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PREVALENCE OF ANEMIA IN SCHOOL GOING CHILDREN OF RURAL AND URBAN AREAS OF DISTRICT SHEIKHUPURA

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Abstract

Anemia is a disorder in which the blood haemoglobin concentration falls below the normal level. It results from significant blood loss, parasite infections and a lack of one or more important nutrients. The objective of this study was to determine the prevalence of anemia among school-going children in rural and urban areas of District Sheikhupura. Iron deficiency accounts for about half of all anemia cases with multifactorial infections and nutritional inadequacies serving as additional causes. Random sampling was used to access the incidence of anemia in school children of both rural and urban areas. Children aged 5 and 20 years living in rural and urban areas of District Sheikhupura were targeted. The overall prevalence of anemia was 40% among school-going children. Area wise prevalence showed that anemia was more prevalent in rural areas (46%) than in urban areas (34%). In rural areas, anemia prevalence was 48.3% in girls and 37.5% in boys. Mild anemia was the most common category in both rural (26%) and urban (27%) areas. Serum iron was below the normal level in 32% of rural children and 26% of urban children. Serum ferritin measured by ELISA, was below the normal level in 28% of rural children and 22% of urban children. Statistically significant differences between rural and urban children were observed for haemoglobin ($p=0.031$), serum ferritin ($p=0.046$) and MCH ($p=0.021$). Anemia remains a public health concern among school-going children in District Sheikhupura, particularly in rural areas and warrants targeted nutritional interventions.

2. INTRODUCTION

The general name given to the essential vitamins and minerals that need to be obtained through food to maintain almost every normal cellular and molecular function is micronutrient. While the required amounts of micronutrients are very small, micronutrient deficiency (MND) can have wide-range negative health impacts that will ultimately result in death if untreated. MNDs are very prevalent and about 2 billion people are

thought to be affected by some type of MND worldwide. The most common deficiencies exist for vitamin A, folate, iron, iodine, and zinc; however, several other MND disorders exist.[1]

Iron deficiency anemia also increases risk of mortality and morbidity from infectious disease. The devastating implication of still anemia is a public health problem among children under five in Africa.[2] In Ethiopia, like the other countries of Africa, burden of anemia also has a public health importance among children.[3] However, few data are available that demonstrate the burden of anemia and its risk factor among young children under two years of age. Therefore, this study was aimed to assess prevalence of anemia and its associated factors among children.

Primary health care (PHC) facilities in China are responsible for anemia screening for children living in the residence at least once a year. Although it was implemented for several years, data on anemia among children from PHC facilities are scarce. In poor regions of China the government distributes nutrient sachets to help children with anemia, 6 to 23 months of age; this has helped reduce the high prevalence of anemia in children in western China. But only a few studies have focused on the prevalence of anaemia or the impact of the nutrient sachet program on anaemia in children in Huaihua.[4]

Iron deficiency is the most important nutritional risk factor in, accounting for over 3% of all disability-adjusted life years (DALYs) lost, according to WHO. In this study, we estimated the social costs of iron deficiency anemia (IDA) in children aged 6–59 months in terms of intangible costs and production losses.[5] According to a study, anaemic children made up 27.8% of the population in rural areas and 15.3% of the population in urban areas.[6] Mostly at the age of five, children are admitted to Pakistani schools. Children at that age are under more stress and require more nutrients. In Pakistan's Dera Ismail Khan, school-age students were studied, and it was discovered that male anaemia peaked at age 6 is (58.8%) and female anaemia peaked at age 6 is (100%).[7]

Over 1.62 billion people worldwide suffer from anaemia, according to the World Health Organization's 2008 global database report. Poor academic performance and cognitive impairment are two harmful effects of anaemia on school-aged children's health. The World Health Organization (WHO) estimates that 1.9 billion people worldwide are anaemic, with the prevalence of anaemia among children being the highest (42.6 percent).[8]

Some children will also have acute life-threatening clinical events such as palpitation, tachypnea, low blood pressure, dyspnoea, and congestive heart failure (CHF) in addition to the known long term consequences of ID anemia (IDA).[9] If any of these findings is present, they will require admission to the paediatric inpatient units. Naturally, there is equilibrium between gaining and consuming iron and ID occur when this equilibrium becomes negative. Children slowly use up their stores of iron, especially with increased iron requirements and poor dietary sources of iron. If these patients are treated with suitable iron supplement at this stage, no anemia would occur.

Insufficient consumption of iron, increase Requirements due to growth and development, iinsufficient iron absorption and blood Loss could lead to iron deficiency. Iron deficiency is a prevalent cause of anaemia, which is defined as a low haemoglobin concentration in the blood. A leading deficiency condition in the world, adolescent anaemia is associated with functional abnormalities of neutrophils and lymphocytes and is a major cause of infant mortality. When combined with other measures of iron status, anaemia is a sign of both inadequate nutrition and poor health, and the haemoglobin concentration can reveal how severe an iron shortage is.[10]

There are many distinct varieties of anaemia, and based on the type, symptoms can range from moderate to severe. It includes aplastic anemia, hypochronic anemia, megaloblastic anemia, microlytic anemia, and perniciuos anemia. Sickle cell anemia (SCA) has been known for generations, but it was not described in the

western literature until November 1910 when Herrick reported a case of anemia with "peculiar elongated and sickle-shaped red blood corpuscles" when he examined a dental student from Grenada.[11] SCA is later proclaimed to be the first "molecular disease" when Pauling tells that it is based upon the presence of an abnormal haemoglobin, haemoglobin S (HbS); it is found to be due to a single amino acid substitution (glutamic acid changed to valine) at position 6 of the β-globin chain of haemoglobin.[12]

3.Materials and Methods:

3.1 Study area and Population:

The study was conducted in District Sheikhupura in this cross-sectional study, children between the age of 5 to 20 years were included.

3.2 Study design:

This study was conducted during December 2021 to March 2022 in the rural and urban areas of District Sheikhupura. The schools were selected along with proportional probability to size to increase the accuracy in the sample design.

3.3 Data collection:

Data of 200 children including males and females from rural and urban areas was collected on prescribed format (Annexure-I), after acquiring institutional ethical review committee clearance and obtaining the parents' consent (Rafiq *et al.*, 2021). By applying the World Health Organization (WHO) threshold values, the anaemia status was assessed. The non-anaemic value of children is above 11 g/dL on the base of severity anemia is divided into the three groups, mild (9.0 to 10.9 g/dL), moderate (7.0 to 8.9 g/dL) and severe anemia (< 7.0 g/dL).

Different schools were visited on scheduled date. All of the children were informed the significance of the study and were urged to take part. Children were selected using systematic random sampling. Two groups were made to check the presence and absence of anemia.

Group I (anaemic): In this group children who had abnormal level of HB were included that is below 11 g/dl.

Group II (Non-anaemic): In this group child who had normal level of HB were included that is above 11 g/dl.

3.4 Distribution of study Groups:

Different study groups were categorized in this research showed in figure 3.1. On the basis of age, gender, diet, social economic level, severity of anemia, area and education level.

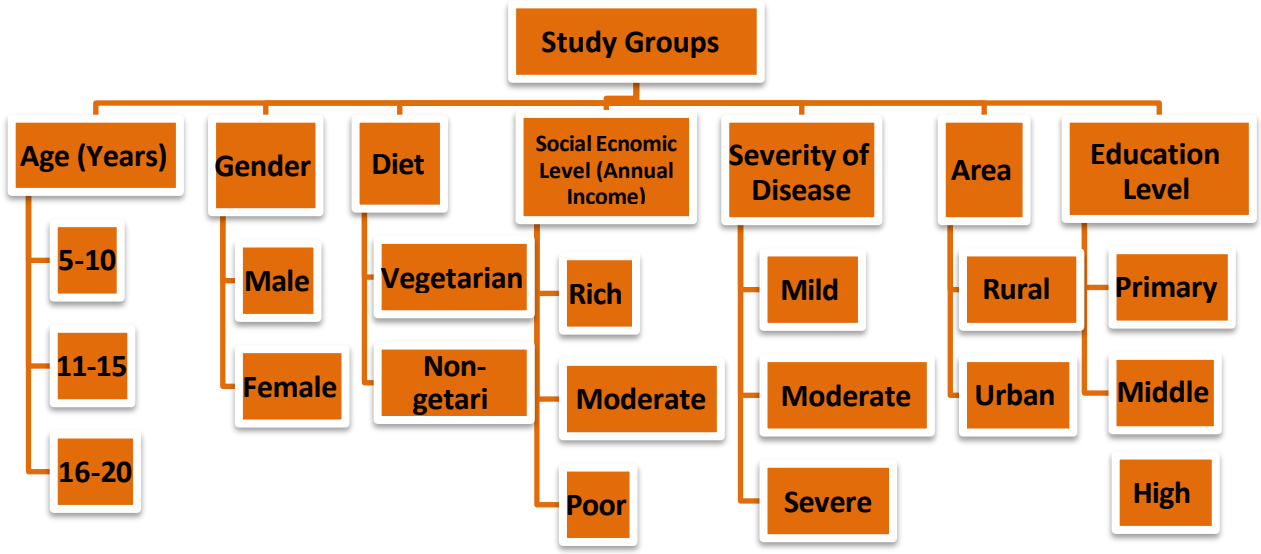


Figure 3.1: Distribution of study groups

3.5 Blood Sampling:

The participants who met the requirements for participation were chosen for blood sampling. Diamine tetra acetic acid (EDTA) vials were used for complete blood count test and chemistry vials were used from iron and ferritin estimation. The patient's ID was written on each vial labels. With the assistance of a medical technician 5ml of blood were drained from the median vein of each child. 3ml of blood were kept in diamine tetra acetic acid (EDTA) vials and 2ml of blood were kept in chemistry vials the samples of blood stored in (EDTA) vials were store in the ice box for further lab estimation and remaining 2ml of blood was kept in chemistry vials for the purpose of clotting at room temperature.



Figure 3.2: Blood sample collection

3.6 Complete blood count test:

After the storage of sample in an icebox (EDTA) vials were transferred to the laboratory for the further estimation. On an automatic haematology analyzer each sample was analysed for haemoglobin (Hb), haematocrit (HCT), red blood cell count (RBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), and mean corpuscular haemoglobin concentrations (MCHC).

3.7 Serum separation:

The serum was separated via the process of centrifugation to check the quantification of serum ferritin by using an automatic immunoassay analyzer and iron level were measured using chemistry analyzer. Blood was stored in vials for serum separation the clot of blood is developed after the removal of clot by centrifuging at 1000-2000 x g for 10 minutes in a refrigerated centrifuge. The resulted supernatant was a designated serum. After the process of centrifugation the resulted liquid component (serum) was immediately transfer to a tube using a pipette and was stored at – 20 ˚C and transported to the lab for further estimation of iron using chemistry analyzer and ferritin using ALISA technology.

4. Results:

Anemia is a disorder in which the blood haemoglobin concentration is lower than normal. It results from significant blood loss and parasite infections and causes a lack of one or more important nutrients. This research aims to determine the frequency of anaemia among school-age children in both rural and urban areas.

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4.1. Prevalence of anemia in rural and urban areas:

Prevalence of anemia was calculated in rural and urban areas were observed that in the rural areas 46% of the children were anaemic (Table 4.1, Figure 4.1) while in the urban areas 34% of the children were anaemic (Table 4.1, Figure 4.2).

Table 4.1 Prevalence of anemia in rural and urban areas

No. of selected children from rural area	Anemic children	Non-anemic children
100	46	54
Total no of children in urban area	**Anemic children**	**Non-Anemic children**
100	34	66

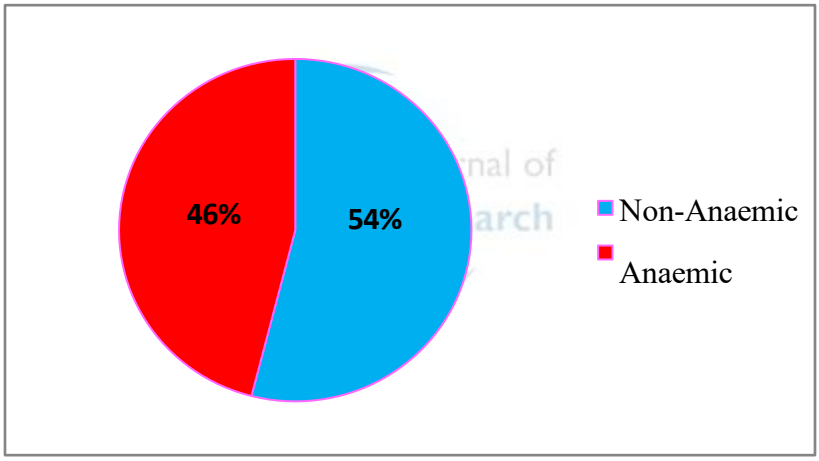


Figure 4.1: Prevalence of anemia in rural areas

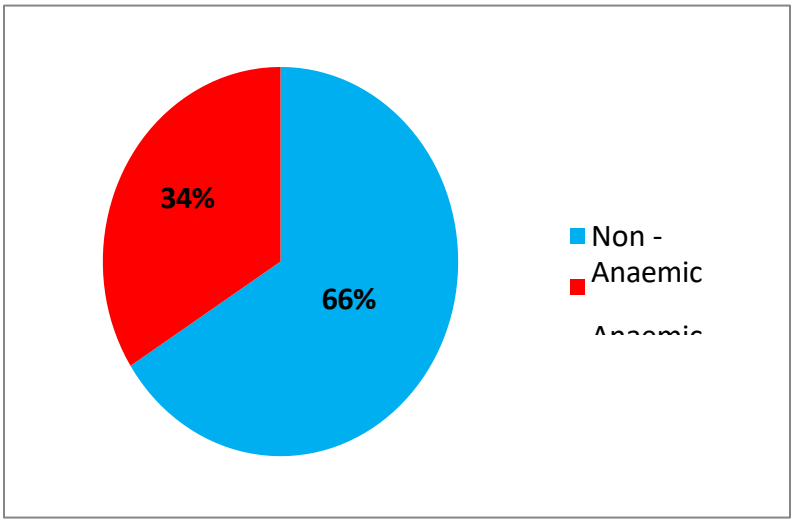


Figure 4.2: Prevalence of anemia in urban areas

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4.2. Comparison of anemia in rural and urban areas:

Comparison of anemia in rural and urban areas showed that rural area had higher anaemic percentage 46% as compared to urban area that was 34% (Table 4.2).

Table 4.2 Comparison of anemia in rural and urban areas

Anemic Status	Rural	Urban
Non-Anemic	54	66
Anemic	46	34

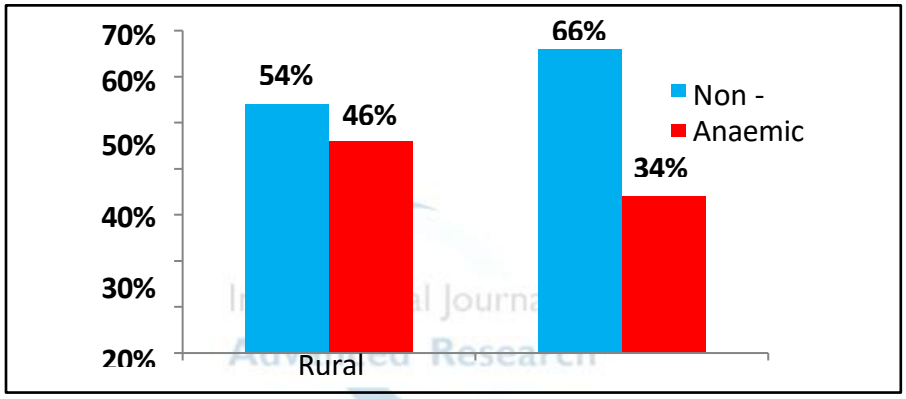


Figure 4.3 Comparison of anemia in rural and urban areas

4.3. Age wise prevalence of anemia in rural and urban areas:

The overall prevalence in rural areas among the age groups of 05–10 years, 11–15 years, and 16–20 years was found to be 51%, 43%, and 42%, respectively. Numbers of anaemic and non-anaemic children have shown in table 4.3 and figure 4.4 while in urban areas it was observed that the percentage of prevalence of urban areas in age groups of 05-10 years, 11-15 years, and 16-20 years was 50%, 25%, and 17%, respectively and it was mentioned in table 4.3 and figure 4.5.

Table 4.3 Age wise prevalence of anemia in rural and urban areas

Rural Areas			
Age Group (Years)	**Total children**	**Anemic**	**Non-Anemic**
5 to 10	39	20	19
11 to 15	49	21	28
16 to 20	12	5	7
Urban Areas			
Age Group (Years)	**Total children**	**Anemic**	**Non-Anemic**
5 to 10	40	20	20
11 to 15	48	12	36
16 to 20	12	2	10

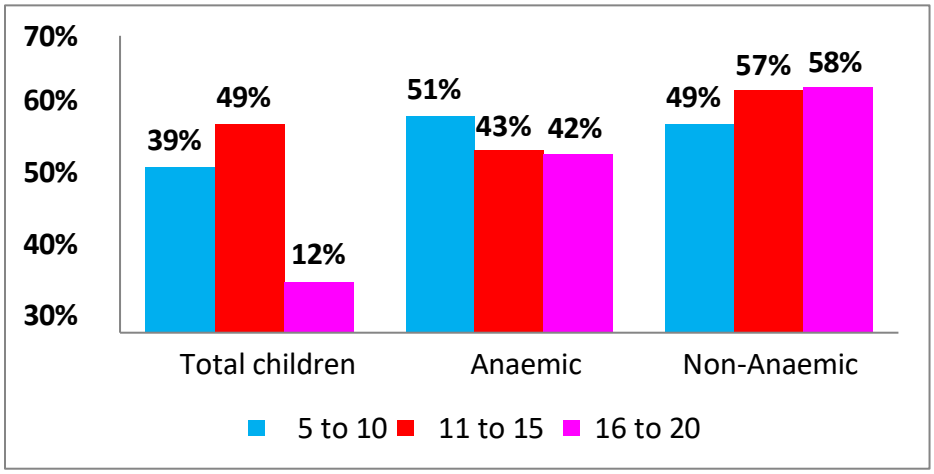


Figure 4.4 Age wise prevalence of anemia in rural areas

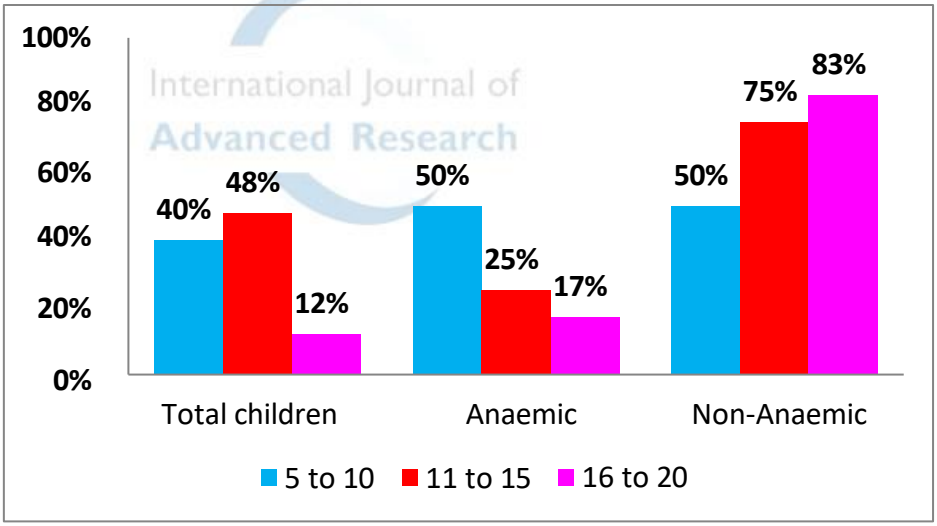


Figure 4.5 Age wise prevalence of anaemic in urban areas

4.4. Gender wise prevalence of anemia in rural and urban areas:

Gender wise prevalence of rural areas was calculated which represented that 27% of males and 33% females were anaemic as mentioned in table 4.4 and figure 4.6 while in urban areas gender wise prevalence was calculated which represented that 27% of males and 20% females were anemic as shown in table 4.4 and figure 4.7.

Table 4.4 Gender wise prevalence of anemia in rural and urban areas

Rural areas			
Gender	**Total children**	**Anemic children**	**Non-anemic children**
Male	40	15	25

Female	60	31	29
Urban areas			
Gender	Total children	Anemic children	Non-anemic children
Male	40	15	25
Female	60	19	41

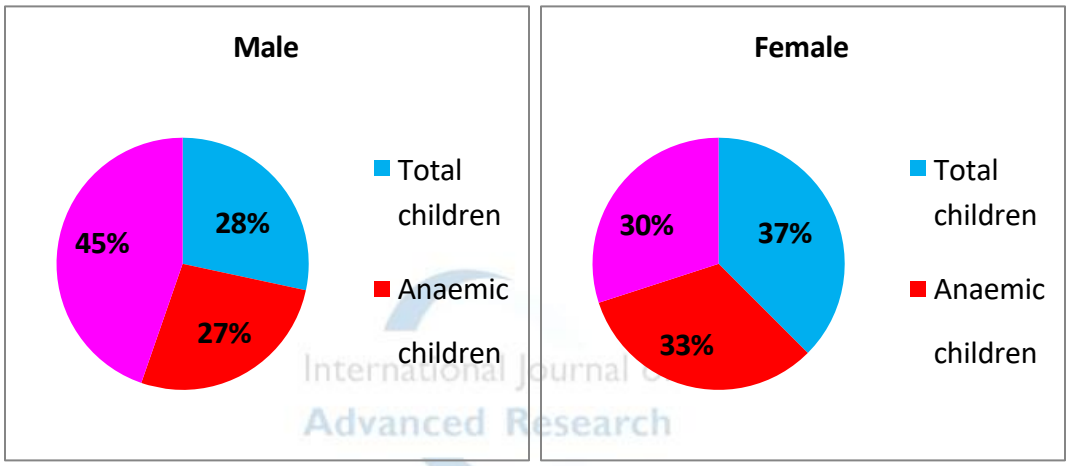


Figure 4.6 Gender wise prevalence of anemia in rural areas

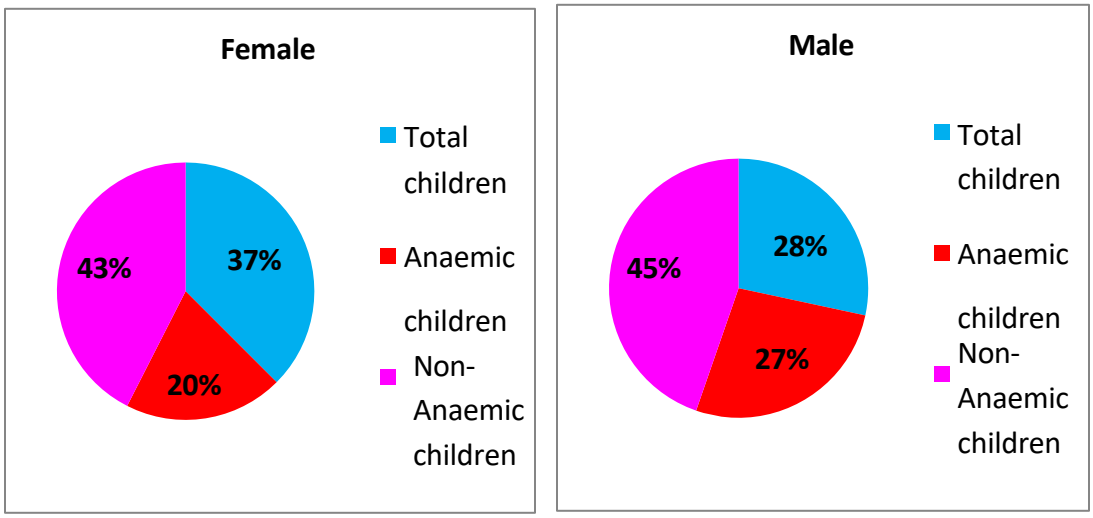


Figure 4.7 Gender wise prevalence of anemia in urban areas

4.5. Prevalence of anemia based on severity in rural and urban areas:

Severity of anemia was distributed in four stages severe, moderate, mild and normal. Cases of anemia in rural areas were 6%, 6%, 33%, and 52% respectively. Cases of severe and moderate anemia were equal although mild anemia cases were high in rural areas. Table 4.5 showed the numbers of children anaemic while figure 4.8 showed the percentage of anemia. Cases of anemia stages in urban areas were 3%, 4%, 27%, and 66% respectively. Cases of severe and

moderate anemia were close to each other although mild anemia cases were high in urban areas also just like results were in rural areas. Table 4.5 showed the numbers of children anaemic while figure 4.9 showed the percentage of anemia.

Table 4.5 Prevalence of anemia based on severity in rural and urban areas

Severity of anemia	Rural	Severity of anemia	Urban
Severe	6	Severe	3
Moderate	6	Moderate	4
Mild	36	Mild	27
Normal	52	Normal	66

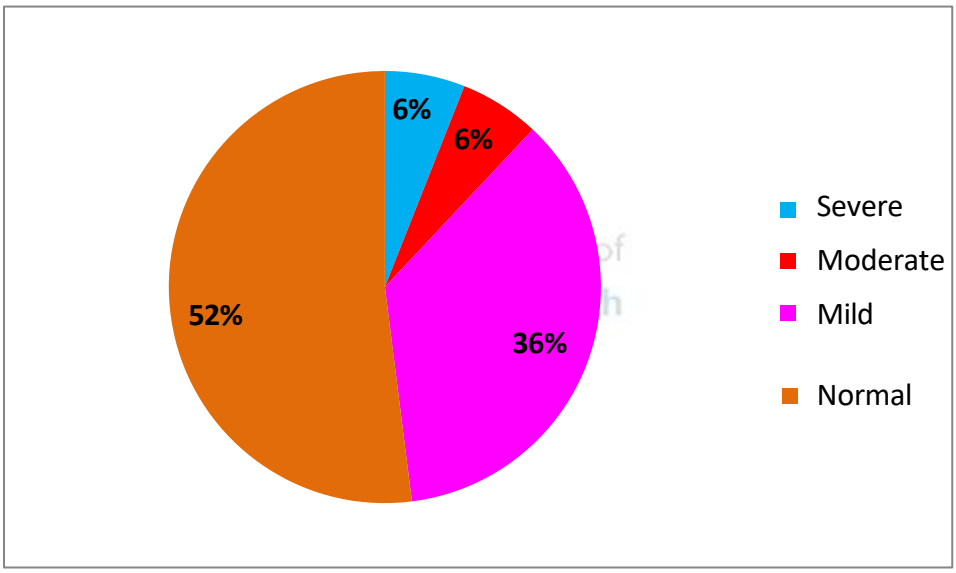


Figure 4.8 severity of anemia in rural areas

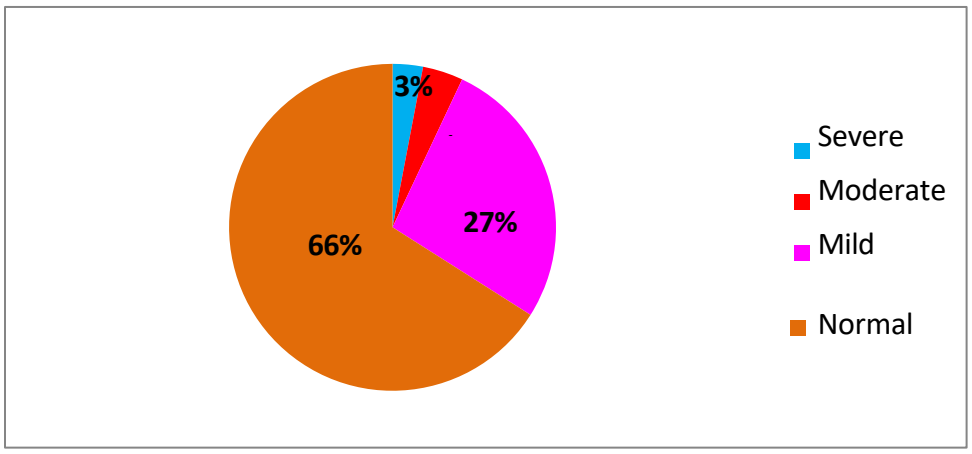


Figure 4.9 Severity of anemia in urban areas

4.6. Study of anemia based on socio economic and education level in rural areas:

Based on their socioeconomic status, 100 students from rural areas were chosen. Three different groups of students were chosen. Depending on their socioeconomic standing, people have rich incomes, average incomes, and poor incomes. Out of 100 children in rural areas having rich, average and poor income had 44%, 47% and 46% of anemia respectively. On the other hand based on education level 100 students from rural areas were chosen and they are also categorized into three level of education as primary, middle and high class students. So out of 100 children in rural areas having primary, middle and high school education anaemic status were 57%, 40% and 45% respectively. Table 4.6 and figure 4.10 showed the socio economic results.

Table 4.6 Study of anemia based on socio economic and education level in rural areas

Risk factors	Category	Total children	Anemic	Non-Anemic
Economic status	Rich	18	8	10
	Average	58	27	31
	Poor	24	11	13
Education level	Primary	28	16	12
	Middle	50	20	30
	High	22	10	12

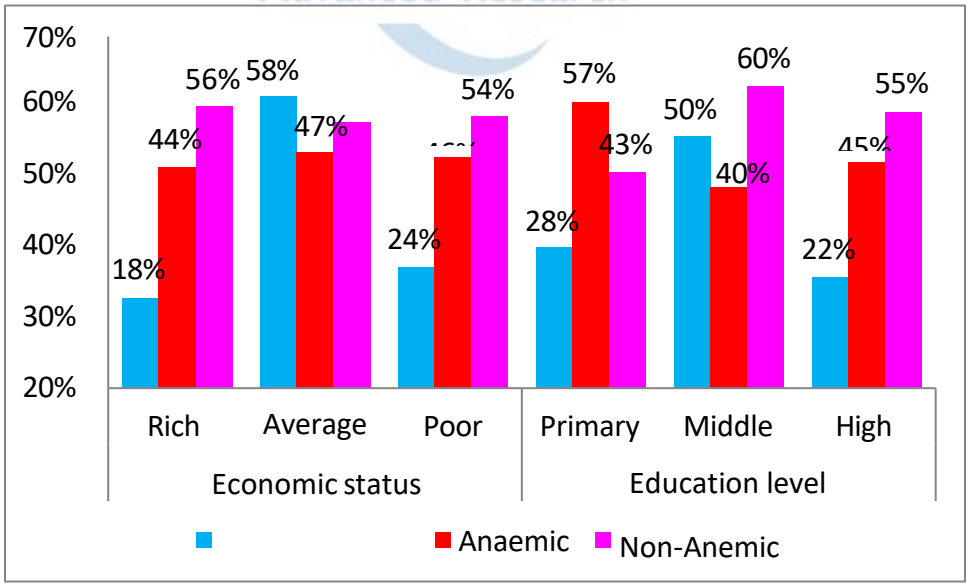


Figure 4.10 Study of anemia based on socio economic and education level in rural areas

4.7. Study of anemia based on socio economic and education level in urban areas:

Based on their socioeconomic status, 100 students from urban areas were chosen. Three different groups of students were chosen. Depending on their socioeconomic standing, people have rich incomes, average incomes, and poor incomes. Out of 100 children in urban areas having rich, average and poor income had 47%, 30% and 37.5% of anaemic children respectively. On the other hand based on education level 100 students from urban areas were chosen and they are also categorized into three level of education as primary, middle and high class students. So

out of 100 children in urban areas having primary, middle and high school education anemic status were 63%, 21% and 23% respectively. Table 4.7 and figure 4.11 showed the socio economic and education based results of anaemic children.

Table 4.7 Study of anemia based on socio economic and education level in urban areas

Risk factors	Category	Total children	Anemic	Non-Anemic
Economic status	Rich	19	9	10
	Average	73	22	51
	Poor	8	3	5
Education level	Primary	30	19	11
	Middle	48	10	38
	High	22	5	17

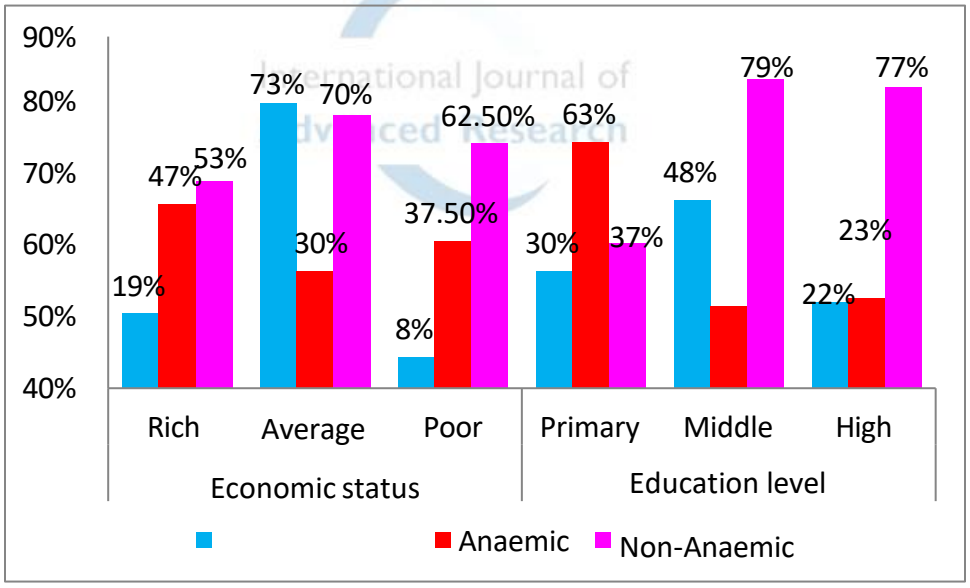


Figure 4.11 Study of anemia based on socio economic and education level in urban areas

4.8. Prevalence of anemia based on diet in rural and urban areas:

Table 4.8 and Figure 4.12 indicate the prevalence of anemia dependent on dietary conditions. Effects of diet were seen in relation with anemia. Children were distributed in two categories as vegetarian and non-vegetarian. 57% of children using vegetarian diet were anaemic and 43% children using non-vegetarian diet were anaemic. Table 4.8 and Figure 4.13 indicate the prevalence of anemia in urban areas dependent on dietary conditions. Effects of diet were seen in relation with anemia. Children were distributed in two categories as vegetarian and non-vegetarian. 26% of children that used vegetarian food was anaemic as compared to non-vegetarian 38% of children were anaemic.

Table 4.8 Prevalence of anemia based on diet in rural and urban areas

Rural areas			
Diet	Total children	Anemic	Non-Anemic
Vegetarian	57	32	25
Non-Vegetarian	43	14	29
Urban areas			
Vegetarian	35	9	26
Non-Vegetarian	65	25	40

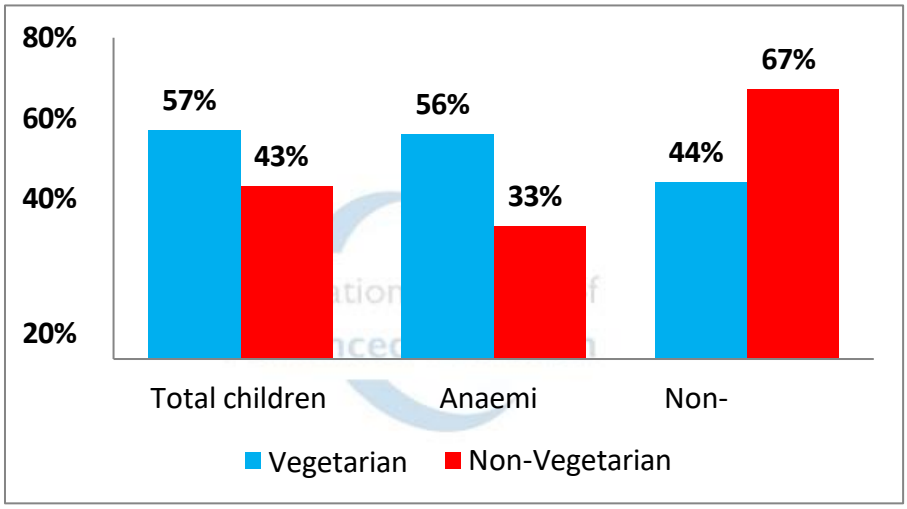


Figure 4.12 Prevalence of Anemia based on Diet in rural areas

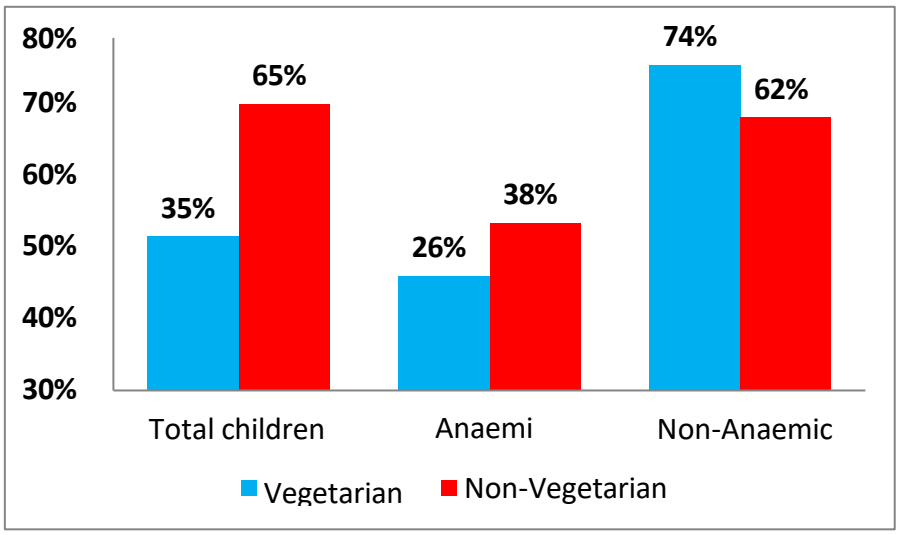


Figure 4.13 Prevalence of Anemia based on diet in urban areas

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4.9. Study of ferritin in rural and urban areas:

Level of ferritin was observed in rural areas the normal level of ferritin was 20-350 ng/ml. It was seen that out of 100 rural children 28% of children were abnormal value of ferritin and 72% of children were in normal range. Table 4.9 and figure 4.14 showed the results of ferritin in rural areas while in urban areas the normal level of ferritin was 20-350 ng/ml. It was seen that out of 100 rural children 22% of children were abnormal value of ferritin and 78% of children were in normal range. Table 4.9 and figure 4.15 showed the results of ferritin in urban areas.

Table 4.9 Study of ferritin in rural and urban areas

Rural areas			
Indicators (ng/ml)	**Area**	**Children below normal level of ferritin**	**Children with normal value of ferritin**
Ferritin	Rural	28	72
Urban areas			
Ferritin	Urban	22%	78%

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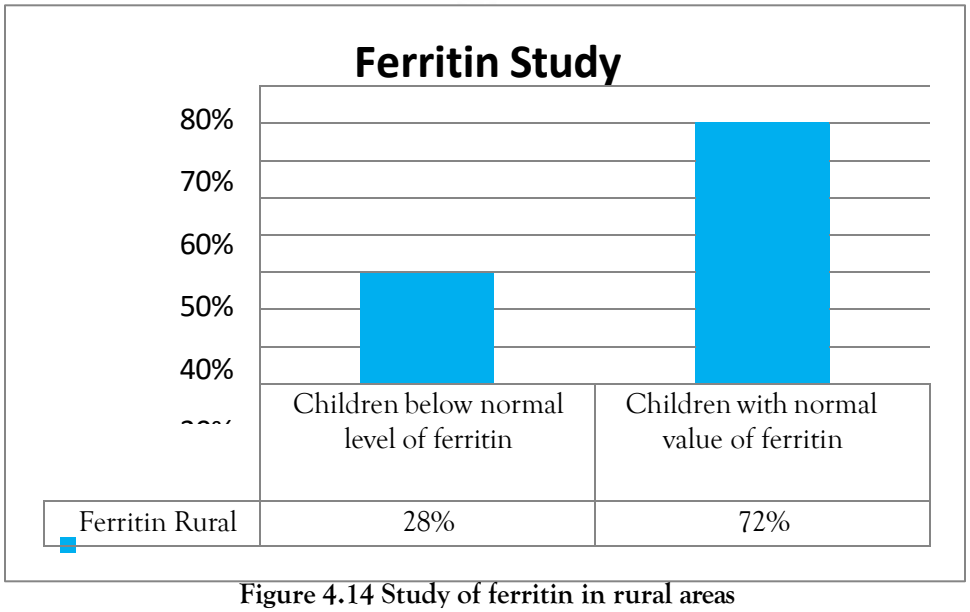


Figure 4.14 Study of ferritin in rural areas

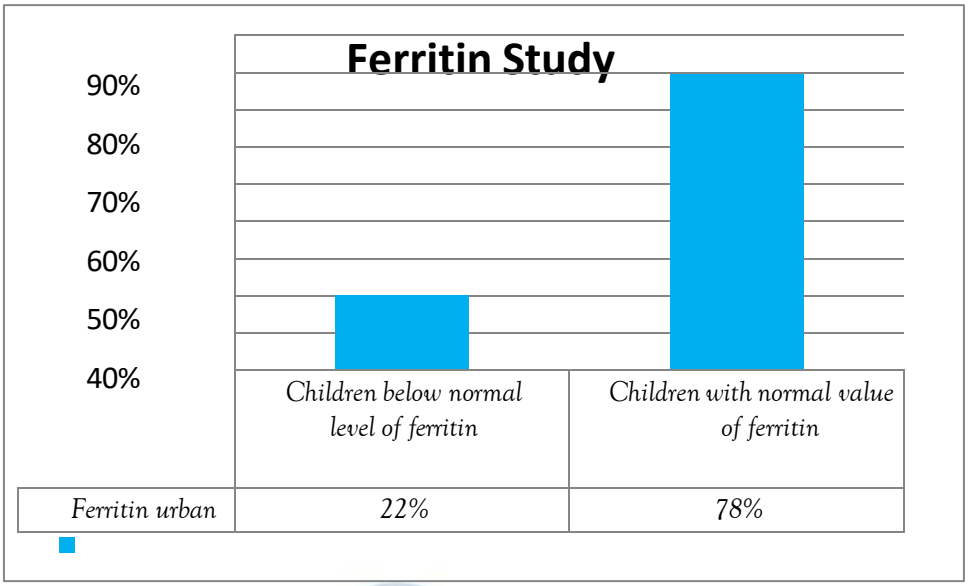


Figure 4.15 Study of ferritin in urban areas

4.10. Study of iron in rural and urban areas:
The body contains iron, which is used to make haemoglobin and myoglobin, as well as stored in ferritin and transported in plasma while bound to transferrin. In hemochromatosis and liver damage, iron levels are higher. Reduced iron levels brought on by poor absorption as a result of gastrointestinal conditions might result in anaemia. Anaemia can also result from blood loss caused by gastrointestinal diseases or severe menstrual bleeding.

The normal level of iron was 22-135 ug/dl. Iron level in 32% of rural children was below the normal level (22 ug/dl) while 68% of children were in normal range of iron level. Table 4.10 and figure 4.16 showed the results of iron. Iron level in 26% of urban children was below the normal value, while 74% of children were in normal range of iron level. Table 4.10 and figure 4.17 showed the results of iron.

Table 4.10 Study of iron in rural and urban areas

Rural area			
Indicators (ug/dl)	**Area**	**Children below normal level of iron**	**Children with normal value of iron**
Iron	Rural	32	68
Urban areas			
Indicators (ug/dl)	**Area**	**Children below normal level of iron**	**Children with normal value of iron**

Iron	Urban	26	74

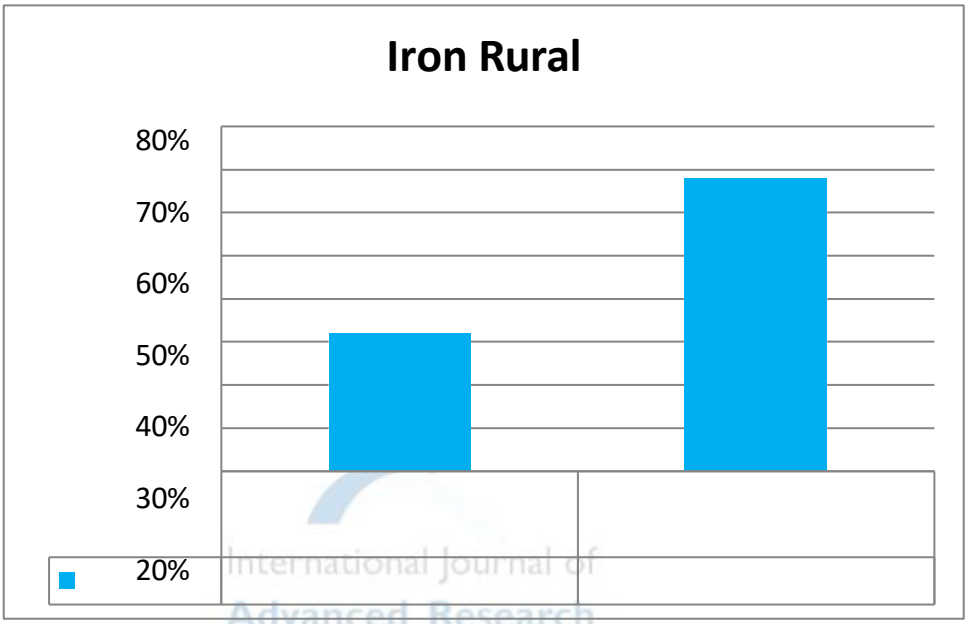


Figure 4.16 study of iron in rural areas

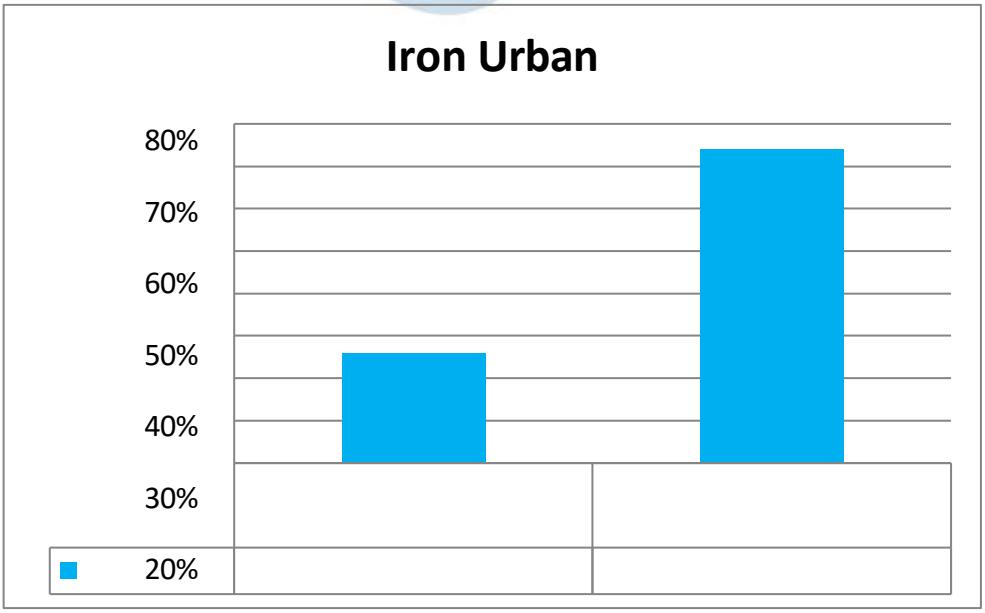


Figure 4.17 study of iron in urban areas

4.11. Difference in blood picture of students residing in rural and urban areas:

All the study parameters were discussed in table 4.11 in rural and urban areas. The results shown that out of nine research parameters three parameters of research were statistically significant. (Haemoglobin = 0.031, serum ferritin = 0.046 and MCH

= 0.021). All other parameters were not statistically significant.

Table 4.11 Difference in blood picture of students residing in rural and urban areas

Parameters	Area	Mean ± SE	T	p Value
HB	Rural	11.14 ± 0.20	2.171	0.031
	Urban	11.70 ± 0.17		
Serum Iron	Rural	44.97 ± 3.49	1.714	0.088
	Urban	53.45 ± 3.50	1.714	0.088
Serum Ferritin	Rural	1.49 ± 0.50	2.004	0.046
	Urban	1.63 ± 0.49	2.004	0.046
RBC	Rural	1.97 ± 0.02	0.41	0.682
	Urban	1.98 ± 0.03	0.41	0.683
HCT	Rural	1.37 ± 0.05	1.358	0.176
	Urban	1.28 ± 0.05	1.358	0.176
MCV	Rural	1.40 ± 0.05	0.571	0.569
	Urban	1.44 ± 0.05	0.571	0.569
MCH	Rural	1.77 ± 0.04	2.323	0.021
	Urban	1.62 ± 0.05	2.323	0.021
MCHC	Rural	1.80 ± 0.04	1.127	0.261
	Urban	1.86 ± 0.04	1.127	0.261
Age	Rural	11.70 ± 0.32	0.198	0.843
	Urban	11.61 ± 0.33	0.198	0.843

4.12. Qualitative parameters:

Different parameters which were particularly about the qualitative data of children were discussed in table 4.19 in which only socio-economic level of children were statistically significant (socio economic level = 0.008).

Table 4.12 Qualitative parameters

Parameters	Anemic Status	Area		Mean	P value
		Rural	Urban		
Severity	Severe	6	3	4.347	0.226
	Moderate	6	4		
	Mild	36	27		
	Normal	52	66		
Economic Level	High	18	19	9.745	0.008
	average	58	73		

	Low	24	8		
Education Level	Primary	28	30	0.11	0.947
	Middle	50	48		
	High	22	22		

4.13. Qualitative parameters:
In the table 4.20 anemic status and diet was statistically significant and their p- value was 0.056 and 0.001 respectively.

Table 4.13 Qualitative parameters

Parameters	Anemic Status	Area		O. R	Confidence Interval		Mean	P value
		Rural	Urban		Lower	upper		
Anemia	Yes	54	66	1.294	0.957	1.75	3	0.056
	No	46	34					
Diet	Vegetarian	57	35	0.632	0.467	0.855	9.742	0.001
	Non Vegetarian	43	65					
Gender	Female	60	60	1	0.754	1.327	0	0.557
	Male	40	40					

5. Discussion:
Anemia is common all over the world and there are around one billion iron deficient people in the world. Studies on the prevalence of anaemia among school-age children in Pakistan's rural and urban areas are rare. In this research, prevalence of anemia was 40% of the overall population including urban and rural areas. The goal of the current study was to determine the prevalence of anaemia in rural and areas of Sheikhupura. In current study, 200 children between the ages of 5 to 20 years were participated.
In current study, the overall prevalence of anaemia was 46% in rural areas and 34% in urban areas. Jamali in a study examined the prevalence of anaemia as 59.7% in rural regions and 40.3% in urban regions.[13] Therefore, it is concluded that both studies have more anaemic population in rural areas and less anaemic population in urban areas respectively. Prayag conducted a study and found that anemia was more common among rural children than urban children in the age groups of 5 to 10 years rural children shown 19% prevalence and urban shown 23.7%), children between the age group of 11 to 15 years in rural areas shown 30.2% and urban shown 28.5%) and in last age group of study from 16 to 20 years rural children had a prevalence of 17.2% whereas urban children had a prevalence of 13.7%.[14] As mentioned in figure 4.4 and figure 4.5 in this research anemia prevalence in the age groups of 5 to 10 years was 51% in rural area and 50% in urban area. children between the age of 11 to 15 years in rural areas were 43% and in urban areas 25%. and in the age group of 16 to 20 years children in rural areas had a 42% prevalence of anemia whereas urban children had 17% anemia prevalence. It was observed that age group 5 to 10 years in both areas population were more affected from anemia and overall rural areas were more anaemic prevalence due to less iron intake.

The gender wise prevalence of anemia in rural areas in females was 33% and in males was 27%. The anemia prevalence in urban females was 20% and in males it was 27%. Clermont conducted a study that illustrates the prevalence of anemia in females was 60.33% and in males it was 39.67 %. The difference between the both studies was due to the difference between the numbers of individuals.[15]

In current study, the prevalence of severe, moderate, and mild anaemia was 6%, 6%, and 36% in rural areas, and 3%, 4%, and 27% in urban areas respectively. (Figure 4.8 and 4.9). According to economic status, the prevalence of anaemia was split into three groups: rich, average and poor. Rural areas had a proportion of 44%, 47%, and 46% urban areas had a percentage of 47%, 30%, and 37.5%. The majority of children skipped meals or ate meals with little protein. A study done by Al-kassab found 20.73%, 3.71%, and 1.00% respectively in rural areas. In urban areas results was 25.45%, 25.57 and 22.72 respectively.[16] The study results were more or less similar to each other. At various educational levels, anaemic prevalence was also seen. It was observed that primary, middle and high class's anemia rates were (57%, 40% and 45%) in rural areas respectively and 63%, 21% and 23% in urban areas. A study conducted in primary, middle, and high schools there were 47.07%, 43.81% and 9.08% in rural areas respectively. While in urban areas the prevalence was 10.26%, 45.83%, and 43.91% respectively. (Figure 4.10 and 4.11).

Anemia based on dietary intake. In rural areas 56% of students were anaemic which eat vegetarian meal every day and 33% anaemic cases were found in those who take non-vegetarian food. In urban areas 26% of students were anaemic which use vegetarian meal every day and 38% anaemic cases were found in those who take non- vegetarian food. As a result, anemia was more common in rural students than in urban students. Ferritin levels were also found low in both urban and rural children. It was observed that 28% children in rural areas and 22% in urban areas both have low ferritin from normal level. The mean and standard error was 1.49 ± 0.50 in rural areas and 1.63 ± 0.49 in urban areas. Both rural and urban students had low iron levels. In rural areas 32% of children were found to have low ferritin levels and in urban areas 26% of children have low level of ferritin. The mean and standard error was 44.97 ± 3.49 in rural areas and 53.45 ± 3.50 in urban areas.

Chauhan conducted a study shown ferritin level 25.95 ± 19.70 and iron level 73.38 ± 32.69. [17] By looking the table 4.20 in which diet parameters have significantly different in rural areas because people use to take mostly vegetarian diet. And ferritin on the other hand was also statistically significant shown in table 4.18 so it was concluded that in rural areas people take vegetarian diet (protein less diet) so that's why there was low ferritin level in rural areas.

As a result, the findings of the current study, which have been discussed above, showed that anaemia was highly prevalent in the group of teenagers. This study emphasis the significance of implementing intervention programs to improve the haemoglobin levels in adolescent girls. These programs should focus on prophylaxis treatment, dietary modifications, and controlling helminthic infections. It emphasizes the significance of including adolescents in the at-risk group and addressing their iron status to improve overall health. The effectiveness of the programmes may be improved by proper monitoring. The goal would be accomplished by giving teachers refresher training on WIFS (Weekly Iron Folic Acid Supplementation).

Future research on developing a more effective, feasible peripheral screening method for mild anaemia might benefit the cause. Instead, then treating severe types of anaemia, which would have already affected the child's immune response system, physical growth, and cognitive development, prevention during the milder kinds of anaemia is a more realistic approach. This study has some limitations. The cross-sectional, single-district design limits causal inference. The sample size (n=200) restricted subgroup analyses, particularly for severe anemia and small socioeconomic categories (e.g., urban poor, n=8).

Dietary intake was recorded only as vegetarian versus non-vegetarian, without quantitative assessment of iron, folate or vitamin B12. Children absent on the day of dat collection or without rental consent were excluded, which may introduce selection bias. Finally risk factors were examined individually.

6. Conclusion:

It has been concluded that, compared to their urban counterparts, school children in rural areas had a higher frequency of anemia. In rural regions, girls were more likely to have anemia. In our study, both urban and rural areas belong to communities with serious public health problem (prevalence 40%). In both male and female residents of urban and rural areas, mild anemia was more common than moderate or severe anemia.

Conflict of Interest

The authors declare no conflict of interest.

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REFERENCES

1. English, k., et al., *scoping review of micronutrient imbalances, clinical manifestations, and interventions.* World journal of methodology, 2025. **15**(4): p. 107664.
2. Liu, y., et al., *global burden of anemia and cause among children under five years 1990–2019: findings from the global burden of disease study 2019.* Frontiers in nutrition, 2024. **11**: p. 1474664.
3. Azmeraw, m., et al., *prevalence of anemia and its associated factors among children aged 6–23 months, in ethiopia: a systematic review and meta analysis.* Bmc public health, 2023. **23**(1): p. 2398.
4. Li, h., et al., *anemia prevalence, severity and associated factors among children aged 6–71 months in rural hunan province, china: a community-based cross-sectional study.* Bmc public health, 2020. **20**(1): p. 989.
5. Elmrayed, s., et al., *value for health: how fortified infant cereals provide cost-effective solutions to iron deficiency anaemia in egypt.* Frontiers in nutrition, 2025. **12**: p. 1570683.
6. Chauhan, s., et al., *prevalence and predictors of anaemia among adolescents in bihar and uttar pradesh, india.* Scientific reports, 2022. **12**(1): p. 8197.
7. Haider, a., et al., *evaluating the influence of age and gender on hemoglobin variation and red cell characteristics in anemic patients of dera ismail khan.* Mader-e-milat international journal of nursing and allied sciences, 2025. **3**(3): p. 71–88.
8. Baldi, a. And s.-r. Pasricha, *anaemia: worldwide prevalence and progress in reduction*, in *nutritional anemia*. 2022, springer. P. 3–17.
9. Kebede, a.f., et al., *initial recognition and emergency department management of pediatric cardiac emergencies.* 2026.
10. Iolascon, a., et al., *recommendations for diagnosis, treatment, and prevention of iron deficiency and iron deficiency anemia.* Hemasphere, 2024. **8**(7): p. E108.
11. Ikolo, b., et al., *sickle cell disease: from ancient origins to modern breakthroughs in gene therapy.* Biomedicines, 2026. **14**(7): p. 1649.
12. Das, s. And b.p. dash, *a systematic review on abnormal hemoglobin of sickle cell disorder patients.*

13. Habib, n., s.-u.-r.s. abbasi, and w. Aziz, *an analysis of societal determinant of anemia among adolescent girls in azad jammu and kashmir, pakistan.* Anemia, 2020. **2020**(1): p. 1628357.
14. Zeleke, m.b., et al., *anemia and its determinants among male and female adolescents in southern ethiopia: a comparative cross-sectional study.* Anemia, 2020. **2020**(1): p. 3906129.
15. Varshney, a., *a prospective study to assess prevalence of anemia in school going children.* Journal of advanced medical and dental sciences research, 2020. **8**(10): p. 165–168.
16. Fang, x.-h., et al., *refractive errors in tianjin youth aged 6–18 years: exploring urban–rural variations and contributing factors.* Frontiers in medicine, 2024. **11**: p. 1458829.
17. Ghuge, d.b., *study of serum ferritin in acute myocardial infarction at a rural hospital*. 2020.

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