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A Cross-sectional assessment of anemia and associated risk variables among different age groups in Gilgit-Baltistan

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ABSTRACT

Background: Anemia poses a significant global health challenge and has a significant influence regarding both morbidity and mortality across diverse demographics. This cross-sectional study aim to assess the prevalence and risk variables associated with anemia in different age groups within the culturally diverse population of Gilgit-Baltistan (GB).

Methods: The prevalence of anemia within each age group was determined through hemoglobin (Hb) level assessment using Hemocue Hb 201+. This analysis encompassed various gender categories and examined the risk variables contributing to anemia in GB. Samples were collected from different regions in order to obtain a representative sample of the population. A total of 720 individuals (386 males and 334 females) participated in this study.

Results: About 32.40% males (65.2% mild, 31.7% moderate and 3.1% severe) and 56.07% females (36.5% mild, 46.3% moderate and 17.2% severe) were found anemic. Prevalence of anemia in male were highest in the age group 20-40 years (31.2%), followed by age group 10-19 years (26.4%) as compared to age group 41-60 (19.2%) and above 61 years (23.2%) and mean hemoglobin level (Hb) was 11.98 ± 0.90 g/dL. Among females the highest prevalence were found in reproductive age 20-40 years (37.3%) and age between 10-19years (29.4%), followed by the age group 41-60 (13.4%) and above 61 years (19.7%) and mean hemoglobin level (Hb) was 9.93 ± 0.83 g/dl. Risk variables include socio economic status of respondents, the higher prevalence was found in lower class population (37.7% males and 43.6% Females).

Conclusion: The findings highlight the vulnerability of both genders and lower class to anemia in GB. Addressing this public health concern requires research extending beyond the prevalence and socio-demographic factors.

Keywords: Anemia, Gilgit-Baltistan, Women of Reproductive Age, Hemoglobin, Body Mass Index, Socio-demographic Factors.

Introduction

Anemia is a hematological state characterized by reduced count of red blood cells (RBC) or a lower concentration of hemoglobin (Hb) level in blood. Iron is essential micronutrient and part of hemoglobin, its deficiency leads to anemia in all individuals. The World Health Organization (WHO) has set specific standards for anemia that may vary depending on factors i.e. age, gender, altitude, smoking, pregnancy and health status[1].

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Iron is an essential component of numerous metallo-proteins, particularly cytochromes, ferritin, transferrin, hemoglobin and myoglobin. Iron is also vital for metabolic processes, such as those that involve the Fe-sulfur complex and enzymes including the oxidase, cytochromes, catalase, NADPH reductase, peroxidase, and superoxide dismutase. Iron plays many important roles, some of which are the transportation of oxygen (O_2) and carbon dioxide (CO_2), red blood cell formation, involvement in redox reactions, electron transfer mechanism facilitation, electron transfer production, and gene control. [2, 3, 4, 5].

Iron deficiency is caused via inadequate food intake or lack of absorption in the gastrointestinal tract (GIT).The primary approach to manage an iron deficiency is to consume food high in this essential vitamin, which allows you to absorb a sufficient amount of iron[6]. The hemoglobin threshold levels

were approximately 115 g/L for children, around 120 g/L for women, and roughly 130 g/L for men[7]. Furthermore high intake of chemical inhibits iron from being absorbed in GIT, which decrease the iron supply to body[8].

Approximately 2 billion people worldwide suffer from anemia. Around 75–80% of the global anemia burden can be attributed towards this prevalent nutritional deficiency, which is common throughout the world[9]. The highest incidence of anemia are observed in developing countries, where it affects 33% of men, 44% of women, 42% of children who are considered too young to get into schools, and 53% of children in Asia and Africa who are pursuing education in schools[10]. Anemia is one of the most common nutritional disorders that affect numerous children in Pakistan. Anemia has been found to affect 65% of Pakistani children between the ages of 7 and 60 months, according to the National Nutritional Survey (NNS, 2018) of Pakistan[11]. Programmatic approaches to address anemia challenges have been mandated by socioeconomic determinants of health, as indicated by the prevalence of anemia among children, unmarried, married, non-pregnant adolescents, young women, and men in Pakistan[12].Unfortunately, anemia contributes to around a million fatalities per year; worldwide, prevalence rates for pregnant women and children under five are 51% and 43%, respectively.[13] According to NNS 2011, around 23.3% of the population in GB suffers from anemia.[13] In terms of micronutrients deficiencies malnutrition and food security are prevalent in GB. According to national nutrition survey NNS (2018), especially pregnant women face severe dietary deficiencies 47%, 41% and 47.6% for iron, zinc and iodine respectively.[14]

This study ascertains the prevalence of anemia among various age groups and identifies the associated risk factors influencing the incidence of anemia in GB using a cross-sectional survey. We conducted an extensive baseline survey to fulfill the knowledge gaps which enable the planning and policymakers to address the risk of anemia with the valuable considerations that will be provided.

Methods

This study was conducted in mountainous northern region of Pakistan, Gilgit-Baltistan (GB) from September 2020 to December 2022. This region consists of three divisions (Chilas, Gilgit and Baltistan) which are further divided into ten districts; Diamer, Gilgit, Hunza, Nagar, Ghizer, Astore, Skardu, Shigar, Kharmang and Ghanche. The population is about two million and total covered area is 73,000 square kilometers (28,000 square miles). The region of GB also shares its borders with Afghanistan, China, and India.

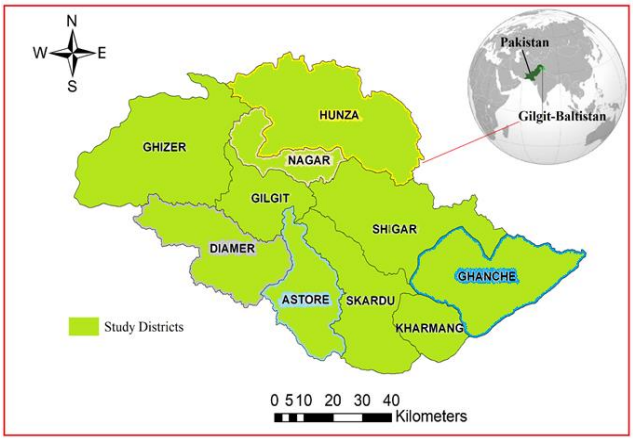

Figure 1: Study area showing major districts Gilgit Baltistan.

This cross-sectional study was approved by the Department of Agriculture and Food Technology, Karakoram International University Gilgit Baltistan, Pakistan (KIU) committee dated August 2020. This study was designed to determine the prevalence among different age groups in Gilgit Baltistan by analyzing blood samples to measure serum iron (SI). Moreover, a mixed-method was used to carry out the related information for this research by using a questionnaire-based survey and Key Informant Interviews (KII). The research design was also intended to assess the socio-demographic factors affecting the economic status of households, anthropometric measurement, clinical examinations and social habits which leads to iron deficiencies in population.

In current study, there are 720 participants (males and females) which were selected from each cluster randomly from all districts. The samples comprised of 386 males and 334 females of various ages groups. The sample size was varying depending on the population of the respective cluster to achieve a better representation of the whole population's characteristics. A questionnaire was administered to each sample to determine, socioeconomic status, demographic information, anthropometric measurements, clinical examination, hemoglobin level and social habits to assess anemia. These informations were gathered using interactive communication and surveys[15].

A portable manual weighing machine with zero error was used to determine weight, and measurements were made while wearing no shoes and with the least amount of clothing possible to ensure precision to the closest 100 grams. A measuring tape was fastened to the wall to ascertain height, and centimeter measurements were recorded[16]. Based on the WHO BMI-for-age chart, participants were classified as underweight, normal, or overweight. BMI was determined using the following formula.

$$\boldsymbol{BMI} = \frac{Weight\ (kg)}{Height\ (m2)}$$

A qualified examiner performed clinical analysis in respondent homes using methodology described by Hassan et al. [17]The interviewee was asked questions about how to identify the symptoms and indicators of micronutrient deficiencies, and their responses were recorded.

The Hemocue Hb 201+ (HemoCue AB, Ängelholm, Sweden) was used to measure hemoglobin levels. Anemia was categorized based on the WHO reference range for hemoglobin: Mild (11-11.9 g/dL), Moderate (8-10.9 g/dL), and Severe (<8 g/dL) (WHO, 2011).

A biochemical examination was performed using the Resonance Quantum Magnetic Analyzer (RQMA), version 4.7.0 Health Leader Diagnosis Machine, in accordance with the protocol described by (Zoawe et al.[18], to evaluate the participant's body micronutrient status, with a particular emphasis on iron. The device, which was attached to an HP laptop, was turned on, and participants were told to grasp the magnetic handle with their right hand for women and their left hand for men. Within four to five minutes of the analysis, the machine produced a PDF result on the laptop screen.

The data was analyzed by using Microsoft Excel, Statistical Package for Social Sciences (SPSS) V. 20, and Global information system (GIS). The socio-demographic, anthropometric, clinical, and biochemical sets of data were analyzed by frequency distribution method of analysis. Tables and figures have been constructed to summarize the results obtained.

Results

The current study included n=720 respondents, who were agree for hemoglobin estimation from each cluster of all regions among which 46.3% were male and 53.6 % were females (n=334 males and n=386 females) as shown in the Table 1.

Table 1: Distribution of anemia based on severity across GB.

S no.	Anemia	Male		Female	
		Frequency	Percentage (%)	Frequency	Percentage (%)
1	Anemia (≥ 12) absent	261	67.8	144	43.3
2	Anemia (< 12) present	125	32.4	190	56.7
3	**Total (n=720)**	386	100	334	100
Severity of Anemia		**(n=125)**	**32.40%**	**(n=190)**	**56.70%**
1	Mild (11-11.9)	82	65.2	70	36.5
2	Moderate (8-10.9)	39	31.7	88	46.3
3	Severe(< 8)	4	3.1	32	17.2

The study participants exhibited varying degrees of anemia prevalence; 32.40% of males and 56.7% of females were affected. The study found that the incidence of moderate and severe anemia was higher in females 46.3% and 17.2%, respectively than in males 31.7% and 3.1%, respectively. On the other hand, mild anemia was found in 65.2% of males and 36.5% of female individuals. The distribution of anemia across GB is presented in Table 1.

In Figure 2 the range of hemoglobin (Hb) levels in males and females, from low (dark green) to high (red). The districts of Hunza and Shigar had the lowest Hb levels among males, according to the GIS map. For females, the lowest Hb levels were found in the upper regions of Ghizer, Hunza, and

Ghanche, followed by Skardu, Diamer, Nagar, Kharmang, Gilgit, and Astore.

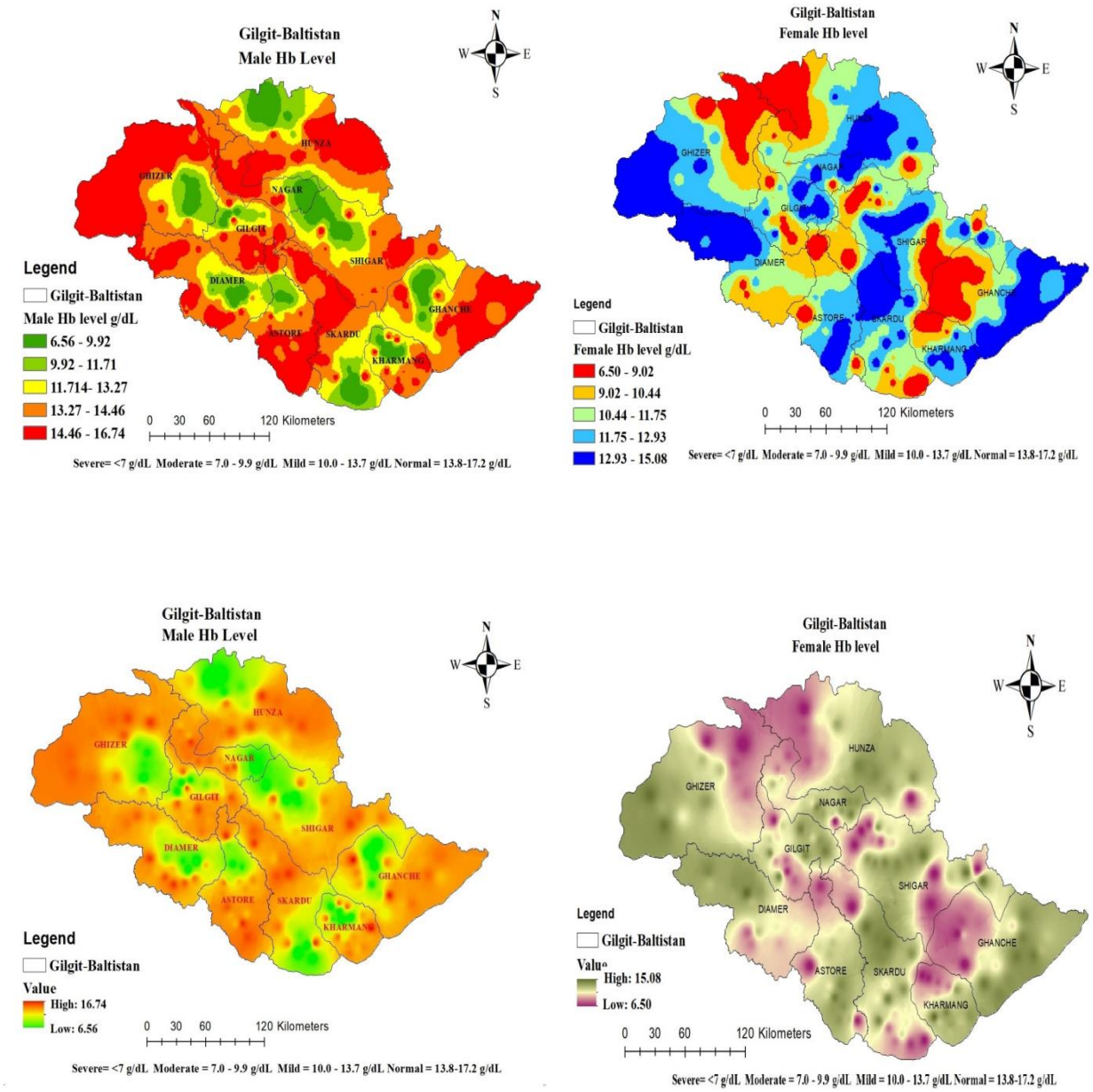

Figure 2: Standardized distribution of anemia across all districts

The geographic information system (GIS) map shows, broken down by gender and with hemoglobin levels ranging from high to low, the frequency of mild anemia, moderate or severe anemia, and overall anemic situation in each district and union territory of GB.

Cross-tabulation was performed to describe the association between anemia and gender, age, education level, family size, household income, and body mass index. Table 2 shows the overall prevalence of anemia by gender and age.

Table.2: Anemia prevalence in different gender, age groups and related risk factors.

Sr. #	Parameters	Anemic (n = 315)				Non Anemia (n = 405)				*P* value
	Gender	Male	%	Females	%	Male	%	Females	%	
		125	32.4	190	56.7	261	67.8	144	43.3	
1	**Age by year**									
	10-19	33	26.4	56	29.4	53	20.3	39	27.1	< 0.001
	20-40	39	31.2	71	37.3	82	31.6	25	17.8	
	41-60	24	19.2	25	13.4	69	26.1	46	31.7	
	above 61	29	23.2	38	19.7	57	22	34	23.4	
2	**Hb (g/dL)**									
	mean ± SD	11.98 ± 0.90		9.93 ± 0.83		14.11 ± 0.94		12.91 ± 0.79		< 0.001
3	**Education**									
	≤ Primary	27	21.6	40	21.3	16	6.1	9	6.2	< 0.001
	Middle	33	26.4	47	24.5	34	13	23	15.9	
	Secondary	28	22.7	61	32.1	87	33.3	29	20.1	
	≥ College	37	29.3	42	22.1	125	47.8	83	57.6	
4	**Family size**									
	≤ 4	14	11.2	28	14.7	26	9.9	17	11.8	< 0.001
	5-7	57	46.6	95	49.8	203	77.7	106	73.6	
	8-10	51	40.3	61	32.3	32	12.2	21	14.5	
	≥ 10	3	2.2	6	3.2	1	0.3	0	0	
5	**Socioeconomic Status**									
	Upper Middle	19	15.2	19	10	21	8	16	11.1	< 0.001
	Middle	33	26.4	21	11	57	21.8	43	29.8	
	Lower Middle	26	20.8	67	35.2	112	42.9	59	40.9	
	Lower	47	37.7	83	43.6	71	27.2	26	18	
6	**Body Mass Index**									
	< 18.5	85	67.8	113	59.6	28	10.7	18	12.3	< 0.001
	18.5-24.99	16	12.7	27	14.1	198	75.8	105	73.1	
	> 25	24	19.5	50	26.3	35	13.5	21	14.6	

The prevalence of anemia in age group 10-9 years were found 26.4% and 29.4% in male and female respectively, higher cases were reported among male (31.2%) and female (37.3%) was found in age 20-40 years as compared to age 41-60 years (19.2% male and 13.4% female) and in age group above 61 (23.2% in male and 19.7% in female). Furthermore, the mean value of hemoglobin in male and female were found 11.98 g/dl (SD ± 0.90) and 9.93 g/dL (SD ± 0.83) with lower statistical significant ($p < 0.001$) as compared to non-anemic male (14.11 g/dl; SD ± 0.94) and non-anemic female (12.91 g/dl; SD ± 0.79).

Table.2 also demonstrates that in middle education level, 46.4% males and 21.5% females are anemic. Likewise, in secondary education level 20% of the males and 33.1% females were anemic. In ≥ College education level, 31.2% males whereas, 17.8% of the females were anemic. In the family size category of ≤4, 7.2% males, while 6.8% of the females were anemic. Similarly, in the same category, 9.9% of the non-anemic individuals were males, and 11.8% females. In the categories of family size, among 5 to 7 68.8% of males and 76.8% females were anemic. In 8 to 10 member's category, 23.2% of males and 16.3% of the females are anemic. Moreover, most of the study participants belongs to lower middle class 41.8% (n=301) among them 37.3% males and 43.6% females were anemic followed by lower class 27.3% (n=197) males 26.4% and females 35.2%, Middle class 19.4% (n=140) (males 15.2% females 11% and upper class 11.3% (n=82) has lowest anemic cases were found.

According to the body mass index (BMI) respondents having BMI <18.5, 67.8% of males, while 59.6% of the females were anemic and among non-anemic category 10.7% of males and 12.3% females were underweight. Respondents having BMI 18.5-24.9, 12.7 % of males and 14.1% females were anemic and in non-anemic category 75.8% of males and 73.1% of females were normal. BMI >25, 12.7% of males and 14.1% females were anemic and 13.5% of the non-anemic

respondents were males, and 14.6% females were Overweight/Obese.

Regarding the awareness of anemia among subjects (n=720), 31.6% (n=228) of the respondents heard about anemia, among which 21.4% (n=48) were males and 78.6% (178) females. Meanwhile, clinical symptoms were listed as fatigue, weakness, dizziness, headache, pallor, and others complications. All the respondents (n=720) included in study (n=225) 31.3% experienced fatigue (16.3% male and 83.7% female), Weakness (27.9% male and 72.1% female), dizziness 36.6% (18.2% male and 81.8% female), Headache 21.8% (13.5% male and 86.5% female), Pallor 10.1% (9.8% male and 90.2% female) and 21.5% other health complications. Section 3 indicates the smoking/smokeless tobacco conditions of respondents, among all respondents, n=178 (24.8%) use smoke or smokeless tobacco, among them 79.5% was male and 20.5% females. Moreover, the dominance of anemia was more significant in respondent who had regular tea daily intake > 4 cups/day (37 %) and tea intake right after meal (30.1%). (Table 3).

Table.3: Clinical examination and social habits of population

S no.	Parameters	Total (n=720)	Male (n=386)	Female (n=334)
1	**Heard about anemia**	155 (21.6%)	49 (31.7 %)	106 (68.3 %)
2	**Symptoms of Anemia**			
	Fatigue	225 (31.3%)	37 (16.3 %)	188 (83.7 %)
	Weakness	433 (60.2 %)	121 (27.9 %)	312 (72.1 %)
	Dizziness	263 (36.6%)	47 (18.2%)	215 (81.8 %)
	Headache	156 (21.8%)	21 (13.5 %)	134 (86.5 %)
	Pallor	72 (10.1 %)	7 (9.8 %)	65 (90.2 %)
	Others	155 (21.5 %)	42 (27.1 %)	113 (72.9 %)
3	**Smoking/ Smokeless Tobacco**			
	Yes	178 (24.8 %)	142 (79.5 %)	36 (20.5 %)
	No	541 (75.2 %)	195 (36.5 %)	346 (63.5 %)
4	**Drinking tea/day**			
	No	22 (3.1 %)	9 (40.9 %)	13 (59 %)
	after every meal	81 (11.3 %)	69 (85.1 %)	12 (14.8 %)
	Snack time (2 - 3 cups)	349 (48.6 %)	154 (44.3 %)	194 (55.7 %)
	Yes (above 4 cups)	266 (37 %)	164 (61.5 %)	102 (38.5 %)

Discussion

To our knowledge this is a novel study, from a sizable and diversified sample of both males and females of different age groups suffering from anemia, carried out in the GB. The prevalence of anemia is higher in females but varies in different regions of Pakistan, where an overall prevalence of anemia in women of reproductive aged (15-49 year) was 41.7 %, adolescent girls (10-19 years) 56.6% and in children 28.6% with a slightly higher proportion (29.1%) among boys than girls (NNS, 2018). Anemia is still a problem in under developing countries, it affects 27% of population. More than 89% of the overall burden of anemia is faced by developing countries[11].

The prevalence of anemia in males was 23.2% moderate anemia was 5.1% and severe anemia was 0.5%. As assessed 21.7% of male's respondent with any degree of anemia had moderate and severe anemia compared with 53.2% of females with any anemia[19].The prevalence of anemia among women of reproductive age is about 29.4%, and anemia impacts about 40% of pregnant women and more than 20% of non-pregnant women worldwide[20]. In our findings, prevalence of anemia was highest in aged 20-40 years in males (31.2%) and females (37.3%), as the results almost resemble to NNS 2018 for prevalence of anemia in women of reproductive age (41.7%) in Pakistan. In a study by Melwani et.,al [21] the overall prevalence of anemia globally among adolescents was 27% in developing countries and 6% in developed countries. In this study, age group 10-19 years (Adolescents) 26.4% males and 29.4% females were anemic. This is the most vulnerable period of life for the development of nutritional anemia .Puberty, growth and other developmental factors influence the nutritional demand of body leading to illnesses i.e. malnutrition if proper diet is not administered according to the daily dietary allowance. Our results are consistent with earlier studies showing that women are more likely than men to suffer from anemia [22, 23] and is generally clarified by the loss of iron in menstrual cycles (WHO, 2017).

In this study, there was no significant association of education level, family size with anemia but there is impact of socio economic status on anemia. In other countries, the lowest income households and least educated individuals have frequently been reported to have a higher risk of anemia and its impacts[24, 25]. Malnutrition is a major concern and it requires serious attention to control the rate of non-communicable diseases country wide[26]. The current study reports the higher prevalence of anemia in undernourished male (67.8%) and females (59.6%) and BMI < 18.5.

The poor awareness about balance diet, anemia symptoms, anemia causes and therapeutic interventions to reduce anemia are associated with higher probability of anemia[26]. To ensure early detection, rapid treatment and better outcomes for those affected by this illness, it is necessary to increase awareness of anemia, its causes, symptoms, and appropriate management[27]. As mentioned by United Nation, (2021) for the prevention of anemia among the most susceptible population groups and accelerate progress toward the Global Nutrition Target 2 (50% reduction in the prevalence of anemia in women of reproductive age by the year 2025) and the Sustainable Development Goals (SDG) indicator 2.2.3 (prevalence of anemia in women 15–49 years of age, by pregnancy status) [28].

Many studies have found a correlation between smoking and increased risk of developing anemia[29]. Cigarette smoking is associated with carbon monoxide exposure, which lowers oxygen tension and results in hypoxia in the body. As a result, hypoxia boosts the production of erythrocytes from blood-forming organs and elevates hemoglobin and hematocrit levels, but serum ferritin levels may be low. However, it is uncertain how smoking affects other iron indices[30]. On the other hand, the current study revealed that the tea consumption is associated with anemia; tea intake was higher in anemic people as compared to non-anemic respondents, which is linked to earlier studies indicating that people who were anemic consumed significantly more tea[31].

Conclusions

In summary, this study clarifies the incidence and risk factors for anemia in the mountainous regions of Gilgit Baltistan, highlighting the contributions of socioeconomic characteristics and inadequate nutrition. The need for improved preventative interventions is highlighted especially for high-risk populations like adolescents, women in reproductive age, and the elderly.

Limitations

The cross-sectional form of the study hinders the development of causal correlations and the absence of precise data on important variables like iron indices and vitamin levels.

Future Perspectives

Favorable outcomes could be obtained by implementing interventions like as micronutrient supplementation and dietary modifications like development of iron enriched formulas from staple food, that are aimed at these groups.

Conflicts of Interest: None declared.

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