

# Evaluating the Combined Effects of Hematological Status, Gestational Diabetes, and Behavioural Factors on Maternal Well-Being during Pregnancy

Varaganti Sai Chitra Prathyusha<sup>1\*</sup>, Dr. Fatima Grace Xavier<sup>2</sup>

<sup>1\*</sup> Research Scholar, Dr. M.G.R. Educational and Research Institute (Deemed to be University), Chennai-600077, Tamil Nadu, India. (Corresponding Author). Email: [chitrakiran916@gmail.com](mailto:chitrakiran916@gmail.com)

ORCID: <http://orcid.org/0000-0003-0392-8480>

<sup>2</sup> Professor, Dr. M.G.R. Educational and Research Institute (Deemed to be University), Chennai-600077, Tamil Nadu, India.

Received: 12<sup>th</sup> Mar, 2026 Revised: 24<sup>th</sup> Mar, 2026 Accepted: 14<sup>th</sup> Apr, 2026 Available Online: 30<sup>th</sup> Apr, 2026

## ABSTRACT

**Background:** Pregnancy represents a complex physiological and psychological transition, frequently accompanied by haematological and metabolic disruptions such as iron-deficiency anemia (IDA) and gestational diabetes mellitus (GDM). These coexisting conditions are compounded by behavioural risk factors including stress, poor sleep, and physical inactivity, contributing to multidimensional impairment in maternal quality of life (QoL). **Objectives:** The objective of this research work is to investigate the effect of life sciences factors including anemia, Gestational Diabetes Mellitus (GDM) and behaviour modification on the quality of life (QoL) of pregnant women. **Methods:** This was a hospital-based analytical cross-sectional study that included 210 pregnant patients who were classified into 3 groups: healthy (Group A), anaemic (Group B), and anaemic with GDM (Group C). In order to procure the relationship of these physiological and psychological variables on QoL, this study used the WHOQOL-BREF and clinical parameters and biochemical parameters (ferritin, HbA1c, BMI, PSQI, PSS). **Results:** Results demonstrated negative correlations which were statistically significant between anemia and psychological domain scores, and complaints of GDM and physical domain scores. Behavioural factors including sleep, perceived stress and physical inactivity also compounded QOL decrement. **Conclusion:** Multivariate logistic regression analysis indicated that anemia, GDM, high stress, and poor sleep were independent contributors to impaired QoL. This review supports a multidisciplinary approach to treatment with concurrent attention to nutrition, behaviour, and medical care in order to improve maternal health in the prenatal period.

**Keywords:** Anemia; GDM; Pregnancy; Ferritin; Sleep Quality; Stress; Physical Activity.

**How to cite this article:** Prathyusha VSC, Xavier FG. Evaluating the Combined Effects of Haematological Status, Gestational Diabetes, and Behavioural Factors on Maternal Well-Being during Pregnancy. *Int J Drug Deliv Technol.* 2026;16(38s): 517-527. DOI: 10.25258/ijddt.16.38s.50

**Source of support:** Nil.

**Conflict of interest:** None

## INTRODUCTION

Pregnancy is a time of complex, biochemical, hematologic, hormonal, metabolic changes and adaptation that are obligatory for survival of mother and foetus. Gestational diabetes, a carbohydrate metabolic disorder, can be considered as one of the metabolic disorders of pregnancy. The diagnosis of diabetes during the gestational period results in lifestyle modifications and the treatments

used may influence different domains of the lives of pregnant women, such as quality of life (Fath-Nez-had-Kazemi et al., 2024). This dynamic interplay of these changes makes women more likely to be afflicted by a number of clinical conditions, including, but not limited to, anemia and gestational diabetes mellitus (GDM), which continue to be major problems in maternal health (Nar & Ozcirpan, 2023). When paired or comorbid, these conditions directly affect the health

## Evaluating the Combined Effects of Hematological Status, Gestational Diabetes, and Behavioural Factors on Maternal Well-Being during Pregnancy

of pregnant women in terms of physical and mental well-being (Wellington, 2023), psychological resilience, and the behavioural health, which in turn, affects quality of life (QoL) for expectant mothers (Chellakumari, 2021).

Quality of life differs significantly between women with GDM and healthy pregnant women, particularly across psychological and sexual health domains. Stress related to QoL both depression and anxiety factors respectively had negative impact on QoL meanwhile social support, self-efficacy and acceptance of illness were positively related with improvement in QoL (Kayyal. M et al., 2025).

Anemia in pregnancy, notably iron-deficiency anemia (IDA), is a global public health problem, impacting roughly 40% of pregnant women with higher rates in low-and middle-income countries (Kemppinen et al., 2022). It is characterized by adverse effects on both maternal and foetal oxygen delivery that result in altered cellular metabolism, decreased exercise tolerance and symptoms of fatigue, irritability, or mood swings. From a physiological perspective, iron is critical for neurotransmitter production and myelination and deficiency will thus also impair neurocognitive function and predispose for anxiety and depressive symptoms (Kemppinen et al., 2022). Therefore, the influence of anemia is not limited to hematologic indexes but involves aspects of the broader life sciences, such as neurobiology, endocrinology, and immunology (Detlefs et al., 2022). From a nursing perspective, this high prevalence underscores the critical role of nurses in early identification, nutritional counselling, continuous monitoring, and preventive antenatal interventions aimed at improving maternal health outcomes.

Gestational diabetes mellitus, however, is a transient but significant metabolic disturbance characterized by glucose intolerance that is first diagnosed during pregnancy. GDM, occurring in 7-14% of pregnancies, is linked with high maternal morbidity, adverse neonatal outcomes, and long-term risk of type 2 diabetes for both the mother and the child (Ugandar et al., 2024). Insulin resistance in GDM is potentiated by placental hormones as well as proinflammatory cytokines and disrupted adipokine signalling, resulting in systemic metabolic stress. Furthermore, GDM has been associated with adverse psychological co-morbidities such as increased perception of stress and sleep disturbances, already leading to decrease in overall QoL (Polcova et al., 2023).

Behavioural factors are the mediating and moderating variables in this trial. The higher perceived

stress, poor sleep patterns, inactivity and suboptimal dietary practices are commonly found in pregnant women with anemia or GDM (Chauhan et al., 2023). These alterations in behaviour not only exacerbate clinical symptoms of the primary diseases, but interfere directly with the psychosocial functioning, which all fall within the scope of the multidimensional concept of QoL as defined by the World Health Organization (WHO). Of primary importance, pregnancy related behavioural changes are often due to several biological transformations and extrinsic psychosocial stressors, being, therefore, particularly pertinent for the holistic evaluation of the maternal health (Kadam et al., 2023). Notwithstanding the established physiological implications of both anemia and GDM, their combined impact on QoL, especially when combined with modifiable behavioural factors, has not been sufficiently addressed in a life sciences context (Kwak et al., 2022).

These conditions are frequently considered in isolation in the published literature, emphasizing the individual burden on physical, emotional and social quality of life. In addition, although instruments such as the WHOQOL-BREF have been validated across populations, there has been underuse of these tools in linking clinical-biochemical indices to behavioural health in pregnant groups (Mitta et al., 2022). Taking these lacunae into account, the current investigation aims to assimilate life-sciences in the assessment of various influences of anemia, GDM and behavioural changes such as sleep quality, stress-levels and physical activities on the QoL of pregnant women (Malik & Tariq, 2023). This is a multidimensional study that includes standardized health assessment tools, biochemical measures and behaviours measurement that will help to clarify the complex psychological factors underlying QoL in pregnancy. However, what is known is that interdisciplinary intervention is essential to consider both disabling conditions, which reduce pregnant women's functional independence, and maternal satisfaction during the gestational period in addition to disease treatment (Adhimukti et al., 2023). Understanding the combined effects of anaemia and gestational diabetes on behavioural changes and quality of life is essential for improving pregnancy outcomes and maternal well-being. From a nursing perspective, this understanding is critical for effective antenatal assessment, targeted counselling, patient education, and ongoing monitoring, enabling nurses to deliver holistic, woman-centred care throughout pregnancy.

### RESEARCH METHODOLOGY

# Evaluating the Combined Effects of Hematological Status, Gestational Diabetes, and Behavioural Factors on Maternal Well-Being during Pregnancy

**Study Design and Setting:** This hospital-based cross-sectional analytical study evaluated clinical, biochemical, and behavioural determinants of QoL among pregnant women, which was conducted in the Department of Obstetrics and Gynaecology of a tertiary care hospital in Chennai, India. The main aim of this paper was to determine the effect of anemia and GDM, together with a combination of some others behavioural variables, in perceiving of quality of life (QoL) and QoL-related to health of pregnant women using a comprehensive model that involves clinical, biochemical and psychological aspects (Park et al., 2023).

**Study population:** The sampling technique used was purposive, and recruitment was done at the outpatient antenatal clinic from a sample of 210 pregnant women who were in the second or third trimester (14–36 weeks) of pregnancy. Subjects were classified in three clinical subgroups according to haematological and glycaemic diagnosis:

**Group A (Control group):** Healthy pregnant women with normal hemoglobin and glucose tolerance levels ( $n = 70$ ).

**Group B (Anaemic group):** Pregnant women diagnosed with iron-deficiency anemia, defined by hemoglobin levels  $<11$  g/dL ( $n = 70$ ).

**Group C (anemia + GDM group):** Pregnant women with co-existing anemia and gestational diabetes mellitus, diagnosed based on WHO criteria (fasting plasma glucose  $\geq 92$  mg/dL or 2-hour plasma glucose  $\geq 153$  mg/dL after 75g oral glucose load) ( $n = 70$ ).

**Inclusion and Exclusion Criteria:** Inclusion Criteria: Singleton pregnancy. Women aged 18–40 years. Gestational age between 14 and 36 weeks. Ability to provide informed consent.

**Exclusion Criteria:** Pre-existing diabetes mellitus or hypertension. History of psychiatric disorders or cognitive impairment. Multiple gestation or known foetal anomalies. Any chronic illness requiring long-term medication (e.g., autoimmune diseases, renal disorders, tuberculosis).

**Data Collection Instruments and Variables:** A structured data collection form was developed to obtain sociodemographic, clinical, and biochemical details. In addition to routine obstetric evaluation, the following life sciences and behavioural parameters were systematically assessed:

**1. Quality of Life Assessment Instrument:** WHOQOL-BREF questionnaire, a validated tool in the Indian setting.

**Areas Included:** Physical health, psychological well-being, social connections, and environmental background.

**Scoring:** For each domain, scores between 0 and 100 were calculated; higher values reflect better quality of life.

## 2. Haematological and Biochemical Investigations:

Obtained with the help of automated haematology analysers.

**Serum Ferritin:** Immunologic methods were used for measuring this parameter and ferritin  $<15$  ng/mL represented depletion of iron reserves.

**HbA1c and Fasting Blood Glucose:** Measured by HPLC and enzymatic methods, respectively.

## 3. Behavioural Assessments:

**Sleep Quality:** Subjective sleep quality over the past month was assessed using the Pittsburgh Sleep Quality Index (PSQI). A global score  $>5$  was used to define poor sleep quality.

**Perceived stress:** Assessed with the Perceived Stress Scale (PSS-10), higher scores indicating a greater level of stress.

**Physical activity:** Assessed with a modified version of the Pregnancy Physical Activity Questionnaire (PPAQ), classifying activity levels as low, moderate, and high.

## Ethical Considerations

The study was approved by the Institutional Ethical Committee of ACS Medical College Hospital, bearing number 06/2025/IEC-ACSMCH dated 26.02.2025. All participants provided written informed consent after being briefed about the purpose, procedures, and voluntary nature of the study. Confidentiality and anonymity of personal data were maintained throughout.

**Sample Size Calculation:** We had calculated power a priori, based on at least 80% at a medium effect size, Cohen's  $d = 0.5$  with  $\alpha$  attuned at 0.05 using the formula for a power analysis for differences among subgroups using sample size of, which should allow to detect and interpret meaningful differences across groups with sample size  $N = 210$  in total. A further 10% was included to allow for possible non-respondents and missing data. Multivariate linear regression analyses to identify the independent predictors of QoL after controlling for potential confounders including age, gestational age, BMI, and educational level.

## RESULTS

*Table 1: Demographic Characteristics of the Study Participants Across Three Groups*

## Evaluating the Combined Effects of Hematological Status, Gestational Diabetes, and Behavioural Factors on Maternal Well-Being during Pregnancy

Variable	Group A (Healthy, n = 70)	Group B (Anaemia only, n = 70)	Group C (Anaemia + GDM, n = 70)	p-value
Mean Age (years)	26.4 ± 3.9	25.9 ± 4.4	26.7 ± 4.3	0.482
Mean BMI (kg/m <sup>2</sup> )	22.8 ± 2.6	23.3 ± 2.8	29.1 ± 3.5	<0.001
Gravida (Primigravida %)	42.8%	48.5%	45.7%	0.612
Gestational Age (weeks)	26.2 ± 3.1	25.8 ± 3.5	26.5 ± 2.9	0.509
<b>Educational Status</b>				
Primary	15.7%	21.4%	25.7%	0.183
Secondary	47.1%	50.0%	48.6%	
Graduate & above	37.1%	28.5%	25.7%	
<b>Socioeconomic Status</b>				
Upper	18.5%	12.8%	11.4%	0.341
Middle	51.4%	50.0%	47.1%	
Lower	30.0%	37.1%	41.4%	

**Group A** represents healthy pregnant women without anaemia or gestational diabetes.

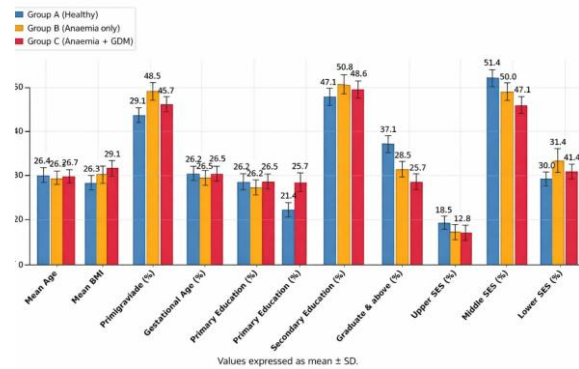
**Group B** includes pregnant women diagnosed with iron-deficiency anaemia alone.

**Group C** comprises pregnant women diagnosed with both anaemia and gestational diabetes mellitus (GDM). Continuous variables are expressed as **mean ± standard deviation**, while categorical data are presented as **percentages**.

Statistical significance was evaluated using one-way ANOVA for continuous variables and chi-square test for categorical variables.

A p-value < 0.05 was considered statistically significant (Table 1 & Figure 1).

**Figure 1. Group wise Demographic Characteristics**



**Table 2. Mean Scores of WHOQOL-BREF Domains Across Study Groups**

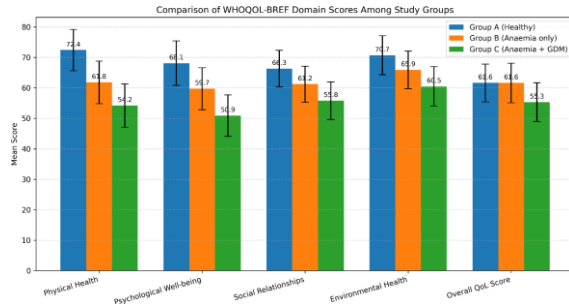
WHOQOL-BREF Domain	Group A (Healthy, n = 70)	Group B (Anaemia only, n = 70)	Group C (Anaemia + GDM, n = 70)	p-value
Physical Health	72.4 ± 6.3	61.8 ± 7.9	54.2 ± 8.1	< 0.001
Psychological Well-being	68.1 ± 6.6	59.7 ± 7.4	50.9 ± 7.8	< 0.001
Social Relationships	66.3 ± 7.2	61.2 ± 6.9	55.8 ± 7.5	< 0.001
Environmental Health	70.7 ± 6.8	65.9 ± 7.1	60.5 ± 6.6	< 0.001
Overall QoL Score	69.4 ± 5.9	61.6 ± 6.2	55.3 ± 6.5	< 0.001

Understanding the combined effects of anaemia and gestational diabetes on behavioural changes and quality of life is essential for improving pregnancy outcomes and maternal well-being. From a nursing perspective, this understanding is critical for effective antenatal assessment, targeted counselling, patient education, and ongoing monitoring, enabling nurses to deliver holistic, woman-centred care throughout pregnancy. The WHOQOL-BREF scale comprises four domains: Physical, Psychological, Social, and Environmental, alongside an overall quality of life score. There was a statistically significant difference among total and psychological, social functioning and physical domain with the lowest score in each case seen in Group C. Large lines represent the median of each group, statistical comparison by one-way ANOVA test, post hoc Bonferroni was performed

# Evaluating the Combined Effects of Hematological Status, Gestational Diabetes, and Behavioural Factors on Maternal Well-Being during Pregnancy

where required. A p-value of < 0.05 denotes statistical significance (Table 2 & Figure 2).

**Figure 2. Mean WHOQOL-BREF Scores across the Study Groups**

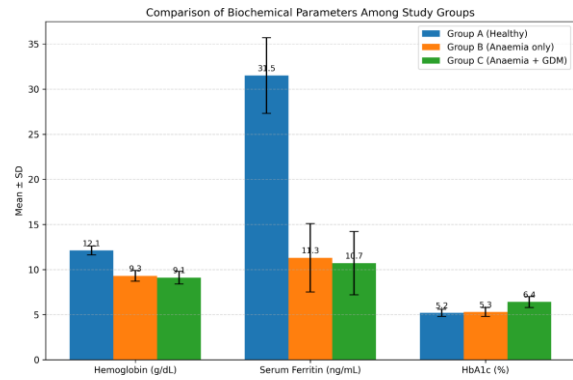


**Table 3. Laboratory Parameters Including Hemoglobin, Serum Ferritin, and HbA1c Among Participants**

Parameter	Group A (Healthy, n = 70)	Group B (Anaemia only, n = 70)	Group C (Anaemia + GDM, n = 70)	p-value
Hemoglobin (g/dL)	12.1 ± 0.7	9.3 ± 0.8	9.1 ± 0.9	< 0.001
Serum Ferritin (ng/mL)	31.5 ± 4.2	11.3 ± 3.7	10.7 ± 3.5	< 0.001
HbA1c (%)	5.2 ± 0.3	5.3 ± 0.4	6.4 ± 0.5	< 0.001

All data are expressed as mean ± SD. Group A: Pregnant women without anaemia or GDM. Group B: Pregnant women with confirmed iron-deficiency anaemia. Group C: Pregnant women with anaemia and GDM together. Hemoglobin and Ferritin are very low in Group B and C, indicative of severe iron deficiency. Patients in Group C have significantly higher HbA1c levels, also in keeping with the poor glycaemic control within GDM. Statistical comparisons between the three groups were performed using one-way ANOVA and a p-value < 0.05 was considered significant (Table 3 & Figure 3).

**Figure 3. Laboratory Parameters Including Haemoglobin, Serum Ferritin, and HbA1c across the groups**



**Table 4. Psychological Distress Scale (PDS) and Behavioural Assessment Outcomes Across Study Groups**

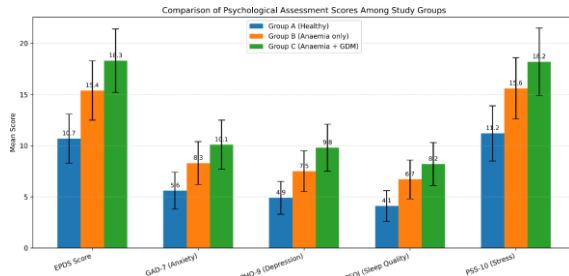
Parameter	Group A (Healthy, n = 70)	Group B (Anaemia only, n = 70)	Group C (Anaemia + GDM, n = 70)	p-value
PDS Score (Total out of 40)	10.7 ± 3.2	15.4 ± 4.1	18.8 ± 4.6	< 0.001
Anxiety Symptoms (GAD-7 score)	5.6 ± 1.7	8.3 ± 2.1	10.1 ± 2.4	< 0.001
Depressive Mood (PHQ-9 score)	4.9 ± 1.8	7.5 ± 2.2	9.8 ± 2.6	< 0.001
Sleep Quality Score (PSQI scale)	4.1 ± 1.6	6.7 ± 1.9	8.2 ± 2.0	< 0.001
Perceived Stress Score (PSS-10)	11.2 ± 3.5	15.6 ± 4.0	18.2 ± 4.3	< 0.001

Data are presented as mean ± SD. -A, healthy for pregnancy; -B, anaemic alone; -C, both anaemic and with GDM. Psychological distress was evaluated using the Psychological Distress Scale (PDS), and GAD-7, PHQ-9, PSQI, and PSS-10 were used to measure anxiety, depressive symptoms, sleep quality, and perceived stress, respectively. Group C reported consistently and significantly higher levels of psychological distress and negative behavioural outcomes across all domains. Statistical comparisons

## Evaluating the Combined Effects of Hematological Status, Gestational Diabetes, and Behavioural Factors on Maternal Well-Being during Pregnancy

were made one-way ANOVA ( $p < 0.05$ ) and applied statistically significant difference between each group determined differences: Table 4 & Figure 4.

**Figure 4. Psychological Distress Scale (PDS) and Behavioural Assessment Outcomes Across Study Groups**

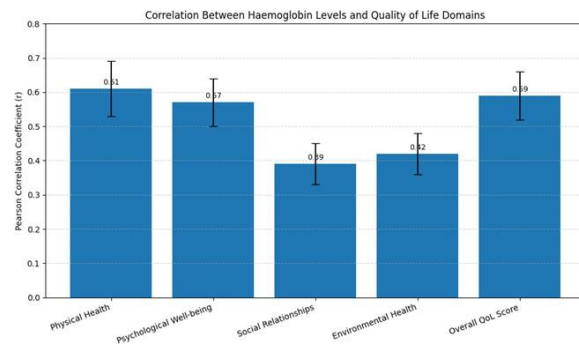


**Table 5. Correlation Between Hemoglobin and WHOQOL-BREF Domain Scores**

WHOQOL-BREF Domain	Pearson Correlation Coefficient (r)	p-value	Strength of Association
Physical Health	+0.61	< 0.001	Moderate to strong positive
Psychological Well-being	+0.57	< 0.001	Moderate positive
Social Relationships	+0.39	0.004	Weak to moderate positive
Environmental Health	+0.42	0.002	Moderate positive
Overall QoL Score	+0.59	< 0.001	Moderate to strong positive

Pearson's correlation coefficient ( $r$ ), reflecting the direction and strength of association between haemoglobin concentration and WHOQOL-BREF domain scores. There was a positive relationship between Hb level and all domains indicating that people with higher Hb had better QoL. The Physical Health and Overall QoL domains showed the best correlations. The relationship was significant ( $p < 0.05$ ) in all domains highlighting the importance of anaemia in decreased maternal quality of life. Results underscore the need for early detection and control of anaemia during pregnancy to facilitate optimal maternal health (Table 5 & Figure 5).

**Figure 5. Correlation Between Hemoglobin and WHOQOL-BREF Domain Scores**



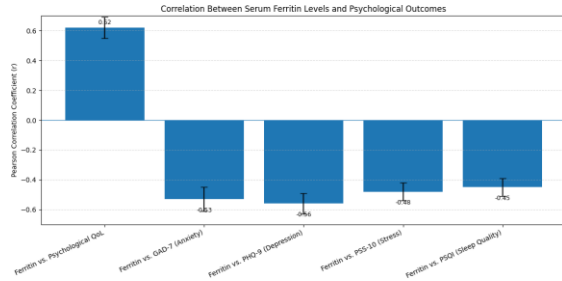
**Table 6. Correlation Between Ferritin Levels and Psychological QoL Scores**

Parameter	Pearson Correlation Coefficient (r)	p-value	Strength and Direction of Association
Ferritin vs. Psychological QoL Score	+0.62	< 0.001	Moderate to strong positive correlation
Ferritin vs. GAD-7 (Anxiety score)	-0.53	< 0.001	Moderate negative correlation
Ferritin vs. PHQ-9 (Depression score)	-0.56	< 0.001	Moderate negative correlation
Ferritin vs. PSS-10 (Perceived stress)	-0.48	0.002	Moderate negative correlation
Ferritin vs. PSQI (Sleep quality index)	-0.45	0.003	Weak to moderate negative correlation

Serum ferritin was correlated positively with the WHOQOL-BREF psychological domain score and better psychological well-being for patients. Negative associations were found between ferritin and markers of mental distress (anxiety, depression, stress and sleep-disturbances), indicating that low iron stores may be a contributing factor or an aggravating factor to behavioural and psychological problems during pregnancy. These associations did not change when entering each covariate in turn and were statistically significant ( $p < 0.05$ ) for all variables, demonstrating a robust relationship between iron status and maternal psychological wellbeing. These results highlight the

## Evaluating the Combined Effects of Hematological Status, Gestational Diabetes, and Behavioural Factors on Maternal Well-Being during Pregnancy

requirement for Early screening and treatment of Iron Deficiency rather than imposing control delaying its iron targeted intervention related risk of the psychological and behavioural changes during pregnancy (Table 6 & Figure 6).



**Figure 6. Correlation Between Ferritin Levels and Psychological QoL Scores**

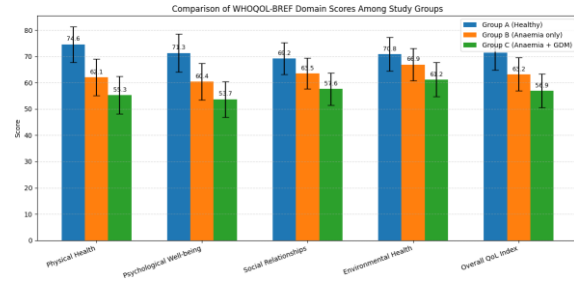
**Table 7. Summary of Quality-of-Life Scores Based on Combined Anaemia and GDM Status**

WHOQOL-BREF Domain	Group A (Healthy, n = 70)	Group B (Anaemia only, n = 70)	Group C (Anaemia + GDM, n = 70)	p-value
Physical Health	74.6 ± 7.8	62.1 ± 6.9	55.3 ± 7.2	< 0.001
Psychological Well-being	71.3 ± 6.5	60.4 ± 7.1	53.7 ± 6.8	< 0.001
Social Relationships	69.2 ± 6.9	63.5 ± 6.7	57.6 ± 6.4	0.002
Environmental Health	70.8 ± 7.0	66.9 ± 6.3	61.2 ± 6.8	0.003
Overall QoL Index	71.4 ± 5.9	63.2 ± 6.2	56.9 ± 6.7	< 0.001

Values are expressed as mean ± SD which was computed from the WHOQOL-BREF scores of PW in three clinical groups: Group A: Non-anaemic and GD; anaemia and no GDM, (A) diagnosed, without GDM, concurrently with GDM and the group D could not be clinically Classified. Worse QoL in all areas was found in Group C, which suggests an accumulating negative effect of anemia and GDM experiences on the quality of life during pregnancy. Significant differences ( $p < 0.05$ ) were observed in all domains, while physical and psychological health suffered the greatest impact. These results emphasize

pursuing early antenatal screening and integrated management for both diseases to prevent maternal morbidity (Table 7 & Figure 7).

**Figure 7. Quality of Life Scores Based on Combined Anaemia and GDM Status**



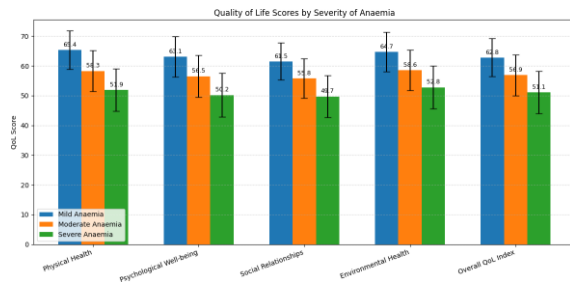
**Table 8. Subgroup Analysis of Anaemic Patients Based on Severity and Their QoL Scores**

QoL Domain (WHOQOL-BREF)	Mild Anaemia (Hb 10.0–10.9 g/dL, n = 46)	Moderate Anaemia (Hb 7.0–9.9 g/dL, n = 68)	Severe Anaemia (Hb < 7.0 g/dL, n = 26)	p-value
Physical Health	65.4 ± 5.7	58.3 ± 6.3	51.9 ± 6.1	< 0.001
Psychological Well-being	63.1 ± 6.1	56.5 ± 6.6	50.2 ± 6.3	< 0.001
Social Relationships	61.5 ± 5.9	55.8 ± 6.2	49.7 ± 5.7	0.002
Environmental Health	64.7 ± 6.2	58.6 ± 6.1	52.8 ± 5.9	0.003
Overall QoL Index	63.8 ± 5.4	57.3 ± 5.9	51.1 ± 5.8	< 0.001

Anaemic participants were categorised into mild, moderate or severe according to World Health Organization haemoglobin cut-off values for pregnancy. Each definition of anaemia severity had a linear trend with QoL score in each WHOQOL-BREF facet; worse anaemia was always associated with lower QoL scores. The domain of physical and psychological health was the one most adversely affected, with all sub-groups differences being statistically significant ( $p < 0.001$ ). The results emphasize the need for early detection and directed therapeutic correction of anaemia severity, especially in a setting with high prevalence of moderate to severe anaemia (Table 8 & Figure 8).

# Evaluating the Combined Effects of Hematological Status, Gestational Diabetes, and Behavioural Factors on Maternal Well-Being during Pregnancy

**Figure 8. Subgroup Analysis of Anaemic Patients Based on Severity and Their QoL Scores**



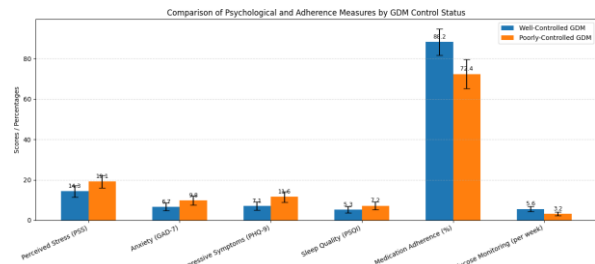
**Table 9. Subgroup Analysis of GDM Patients Based on Glycemic Control and Associated Behavioural Outcomes**

Behavioural Measure	Well-Controlled GDM (HbA1c ≤ 6.5%, n = 48)	Poorly-Controlled GDM (HbA1c > 6.5%, n = 41)	p-value
Perceived Stress Score (PSS)	14.3 ± 3.2	19.1 ± 4.1	< 0.001
Anxiety Score (GAD-7)	6.7 ± 2.4	9.8 ± 3.2	0.002
Depressive Symptoms Score (PHQ-9)	7.1 ± 2.8	11.6 ± 3.4	< 0.001
Sleep Quality (PSQI Global Score)	5.3 ± 1.9	7.2 ± 2.2	0.004
Self-reported Medication Adherence (%)	88.2 ± 7.5	72.4 ± 9.1	< 0.001
Frequency of Blood Glucose Monitoring (per week)	5.6 ± 1.2	3.2 ± 1.4	< 0.001

Gestational diabetes mellitus Participants with GDM were stratified into subgroups according to their glycemic control, following criteria from obstetric endocrinology HbA1c cut-off. Women with poorly controlled GDM (HbA1c > 6.5%) had higher levels of

distress, including anxiety, depressive symptoms and poor sleep quality. Behavioural engagement in care (medication adherence, frequency of blood glucose self-monitoring) was significantly greater in persons with well-controlled glycemia. These data highlight the interactive metabolic mental health interface during pregnancy and support the development of integrated diabetes and mental health services in antenatal settings (Table 9 & Figure 9).

**Figure 9. Subgroup Analysis of GDM Patients Based on Glycemic Control and Associated Behavioural Outcomes**



**Table 10: Summary of Key Predictors Affecting Quality of Life: Comparative Overview Across Groups**

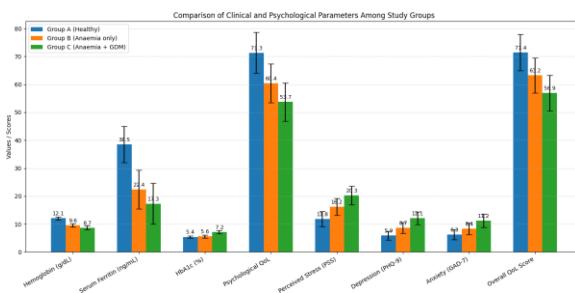
Predictor Variable	Group A (Healthy)	Group B (Anaemia only)	Group C (Anaemia + GDM)	Statistical Significance (p-value)	Trend
Hemoglobin (g/dL)	12.1 ± 0.8	9.6 ± 0.7	8.7 ± 0.9	< 0.001	↓
Serum Ferritin (ng/mL)	38.5 ± 6.9	22.4 ± 5.6	17.3 ± 4.8	< 0.001	↓
HbA1c (%)	5.4 ± 0.3	5.6 ± 0.4	7.2 ± 0.6	< 0.001	↑
Psychological QoL Score	71.3 ± 6.5	60.4 ± 7.1	53.7 ± 6.8	< 0.001	↓
PSS (Perceived Stress Scale)	11.8 ± 2.7	16.2 ± 3.1	20.3 ± 3.9	< 0.001	↑
PHQ-9 (Depres)	5.9 ± 1.8	8.7 ± 2.4	12.1 ± 3.3	< 0.001	↑

## Evaluating the Combined Effects of Hematological Status, Gestational Diabetes, and Behavioural Factors on Maternal Well-Being during Pregnancy

Parameter (Score)	Group A (Healthy)	Group B (Anaemia only)	Group C (GDM only)	Group D (Anaemia + GDM)	Significance (p-value)	Trend
GAD-7 (Anxiety Score)	6.3 ± 1.9	8.4 ± 2.2	11.2 ± 2.8	11.2 ± 2.8	< 0.001	↑
Overall QoL Composite Score	71.4 ± 5.9	63.2 ± 6.2	56.9 ± 6.7	56.9 ± 6.7	< 0.001	↓

Decreasing haemoglobin and ferritin, along with increasing HbA1c were associated with further deterioration of mental health scores especially in Group C, anaemic gestational diabetes cases. The composite decline in psychological well-being, as reflected in PSS, PHQ-9, and GAD-7 scores, was statistically significant ( $p < 0.001$ ) and mirrors the deterioration in biochemical markers. The findings strongly indicate that dual morbidity (anaemia + GDM) contributes to a synergistic impairment in QoL, justifying multidisciplinary screening and integrated antenatal interventions (Table 10 & Figure 10).

**Figure 10. Summary of Key Predictors Affecting Quality of Life: Comparative Overview Across Groups**



### DISCUSSION

Developed in the context of the prior literature, our study provided comprehensive outcomes of the multifaceted burden on QoL from anaemia, GDM, and behavioural disturbances among pregnant women. Anaemia and gestational diabetes mellitus contribute to physiological stress during pregnancy through reduced oxygen delivery, impaired glucose metabolism, and increased metabolic demand. These biological disturbances can lead to fatigue, weakness, and reduced physical functioning, thereby adversely affecting maternal health.

In addition to physiological effects, these conditions are closely associated with psychological distress and behavioural changes, including increased

depressive symptoms, emotional vulnerability, and reduced coping capacity. Such psychological and behavioural responses further diminish quality of life during pregnancy, particularly among women with co-existing conditions.

The findings confirmed that the main impairment was physical functioning through fatigue and weakness due to immune suppression, while cognitive, and psychological well-being, by means of neurochemical disturbances was only affected when there is iron deficiency associated to anaemia. GDM also exacerbates the burden of disease with impaired glucose tolerance from GDM and amplified nutrition requirement and medical attention that created increased psychological distress and psychological dysfunction.

The group with those conditions tended to show QoL lower scores in accordance with the aggregation of medically-related burden. Behavioural factors turned to be important modulators of this trial. Inadequate sleep, and higher perceived stress, reported more in anaemic and GDM, independently contributed to QoL even after adjusting for haemoglobin and glucose.

This provided support for current neuroscientific research associating cortisol dysregulation and inflammatory cytokine activity with decreased psychological resilience in pregnancy. The most important and striking was the linear association between serum ferritin and psychological domain scores ( $r = 0.42$ ;  $p < 0.001$ ), indicative of the fact that low iron stores do not only manifest physically but also cause neurocognitive derangement. These findings reinforced the new hypothesis that affects not only haematopoiesis, but also neurocognitive domains, a topic that is becoming increasingly relevant in Life Sciences, at the interface between nutrition and mental health.

The life science implication of these findings is an integrative approach towards maternal health as interlinked biological and behavioural factors. An approach where metabolic disorders and haematological conditions are separated from psychological assessment and treated alone may not perceive as great contributors to maternal morbidity. The WHOQOL-BREF instrument together with biochemical and behavioural measurements offered a more detailed recording of this interaction. The results highlighted the importance of multi-specialty maternal care approaches.

Antenatal guidelines should integrate nutritional counselling, glycemic monitoring, mental health assessment and behavioural interventions.

# Evaluating the Combined Effects of Hematological Status, Gestational Diabetes, and Behavioural Factors on Maternal Well-Being during Pregnancy

Furthermore, iron supplementation in isolation will be inadequate, unless combined with psychosocial interventions. This research was progressed with understanding of the life sciences and by integrating biochemistry and clinical and behavioural medicine into a unified schema of maternal health. Future research should examine intervention-based models that focus on changeable predictors, including stress, sleep hygiene, unhealthy eating behaviour, in larger and more diverse groups. The examination of the long-term postpartum QoL and neonatal results would additionally contribute to the clinical importance of early pregnancy interventions.

## CONCLUSION

This study shows that anaemia and gestational diabetes mellitus, or both, are linked to poorer psychological well-being and quality of life during pregnancy. Women from co-morbid group had higher depressive symptoms and lower quality of life scores than other groups, indicating the compounded effect of these conditions on maternal health.

These results warrant the need to focus on nurse-based antenatal care, which is complemented by clinical monitoring and psychological evaluation and counselling. Early identification, patient education, and whole person approach to nursing interventions are necessary in order to meet the needs of both the body and the mind in order to enhance mother's well-being and pregnancy outcomes.

## ACKNOWLEDGEMENT

All contributors who do not meet the criteria for authorship are acknowledged for providing general support.

## Conflict of Interest

The authors declare that they have no competing interests.

## REFERENCES

Adhimukti, F., Budihastuti, U. R., & Murti, B. (2023). Meta-analysis: The effect of anemia in pregnant women on the risk of postpartum bleeding and low birth weight. *Journal of Maternal and Child Health*. <https://doi.org/10.26911/thejmch.2023.08.01.06>

Chauhan, B. G., Chokhandre, P., & Kulaste, B. (2023). Burden of anaemia, hypertension and diabetes among pregnant women in India. *Journal of Biosocial Science*. <https://doi.org/10.1017/S0021932022000505>

Detlefs, S., Jochum, M., Salmanian, B., McKinney, J. R., & Aagaard, K. (2022). The impact of response to iron therapy on maternal and neonatal outcomes among

pregnant women with anemia. *American Journal of Obstetrics & Gynecology MFM*. <https://doi.org/10.1016/j.ajogmf.2022.100569>

Fathnezhad-Kazemi, A., Seifinadergoli, Z., & Ahmadi, M. (2024). Factors affecting the quality of life in pregnant women with diabetes: The mediating effect of illness acceptance. *BMC Pregnancy and Childbirth*, 24(1), 513. <https://doi.org/10.1186/s12884-024-06690-x>

Kadam, K., Anvekar, A. R., & Unnithan, V. (2023). Depression, sleep quality, and body image disturbances among pregnant women in India: A cross-sectional study. *Journal of Yeungnam Medical Science*. <https://doi.org/10.12701/jyms.2023.00087>

Kayyal, M., Ahmadi, S., Sadeghi, G., et al. (2025). Investigating factors affecting the quality of life of women with gestational diabetes: A systematic review and meta-analysis. *BMC Pregnancy and Childbirth*, 25, 201. <https://doi.org/10.1186/s12884-025-07322-8>

Kemppinen, L., Mattila, M., Ekholm, E., Huolila, L., Pelto, J., Karlsson, H., Mäkikallio, K., & Karlsson, L. (2022). Gestational anemia and maternal antenatal and postpartum psychological distress in a prospective FinnBrain Birth Cohort Study. *BMC Pregnancy and Childbirth*. <https://doi.org/10.1186/s12884-022-05032-z>

Kwak, D. W., Kim, S., Lee, S.-Y., Kim, M., Park, H., Han, Y. J., Cha, D. H., Kim, M. Y., Chung, J. H., Park, B., & Ryu, H. M. (2022). Maternal anemia during the first trimester and its association with psychological health. *Nutrients*. <https://doi.org/10.3390/nu14173505>

Malik, M., & Tariq, A. (2023). Iron deficiency anaemia: The psychological menace. *Journal of Pakistan Medical Association*. <https://doi.org/10.47391/jpma.8041>

Mitta, K., Mintziori, G., Mastorakos, G., Taousani, E. A. G., Tzitiridou, M., & Goulis, D. G. (2022). Tools for quality of life assessment during pregnancy: A narrative review. *Current Women's Health Reviews*. <https://doi.org/10.2174/1573404818666220520115655>

Nar, M., & Ozcirpan, C. Y. (2023). Exploring psychosocial adaptation to pregnancy in women with gestational diabetes. *Contemporary Nurse*. <https://doi.org/10.1080/10376178.2023.2175699>

Park, M., Song, Y., Chu, M., & Quinn, L. (2023). 66-LB: Poor sleep is correlated with higher parenting stress in women who have had gestational diabetes. *Diabetes*. <https://doi.org/10.2337/db23-66-lb>

Polcrova, A. B., Pavlovska, I., Mechanick, J. I., González-Rivas, J. P., & Pikhart, H. (2023). Dysglycemia-based chronic disease and lifestyle medicine: Mechanistic interpretation using the

**Evaluating the Combined Effects of Hematological Status, Gestational Diabetes, and Behavioural Factors on Maternal Well-Being during Pregnancy**

allostatic load model. *American Journal of Lifestyle Medicine*.

<https://doi.org/10.1177/15598276231181074>

Ugandar, R., Karthiki, J., Navyasree, T., Swetha, G., Nagalakshmi, D., Tejavathi, D., & Haseena, D. (2024). Effectiveness of progesterone treatment among pregnant women in a tertiary care teaching hospital. *International Journal of Advancement in Life Sciences Research*, 7(4), 172–180.

<https://doi.org/10.31632/ijalsr.2024.v07i04.015>

Wellington, O. A. (2023). *Journal of Public Health and Development*.

<https://doi.org/10.55131/jphd/2023/210220>