n=80).

HAEMATOLOGY

The packed cell volume was measured by standard wintrobe method and weight gain by a standard weighing scale at pre and post interventional stage.

STATISTICAL ANALYSIS

Students paired 't' test was performed to test the level of significance between pre and post intervention data's. Hypothesis testing was done at 95 per cent confidence interval.

RESULTS

The mean baseline(30.10±0.81) volume of packed cell (13-15yrs) percentage gradually increased at the post-test level (39.54±1.09) with fortified beet-root extract intervention (45days).The mean difference(9.44 ±1.09)was significant (t=18.03,p< .0001) statistically .Consuming beet-root juice helps in regeneration of red blood cells. In the control (Table-1) group with nutrition education alone the difference between the baseline (30.12±1.33) and the third month(30.35±1.20) was not significant (t=1.6,p=0.126).Beet-root is known to be a good home remedy for menstrual disorders and menopause symptoms. Fortified beet-root extract intervention for three months (45days) had significant ((t=11.26, p<.0001) impact on the mean volume of packed cell as compared to girls in the control group. Fortified food supplementation is a sustainable strategy to maintain blood haemoglobin level even after cessation compared to oral iron.

Table 1
Mean packed cell volume of adolescents

Groups	Baseline	Final 3rd month 45th day	Mean difference	t value		Sood-1990
Experimental (13-15yrs) A_1	30.10 ±0.81	39.54 ±1.09	9.44 ±1.09	18.03	<.0001	37-47%
Control (13-15yrs) B_1	30.12 ±1.33	30.35 ±1.20	0.23 ±0.30	1.6	P= 0.126	
				A_1vsB_1: 11.26	p <.0001	
Experimental (16-8yrs)A_2	29.97 ±0.92	38.90 ±1.20	8.93 ±0.74	25.1	p <.0001	
Control (16-18yrs)B_2	30.19 ±1.29	30.60 ± 1.22	0.41 ±0.39	2.15	P= 0.044	
				A_2vsB_2: 18.8	p <.0001	

Values are means ±SD

There was significant(t =25.1,p< .0001) increase in the packed cell volume(16-18yrs) of the post- intervention group. Processing procedures that lower the number of phosphate groups improves the bioavailability of non-haem iron. The mean baseline (29.97±0.92) packed cell volume gradually increased (38.90±1.20) after three months of intervention with significance(t=25.1, p <.0001) statistically. Home food processing like soaking, germination, fermentation and malting of grains are natural ways of increasing the bio-availability of iron.[11] A high significance((t=18.8, p <.0001) was observed between intervention and placebo(Fig-1).

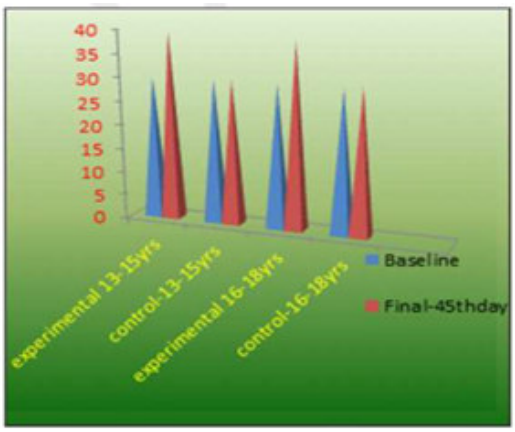

Figure 1
Changes in mean packed cell volume of adolescents

The mean weight(13-15years) gradually increased from baseline (39.39 ± 2.25) with fortified beet-root extract intervention (44.88±2.04) for three months (45days) .Weight gain is associated with food intake, poverty, inadequate diet, iron stores and communicable diseases. The mean difference (5.49±1.22) in the weight gain was highly significant (t=9.37,p<.0001) as shown in Table 2. Iron and folate supplementation is one of the most important nutritional interventions for adolescent girls to improve linear growth and development.[12]The mean difference (0.48±1.9) was not significant (t=0.53,p=0.602) in the placebo group.With fortified beet-root extract intervention for three months (45days) a significant (t=3.42,p<.0001) weight gain was seen in the intervention group, whereas girls in the control group showed little change.

Table 2
Mean body weight of adolescents

Groups	Baseline kgs	Final 3rd month 45th day(kgs)	Mean Difference (kgs)	t value		ICMR 1998(kgs)
Experimental (13-15yrs) A_1	39.39±2.25	44.88±2.04	5.49±1.22	9.37	p <.0001	46.66
Control (13-15yrs) B_1	39.89±1.8	40.37±1.6	0.48±1.9	0.53	P= 0.602	
				A_1vsB_1: 3.42	p <.0001	
Experimental (16-8yrs)A_2	45.20±2.25	49.42±2.34	4.22±1.0	8.77	p <.0001	49.92
Control (16-18yrs)B_2	43.60±1.29	43.63±1.45	0.03±1.34	0.05	P= 0.96	
				A_2vsB_2: 4.8	p <.0001	

Values are means ±SD

Weight change at each time point (16-18years) from the early phase (45.20±2.25) of fortified beet-root extract intervention (45days) to the late-phase (49.42±2.34) was significant (t=8.77,p <.0001). Home food processing is a natural way of increasing the iron bio-availability. The mean difference (0.03 ±1.34) in the weight gain of the girls in the control group was not statistically significant (t=0.05,p =0.96).The antioxidant property of beet root helps to scavenge free radicals and improve the uptake of oxygen by the muscles. Fortified beet-root extract intervention for three months (45days) had a significant (t=4.8,p <.0001) improvement in weight gain in the late adolescent age group(Fig-2).

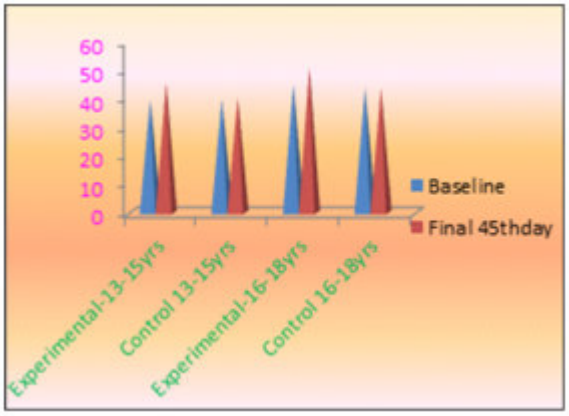

Figure 2
Changes in mean body weight of adolescents

DISCUSSION

The adolescents who received fortified beet-root extract intervention on alternate days(45days) for three months had an increased rate of weight gain and achieved the expected rate of development. The weight gain was very much significant in both age groups. Chronic anaemia in adolescents when associated with severe micronutrient deficiency results in weight loss due to low appetite, may affect school performance and physical work capacity. While iron deficiency anaemia is unlikely to be the only factor in the slower development of adolescents living in underprivileged circumstances, it can at least be easily identified and treated by nutritional interventions[13]. The packed cell volume(Haematocrit) improved each month in both the intervention groups. A statistical significance (t=11.26, p<.0001) was observed between(13-15years) the placebo and intervention group. The majority of the population in India rely on plant foods for most of the nutrients. The availability of iron from these sources are very low. Food-based approaches should address the production, processing, feeding practices, such as intra-family food distribution and care for vulnerable groups.Dietary modification activities require not only information on real food availability by groups at risk but also on dietary patterns, the bioavailability of iron in local diets, cultural aspects and local preferences. For effective food fortification, the fortified food consumed by the target population must be low in cost with good organoleptic properties.[14]Beet-root should be used only in its raw state because the betalin

in beet-root when cooked is reduced and oxalic acid crystals are released forming oxalate stones. The haemoglobin is a red colour pigment with a porphyrin ring and iron as central atom as chlorophyll with same porphyrin ring has magnesium as central atom. The coloured pigments can easily be converted to haemoglobin in the blood. The anthocyanin in beet root is a blue purple pigment similar to green colour chlorophyll that helps to alleviate anaemia and its related weight loss when administered with lime juice as fortified beet root extract.[15]

CONCLUSION

The study substantiates the effect of fortified beet-root extract supplementation on alternate days along with nutrition education in improving the,packed cell volume and weight gain.As compared to oral iron, fortified food supplementation is a sustainable strategy to maintain blood haemoglobin level even after cessation. School girls model was found to be an effective intervention strategy to reach the susceptible population.

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CONFLICT OF INTEREST

Conflict of interest declared as none.

REFERENCES

1. Sudha Rani G and Suryaprabha ML. Prevalence of anaemia and factors influencing anaemia in adolescent girls in urban and rural area of a south indian city:A comparitive study. Int J Pharm BioSci 2013 Oct; 4(4):1352 – 8.
2. Srinivasan K, Shekhar C, Arokiasamy P. Reviewing reproductive and child health programmes in India. Economic and Political Weekly. 2007 Jul 14;2931-9.
3. Sivakumar B, Brahmam GN, Nair KM, Ranganathan S, Rao MV, Vijayaraghavan K, Krishnaswamy K. Prospects of fortification of salt with iron and iodine. British Journal of Nutrition. 2001 May 1;85(S2):S167-73.
4. Indian Education Commission. Government of India, Ministry of Human Resource Development. New Delhi. 1964.
5. Bhanushali MM, Shirode AR, Joshi YM, Kadam VJ. An intervention on iron deficiency anaemia and change in dietary behavior among adolescent girls. International journal of pharmacy and pharmaceutical sciences. 2011;3(1):40-2.
6. Thompson B. Food-based approaches for combating iron deficiency. Nutritional anemia. 2007:337
7. Ramalingaswami V. Challenges and opportunities—One vitamin, two minerals. Nutrition research. 1998 Feb 28;18(2):381-90.
8. Coles LT, Clifton PM. Effect of beetroot juice on lowering blood pressure in free-living, disease-free adults: a randomized, placebo-controlled trial. Nutrition journal. 2012 Dec 11;11(1):1.
9. Tunnessen WW, Smith C, Oski FA. Beeturia: a sign of iron deficiency. American Journal of Diseases of Children. 1969 Apr 1;117(4):424-6.
10. Meyer LH. Food chemistry. 3 rd edi .Avi; 1974.
11. Pandey S, Singh V. Food Fortification to Combat Iron Deficiency Anaemia. International Journal of Advanced Nutritional and Health Science. 2013 Sep 23;1(1):pp-39.
12. Bothwell TH, MacPhail P. Prevention of iron deficiency by food fortification. InNestle nutrition workshop series (USA) 1992.
13. Patil SV, Durgawale PM, Kakade SV, Dighe S. An assessment of interventional strategies for control of anemia among adolescent girls in an urban slum of Karad, Dist. Satara, Maharashtra. Al Ameen Journal of Medical Sciences 2014;07(3):195-200.
14. DeMaeyer EM, Dallam P, Gurney JM, Hallberg L, Sood SK, Srikanta SG. A guide for health administrators and programme managers. World Health Organization. 1989.
15. Khan MA. Food chemistry. 3rd ed. Neha; 2011.