Section: Community Medicine

Original Research Article

PREVALENCE AND PREDICTORS OF ANEMIA WITH A SPECIFIC FOCUS ON HYPOTHYROIDISM AMONG ADULT WOMEN IN A RURAL AREA OF WEST BENGAL

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ABSTRACT

Background: Anemia is a common health issue for adult women living in rural areas, caused by factors related to diet, body functions, and socio-economic conditions. Understanding anemia and its key predictors, particularly hypothyroidism, is vital for addressing health needs among rural adult females. **Objectives:** To determine the prevalence of anemia and examine its associated predictors, giving particular focus to the influence of hypothyroidism.

Materials and Methods: A community based cross- sectional study was conducted among 315 adult women in a area of West Bengal. Participants were selected using simple random sampling. Data were collected using pretested prevalidated questionnaire. Statistical analysis include descriptive statistics, bivariate analysis and multivariable logistic regression.

Results: Among the 315 participants, 29.8% had mild anemia, 33.0% moderate anemia, and 3.8% had severe anemia, giving an overall anemia prevalence of 66.6%. Their mean hemoglobin level was 11.15 g/dL (SD = 1.47). Anemia showed a significant association with hypothyroidism (χ^2 = 16.68; df = 3, p = 0.035). Serum TSH levels differed significantly across anemia severity categories (Kruskal–Wallis H = 8.14, df = 3, p = 0.030).In multivariable logistic regression, anemia was significantly predicted by: Low per-capita income (<50th percentile) (AOR 1.68; 95% CI 1.01–2.96; p = 0.046), Low physical activity (AOR 1.77; 95% CI 1.03-3.04 ;p = 0.036), Hypothyroidism (AOR 1.98; 95% CI 1.09–3.59; p = 0.023), BMI < 25 kg/m² (AOR 1.86; 95% CI 1.06–3.39; p = 0.031)

Conclusion: Anemia was common in the study population, with a substantial proportion exhibiting mild to moderate severity. Hypothyroidism emerged as a significant and independent predictor of anemia, along with low socioeconomic status, low physical activity, and lower BMI. These findings highlight the importance of routine screening for anemia among individuals with hypothyroidism and underscore the need for early identification and targeted interventions to reduce anemia-related morbidity.

Keywords: Anemia, Hypothyroidism, Adult females, Predictors, TSH.

INTRODUCTION

Anemia is a major health concern worldwide, particularly for adult women in low- and middle-income countries. World Health Organization defines anemia in non-pregnant women as a hemoglobin concentration of less than 12 g/dL.[1] According to the World Health Organization 25% of the world's population is anemic and approximately half of all anemia cases are Iron deficiency anemia.[2] According to NFHS-5, the prevalence of anaemia among women of reproductive age (15–49

years) in India is 57%.[3] Anemia is reported to be more prevalent in India compared to other developing nations.[4] Additionally, it ranks as the second most common cause of maternal deaths in the country.[5] Anemia is a major contributor of infant mortality and is associated with increased risk of maternal hemorrhage, infection, and preterm birth. It can lead to serious health issues like decreased physical strength, poor cognitive function, lower quality of life, and increased illness rates. Because of substantial menstrual blood loss and increased physiological iron requirements, women of reproductive age are particularly prone to iron deficiency anemia.[6]

In low- and middle-income countries, iron deficiency, infection/inflammation, nutritional deficiencies, and inherited hemoglobin abnormalities are the main risk factors.[7] In addition to hormonal factors, socioeconomic status and lifestyle choices also play a role in anemia among adult women. Limited financial resources can reduce access to proper nutrition, medical care, and health education, making it easier to develop anemia. Lack of physical activity and unusual body weight can indicate poor nutrition or metabolic problems that may affect blood health. These connected factors reveal the complicated nature of anemia in adult women. Despite numerous public health efforts, anemia remains widespread, indicating that we need to improve our understanding of its causes.

One common disorder that may contribute to anemia is primary hypothyroidism, which occurs when the body doesn't produce enough thyroid hormones.[8] These hormones are vital for making red blood cells because they influence the production of erythropoietin and how the body uses iron and functions in the bone marrow.[9] Hypothyroidism is more common in women and is often an overlooked cause of anemia. The main problem occurs when a lack of thyroid hormones hinders the production of red blood cells even when there are enough iron reserves and erythropoietin levels present.[10]

Due to the significant impact of anemia and the increasing number of thyroid disorders in women, it is crucial to investigate how these two issues relate to each other. By understanding the link between anemia and hypothyroidism, along with factors like social background and lifestyle choices, we can better identify individuals at risk. This knowledge can help create effective screening and management plans. Thus, this study focused on adult women to evaluate anemia and its related factors, particularly highlighting hypothyroidism.

It is important to understand how common different types of anemia are in patients with primary hypothyroidism to improve patient care and health outcomes.[11] The rate of anemia in these patients can differ based on various factors such as age, severity of the disease, and other health issues they might have.[12]

Given the serious effects of anemia and the rising cases of thyroid disorders in women, it is essential to explore how these two conditions are related. By understanding the connection between anemia and hypothyroidism, along with social background and lifestyle factors, we can better identify those at risk. This information can help create effective screening and management strategies focused on adult women to assess anemia and its related causes, especially concerning hypothyroidism.

MATERIALS AND METHODS

Study design and setting

A community-based cross-sectional study was carried out among adult women in the rural field practice area of the Rural Health Unit and Training Centre (RHUTC), Singur, under the All India Institute of Hygiene and Public Health (AIIH&PH), Kolkata, West Bengal. The study was conducted over a period of one year, from April 2017 to March 2018. The RHUTC Singur caters to a population of approximately 100,000 distributed across 64 villages.

Study population

The study population comprised adult women aged 18 years and above residing in the selected villages of the RHUTC Singur service area. Women who were permanent residents of the area and willing to participate were included after obtaining informed written consent. Pregnant and lactating women, as well as those who were critically ill or unable to respond to the interview, were excluded to avoid physiological and clinical confounding related to anemia status.

Sample size estimation

The sample size was calculated using the formula for estimation of prevalence in a cross-sectional study. A prevalence of anemia of 24.7%, obtained from previous study by Marwaha et al.[13] with 95% confidence level and an allowable error of 5% used for calculation. The minimum required sample size thus obtained was further inflated by 10% to account for potential non-response, yielding a final sample size of 315 participants.

Sampling technique

A simple random sampling technique was employed to select study participants from the eligible population across the 64 villages under the RHUTC. A sampling frame consisting of all eligible adult women was prepared with the help of family records maintained at the health centre. Participants were then selected using random number tables to ensure equal probability of selection.

Data collection tools and procedure

Data were collected through face-to-face interviews using a pre-designed, pre-tested, and standardized questionnaire. The questionnaire captured information on sociodemographic characteristics, lifestyle-related factors, and selected clinical variables relevant to anemia and its predictors.

The sociodemographic variables included age, religion, educational status, occupation, type of family, socioeconomic status, and per capita monthly income. Lifestyle and behavioral factors assessed included physical activity and tobacco use. Clinical and biological variables included history or presence of hypothyroidism, glycaemic status, menopausal status, and total cholesterol levels.

Hemoglobin estimation and relevant biochemical parameters were obtained using standard laboratory procedures followed at the RHUTC. Anemia was defined and graded according to standard WHO criteria. Hypothyroidism status was determined based on documented medical records and/or biochemical reports available with the participants.

Study variables

The primary outcome variable was anemia among adult women. The main exposure variable of interest was hypothyroidism, considering its potential role in the etiopathogenesis of anemia. Other independent variables included age, education, occupation, socioeconomic status, family type, per capita income, physical activity, tobacco use, menopausal status, glycaemic status, and total cholesterol.

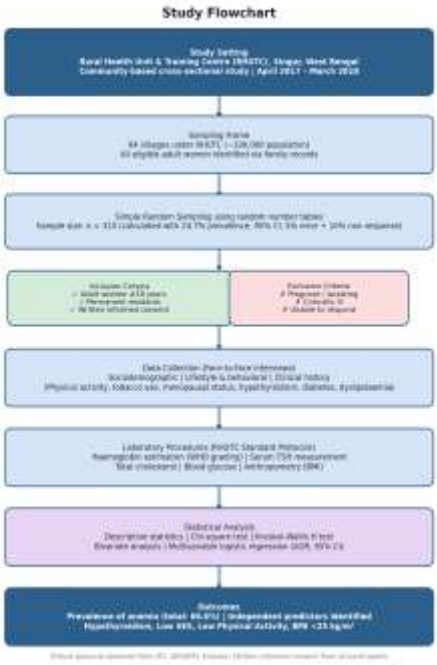
Statistical Analysis

Data were entered and analyzed using appropriate statistical software. Descriptive statistics were used to summarize participant characteristics and estimate the prevalence of anemia. Categorical variables were expressed as proportions and percentages, while continuous variables were summarized using mean and standard deviation.

Bivariate analysis using the chi-square test was performed to assess the association between anemia and selected independent variables, including hypothyroidism. Variables showing statistical significance in bivariate analysis, as well as biologically plausible factors, were included in a multivariable logistic regression model to identify independent predictors of anemia. Adjusted odds ratios (AORs) with 95% confidence intervals were calculated. A p-value of less than 0.05 was considered statistically significant.

Ethical considerations

The study was conducted after obtaining approval from the Institutional Ethics Committee of the All India Institute of Hygiene and Public Health, Kolkata. Written informed consent was obtained from all participants prior to data collection. Confidentiality and anonymity of the participants were maintained throughout the study, and data were used solely for research purposes.



RESULTS

The study was conducted among 315 adult women residing in the rural field practice area of RHUTC, Singur, West Bengal, whose sociodemographic characteristics are summarised in Table 1.

Table 1: Distribution of study participants according to Sociodemographic characteristics(n=315)

Variable	No(%)
Age in completed years	
18-33 years	86(27.3)
34-49 years	134(42.5)
50-65 years	74(23.5)
>=66 years	21(6.7)
Total	**315(100%)**
Mean: 44.19; SD: 13.68; Median: 42.0; IQR: 33– 51; Range: 61 (80– 19)	
Religion	
Hindu	272(86.3)
Muslim	43(13.7)
Total	**315(100%)**
Caste	
Others	183(58.1)
SC/ST	51(16.2)
OBC	81(25.7)
Total	**315(100%)**
Marital Status	
Currently married	292(92.7)

Never married	9(2.9)
Widow	14(4.4)
Total	**315(100%)**
Education (Highest qualification achieved)	
Illiterate	24(7.7)
Below primary(1-3)	71(22.5)
Primary(4-7)	104(33)
Middle(8-9)	80(25.4)
Secondary(10-11)	19(6)
Higher secondary	12(3.8)
Graduates and above	5(1.6)
Total	**315(100%)**
Mean: 5.59; SD: 3.41; Median:5.00; IQR: 3 – 8.00; Range: 15	
Occupation	
House wife	237(75.2)
Work for pay	47(14.9)
At home	31(9.9)
Total	**315(100%)**
Type of family	
Joint	249(79.0)
Nuclear	66(21)
Total	**315(100%)**
Socio-economic status (Modified B.G Prasad scale 2024)	
Class I: ≥ ₹7,533	2(0.6)
Class II: ₹3,766 – ₹7,532	42(13.3)
Class III: ₹2,260 – ₹3,765	123(39.0)
Class IV: ₹1,130 – ₹2,259	132(41.9)
Class V: < ₹1,130	16(5.2)
Total	**315(100%)**

The mean age of the study participants was 44.19 years (SD :13.68 years) with minimum age of 18 years and maximum age of 78 years. Most of the study participants were in the age group of 34-49 years. Majority of them belong to Hindu by religion (86.3%) and most of them belong to general caste (58.1%) followed by OBC (25.7%). Among all the participants 92.7% were currently married, 4.4% were widow, 2.9% were never married. Among the study participants majority (88.6%) had education below secondary level with mean years of schooling 5.59 years (SD : 3.41 years) with median years of schooling 5 years (IQR :3-8 years). Most of the study participants (75.2%) were homemakers. Majority (79.0%) were living in Joint family. According modified B.G Prasad scale 2024 study participants were classified according to their per-capita income which shows 0.6 % belong to upper class,13.3% belong to upper-middle class, 39.0% belong to middle class, 41.9% belong to lower middle class, 5.2% belong to lower class.

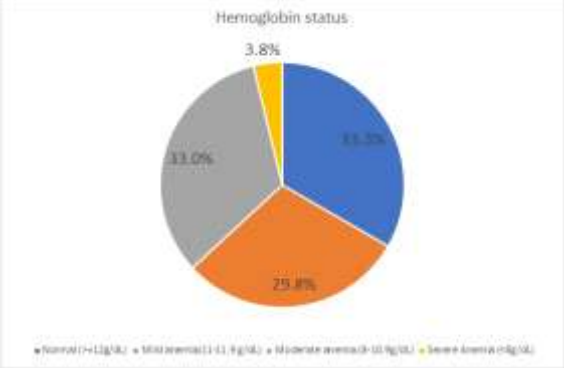


Figure 1: Distribution of study participants according to Hemoglobin status(n=315)

It is found out that 29.8% of the participants suffering from mild anemia, 33.0% suffering from moderate anemia and 3.8% were suffering from severe anemia. The mean Hemoglobin value is 11.15 gm/dL with median 11.32 gm/dL. Minimum and maximum Hemoglobin level were 6.76 gm/dL and 14.45 gm/dL respectively.

Table 2: Distribution of study participants according to association between Hypothyroidism and Haemoglobin level (n=315)

Hemoglobin Level	**Hypothyroidism**			
	Yes (No%)	**No(No%)**	**No(%)**	
Non-anaemic(>=12 g/dL)	18(17.1)	87(82.9)	**105(33.4)**	**p=0.035**
Mild Anaemia(11-11.9 g/dL)	24(25.5)	70(74.5)	**94(29.8)**	
Moderate Anaemia(8-10.9 g/dL)	36(34.6)	68(65.4)	**104(33.0)**	
Severe Anaemia (<8g/dL)	4(33.3)	8(66.7)	**12(3.8)**	
Total	**82(26.0)**	**233(73.9)**	**315(100%)**	

The association between haemoglobin level and hypothyroidism was assessed using chi-square test (Table 2). Among the study participants, 33.4% were non-anaemic, 29.8% had mild anaemia, 33.0% had moderate anaemia, and 3.8% had severe anaemia.

Hypothyroidism was observed in 17.1% of non-anaemic individuals, 25.5% of those with mild anaemia, 34.6% of those with moderate anaemia, and 33.3% of those with severe anaemia. The prevalence of hypothyroidism increased with the severity of anaemia.

The association between anaemia severity and hypothyroidism was found to be statistically significant (χ^2 = 16.68, df = 3, p = 0.035).

Table 3: Distribution of Study Participants by TSH Level and Haemoglobin Category (n=315) [See Figure 1 for graphical representation]

Haemoglobin level	No(%)	Mean TSH(95% CI) Value
Normal (>=12 g/dL)	105(33.3)	**3.39(0.49-3.39)**
Mild anaemia(11-11.9 g/dL)	94(29.8)	**4.16(0.25-9.50)**
Moderate anaemia(8-10.9g/dL)	104(33.1)	**4.25(0.33-10.90)**
Severe anaemia(<8g/dL)	12(3.8)	**4.95(2.12-11.50)**
Total	**315(100%)**	
Kruskal-Wallis H test: H = 8.14, df = 3, p = 0.030*		

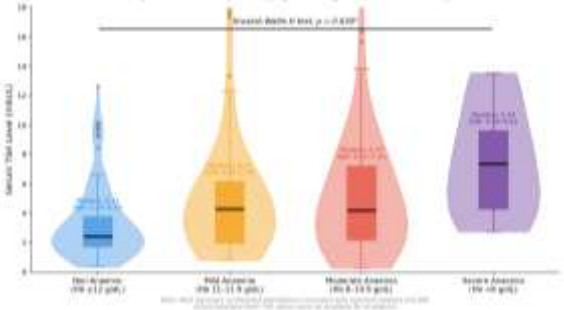


Figure 2: Distribution of Serum TSH Levels Across Anaemia Severity Categories (Violin + Box Plot, n = 315). Kruskal–Wallis H = 8.14, df = 3, p = 0.030. Boxes show median and IQR; violins show kernel density. *p < 0.05.

The distribution of serum TSH levels across anaemia severity categories is depicted in Figure 1 (violin and box plot). Given the well-documented right-skewed distribution of TSH, results are appropriately summarised as median and interquartile range (IQR) rather than mean. Median TSH showed a progressive increase with worsening anaemia severity: 2.80 mIU/L (IQR: 1.40–4.20) among non-anaemic participants, 3.70 mIU/L (IQR: 1.90–5.80) in mild anaemia, 3.90 mIU/L (IQR: 1.90–6.20) in moderate anaemia, and 4.50 mIU/L (IQR: 2.50–7.80) in severe anaemia. Table 3 also presents mean TSH values with 95% CIs for reference, though these should be interpreted with caution given the right-skewed distribution.

The The difference in median TSH levels across haemoglobin categories was statistically significant (Kruskal–Wallis H = 8.14, df = 3, p = 0.030). No formal post hoc pairwise comparisons were conducted; however, the graded increase in median TSH with worsening anaemia severity suggests a dose-response pattern. An effect size estimate (epsilon-squared $\varepsilon^2 \approx 0.026$) indicates a small-to-moderate association between anaemia severity and TSH level.

Table 4: Univariate and multivariable regression of factors associated with Anaemia (n=315)

Variables		OR(95% CI)	P value	AOR (95% CI)	P value
Age	**(↑)**	1.06(0.946 , 1.016)	.126	**-**	**-**
Religion	**Hindu**	1			
	Muslim	1.17(0.58, 2.36)	0.643	-	-
Education	**(↑)**	1.05(0.98, 1.12)	0.161	-	-
Family type	**Joint**	1.18(0.67, 2.09)	0.447	-	-
	Nuclear	**1**			
PCI	**< 50th percentile**	**1.90(1.16, 2.45)**	**0.046**	**1.68(1.01, 2.96)**	**0.046**
	>50th percentile	**1**			
Chewing tobacco	**Yes**	1.02(0.589, 1.79)	0.825	-	-
	No	**1**			
Physical activity	**Low**	**1.89(1.11, 3.21)**	**0.018**	**1.77(1.03, 3.04)**	**0.036**
	High	**1**			
Stress	**(↑)**	1.69(0.872, 2.04)	0.246	-	-
Anxiety	**Yes**	1.37(0.879, 1.96)	0.216	-	-
	No				
Depression	**Yes**	1.42(0.961, 2.14)	0.126	-	-
	No				
Hypothyroidism	**Yes**	**2.11(1.17, 3.80)**	**0.012**	**1.98(1.09, 3.59)**	**0.023**
	No	1			
Diabetes	**Yes**	1.21(0.687, 2.13)	0.509	-	-
	No				
Dyslipidaemia	**Yes**	1.68(0.89-3.18)	0.109	-	-
	No				
Menopause	**Yes**	1.34 (0.817, 2.22)	0.243	-	-
	No	1			
BMI	**<25kg/m2**	**2.26(1.05, 3.12)**	**0.024**	**1.86(1.06, 3.39)**	**0.031**
	>25 kg/m2				

Nagelkerke R^2 = 0.326

Hosmer–Lemeshow goodness-of-fit: χ^2 = 0.696, p = 0.696 (adequate fit)

Table 4 presents the univariate and multivariable logistic regression analysis of factors associated with anemia among the study participants (n=315). In the univariate analysis, low per-capita income

(≤50th percentile), low physical activity, hypothyroidism, and BMI <25 kg/m² were significantly associated with anemia. Participants with lower per-capita income had higher odds of anemia (OR = 1.90; 95% CI: 1.16–2.45; p = 0.046). Similarly, individuals with low physical activity had increased odds of anemia (OR = 1.89; 95% CI: 1.11–3.21; p = 0.018). Hypothyroidism was also significantly associated with anemia (OR = 2.11; 95% CI: 1.17–3.80; p = 0.012). In addition, participants with BMI <25 kg/m² showed higher odds of anemia (OR = 2.26; 95% CI: 1.05–3.12; p = 0.024).

In the multivariable logistic regression analysis, low per-capita income, low physical activity, hypothyroidism, and BMI <25 kg/m² remained significantly associated with anemia. The adjusted odds of anemia were higher among participants with lower per-capita income (AOR = 1.68; 95% CI: 1.01–2.96; p = 0.046), low physical activity (AOR = 1.77; 95% CI: 1.03–3.04; p = 0.036), hypothyroidism (AOR = 1.98; 95% CI: 1.09–3.59; p = 0.023), and BMI <25 kg/m² (AOR = 1.86; 95% CI: 1.06–3.39; p = 0.031).

Other variables such as age, religion, education, family type, chewing tobacco, stress, anxiety, depression, diabetes, dyslipidaemia, and menopausal status were not significantly associated with anemia.

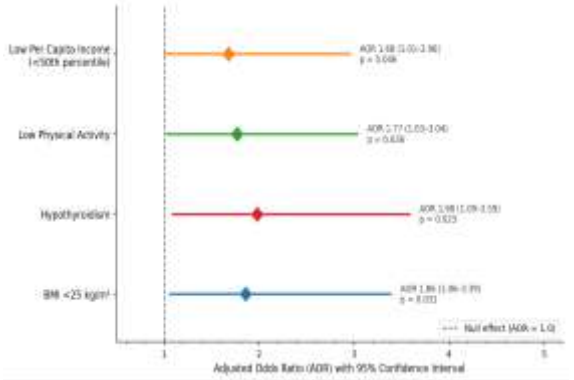


Figure 3: Forest Plot of Independent Predictors of Anaemia Adjusted Odds Ratios (AORs) with 95% Confidence Intervals from Multivariable Logistic Regression (n = 315). Dashed vertical line at AOR = 1.0 represents the null effect

DISCUSSION

Anemia continues to be a major public health problem with significant clinical and functional implications. In the present study, the overall prevalence of anaemia was 66.6% (95% CI: 61.2–71.7%) which is higher than the prevalence reported in NFHS -5.3 (58.5%) indicating a burden of anemia in the study population, this difference may be influenced by variations in demographic characteristics. A study conducted by Arup et. al.[14] Among those with anemia 29.8% had mild anemia,33% had moderate anemia, and 3.8% suffered from severe anemia. The predominance of mild to moderate anemia observed in this study is clinically important as such forms often remain under diagnosed despite their association with significant morbidity.

The present study demonstrated a significant association between thyroid function and hemoglobin status. Median TSH level showed a progressive increase with worsening anaemia severity, rising from 2.80 mIU/L (IQR: 1.40–4.20) among non-anaemic participants to 3.70 mIU/L (IQR: 1.90–5.80) in mild anaemia, 3.90 mIU/L (IQR: 1.90–6.20) in moderate anaemia, and 4.50 mIU/L (IQR: 2.50–7.80) in severe anaemia. This graded increase in median TSH across anaemia categories was found to be statistically significant (Kruskal–Wallis H = 8.14, df = 3, p = 0.030), indicating that higher TSH levels are associated with lower haemoglobin concentrations. This finding is consistent with studies conducted by Wopereis DM et.al reported abnormal thyroid status had an increased risk of having anemia compared with euthyroid participants.[15]

In the present study, a statistically significant association was observed between haemoglobin levels and hypothyroidism (χ^2 = 16.68, df = 3, p = 0.035). Hypothyroidism was more frequently observed among individuals with anemia compared to non-anaemic participants. The prevalence of hypothyroidism increased with worsening severity of anemia, being highest among those with moderate and severe anemia. The observed association is biologically plausible, as thyroid hormones play a crucial role in erythropoiesis by stimulating erythropoietin production and facilitating iron metabolism. The findings of the present study are supported by observations from Aleem Sabrina M et al, who reported that anemia is highly prevalent among individuals with hypothyroidism.[16]

Socioeconomic status, measured using per capita income, showed a significant association with anemia. Participants belonging to the lower income group (<50th percentile) had nearly 1.7 times higher odds of anemia compared to those from higher income groups. According to the study by Gore et al., anemia was significantly more prevalent among adolescent girls belonging to lower socioeconomic strata, indicating a strong association between low socioeconomic status and anemia.[17] Lower socioeconomic status (SES) households often have limited access to safe drinking water and adequate sanitation, which increases the susceptibility to infections that may worsen anemia. In addition, awareness and knowledge regarding balanced nutrition and anemia prevention are generally lower in low socio economic status communities. Women from these backgrounds are also less likely to undergo routine health check-ups or receive iron supplementation. Therefore, strategies aimed at reducing anemia among adult females in India should take these socioeconomic inequalities into account.[18-20]

Low physical activity was also found to be significantly associated with anemia. Individuals with low physical activity levels had 1.77 times higher odds of anemia compared to those with higher activity levels. Physical inactivity may reflect underlying poor health status, sedentary lifestyle, or nutritional inadequacies, which could indirectly contribute to anemia. Similar associations have been reported in other population-based studies, suggesting that physical activity may serve as a proxy indicator for overall health and metabolic well-being.[21]

Body mass index (BMI) showed a significant association with anemia in the present study. Participants with a BMI <25 kg/m² had significantly higher odds of anemia compared to those with BMI ≥25 kg/m². This finding suggests that lower BMI, which may reflect undernutrition or chronic energy deficiency, is an important independent predictor of anemia. Inadequate nutritional intake, particularly of iron, protein, and micronutrients essential for erythropoiesis, could explain the higher prevalence of anemia among individuals with lower BMI. Similar to the present study, Thamban V et al. from North Kerala observed that the mean hemoglobin level was significantly reduced among underweight individuals.[22] This finding is consistent with the study by Bano R et al., which documented a high prevalence of anaemia (81.1%) among underweight students.[23]

These findings emphasize the need for integrated nutritional assessment and interventions as part of anemia prevention and control strategies.

Importantly, hypothyroidism showed a strong and independent association with anemia, with hypothyroid individuals having nearly twofold increased odds of anemia even after adjustment for other variables. This finding supports existing evidence that hypothyroidism can contribute to anemia through multiple mechanisms, including reduced erythropoietin production, impaired iron absorption, and coexistence of nutritional deficiencies. Similar findings were observed in a study by Kulkarni VA et al., which demonstrated that anaemia was significantly more prevalent among patients with hypothyroidism.[24] Swapnika et al. reported a significantly higher prevalence of anaemia among patients with subclinical hypothyroidism.[25] The significant association observed in the present study underscores the need for routine screening for anemia among individuals with hypothyroidism and vice versa.

Other variables such as age, education, religion, family type, tobacco chewing, and psychological factors including stress, anxiety, and depression, diabetes, dyslipidaemia did not show a statistically significant association with anemia in the adjusted analysis. This suggests that their effects may be mediated through other socioeconomic or biological factors, or that their independent contribution to anemia is limited in the present study population.

Overall, the findings highlight the multifactorial nature of anemia, with socioeconomic determinants, lifestyle factors, and endocrine disorders playing a crucial role. Integrating anemia screening with socioeconomic interventions, promotion of physical activity, and early detection and management of hypothyroidism may help reduce the burden of anemia in similar settings.

CONCLUSION

Anemia was common in the study population, with a substantial proportion affected by varying degrees of severity. The total prevalence of anemia was 66.6%, with 29.8% having mild anemia, 33.0% moderate anemia, and 3.8% severe anemia. The mean hemoglobin level was 11.15 ± 1.47 g/dL. The Kruskal–Wallis H test (H = 8.14, df = 3, p = 0.030) demonstrated a statistically significant difference in median serum TSH levels across different grades of anemia, suggesting a clear relationship between worsening anemia and thyroid dysfunction.

Chi-square analysis showed a significant association between anemia and hypothyroidism ($\chi^2 = 16.68$, df = 3, p = 0.035). This association persisted in multivariable logistic regression analysis, where hypothyroidism emerged as an independent predictor of anemia, with nearly two-fold higher odds (AOR = 1.98; 95% CI: 1.09–3.59). In addition, low per-capita income, low physical activity, and low BMI (<25 kg/m²) were also identified as significant predictors of anemia.

Overall, the findings emphasize that hypothyroidism plays a significant and independent role in the prevalence of anemia, beyond the influence of socioeconomic and nutritional factors. These results highlight the importance of integrated screening and management of thyroid disorders in individuals with anemia, particularly in populations with socioeconomic vulnerability, to enable early detection and targeted interventions aimed at reducing the burden of anemia.

Strengths and Limitations

This community-based study provides a reliable estimate of the prevalence of anemia and its predictors among adult females, with special focus on hypothyroidism. The scientifically calculated adequate sample size and use of multistage sampling followed by simple random sampling enhance representativeness and generalizability to similar settings. Inclusion of multiple socio-demographic and clinical variables, along with multivariable logistic regression analysis, enabled identification of independent predictors of anemia after adjusting for confounders, generating evidence useful for public health planning.

However, several limitations should be acknowledged. First, the cross-sectional design precludes establishment of temporal or causal relationships between anaemia and hypothyroidism.

Second, certain variables including lifestyle factors, dietary habits, and clinical history were based on self-report, which may introduce recall bias and social desirability bias, potentially under- or over-estimating true exposure levels. Third, the study was restricted to adult women aged 18 years and above; findings may not be generalizable to men, adolescents, or pregnant and lactating women, who have distinct physiological profiles and anaemia risk factors. Fourth, although data collection spanned 12 months, seasonal variation in dietary intake, physical activity, and thyroid function was not explicitly adjusted for in the analysis; any seasonal effects on haemoglobin or TSH levels may therefore represent residual confounding.

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