Indian J Hematol Blood Transfus (Jan-Mar 2019) 35(1):114–118
https://doi.org/10.1007/s12288-018-1001-6

ORIGINAL ARTICLE

Anemia Among School Children in Ernakulam District, Kerala, India

P. S. Rakesh[1,2] · Leyanna Susan George[1] · Teena Mary Joy[1] · Sobha George[1] · B. A. Renjini[1] · K. V. Beena[2]

Received: 29 May 2018 / Accepted: 31 July 2018 / Published online: 2 August 2018

Abstract Anaemia has significant negative impact on the health of school children including poor scholastic performance and cognitive impairment. The present study was done with the objective to estimate the prevalence of anemia among school going children in Ernakulam district, Kerala and to determine a few factors associated with anemia. Hemoglobin of 880 students of 6th to 9th standard in 11 randomly selected schools of Ernakulam district was estimated using HemoCue 201 photometer. Prevalence of anaemia was expressed using frequencies and percentages. Univariate analysis for factors associated with anemia was done. Selected variables were entered into a logistic regression model. The prevalence of anemia was estimated to be 44% (95% CI 40.67–47.33). Among them 0.8% had severe anemia, 3.5% had moderate anemia and 39.7% had mild anemia. Among them 21.3% and 52.6% reported not in the habit of consuming green leafy vegetables and citrus fruits respectively, at least three times on a usual week. Anemia among children was associated with female gender (adjusted OR 1.53, 95% CI 1.16–2.04), higher age group (adjusted OR 2.24, 95% CI 1.69–2.91) and regular intake of tea/coffee along with major meals (adjusted OR 1.62, 95% CI 1.20–2.04). Anemia among school going children in Ernakulam remains a public health problem and was more among females, higher age groups (12–15 years) and those reported regular intake of tea/coffee along with major meals. The consumption of iron rich foods among the students was poor. Behavior change communication for dietary modification and universal supplementation of iron is warranted.

Keywords Adolescent anemia · Anemia · Hemoglobin · Iron deficiency anemia

Globally, anemia is the most common nutritional problem and one of the leading causes of disability [1]. Iron deficiency is the most common cause of anemia. Numerous studies have shown that anaemia remains as a major public health problem among children and adolescents in India [2–7].

Anaemia has negative impact on the health of school children including poor scholastic performance and cognitive impairment [8]. Iron deficiency has also been linked to many learning and behavioural problems [9]. It has been demonstrated to affect aerobic fitness and efficiency of work [10].

Kerala, a state in southern India, has achieved impressive improvements in people's health. Despite having a low per capita income, many of its maternal and child health and social development indicators are at par with that of many developed countries [11]. Kerala has initiated Weekly Iron Folic Acid Supplementation (WIFS) program in 2013, but has faced a severe setback as most of the beneficiaries are apparently hesitant to consume the tablet, supplied via schools [12]. As the state is working on achieving state specific targets for sustainable development goals related to health, it is important to know the exact prevalence of anaemia in the state. However a recent systematic review on prevalence of anaemia in Kerala pointed out that studies with good sample size focusing on the

✉ P. S. Rakesh
rakeshrenjini@gmail.com

[1] Department of Community Medicine, Amrita Institute of Medical Sciences, Amrita University, Kochi, Kerala, India

[2] Centre for Public Health, Amrita Institute of Medical Sciences, Amrita University, Kerala, India

prevalence of anemia among children are scarce from the state [13].

The present study was done with the objective to estimate the prevalence of anemia among school going children in Ernakulam district and to determine a few factors like age, gender, type of school and food habits associated with anemia. The results from the study could add on evidences to the epidemiology of anemia in the state and also form a baseline for future impact evaluation of interventions.

Methodology

Study Setting

Ernakulam district is the industrial capital of Kerala state situated on the coast of the Arabian Sea, with a population of 3.2 million. More than 50% of the populations reside in urban areas. Adult literacy rate is 95% and sex ratio is 1027 per 1000 males. The school enrollment rate is universal with negligible dropout rate till tenth standard [14].

Study Design

Cross sectional study.

Study Population

Children studying in schools from VIth TO IXth standard in Ernakulam district.

Sample Size

With the prevalence of anemia from previous study as 31.4% and with10% relative precision, 95% confidence, a sample size of 880 was calculated [4].

Sampling Methods

Eleven schools were selected randomly from the list of all [99 Government schools, 175 Government aided private schools and 51 unaided private schools]high schools in the district. A division was selected using simple random sampling from 6th to 9th standard from each school. 10 boys and 10 girls from each division were selected by simple random sampling from the school roll. Thus 80 students from each school—40 male and 40 females—and 10 each from 6th to 9th standard were selected. If the selected student did not consent for blood examination or if not available, the very next person of same gender on the roll was invited for the study.

Study Tool

Questionnaire was framed to collect details of age, gender, food frequency of citrus fruits, meat and green leafy vegetables and intake of iron tablets of the students. Eight interns were trained in estimating hemoglobin using HemoCue® Hb 201 System [15]. The HemoCue photometer has been widely used for estimation of hemoglobin in recent years because it is portable, requires only a small sample of capillary blood, is relatively simple to use, does not require electricity, and gives immediate, digitally displayed results. Hemoglobin determined by the HemoCue method is comparable to that determined by both the Cyanmethemoglobin and automated hematology analyser (Sysmex KX-21 N) methods [16–18].

The HemoCue instrument has an internal self-test that verifies the analyser each time it is turned on and every second hour thereafter. Quality Control has been ensured by testing the function of the HemoCue photometer on a daily basis by measuring the control cuvette (Serial no: 0214-003 071) and a standard of known concentration.

Ethics

The study has got ethical clearance from Institutional Review Board. Permission from school authorities, consent of parents and assent of children were taken.

Analysis

The data was entered in Microsoft Excel and was analyzed using SPSS 16 for Microsoft windows. Anemia status was decided as per WHO guidelines; less than 11.5 g/dl for children less than 12 years; less than 12 g/dl for girls from 12 to 18 years and boys less than 14 years and less than 13 g/dl for boys from 15 to 18 years of age. Severe anemia was hemoglobin less than 8 g/dl and moderate anemia was hemoglobin between 8.1 and 10 g/dl [19]. Descriptive statistics and univariate analysis for factors associated with anemia was done. Chi square test was used to test the difference between proportions. Selected variables were entered into a logistic regression model and adjusted odds ratios were calculated.

Results

880 children participated in the study. Two children did not give assent. The general characteristics of the children were shown in Table 1. The prevalence of anemia was estimated to be 44% (95% CI 40.67–47.33). Among them 0.8% had severe anemia, 3.5% had moderate anemia and 39.7% had mild anemia. The anemia status by gender is

Table 1 Characteristics of the study children (N = 880)

Characteristics	Categories	Number	Percentage
Age group	< 12 years	368	41.8
	12–15 year	512	58.2
Gender	Male	440	50
	Female	440	50
Type of school	Government	560	63.6
	Private	320	36.4

shown in Table 2. The mean hemoglobin level was 11.86 g/dl (SD 1.14) and the median was 11.9 g/dl.

In the study 47.7% of girls (214/440) and 39.6% (173/440) of boys had anemia. Anemia was highest in the age group of 12–15 (51.2%). About 47.2% of those reported drinking tea/coffee along with major meals had anemia while 38.4% of those who reported not taking tea/coffee with major meals had anemia. The univariate and multivariate analysis of factors associated with anemia had been described in Table 3.

Among them 81.7%, 21% and 52.6% reported not in the habit of consuming meat, green leafy vegetables and citrus fruits respectively, at least three times on a usual week. In the logistic regression model, anemia among school going children was associated with female gender (AOR 1.53, 95% CI 1.16–2.04), higher age group (AOR 2.24, 95% CI 1.69–2.91) and regular intake of tea/coffee along with major meals (AOR 1.62, 95% CI 1.20–2.04).

Discussion

Iron deficiency anemia represents the extreme lower end of the spectrum of iron status which varies from iron deficiency with anemia, iron deficiency with no anemia to normal iron stores. The hemoglobin concentration could be a surrogate indicator of the amount of iron available for new RBC synthesis [19]. It is estimated that the prevalence of iron deficiency in a population will be about 2.5 times that of the prevalence of anaemia. WHO recommends that when the prevalence of iron deficiency anaemia reaches

Table 2 Anaemia status of children by gender (N = 880)

	Severe anaemia	Moderate anaemia	Mild anaemia	No anaemia
Female	6 (1.3)	20 (4.5)	184 (41.8)	230 (52.3)
Male	1 (0.2)	11 (2.5)	168 (38.2)	260 (59.1)
Total	7 (0.8)	31 (3.5)	352 (39.7)	496 (56%)

Table 3 Factors associated with anemia (N = 880)

Characteristics	Categories	Number of children in each category (%)		Odds ratio (95% CI)	Adjusted odds ratio
		Anemia	No anemia		
Gender	Female	214 (47.7)	235 (52.3)	1.39*	1.53*
	Male	173 (39.6)	264 (60.4)	(1.06–1.81)	(1.16–2.04)
Age group	12–15 years	270 (51.2)	257 (48.8)	2.13*	2.24*
	< 12 years	117 (33.1)	236 (66.9)	(1.61–2.80)	(1.69–2.9)
Type of school	Government	237 (42.3)	323 (57.7)	0.83	0.74
	Private	150 (46.9)	170 (53.9)	(0.63–1.09)	(0.54–1.04)
Frequency of Vitamin C rich	< 3 times a week	204 (44.1)	259 (55.9)	1.02	0.97
				(0.78–1.33)	(0.76–1.31)
Food intake	At least 3 times a week	183 (43.9)	234 (56.1)		
Frequency of green leafy food	< 3 times a week	87 (47)	98 (53)	1.17	1.13
				(0.84–1.62)	(0.80–1.54)
Intake	At least 3 times a week	300 (43.2)	395 (56.8)		
Habit of drinking tea/coffee	YES	263 (47.2)	294 (52.8)	1.43*	1.62*
				(1.08–1.89)	(1.20–2.04)
Along with major meals	NO	124 (38.4)	199 (61.6)		

*$p < 0.05$

about 30% in specific population, it is more effective to provide universal supplementation of iron than to screen the individuals for case-management purposes. [19].

Several studies across India reported a wide range of prevalence of anemia between 25 and 95% among adolescents. [2–7] Variation in the prevalence estimates could be due to different methods used for haemoglobin estimation. It could also be due to the different cut offs used to define anemia. District Level Household and Facility Survey (DLHS 4) reported the prevalence of anemia among adolescent boys as 22.9% and among girls as 31.3% in Kerala [20]. DLHS 4 used the anemia cut off as 11 g/dl while we used a higher cut off.

A similar study done by in Kollam district, Kerala in 2014 had found the prevalence of anemia as 31.3% among school children [4]. The Kollam study also found out that anemia was lower in children who regularly consumed WIFS. The current study reported a higher prevalence with same cut off and same method for haemoglobin estimation. The efficacy of the WIFS program in reducing anemia prevalence in schools has been demonstrated previously [21, 22]. It is tempting to postulate that the stricter implementation of WIFS in 2013–2014 in the state might have resulted in a lower prevalence of anaemia among school children at that time which eventually waned off after collapse of the WIFS program at schools.

In the current study, prevalence of anemia was found to be more among those who reported usually drinking tea or coffee along with major meals. Similar finding has been observed in the Kollam study also. The inhibitory effect of tea and coffee on the absorption of iron is well proven [23, 24].

The present study was not designed specifically to study all the risk factors for anemia. Many possible risk factors like socio economic status could not be assessed as information was collected from schoolchildren. Though we included children above 6th standard, menarche status was not captured. Hemoglobin estimation was done only once in this study. The quantity of blood taken for each test may differ and the hemoglobin estimation can vary with single estimation. Estimation of iron stores using serum ferritin or transferrin saturation would have made the picture of iron deficiency clearer.

To summarise, the prevalence of anemia among school going children in Ernakulam district was found to be 44%. Anemia was more among females and in the age group of 12–15 years. Anemia among school going children was more among those who reported regular intake of tea/coffee along with major meals. The iron rich food consumption among children is poor. A school health anemia prevention program with behaviour change communication for dietary modification and universal supplementation of iron need to be considered.

Acknowledgements We acknowledge Interns, Mr Retheeshkumar, Health Inspector and team at Amrita Urban Health Centre Kaloor and Dr Midhun Rajiv, Mr Arunkumar, Dr Carmel Regeela and Dr Devika Babu, MPH students of AIMS for help in co-ordinating data collection.

Author Contribution We declare that the manuscript has been read and approved by all the authors, that the requirements for authorship have been met, and that each author believes that the manuscript represents honest work.

Funding Institutional Funding by Amrita Institute of Medical Sciences.

Compliance with Ethical Standards

Human and Animal Rights All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Permission was obtained from school Principal; consent was obtained from parents and assent from all children included in the study.

Conflict of interest The authors declare that they have no conflict of interest.

References

1. World Health Organization (2011) Anaemia prevention and control [Internet] WHO, Geneva. Available at www.who.int/medical_devices/initiatives/anaemia_control/en. Accessed 20 Aug 2017
2. Gupta S, Taraphdar P, Roy TG, Haldar D, Dey SK, Purkait B (2012) The silent burden of anemia in school age children: a community based study in West Bengal. Indian J Med Sci 66:163–168
3. Rawat CMS, Garg SK, Singh JV, Bhatnagar M, Chopra H (2001) Sociodemographic correlates of anemia among adolescent girls in rural area of district Meerut (U.P). Indian. J Community Med 26:173
4. Rakesh PS, Rajeswaran T, Rakesh R, Mathew G, Sheeja AL, Subhagan S et al (2015) Anaemia among school children from southern Kerala, India: a cross-sectional study. Nat Med J Ind. 28(5):225–230
5. Kaur S, Deshmukh PR, Garg B (2010) Epidemiological correlates of nutritional anemia in adolescent girls of rural Wardha. Indian J Community Med 31:4
6. Singh Rita (2008) Sociodemographic factors causing anemia in adolescent girls in Meerut. Health Popul-Perspect Issues 38:198–203
7. Chaudhary SM, Dhage VR (2008) A study of anemia among adolescent females in the urban area of Nagpur. Indian J Community Med 33:243–245
8. Grantham-McGregor S, Ani C (2001) A review of studies on the effect of iron deficiency on cognitive development in children. J Nutr. 131(2S-2):649S–666S
9. Oski FA (1979) The non hematologic manifestations of iron deficiency. Am J Dis Child 133(3):315–322
10. Brownlie T, Utermohlen V, Hinton PS, Giordano C, Haas JD (2002) Marginal iron deficiency without anemia impairs aerobic adaptation among previously untrained women. Am J Clin Nutr 75(4):734–742

11. Government of Kerala (2015) Economic Review 2014. State Planning Board, Thiruvananthapuram, Kerala, India. http://spb.kerala.gov.in/images/er/er14/index.html#p=1
12. National Health Mission (2013) Weekly Iron Folic Acid Supplementation (WIFS) [Internet]. New Delhi:MOHFW. http://nrhm.gov.in/nrhm-components/rmnch-a/adolescent-health/weekly-iron-folic-acid-supplementation-wifs/background.html. Accessed 20 Aug 2014
13. Rakesh PS (2017) Prevalence of Anaemia in Kerala State, Southern India—a systematic review. J. Clin Diagn Res 11(5):01–04. https://doi.org/10.7860/jcdr/2017/24681.9951
14. Census 2011. Ernakulam district. https://www.census2011.co.in/census/district/278-ernakulam.html
15. HemoCue. Hb 201 System. [Internet]. HemoCue America, USA. http://www.hemocue.us/en-us/products/hemoglobin/hb-301-system. Accessed 31 Dec 2014
16. Lardi AM, Hirst C, Mortimer AJ, McCollum CN (1998) Evaluation of the HemoCue® for measuring intra operative haemoglobin concentrations: a comparison with the Coulter Max M®. Anaesthesia 53(4):349–352
17. Schenck H, Falkensson M, Lundberg B (1986) Evaluation of HemoCue- a new device for determining hemoglobin. Clin Chem 32(3):526–529
18. Nkrumah B, Blay NS, SarpongN Dekker D, Idriss A, May J et al (2011) Hemoglobin estimation by the HemoCue® portable hemoglobin photometer in a resource poor setting. BMC Clin Pathol 11:5
19. World Health Organization (2001) Iron Deficiency Anaemia: Assessment, Prevention, and Control. A guide for program managers [Internet]. WHO, Geneva. http://www.who.int/nutrition/publications/en/ida.pdf. Accessed 20 Aug 2014
20. International institute for population sciences. District Level Household and Facility survey -4. State Fact Sheet. Kerala. Mumbai; IIPS:2012-13
21. Agarwal KN, Gomber S, Bisht H, Som M (2003) Anemia prophylaxis in adolescent school girls by weekly or daily iron-folate supplementation. Indian Pediatr 40:246–301
22. Cook JD, Reddy MB (1995) Efficacy of weekly compared with daily iron supplementation. Am J Clin Nutr 62:117–120
23. Disler PB, Lynch SR, Charlton RW, Torrance JD, Bothwell TH (1975) The effect of tea on iron absorption. Gut 16:193–200
24. Disler PB, Lynch SR, Torrance JD, Sayers MH, Bothwell TH, Charlton RW (1975) The mechanism of the inhibition of iron absorption by tea. S Aft J Med Sci 40:109–116