



Prevalence of anemia in adolescence girls of Arunachal Pradesh, India

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KEYWORDS

Adolescent girl, Anaemia, Arunachal Pradesh, body mass index, haemoglobin

ABSTRACT

A cross-sectional descriptive study was carried out among the adolescent girls of Dera Natung Government College Itanagar, Arunachal Pradesh on 21st September 2019 to understand the prevalence of anaemia among adolescent college students. The study showed that only 19.29% students were normal and 80.70% were affected with various grade of anaemia condition. 24.56% subjects being mildly anaemic and 54.38% moderately anaemic while 1.75% suffered from severe anaemia. The prevalence of underweight among 57 students was 6 (10.53%), while 44 (77.19%) had normal BMI, 2 (3.51%) had severely underweight and 5 (8.77%) were overweight. The prevalence of anaemia among underweight student was 8.77% and in student with normal BMI was 57.89% and overweight has prevalence of 8.77% and severely underweight has prevalence of 3.50%.

Introduction

Anaemia is a serious global public health problem that particularly affects young children and women. India continues to be affected by this serious health problem (Pal et al. 2014). As per the National Family Health Survey-4 (2015-2016) anaemia is widespread in India--58.6% of children, 53.2% of non-pregnant women and 50.4% of pregnant women were found to be anaemic. According to the survey, about 40% of women are mildly anaemic, 12% are moderately anaemic, and 1% are severely anaemic. Hence, Sharma et al. (2018) noted “When over half of the women in the country suffer due to anaemia, the idea of ‘Health for All’ seems to be an illusion”.

According to the World Health Organization (WHO, 2011), anaemia is a condition in which the number of red blood cells or the haemoglobin concentration within them is lower than normal. Sharma et al. (2018) noted ‘Various intermixed factors cause anemia but poor intake of nutrients and iron content in diet seem to be the ultimate reason behind it. Anemia is known to have disastrous implications on the health of particular groups like children, adolescent girls and women of reproductive age group’.

India is home to more than 243 million adolescents. Unfortunately, it is estimated that about 56% of the adolescent girls are prone to anemia (Dambal & Pannerselvam 2018). Adolescent girls

are particularly at high risk of malnutrition because of gender discrimination in distribution of, and access to, food within the family (Bhattacharya & Barua, 2013). Very often, in India, girls get married and pregnant even before the growth period is over, thus doubling the risk for anaemia (Upadhye et al. 2017). Besides, poor eating habits are a major public health concern among college and university students (Kannan and Ivan 2017, Singh et al., 2018). Similarly, Hanafi et al. (2013) noted 'Faulty feeding habits could be attributed to the occurrence of iron deficiency anemia among young adults. The most prevalent habits accustomed in this age group include changing the main meals for snacks, skipping breakfast, reducing the intake of fruits and vegetables, and the increasing consumption of sodas and high calorie foods. These habits can result in iron deficiency and increase the risk of obesity'.

In this scenario, there is serious need to raise awareness of anaemia and anaemia-related health problems among adolescent girls. Since the large majority of adolescent girls are school and college goers, reaching them at an early impressionable age can lay a foundation for a better and healthy lifestyle. According to Sharma (2018:1) observed 'The prevalence of anaemia decreases with schooling from 56% among women with no schooling to 49% among women with 12 or more years of schooling'. Kakkar *et al.* (2011: 38) wrote 'Improving the target population's knowledge and awareness may increase compliance'. Hence, necessary interventional measures such as health education to adolescent, about various personal and environmental hygiene practices and maintaining a good balanced diet could significantly alter the health status of the adolescent and the society in total (Kumar et al. 2019).

Unfortunately, no attempts have been done to understand the prevalence of anaemia among adolescent girls in Arunachal Pradesh. According to the National Family Health Survey-4 (2016), anaemia is a major health problem in Arunachal Pradesh, especially among women and children. The survey noted "Forty percent of women in Arunachal Pradesh have anaemia, including 32 percent with mild anaemia, 8 percent with moderate anaemia, and 1 percent with severe anaemia. Anaemia is particularly high for women who are breastfeeding, but anaemia exceeds 35 percent for every group of women except those who are pregnant and those belonging to "other" religions. The proportion of women having anaemia is particularly high among other backward classes and those who do not belong to scheduled castes, scheduled tribes, or other backward classes" (NFHS, 2016: 21). This raises an alarming question, how the state fails to contain anaemia in the state. This question however demands a further investigation. In the present study an attempt has been made to get a clear idea of the different degree of anaemia among college students of the Dera Natung Government College, district Papumpare, Itanagar - Arunachal Pradesh and to draw out its correlation with their height and haemoglobin, weight and haemoglobin and height and weight.

Arunachal (the Land of Dawn) is located in the extreme north-eastern corner of India. It is bordered by Bhutan on the west, China (Tibet) on the north and north-east, Myanmar on the east and south-east and the States of Assam and Nagaland to its south. The State has a territory of 83,743 square kilometer. It is the homeland for a large number of tribes that exhibit cultural heterogeneity in spite of having some common cultural and linguistic elements (Chaudhuri & Tayeng, 2015). Of the many communities, the more prominent ones (due to their numerical strength) are the Nyishi, Adi, Galo, Apatani, Mishmi, Tagin, Khampti, Khamiyang, Singpho, Tangsa, Nocte, Wangcho, Monpa, Sherdukpen, Aka, Bugun, Bangro, Yobin, Memba, Nah, Puroik, Meyor, Sartang and Miji.

Materials and Methods

The survey was conducted among 57 adolescent girls of the college. The study was conducted on

21st September 2019 as part of the Poshan Abhiyaan¹ of Government of India at the Dera Natung Government College Itanagar, Arunachal Pradesh. The students under study were between the age group of 17-21 years. They came from different socio-economic, cultural background and geographical regions of the Arunachal Pradesh. The data were recorded in the proforma and privacy of data was strictly maintained to protect the physical, mental and social integrity of participants. Age, height, weight and haemoglobin were recorded. The blood sample was taken from them with sterile needles and blood haemoglobin level estimated as per Dacie and Lewis (1975). All subjects were assessed for the presence of anaemia using WHO criteria. Anaemia is established if the haemoglobin is below the cut off points as recommended by WHO (for adult males-13.0 gm/dl and for adult non-pregnant females-12.0 gm/dl). The observations were interpreted as per WHO criteria cut off directed by WHO which is given as below. Each student was directed for the measurement of height and weight to evaluate their nutritional status with the help of BMI according to cut off directed by WHO which is given below:

- a) Measuring the prevalence rate of anaemia among college students using haemoglobin percentage as cut off value.
- b) Comparing the nutritional status (Body Mass Index) with the prevalence of anaemia in college students.
- c) finding the correlation between height and haemoglobin, weight and haemoglobin, and height and weight.

Table 1: Table showing the grade of BMI according to WHO

Nutritional Status	BMI kg/m ²
Severely Underweight	Less than 17.0
Underweight	17.0-18.5
Normal	18.5-24.9
Overweight	25.0-29.9

Table 2: Table showing the cutoff of anemia according to WHO

Symptoms Severity	Haemoglobin Value (gm/dl)
Severe Anaemic	<8.0
Moderate Anaemic	8.0-10.9
Mild Anaemic	11.0-11.9
Normal	12-14

Results

Table 3: Distribution of anaemia among college students (as per WHO criteria)

Symptoms severity	No. of students	Percentage
Severely anaemic	1	1.75%
Moderate anaemic	31	54.38%
Mild anaemic	14	24.56%
Normal	11	19.29%

¹ Poshan Abhiyaan is India's flagship programme to improve nutritional outcomes for children, adolescents, pregnant women and lactating mothers by leveraging technology, a targeted approach and convergence. It was launched by Prime Minister Narendra Modi in March 2018.

In the present study, anaemia was observed in 46 (80.70%) students out of total 57 students. Anaemia was absent in the remaining 11(19.29%) students. Mild anaemia was observed among 14 (24.56%) students, moderate anaemia in 31 (54.38%) and severe anaemia in only 1 (1.75%) student.

Table 4: Distribution of BMI among college students (as per WHO criteria)

BMI	No. of students	Percentage (%)
Severely Underweight	2	3.51%
Underweight	6	10.53%
Normal	44	77.19%
Overweight	5	8.77%
Total	57	100%

According to the WHO standard of BMI, students are classified as severely underweight (BMI below 17.0), underweight (BMI 17.0- 18.5), normal (BMI 18.5-24.99), and overweight (BMI greater than 25). The prevalence of underweight among 57 students was 6 (10.53%), while 44 (77.19%) had normal BMI, 2 (3.51%) had severely underweight and 5 (8.77%) were overweight (Table V).

Table 5: Prevalence of anaemia among students belonging to different nutritional level

Anaemia	Underweight	Severely underweight	Normal	Overweight	Total
Present	5 (8.77%)	2 (3.50%)	33(57.89%)	5 (8.77%)	46(80.70%)
Absent	1 (1.75%)	0 (0.00%)	10(17.54%)	0 (0.00%)	11(19.29%)
Total	6 (10.52%)	2 (3.50%)	44(77.19%)	5 (8.77%)	57 (100%)

Cfr. Fig 1 (Correlation graph between haemoglobin and weight among students: $r=0.04$), Fig 2 (Correlation graph between haemoglobin and height among students: $r=0.01$) and Fig 3 (Correlation graph between weight and height among students: $r=0.41$)

After the analysis it was found that anaemia was more prevalent in student with normal weight. The prevalence of anaemia among underweight student was 8.77% and in student with normal BMI was 57.89% and overweight has prevalence of 8.77% and severely underweight has prevalence of 3.50%. As it is shown from the above calculation part that no correlation ($r=0.04$) is found between haemoglobin and weight of the students. When compared with height with haemoglobin there is no correlation is observed and the value of correlation is $r=0.01$. As it is shown in the table that there is correlation is (0.41) found between height and weight of the students.

Discussion

The present study shows that the prevalence of anemia was 80.70%. The present study revealed that anaemia is one of the biggest health problems among teenagers going to college. In the present study among the college students, there were moderate anaemia among 54.38% student followed by mild anaemia among 24.56% students but there was only 1.75% students having severe anaemia. Similar to our study, Sharma et al. (2018) who analyzed the data of NFHS-4 revealed that in India, "mild anemia was significantly high among women of age 15-24 along with moderate anemia in the same age group. Similarly, a study conducted by Shedole et al. (2017) on the prevalence of anaemia among urban and rural adolescent high school girls of Davangere, Karnataka found that the prevalence of mild, moderate and severe anaemia is 53.69%, 17.54% and 13.23%. A study carried out by Panyang

et al. (2018) on the prevalence of anemia among the women of the tea garden community of Assam also revealed a similar prevalence of severe anemia of 8.4% while moderate anemia accounts for 91.6%. A study by Goyal et al. (2015) on the prevalence of anaemia among school adolescent girls in Haldwani, Nainital, found that 48.18% of adolescent girls were found to have a prevalence of mild, followed by moderate and severe anaemia among the study population. Again, a similar study, carried out among 371 adolescent girls in schools of Haldwani, Uttarakhand by Goyal and Rawat (2018), concluded that nearly half of the schools going adolescent girls are still suffering from mild, moderate to severe anaemia. A recent study by Kumar et al. (2019) on the prevalence of anaemia among tribal school going children found that the presence of anaemia was 11.21%. Among the identified cases of anaemia all of them were of the moderate type and no cases of severe anaemia were noted.

Apart from these studies, a number of studies were undertaken in many parts of India, for example, a study carried out among the tea tribe adolescent girls living in the Dibrugarh district of Assam in 2013 by Mahanta et al. (2015) discovered that anaemia soared up to 96.3% among adolescent girls. Joshi and Kushawaha's (2018) study on the prevalence & correlates of nutritional anaemia among the adolescent girls of Uttarakhand revealed that 83.18 % of them were anaemic. Kakkar et al. (2011), who carried out their survey among the adolescent school girls of Bhopal, revealed a prevalence of anemia of 58.4% among the study participants. A study carried out among 300 adolescent girls in Nagpur in 2017 by Upadhye et al. (2017) discovered a high prevalence of anaemic girls up to 90%. Deshpande et al.'s (2013) study on the prevalence of anemia in adolescent girls found that 60 percent were anaemic, 18.4 percent mild, 41.3 percent moderate, and 0.4 percent suffered from severe anaemia. A study carried out by Melwani et al. (2018) on the prevalence of anaemia amongst adolescent girls residing in a selected slum of Bhopal city found that the overall prevalence of anaemia among adolescent girls was 57.65%. However, in contrast to our study, a study conducted by Vibhute et al. (2019) on the prevalence and awareness of nutritional anemia among 300 female medical students in Karad, Maharashtra found that only 28.6% were suffering from anaemia. Similarly, a study conducted by Patel et al. (2017) on the nutritional anemia status in adolescent girls in rural schools of Raipur, India revealed that 36.4% were found to be anemic. A study carried out by Atram et al. (2019) among 150 medical students on the prevalence of anaemia, discovered that majority of students had a mild grade of anaemia.

In the neighboring country of Nepal, a study carried out by Gautam et al. (2019) on the prevalence of anemia in women of reproductive age reveals that 41% of women aged 15–49 years were anemic. In Bangladesh, a study carried out by Mistry et al. (2017) on anemia among adolescent girls in Bangladesh revealed that as many as 51.6% of adolescent girls were suffering from a form of anemia. In Pakistan, a study carried out by Jamali et al. (2016) on the prevalence of Iron Deficiency Anaemia in school and college students of the District Shaheed Benazirabad, Sindh Province, Pakistan found that 43.1% of the students were anaemic. More recently, a study conducted by Hassan et al. (2017) on the prevalence of iron deficiency anemia in adolescent girls from low income communities in Lahore revealed that anaemia was present in 68.8% of adolescent girls. A study carried out in Bhutan by Campbell et al. (2018) on the epidemiology of anaemia in children, adolescent girls, and women of reproductive age revealed that in all groups, anaemia prevalence was high. A study carried out by Hettiarachchi et al. (2006) on the prevalence and severity of micronutrient deficiency among adolescents in Sri Lanka revealed that the prevalence of iron deficiency anemia (IDA) was 24.6 % in males and 40.0 % in females (overall 33.9% for the age group). As far as Myanmar is concerned, a study conducted by Htet et al. (2013) on the influence of vitamin A status on iron-deficiency anaemia in anaemic adolescent schoolgirls in Myanmar found out that 30% of anaemia cases were due to iron deficiency.

In the present study, it was found that anaemia is more prevalent among the students who have normal BMI. The prevalence of anaemia among underweight (BMI less than or equal to 18.5) was 8.77% and normal (BMI 18.85-24.99) of 57.89% and over weight (BMI more than or 25) have prevalence of 8.77%. A similar trend was observed in a study carried out by Agarwal et al. (2017) in their study of 344 medical and para medical students of the Rohilkhand Medical College and Hospital, Bareilly found the prevalence of anaemia among normal weight (31.92%) followed by underweight (27.02%), then in preobese (25.86%) while the least was among the obese (20.83%). A study conducted by Khan et al. (2018) on the undergraduate students of a medical college of Haryana also revealed that anaemia prevalence was significantly higher among underweight students (88.9%) compared to normal (54.2%) and overweight/obese (46%) students. Pandey and Singh's (2013) study among medical students in a medical college, at Bilaspur, Chattisgarh, found that the prevalence of anemia among underweight (BMI below 18.5) was 60%, and normal (BMI 18.5 – 24.99) of 27.5% and overweight (BMI >25) have prevalence of 12.5%. A similar trend was reported by Pal et al. (2014) in their study of the prevalence of anaemia in relation to BMI among adult rural population of West Bengal, where the prevalence of anaemia was the lowest in the overweight and significantly higher prevalence was noted in normal groups and underweight group. This suggests that anemia prevalence decreases as the nutritional status of subject increases.

When we compared haemoglobin and weight of the students, we observed no correlation ($r=0.04$) between them. When compared height with haemoglobin, there is no correlation observed and the value of correlation is $r=0.01$. As it is shown in the fig. 3 that there is a correlation (0.41) found between height and weight of the students. Similar results were found in a study done by Chinchole and Najan (2017) as they found that there is no significant difference in the prevalence of anemia in different BMI groups. Saratha et al.'s (2010) study on the prevalence of Anaemia among young adult female students in a medical teaching institution in Pondicherry found that there was also no significant association between anaemia with height, weight and BMI. Joshi and Kushwaha's (2018) study on the prevalence & correlates of nutritional anaemia among adolescent girls of Uttarakhand revealed no significant association between BMI and anaemia. Similarly a study conducted by Hanafi et al. (2013) on hemoglobin levels and body mass index among the preparatory year female students at Taibah University, Kingdom of Saudi Arabia found that there is no significant association between hemoglobin status (anemia) and BMI status among the studied population. Kannan and Achuthan (2017) noted that when grades of Body mass index were correlated with hemoglobin status, undernutrition showed a positive correlation and an inverse relationship in overweight and obese adolescent girls when age was controlled both in boys and girls, however none of the correlation showed significance to the levels of <0.05 .

Conclusion

In the present study, the prevalence of anemia was found to be 80.70%. 24.56% subjects being mildly anaemic and 54.38% moderately anaemic while 1.75% suffered from severe anaemia. Most students had a mild grade of anaemia. BMI shows a higher prevalence of anaemia among the normal weight people, followed by over-weight and under-weight. There is no significant difference in the prevalence of anemia in different groups of BMI. However, there is a correlation (0.41) found between height and weight of the students. However, further studies with a large sample size are needed to draw out the exact proportion of prevalence of anaemia, so that appropriate remedial measures can be taken.

Thus, this study highlights that adolescent college students are a vulnerable population and there is an urgent need for interventional programs at colleges. Most importantly, to reduce the level of

anaemia, frequent screening of the students for the presence of anemia and regular health checkups is mandatory in all the school and college students.

Recommendations

The general health of adolescent girls in Arunachal Pradesh still needs to be improved. The awareness regarding healthy eating habits and regular exercise has to be improved by conducting health education classes and awareness programs in colleges.

Acknowledgements

The authors are deeply indebted to all the students of Dera Natung Government College, Itanagar who participated in the study.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

Conflict Of Interest

The Authors declares that there is no conflict of interest.

References

- Agarwal A.K., Katiyar G.D., Mahmood S.E., Khan S., Sharma M. (2017). A cross sectional study of association of anaemia with BMI in medical and paramedical students. *International Journal of Community Medicine and Public Health*, 4: 4697-701.
- Atram P.G., Atram G.G. (2019). Prevalence of anaemia, obesity and its effects on academic performance among medical students. *Indian Journal of Applied Research*, 9 (10): 40-42.
- Bhattacharyya H, Barua A. (2013). Nutritional Status and Factors Affecting Nutrition among Adolescent Girls in Urban Slums of Dibrugarh, Assam. *National Journal of Community Medicine*, 4(1): 35-9.
- Campbell R.K., Aguayo V.M., Kang Y. (2018). Epidemiology of anaemia in children, adolescent girls, and women of reproductive age in Bhutan. *Maternal & Child Nutrition*, 14(S4): 1-9.
- Chinchole S.B., Najan A.B. (2017). Prevalence of anemia among medical students at medical college, Ambikapur, Chhattisgarh. *International Journal of Medical Science and Public Health*, 6(9): 1442-1444.
- Dacie J.V. and Lewis S.M. (1975). *Practical Haematology*. Edinburgh, New York: Churchill Livingstone
- Dambal S., Panneerselvam S. (2018). Anemia in Adolescent Girls. *Asian Pacific Journal of Nursing*, 5(1): 7-8.
- Deshpande N.S., Karva D., Agarkhedkar S., Deshpande S. (2013). Prevalence of anemia in adolescent girls and its correlation with demographic factors. *International Journal of Medicine and Public Health*, 3: 235-9.
- Gautam S, Min H, Kim H, Jeong H-S. (2019). Determining factors for the prevalence of anemia in women of reproductive age in Nepal: Evidence from recent national survey data. *PLoS ONE*, 14(6): 1-17.
- Goyal N., Rawat C.M.S., Jha S.K. (2015). Prevalence of anaemia among school adolescent girls. *Indian Journal of Community Health*, 27(3): 398-401.
- Goyal N., Rawat C.M.S. (2018). A study of anaemia and its correlates among adolescent girls in schools of Haldwani, India. *International Journal of Research in Medical Sciences*, 6: 3320-6.
- Hanafi M.I., Abdallah A.R., Zaky A. (2013). Study of hemoglobin level and body mass index among preparatory year female students at Taibah University, Kingdom of Saudi Arabia. *Journal of Taibah University Medical Sciences*, 8(3): 160-166.
- Hassan F, Salim S., Humayun A. (2017). Prevalence and Determinants of Iron Deficiency Anemia in Adolescents Girls of Low Income Communities in Lahore, *Annals of King Edward Medical University Lahore Pakistan*, 23(2):116-125.
- Hettiarachchi M., Liyanage C., Wickremasinghe R., Hilmers D.C., Abrams S.A. (2006). Prevalence and severity of micronutrient deficiency: a cross-sectional study among adolescents in Sri Lanka. *Asia Pacific Clinical Nutrition*, 15(1): 56-63.
- Htet M.K., Fahmida U., Dillon D., Akib A., Utomo B., Thurnham D.I. (2013). The influence of vitamin A status on iron-deficiency anaemia in anaemic adolescent schoolgirls in Myanmar. *Public Health Nutrition*, 17(10): 2325-2332.
- World Health Organization. (2001). *Iron Deficiency Anaemia Assessment, Prevention and Control, A guide for programme managers*. From <https://www.who.int/nutrition/publications/en/ida_assessment_prevention_control.pdf>
- Jamali, N.H., Mahesar, H. and Bhutto, M.A. (2016). Prevalence of Iron Deficiency Anaemia in School and College Going Students of District Shaheed Benazirabad Sindh Province, Pakistan. *Open Journal of Blood Diseases*, 6: 67-78.
- Joshi D., Kushwaha A. (2018). Prevalence & correlates of Nutritional Anaemia among Adolescent girls of Distt. U. S. Nagar, Uttarakhand. *European Journal of Nutrition and Food Safety*, 8(4):348-360.
- Kakkar R., Kakkar M., Kandpal S.D., Jethani S. (2011). Study of anaemia in adolescent school girls of Bhopal. *Indian Journal of Community Health*, 23(1): 38-40.
- Kannan U., Achuthan A. (2017). Correlation of Hemoglobin concentration with Body Mass Index among medical students. *Indian Journal of Clinical Anatomy and Physiology*, 4(2):227-230.
- Kannan B., Ivan E.A. (2017). Prevalence of anemia among female medical students and its correlation with menstrual abnormalities and nutritional habits. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*, 6: 2241-5.
- Khan Z.A., Khan T., Bhardwaj A., Aziz S.J., Sharma S. (2018). Underweight as a Risk Factor for Nutritional Anaemia –A Crosssectional Study among Undergraduate Students of a Medical College of Haryana. *Indian Journal of Community Health*, 30(1): 63-69.
- Kumar S.V., Ramalingam K. (2019). Intestinal parasitic infections and prevalence of anaemia among tribal school going children—a one year study. *International Journal of Contemporary Pediatrics*, 6:1893-7.
- Mahanta T.G., Mahanta B.N., Gogoi P., Dixit P., Joshi V., Ghosh S. (2015). Prevalence and determinants of anaemia and effect of different interventions amongst tea tribe adolescent girls living in Dibrugarh district of Assam, *Clinical Epidemiology and Global Health*, 3: 85-93.
- Melwani V., Dubey M., Khan A., Toppo M., Choudhary Y., Priya A. (2018). A study to assess the prevalence of anaemia amongst adolescent girls residing in selected slum of Bhopal city. *International Journal of Community Medicine and*

- Public Health, 5: 1096-9.
- Ministry of Health and Family Welfare, Government of India. (2017). India National Family Health Survey (NFHS4) 2015–16. Mumbai: International Institute for Population Sciences
- Mistry S.K., Johhura F.T., Khanam F., Akter F., Khan S., Yunus F.M., Hossain M.B., Afsana K., Haque M.R., Rahman M. (2017). An outline of anemia among adolescent girls in Bangladesh: findings from a cross-sectional study. *BMC Hematology*, 17 (13): 1-8.
- National Family Health Survey (NFHS-4), India, 2015-16: Arunachal Pradesh. (2018). International Institute for Population Sciences (IIPS) and ICF. 2018. Mumbai: International Institute for Population Sciences
- National Family Health Survey (NFHS-4), 2015-16: India. (2017). International Institute for Population Sciences (IIPS) and ICF. Mumbai: International Institute for Population Sciences
- Pal A., De S., Sengupta P., Maity P., Dhara P.C. (2014). An investigation on prevalence of Anaemia in relation to BMI and nutrient intake among adult rural population of West Bengal, India *Epidemiology Biostatistics and Public Health*, 11(2): 2-10.
- Pandey S., Singh A. (2013). A cross sectional study of nutritional anemia among medical students in a medical college, at Bilaspur, Chhattisgarh, *National Journal of Medical Research*, 3(2): 143-146.
- Panyang R., Teli A.B., Saikia S.P. (2018). Prevalence of anemia among the women of childbearing age belonging to the tea garden community of Assam, India: A community-based study. *Journal of Family Medicine and Primary Care*, 7: 734-8.
- Patel S., Dhuppar P., Bhattar A. (2017). Nutritional Anemia Status in Adolescent Girls in Rural Schools of Raipur, India. *Medical Chemistry*, 7: 853-856.
- Rai R.K., Fawzi W.W., Barik A., Chowdhury A. (2018). The burden of iron-deficiency anaemia among women in India: how have iron and folic acid interventions fared? *WHO South-East Asia Journal of Public Health*, 7(1):18–23.
- Saratha A., Singh Z., Datta S.S., Boratne A.V., Senthilvel V., Joice S. (2010). Prevalence of Anaemia among Young Adult Female Students in a Medical Teaching Institution in Pondicherry, *Indian Journal of Maternal and Child Health*, 12 (4): 1-8.
- Sharma H., Singh S.K., Srivastava S. (2018). Major Correlates of Anemia among Women (Age 15-49) in India and Spatial Variation, Evidence from National Family Health Survey-4. *Journal of Women's Health Care*, 7: 440.
- Sharma, N.C. (2018). "Prevalence of anaemia sees little change over 10 years, shows survey", *livemint*, 13 January, p-1.
- Shedole D.T., Vidya G.S., Suryakantha A.H., Vijaykumar B. (2017). A comparative study on prevalence of anaemia among urban and rural adolescent high school girls of Davangere, Karnataka. *International Journal of Community Medicine and Public Health*, 4: 4638-43.
- Singh V., Pandey P.T., Kislai, Devesh, Haider J. (2018). Study of Gender Correlation with Weight, Height, and BMI on Hemoglobin. *International Journal of Physiology*, 6(3): 143-147.
- Upadhye J.V., Upadhye J.J. (2017). Assessment of anaemia in adolescent girls. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*, 6: 3113-7.
- Vibhute N.A., Shah U., Belgaumi U., Kadashetti V., Bommanavar S., Kamate W.. (2019). Prevalence and awareness of nutritional anemia among female medical students in Karad, Maharashtra, India: A cross-sectional study. *Journal of Family Medicine and Primary Care*, 8: 2369-72.
- WHO. (2015). The global prevalence of anaemia in 2011. Geneva: World Health Organization.
- Yadavar, Swagata. (2019). "Improve Women's Education, Health Services To Reduce India's Anaemia Burden, World's Highest", *IndiaSpend*, 16 February, p.1.

Images

Fig 1: Correlation graph between haemoglobin and weight among students: $r=0.04$

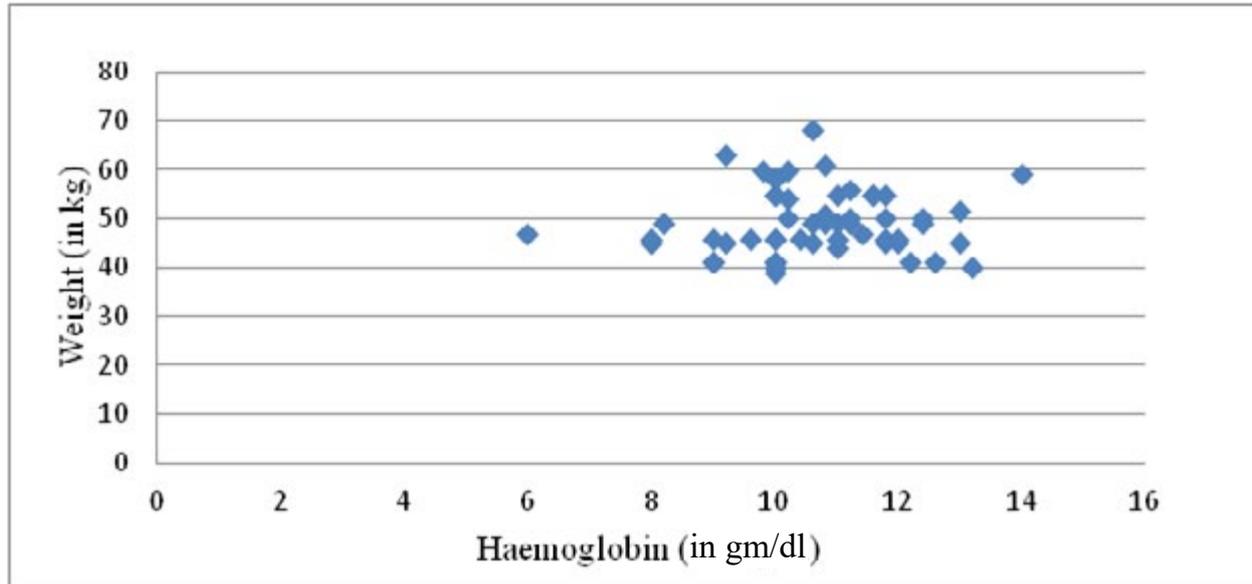


Fig 2: Correlation graph between haemoglobin and height among students: $r=0.01$

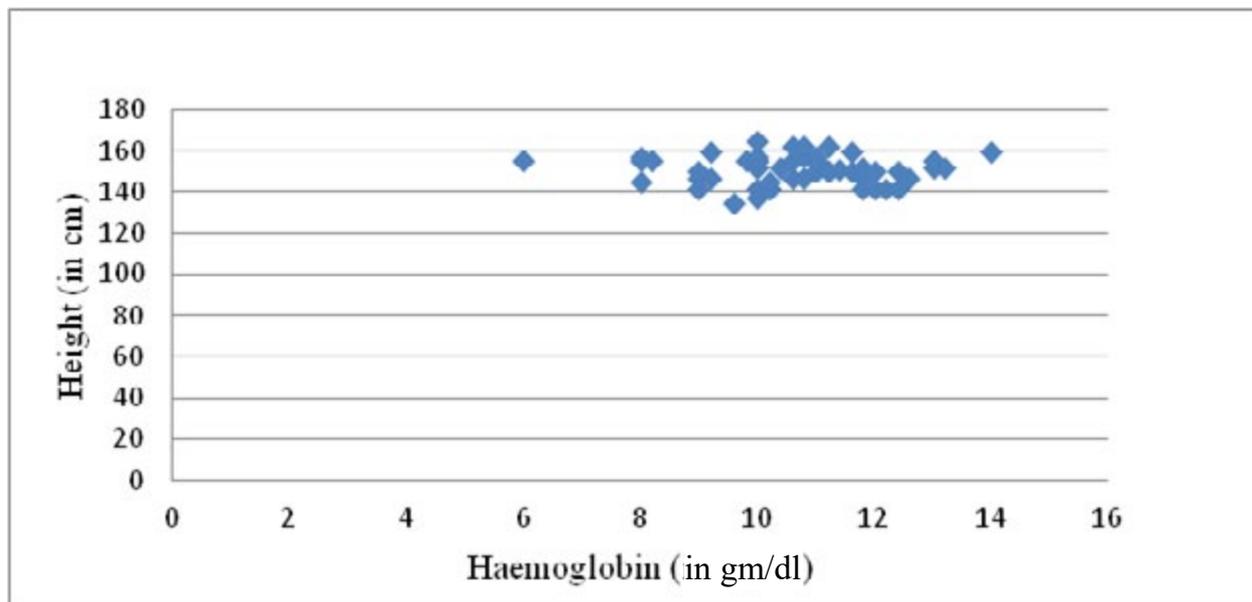


Fig 3: Correlation graph between weight and height among students: $r=0.41$

