ORIGINAL RESEARCH PAPER
Volume - 13 | Issue - 09 | September - 2024 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

"UNSEEN SHADOWS: ADDRESSING ANAEMIA IN ADOLESCENTS WITHIN GOVERNMENT SCHOOLS OF SOUTH INDIA"

Community Medicine

Mr. Ravishankar Suryanarayana* Community Medicine SDUMC(SDUAHER), Kolar, India *Corresponding Author
Dr. Harish Reddy Department of Biochemistry, HIMS, Haveri, India.
Dr. Shilpa MD Department of Pathology, SDUMC(SDUAHER), Kolar.
Dr. Bindu Madhavi Department of Microbiology, SDUMC,(SDUAHER), Kolar, India.
Dr. Karthik S Department of Pediatrics, SDUMC, (SDUAHER), Kolar, India.

ABSTRACT

Context/Background: Anaemia a condition develops when the blood produces lower amount of healthy red blood cells and body does not receive enough oxygen rich blood and intern the person feels weaker. Anaemia identified as one of the major a public health problem affecting both human health and social and economic development. The prevalence of nutritional anaemia globally among adolescents was estimated to be 40%. The prevalence in Indian states varied from 40-60%. A study conducted in India where 40% of girls and 18% of boys were found to suffer from anaemia. 1, 3. A comprehensive study on adolescent anaemia in India is essential to address this pervasive health issue. By focusing on the prevalence, risk factors, and consequences of anaemia, the present study aims to provide actionable insights for improving public health strategies, enhancing educational outcomes, and reducing the socio-economic impact of anaemia. **Methodology:** Methods: Descriptive Cross-sectional study was conducted among 253 adolescent school children from government schools. Multi stage cluster sampling was used to select the children. 50 students from each of these 5 randomly selected clusters (Classes) and were enrolled for the study. **Results:** In the present study overall prevalence of anaemia was 17.4%. The prevalence was 14.7% among boys and among adolescent girls was 20.16%. The overall mean Hb level was (13.04 ± 1.48) and among girls the mean haemoglobin level was (12.67±1.34) and among boys (13.04±1.48). The major risk factors associated were religion, Low BMI, not taking deworming tablets, Irregular periods and excessive bleeding, type of diet. **Conclusions:** A healthy dietary and personal hygiene practices, usage of iron and folic acid supplementation, deworming helps to control adolescent anaemia. Regular deworming among adolescent educating the children regarding locally available iron rich food items, personal hygiene is very essential to reduce adolescent anaemia.

KEYWORDS

Prevalence, Adolescents, Cluster sampling, anaemia, diet.

INTRODUCTION:

Anaemia, characterized by a deficiency in healthy red blood cells, hinders the body's ability to receive sufficient oxygen-rich blood, resulting in weakness. This condition is not only a significant public health concern but also impacts social and economic development. Globally, anaemia affects a quarter of individuals aged 10-24, with its highest prevalence observed in low- and middle-income nations. Nutritional anaemia alone was estimated to be 40% of the world's population.[1] Adolescence, spanning from 10 to 19 years, is a critical period for physical, mental, and behavioural growth, necessitating additional nutritional support. Recent data from NFHS-5 shows alarming rates of anaemia among adolescents, with an average prevalence of 44.6%, varying between genders.[2] The prevalence of Anaemia among adolescents was 40% among girls and 18% among boys as reported by a study conducted in India.[3]

Anaemia among adolescents stems from various factors, including both nutritional and non-nutritional causes such as micronutrient deficiencies, genetic blood disorders like sickle cell anaemia, inflammation, infections, and physiological conditions like menstruation.[3] Micronutrient deficiency not only contributes to anaemia but also impedes cognitive and psychomotor development, leading to lower intelligence quotient.[4] Adolescents, experiencing rapid growth and increased iron requirements for muscle and blood development, are particularly vulnerable to anaemia.[5] Despite extensive efforts by international agencies like UNICEF and WHO, global anaemia prevalence remains persistently high, underscoring the need for more effective control programs.[6] Despite numerous national programs targeting anaemia, the high prevalence among government school children in rural areas persists, largely due to poor socioeconomic status. Programs like regular deworming, school-based feeding practice will help in improving nutritional status.[7] Therefore, this study was undertaken to estimate the prevalence of anaemia among rural adolescent school children and investigate the contributing risk factors to reduce the burden of anaemia.

Methodology:

The study was conducted using a descriptive cross-sectional design to estimate the prevalence of anaemia among adolescent school children. The institutional ethical committee has approved the study and assent from the students and consent from their parents was taken. The confidentiality of the collected information was assured to the participants. The sample size was estimated based on a previous study indicating a 20% prevalence of anaemia among adolescents in rural school children in Karnataka,[8] with a 95% confidence interval and a 5% absolute error. Consequently, the estimated sample size was 250.

A list of Government High Schools and Higher Primary schools in Rural Kolar area was compiled based on information from the Educational Officer. From a total of 22 Schools, 4 schools were randomly selected using Simple Random Sampling method. Subsequently, out of the 460 students across these selected schools from 6th to 10th grade (14 clusters), approximately 50 students from each of the 5 randomly chosen clusters were enrolled for the study.

A list of rural Government High Schools and Higher Primary schools in Rural Kolar area was compiled based on information from the Educational Officer. From a total of 22 Government High Schools and Government Higher Primary Schools, 4 schools were randomly selected using Simple Random Sampling method. Subsequently, out of the 460 students across these selected schools from 6th to 10th grade (14 clusters), approximately 50 students from each of the 5 randomly chosen clusters were enrolled for the study using cluster sampling method.

The data on socio-demographic information and anthropometric measurements from the children was collected using a pretested questionnaire. Additionally, a venous blood sample of 5ml was collected and analysed for Haemoglobin levels, with anaemia classification based on WHO reference ranges.

For biochemical investigation, laboratory tests including Serum Iron, Ferritin, TIBC, Transferrin, and Folic acid were conducted. Pathological investigations, including Complete Blood Count (CBC) parameters such as Red Blood Cell (RBC) count, Haemoglobin (HGB), Haematocrit (HCT), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), and Mean Corpuscular Haemoglobin Concentration (MCHC), were estimated using an automated cell counter method with a SYSMEX automated haematology analyser. Additionally, peripheral blood smears stained with Leishman's stain were examined to assess the count and

morphology of RBCs, WBCs, platelets, and the presence of any parasites.

Microbiological investigation involved collecting stool samples from a subsample of students, which were then examined under microscopy for the presence of parasites or parasitic eggs.

Statistical analysis: Statistical analysis was carried out using IBM SPSS Statistics version 22. The socio-demographic, health, and nutrition characteristics of the study population were summarized by frequency and percentage. Continuous variables presented as mean and standard deviation (SD). Univariate analysis was performed to assess the association between anaemia and associated factors using chi-square ($\chi 2$) test, Binary Logistic regression was performed to identify the factors associated with anaemia and significance level was set at 5%.

RESULTS:

Table 1 Prevalence of Anaemia

Anaemia Status	Female	Male	Total
< 7 gms %(Sever)	00	00	00
(7-9.9) gms %(Moderate)	09	02	11
(10-11.9) gms %(Mild)	17	16	33
> 12 gms %(Normal)	98	111	209
Total	124	129	253

Overall anaemia among school children was 17.4% with 95 % Confidence Interval (6.3-28.5) % 21% of female school children were anaemic. Among boys' anaemia was 13.9%.

Table 1 Prevalence of anaemia according to demographic profile

Demographic Variables		Anaemia Grade			χ^2 Value P-Value
		Moderate Anaemia	Mild Anaemia	Normal	
Age (years)	11	00	03	20	5.44 (0.065)
	12	00	06	36	
	13	01	11	53	
	14	02	03	28	
	15	05	06	51	
	16	02	05	20	
	17	00	00	01	
Gender	Girls	08	17	99	2.784 (0.248)
	Boys	03	16	110	
Religion	Hindu	10	31	205	4.990 (0.025*)
	Muslim	03	00	4	
Caste	General	01	00	5	1.643 (0.440)
	OBC	01	13	88	
	SC/ST	09	20	116	
Socio-economic Status	Above Poverty Line	01	01	13	0.183 (0.669)
	Below Poverty Line	10	32	196	
Type of Family	Nuclear	03	13	78	0.359 (0.836)
	Joint	07	15	109	
	Joint Extended	00	06	22	
Education of Mother	Illiterate	05	11	57	2.250 (0.284)
	Primary/Higher -Primary/ High School	04	14	81	
	Matriculation/ PUC/Degree	3	7	71	
Education of Father	Illiterate	5	6	43	2.708 (0.258)
	Primary/Higher Primary/High School	1	15	57	
	Matriculation and above	5	12	109	
Siblings	Less than 2	9	27	188	2.370 (0.126)
	More than 2	4	4	21	
Haemoglobin Level	Over all	10.17±0.72		13.55± 0.92	<0.001###

* Chi-square p value, # t test p value

Except for religion and the difference in Haemoglobin levels none of the factors like age, gender, type of family, education of parents, and number of siblings does not show any significant association with prevalence of anaemia. The Mean difference in haemoglobin levels between Anaemia group and non-anaemia group was statistically significant (Table 1)

Table 3 Associated risk factor and Anaemia

Factors		Anaemia	No anaemia	P value
BMI	< 18.5	30(16.8)	148(83.2)	0.552
	18.5-24.9	13(18.8)	56(81.2)	
	25-29.9	0(00)	5(100)	
Diet	Non-Vegetarian	26(13.61)	165(86.39)	0.005*
	Vegetarian	18(29.0)	44(71.0)	
Excessive Bleeding/Irregular periods	Yes	9(31.0)	20(69)	0.030*
	No	35(15.02)	60(84.98)	
Consumed deworming tablets in last 6 months	Yes	40(16.4)	204(83.6)	0.002*
	No	4(44.5)	5(55.6)	

*Indicates Chi-square P Value

Univariate analysis shows that Type of diet, excessive bleeding and consumption of deworming tablets are associated with anaemia. (Table2)

Table 4 Binary Logistic regression for associate factors for Anaemia

Demographic factors	B	Wald	P-Value	Odds Ratio	95% C.I. for EXP(B)	
					Lower	Upper
Age Group	.288	1.173	0.279	1.334	.792	2.245
Gender (Female)	.540	1.928	0.165	1.716	.801	3.677
Religion (Hindu)	-.363	.093	0.760	.695	.068	7.158
Family size	-.160	.288	0.592	.852	.476	1.528
Mothers Education	.029	.005	0.945	1.029	.452	2.342
Fathers Education	.172	.137	0.712	1.187	.478	2.949
Siblings	.140	.059	0.807	1.151	.372	3.557
Excessive bleeding	.565	1.106	0.293	1.760	.614	5.048
Deworming	-.014	.000	0.991	.986	.095	10.277
Diet	.557	1.634	0.201	1.745	.743	4.098
BMI	-.206	.329	0.566	.814	.403	1.645

In the present study none of the predictors in this model show significant effects on anaemia at the 0.05 level, as indicated by their p-values. However, the variables like age, gender, education of parents, number of siblings, excessive bleeding among girls, diet seems to be associated with anaemia with higher odds ratio. Better the body mass index study shows a low risk of anaemia, also those children consumed deworming tablets had less risk of anaemia. **(Table 3)**

DISCUSSION:

In the present study prevalence of anaemia was 17.4% with 95% confidence interval. (6.3-28.5). % Among boys the prevalence of anaemia was 14 %, prevalence among adolescent girls was 21 % (Table 1). In a secondary data analysis by Samuel Scott et.al estimated a prevalence of anaemia among adolescents was 28.5% overall. Anaemia among girls was 40% and among boys it was reported to be 18%. [3] In a similar cross sectional study conducted in Kerala by P.M. Siva et, al and Mohan CR et.al reported a prevalence of anaemia among adolescent girls as 21%,and a very high prevalence of 74.52% respectively.[9,10] In another cross-sectional study conducted by Bushan Kamble et.al also reported a prevalence of 59% among adolescent girls in government school.[11] Chandra kumari et.al in their cross-sectional study also observed an overall prevalence of 48.63% among girls.[12] Shekhar Chauhan et.al in a secondary data analysis on cross-sectional survey observed that anaemia was more prevalent among adolescent girls than adolescent boys which was 20% and 8.7% respectively.[13] In a cross sectional study by Vijay Shree Mathad et.al also made an observation that overall prevalence of anaemia was 37.7%. [14] In a study conducted by S Chenna Reddy et.al among adolescent school girls in the same age of the present study find that the prevalence was 23.71% almost similar to the present study findings.[15] A study of adolescents in Maharashtra by Ashish Verma et.al and Kumari R et.al in Patna tertiary care hospital reported a very high prevalence among adolescents. Anaemia was between 50-61.19% among adolescents and among

gender prevalence of anaemia was 53.79% in boys and 71.7% in girls.[16,17] The low level of anaemia in the present study among government school adolescent children could be attributed to mid-day meal provided to rural school children.

The overall mean Hb level was (13.04 ± 1.48) and among girls the mean haemoglobin level was (12.67±1.34) and among boys (13.04±1.48). The overall average haemoglobin levels in the present study were comparatively higher than many south Indian studies. The mean haemoglobin level among girls was (10.33 ± 1.34) as reported in a study conducted by Chandrakumari et.al. [12] A cross sectional study by Rekha Kumari also reported that the mean Haemoglobin levels in early adolescents was (9.8 ± 1.3) Gms% and in late adolescents it was (11.3 ± 2.2) Gms% and the prevalence of anaemia was 53% and 47% respectively.[17]

In the present study the haemoglobin levels of normal subjects were (13.55±0.92) and among anaemia group it was (10.17±0.72) the difference was highly statistically significant.

In the present study age-wise anaemia prevalence indicates that its higher among early adolescent (11-14) which was 59.1% and it was 40.9 % among late adolescent (15-17) Years. The association between age and anaemia was not statistically significant (P=0.065) Shekar Chauhan et.al in their study reports a prevalence of anaemia (mild/moderate /sever) among early adolescent boys as 33.6% and girls as 55.2%. Whereas among late adolescents it was 30.6% among boys and 65.3% among girls. They also found a significant association between age and anaemia.[13] In a cross-sectional study conducted in state of Maharashtra by Ashish Verma et.al reported a prevalence of (58.76% to 63%) among adolescents in the age (11-14) years and 55.81% in the age 15 years almost like our findings. Though the association was not statistically significant they found the prevalence was higher among late adolescents.[16] The high incidence of anaemia in early adolescent year in the present study could be because of less attention toward eating and more towards the games, among the late adolescence the energy expenditure is less as they study in higher classes take tutorials and gave importance to eating habits. (Table 2)

In the present study most of the students belongs to Hindu religion and 93% of anaemia cases were from the same category. The difference in proportion of anaemia among Hindus and other religion was found to be statistically significant. (P=0.025) Study by Chauhan S et.al indicated that among Hindu religion 9.2% of boys and 20.3% were mild or moderately anaemic and among non-Hindus it was 5.8% and 18.6% respectively. The study also reported a significant association between religion and anaemia prevalence.[13] Caste wise prevalence of anaemia in the present study reveals that 20 % of adolescents belonging to SC/ST are anaemic. 13.72% of adolescents who belonged to OBC and 16.7% in general category were anaemic. The association was not statistically significant(P=0.440) In a community-based cluster-randomised controlled trial conducted Aakriti Gupta et.al in northern part of India identified caste also as a determinant factor of anaemia, in that study the prevalence of anaemia among SC/ST adolescents was 57.9% as compared to 22.2 % among adolescents belonging to OBC category. The study also reported a significant association between anaemia status and caste.[18]

The prevalence of mild and moderate anaemia was 17.65% among adolescents from families belonging to Below Poverty Line (BPL) and 13.3% adolescents with anaemia were from Above Poverty Line (APL) families. The association between socioeconomic status and anaemia was not statistically significant but prevalence of anaemia was very high in lower socioeconomic group compared to higher socioeconomic groups. (P=0.669) Ashish Verma et.al in their study observed a very high prevalence of anaemia in lower socio-economic group (70.55%) and as low as 45% in higher socioeconomic group. Lower socio-economic status is associated with high prevalence of anaemia. Similar observation was made in a cross-sectional study of anaemia among adolescent boys by Pravin N Yerpude reported that among lower and upper lower socioeconomic group a prevalence varied between (41.18%-45.45%) and in other economic categories it varied from (14.29-37.57) %. Sajith Kumar Soman also made similar observation in his cross-sectional study of high prevalence of anaemia in low-income group 64.3% varied between (46.4-54.3) %. The association was found to be statistically significant[16,19,20]. In the present study 36.36% of the anaemia cases among adolescents was among nuclear families whereas 63.64 % anaemia was seen among adolescent from Joint or Joint extended families. But the association was not found to be significant(P=0.836) Similar findings were reported in a study by Goyal N and they reported that 39.22% adolescents were anaemic who were from nuclear families and 63.60% belonged to Joint families. Study reported that type of family was significantly associated with presence of anaemia. [20] In the present study of the total anaemia cases among adolescents 36.36% was among their illiterate mothers, 40.9% was among mothers having education level from primary to High school, and it was 22.72% among mothers with education level matriculation and above. Though the prevalence of adolescent anaemia was low among their illiterate mother compared to mothers having education above matriculation the association was not statistically significant. (0.284) Goyal et.al in their study also found high prevalence of anaemia in adolescents with their mothers with no formal education (33%) and 27% among mothers with higher education and reported a significant association. [21] Shaban L et.al in their study found that there was no significant association between education of mother and prevalence of anaemia among adolescents.[22] In the present study 25% of the mild and moderate anaemia among adolescents was seen among their father who was illiterate. Anaemia was 36.4 % among their father who has studied up to High school and it was 38.6% and among their father who has education level above matriculation. A cross-sectional study by Hamal S et.al also has reported that anaemia among adolescent girls and the education status of father has a significant association.[23] The prevalence of anaemia16.07 % among adolescents having siblings less than two and 27.6% for siblings more than two, the association was not statistically significant. In a cross-sectional observation study Anandi C et.al observed that the prevalence of anaemia was high among adolescents having sibling more than two which was statistically significant. [24] (Table 2).

In this study univariate analysis done indicates that excessive bleeding and irregular periods was significantly associated with anaemia. (P=0.030) Mathad V et.al observed significant association of anaemia with excessive bleeding girls also having irregular periods.[13] In the present study Though BMI does not seem to have any significant association with anaemia, (P=0.552) but proportion was more among low BMI group. Mathad V et.al observed significant association of anaemia with low BMI.[13] Type of diet in the present study indicates that anaemia was more among adolescent on vegetarian diet compared to non-vegetarian and was statistically significant. (P<0.005) A similar finding was reported by Abhishek MG et.al in their cross-sectional study.[25] The anaemia among adolescent consuming deworming tablets was found to be on the lower side compared to those who have not consumed and the difference was statistically significant. Abhishek MG et.al also observed that anaemia was significantly low among those consuming deworming tablets.[25] (Table 3)

Binary logistic regression used to identify the associated factors revealed that age, gender (girls), parent's education, number of siblings, excessive bleeding, diet had a higher odds for anaemia but the association was not statistically significant. Similar study by Chauhan reported an higher odds ratio for deworming (1.25), BMI (0.92), religion (0.82) but has not shown any statistically significant association with anaemia.[13] Yusufu et.al in their study conducted in Tanzania also reported that variables like age, gender, BMI, number of siblings and even education of parents does not seem to have any association with anaemia.[26](Table 4)

CONCLUSION:

Anaemia is one of the burning problems among adolescent schoolchildren. In this study Prevalence of mild to moderate anaemia was predominant among adolescent school going children. The decreased prevalence of anaemia in our study group compared to prevalence in India could be due to the impact of school based effective interventional programs. The major risk factors found associated were religion, Low body mass index, not taking deworming tablets, Irregular periods and heavy prolonged bleeding, and type of diet. This evidence can be used to guide policy and programs directed towards the problem of anaemia among adolescents of government schools.

Recommendation: There is a need for regular supply of iron and folic acid tablets and for improving medication adherence regarding consuming these tablets. Regular deworming among adolescent, educating the children regarding locally available iron rich food items, personal hygiene is very essential. Anaemia among adolescents must

be addressed through effective public health policy targeting adolescents studying in government rural schools especially in rural areas.

Funding: The study was funded by SDUAHER
Conflict of interest: None
Declared Ethical approval: The study was approved by the Central Ethics Committee

Acknowledgement: To Dr.Varsha,Associate professor for her initial contributiopn and also to District Education Officer,Principal and Head Masters of schools for their support to carryout the research

REFERENCES:

1. Tandon MA, Appiah AO, Edusei AK. Prevalence of anaemia and undernutrition of adolescent females in selected schools in Ghana. Journal of Nutrition and Metabolism. 2021,8:1-5.
2. Sharma M, Gaidhane A, Choudhari SG. A Review of Infant and Young Child Feeding Practices and Their Challenges in India. Cureus. 2024 Aug 9;16(8).
3. Scott S, Lahiri A, Sethi V, Menon P, Yadav K, Varghese M, Joe W, Vir S. C, Nguyen P. H. Anaemia in Indians aged 10–19 years: Prevalence, burden and associated factors at national and regional levels. Maternal & Child Nutrition.2022:18(4), e13391.
4. Awasthi S, Kumar D, Singh S, Dixit S, Agarwal G, Mahdi AA. Prevalence of specific micronutrient deficiencies in urban school going children of India aged between 6 and 16 years: study protocol for a multicentre cross-sectional study. BMJ 2021;11: e046783.
5. Balcı YI, Karabulut A, Gürses D, Çövüt IE. Prevalence and risk factors of anaemia among adolescents in Denizli, Turkey. Iranian journal of paediatrics. 2012; 22(1):77.
6. Ahmed A, Mohammed A. Anaemia and its associated factor among adolescent school girls in GODEY and DEGEHABUR council Somali region, eastern Ethiopia. BMC nutrition. 2022;8(1):1-6.
7. Gemechu K, Asmerom H, Gedefaw L, Arkew M, Bete T, Adissu W. Anemia prevalence and associated factors among school-children of Kersa Woreda in eastern Ethiopia: A cross-sectional study. Plos one. 2023 Mar 24;18(3):e0283421.
8. Mahroof MK, Khan SA, Saldanha P. Clinical study of anemia in rural school children of Mangalore, Karnataka, India. Int J Contemp Pediatr. 2019 Mar;6(2):416-21.
9. Siva PM, Sobha A, Manjula VD. Prevalence of Anaemia and Its Associated Risk Factors Among Adolescent Girls of Central Kerala. J Clin Diagn Res.2016; 10(11):LC19-LC23.
10. Mohan CR, Gowda GC, Chandrika BR, Anupama D. Study of Anaemia amongst school going Adolescent girls in rural Tumkur. AGE. 2019; 10(37):4.
11. Kamble BD, Gunjan M, Sumit J, Singh SK, Jha D, Singh S. Prevalence of anaemia among school going adolescent girls attending Test, Treat and Talk (T-3) camp under Anaemia Mukt Bharat in Delhi. J Family Med Prim Care 2021; 10:898-903.
12. Chandrakumari AS, Sinha P, Singaravelu S, Jaikumar S. Prevalence of anaemia among adolescent girls in a rural area of Tamil Nadu, India. jfmpc. 2019; 8(4):1414.
13. Chauhan S, Kumar P, Marbaniang S.P, Srivastava S, Patel R. Prevalence and predictors of anaemia among adolescents in Bihar and Uttar Pradesh, India. Scientific Reports. 2022; 17; 12(1):8197.
14. Mathad V, Badiger S, Manjunath N. Assessment of anaemia and malnutrition among adolescent in Kalyan Karnataka region of Karnataka. Clinical Epidemiology and Global Health. 2023; 1; 21:101307.
15. Krishna Reddy CS, Mohammad Rafi. A study of the various factors associated with non-communicable diseases at field practice area of UHTC of a tertiary health care centre. MIJOCM. 2018; 8(2): 17-20.
16. Varma A, Vagha J, Agrawal A, Meshram R, Damke S, Thakur S. Sociodemographic determinants in prevalence of anaemia in adolescents of rural area of Maharashtra. Journal of Datta Meghe Institute of Medical Sciences University. 2020;15(2):209-14.
17. Kumari R, Bharti RK, Singh K, Sinha A, Kumar S, Saran A, Kumar U. Prevalence of iron deficiency and iron deficiency anaemia in adolescent girls in a tertiary care hospital. Journal of clinical and diagnostic research. 2017;11(8).BC04.
18. Gupta A, Sachdev HS, Kapil U, Prakash S, Pandey RM, Sati HC, Sharma LK, Lal PR. Characterisation of anaemia amongst school going adolescent girls in rural Haryana, India. Public Health Nutrition. 2022; 25(12):3499-508.
19. Yerpude PN, Jogdand KS. A cross-sectional study of socio-demographic determinants of anaemia in adolescent boys of urban slum area in south India. International Journal of Medical Research and Health Sciences. 2013;2(3):463-8.
20. Soman SK, Areekal B, Murali AJ, Varghese RG. Adolescent anaemia its prevalence and determinants: a cross-sectional study from south Kerala, India. International journal of Community Medicine and public health. 2017; 4(8):2750-6.
21. Goyal N, Rawat CM. A study of anaemia and its correlates among adolescent girls in schools of Haldwani, India. International Journal of Research in Medical Sciences. 2018; 6(10):3320-6.
22. Shaban L, Al-Taiar A, Rahman A, Al-Sabah R, Mojiminiyi O. Anaemia and its associated factors among adolescents in Kuwait. Scientific reports. 2020; 10(1):5857.
23. Hamal S, Dhungana GP, Shrestha P, KC N. Prevalence of anaemia and its associated factors among school adolescent girls in Baglung municipality, Nepal. Global Journal of Medicine & Public Health. 2018;7(5):1-8.
24. Anandi C. Yoganandh. Prevalence and factors influencing anaemia among adolescent females in rural area of South India. Indian J Basic Appl Med Res. 2017; 6(3):258-65.
25. Abhishek MG, Deepika, Evaluation of the Prevalence of Anaemia in High School Going Adolescent Females in a Rural Area of South India, Indian Journal of Pathology and Oncology.2015;2(3);113-117.
26. Yusufu, I., Cliffer, I.R., Yussuf, M.H. et al. Factors associated with anaemia among school-going adolescents aged 10–17 years in Zanzibar, Tanzania: a cross sectional study. BMC Public Health **23**, 1814 (2023)