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Iron-folic acid rich biscuit supplementation to reduce anaemia among adolescent girls

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Adolescence is a vulnerable period for the development of nutritional anaemia. Thus the study aimed to find out the effect of supplementation of iron-folic acid rich biscuits on the anaemic adolescent girls of Kottayam Taluk area. The study was conducted among 500 adolescent girls (12-19 yrs) of Kottayam Taluk of Kottayam District in Kerala. Overall prevalence of anaemia was 57 per cent. Fortified wheat flour, Rice bran flour, soy bean flour, gingelly seeds, peanut butter, egg, sugar and baking powder were the ingredients used for biscuit formulation. A sub sample of 50 from the anaemic adolescents was taken for this study. The biscuit was supplemented for a period of three months for the experimental group (N=25) and the effects were compared to that of control group (N=25). A statistically significant increase in haemoglobin, serum iron and serum folic acid levels was observed among the experimental group after the supplementation of iron-folic acid rich biscuits.

Key Words : Supplementation, Iron-folic acid rich biscuits, Adolescents, Anaemia

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INTRODUCTION

Adolescence, a period of transition from childhood to adulthood, is crucial in the life of human beings. Adolescence is a particularly unique period in life because it is a time of intense physical, psychological and cognitive development". Adolescents constitute about 22.8 per cent of the population in India (Dasgupta *et al*., 2010).

Nutrition is usually taken as a significant indicator of the health and overall status of adolescence. Adequate nourishment is especially critical for adolescence as it is an essential determinant of the spurt of development that describes puberty (Spear, 2002). Nutrition of adolescent girls is particularly important, but under nutrition in adolescents, frequently goes unnoticed by the parents or the adolescents themselves. The most serious aspect of this negligence is that the negative effects of under nutrition developed during the adolescent stage are carried throughout a women's productive life (Zaimin *et al*., 2003). Women in the childbearing age, young children, particularly adolescent girls are affected by anaemia (Gautam *et al*., 2002). Lumley *et al.* (2001) cited studies to show that about 70 per cent of birth defects, such as Neural Tube Defects could be prevented, if adequate folic acid is ensured before conception and during the early months of pregnancy. Some studies have shown that fortifying with iron, vitamin A, and multiple micronutrients (MMN) increased haemoglobin levels and reduced the prevalence of anaemia (Gera *et al.*, 2012 and Das *et al.*, 2013). "Adolescence is an opportune time for interventions to address anaemia. Not only is there a

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need (growth, preparation for pregnancy), but large numbers of both boys and girls can be reached easily if school attendance or participation in other group activities is high" (WHO, 2011). Nutritional deficiencies lead to giving birth to undernourished babies transferring the under nutrition to the next generation too (Singh *et al*., 2012).

With this background the study was designed with the objective to determine the incidence of anaemia and to find out the effect of supplementation of iron-folic acid rich biscuits on the anaemic adolescent girls of Kottayam Taluk area.

METHODOLOGY

Hypothesis :

The null hypothesis is that there is no effect of supplementation of iron-folic acid rich biscuits on anaemia of the adolescent girls.

Definition of terms :

Anaemia :

According to the World Health Organization (WHO, 1989), anaemia is defined as a haemoglobin level of less than 12 g/dL in women.

Supplementation :

In the present study supplementation refers to the process of supplementing concentrated sources of nutrients intended to increase the nutritional value to the normal diet.

Iron-folic acid rich biscuits :

Iron-folic acid rich biscuits in the current study refer to a small, flat cake that is dry, crisp and sweet. Which was made up of iron and folic acid rich items like fortified wheat flour, rice bran flour, soy bean flour, gingelly seeds, peanut butter and egg.

Sampling :

On the basis of sample determination equation five hundred adolescent girls between the age of 12-19 years were selected from Kottayam Taluk area. Multistage random sampling was the technique adopted for sample selection. Out of the 500 adolescent girls selected a sub-sample of 202 subjects were selected for screening of anaemia based on the following criteria. i) Those who are in the late adolescent age group (17-19 years), ii) Who were willing to participate and permitted by their parents to take blood sample.

Haemoglobin analysis revealed that 115 adolescent girls were anaemic. Out of the 115 anaemic adolescent girls two groups *i.e.* i) intervention group (n=25) and ii) control group (n=25) were formulated.

Inclusion criteria for intervention:

Those who had mild (10-11.9 g/dl) and moderate (7-9.9 g/dl) anaemia, and who were in the late adolescent age group, were purposively selected for the intervention study.

Exclusion criteria for intervention :

Consumption of nutritional supplements, anticonvulsant drugs and other medicines and gynaecological problems were the exclusion criteria considered for selecting subjects for interventions.

Justification of inclusion and exclusion criteria :

Late adolescence, being close to the reproductive phase of a woman's life, is very significant. Nutritional status during late adolescence thus requires immediate attention and appropriate interventions. Subjects receiving anticonvulsant drugs were excluded because enzyme-inducing anticonvulsants, such as phenytoin, carbamazepine, primidone, and phenobarbital, are known to decrease folate levels, and valproic acid may interfere with folate metabolism (Morrell, 2002). Also heavy bleeding due to gynaecological conditions can interfere with the results of intervention. Subjects consuming nutritional supplements and medicines were also excluded for the same reason.

Tools and techniques :

A semi-structured interview schedule was used to collect data from the respondents on socio-economic background. The same was pre-tested among 20 adolescent girls, not involved in the study, which were later excluded from the actual study. After the pre-test appropriate changes were made in the survey instrument.

The biochemical parameters assessed were (a) Haemoglobin (Cyanmethymoglobin method), (b) Serum iron (Spectrophotometry) (c) Serum folic acid (Microbiological assay using Lactobacillus casei) and (d) Vitamin B_{12} (Microbiological assay using Euglena gracilis).

The iron-folic acid rich biscuit was prepared as follows:

– Mix wheat flour, soybean flour, rice bran flour and gingelly seed powder in a bowl. To this mixture add cold peanut butter and beated egg, mash it with hand.

– Once the flour and butter are mixed thoroughly add powdered sugar and baking powder to it. Roll out on a floured board and cut it into rounds using biscuit cutter.

– Place on greased tins and bake at 180^{0}C in an Oven for 10 minutes

Direct interview method was adopted for the data collection. The researcher explained each item of the schedule and the responses were recorded accordingly. Written consent was obtained from adolescent girls and their parents before blood collection. 5ml of venous blood was drawn using a disposable syringe from 202 adolescent girls with the help of trained lab technicians and 1 ml of the sample used for measuring haemoglobin levels using Cyanmethemoglobin method, which revealed that 115 subjects were anaemic. Further serum iron, serum folic acid and vitamin B_{12} levels were analysed for these 115 anaemic adolescent girls. Anaemic adolescent girls (n=25) in the intervention group received 100g per day of iron-folic acid rich food supplement in the form of biscuits weighing 20 g each, for a period of three months. These biscuits formed a part of their daily diet and were advised to take in mid-morning and in the mid-evening. Care was taken to see that the adolescent girls consumed five of those Iron-Folic acid rich biscuits regularly, even on holidays under the supervision of the investigator.

Haemoglobin, serum iron, serum folic acid and vitamin B_{12} analysis done prior to the interventions revealed that vitamin B_{12} deficiency was not existed among the subjects. Therefore the study of impact of intervention on the haematological parameters was limited to the initial and final analysis of haemoglobin, serum iron and serum folic acid levels. And the effect was compared with that of the control group. The statistical software SPSS version 17 was used for the data analysis.

OBSERVATIONS AND ASSESSMENT

The results obtained by the present investigation are presented in Tables 1 to 5.

It was observed that among the 500 adolescent girls selected, majority (60%) belonged to early adolescent period; age ranged from 12 to 16 years. The percentage of girls in the late adolescence period was 40 in the age group of 17 to 19 years. Majority (78.4%) of them were from nuclear families. As per HUDCO (2007), most of the subjects belonged to low income group (39.4%) and middle income group (24.6%). Economically weaker section constituted 19.6 per cent of the total respondents. The religious distribution of respondents was that half (51.8%) of the subjects were Hindus, whereas Christians and Muslims constituted 34.6 per cent and 13.6 per cent, respectively.

The total percentage of anaemia of adolescent girls under study was 57 and it is significantly higher percentage with a mean haemoglobin level of 11.7g/dl. As per the anaemia classification of WHO (1989) only 43.06 per cent of the subjects had normal haemoglobin levels ($\geq$12 g/dl). Mild anaemia was seen among 55 per cent of the subjects (10-11.9 g/dl), whereas, only 1.9 per cent of the subjects had moderate anaemia (7-9.9 g/dl). Severe anaemia (<7g/dl) was not observed among the study respondents. These results support the UNICEF (2011) data in which the prevalence of anaemia in adolescent girls is estimated at 56 per cent.

The respondents under this present study had an average Hb level of 11.7 g/dl, a little below the normal range. Serum iron level was found to be well below (25.69 µg/dl) the normal range (35-150 µg/dl) indicated by Monson *et al*. (2002). Also the serum folic acid level was found to be well below (2.5 ng/ml) the normal range (3-17 ng/ml) prescribed by Ashraf *et al*. (2008), whereas vitamin B_{12} status of the subjects found satisfactory with a mean of 359.2 pg/ml. Hence, it has been concluded that haemoglobin, serum iron and serum folic acid levels measured for the anaemic girls in the study were below the respective average levels indicated.

The mean deficit of iron and folic acid in the diets of adolescent girls were found to be 13mg and 32µg,

Table 1: Background information of the subjects **(n=500)**

Particulars	Number	Per cent
Age category		
Early adolescence (≤16 years)	300	60
Late adolescence (17-19 years)	200	40
Type of family		
Joint family	108	21.6
Nuclear family	392	78.4
Family income*		
Economically weaker section (EWS) (< Rs.3,300)	98	19.6
Low income group (LIG) (Rs.3,301-7,300)	197	39.4
Middle income group (MIG) (Rs.7,301-14,500)	123	24.6
High income group (HIG) (> Rs.14,500)	82	16.4
Religion		
Hindu	259	51.8
Christian	173	34.6
Muslim	68	13.6

*Housing and Urban Development Corporation Ltd (HUDCO, 2007)

Table 2 : Haemoglobin, serum iron, serum folic acid and vitamin B_{12} levels of adolescent girls

Parameters (n=115)	Present study	Normal range
Haemoglobin (g/dl)	11.7± 0.88	≥12g/dl**
Serum iron (µg/dl)	25.69 ± 4.82	35-150µg/dl♦
Serum folic acid levels (ng/ml)	2.54 ± 0.45	3-17ng/ml*
Vitamin B_{12} (pg/ml)	359.2±106.6	200-960 pg/ml•

*Ashraf *et al.* (2008) • WHO (1968) **WHO (2001) ♦Monson *et al.* (2002)

Table 3 : Nutrient content of the iron-folic acid rich biscuits

Ingredients	Amount (g)	Energy (Kcal)	Protein (g)	Fat (g)	Calcium (mg)	Iron (mg)	Folic acid(µg)
Fortified wheat flour	40	136.4	4.84	0.68	19.2	2	60
Rice Bran Flour	13	51.09	1.75	2.10	8.71	4.55	-
Soy bean flour	10	43.2	4.32	1.9	24	1.04	0.8
Gingelly seeds	20	112.6	3.66	8.6	290	1.86	10.2
Peanut butter	7	33.33	1.33	2.66	-	2.85	2.85
Egg	30	52	4	4	18	0.63	21.09
Sugar	18	71.04	0.02	0	2.14	0.02	-
Total		499.6	19.9	20.0	362.05	12.95	94.94
Total amount of folic acid in biscuit after baking							50
% of baking loss of folic acid							47

Table 4 : Effect of intervention on haemoglobin levels

Groups	Mean haemoglobin levels (g/dl)		Difference	t-test
	Before intervention	After intervention		
Experimental group (n=25)	11.28 ±0.510	11.91±0.512	0.63	t = -22.085 p = .000 df = 24
Control group (n=25)	11.21±0.63	11.38±0.599	0.17	t = -2.687 p = .013 df = 24

Table 5 : Effect of intervention on serum folic acid levels

Groups	Mean serum folic acid levels (ng/ml)		Difference	t-test
	Before intervention	After intervention		
Experimental group (n=25)	2.74±0.349	3.42±0.358	0.68	t = -17.850
				p = .000
				df = 24
Control group (n=25)	2.32±0.379	2.33±0.4019	0.01	t = -0.464
				p = .647
				df = 24

respectively. To bridge these existing deficits, a biscuit rich in iron and folic acid was formulated with fortified wheat flour 40g, a rich source of folic acid and iron. Gingelly seeds, peanut butter and egg are good sources of iron and folic acid. Forty seven per cent of baking loss was occurred in the actual folic acid content of the biscuit. The formulated biscuit provided 50 µg of folic acid and 12.95 mg of iron per 100 g. Johansson *et al.* (2002) reported 20-25 per cent loss of fortified folic acid in the wheat breakfast rolls used for intervention. Gujska and Majewska (2005) also reported 12-21 per cent baking loss during bread making of wheat and rye.

Paired *t*-test result (before and after) for the experimental group shows that t (24) = 22.085 and p = .000, indicates significance (as P < .05) and for the control group t (24) = 2.687 and the associated p = .013, indicates significance (as P < .05). Based on the above test results, it has been concluded that a significant increase in the haemoglobin level was found due to iron-folic acid rich biscuit supplementation in the experimental group respondents. There was also significant improvement in the post-haemoglobin level among the control group respondents.

Paired t-test results (before and after) for the intervention group show t (24) = 9.332 and p = .000, which indicates significance (as P< .05) and for the control group t (24) = 1.038 and its associated p = .310, indicates no significance (as P> .05). Based on the above test results, it has been concluded that a significant increase in the serum iron level was found due to intervention in the experimental group respondents. No significant increase in the serum iron level was found in the control group respondents. A study by Goyle and Prakash (2010) also reported that supplementation with iron and folic acid with other micronutrients improved the haemoglobin and serum iron levels of the adolescent girls significantly.

Paired t-test results (before and after) for the intervention group show t (24) = 17.850 and p = .000, which indicates significance (as P< .05) and for the control group t (24) = 0.464 and its associated p = .647, indicates no significance (as P> .05). Based on the above test results, it has been concluded that a significant increase in the serum folic acid level was found due to intervention in the experimental group respondents. Again a significant increase in the serum folic acid level was found in the control group respondents.

Summary and Conclusion :

This study establishes that the supplementation of iron-folic acid rich biscuits improved anaemia among the adolescent girls. As the intervention method studied in this present investigation was found to be effective among the adolescent population, those in modified forms may have scope for the development of appropriate policies and programmes to address anaemia and thereby bridging the gap of under nutrition. The strength of the present study is that a multi disciplinary approach was taken in the intervention. The study was conducted with the support of a government medical practitioner during the intervention.

LITERATURE CITED

Ashraf, J., James, R.C., Michael, B. and Rothberg (2008). Clinical utility of folic acid testing for patients with anaemia or dementia. *J. Gen. Internat. Med.*, **23** (6):824-826.

Dasgupta, A., Butt, A., Saha, T.K., Basu, G., Chattopadhyay, A. and Mukherjee, A. (2010). Assessment of malnutrition among adolescents: can BMI be replaced by MUAC. *Indian J. Commu. Med.*, **35** (2): 276-279.

Das, J.K., Salam, R.A., Kumar, R. and Bhutta, Z.A. (2013). Micronutrient fortification of food and its impact on woman and child health: a systematic review. *Syst Rev.*, **2** (1) : 67.

Gautam, V.P., Bansal, Y., Taneja, D.K. and Saha, R. (2002). Prevalence of anaemia amongst pregnant women and its socio-demographic associates in a rural area of Delhi. *Indian J. Commu. Med.*, **27** (4):157-160.

Gera, T., Sachdev, H.S. and Boy, E. (2012). Effect of iron-fortified foods on hematologic and biological outcomes: systematic review of randomized controlled trials. *American J. Clin. Nutr*., **96**(2) : 309-324.

Goyle, Anuradha and Prakash, Shyam (2010). Effect of supplementation of micronutrient fortified biscuits on haemoglobin and serum iron levels of adolescent girls from Jaipur city, India. *J. Nutr. Food Sci*., **40** (5) : 477- 484.

Gujska, E. and Majewska, K. (2005). Effect of baking process on added folic acid and endogenous folates stability in wheat and rye breads. *Plant Foods Hum Nutr.*, **60** (2): 37-42.

HUDCO (2007). *Board meeting, vide item no.4*, held on 4 July, Housing and Urban Development Corporation Ltd. 2007.

Johansson, M., Witthöft, C.M., Bruce, A. and Jägerstad, M. (2002). Study of wheat breakfast rolls fortified with folic acid – The effect on folate status in women during a 3-month intervention. *Eur. J. Nutr*., **41** (6): 279-286.

Lumley, J., Watsson, L., Watson, M. and Bower, C. (2001). Periconceptional supplementation with folate and/or multivitamins for preventing neural tube defects. *Cochrane Database Syst Rev.*, **3**. (DOI: 10.102/ 14651858.CD001056).

Monson, T., Steven A. Schichman, S.A. and Zent, C.S. (2002). Linezolid-Induced Pure red blood cell Aplasia, *Clin. Infect. Dis.*, **35** (3) : 29- 31.

Morrell, M.J. (2002). Folic acid and epilepsy. *Epilepsy Curr*., **2** : 31-34.

Spear, B.A. (2002). Adolescent growth and development. *Supplement J. Am. Diet. Assoc.*, **102** (3): 23.

UNICEF. (United Nations International Children's Emergency Fund). (2011). *The adolescent girls anaemia control programme breaking the inter-generational cycle of undernutrition in India with a focus on adolescent girls. briefing paper series:innovations, lessons and good practices*. The United Nations Children's Fund, 1-4. NEW DELHI, INDIA.

WHO (World Health Organization) (1968). Nutritional anaemias. Report of a WHO scientific group, *World Health Organization Technical Report Series.*, **405**: 22.

WHO (World Health Organization) (1989). DeMaeyer, E.M., Dallman, P., Gurney, J.M., Hallberg, L., Sood, S.K. and Srikantia, S.G. *Assessment, prevalence and consequences of iron deficiency anaemia through primary health care*. World Health Organization, Geneva:26.

WHO (World Health Organization) (2001). *Iron deficiency anaemia: Assessment, prevention and control – A guide for programme managers*. Methods of assessing iron status, WHO/NHD: 33.

WHO (World Health Organization). (2011). *Prevention of Iron Deficiency Anaemia in Adolescents, Role of Weekly Iron Folic acid Supplementation*, WHO regional office for south-east Asia: 8.

Zaimin, W., Patterson, C.M. and Andrew, H.A. (2003). The Relationship between BMI and Intake of Energy and Fat in Australian Youth: A Secondary Analysis of the National Nutrition Survey, 1995. In: Preetha, N., Shiny, P. and Hemamalini, A.J. (2013). Assessment PCOS and implementation of nutritional knowledge among adolescent girls (15-18 years). *IJIRD*, **2** (9): 197-202.

WEBLIOGRAPHY

Singh, S., Kansal, S. and Kumar, A. (2012). Assessment of nutritional status of adolescent girls in rural area of district, Varanasi., *IJRA.*,**6**(6) : 31, *http://www.anvikshikijournal.com/viewpaper.aspx?pcode=* 3ad49f8d-fda9-4eee-932d-a30f7c1c0c80.

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