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Impact of Nutrition Education to Rural Women for Prevention of Iron Deficiency Anemia through Dietary Approach

Anamika Singh[1], Kiran Bains[2] and Renuka Aggarwal[3]

ABSTRACT

Sixty adult women in the age group of 25-35 years belonging to farm families were selected. The basic meal of dal and chapati supplemented with individual key foods such as salad, orange, lemonade, chicken, milk, curd, egg and tea were analyzed for total iron, dialyzable iron and in vitro iron bioavailability. The knowledge generated through experiment was transferred to the surveyed women through a nutrition education. Inclusion of 200 g of chicken and 250 ml of lemonade to the basic meal enhanced iron absorption by 25.74 per cent and 12.16 per cent , respectively. The in vitro bioavailability of iron was reduced by 3.8 and 1.5 per cent, when basic meal was fortified either by milk or curd, respectively. The major inhibitors of iron bioavailability were egg and tea, the percent reduction caused by egg being 50.2 per cent while by tea it was 44.6 per cent. The nutrition education intervention through a developed visual aid proved effective in improving the knowledge of rural women regarding anemia and its prevention through a dietary approach as the mean gain in knowledge was 67.8 per cent. Hence, nutrition education to women folk can prove effective in preventing iron deficiency anemia.

Key words: Iron deficiency anemia, in vitro bioavailability, dialyzable iron, nutrition education

INTRODUCTION

The prevalence of anemia is high in India because of poor dietary intake especially iron and folic acid, poor availability of iron in phytate and fiber rich Indian diet, chronic blood loss due to infections such as malaria and hookworm infestation. The amount of dietary iron needs to meet the physiological iron requirements and depends on the iron bioavailability of diet which may vary from approximately 5-18 per cent (WHO, 2004). A survey conducted by the National Nutrition Monitoring Bureau (NNMB) in year 2003 and National Family Health Survey(NFHS) in year 2005-06 showed a high prevalence of anemia. NFHS-3 has reported anemia prevalence of 56.2 per cent in women of 15-49 years, 72.2 per cent among children aged 6-35 months, 57.9 per cent in pregnant women and 24.3 per cent in men aged 15-49 years. Women in urban areas are more likely than those in rural areas to include every type of food in their diet, particularly nutritious foods such as fruits and milk or curd. Illiterate women have poorer and less varied diets than literate women. Punjab state has a surplus of food grain production. There is also abundant production of green leafy vegetables in the winter. In spite of adequate food production, iron deficiency continues to be the major nutritional disorder adversely affecting work efficiency of women (Bains and Mann, 2000). The anemia prevalence was high regardless of adequate consumption of iron which is attributed to poor availability of dietary iron from traditional Punjabi diets. (Bains *et.al.*, 2006)

The major approaches to control iron deficiency anemia which are not mutually exclusive, are medicinal supplementation with iron and folic acid and foodbased approaches, i.e. dietary diversification and fortification of foods, both complemented by programs to contradict parasitic infestations. While supplementation with iron is considered necessary for groups at high risk as a short-term emergency measure, it fails to address the root causes and cannot provide the overall long-term benefits of economy and sustainability. Evaluation studies of India's nationwide and long-standing supplementation program showed irregular supplies, non-compliance by the beneficiaries, poor counseling etc. As such, the supplementation strategy has proved to be inadequate (Vijayaraghvan 2002). Therefore, looking to these attempts, one slant that needs attention in future is the enhancement of bioavailability of iron which is highly affected by the inhibitors and enhancers present in Indian traditional meals. Endeavor can be made to balance the

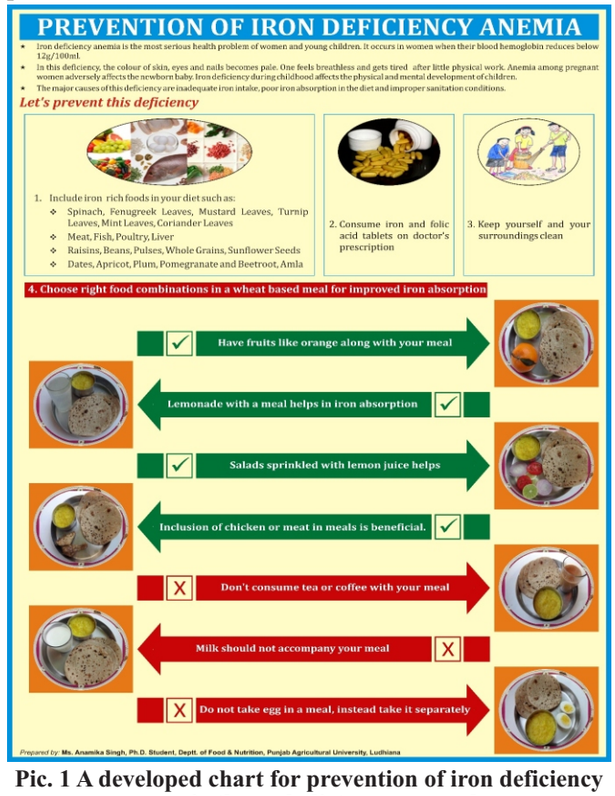
Department of Food and Nutrition, Punjab Agricultural University, Ludhiana

meals for enhanced iron bioavailability through a scientific approach and subsequently educating the general population and specially the women regarding the quality meals which can play a pivotal role in addressing the problem of iron malnutrition. Hence, the present study was planned to assess the impact of nutrition education intervention to prevent iron deficiency anemia in general and specifically through dietary approach.

METHODOLOGY

The study was conducted in village Ayali Kalan, which is situated in Ludhiana-1 Mandal, Ludhiana District, Punjab, India. It is 7.7 km distance from its Mandal Main Town Ludhiana-1. It is 10.7 km distance from its District Main City Ludhiana-1 and 99 km distance from the State Main City Chandigarh. The total population of the village is 3442, the male and female population being 53 and 47%. A total of 60 non-pregnant and non-lactating adult women in the age group of 25-35 years from the farm families of this village with land holdings between 2 to 4 ha were purposively selected. An interview schedule was developed to collect the general information of the subjects with respect to their age, education, occupation, type of family, family income and number of children, etc,

The haemoglobin (Hb) of the subjects was determined using hemoglobin kit (Becan Diagnostic Pvt. Ltd, Navsari, Gujarat, India). Blood samples (20 µg each) were drawn from the 3rd finger of left hand with a haemoglobin pipette and delivered into a test tube containing 5 ml Drabkin's solution. Haemoglobin is converted to cyanomethaemoglobin containing potassium cyanide and potassium ferricyanide which is measured colorimeterically (Dacie, 1988) and Hb calculated from the standard curve prepared from the standards provided in the kit. The subjects were classified on the basis of their hemoglobin levels into anemia classification of WHO (2011) In Punjab, dal and chapatti are essential part of daily diet, hence, a laboratory experiment was conducted where a basic meal with combination of dal+chapati was fortified with key foods such as salad, orange, lemonade, chicken, milk, curd, egg and tea at different levels (Table 1). Total iron of the meals was determined by Atomic Absorption Spectro-photometer after wet digestion. Bioavailability of iron from the samples was determined using an in vitro method (Luten et al. 1996). The knowledge generated through the experiment was transferred to the surveyed women through a nutrition education intervention. The subjects were gathered at a place in six groups and were imparted knowledge about anemia, its prevention and optimum meal combinations to prevent anemia. The teaching was carried out in vernacular (Punjabi) through lecture and discussion using the chart as visual aid as chart is considered as useful teaching aid especially in rural areas where electronic aids are less practical due to an uneven supply of electricity. These are easy to carry and comprehensive, hence more functional. A chart in Punjabi and English(Pic.1) was developed with the assistance of experts to educate the surveyed women regarding prevention of iron deficiency anemia. The contents of the chart were explained to each group in a session of 2 hours. The pre and post test knowledge was assessed with the help of question schedule comprised of 10 questions related to anemia and its prevention. Pre test was conducted prior to intervention to judge the existing knowledge of the subjects. Post test was carried out three weeks after the intervention. The gain in knowledge was reflected by scores obtained in the post test. A comprehensive wall chart containing information with photographic presentation of anemia, its prevention and meal combination with key foods which influenced iron absorption based on the findings of the experiment was prepared. All the subjects were imparted nutrition education. The impact of intervention was determined by pre and post intervention test scores. Data was analyzed using Microsoft Excel (2007) statistical analysis tool pack.



Pic. 1 A developed chart for prevention of iron deficiency anemia through dietary approach

RESULTS AND DISCUSSION

Basic information of the subjects

The agriculture was the sole family occupation of 43 per cent of the subjects whereas 30 and 27 per cent subjects reported service and business, respectively, as the additional occupation of their husbands. The monthly family income <₹10,000 were reported by 33 per cent of the subjects while 37 per cent had income > ₹ 20,000. The average monthly family income of the subjects was ₹ 15,958. The findings showed that the selected subjects belonged to families with modest income and limited purchasing power. The subjects were in the age category of 25-35 years with mean age of 31.3 years. About 30 per cent subjects were educated up to matric level while 40 per cent and 30 per cent were educated up to intermediate and graduate level. Majority of the subjects 83 per cent were housewives and 60 per cent had joint families. About 50 per cent women had two or less children whereas 40 per cent had three to four children.

Majority of the subjects *i.e.* 83 per cent were vegetarians. All the subjects belonged to Sikh religion where there are no religious reasons for being vegetarian. As reported by the subjects, wide prevalence of vegetarianism among Punjabi women has roots in cultural practices rather than due to religious reasons. Only 20 per cent subjects used to take various dietary supplements, out of which 58 per cent used to take multi-mineral supplements including iron thereby indicating a dire need of nutrition education to the rural women to curb iron deficiency anemia. Forty percent of the subjects had their Hb tested, out of which 42 per cent reported a recent testing of Hb for less than three months.

The Hb of the subjects ranged between 8.3 to 12.4g dl-1 with a mean value of 10.5 ± 1.18 g dl-1. The mean Hb was unsatisfactory when compared with the reference value of 12 g dl-1 or above (WHO, 2011). The results showed that 83 per cent of the subjects were anemic out of which 13 and 70 per cent were found to be mildly and moderately anemic. Severe degree of anemia (Hb<8.0 g/dl) was not prevalent in the studied group. Bain set al. (2012) found the mean blood hemoglobin level of rural women to be 10.4 g dl-1 with anemia prevalence of 50.6 per cent. The data depicts a dismal picture of iron status of the women in the present study. As per NNMB (2006) and NFHS-2 (1998-1999) data, 75.1 per cent women in the age group of 20-49 years were anemic. As per WHO categorization, 83 per cent subjects were found anemic, of which 13 and 70 per cent were mildly and moderately anemic, respectively. Severe degree of anemia (Hb<8.0 g dl-1) was not prevalent in the studied group, however the incidence of moderate anemia was very high. Bains and Mann (2000) have reported that moderate degree of anemia significantly reduced the physical fitness of young Punjabi women. Two studies carried out in Punjab (Bains et al., 2006; 2012), where hemoglobin was tested at the end of winter season revealed less prevalence of anemia (47-51 per cent), the prevalence of mild, moderate and severe anemia in later study being 26.0. 22.4 and 2.2 per cent of the subjects, respectively. The results confirmed that the hemoglobin level of Punjabi women dips after summers, mainly attributed to the lesser availability of greens during summer season.

The survey revealed that the majority (70 per cent) of rural women were not aware of iron deficiency anemia and role of diet in its prevention. Of the women who knew that, 73 per cent knew that diet has a role in occurrence and prevention of anemia, however they did not know the ways to prevent this deficiency through diet. The findings revealed that there is enormous scope for educating rural women about the prevention of iron deficiency anemia through the dietary approach. Previous studies have revealed that women folk have little information on iron deficiency anemia and nutrition education to them resulted in significant improvement in their knowledge about anemia (Kaur, 2006; Malhotra, 2002).

In vitro iron bioavailability of dal and chapatic as basic meal fortified with key foods

Table 1 showed that the total iron content of basic meal was 5.20 mg. A significant ($p \leq 0.01$) difference was observed in total iron content among meal combinations. The total iron in meals with chicken > salad > egg > orange > lemonade. No significant difference was observed in basic meal and the basic meal fortified with milk, curd or tea. The dialyzable iron was highest in the meal fortified with Chicken (1.66 mg). Addition of lemonade to basic meal increases the dialyzable iron by 2.4 folds, whereas addition of chicken increases it by 6.9 folds. A small but significant ($p \leq 0.01$) increase in dialyzable content was also observed when salad and orange were added to the basic meal.

Table 1: Total iron, dialyzable iron and in vitro iron bioavailability of dal and chapatti as basic meal fortified with key foods

Meal combination	Meal Weight, g	Total iron, mg	Dialyzable iron, mg	*In vitro* iron bioavailability, %
Basic meal				
Dal + chapati	200+120	4.56±0.01	0.24±0.01	5.20±0.15
Basic meal with key foods				
Dal + chapati+ salad	200+120+135	5.60±0.01	0.32±0.01	5.71±0.09
Dal + chapati+ orange	200+120+120	4.95±0.01	0.28±0.01	5.73±0.23
Dal + chapati+ lemonade	200+120+250	4.78±0.01	0.58±0.01	12.16±0.19

Dal + chapati+ chicken	200+120+200	6.45±0.01	1.66±0.02	25.74±0.28
Dal + chapati +milk	200+120+250	4.57±0.01	0.23±0.02	5.00±0.34
Dal + chapati+ curd	200+120+200	4.57±0.01	0.23±0.01	5.12±0.15
Dal + chapati+ egg	200+120+50	5.02±0.01	0.13±0.01	2.59±0.14
Dal + chapati+ tea	200+120+200	4.55±0.01	0.13±0.01	2.88±0.33
P value		≤0.01	≤0.01	≤0.01
CD at 5%		0.02	0.02	0.36

The dialyzable iron with chicken > lemonade > salad > orange. A significant (p≤0.01) reduction in dialyzable iron was observed when egg and tea was included in the basic meal. The findings revealed that egg and tea reduced dialyzable iron while addition of salad, orange, lemonade and chicken had positive effect on dialyzable iron when fortified to basic meal of dal and chapati. The addition of chicken to the basic meal showed marked increase in iron absorption (25.74%). Next to the flesh food, it was lemonade, which showed positive effect on iron absorption, the value of iron bioavailability being 12.16%. A significant (p≤0.01) increase was observed when orange was included in the main meal. A non-significant reduction was observed in the in vitro iron bioavailability of meals fortified with either milk or curd when compared to the basic meal, however, the bioavailability decreased significantly(p≤0.01)when egg and tea were included in the meal, the values of bioavailability iron being 2.59 and 2.88 per cnet, respectively.

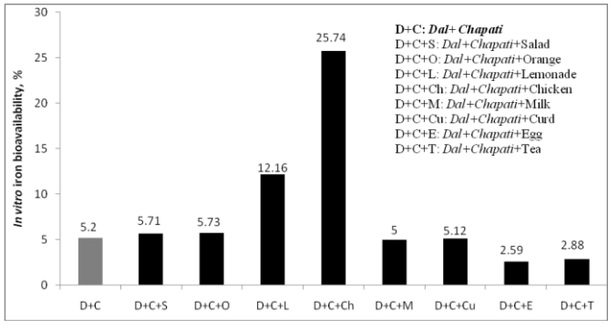


Fig.1 In vitro iron bioavailability of dal and chapati as basic meals fortified with key foods

The findings revealed that egg and tea were the major inhibitors of iron absorption as they reduced the iron bioavailability by 50.2 and 44.4 per cent while chicken and lemonade were the noteworthy promoters of iron absorption as they increased the iron absorption by 4.95 and 2.34 folds. Cook and Monsen (1976) reported an addition of animal tissue to semi-synthetic meal resulted in a fold to 4 fold increase in iron absorption. Bach (2005) observed that inclusion of meat to a vegetarian diet increased iron absorption by 50 per cent. The addition of citrus fruit can increase iron availability markedly as reported by Seshadri(1993). Gracia(1998) reported that the addition of 25 mg of ascorbic acid as lemonade consumed at two meals and improved the iron status of women. Based on the results of the experiment carried out, the meals of vegetarian and non- vegetarian adult women were optimized(Table 2). The best enhancer of iron absorption for vegetarian women is lemonade (250ml) which resulted in 1.3 fold increase in iron bioavailability.

Table 2: Enhancers and Inhibitors of in vitro iron bioavailability of dal and chapatti as basic meal fortified with key foods

Key Foods	Amount g/ml	Dal + chapatti (200+120 g)
Enhancers		
Salad	135	9.8↑
Orange	120	10.2↑
Lemonade	250	133.8↑
Chicken	200	395.0↑
Inhibitors		
Milk	250	3.8↓
Curd	200	1.5↓
Egg	50	50.2↓
Tea	200	44.6↓

Values are percent increase(↑) or decrease(↓) inin vitro iron bioavailability

The in vitro bioavailability of iron was reduced by 3.8 and 1.5 per cent, when basic meal was fortified either by milk or curd, respectively. The major inhibitors of iron bioavailability were egg and tea, the percent reduction caused by egg being 50.2 per cent while by tea it was 44.6 per cent. Therefore, the consumption of these must be avoided with the meals.

Nutrition education using developed visual aid

The gain in knowledge was assessed from pre and post test comprising of ten questions showed that scores for individual questions of pre-test varied from 0.1 to 0.53, whereas, the post-test scores varied from 0.63 to 0.99 with the mean values of 2.72 and 8.50, respectively(Table 3). The gain in knowledge was found to be 3.1 times after the intervention.

The per cent gain in knowledge for ten questions ranged between 34 to 85 per cent with the mean value of 67.8 per cent. The statistical analysis revealed that developed chart was effective in improving nutrition knowledge of the subjects as there was significant (p≤0.01) improvement in post test scores as compared to pre-test scores.

Table 3: Gain in knowledge after imparting nutrition education to prevent iron deficiency anemia through developed visual aid

n=60

Question No.	Pre-test	Post- test	Gain in Knowledge, %
1	0.37±0.49	0.87±0.35	50
2	0.10±0.31	0.83±0.38	73
3	0.20±0.41	0.83±0.38	63
4	0.43±0.51	0.90±0.37	47
5	0.37±0.49	0.93±0.25	56
6	0.07±0.25	0.80±0.47	73
7	0.53±0.14	0.92±0.12	39
8	0.23±0.21	0.79±0.22	56
9	0.29±0.10	0.63±0.27	34
10	0.14±0.20	0.99±0.04	85
Mean±SD	**2.72±0.91**	**8.50±0.94**	**67.8**
t-value		**24.17*** **	

*** Significant at 1%

Khosla (1998) revealed an increase of 1.3 folds in the knowledge score of mothers of anemic children after the nutrition education while Gagandeep (2000) observed a higher increase *i.e.* 2.4 times in the knowledge score of anemia adolescent girls.

CONCLUSION

The study concluded that the inclusion of foods like chicken, lemonade and orange with the basic meal of dal+chapatti enhances iron bioavailability, on the other hand, inhibitors like milk, curd, egg and tea need to be avoided along with meals. The knowledge about the scientific dietary approach to prevent anemia when given to the rural women proved effective in improving their knowledge. Hence, nutrition education to women folk regarding appropriate food combinations for enhanced iron bioavailability can prove effective and sustainable in preventing iron deficiency anemia.

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