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ASSOCIATION OF DIETARY PATTERNS AND GESTATIONAL DIABETES MELLITUS WITH ANEMIA AMONG PREGNANT PAKISTANI WOMEN: A CROSS - SECTIONAL STUDY

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Abstract

AIMS: *The purpose of this study is to investigate the relationship between dietary habits and the prevalence of anemia and Gestational Diabetes Mellitus (GDM) in Pakistani pregnant women.*

MATERIALS AND METHODS: A cross-sectional study was conducted on 178 pregnant Women who attended prenatal clinics at various hospitals in different regions of Pakistan. A validated food frequency questionnaire (FFQ) was used to assess dietary intake. Gestational Diabetes Mellitus was diagnosed using the International Association of Diabetes and Pregnancy Study Groups (IADPSG) criteria, while anemia was diagnosed with World Health Organization (WHO) guidelines.

RESULT: *The Chi-squared ($p<0.05$) test was used to investigate the relationships between anemia, GDM, and dietary habits. The prevalence of anemia was 108 (60.6%) among the participants, with 58 (32.5%) classified as having mild anemia, 34 (19.10%) as moderate and 16 (8.9 %) as severe anemia. In contrast, 70 (39.3%) were non-anemic. The prevalence of GDM in Pakistani women was 18 (10.1%), while 160 (89.8%) did not have GDM. A diet high in carbohydrates and low in fruits and vegetables was significantly linked to increased prevalence rates of anemia and GDM.*

CONCLUSION: *The study emphasizes the importance of dietary habits in the development of GDM and anemia in pregnant Pakistani women. A diet high in carbohydrates and low in essential nutrients is one of the main risk factors for these conditions. These findings highlight the need for dietary modifications and nutritional education to promote better eating practices among pregnant Pakistani women.*

INTRODUCTION

Pregnancy, a complex physiological state, involves intricate interactions between various factors that significantly impact maternal and fetal health [1]. Anemia is the significant risk for expecting mothers due to several factors, such as eating choices and parasite infection [2]. Anemia occurs when the blood

has a lower- than- a normal count of red blood cells and hemoglobin. It can be classified into three forms: mild, moderate, and severe. A woman's hemoglobin concentration during pregnancy should be considered as 10.0 to 10.9 g/dl for mild anemia, 7 to 8.9 g/dl for moderate anemia, and less than 7 g/dl for severe anemia [3]. Mild anemia is a common condition in expectant mothers. Due to a lack of iron, vitamin D, or other nutrients, women are more frequently affected by anemia than men. Fatigue and tiredness are common consequences of anemia.

According to the World Health Organization (WHO), anemia is classified as physiological condition when the hemoglobin concentration is less than 11 g/dl. Severe anemia is defined as a hemoglobin concentration less than 7 g/dl and is considered a global health issue [4]. The dietary choices of the mother during pregnancy significantly impact both her and the fetus. The physiological demands of pregnancy require an optimal diet, and deficiencies or excesses in specific nutrients can have major consequences [5].

The Pakistan National Nutritional Survey (2011) found that pregnant women in Pakistan generally do not follow dietary guidelines. Factors affecting pregnant women's nutritional status include cultural customs, gender discrimination, misconception and taboos, food insecurity, and a lack of knowledge about healthy eating [6]. There is a strong correlation between mother's diet and fetal growth. Poor maternal nutrition can lead to low birth weight, early intrauterine growth retardation, and complications during delivery [7].

Gestational diabetes mellitus (GDM) is categorized by hyperglycemia that occurs during pregnancy and resolves after delivery. GDM typically manifests after the 1st trimester (13 weeks) and has become more prevalent due to rising obesity rates and early pregnancies. About 5% of women of reproductive age are diagnosed with GDM and its occurrence varies across nations due to differences in diet and life styles [8]. GDM is associated with β-cell dysfunction, resulting in mild hyperglycemia, which contributes to the development of GDM [9].

Studies indicate an intricate relationship between dietary habits, GDM, and anemia during pregnancy. Poor dietary habits such as consuming high levels of refined carbohydrates and insufficient fruits, vegetables, and protein, are linked to an increased risk of both GDM and anemia [10]. Women with GDM are more prone to develop anemia due to altered glucose metabolism, which affects iron absorption and utilization [11].

Understanding the complex links between dietary habits, GDM, and anemia among women is the focus of this study. Identifying these relationships provides important insights that can inform health programs and targeted dietary interventions aimed at improving maternal and fetal health outcomes in this population.

MATERIALS AND METHODS

Study Design and Study Population

A cross-sectional study was conducted from December 2023 to March 2024 involving 178 pregnant women attending antenatal checkups at obstetrics and gynecology departments in various public and private hospitals across Pakistan. The study included pregnant women between the ages of 18 and 42.

Data Collection Tool (Questionnaire)

We collected data on socio-demographics factors, reproductive history, dietary habits, anemia, GDM, and biological factors affecting pregnant women using a standardized and validated questionnaire.

Dietary patterns

A Food frequency questionnaire (FFQ) was used to measure food intake.

Anemia Diagnosis

Anemia was categorized according to WHO classification for pregnant women. Hemoglobin values between 9.0 and 10.9 g/dl were classified as mild anemia; 7.0 to 8.9 g/dl as moderate anemia; and less than 7.0 g/dl as a severe anemia. Participants with the hemoglobin concentration equal to or greater than 11g/dl were considered non-anemic.

GDM Diagnosis

Gestational diabetes mellitus was diagnosed at 24–28 weeks of pregnancy using a 75-g oral glucose tolerance test (OGTT). At least one abnormal result was required, with fasting plasma glucose levels of ≥ 92 mg/dl, 1-hour glucose levels of ≥ 180 mg/dl, or 2-hour glucose levels of ≥153 mg/dl.

Statistical Analysis

The data was analyzed using SPSS (version 29.0.2.0). The Pearson chi-squared test was used to evaluate the relationships between variables, with a significance threshold of $p < 0.05$.

RESULTS

Socioeconomic and Demographic Characteristics of Pregnant Women

A total of 178 pregnant women were enrolled in this study. Their ages were divided into two groups: Group-I (18 to 30 years) and Group-II (31 to 42 years). The educational levels of participants were as follows: 23 (12.9%) were illiterate, 65 (36.5%) had completed matriculation, 45 (25.2%) had completed intermediate, 35 (19.6%) had a bachelor's degree and 10 (5.6%) had a master degree. In terms of occupation, 135 (75.8%) were housewives, 9 (5.1%) were job holder and 34 (19.1%) were Laborer. Family income, residence and socioeconomic status are also discussed below (Table I)

Table I: Socio-demographic characteristics of study population

Variables	Mean ± SD / f (%)
N	178
Age (years)	
18-30	98(55.05%)
31-42	80(44.9%)
Occupation	
Housewife	135 (75.8%)
Job	9 (5.1%)
Laborer	34 (19.1%)
Education	
Illiterate	23 (12.9%)
Matric	65 (36.5%)
Intermediate	45 (25.3%)
Bachelor	35 (19.7%)
Master	10 (5.6%)
Family income	
<25,000	55 (30.8%)
25-50,000	75 (42.1%)
>50,000	48 (26.9%)
Residence	
Urban	95 (53.3%)
Rural	83 (46.6%)
Socioeconomic status	
Low	55 (30.8%)
Middle	75 (42.1%)
High	48 (26.9%)

Frequencies and Prevalence of Anemia

The prevalence of anemia was 108 (60.6%) among the participants, with 58 (32.5%) classified as having mild anemia, 34 (19.10%) as moderate and 16 (8.9 %) as severe anemia. In contrast 70 (39.3%) were non-anemic.

Table II: Anemia statuses among the study respondents

Variables	Hemoglobin categories				Total
	Mild Anemia	Moderate Anemia	severe Anemia	Normal	
Anemia Hb level	58	34	16	0	108 (60.6%)
Non-Anemia	0	0	0	70	70 (39.3%)
Total	58 (32.5%)	34 (19.10%)	1 (8.9 %)	70	178 (100%)

Table III: FFQ of eating habits and food consumption of women with and without Anemia:

Variables	Anemia				Non Anemia				*p* value
	Daily	Once in a week	2-3 times in a week	Rarely or never	Daily	Once in a week	2-3 times in a week	Rarely or never	
Rice and pasta	36	32	25	15	20	30	10	10	0.79
White bread\Roti	37	25	36	10	25	15	25	5	0.672
Red meat	13	32	34	29	20	30	10	10	0.001*
Eggs and egg dishes	12	35	29	32	19	33	10	8	0.04*
Salad vegetables	10	33	34	31	20	28	12	10	0.001*
fruit and fruit juices	12	35	23	38	22	18	16	14	0.03*
Soft drinks	28	25	43	12	10	25	10	25	0.01*
Tea and coffee	34	26	36	12	25	15	25	5	0.161

In the current study, all statistical analyses were performed using SPSS version (29.0.2.0). A *p*-value < 0.05 (*) was considered statistically significant

The diet, high in carbohydrates was found to be significantly associated with increased prevalence rates of anemia. Conversely, anemia was negatively correlated with a high-protein diet. Specifically, high-protein foods such as red meat and eggs were negatively correlated with anemia. Additionally, the consumption of salad, vegetables, fruits and juices were also negatively correlated with anemia, whereas soft drinks shows positively correlated with anemia.

Table IV: Findings from Chi –square test assessing the relationship between Hb% and variables

Factors	Chi-square values	*p*-values
Hemoglobin levels of participants / Age of participants	14.28	0.001*

Hemoglobin levels of participants / Education Of participants	3.70	0.504
Hemoglobin levels of participants /Occupation of Participants	3.70	0.157
Hemoglobin levels of participants / Parity of Participants	2.81	0.94
Hemoglobin levels of participants /Gestational Age of Participants	0.004	0.954
Hemoglobin levels of participants / Eating habits about Rice and pasta of Participants	9.88	0.79
Hemoglobin levels of participants / Eating habits about white bread/ Roti of Participants	3.181	0.672
Hemoglobin levels of participants / Eating habits about red meat of Participants	18.57	0.001*
Hemoglobin levels of participants / Eating habits about eggs and egg dishes of Participants	10.87	0.04*
Hemoglobin levels of participants / Eating habits about Salad vegetables of Participants	18.53	0.001*
Hemoglobin levels of participants / Eating habits about	13.28	0.01*
0.01* soft drinks of Participants		
Hemoglobin levels of participants / Eating habits about	11.77	0.03*
0.02 * fruit and fruit juices of Participants		
Hemoglobin levels of participants / Eating habits about tea and coffee of Participants	3.548	0.161
Hemoglobin levels of participants / Blood sugar Level (GDM) of Participants	6.681	0.01*
Hemoglobin levels of participants / Family history Of Diabetes mellitus (DM) of Participants	2.530	0.112
Hemoglobin levels of participants / Family history	3.601	0.05
0.001* Of GDM of Participants		
Hemoglobin levels of participants / Hb categories	178.0	0.001*

In the current study, all statistical analyses were performed using SPSS version (29.0.2.0). A *p*-value <0.05 (*) was considered statistically significant.

Table IV shows the correlation of Anemia with other variables such as age, education, gestational age, food categories, Family History of DM and GDM etc.

Prevalence of GDM

The prevalence of GDM among Pakistani women was 18 (10.1%), while 160 (89.8%) did not have GDM.

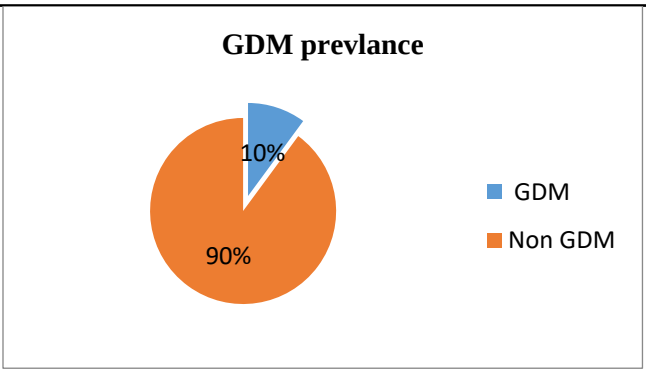

Figure 1: Prevalence of GDM among participants

Table V: FFQ of eating behaviors and food consumption in women with and without GDM

Variables	Gestational diabetes				Non gestational diabetes				*p* value
	Daily	Once in a week	2-3 times in a week	Rarely or never	Daily	Once in a week	2-3 times in a week	Rarely or never	
Rice and pasta	3	7	4	4	21	55	52	32	0.226
White bread\Roti	11	2	3	2	130	5	23	2	0.37
Red meat	3	4	1	8	45	64	26	25	0.001*
Eggs and egg dishes	1	3	3	11	47	58	30	25	0.02*
Salad vegetables	0	2	3	13	55	47	35	23	0.001*
fruit and fruit juices	2	3	4	9	56	49	33	22	0.02*
Soft drinks	5	3	5	5	23	52	53	32	0.01*
Tea and coffee	6	4	6	2	85	30	23	22	0.813

In the current study, all statistical analyses were performed using SPSS version (29.0.2.0). A *p*-value < 0.05 (*) was considered statistically significant.

A diet high in carbohydrates was found to be significantly associated with increased prevalence rates of anemia. Conversely, anemia was negatively correlated with a high-protein diet. Specifically, high-protein foods such as red meat and eggs were negatively correlated with GDM. Additionally, the consumption of salad, vegetables, fruits and juices were also negatively correlated with GDM and anemia, whereas soft drinks showed a positively correlated with GDM and anemia.

Similarly, these same food categories showed positive or negative correlations with both anemia and GDM, although with different significance values.

Table VI: Findings from Chi –square test assessing the relationship between GDM and variables**:**

Factors	Chi-square values	P-values
GDM in participants / Age of participants	8.725	0.003*
GDM in participants / Education Of participants	1.477	0.831
GDM in participants /Occupation of Participants	6.043	0.49

GDM in participants / Parity of Participants	3.071	0.80
GDM in participants /Gestational Age of Participants	2.765	0.96
GDM in participants / Eating habits about Rice and pasta of Participants	6.932	0.226
GDM in participants / Eating habits about white bread/ Roti of Participants	11.87	0.37
GDM in participants / Eating habits about red meat of Participants	6.00	0.001*
GDM in participants / Eating habits about eggs and egg dishes of Participants	11.67	0.02*
GDM in participants / Eating habits about Salad vegetables of Participants	18.53	0.001*
GDM in participants / Eating habits about	13.28	0.01*
0.01* soft drinks of Participants		
GDM in participants / Eating habits about	11.76	0.02 *
0.02 * fruit and fruit juices of Participants		
GDM in participants / Eating habits about tea and coffee of Participants	2.268	0.811
GDM of Participants / Hemoglobin levels of participants	6.681	0.10
GDM in participants / Family history Of Diabetes mellitus (DM) of Participants	11.099	0.001*
GDM in participants / Family history	11.098	0.001*
0.001* Of GDM of Participants		
GDM of Participants / Hb categories	12.265	0.007*

In the current study, all statistical analyses were performed using SPSS version (29.0.2.0). A *p*value < 0.05 (*) was considered as statistically significant.

Table VI shows the correlation of GDM with various variables age, education, gestational age, food categories family history of DM and GDM etc.

DISCUSSION

This cross-sectional study was conducted to explore the relationship between dietary practices, anemia, and gestational diabetes mellitus (GDM) among pregnant women in Pakistan. Our findings on the prevalence of anemia and GDM align with previous research conducted in various rural areas of Pakistan, where anemia prevalence has been reported to range from 41.7% to 77.0% [12].

Our study demonstrated that pregnant women with lower family per capita income exhibited higher levels of anemia compared to those with higher family incomes. Additionally, pregnant women from rural regions had a greater frequency of anemia. A study conducted in Pakistan indicated that individuals with anemia were more likely to be low-income patients than those with higher incomes. Previous research has also suggested a correlation between anemia and factors such as poor educational attainment and multiparty [13]. However, our investigation did not uncover this link which might be attributed to

differences in the research subjects and methodologies used.

In our study population, we found positive association between low meat consumption and anemia. This finding is consistent with prior research suggesting that low meat consumption is a risk factor for anemia in women of reproductive age [14]. The association between low socioeconomic status and anemia align with earlier studies conducted in Pakistani cities, as well as other regions of Asia and Africa [15]. For instance, a study carried out in northern Pakistan demonstrated that women belonging to lower socioeconomic groups had a higher likelihood of being anemic [16].

Gestational Diabetes Mellitus affects both the mother and the fetus. This study also evaluated the dietry consumption patterns during pregnancy and their correlation with the incidence of GDM in Pakistan. A study shown in the Southern United States revealed a trend where commonly consumed foods included eggs, peaches, cereals, fried fish liver, pork meat, and fresh fruit juices [17]. In our investigation, a noteworthy correlation was discovered between the risk of GDM and dietry patterns rich in carbohydrates and low in protein (fish, meat, and eggs).

Our results contrast with research on pregnant Chinese women that revealed a negative correlation between the incidence of GDM and the consumption of high-protein, low-starch foods. Dietary fiber from fruits and vegetables can help reduce insulin resistance. Our findings are in line with a study from Lahore, which found that a higher risk of pregnancy-related hyperglycemia was associated with high carbohydrate consumption and poor intake of fruits and green leafy vegetables [18].

Research conducted in Iran indicated that having a history of GDM was linked to its occurrence in a current pregnancy [19]. Furthermore, a study from Peshawar, Pakistan, reported that the majority of GDM patients had a history of the disease [20]. These findings are consistent with our study, which found that 51.6% of cases had a history of GDM.

Our study demonstrated a substantial correlation between a family history of diabetes and gestational diabetes mellitus, aligning with previous research [21]. This supports findings from an Iranian study showing that cases had a higher prevalence of family history of diabetes [19]. The influence of family history on GDM may result from hereditary and lifestyle risk factors such as socioeconomic status and educational attainment, although the actual impact on GDM may depend on the presence of multiple other risk factors.

There are certain intrinsic limitations to this study. Firstly, women may not have provided accurate information as some questions, including those about the history of abortion and the use of contraception, are sensitive. Second, our dietary history questionnaire might not have accurately captured the women's daily or seasonal eating patterns, as it only inquired about food consumed in the previous month.

The Government should prioritize support for poor rural areas and socioeconomic groups with limited access to healthcare resources, knowledge, and purchasing power. Specifically, the government of Pakistan needs to develop strategies to reduce family poverty by providing employment opportunities for citizens in peripheral regions. One approach to combating poverty is ensuring that both boys and girls receive quality education in schools, particularly in rural areas where public education is heavily relied upon.

Conclusion

The study concludes by emphasizes the significant connections between the dietary practices of pregnant Pakistani women, GDM, and anemia. Addressing these challenges requires a combination of nutritional and metabolic management strategies to enhance maternal and fetal health. Based on these findings, targeted interventions can be developed in the future to mitigate the combined effects of anemia and gestational diabetes mellitus.

Conflicts of Interest Statement

The authors declared that they have no conflicts of interest related to this research.

Studies Involving Humans

The research was completely voluntary. Its goals and methods were explained in detail to the participants. They provided their informed consent after being properly briefed about the study. Their information was kept anonymous, and all of the records were safely kept to protect their privacy.

Abbreviations:
GDM: Gestational Diabetes Mellitus
(IADPSG): International Association of Diabetes and Pregnancy Study Groups
(WHO): World Health Organization
(FFQ): Food frequency questionnaire

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