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Original Research

To determine the maternal and foetal blood parameters interm pregnancies with and without Gestational Diabetes Mellitus: A Prospective Cohort Study

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ABSTRACT

Aim: To determine the maternal and foetal blood parameters in term pregnancies with and without gestational diabetes mellitus.

Materials and Methods: The prospective cohort research was conducted in the Department of Obstetrics and Gynaecology. All enrolled patients provided written informed consent. The research recruited participants with full-term singleton pregnancies, both with and without gestational diabetes mellitus (GDM), regardless of mother age and parity. The research involved 100 individuals. The sample was divided via purposive selection into 50 study participants in the GDM group and 50 study subjects in the control group. The diagnosis of GDM was based on the criteria established by the DIPSI.

Results: The mean maternal Hb in the GDM group was 12.11±0.98 gm%, and in the non-GDM group, it was 12.43±1.32 gm%. There was no significant difference in the mean maternal Hb between the two groups. The mean BMI in the GDM group was 26.87±2.87 kg/m2, and in the non-GDM group, it was 24.76±2.54 kg/m2 (p = 0.001). mean foetal H b in the GDM group was 15.22±2.54 gm%, and in the non-GDM group, it was 5.77±1.98 gm%. The mean foetal ferritin in the GDM group was 86.02±4.45 ng/mL, and in the non-GDM group, it was 101.89±4.65 ng/m L. The mean birth weight in the GDM group was 3.23±0.34 kg, and in the non-GDM group, it was 3.01±0.37 kg.

Conclusion: Serum markers that may indicate the likelihood of developing GDM can be regularly used to aid in early diagnosis. Serum ferritin is increased in GDM, suggesting inflammation or iron overload, leading to enhanced oxidative stress that might impact placental iron transfer and haemoglobin production.

Keywords: serum ferritin, GDM, Hb

Introduction

Gestational diabetes is a disorder characterised by glucose intolerance that specifically occurs during pregnancy. In 2013, the WHO reviewed and developed a new set of diagnostic criteria for gestational diabetes. The new range of values was established according to the risk of negative consequences for both the foetus and the other.[1]Despite the uncertainty in the diagnostic results, there is much data indicating the rising occurrence of gestational diabetes.[2, 3] There is wide region-to-region variation in prevalence, ranging from 2.5% to 21%.[4-6] The incidence varies across various socio-demographic and economic strata. Several studies highlight the ethnic disparities in the occurrence of gestational diabetes. Asian women, particularly those of Indian descent, have been definitively shown to be more susceptible to this illness.[7] In India, the prevalence of gestational diabetes varies widely geographically. Studies conducted in the southern part of the country reveal a higher burden of gestational diabetes than in other states.[8, 9]

Ferritin functions as an indicator of inflammation and an acute-phase protein. Elevated serum ferritin levels are often seen in many acute and chronic inflammatory conditions, such as diabetes and cardiovascular illnesses. Insulin resistance is a result of oxidative damage caused by elevated iron levels.[10] The harmful and dysfunctional impacts of iron may lead to abnormal metabolism, which may affect the likelihood of developing GDM. Research in animals and epidemiology has shown a significant link between higher levels of serum ferritin storage and irregularities in glucose metabolism, as well as a positive association between ferritin levels and type 2 diabetes mellitus.[11] Women with gestational diabetes mellitus (GDM) have a higher likelihood of undergoing surgical delivery, developing preeclampsia, gestational hypertension, and other possible complications.[12] Untreated GDM may lead to complications in the newborn, including hypoglycemia, hypocalcemia, hyperbilirubinemia, hypomagnesemia, and respiratory distress syndrome.

Aims and objectives: The present research compared maternal and foetal blood parameters in term pregnancies with and without gestational diabetes mellitus (GDM).

Materials and Methods:

The prospective cohort research was conducted on 100 term pregnancies with and without gestational diabetes mellitus in the Department of Obstetrics and Gynaecology, Sri Krishna Medical College & Hospital, Muzaffarpur, Bihar, India, in collaboration with the PSM Department, Sri Krishna Medical College & Hospital, Muzaffarpur, Bihar, India. All enrolled patients provided written informed consent. Data such as name, age, etc. was recorded. The study duration was January 2018 to December 2018.

The research recruited participants with full-term singleton pregnancies, both with and without gestational diabetes mellitus (GDM), regardless of mother age and parity. Excluded from the research were term pregnancies with anaemia (Hb<11g% according to WHO criteria), Type-1 and Type-2 diabetes mellitus, hypertension, seizure disorder, acute or chronic liver illness, history of drug misuse, and multifetal gestation.

Methodology:

The research involved 100 individuals. The sample was divided via purposive selection into 50 study participants in the GDM group and 50 study subjects in the control group. The diagnosis of GDM was based on the criteria established by the DIPSI.[13]A comprehensive physical examination, including systemic and obstetrics assessments, was conducted to recruit eligible individuals for the research. During admission, 3 ml of venous blood was taken from the mother using aseptic techniques. Additionally, 3 ml of cord blood was collected from the maternal end of the umbilical cord in a simple vacutainer just after birth. Maternal blood samples were analysed for Hb%, serum iron, and ferritin levels. Cord blood samples were analysed to determine haemoglobin percentage, packed cell volume, iron levels, and serum ferritin in the infant. Serum ferritin levels were determined by the electro-chemiluminescence technique, whereas iron levels were assessed using the ferrozine method.

Statistical Analysis: The data was inputted into a Microsoft Excel spread sheet and analysed using SPSS software. Categorical data were shown using frequencies and proportions. The data's significance was assessed by the chi-square test. The continuous data were expressed as the mean and standard deviation. The data's significance was assessed by an independent t-test. A p-value less than 0.05 were deemed significant.

Results

The mean age in the GDM group (Group A) was 28.02±4.65 years, and in the non-GDM group (Group B), it was 28.11±3.87 years. In the GDM group, 36% were primigravida, and 64% were multigravida. In the non-GDM group, 44% were primigravida, and 56% were multigravida [Table 1]. The mean maternal Hb in the GDM group was 12.11±0.98 gm%., and in the non-GDM group, it was 12.43±1.32 gm%. There was no significant difference in the mean maternal Hb between the two groups. The mean BMI in the GDM group was 26.87±2.87 kg/m2, and in the non-GDM group, it was 24.76±2.54 kg/m2 (p = 0.001).

The mean maternal ferritin in the GDM group was 90.06±7.46, and in the non-GDM group, it was 48.33±5.65 [Table. 2]. The mean foetal H b in the GDM group was 17.22±2.54 gm%, and in the non-GDM group, it was 15.77±1.98 gm%. The mean foetal ferritin in the GDM group was 86.02±4.45 ng/mL, and in the non-GDM group, it was 101.89±4.65 ng/mL. The mean birth weight in the GDM group was 3.23±0.34 kg, and in the non-GDM group, it was 3.01±0.37 kg [Table 3].

Table1: Basic parameter of the participants

Parameters	Group A(n=50)		Group B(n=50)		P value
	Number	Percentage	Number	Percentage	
Age group (years)					
Below25	12	24	21	42	
25-30	30	60	18	36	
Above30	8	16	11	22	0.06
Mean age(years)	28.02±4.65		28.11±3.87		0.001
Parity					
Primi	18	36	22	44	
Multi	32	64	28	56	0.13
Family history of DM					
Absent	41	82	47	94	
Present	9	18	3	6	0.06

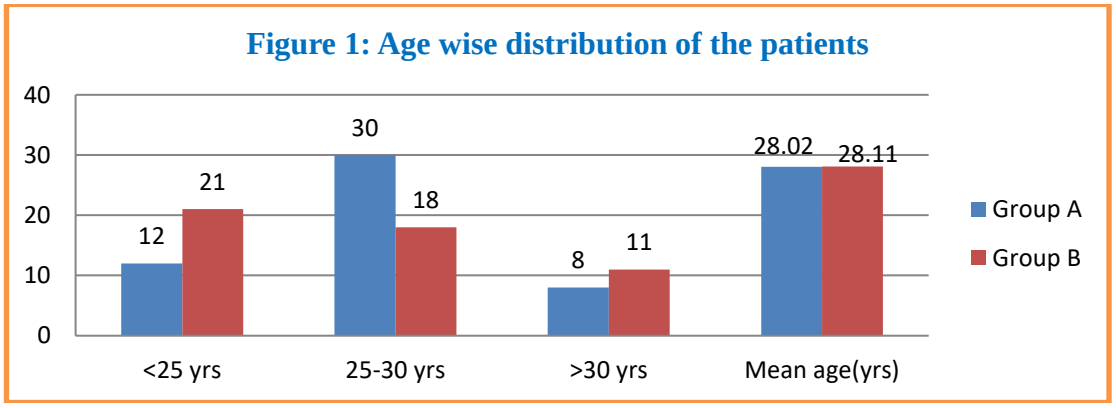


Table2: Maternal Parameter of the Participants

Parameters	Group A (n=50)		Group B (n=50)		P value
	Mean	SD	Mean	SD	
BMI (kg/m2)	26.87	2.87	24.76	2.54	0.001
Maternal Hb (in g%)	12.11	0.98	12.43	1.32	0.21
Maternal ferritin (in ng/mL)	90.06	7.46	48.33	5.65	0.001
Maternal iron (in mcg/mL)	73.33	4.87	83.15	4.98	0.13

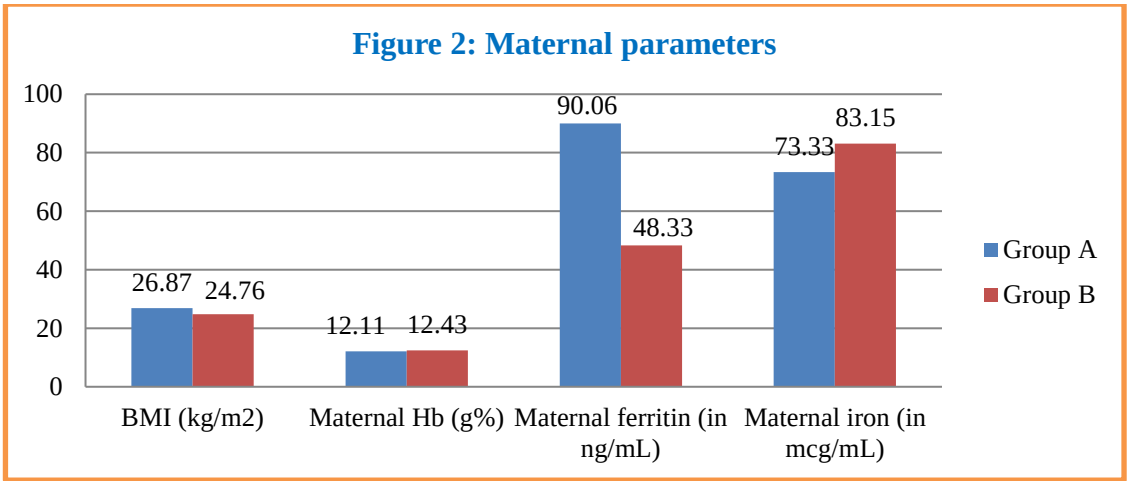
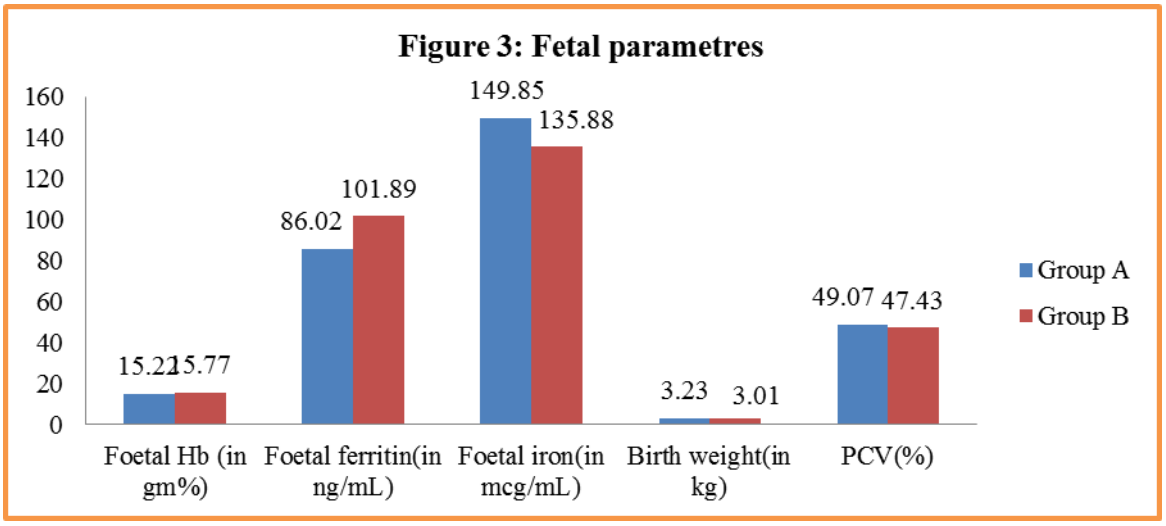


Table3: Foetal parameter of the participants

Parameters	Group A (n=50)		Group B(n=50)		P value
	Mean	SD	Mean	SD	
Foetal Hb (in gm%)	15.22	2.54	15.77	1.98	0.15
Foetal ferritin(in ng/mL)	86.02	4.45	101.89	4.65	0.03
Foetal iron (in mcg/mL)	149.85	4.96	135.88	5.67	0.07
Birth weight (kg)	3.23	0.34	3.01	0.37	0.007
PCV (%)	49.07	3.67	47.43	2.89	0.22



Discussion:

The average age in the GDM group was 28.02±4.65 years, whereas in the non-GDM group, it was 28.11±3.87 years. The mean age of the research participants did not show a statistically significant difference between the two groups. The study conducted by Sharifi F et al.[14] found that the average age of subjects with GDM was 30±4.7 years, while for those without GDM it was 30±4.9 years. In a separate study by Inaniya P et al.[15], the majority of participants in both the GDM group (46.7%) and the control group (48%) were between 26 and 30 years old, followed by 20 and 25 years old. The p-value was statistically insignificant, aligning with the results of the current study. Parity did not show a statistically significant difference between the GDM and non-GDM groups. Multiparous women were more prevalent in both groups, accounting for 64% in the GD M group and56%in the non-GDM group.

Sedigheh Soheilykhah et al.[16] observed that high serum ferritin can be regarded as a significant risk factor for the development of gestational diabetes. Women who developed GDM had a higher concentration of serum ferritin than women who did not develop GDM (p = 0.01). The 75th percentile for healthy pregnant women was shown to be 45 ng/ml of ferritin. Taking this into account, elevated ferritin levels were present in 25.2% of normal participants and 32% of the GDM group (p = 0.01). The risk of GDM with these high levels of ferritin was 1.4-fold higher than that for subjects with lower concentrations. The odds ratio was 1.4 (95% CI = 1–1.87) (p = 0.01). After adjustment for age, the odds ratio was 1.38 (95% CI = 1.01–1.86) (p = 0.03), and after adjustment for pre-pregnancy body mass index, the adjusted odds ratio was 1.31 (CI = 0.96–1.79) (p = 0.08). The adjusted odds ratio following multivariable adjustment (age and body mass index) was 1.3 (0.95–1.8) (p = 0.09).

Rajput R et al.[17], Gopalan S K et al.[18], and Kalyani KR et al.[19] found that about 76%, 58.5%, and 76% of individuals with GDM had given birth many times, which aligns with the results of the current research. This research demonstrated a reduced prevalence of diabetes mellitus history among family members in both the GDM and non-GDM groups, with a non-significant p-value between the groups. Rajput et al.[17] and Gopalan S. K. et al.[18] found that 8.2% and 15.19% of those who got GDM had a family history of diabetes mellitus, respectively. The average maternal haemoglobin in the GDM group was 12.11±0.98, whereas in the non-GDM group, it was 12.43±1.32. There was no notable disparity in the average maternal haemoglobin levels between the two groups.

Sharifi F et al.[14] found that the mean haemoglobin levels were 12.8±0.8 in the GDM group and 12.5±0.58 in the non-GDM group, with a non-significant p-value. Das A et al.[20] conducted research that found a higher incidence rate of gestational diabetes mellitus (GDM) in the high haemoglobin group (Hb> 13 g/dL) at 44.12% compared to the normal haemoglobin group (Hb ≤ 13 g/dL) at 10%. High levels of ferritin have been proposed to have a role in the onset of gestational diabetes mellitus (GDM). The average maternal ferritin levels were 90.06±7.46 in the GDM group and 48.33±5.65 in the non-GDM group in the current research. There was a notable disparity in the average maternal ferritin levels between the two groups. Ferritin, a protein that accumulates iron, may cause insulin resistance due to excess iron-induced oxidative damage. Iron may shift between Fe2+ and Fe3+ states, leading to the Fenton reaction that produces hydroxyl radicals from oxygen, causing cellular damage. Excessive iron buildup in different tissues may lead to impaired glucose absorption by muscle, adipocytes, the liver, and other cell types, as well as compromised insulin signalling in the liver. If pregnant women are advised to take iron supplements regardless of their iron levels, it might result in iron excess and the generation of free radicals, leading to potential problems such as GDM. The average foetal haemoglobin in the GDM group was 15.22±2.54gm%, whereas in the non-GDM group, it was 15.77±1.98gm%. The mean foetal haemoglobin comparison between the two groups was determined to be statistically insignificant. In research by Chauhan P et al.[21], cord blood haemoglobin levels were found to be 14.4±0.76 in the group with gestational diabetes mellitus (GDM) and 13.4±0.63 in the group without GDM. In a study by Baki M. A. et al.[22], they reported that the foetal haemoglobin levels were 19.00±1.39 g/dL in the GDM group and 17.47±1.6 g/dL in the non-GDM group. The mean birth weight in the GDM group was 3.23±0.34 kg, and in the non-GDM group, it was 3.01±0.37 kg in the present study. Yang Y et al.[23] found a significant positive correlation between birth weight and GDM (p-value = 0.0002) [23]. In the research by Baki MA et al.[22], the average birth weight of newborns born to diabetes mothers was 3296±62 gm, whereas it was 2714±32 gm for infants born to non-diabetic mothers (p-value<0.05).

Newborns of mothers with gestational diabetes mellitus (GDM) have greater birth weights due to the increased transfer of blood glucose from the placenta into the foetal circulation, resulting in elevated birth weight. Newborns in the GDM group showed raised levels of serum iron and Hb, perhaps owing to enhanced iron transfer from diabetes moms to meet the higher needs of the fetus. Elevated ferritin levels are linked to a higher risk of developing gestational diabetes mellitus (GDM) and may lead to increased

oxidative stress, potentially impacting the transfer of iron in the placenta and the synthesis of foetal haemoglobin.

The limitation of the study: In the present study, there is a small sample size.

Conclusion:

Serum markers that may indicate the likelihood of developing GDM can be regularly used to aid in early diagnosis. Serum ferritin is increased in GDM, suggesting inflammation or iron overload, leading to enhanced oxidative stress that might impact placental iron transfer and haemoglobin production.

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