Original Article

Prevalence of anaemia in school going adolescents in a municipality town of West Bengal

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Anaemia is a major public health problem in India. It directly causes many premature deaths in population. The deaths due to anaemia as indirect cause far outweigh the number due to many well-known causes of mortality in a developing nation. A cross-sectional survey was conducted in two schools of a municipal town of West Bengal. One school was public and the other was private. The haemoglobin was estimated by HaemoCue® instrument. Two hundred students finally participated in the study. 118 (59%) of these students were studying in a government run institute. 105 (53%) of the study participants were females. The mean (SD) age of the study participants was 14.05 (0.8) years. Majority of the participants belonged to lower middle class. About half (51%) of the study participants have correct knowledge about the cause of anaemia. Out of three major meals of the day, study participants'were taking dinner regularly. Around 47% of them missed or never took a breakfast within last week. Around 91% of the study participants were non-vegetarian, a usual diet pattern in this part of the country. The mean (SD) Haemoglobin concentration of students was 12.58 (1.20) gm/dl. The mean haemoglobin concentration of male students was significantly more than that of female. Overall 70 (35%) students were suffering from anaemia. 45 out 105 (42.9%) female students were suffering from anaemia, whereas 25 (26.3%) male students were suffering from anaemia. Male students were significantly more tall and heavier when compared with female students. Anaemia was statistically more common in students belonging to low socioeconomic strata of the society.

The awareness about anaemia and its causes is low in school students. The prevalence of anaemia is high amongst school going adolescents in urban areas of West Bengal.

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Anaemia is the qualitative and or quantitative diminution of haemoglobin or red blood cells (RBC) or both in respect to the age and sex of individual. The net effect of which is failure in transport of adequate amount of oxygen to the tissues. Generally, anaemia is said to occur when Haemoglobin (Hb) is less than a critical value which depends upon the sex and age of the individual, but symptoms depend not only on the reduction but also on the rate of reduction of Hb[1]. There are several different types of anaemia and each one has a different cause. Nutritional anaemia of which iron deficiency anaemia is a sub-type is the most common type. Other nutritional causes of anaemia are lack of vitamin B12 or folic acid. Iron deficiency anaemia occurs when there is lack of iron in the body. The major dietary sources of iron are meat, dried fruit and some vegetables. Some food items and medicines make iron absorption difficult. Iron is used by the body to make haemoglobin, which helps store and carry oxygen in red blood cells. There are many conditions that can lead to a lack of iron. In men, and postmenopausal women the most common cause is bleeding in the stomach and intestines caused by regular and indiscriminate use of non-steroidal anti-inflammatory drugs (NSAIDs), peptic ulcer, stomach cancer or bowel cancer. In women of reproductive age, the most common causes of iron deficiency anaemia are heavy menstruation and pregnancy. If iron deficiency anaemia is left untreated it can make one susceptible to repeated episodes of illness and infection, as lack of iron in the body affects one's immune system. Severe iron deficiency anaemia may increase the risk of developing complications that affect the heart or lungs such as, tachycardia and heart failure. Pregnant women also have a

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higher risk of complications before and after birth. A major underlying cause of maternal deaths in India is anaemia.

Anaemia is India's major public health problem. There is a wide range of prevalence data available from different regions of the country. In India, anaemia is primarily due to poor nutrition. According to the fourth round of National Family Health Survey (NFHS - 4) conducted during 2015-16, anaemia is prevalent in 53% of women in the age group of 15 to 49 years. It is present in 23% of men in the age group of 15 to 45 years[2].

Adolescence is the period of rapid growth when iron requirement for both boys and girls increase. The incidence of iron deficiency anaemia among adolescents is rising. The awareness regarding anaemia and appropriate diet is extremely poor among adolescents which are made worse by the misleading advertisements in the media. Risk factors for anaemia among adolescents are low intake of meat, fish, poultry and iron fortified foods, frequent dieting, vegetarian life style, heavy menstrual periods, rapid growth, overweight and obesity.

Keeping in view of the importance of anaemia amongst adolescents in Indian context and paucity of studies relating the dietary habits and prevalence of anaemia amongst school going students, a cross-sectional study was done with the aim of finding the prevalence of anaemia in the adolescent boys and girls.

Materials and Methods

A cross-sectional survey was conducted with the primary objective of finding out prevalence of anaemia amongst school going students. The secondary objectives were finding out the factors associated with decreased level of haemoglobin in school students and finding out the gender difference in haemoglobin level and factors associated with these differences. Both boys and girls students studying in two identified schools in the study area were told about the study. They were enrolled once they gave written informed assent. Students studying in standard IX of these schools were enrolled for the study. For comparison purpose schools catering to two different socio-economic background students were covered. Students suffering from serious medical condition where haemoglobin concentration is known to be low were excluded from the study. A sample size of 200 students was calculated based upon the assumption of prevalence of anaemia to be 50% amongst the study population and an absolute error of 7%. We enrolled 100 students studying in standard IX of each of the selected two schools. There was more than one section of class IX in the two schools. Students were randomly selected from the three sections of class IX of each school. The sampling frame contained only those students of class IX of all sections present on the day of the interview and blood draw for haemoglobin estimation. The study was conducted in Kalyani which is a municipality town in Nadia District of state of West Bengal. The two schools chosen were Kalyani Experimental Higher Secondary School, a renowned private educational institution, located in the heart of the city and the Kalyani Shikshayatan, run by the Government of West Bengal. The later school normally caters to students belonging to lower socio-economic strata of the society.

The clearance from the Institutional Ethics Committee (IEC) was taken prior to initiation of the study. Students were told in detail about the study and the procedure to be performed for measurement of the haemoglobin level. Since the students were below 18 years of age, written informed consent of their parent was taken. The students were free to opt out of the study at any time they felt like. The confidentiality of the study participants was maintained, and no personal identifying data were collected. Proper dietary advices for correction of anaemia were imparted to all students after the blood collection. The students identified to be anaemic were given health education regarding the prevention and management of anaemia. Those found anaemic were referred to their nearest health care centre for further evaluation and management of anaemia.

A semi-structured self-administered questionnaire was designed in English. It had questions related to basic socio-demographics-economic status of the participants. Usual dietary history of students was collected. The questionnaire was pre-tested in the same school but in different class which was not part of the study before the conduction of the study. The haemoglobin of the students was measured by an instrument called HaemoCue®. The HemoCue® haemoglobin analyser is a portable, rapid and accurate method of measuring haemoglobin at the bedside. It has a sensitivity of 99.4% and specificity of 88.4%[3]. Height and weight of the students were measured following standard procedures. For the study purpose, anaemia was defined as per the World Health Organization criteria of haemoglobin of less than 12 gm/dl in females and males less than 15 years of age. For males of age ≥15 years the cut-off for anaemia was haemoglobin level of 13 gm/dl[4].

The data collected were entered in MS Excel 2010. The data was analysed by IBM SPSS® version 22.0. The difference of mean haemoglobin concentrations between the schools and also between the genders was tested by independent t- test. Chi-square test was used to compare the proportions. Two-tailed significance test with p value of 0.05 or less was considered to be statistically significant.

Results

Two hundred students finally participated in the study. 118 (59%) of these students were studying in Kalyani Shikshayatan School, a Government run Institute. 105 (53%) of the study participants were females. The mean (SD) age of the study participants was 14.05 (.8) years. The minimum age was 12 years and the maximum age was 16 years. While 15% of the participants' father possessed some professional qualification, majorly (27.5%) were high school pass. All the study participants were classified for their socioeconomic status using modified Kuppuswamy socioeconomic scale. The income ranges for the year 2019 was taken into account[5]. Majority of the subjects belonged to lower middle class (Table 1).

About half (51%) of the study participants have correct knowledge about the cause of anaemia. Rest were either ignorant or had false information about the causes of anaemia. When asked whether they were suffering from anaemia, 8 (4%) replied affirmatively (Table 2).

Out of three major meals of the day, study participants took dinner regularly. Around 47% of them missed or never took breakfast in the preceding week (Fig 1).

Majority of the students were taking any one or more fast foods during 1 to 3 days in a week. 95% of the study participants were in the habit of washing hands before taking any meal. Helminthiasis is one of the prime reasons of anaemia in our country. Students' were asked whether they took an anti-helminthic tablet or suspension within last six months of the date of study. 83% of them either did not take it or they were unaware about it. Around 91% of the study participants were non-vegetarian, a usual diet pattern in this part of the country. Majority (112, 56%) of the non-vegetarians were taking any meat product for 1-3 days in a week. Only 10% of the students were taking any fruit every day. Around 80% of the students were taking at least two servings of green leafy vegetables, a rich source of iron every day. The mean (SD) Haemoglobin concentration of students was 12.58 (1.20) gm/dl. The minimum value of Hb was 9.3 gm/dl and the maximum were 16.4 gm/dl. The mean haemoglobin concentration of male students was significantly more than that of female (13.13 *versus* 12.09, p value <0.000, Table 3).

Overall 70 (35%) students were suffering from anaemia. 45 out 105 (42.9%) female students were suffering from anaemia, whereas 25 out of 95 (26.3%) of male students were suffering from anaemia (Table 4). Anaemia was significantly more common in females compared to males (Chi square statistic 5.99, p value: 0.014)

Out of 70, 54 (77%) students were suffering from mild anaemia and 16 (23%) were suffering from moderate anaemia; no one had severe anaemia (Fig 2).

Male students were significantly more tall and heavier when compared with female students (p value <0.01, Table 5).

Anaemia was not statistically associated with the usual food habits of the respondents (chi square statistic 0.454, p value 0.501). It may be due to large number of non-vegetarians in the sample. Anaemia was statistically more common in students belonging to low socioeconomic strata of the society (Table 6).

Table 1 — *Distribution of study participants according to their socioeconomic status (n=200)*

Socioeconomic class	Frequency	Percentage
Upper (I)	23	11.5
Upper middle (II)	52	26.0
Lower middle (III)	73	36.5
Upper lower (IV)	52	26.0
Lower (V)	0	0.0
Total	200	100.0

Table 2 — *Self-reported prevalence of anaemia (n=200)*

Suffering from anaemia	Frequency	Percentage
Yes	8	4.0
No	42	21.0
Don't know	150	75.0
Total	200	100.0

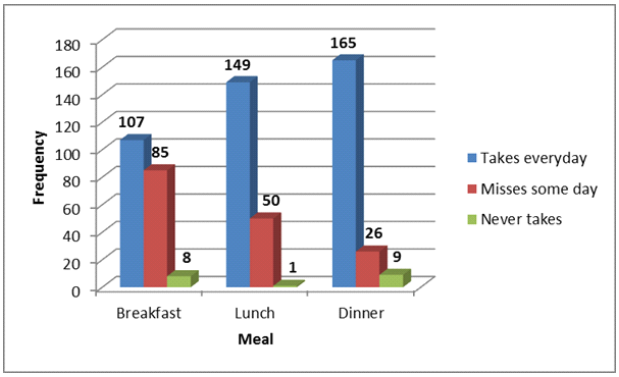

Fig 1 — Intake of regular meals of the day of participants (n=200)

Discussion

The findings of this school-based study to find out

Table 3 — *Sex-wise distribution of mean haemoglobin of study participant (n=200)*

Sex	Mean Hb (in gm/dl)	Standard deviation	t-statistic, p value
Male	13.13	1.07	6.8, <0.000
Female	12.09	1.09	

Table 4 — *Prevalence of anaemia in different sexes (n=70)*

Sex	Frequency	Percentage	Chi square statistic, p value
Male	25	26.3	5.99, 0.014
Female	45	42.9	
Total	70	35.0	

Table 5 — *Anthropometric detail of study subjects (n=200)*

Sex	Male (n=95)	Female (n=105)	t-statistic and p value
Mean (SD) height in cms	158.8 (9.5)	149.6 (5.3)	8.52, 0.0000
Mean (SD) weight in kgs	46.2 (9.9)	43.4 (7.9)	2.22, 0.027

Table 6 — *Distribution of study participants according to their socioeconomic and anaemia status (n=200)*

Socioeconomic class	No anaemia	Anaemia	Total	Chi square statistic, p value
Upper (I)	16	17	23	10.065, 0.017
Upper middle (II)	42	10	52	
Lower middle (III)	45	28	73	
Upper lower (IV)	27	25	52	
Total	130	70	200	

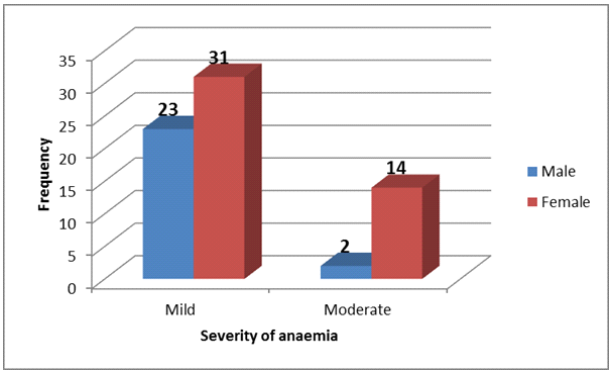

Fig 2 — Distribution of anaemic students according to the severity of anaemia (n=70)

prevalence of anaemia amongst students revealed that 35% of the total sample population had anaemia. We could not find any case of severe anaemia. Majority were suffering from mild anaemia. Various studies found out the prevalence of anaemia to be between 19 to 88% in different part of the country[6]. Soma Gupta *et al*[7] conducted a study in the Midnapore district of West Bengal wherein they measured the haemoglobin concentration of school students (6 - 16 years). They found out that overall prevalence of anaemia in school going students was 80.2%. It was more in female students (86.1%) compared to male (76.0%). According to a study done by Saratha A *et al*[8] in South India, out of total 300 medical and nursing female students 228 (76%) were anaemic. Of them 170 (56.67%) had mild and 58 (19.33%) had moderate anaemia. A community-based cross-sectional study was carried out in rural areas of West Bengal by Arlappa N *et al*[9] during 2002 - 2003. A total of 437 pre-school children were covered for the estimation of blood haemoglobin levels. Majority (81%) of them were anaemic, and the prevalence was significantly (p<0.001) higher among 1 – 3 year-old (91%) as compared to 4 - 5 year-old (74.6%) children. Santanu K Sharma *et al*[10] did a community-based survey in Assam to find out anaemia amongst adolescent females. They found out that 71.5% of the surveyed females had anaemia. Sabita Basu *et al*[11] conducted a study to assess the prevalence of anaemia among 1120 apparently healthy adolescents (12 to 18 years) sampled from 11 city and 2 rural schools in Chandigarh. All the boys and the girls were subjected to anthropometric examination and haemoglobin estimation. The estimation of haemoglobin was done by cyanmethemoglobin method. The overall prevalence of anaemia calculated as per WHO Guidelines was significantly higher among girls (23.9%) as compared to boys (odds ratio 3.75, 95% CI2.59 to 5.43, P<0.01). A cross sectional study done in urban schools of Ludhiana, Punjab found out that overall prevalence of anaemia was 51.5%. Girls had a significantly higher prevalence of anaemia except at 5 years and 10-12 years age[12]. Another cross-sectional survey done in Bangalore of South India amongst 2030 boys and girls, aged 5-15 years, attending schools found out that mean (SD) Hb concentration of all children were 12.6 (1.1) g/dl (range 5.6-16.7). The overall anaemia prevalence was 13.6%. Anaemia prevalence was lower in boys than girls (12.0% *versus* 15.3%)[13]. Researchers estimated the prevalence of iron deficiency anaemia among adolescent schoolgirls in the age group of 13-17 years in Chennai. Haemoglobin was estimated using cyan method. The prevalence of anaemia was found to be 78.75% among school students[14].

Saratha A *et al*[8] found out that 157 (89.71%) students who did not consume green leafy vegetable regularly were anaemic. They also found out that anaemia was associated with increasing age, increasing academic year, consumption of non-green leafy vegetable and passage of worms in stool. They could not find any significant association between anaemia and consumption of veg/non-veg foods, history of chronic illness, type and duration of menstrual cycle. Similarly, there was no significant association between anaemia with height, weight and BMI. According to Arlappa N *et al*[9] children belonging to lower socio-economic Scheduled Caste and Scheduled Tribe communities were at higher risk for anaemia (OR=2.3; 95% CI 1.3–3.9). Ludhiana study[12] found out that more menarcheal girls were anaemic as compared to non-menarcheal ones. The prevalence of anaemia was high (38%) even in higher socioeconomic groups. Nearly half (47.6%) of well-nourished children were anaemic. The mean Hb also was lower than expected normal values in both nutritional groups. Compared to non-vegetarians (38%), more vegetarians (65.9%) were anaemic. Chennai study[14] showed significant association of anaemia with type of

family, socioeconomic status and diet. In this study 42.5% of girls with BMI < 18 were found to be anaemic.

The result of the present study is somewhat in between of these extremes. This study is unique in a sense that it was carried out amongst students studying in a particular class of two schools. There was little variability in the age of the sample students. The major difference between the prevalence of anaemia in adolescents in this research and others may be due to three reasons. First, none of the study found out by us was conducted by HemoCue® device. The other reason may be the students were comparatively belonging to better socio-economic strata of the society compared to others tudies. The third reason of finding a low prevalence of anaemia may be the school health programme run by the Indian government wherein iron folic acid tablets and albendazole tablet is regularly given to school students. The finding of this study that anaemia is more prevalent in female students compared to male is similar to almost all searched studies. The mean haemoglobin concentration of all students of our study (12.58 gm/dl) is similar to that of the Bangalore study[13] (12.6 gm/dl).We could not find any association between the consumption of vegetarian food with anaemia. Saratha A *et al*[8] also could not find any similar association. Our finding of increased anaemia in lower socioeconomic strata of society is consistent with Arlappa N *et al*[8] study. Low quality of nutrient intake is common in those who cannot afford to buy green leafy vegetable and meat products. The limitation of the study is that the researchers did not attempt to find out the reason of anaemia whether iron, vitamin B12 or folate deficiency in diagnosed cases of anaemia.

We conclude that the awareness about anaemia and its causes is low in school students. The prevalence of anaemia is high amongst school going adolescents in urban areas of West Bengal. Anaemia is more common in female adolescents compare to their male counterparts. Low socioeconomic status is significantly associated with high prevalence of anaemia. The mean haemoglobin concentration of females is low compared to males even when analysed for all children below 15 years of age.

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