Original Article

Anaemia among schoolchildren from southern Kerala, India: A cross-sectional study

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ABSTRACT

Background. Iron deficiency anaemia remains a major nutritional problem among adolescents in India. The weekly iron and folic acid supplementation programme was launched in Kerala in 2013–14. We aimed to estimate the prevalence of anaemia among schoolchildren in Kollam district, Kerala and determine the associated factors.

Methods. The haemoglobin level of 1600 boys and 1600 girls belonging to class V to IX in 32 randomly selected schools in Kollam district was measured using HemoCue 301 photometers by trained nurses. They also recorded details about the intake of food as well as iron tablets by the students. The anaemia status was evaluated as per the WHO guidelines. Univariate analysis for factors associated with anaemia was done and selected variables were entered into a logistic regression model.

Results. The prevalence of anaemia among the students was estimated to be 31.4% (95% CI 29.76–33.04). About 1% had severe, 11.9% had moderate and 18.5% had mild anaemia. Among them 35.3%, 22.3% and 45.3% reported that they were not in the habit of consuming meat, green leafy vegetables and citrus fruits, respectively, at least once a week. Anaemia among schoolgoing children was associated with irregular consumption of weekly iron folic acid supplementation tablets (adjusted OR 1.39, 95% CI 1.08–1.82) and regular intake of tea/coffee along with major meals (adjusted OR 1.41, 95% CI 1.21–1.66).

Conclusion. Anaemia among schoolgoing adolescents in Kollam district is a public health problem and is more among those who consumed less quantities of weekly iron and folic acid supplementation tablets and those who regularly consumed tea/coffee along with major meals. It may be helpful to introduce a comprehensive school health anaemia prevention package with effective behaviour change communication for dietary modification as well as strategies to improve the coverage of the iron and folic acid supplementation programme along with its monitoring and evaluation.

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INTRODUCTION

Anaemia is the world's second leading cause of disability and thus one of the most important global public health problems.[1] Iron deficiency is a major cause of anaemia. It is a common nutritional problem among children and adolescents in India.[2–4]

Iron deficiency anaemia adversely affects aerobic fitness, endurance capacity and efficiency of work.[5] It impacts cognition by decreasing the activity of iron-containing brain enzymes.[6] Iron deficiency has also been linked to behavioural and learning problems among children and adolescents.[7]

Kerala has achieved substantial progress in the realm of education and health. The government initiated a weekly iron folic acid supplementation (WIFS) programme in schools during 2013–14.[8] Most studies in India on anaemia are among women and on the impact of non-governmental organization and donor-funded projects. Recent studies with a good sample size focusing on the prevalence of anaemia among schoolchildren in Kerala are scarce. We aimed to estimate the prevalence of anaemia among schoolgoing children in Kollam district and determine the associated factors.

The HemoCue photometer has been used widely to measure the haemoglobin level because it is simple to use, portable, requires only a small sample of capillary blood, does not require electricity, and immediately displays results digitally. Haemoglobin levels measured by the HemoCue method are comparable with those determined by both the Cyanmethemoglobin and automated haematology analyser (Sysmex KX-21N) methods. The HemoCue photometer is recommended as an on-the-spot device for determining haemoglobin levels in resource-limited settings as well as in critical care areas of health facilities.[9–11]

METHODS

Kollam, a district located on the southwest cost of Kerala, with a population of around 2.6 million, has a 0.2% population of tribals. The sex ratio is 1113 women for 1000 men and the literacy rate for women is 91.95%. The school enrolment rate is universal with a negligible dropout till class X. The WIFS programme was rolled out in this area during 2013–14 as an evidence-based programmatic

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response to the prevailing anaemia situation among adolescent girls and boys through supervised weekly ingestion of iron and folic acid (IFA) supplementation and biannual helminthic control. The programme includes the administration of 100 mg of elemental iron and 500 µg of folic acid under supervision of the class teacher using a fixed-day approach.

We did a cross-sectional study including schoolchildren from class V to IX in Kollam district during January–February 2014.

A sample size of 1600 was calculated with an expected prevalence of anaemia of 20% and a 10% relative precision, 95% CI and 80% power. Since the sampling involved stratification according to gender, the final sample size was calculated as 3200.

Thirty-two schools were selected randomly from the list of all government/management high schools in the district. One hundred students from each school, 10 boys and 10 girls from class V to IX were selected by random sampling from the school roll.

A questionnaire was prepared to collect details of the age, gender, food frequency of citrus fruits, meat and green leafy vegetables and intake of iron tablets of the students. Thirty school health nurses were trained in measuring the haemoglobin level using the HemoCue® Hb 301 system.[12] The responses for intake of iron tablets were verified with the help of the class teacher. Anthropometry was done and nutritional status was evaluated using the WHO recommended age-specific cut-offs for body mass index (BMI).

The HemoCue instrument has an internal self-test that verifies the analyser each time it is turned on and every second hour thereafter. One hundred and sixty venous samples (5 randomly selected samples from each school) were also processed in an automated cell counter (Beckman Coulter LH 780), which measures the concentration of haemoglobin using the cyanmeth haemoglobin method.

Anaemia status was evaluated as per the WHO guidelines: <11.5 g/dl for children <12 years; <12 g/dl for girls between 12 and 18 years and boys <14 years; and <13 g/dl for boys between 15 and 18 years of age. Severe anaemia was defined as haemoglobin levels <8 g/dl and moderate anaemia as haemoglobin levels between 8.1 and 10 g/dl.[13]

Analysis

The data were entered in Epi-info and were analysed using SPSS 12 for Microsoft windows. Descriptive statistics and univariate analysis for factors associated with anaemia were done. Chi-square test was used to assess the difference between proportions. Selected variables were entered in a logistic regression model and adjusted odds ratios were calculated.

RESULTS

Two-thirds of the students included (61.8%) in the study were from government schools (Table I). The prevalence of anaemia was estimated to be 31.4% (95% CI 29.76–33.04). About 1% (31/3200) had severe anaemia, 11.9% had moderate anaemia and 18.5% had mild anaemia; 31.1% of girls (497/1200) and 31.8% (508/1200) of boys had anaemia.

Anaemia was commonest in the age group of 12–14 years (35.3%) (Table II). Among the students who had taken at least 40 weekly IFA supplementation tablets, 26.3% had anaemia, while among those who were irregular in taking the tablets 32% had anaemia. About one-third (34.2%) of those reported drinking tea/coffee along with major meals had anaemia while 26.9% of those who reported not taking tea/coffee with major meals had anaemia (p<0.001). Also, about one-third of the children (32.1%, 231/720) with malnutrition had anaemia, while 31.2% (693/2217) of children with a normal range of nutrition had anaemia (p=0.68). Among the children, 30.3% (343/1130) who reported not consuming meat at least once a week had anaemia while 31.9% (662/2070) of those who consumed meat at least once a week (p=0.34) had anaemia. Among the children studied 35.3%, 22.3% and 45.3% reported that they were not in the habit of consuming meat, green leafy vegetables and citrus fruits, respectively, at least on a weekly basis.

TABLE I. Characteristics of the schoolchildren (*n*=3200)

Characteristics	Categories	Number	%
Age group	<12 years	1124	35.1
	12–14 years	1405	43.9
	>14 years	671	21.0
Gender	Male	1600	50.0
	Female	1600	50.0
Type of school	Government	1977	61.8
	Management	1223	38.2
Nutritional status: BMI (Z score)	Severe malnutrition (<–3 SD)	270	08.4
	Malnourished (<–2 SD–3 SD)	450	14.1
	Normal (–2 SD–+1 SD)	2217	69.3
	Overweight	189	05.9
	Obesity (>2 SD)	74	02.3

BMI body mass index

TABLE II. Factors associated with anaemia (*n*=3200)

Characteristics	Categories	Number of children in each category (%)		Odds ratio (95% CI)	Adjusted odds ratio
		Anaemia	No anaemia		
Gender	Female	497 (31.1)	1103 (68.9)	1.03 (0.89–1.12)	1.04 (0.89–1.21)
	Male	508 (31.8)	1092 (68.2)		
Age group	<12 years	300 (26.7)	824 (73.3)	1 (Reference)	1 (Reference)
	12–14 years	496 (35.3)	909 (64.7)	1.49 (1.26–1.77)*	1.26 (1.02–1.55)*
	>14 years	209 (31.1)	462 (68.9)	1.24 (1.01–1.53)*	1.15 (1.04–1.28)*
Type of school	Government	596 (30.1)	1381 (61.9)	1.16 (0.99–1.35)	1.15 (0.98–1.27)
	Management	409 (33.4)	814 (66.6)		
Consumption of WIFS tablets	<40 in last year	919 (32.0)	1954 (68.0)	1.32 (1.02–1.71)*	1.39 (1.08–1.82)*
	≥40/year	86 (26.3)	241 (73.7)		
Habit of drinking tea/coffee along with major meals	Yes	676 (34.2)	1300 (65.8)	1.42 (1.21–1.65)*	1.41 (1.21–1.66)*
	No	329 (26.9)	895 (73.1)		

*p<0.05 WIFS weekly iron and folic acid supplementation

Of the 160 students in whom the haemoglobin level was measured using both methods, the mean haemoglobin level using HemoCue® Hb 301 was 12.4 g/dl (SD 1.26) and using the cyanmeth haemoglobin method was 12.7 g/dl (SD 1.01, r=0.823).

In the final analysis, anaemia among schoolchildren was associated with irregular consumption of WIFS tablets (adjusted OR 1.39, 95% CI 1.08–1.82) and regular consumption of tea/coffee along with major meals (adjusted OR 1.41, 95% CI 1.21–1.66).

DISCUSSION

The iron status is a continuum from iron deficiency with anaemia, to iron deficiency with no anaemia, to normal iron status with varying amounts of stored iron. Iron deficiency anaemia represents one end of the spectrum of iron status.

The prevalence of anaemia of 25%–95% has been reported in several studies from the Indian subcontinent among adolescents in the age group of 11–18 years.[2–4] Different methods used for measuring the haemoglobin level also contribute to variations in estimates of prevalence. The district-level household and facility survey (DLHS 4) estimated the prevalence of anaemia among 10–19-year-old boys as 22.9% and among girls as 31.3% in Kerala.[14] DLHS 4 used the anaemia cut-off as 11 g/dl while we used a higher cut-off value. We observed no difference in the prevalence of anaemia between boys and girls. We used the WHO recommended cut-off value for defining anaemia for boys and this could be the reason for there being no gender difference in the prevalence of anaemia.

Our study found the prevalence of anaemia to be more among those who reported drinking tea or coffee along with major meals. The inhibitory effect of tea and coffee on the absorption of iron is well known.[15,16] Absorption of non-haeme iron is inhibited by polyphenols in coffee and tea. These inhibitors chelate non-haeme iron rendering it not available for uptake. Studies have reported that in populations with marginal iron status there appears to be a negative association between tea consumption and iron status.[17] In our study, the consumption of citrus fruits was low among schoolchildren. Iron in the environment and the diet is predominantly ferric iron (Fe3+), which is insoluble and so not bioavailable. Before it can be absorbed, non-haeme iron has to be reduced from ferric (Fe3+) to ferrous (Fe2+) iron by dietary reducing agents, something that ascorbic acid can do. Hence, ascorbic and citric acids enhance non-haeme iron absorption.[18] Citrus fruits are expensive and are not a staple item of food in the Kerala region. Efforts should be made to positively influence school students' behaviour towards modifying these dietary factors.

Weekly supplementation of iron has been shown to improve iron stores among adolescents in many studies from India.[19] It would not be appropriate to comment on the impact of WIFS in this study without knowing the baseline value of haemoglobin levels. Prevalence of anaemia was less in the government as compared to management schools. This is despite the fact that children studying in management schools belong to a higher socioeconomic status, compared with those in government schools. It could be speculated that the difference in the prevalence of anaemia might be due to the stricter implementation of the WIFS strategy in government schools.

Our study was not designed to study all the risk factors for anaemia as it would be difficult to obtain such information from children. Some studies have shown that the HemoCue method overestimates the value of haemoglobin.[20] We considered all anaemia to be due to iron deficiency. However, if we had estimated iron stores using serum ferritin or transferrin saturation, it may have given us a more accurate estimate of iron deficiency. Qualitative studies would be helpful in exploring challenges in the implementation of WIFS strategies.

To summarize, the prevalence of anaemia among schoolchildren in Kollam district was 31.4%. It was more in the age group of 12–14 (35.3%) years and there was no gender difference. Anaemia among schoolchildren was more among those with poorer consumption of WIFS tablets and those who reported a regular intake of tea/coffee along with major meals. Consumption of citrus fruit among the students was low. A comprehensive school health anaemia prevention package with effective behaviour change communication for dietary modification and strategies to improve the coverage of WIFS with good monitoring and evaluation may be helpful.

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