How to Cite:
Rehman, A., Khan, Y., Khan, S., Ahmad, R., Ullah, M., Ahmad, F., Khan, I. U., Ullah, K., & Ullah, W. (2024). Prevalence of microcytic hypochromic anemia and their assosiated risk factor among female students of Sarhad University Peshawar, Pakistan. *International Journal of Health Sciences*, *8*(S1), 483–501. https://doi.org/10.53730/ijhs.v8nS1.14820

Prevalence of microcytic hypochromic anemia and their assosiated risk factor among female students of Sarhad University Peshawar, Pakistan

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International Journal of Health Sciences ISSN 2550-6978 E-ISSN 2550-696X © 2024.
Manuscript submitted: 27 Dec 2023, Manuscript revised: 18 Feb 2024, Accepted for publication: 09 March 2024

***Abstract*---**Background: Microcytic hypochromic anemia which is a type of blood condition in which the cells become paler and smaller than they should be and it is caused by many reasons that include nutritional deficiencies. We will be looking for common type of anemia in the female students at Sarhad University. We need to check its prevalence and potential causes which are very significant in improving the health. Material and methods: It were a descriptive analytical and cross-sectional study conducted at Sarhad University Peshawar, Pakistan that included 50 females. This study was performed in the duration of four months (Feb to Jul 2023). All of them enrolled in this university were included. All the females who were pregnant students, those with prior diagnoses, and thalassemia-positive cases were excluded. Data was collected through questioners and the blood samples were analyzed at HMC Hospital's Hematology Lab, using advanced technology for assessing blood parameters and morphology in the female student population. Results: Within these 50 participants, the income groups were categorized showing a 35% prevalence of hypochromic microcytic anemia in the 40k to 50k income group and 8.5% in the above 50k group. Stress groups showed a 20% prevalence of hypochromic microcytic anemia in those experiencing stress compared to 13.3% in the non-stress group, forming a basis for comparisons in our research analysis with 44 anemia-familiar participants and 6 non familiar participants. Conclusion: In this study we found an unexpected trend: more anemia cases, specifically microcytic hypochromic anemia, were seen in higher-income families, especially those with incomes between 40k to 50k; Stress also seemed to play a role, as stressed students had a higher likelihood of having this type of anemia, highlighting the complex relationship between income, stress, and anemia prevalence.

***Keywords*---**Prevalence, Iron deficiency anemia, Hypochromic anemia.

Introduction

Anemia is defined as a hemoglobin concentration below an age- sex and pregnancy-specific cutoff value. For non-pregnant women, for example, a hemoglobin concentration of 110–119 g/L is defined as mild anemia, a concentration of 80–109 g/L as moderate anemia, and a hemoglobin concentration below 80 g/L is considered severe anemia (Hess et al., 2023). Microcytic hypochromic anemia is a type of anemia which results in the smaller size of the circulating RBCs than that of the usual size of RBCs and also includes in the decreased red color. (Hammad S *et al.,* 2023). This of microcytic hypochromic anemia has further subtypes that includes anemia of chronic disease (ACD) and sideroblastic anemias (SAs) (Bakry & Elhefny, 2022).

Iron deficiency anemia and thalassemia are characterized by the low production of hemoglobin because of insufficient availability of globin or heme, respectively and both of these diseases causes the hypochromic microcytic anemia. The most common nutrient deficiency is the Iron deficiency that is frequently observed

throughout the in different parts of the world that do not have proper amount of nutrition and the have a low socioeconomic status (Aydogan et al., 2019). The symptoms of microcytic anemia include excessive sleepiness, irritability or inappropriate behavior, decrease in exercise tolerance, syncope, palpitations, shortness of breath and orthopnea(Jain & Kamat, 2009).

Microcytic anemia treatment depends upon the cause of disease. The prognosis also depends upon the factors underlying the anemia conditions. Iron deficiency anemia treatment is the causative treatment that prevent recurrent anemia. Iron preparations can be used to correct the iron deficiency in the body (replacement therapy) (Umar, 2020).Oral iron supplementation can be provided because of its safety, efficacy and cost-effectiveness (Afroz et al., 2020). Iron deficiency can be easily treated and the oral therapy showed very good effects. In the pregnant women, the disease was associated with the increased preterm delivery, mortality and infants with low birth weight. (S Lembar *et al.,* 2015).

Anemia is considered as a health problem worldwide that is affecting about 1.62 billion individuals on international level and 24.8% population worldwide, according to the World Health Organization (Bakry & Elhefny, 2022). World Health Organization estimated 2 billion people suffer from anemia in the world. Besides pregnant women, children (both preschool and school-age) are the most affected group by ID because of the quick growth and the general cognitive development**.** (Jamali *et al.*, 2016). Iron deficiency anemia has about 5% prevalence worldwide, but in the developing countries it is present in 18% among adult women and almost 10% inn adult men (Bolyen et al., 2019).

Previous documentations in 2015 from Lahore, a city of Pakistan has reported that 50% of the Pakistani females of reproductive age were suffering from anemia and 21% of the females of age group 9-29 years face the same problem in Punjab, a province of Pakistan. (Jawed *et al.*, 2017). Iron deficiency anemia (IDA) in children is a major cause of nutritional anemia is one of the major public health issues in Pakistan. The reported prevalence of IDS in, under-five children of Pakistan is 40% to 70%. Nutritional Survey 2018, the prevalence of IDA in children is 28.6%. The proportion of IDA in urban boys was 29.1% and 28.9% in rural areas (Sherali et al., 2023).

Nutritional anemia is a global problem increasing in developing countries. This problem is most commonly faced by young females of 18 to 25 years of age. Global Prevalence of iron deficiency anemia was 50% among the females of reproductive age (Sherali et al., 2023). According to WHO the recommended Hemoglobin level, for nonpregnant women (age 15 and over) is 120 gm/L and for males (15 years and over) it is 130 gm/L (Mawani & Aziz Ali, 2016).

Iron deficiency anemia (IDA) in women of reproductive age is a public health concern that globally affects 17% of women including 15% (248 million) of nonpregnant and 19% (16.2 million) of pregnant women. IDA impairs health and wellbeing in women and is associated with adverse reproductive outcomes. Annually it is estimated that 22% of maternal deaths and 24% of parental deaths around the world are attributed to IDA (Afroz et al., 2020). Nutritional anemia is most commonly faced by young females of 18 to 25 years of age. Global

Prevalence of iron deficiency anemia was 50% among the females of reproductive age. (Jamali *et al.*, 2016).

Materials and Methods

This descriptive study was conducted in the female students of Sarhad University of Science and Information Technology Peshawar. The duration of our study was 4 months from May 2023 to August 2023. A total of 50 subjects (female student) were selected for this study. Only Female student of Sarhad University were included in this study. Pregnant, already diagnosed female students and thalassemia positive female students were excluded from this study population. Primary data was collected by questionnaire from female student's population attending Sarhad University of Science and Information Technology in the MLT lab of (SUIT). Blood sample was collected through vein puncture technique and added to EDTA tube. Then the samples were sent to the hematology laboratory of HMC hospital for full blood count and blood smear. The materials used in this study were Syringe, EDTA Tube, Alcohol swab, Tourniquet, Hematology analyzer, Microscope, Glass slide, Giemsa stain, Ethanol, Emersion oil. 3 ml of blood was collected from the female students of (SUIT). Added to (EDTA) tubes. Subsequently, the blood tubes were sent to hematology section of (HMC) hospital Peshawar for testing the blood parameters and morphology. After that the tubes were run by hematology analyzer to find hematological parameters and for Smear, Microscopy was used to find blood Morphology.

Results

In this descriptive analytical study, the prevalence of hypochromic microcytic anemia among female students of Sarhad University Peshawar was investigated. The study included 50 female participants with age ranges as follows: 15-20 (20 participants), 21-25 (29 participants), and 26-30 years (1 participant).

Table 4.1. Prevalence of Hypochromic Microcytic Anemia

Total participants	Normal	HMA (Hypochromic Microcytic Anemia)	Percentage % of prevalence
50	44	6	12%

4.1. Percentage of family wise distribution

The study explored the family-wise distribution and found that participants from nuclear families had a higher prevalence of Normocytic Normochromic (24%) and hypochromic microcytic anemia (12%). Joint families showed 28% Normocytic Normochromic and 8% hypochromic microcytic anemia, extended families showed 4% Normocytic Normochromic and 6% hypochromic microcytic anemia, while any other families had 16% Normocytic Normochromic and 2% hypochromic microcytic anemia as shown an Fig.

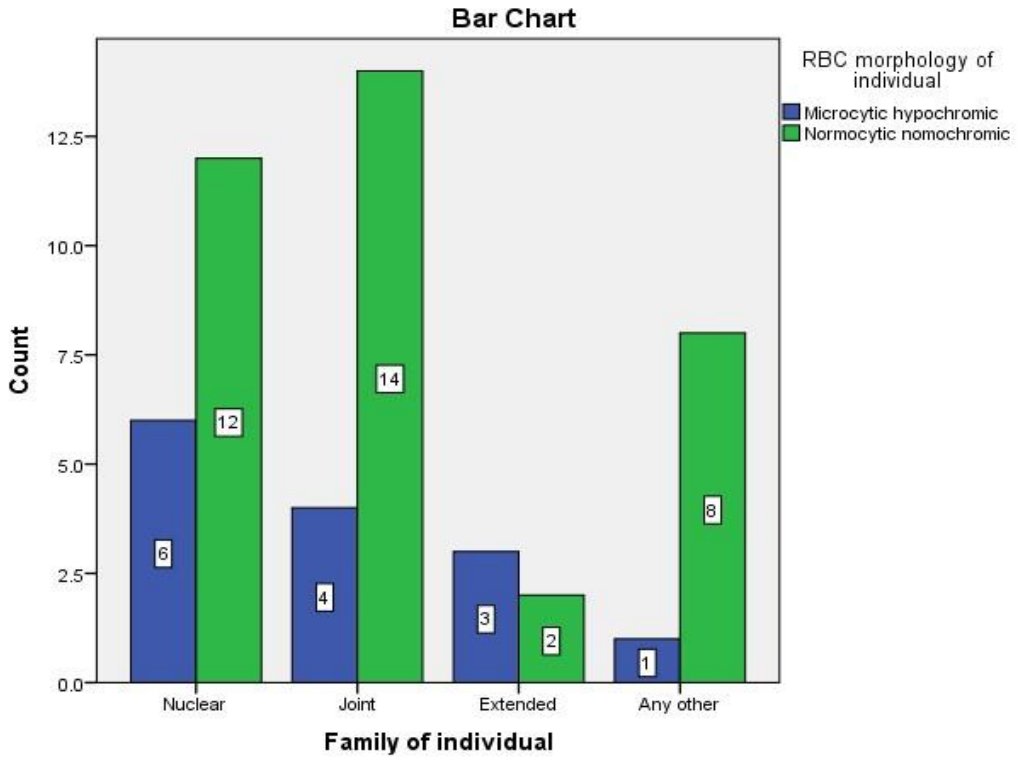

Figure 4.1. Relationship of family wise distribution with RBC morphology 4.2

Percentage income wise distribution of individual Income-wise distribution revealed that participants with income above 30k had the highest percentage of Normocytic Normochromic (56%) and hypochromic microcytic anemia (16%). Participants with income from 26k to 30k had 6% Normocytic Normochromic and 12% hypochromic microcytic anemia, while those with income from 20k to 25k had 8% Normocytic Normochromic and no hypochromic microcytic anemia. Participants with income less than 20k showed 2% Normocytic Normochromic and no hypochromic microcytic anemia as shown in Table 4.2 and Fig.4.2.

Table 4.2. Shows correlation of income with RBC morphology

		RBC morphology of individual		
		microcytic hypochromic	NormocyticNormochromic	Total
Income of individual	<30k	0	1	1
	30k to 40k	0	5	5
	40k to 50k	6	3	9
	above 50k	8	27	35
Total		14	36	50

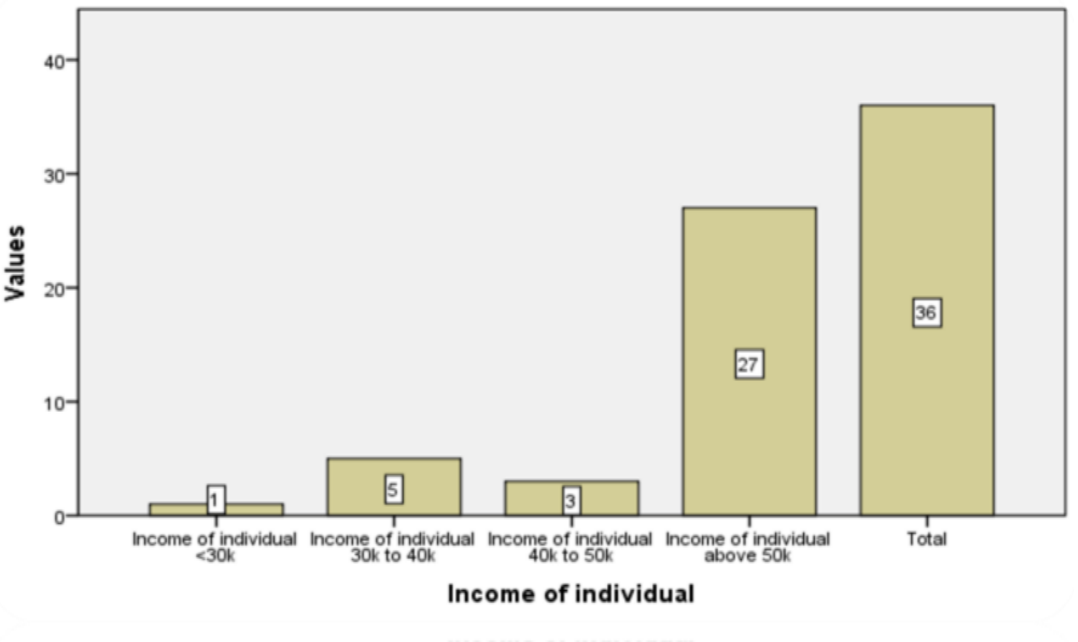

Figure 4.2 Relationship of family income with RBC morphology

The study also examined the relationship between nutrition habits and anemia. Participants who consumed fresh fruit, vegetables, and meat daily (34%) showed 24% Normocytic Normochromic and 10% hypochromic microcytic anemia. Those who consumed the twice a week (34%) showed 30% Normocytic Normochromic and 4% hypochromic microcytic anemia. Participants who consumed them weekly (24%) showed 12% Normocytic Normochromic and 12% hypochromic microcytic anemia. Participants who consumed them very rarely (32%) showed 18% Normocytic Normochromic and 14% hypochromic microcytic anemia as shown in Fig 4.3.

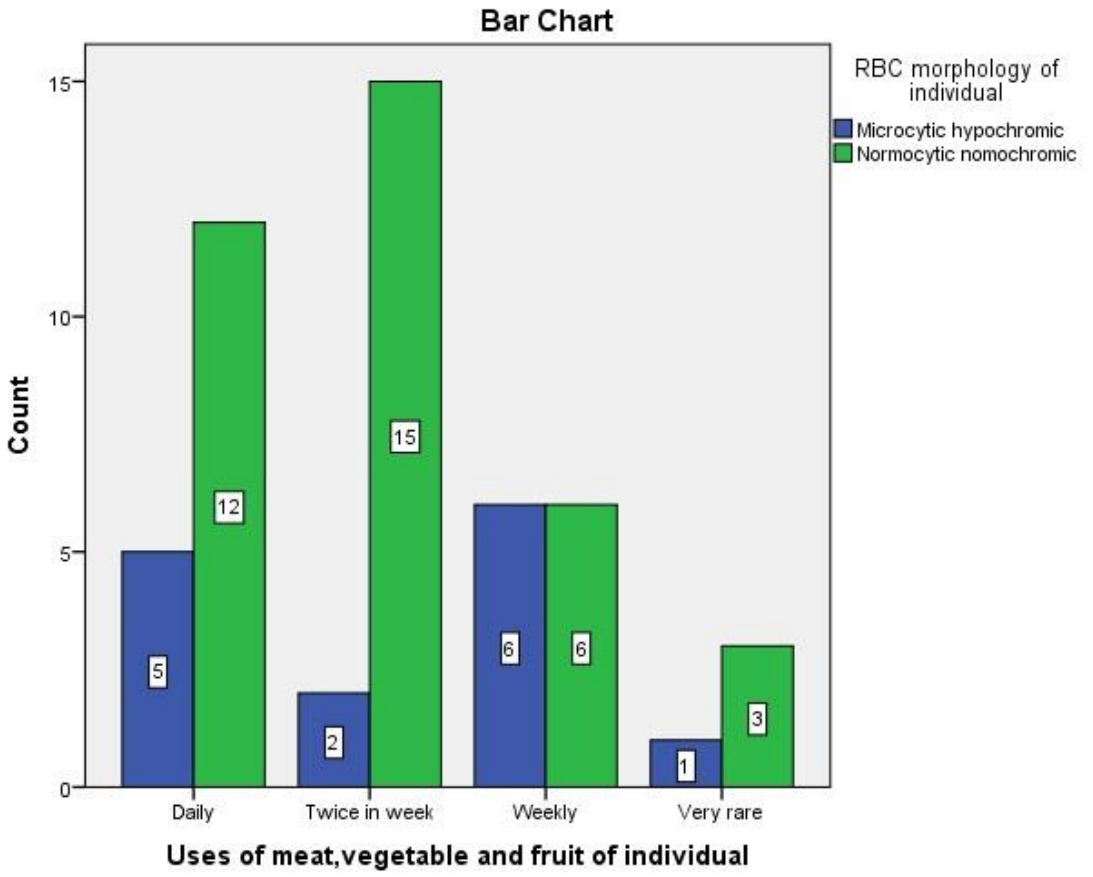

Figure 4.3 Relationship of diet with times

Regarding knowledge of alternative food, participants who are aware (34%) have 24% Normocytic Normochromic and 10% Hypochromic Microcytic anemia. Those without knowledge (66%) show 48% Normocytic Normochromic and 18% Hypochromic Microcytic anemia as shown in Fig 4.4.

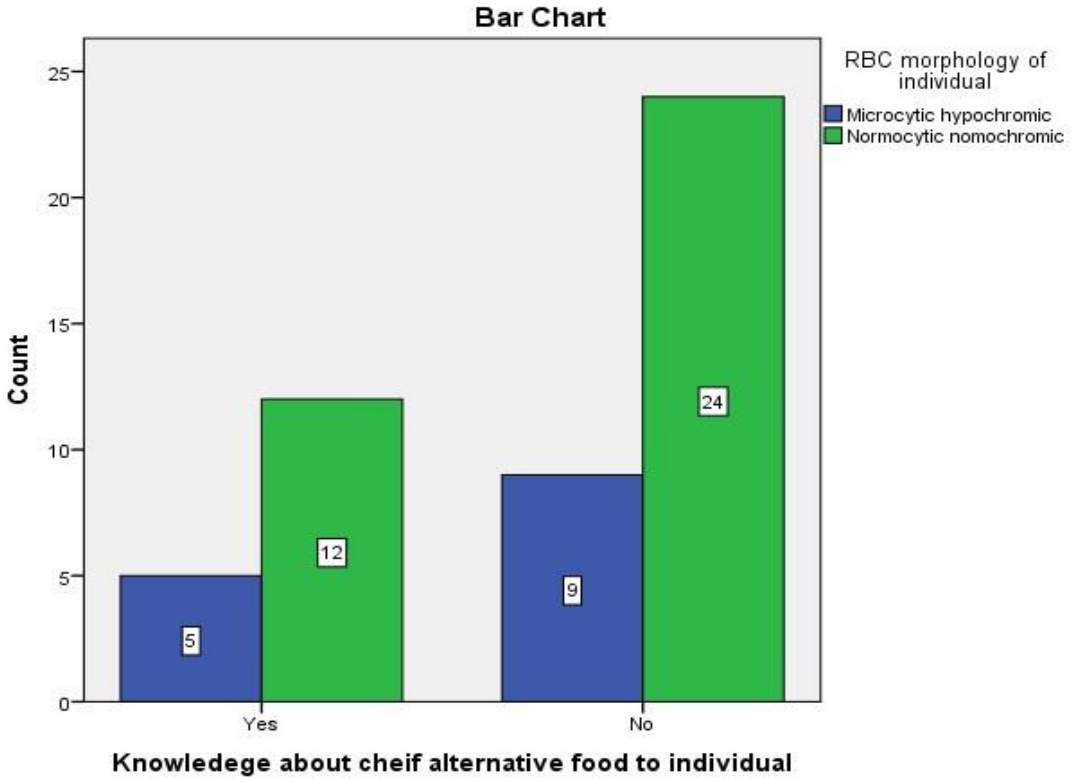

Figure 4.4. Shows the knowledge of participants towards substitute food of meat or iron rich food

The participants (60%) who have stress show 42% Normocytic Normochromic and 18% Hypochromic Microcytic anemia. The participants (40%) who have No stress show 30% Normocytic Normochromic and 10% Hypochromic Microcytic anemia. Stress also plays a role, as stressed participants (60%) show 42% Normocytic Normochromic and 18% Hypochromic Microcytic anemia. Those without stress (40%) have 30% Normocytic Normochromic and 10% Hypochromic Microcytic anemia as shown in Fig 4.5.

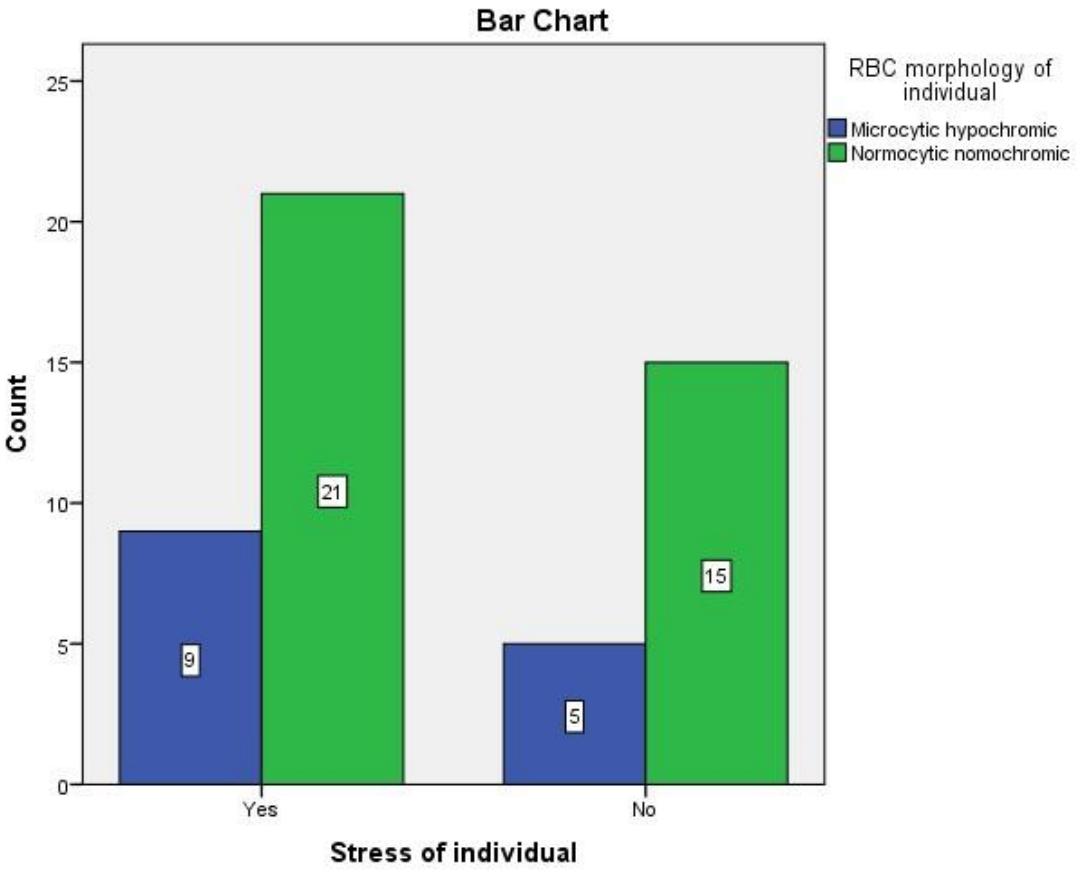

Figure 4.5 Relationship of participants with stress and without stress

Normal HB levels (84%) correspond to 72% Normocytic Normochromic and 12% Hypochromic Microcytic anemia. Those with lower HB levels (16%) show no Normocytic Normochromic and 16% Hypochromic Microcytic anemias shown in Fig 4.6.

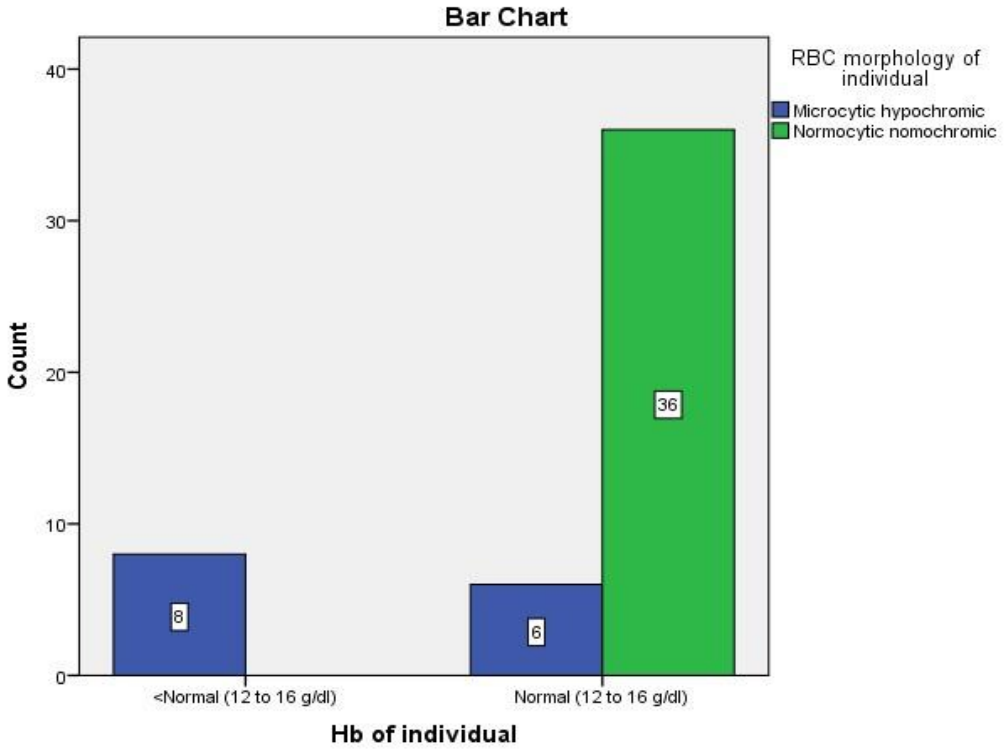

Figure 4.6: Relationship of HB level with RBC morphology

Similarly, normal HCT levels (78%) relate to 68% Normocytic Normochromic and 10% Hypochromic Microcytic anemia. Higher HCT levels (2%) result in 2% Normocytic Normochromic and no Hypochromic Microcytic anemia, while lower levels (20%) yield 2% Normocytic Normochromic and 18% Hypochromic Microcytic anemia as shown in Fig 4.7.

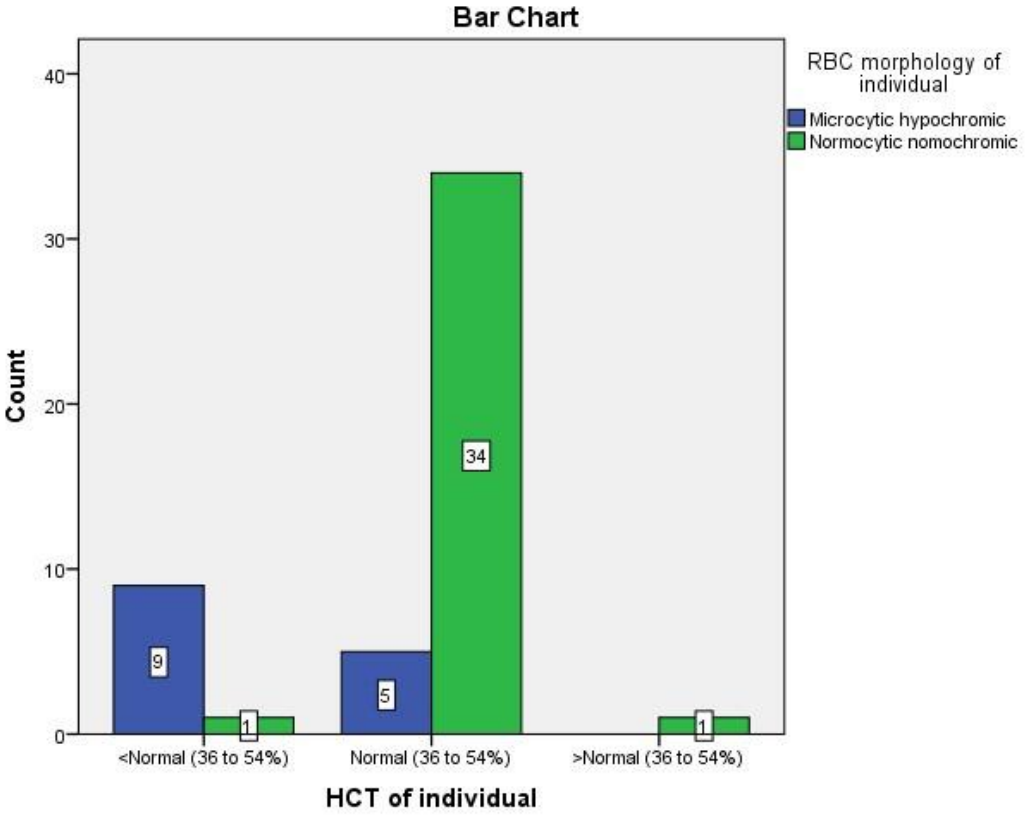

Figure 4.7 Relationship of HCT with RBC morphology

In terms of MCV levels, participants with normal levels (84%) exhibit 72% Normocytic Normochromic and 12% Hypochromic Microcytic anemia. Those with lower MCV levels (16%) have no Normocytic Normochromic and 16% Hypochromic Microcytic anemia as shown in Fig 4.8.

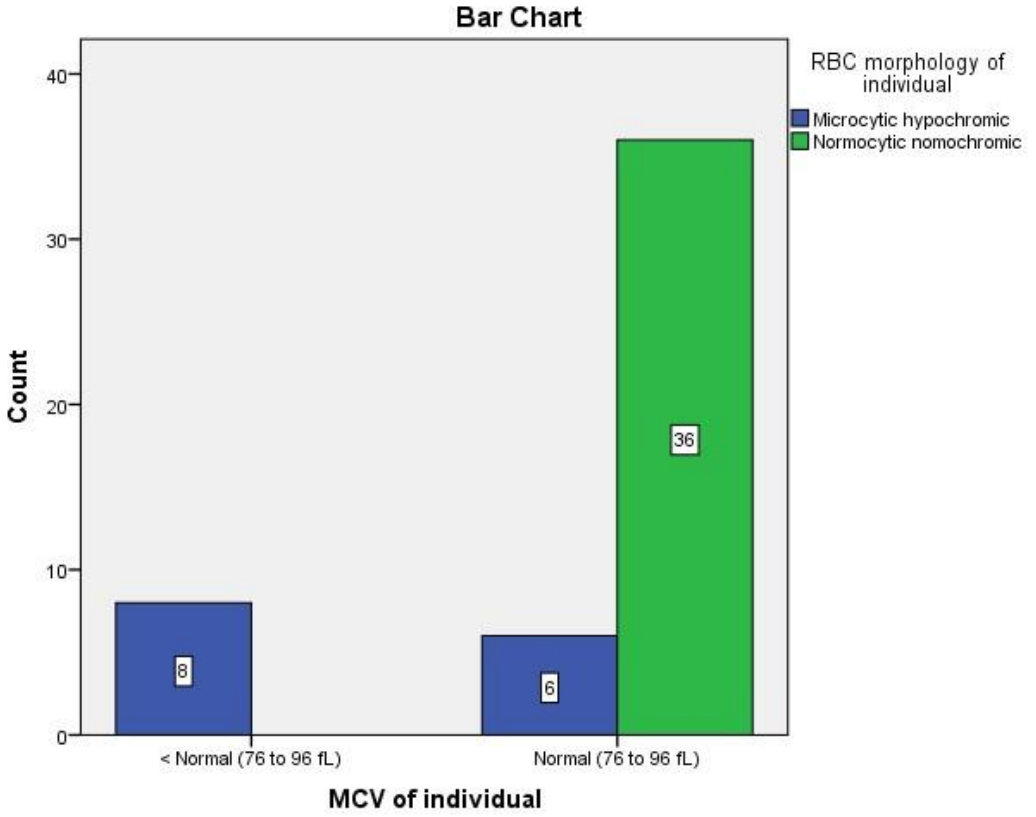

Figure 4.8 Relationship of MCV with RBC morphology

Normal MCH levels (70%) correspond to 68% Normocytic Normochromic and 2% Hypochromic Microcytic anemia. Lower MCH levels (30%) result in 4% Normocytic Normochromic and 26% Hypochromic Microcytic anemias shown in Fig 4.8.

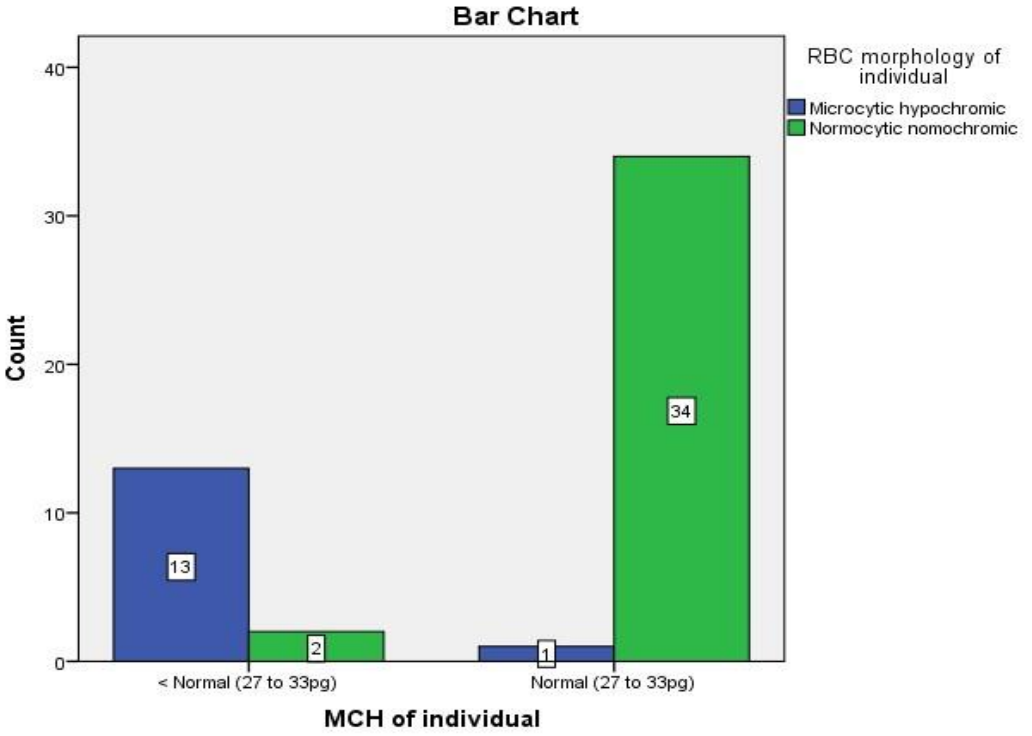

Figure 4.9 Relationship of MCH with RBC morphology

The participants (90%) who have normal MCHC level show 68% Normocytic Normochromic and 22% Hypochromic Microcytic anemia. The participants (10%) who have less than normal MCHC level show 4% Normocytic Normochromic and 6% Hypochromic Microcytic anemias shown in Fig 4.10.

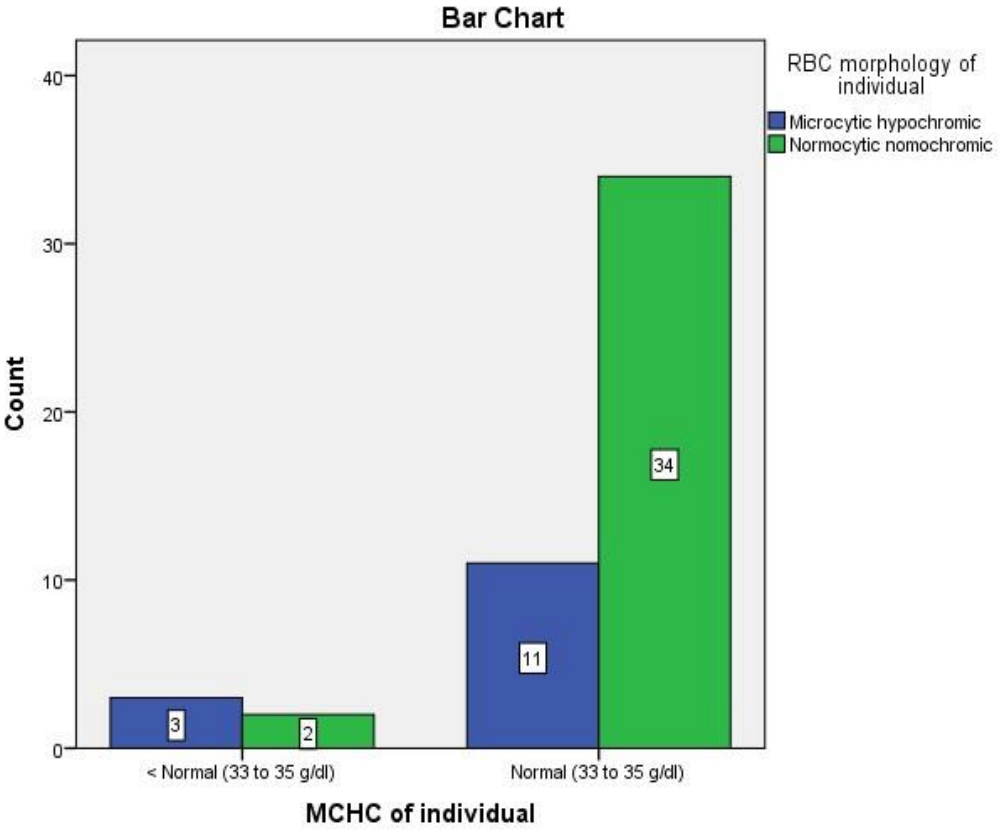

Figure 4.10 Relationship of MCHC with RBC morphology

In our study we included 50 participants; we categorized them into four categories on the basis of their family income. In first category (<30k family income) falls only one participant having normal MCV and HB level. In 2nd category (30k to 40k family income) falls (05) participants all of them having normal MCV and HB. In 3rd category (40k to 50k family income) falls (09) participants; out of them (03) participants having low MCV and HB levels, and remaining (06) participants were having normal MCV and HB level except (01) who have low HB level. The hypochromic microcytic condition in this category is almost high (35%).In 4th category (above 50k family income) falls 35 participants; out of them (05) participants having low MCV, and among these (03) participants having low HB level and (02) participants were having normal HB level, the remaining (30) participants having normal MCV and HB level. The hypochromic microcytic condition in this category is almost (8.5%) anemia as shown in Fig 4.11 and Table 4.2.

Table 4.2 Relationship of MCV & family income with HB level

MCV of individual		Hb of individual <(12 g/dl)	Normal (12 to 16 g/dl)	Total
< normal (76 to 96 fL)	Income of individual	of 40k to 50k	3	0	3
		above 50k	3	2	5
normal (76 to 96 fL)	Income of individual	of <30k	0	1	1
		30k to 40k	0	5	5
		40k to 50k	1	5	6
		above 50k	1	29	30

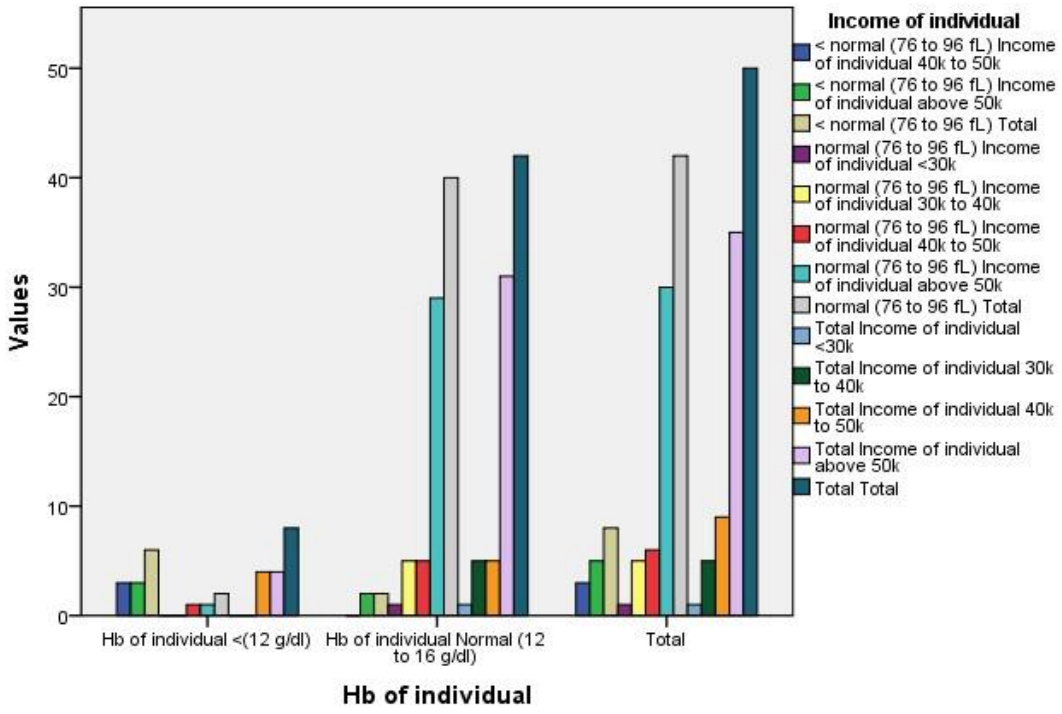

Figure 4.11 Relationship of family income and MCV with HB level

In current study we included 50 participants; we categorized them into two categories on the basis of stress.

In first category having stress falls (20) participants; out of these (04) participants having low MCV and HB level but one of them have normal HB. The remaining (16) participants were having normal MCV and HB level but just (02) participants were having low HB level.

In 2nd category those who having no stress falls 30 participants; among these (04) participants having low MCV and HB level except (01) participant who have normal HB level, and remaining (26) participants; all of them having normal MCV and HB level as shown in Fig 4.12 and Table 4.3.

Table 4.3 Relationship of stress and MCV with HB level

Hb of individual		MCV of individual		Total
		< normal (76 to 96 fL)	normal (76 to 96 fL)	
<(12 g/dl)	Stress of individual No	3	2	5
yes		3	0	3
Total		6	2	8
Normal (12 to 16 g/dl)	Stress of individual No	1	24	25
	yes	1	16	17
	Total	2	40	42
Total	Stress of individual No	4	26	30
	yes	4	16	20
	Total	8	42	50

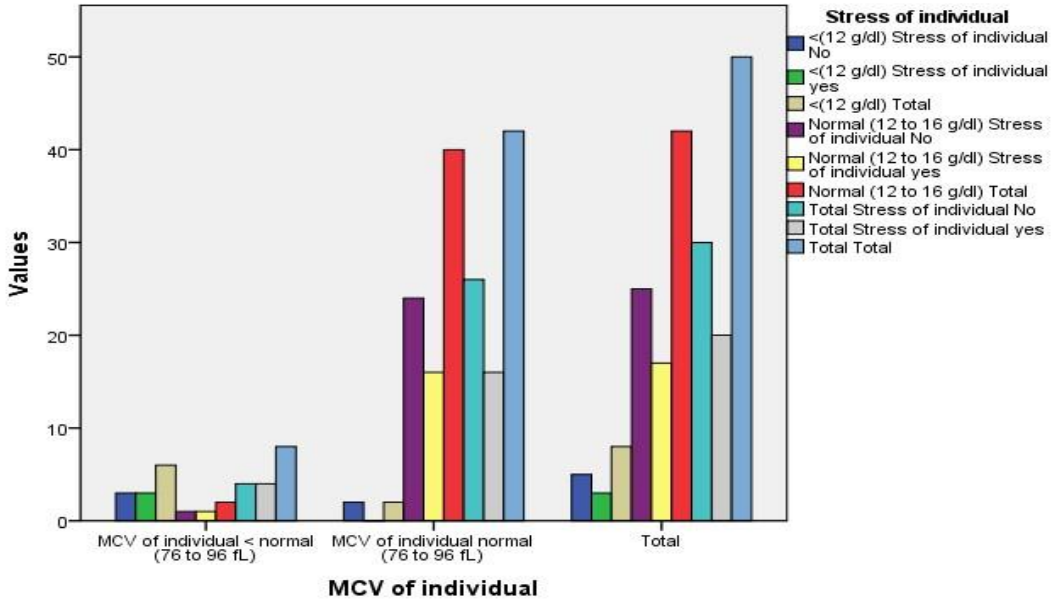

Fig 4.12 Relationship of stress and MCV with HB level

Discussion

In our study of 50 participants, categorized into four income groups, the first two groups (<30k and 30k-40k family income) had six participants with normal MCV and HB levels. In the third group (40k-50k family income), nine participants had hypochromic microcytic anemia (35%). The fourth group (>50k family income) had an 8.5% prevalence. Regarding stress, 20 participants experiencing stress showed some anemia presence (4 with low MCV and HB levels), while the 30 participants without stress had a lower prevalence. This information sets the basis for comparison with a research analysis involving 44 participants familiar with anemia and 6 who were not.

(Al-Alimi et al., 2018) conducted a cross sectional study on microcytic hypochromic anemia among 500 in which 326 were males and 174 were females that were collected randomly from the medical students at Hodeida University. He observed that the overall prevalence of IDA was 30.4% (n = 152) in which females were 54.00% (n = 82) and males were 46.0% (n = 70). The students that were aged 20-22 years old were found to be more anemic with the prevalence of 59.2% as compared to the students that were aged 17-19 years old (25.0%) and 23–25 years (15.8%). His results suggested that by providing the proper and complete knowledge related to healthful diet, harmful effects and improved lifestyle can prevent IDA to the students.

((Kolahi et al., 2008) conducted a study based on Hypochromic microcytic anemia that included the iron deficiency anemia and thalassemia with an easy treatment and has significant unwanted symptoms that are widely prevalent in Iran. He conducted his study in which the blood counts were performed by the electronic counter. The serum ferritin was assayed by the Elisa, hemoglobin electrophoresis, TIBC (Total Iron Binding Capacity), MCH (Mean Cell Hb) and MCV (Mean Cell Volume) were performed. This study showed the prevalence of anemia specifically the IDA and minor thalassemia in female by 9.7%, 7%, 1%, respectively and in men it showed about 9.7%, 2%, 5%.

(Aydogan et al., 2019) in his study conducted that IDA and thalassemia are the primary cause of microcytic anemia in children. His study population consisted of 200 in which 107 were male (53.5%). In total 154 had iron deficiency anemia (77%), 27 had β-TT (13.5%), and in 11 (5.5%) both the conditions coexisted. His study aimed to characterize the frequency of thalassemia trait (TT) and IDA in the children. It also aimed to identify the importance of blood count parameters in differential diagnosis. There were 8 patients that had α-thalassemia gene mutations and 3 of them also had iron deficiency anemia. His study founded 7% of the children that were referred to the clinic for hypochromic, microcytic anemia had both TT and IDA and the MCV, ferritin, serum iron, TIBC.

Conclusion, Recommendations & Limitations

Conclusion

In a study of 50 female students at Sarhad University, we found a higher prevalence of microcytic hypochromic anemia among those with higher family

incomes (40k to 50k range). Additionally, stress appeared to be linked to anemia, with stressed participants showing a higher likelihood of microcytic hypochromic anemia. These unexpected results highlight the complex interplay of anemia prevalence with socioeconomic factors and stress levels.

Recommendations

Further Research: Conduct further research to explore the unexpected link between higher family income and elevated microcytic hypochromic anemia among female students. Aim for a deeper understanding of the underlying factors driving this unusual pattern.
Stress Management Interventions: Establish and execute stress management programs in educational institutions to address the potential connection between stress levels and anemia, fostering overall student well-being.

Limitations

Sample Size and Specificity:
The study had limitation due to the small sample size and only single university taken under study. This may not allow the fully representation of the broader population. Talking only one gender could limit the generalizability of the findings to a wider demographic.

Cross-Sectional Nature:
The study adopted a cross-sectional design instead of longitudinal studies which would be required to establish causality and explore how these trends may change over time.

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