Prevalence of folate deficiency among adolescent school girls in rural areas of Mysuru district, Karnataka, India

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Abstract

Introduction: Adequate levels of folate are particularly important to adolescent girls and pregnant women. Inadequate maternal folic acid levels have been associated with placental abruption, pre-eclampsia, spontaneous abortion, stillbirth, prematurity, low birth weight and neural tube defects.

Objectives: To assess the prevalence of folate deficiency among adolescent school girls in rural areas of Mysuru District, Karnataka, India.

Method: This cross sectional, community based study was undertaken among 100 adolescent girls aged 14 to 16 years studying in four randomly selected rural schools of Mysuru district for a period of one year. Details regarding sociodemographic characteristics, dietary history and findings on clinical examination were recorded in a pre-tested structured schedule. Estimation of haemoglobin, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) and serum folic acid levels was done along with peripheral blood pictures in all cases.

Results: Majority (66%) of the girls were 15-16 years old. Prevalence of anaemia was 24% and prevalence of folic acid deficiency (serum folic acid <2.7ng/ml) was 19%. Around half (42.1%) with folic acid deficiency had anaemia. Out of 19 girls with folic acid deficiency 16 (84.2%) were vegetarians.

Conclusions: In this study the prevalence of folate deficiency was 19% among adolescent school girls in rural areas of Mysuru District, Karnataka, India.

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(Key words: Adolescent rural girls, folic acid, anaemia, vegetarian)

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Introduction

Folate is naturally present in leafy vegetables, legumes, egg yolk, liver and citrus fruit[1]. Folate deficiency causes megaloblastic anaemia. When there is an increase in cell turnover, folic acid requirement increases[1]. Adolescence is a period of rapid growth requiring sufficient folate intake[1]. Adequate levels of folic acid are particularly important for adolescent females and pregnant women. Inadequate maternal folic acid levels have been associated with placental abruption, pre-eclampsia, spontaneous abortion, stillbirth, premature birth, low birth weight and neural tube defects (NTDs)[1,2]. World Health Organisation (WHO) recommends optimum serum and red cell folic acid levels in women of reproductive age, to prevent NTDs[3]. A meta-analysis of several Indian studies comprising 308,387 births detected NTDs in 4.1 per 1,000 births[4]. Therefore attention should be paid to folate status in adolescent females. Folate fortification has increased serum and red cell folate levels in USA and Canada[5]. Data on folate levels in rural adolescent girls are however scanty.

Objectives

To assess the prevalence of folate deficiency among adolescent school girls in rural areas of Mysuru District, Karnataka, India.

Method

A cross sectional, community based study was carried out in rural schools of Mysuru district, India, which are under the field practice area of JSS Medical College, from 2017–2018, a period of 12 months. A total of 94 high schools in the rural area of Mysuru district were line listed and 4 schools randomly selected by lottery. Adolescent girls aged 14-16 years were included in study. The number of girls was selected by strength of particular high school by Probability Proportion to Size (PPS) sampling method. Sample size calculation, based on reported prevalence of folate deficiency of 52.5% with absolute allowable error of 10%, 95%

confidence level and 80% power, was 99.8, which was rounded to 100. Girls who received blood transfusion in past 3 months and girls who received haematinics and multivitamins in the past 4-6 months were excluded from the study.

Institutional ethical committee clearance was obtained and informed consent was taken from the school authority and subjects. A detailed pro-forma with questions regarding the details was collected and a thorough examination was done. Weight and height of each adolescent girl was measured using a calibrated weight scale and stadiometer and body mass index (BMI) for age was calculated based on the CDC growth charts for children and teens (CDC, Atlanta, GA, USA). Estimation of serum folic acid level was done by electro chemiluminescence immunoassay "ECLIA" in fully automated hormone analyser Cobas E601E4 level. Haemoglobin, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) levels were estimated by automated 6 part differential cell counter. Peripheral blood pictures were done by slide method using Leishman stain.

Statistical analysis: Data were entered into MS EXCEL and analysed utilising SPSS version 23. Inferential statistical tests like Chi-square test and Pearson correlation at ANOVA was applied.

Results

Of the 100 girls 66% were 15-16 years old, 24% were anaemic and 66% were vegetarians. Majority (93%) of the subjects had deficient calorie intake and 53% had adequate protein intake. According to the BMI 29% were underweight (Table 1). Peripheral smear revealed normocytic normochromic picture in 87% of girls. Of the 100 girls, 19 (19%) had folic acid deficiency (serum folic acid <2.7ng/ml). Of the 19 with folic acid deficiency 8 (42.1%) had anaemia and 16 (84.2%) were vegetarians. The MCV was found to be higher (85.968 ± 10.095fl) among subjects with folic acid deficiency compared to their normal counterparts (81.091 ± 7.993fl) and this was statistically significant (p=0.025) (Table 2). Only 2 girls had MCV more than 100 fl.

Table 1
Demographic profile of adolescent rural girls (n=100)

Parameter	*n (%)*
Age (years)	
14 to 15	34 (34)
15 to 16	66 (66)
Anaemia status (Hb <12g/dl)	
Anaemic	24 (24)
Non-anaemic	76 (76)
Menarche	
Attained	84 (84)
Not attained	16 (16)
Diet	
Vegetarian	66 (66)
Mixed	34 (34)
Calorie intake	
Deficient	93 (93)
Adequate	07 (07)
Protein intake	
Deficient	47 (47)
Adequate	53 (53)
Body Mass Index (BMI)	
Normal	66 (66)
Underweight	29 (29)
Overweight	04 (04)
Obese	01 (01)

Table 2: ***Comparison of parameters with respect to serum folic acid levels***

Parameter	Folic acid level		Total *(n=100)* n (%)	p-value
	Deficient *(n=19)*	Normal *(n=81)*		
Age (years)				
14 to 15 n (%)	04 (11.8)	30 (88.2)	34 (34)	0.18
15 to 16 n (%)	15 (22.7)	51 (77.3)	66 (66)	
Anaemia status (Hb <12g/dl)				
Anaemic	08 (33.3)	16 (66.7)	24 (24)	0.04
Non-anaemic	11 (14.5)	65 (85.5)	76 (76)	
Diet				
Vegetarian	16 (24.2)	50 (75.8)	66 (66)	0.063
Mixed	03 (08.8)	31 (91.2)	34 (34)	
Calorie intake				
Deficient	15 (16.1)	78 (83.9)	93 (93)	0.008
Adequate	04 (57.1)	03 (42.9)	07 (07)	
Blood Indices (Mean + SD)				
Haemoglobin (g/dl)	12.163 ±1.174	12.59 ± 1.439	-	0.232
MCV (fl)	85.968 ± 10.09	81.091 ± 7.99	-	0.025
MCH (pg)	28.4 ± 4.365	27.114 ± 3.73	-	0.194
MCHC (g/dl)	32.915 ± 1.549	33.318 ± 1.78	-	0.366

MCV: Mean corpuscular volume, MCH: Mean corpuscular haemoglobin, MCHC: Mean corpuscular haemoglobin concentration

Discussion

Anaemia is highly prevalent in India and 60-90% of adolescents suffer from anaemia[6]. Toteja *et al* reported anaemia in 90% among 4337 adolescent girls in a study conducted in 16 districts of 10 states in India[7]. National Family Health Survey-3 study revealed that 56% Indian adolescent girls were having anaemia[8]. We observed anaemia in 24% of our rural adolescent girls. Deficiencies of folic acid, iron and vitamin B12 are documented as the aetiology of nutritional anaemia[6]. Among the severely anaemic adolescents, megaloblastic anaemia was the commonest (42.5%), iron-deficiency being noted only in 15% cases[9]. Folate is important for adolescent girls to prepare for future pregnancy and prevention of complications secondary to low maternal folate status.

Among 200 anaemic adolescents, iron, folic acid and vitamin B12 deficiency were present in 30.5%, 79.5% and 50% respectively[10]. In a study from Delhi, 39.8% of all adolescents had folate deficiency and it was more in the low income group[6]. Out of 283 pregnant women from Haryana state, 26% had low serum folate levels[11]. Kapil and Sareen reported folate deficiency in 30.7% of children aged 12 to 18 years[12]. A study by Jani *et al* revealed that 66.7% of Indian tribal girls, 16-17 years old, were deficient in red cell folate[13].

Folate deficiency has also been documented in adolescent girls from other countries. A study from Sudan revealed that 96.8% of 187 adolescent school girls had anaemia and folate deficiency was observed in 69% of them[14]. A study from Senegal revealed that 54.8% women were folate deficient[15]. A study from Bangladesh reported folic acid deficiency in 25% in 310 anaemic adolescent 14-18 year old girls[16]. Out of 945 Sri Lankan school children (12-16 years), 54.8% were found to be anaemic. Among the anaemic children folate deficiency was present in 54.6% boys and 52.5% girls[17]. In another study from Sri Lanka, among adolescent girls 45·1% had low serum folic acid concentrations[18]. Out of 100 adolescents from Venezuela, anaemia was observed in 78% and iron, folic acid and vitamin B12 deficiencies were noted in 35%, 91% and 18% respectively[19]. A study from Turkey reported folic acid deficiency in 16.3% of adolescent girls and this was more in rural (20.1%) when compared to urban girls (14.7%)[1]. In our study, 19% rural adolescent girls had deficient folic acid levels, which is similar to the study from Turkey. The difference in prevalence of folate deficiency among various studies could be due to difference in the age group of subjects included or variation in the dietary intake of folic acid, socioeconomic status, infections or maybe food fortification practice in their country.

In a study by Vitolo *et al* from Brazil, out of 722 adolescents, 89% had a lower than recommended folate intake[20]. Among 200 Indian adolescents, folate intake was deficient in 62.5% with anaemia[10]. Among 16 to 17 year old adolescents, girls were 3.8 times more likely have deficient red cell folate than boys and folate intake was significantly lower in girls compared to boys[13]. Thoradeniya *et al* also observed that insufficient dietary intake of folate-rich foods was thought to be the main cause of folate deficiency[18]. In a study from Turkey, rural adolescent girls consumed less folic acid than their urban counterparts[1].

Folate intake of tribal Indian adolescents was lower than the recommended dietary allowance[13]. However, 60% adolescents who were folate deficient had no anaemia[13]. In our study also there was no relationship between anaemia and folate status and only 2 had MCV more than 100fl. Hence adolescents without anaemia could still be folate deficient[13]. Fortification programme in the USA led to an increase in red blood cell folate status by 33% and folic acid intake by 25%[13]. In a study by Choudhary S, *et al*, out of 270 rural adolescent girls 68.5% were undernourished[21]. Even we observed that 29% of our rural adolescent girls were underweight. Green leafy vegetables and citrus fruits are important natural sources of folate in Indian diets[13]. In our study, 66% were vegetarians. Folic acid deficiency was 84% in vegetarians compared to 16% in those who had a mixed diet and this was statistically significant. Verma *et al* observed that 66% of vegetarians were anaemic compared to 38% of non-vegetarians[22].

In the present study, 93% of the adolescent girls had deficient calorie intake, of which 16% had folate deficiency which is statistically significant. Among the subjects with folic acid deficiency, 79% had deficient calorie intake. Similar observations were made among adolescent girls from Turkey[1].

Undernutrition, vegetarian diet, lower daily calorie intake and presence of nutritional anaemia were the factors commonly associated with folate deficiency. Thus there is a need to strengthen existing anaemia prevention and prophylaxis programmes and special emphasis should be paid to the behaviour change communication among the adolescent girls. The strategies for prevention of anaemia amongst adolescents in India should also include folate along with iron supplementation for prevention and control of nutritional anaemia.

Conclusions

In this study the prevalence of folate deficiency was 19% among adolescent school girls in rural areas of Mysuru District, Karnataka, India.

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