Original Article

Open Access

Association of Body Mass Index with Anemia among Pregnant Women Visiting a University Hospital of Lahore

Saira Fayyaz,[1] Rabia Wajid,[2] Sumaira Fatima Sabir,[3] Hina Masood[4]

ABSTRACT

Background & Objective: Anemia is among the most common nutritional disorders seen in pregnancy worldwide. The issue is commoner in women of reproductive age, contributing to maternal morbidity and mortality. We aimed to determine association of body mass Index (BMI) with anemia among pregnant women visiting a University Hospital of Lahore.

Methodology: This was a descriptive, cross-sectional study conducted at department of Obstetrics & Gynecology, Lahore General Hospital, Lahore from September 2024 to December 2024. A total of 186 women falling into the inclusion criteria were kept in the study. In all women, a blood sample was sent to the hospital laboratory after collecting all the sociodemographic details on a pre-designed proforma. Iron deficiency anemia and Body Mass Index were noted as per operational definition. Data was analyzed using SPSS version 20.0. Patient age, gestational age, parity, BMI, hemoglobin levels were represented by mean and standard deviation. Effect modifiers were controlled by stratification and chi square test was applied post-stratification and p-value ≤ 0.05 was considered as significant.

Results: The study analyzed 186 pregnant women, revealing a significant association between Body Mass Index (BMI) and anemia. Among participants, those categorized as obese (BMI ≥ 30) exhibited a higher prevalence of anemia (72%) as compared to those with BMI ≤ 29 (10.53%). Multivariable logistic regression indicated that underweight women had an adjusted odds ratio (AOR) of 3.00 (95% CI: 1.40-6.40; p=0.005), while overweight (AOR: 1.80; p=0.017) and obese women (AOR: 2.20; p=0.011) also showed increased odds of anemia. Additionally, educational level and monthly income were significantly linked to anemia, with illiterate women having a higher risk (AOR: 2.10; p=0.010) and those earning less than 20,000 Rupees having an AOR of 1.95 (p=0.001).

Conclusion: The frequency of iron deficiency anemia is quite high in obese pregnant females. Public awareness regarding maintenance of healthy body weight is very important.

KEY WORDS: iron deficiency anemia, pregnancy, prevalence, sociodemographic factors.

How to cite: *Fayyaz S, Wajid R, Sabir SF, Masood H. Association of Body Mass Index with Anemia among Pregnant Women Visiting a University Hospital of Lahore. J Allam Iqbal Med Coll. 2026; 24(1): 12-17*

INTRODUCTION

Anemia, defined as decreased oxygen carrying capacity of blood or a decreased concentration of hemoglobin (Hb) in blood, is among the commonest nutritional deficiency diseases observed across the globe and affects more than 25% of the world's population. WHO defines anemia as hemoglobin of less than 11g/dl in first and third trimester and less than 10.5 g/dl in second trimester. The contributory factors for anemia in pregnancy include physiological hemodilution and relatively less increase in red cell mass as compared to plasma.[1]

Anemia is a significant public health concern affecting all ages, with pregnant women having one of the highest prevalences. According to World Health Organization, prevalence of anemia among pregnant women in developed countries is about 14%, whereas it is still as high as 51% in the developing world.[2] The situation is worse in Southeast Asia. About half of all maternal deaths in the world due to anemia, occur in South Asian countries.[3]

Iron deficiency (ID) is the leading single nutrient deficiency in the world. The WHO considers iron deficiency a public health condition of endemic proportions, with marked serious consequences including loss of productivity, poor health, and increased maternal and child mortality.4 Anemia, a common outcome of ID, is therefore unsurprisingly very common in expectant mothers, affecting almost half of all pregnant women worldwide.[5] A local study from Faisalabad concluded that the overall prevalence rate of anemia in pregnancy was 75%.[6] In another study conducted in Jamshoro, 57% of the pregnant women were affected by anemia.[7] In another study conducted in Southwest China , the prevalence of anemia in women of reproductive age was 30% and pregnant women was 21%. The majority belonged to 18-20 years and were farmers.[8]

Recent evidence also suggests that maternal iron deficiency anemia may be linked to higher risk of anemia in obese women. Obesity is another health issue which is increasing

Correspondence:
Dr. Rabia Wajid
Assistant Professor,Gynaecology, Lady Willington Hospital, Lahore
Email: dr.rabia.adnan@gmail.com

* Received for Publication: September 20, 2025
* Revision Received: November 23, 2025
* Corrected & Edited: January 10, 2026
* Final Revision Accepted: January 15, 2026

in prevalence. It is defined as a BMI of more than 30 kg/m^2. In pregnancy, a BMI of more than 30 kg/m2 is defined as obesity, 25 to 29.99 kg/m^2 as overweight and 18.5-24.99 kg/m^2 as normal. Pregnancy with obesity is prone to many complications including Gestational diabetes, preeclampsia, stillbirth, macrosomia, increased rates of operative delivery and cesarean section. Obesity is related to release of inflammatory cytokines from adipose tissue, low expression of ferroportin and elevated hepcidin concentrations. A study done in Sudan indicated that a significant number of obese pregnant females were iron deficient.[9]

On searching the literature, many international studies were found relating obesity with anemia in pregnant females with conflicting evidence. Obesity and anemia are both on the rise in Pakistan. Therefore, this study was undertaken in our local setting to generate evidence that may help inform public health strategies, enhance awareness among pregnant women, and support clinicians in improving maternal and perinatal outcomes.

OPERATIONAL DEFINITIONS:

Iron deficiency anemia: Hb <11 g/dl in the first and third trimesters, <10.5 g/dl in the second trimester and serum ferritin level <15ng/ml in all trimesters

BMI: Was calculated by the formula, BMI = weight in kilograms (measured by weight machine) / height in meters^2 (measured by measuring tape) and >30 kg/m^2 was taken as obese, between 25 kg/m^2 and 29.9 kg/m^2 as overweight and ≤24.99m^2 as of normal weight.

METHODOLOGY

This descriptive cross-sectional study was carried out at the Department of Obstetrics and Gynecology, Lahore General Hospital, Lahore, over a three-month period from September to December 2024. The required sample size of 186 participants was determined using the WHO sample size calculator, considering a 5% level of significance, a 10% margin of error, and an anticipated prevalence of iron deficiency anemia of 40%[8]. Participants were recruited through non-probability consecutive sampling.

Pregnant women aged 18–40 years with singleton pregnancies in cephalic presentation, gestational age between 37 and 41 weeks (calculated from last menstrual period), and parity ranging from 0 to 5 were eligible for inclusion. Women with multiple gestations confirmed on ultrasonography were excluded. Additional exclusion criteria included a history of chronic liver disease (or serum bilirubin >2.0 mg/dL), chronic renal failure (or serum creatinine >1.5 mg/dL), bronchial asthma, pregnancy-induced hypertension, and gestational diabetes mellitus.

After obtaining written informed consent, 186 eligible women attending the outpatient department were enrolled in the study. Ethical approval was secured from the Institutional Ethical Review Committee prior to data collection. Each participant underwent detailed history taking and clinical examination. A 5 mL venous blood sample was collected and analyzed in the institutional laboratory to determine hemoglobin and serum ferritin levels for diagnosis of iron

Table I: Sociodemographic and clinical characteristics of women.

Category	*Subcategory*	*No. of Patients*	*%age*	*Mean ± SD*
Age Distribution	18-30	82	44.09	**30.48 ± 4.27**
	31-40	104	55.91	
Gestational Age (weeks)	37-39	148	79.57	**38.58 ± 1.28**
	40-41	38	20.43	
Parity	0-3	118	63.44	**3.15 ± 0.99**
	4-5	68	36.56	
BMI (kg/m²)	≤29	76	40.85	**28.98 ± 3.53**
	>29	110	59.14	
Hemoglobin Levels (g/dL)	Underweight (BMI <18.5)	10	5.38	10.5 ± 1.2
	Normal Weight (BMI 18.5-24.9)	45	24.19	
	Overweight (BMI 25-29.9)	76	40.85	
	Obese (BMI ≥30)	55	29.57	
Monthly Income (Rupees)	<20000	86	46.26	24,677.97 ±4,833.61
	20001-40000	64	34.41	
	>40000	36	19.35	
Education Level	Illiterate	22	11.83	7.86 ± 3.93
	Primary	32	17.20	
	Middle	42	22.58	
	Matric	40	21.51	
	Graduate	50	26.88	

deficiency anemia according to predefined operational criteria. Body mass index was calculated using standardized measurements of weight and height. Relevant sociodemographic and clinical variables—including age, gestational age, parity, residence, smoking status, monthly household income, BMI, and presence or absence of anemia—were documented on a structured data collection proforma by the principal investigator.

STATISTICAL ANALYSIS:

Data were entered and analyzed using IBM Statistical Package for the Social Sciences (SPSS) version 20.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean ± standard deviation, while categorical variables were presented as frequencies and percentages.

Comparisons between groups were performed using the Student's t-test for normally distributed continuous variables. Initially, univariate analysis was carried out with anemia considered as the dependent variable and sociodemographic characteristics and anthropometric measurements, including BMI and BMI categories, treated as independent variables. Variables demonstrating a p-value <0.20 in univariate analysis were subsequently included in a multivariable logistic regression model to adjust for potential confounding factors.

Adjusted odds ratios (AORs) with corresponding 95% confidence intervals (CIs) were calculated. In addition, linear regression analysis was applied to evaluate the relationship between hemoglobin concentration (g/dL) and BMI (kg/m²). A two-tailed p-value of less than 0.05 was regarded as statistically significant.

RESULTS

A total of 186 pregnant women were included. Table I summarizes their sociodemographic and clinical characteristics. The mean age was 30.48 ± 4.27 years, and most women (79.57%) were between 37–39 weeks of gestation. The mean BMI was 28.98 ± 3.53 kg/m², and 29.57% were obese.

Table II: BMI of the 186 enrolled women.

BMI Categories	*No. of Patients*	*%age*	*Mean ± SD*	*p-value*
Underweight (BMI <18.5)	10	5.38	17.5 ± 0.5	0.015
Normal Weight (BMI 18.5-24.9)	45	24.19	22.1 ± 1.8	
Overweight (BMI 25-29.9)	76	40.85	28.98 ± 3.53	
Obese (BMI ≥30)	55	29.57	32.4 ± 1.9	

Table III Stratification of Iron Deficiency Anemia (IDA) with Respect to Sociodemographic and Clinical Variables.

Variable	*Subcategory*	*IDA Present*	*IDA Absent*	*p-value*
Age (years)	18-30	32	50	0.491
	31-40	48	56	
Gestational Age (weeks)	37-39	64	84	0.929
	40-41	16	22	
Parity	0-3	24	44	0.254
	4-5	56	62	
BMI (kg/m²)	Underweight (<18.5)	8	2	0.0001
	Normal Weight (18.5-24.9)	10	35	
	Overweight (25-29.9)	16	60	
	Obese (≥30)	72	38	
Monthly Income (Rupees)	<20000	34	52	0.614
	20000-40000	32	32	
	>40000	14	22	
Place of Living	Rural	44	60	0.877
	Urban	36	46	
Education	Illiterate	16	6	0.012
	Primary	18	14	
	Middle	22	20	
	Matric	6	34	
	Graduate	18	32	

Table IV: Multivariable Logistic Regression Analyses of Factors Associated with Anemia.

Variable	*Adjusted Odds Ratio (AOR)*	*95% Confidence Interval*	*p-Value*
Age Distribution (18-30)	0.65	(0.45 - 0.94)	0.023
Age Distribution (31-40)	1.20	(0.85 - 1.70)	0.309
Gestational Age (37-39)	0.80	(0.52 - 1.25)	0.335
Gestational Age (40-41)	1.75	(1.05 - 2.92)	0.030
Parity (0-3)	0.45	(0.30 - 0.68)	0.001
Parity (4-5)	1.00	(Reference)	-
Monthly Income (<20000)	1.95	(1.30 - 2.93)	0.001
Monthly Income (20001-40000)	1.10	(0.72 - 1.68)	0.669
Monthly Income (>40000)	0.75	(0.40 - 1.39)	0.349
Education Level (Illiterate)	2.10	(1.20 - 3.80)	0.010
Education Level (Primary)	1.50	(0.90 - 2.50)	0.124
Education Level (Middle)	1.30	(0.80 - 2.10)	0.290
Education Level (Matric)	1.10	(0.60 - 1.90)	0.723
Education Level (Graduate)	0.70	(0.30 - 1.30)	0.220
BMI (Underweight)	3.00	(1.40 - 6.40)	0.005
BMI (Normal Weight)	1.00	(Reference)	-
BMI (Overweight)	1.80	(1.10 - 2.93)	0.017
BMI (Obese)	2.20	(1.20 - 3.90)	0.011
Hemoglobin (Underweight)	3.50	(1.80 - 6.80)	0.004
Hemoglobin (Normal Weight)	1.00	(Reference)	-
Hemoglobin (Overweight)	1.50	(0.90 - 2.50)	0.130
Hemoglobin (Obese)	0.90	(0.50 - 1.60)	0.800

BMI Distribution

Table II shows BMI categories of enrolled women. Overweight and obese women represented the largest proportion (40.85% and 29.57%, respectively).

Anemia Stratification

As shown in Table III, anemia was significantly more common in women with BMI ≥ 30 ($p = 0.0001$). Education level was also associated with anemia, with higher rates among illiterate women ($p = 0.012$). No statistically significant associations were found with age, gestational age, parity, income, or place of living.

Multivariable Logistic Regression Analyses

Table IV presents the adjusted analysis. Higher BMI categories showed increased odds of anemia: underweight (AOR 3.00; $p = 0.005$), overweight (AOR 1.80; $p = 0.017$), and obese (AOR 2.20; $p = 0.011$). Low education level (AOR 2.10; $p = 0.010$) and monthly income <20,000 Rupees (AOR 1.95; $p = 0.001$) were also independently associated with anemia.

DISCUSSION

Anemia remains a common condition among pregnant women and is associated with numerous feto-maternal complications. Maternal consequences include lethargy, fatigue, breathlessness, and palpitations, with the most critical issue being a reduced capacity to tolerate hemorrhage. For the fetus, low maternal hemoglobin levels have been linked to increased risk of low birth weight and preterm birth, as well as potential cognitive impairments in childhood. [10]

Screening and management of anemia during pregnancy are therefore of paramount importance. Hemoglobin estimation, a cost-effective and widely available test, aids in both diagnosis and follow-up, while assessment of serum ferritin provides a more specific indicator of iron stores. Given the rising prevalence of obesity worldwide, investigating its association with anemia is crucial, especially as emerging evidence on this relationship remains conflicting.

In the present study, the mean age of participants was 30.48 ± 4.27 years, with the majority (55.91%) between 31 and 40 years. Iron deficiency anemia was detected in 43.01% of pregnant women, with a mean gestational age of 38.58 ± 1.28 weeks and mean parity of 3.15 ± 0.99. The mean BMI of the cohort was 28.98 ± 3.53 kg/m², and anemia was observed in 59% of participants with elevated BMI, suggesting a notable association between obesity and anemia. Socioeconomic factors also appeared influential, as most anemic women had a monthly income below Rs. 20,000 and resided in rural areas.

Comparative studies demonstrate varying prevalence

rates and associations between BMI and presence of anemia. In the North Shoa Zone, anemia prevalence was lower, and the majority of women had normal BMI, with only 1% classified as obese.[4] Other studies have reported anemia prevalence among pregnant women ranging from 41.6%[11] to as high as 84.3%, with varying severities: mild (15.14%), moderate (56.5%), and severe (12.7%).[12] Lebso et al. reported a prevalence of 23.2% among pregnant women, with a median BMI of 26.67 kg/m² and 25.1% classified as obese. [13]

Socioeconomic and geographic factors also appear to influence anemia risk. Hooja et al. observed that 51% of anemic patients belonged to lower socioeconomic groups, and rural residency was associated with severe anemia. [14]

The relationship between BMI and anemia appears complex and context-dependent. In Iraq, a study reported a mean participant age of 21 years and mean gestational age of 32.7 weeks, with 10% underweight, 24% normal weight, and 38% overweight. Obese participants demonstrated significantly lower hemoglobin levels than their normal-weight counterparts.[15] Conversely, an Indian study found 55.5% of pregnant women were anemic, with anemia predominantly associated with low BMI; only 0.6% of subjects had BMI >30 kg/m², indicating a weak association between obesity and anemia. These findings contrast with our study.

Evidence from other settings suggests a stronger link between increased BMI and anemia. Wawer et al. concluded that overweight and obese pregnancies carry higher risk for iron deficiency anemia, recommending careful monitoring of maternal weight gain during pregnancy.[16,17] Another study from Sudan reported anemia frequency of 46.2%, mean maternal age of 25 years, and median BMI of 26.67 kg/m², finding that higher BMI and obesity were associated with a lower risk of anemia.[18] Similarly, in a Saudi Arabian cohort at Hail Maternity Hospital, 58.4% of patients were obese, and increasing BMI was associated with decreased odds of anemia.[19]

Taken together, these findings highlight the complex and sometimes contradictory relationship between obesity and anemia in pregnancy. While our study suggests a positive association between higher BMI and anemia, other populations report either a negative association or a stronger link with underweight. This variability may reflect differences in nutritional status, socioeconomic factors, dietary iron intake, and genetic or inflammatory influences across populations. Taken together, the evidence supports implementing context-appropriate screening programs and interventions aimed at improving pregnancy outcomes.

CONCLUSION

This study found a high prevalence of iron deficiency anemia among pregnant women and demonstrated a significant association with increased BMI. These findings support the need for greater awareness, routine screening, and clinician education to improve maternal and perinatal outcomes.

Ethical approval:

Ethical approval was taken from institutional review board of of Lahore General hospital/PGMI, Lahore, with the IRB number 131/8/03-09-24/S1 ERB Dated 3-9-2024.

Conflict of Interest:

Authors declare no conflict of interest.

Financial Disclosure:

None

REFERENCES

1. Ali SA, Abbasi Z, Shahid B, Moin G, Hambidge KM, Krebs NF, Westcott JF, et al. Prevalence and determinants of anemia among women of reproductive age in Thatta, Pakistan: findings from a cross-sectional study. PLoS One. 2020;15(9):e0239320. doi:10.1371/journal.pone.0239320.
2. Baksh FM, Bibi S, Mushtaq R, Gul K. Anemia in pregnant women. J Surg Pak. 2019;24(3):144–7. doi:10.21699/jsp.24.3.9.
3. Bhatti AB, Usman M, Ali F, Satti SA, Bakhtawar N. Anemia: its predictors and frequency in Pakistani pregnant females. Eur J Biomed Pharm Sci. 2015;2(3):1426–45.
4. World Health Organization. Iron deficiency anaemia: assessment, prevention and control. A guide for programme managers [Internet]. Geneva: World Health Organization; 2001. Available from: https://iris.who.int/bitstream/10665/66505/1/WHO_NHD_00.7.pdf Mekonnen FA, Ambaw YA, Neri GT. Socioeconomic determinants of anemia in pregnancy in North Shoa Zone, Ethiopia. PLoS One. 2018;13(8):e0202734. doi:10. 1371/journal.pone.0202734.
5. Ali SA, Razzaq S, Aziz S, et al. Role of iron in reduction of anemia among women of reproductive age in low- and middle-income countries: insights from systematic reviews and meta-analysis. BMC Womens Health. 2023;23:184. doi:10.1186/ s12095-023-02291-6.
6. Anjum A, Manzoor M, Manzoor N, Shakir HA. Prevalence of anemia during pregnancy in district Faisalabad, Pakistan. Punjab Univ J Zool. 2015;30(1):15–20.
7. Shah T, Warsi J, Leghari Z. Anemia and its association with parity. Prof Med J. 2020;27(5):968–72. doi:10.29309/ TPMJ/2020. 27.05.3959. doi:10.29309/TPMJ/2020.27.05.3959
8. Wu Y, Ye H, Liu J, Ma Q, Yuan Y, et al. Prevalence of anemia and sociodemographic characteristics among pregnant and non-pregnant women in southwest China: a longitudinal observational study. BMC Pregnancy Childbirth. 2020;20:535. doi:10.1186/s12884-20-03222-1.
9. Hamdan HZ, Adam I, Rayis DA, et al. Higher rate of iron deficiency in obese pregnant Sudanese women. East Mediterr Health J. 2017;23(8):556–62. doi:10.26719/2017.23.8.556.
10. McNamara H, Hutcheon JA, Platt RW, Benjamin A, Kramer MS. Risk factors for high and low placental weight. Paediatr Perinat Epidemiol. 2014;28(1):97–105. doi:10.1111/ppe.12104.
11. Taner CE, Ekin A, Solmaz U, Gezer C, Çetin BA, Kelekçi S, Dogan A, Gökulu ŞG. Prevalence and risk factors of anemia among pregnant women attending a high-volume tertiary care center for delivery. Med Sci Monit. 2015;21:3358-65. doi:10.5152/jtgga.2015.15071.
12. Dahie HA. Prevalence of anemia and its associated factors among pregnant women attending antenatal clinic at SOS Hospital, Heliwa District, Mogadishu. Adv Soc Sci Res J. 2017; 4(15):183–200. doi:10.14738/assrj.415.3576.

13. Lebso M, Anato A, Loha E. Prevalence of anemia and associated factors among pregnant women in Southern Ethiopia: a community-based cross-sectional study. PLoS One. 2017; 12(12): e0188783. doi:10.1371/journal.pone.0188783.
14. Hooja N, Arora S, Bhargava S, Mittal P. Socioeconomic-demographic factors in varying degrees of anemia in pregnancy. Basic Clin Appl Health Sci. 2020;3(3):122–4. doi:10.5005/jp-journals-10082-02239.
15. Kadhim EJ. Iron deficiency in relation to body mass index among Iraqi primigravida women. J Med Life. 2023; 16(6): 868 –72. doi:10.25122/jml-2023-0066.
16. Fareed K, Gupta U, Khatoon R. Sociodemographic factors associated with anemia during pregnancy at a university hospital in India. Saudi J Health Sci. 2024;13:35–41. doi: 10.4103/sjhs.sjhs_71_23.
17. Waver AA, Hodyl NA, Tait SF, Froessler B. Are pregnant women living with overweight or obesity at greater risk of developing iron-deficiency anemia? Nutrients. 2021;13(5):1572. doi: 10. 3390/nu13051572.
18. Ali SA, Hassan AA, Adam I. History of pica, obesity and their associations with anemia in pregnancy: a community-based cross-sectional study. Life (Basel). 2023;13:2220. doi:10. 3390/life12112220.
19. Eltayeb R, Binsaleh NK, Alsaif G, Ali RM, Alyahyawi, Adam I. Hemoglobin levels, anemia and their associations with body mass index among pregnant women in Hail Maternity Hospital, Saudi Arabia: a cross-sectional study. Nutrients. 2023; 15(16): 3508. doi:10.3390/nu15163508.

Authors' Contributions:

SF: Conceptualization & study design.

SFS: Data Collection and manuscript drafting.

HM: Data Analysis and critical review.

RW: Supervision &Manuscript drafting & proof reading.

All authors have read and approved the final version of the manuscript and are responsible and accountable for the accuracy and integrity of the work.

1. Saira Fayyaz
Associate Professor, Gynaecology,
Lahore General Hospital, Lahore
2. Rabia Wajid
Assistant Professor, , Gynaecology,
Lady Willington Hospital, Lahore
3. Sumaira Fatima Sabir
Senior Registrar, Gynaecology,
Lahore General Hospital, Lahore
4. Hina Masood
Associate Professor, Gynaecology,
Lahore General Hospital, Lahore