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Relationship of Adiponectin Levels with Body Mass Index (BMI) in Pregnancy

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ABSTRACT

Introduction: Low adiponectin level is an indication of insulin resistance during gestational weight gain, and could be used as a marker for diabetes or hypertension in pregnancy.

Objective: To find relationship between BMI and adiponectin levels in pregnant women.

Methods: In this cross-sectional study, total 200 study participants were selected. Participants were 24 to 40 weeks pregnant, with or without gestational diabetes mellitus. Patients with pre-existing or pre-pregnancy diabetes were excluded from study. BMI was calculated at the time of the study. Adiponectin levels were measured on Metrolab ELISA, using Human Adiponectin ELISA kit by Biovendor, Germany. SPSS version 20 was used to analyze data.

Results: Out of 200 participants, 100 had gestational diabetes. None of the participants was below normal weight, however, about 38% of participants were overweight, and about 58% of participants were obese, according to WHO-Asian criteria. Adiponectin level was below normal in more than 60% patients. No difference was found between BMI within diabetes-based groups. But there was significant difference between adiponectin levels in Group I and Group II. No relationship of BMI was found with diabetes-based groups, gestational age groups, or adiponectin categories. Significant relationship was found between the diabetic group and low serum adiponectin levels. Regression analysis showed that BMI was neither a predictor of diabetes nor adiponectin levels. However, adiponectin levels were a predictor of diabetes in pregnancy.

Conclusion: Our study could not find a relationship of BMI with either adiponectin levels or gestational diabetes. Low adiponectin levels, however, could predict gestational diabetes.

Key Words: Gestational, Weight gain, Adiponectin, Pakistan, Pregnancy trimester, BMI

INTRODUCTION

Weight gained by women during pregnancy is called gestational weight gain (GWG). This weight gain includes the fat and lean mass of the mother's body, the weight of the baby, placenta, and amniotic fluid.[1] Insufficient or excessive weight gained by the mother is of great concern for the healthcare team as this results in adverse health outcomes for both mother and the child. Excessive weight gain could result in the development of gestational diabetes mellitus in the mother and resultant macrosomia in the fetus, or it could lead to hypertension in the mother and resultant placental abruption causing fetal death. Conversely, insufficient weight gain could lead to preterm delivery.[2] According to Institute of Medicine (IOM) guidelines 2009, recommended gestational weight gain is 12.7–18.2 kgs for underweight (<18.5 kg/m²), 11.5 kgs to 16 kgs for those with normal pre-pregnancy BMI (18.5–24.9 kg/m²), 7 to 11.5 kgs for overweight (25–29.9 kg/m²), and 5 to 9 kgs for obese (≥ 30 kg/m²)[2], for healthy maternal and fetal outcome.

Adiponectin levels are inversely related to increased visceral fat in overweight and obese subjects.[3,4,5] Studies show that low adiponectin level is an indication of insulin resistance in conditions like physiological weight gain of pregnancy as well as in gestational DM.[6] Adiponectin could be used as a marker for the prediction of excessive fat deposition, insulin resistance, and hence also for diabetes or hypertension in pregnancy.

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Our study focused on the relationship and effect of BMI of pregnant women with serum adiponectin levels. We also intended to find the relationship between serum adiponectin levels with gestational diabetes.

METHODS

It was a cross-sectional study. The study participants were selected from four public and one private tertiary care hospital of Peshawar, Khyber Pakhtunkhwa (KPK), Pakistan. The study was approved by IRB of Khyber Medical College. IRB No. was 139/PG/KMC. Participants included were those with a single fetus, 24 to 40 weeks pregnant, with or without gestational diabetes mellitus (GDM). Patients with multiple pregnancies and pre-existing or pre-pregnancy diabetes were excluded from the study. The weight and height of all study participants were measured and BMI was calculated by using the formula weight (kgs)/ height (m^2).

Participants of the study were categorized into Group I (non-diabetic pregnant women), and Group II (women with gestational diabetes mellitus). Categories of the 2nd and 3rd trimesters of pregnancy were also made by using a cut-off point of ≥28 weeks of pregnancy. According to WHO recommendations, Asian BMI cut-off values were different from those set for Caucasians.[7] Hence, the BMI cut-off point of <18.5 kg/m^2 was set as underweight, 18.5-22.9 kg/m^2 as normal, and ≥23 kg/m^2 was set as overweight or obese. Adiponectin levels in serum range between 5 and 30 µg/mL.[6] Hence, a cut-off level for hypoadiponectinemia was set at below 5 µg/mL.

SPSS version 20 was used to analyze data. Frequencies and percentages of all categories were calculated. Chi-square tests were run between BMI and adiponectin levels, groups of diabetics and non-diabetics, and gestational age groups. Binary regression analysis was also done to find out the effect of BMI on adiponectin levels and the diabetic status during pregnancy.

RESULTS

There was a total of 200 participants in the study. About 25% of these participants were in their teenage, and the remaining participants were between 19 to 28 years of age. Fifty percent of the study group was suffering from gestational diabetes. Thirty percent of the participants were in their second trimester of pregnancy, and seventy percent of the participants were in their third trimester of pregnancy. None of the participants was below normal weight, however, about 50% of participants fell in the overweight category, and about 30% of participants fell in the obese category according to WHO criteria. But according to WHO-Asian criteria about 38% of participants fell in the overweight category, and around 58% of participants fell in the obese category. Adiponectin level was lower than the normal limit in more than 60% of cases (Table 1).

Table 1: Characteristics of participants:

Variable	Categories	Frequency	Percentage
Age (years)	=<19 years	49	24.5
	>19 years	151	75.5
Diabetic status	Non-diabetic	100	50.0
	Diabetic	100	50.0
Gestational age (weeks)	<28 weeks	59	29.5
	=>28 weeks	141	70.5
Adiponectin level (µg/mL)	<5 µg/mL	123	61.5
	=>5 µg/mL	77	38.5
BMI (kg/m^2) (WHO-Asian criteria)	18.5 – 22.9	10	5
	23 – 27.4	75	37.5
	≥27.5	115	57.5
BMI (kg/m^2) (WHO criteria)	18.5 – 24.9	39	19.5
	25 – 29.9	101	50.5
	≥30	60	30.5

Differences between means of the age of participants, gestational age, BMI, and adiponectin levels were calculated between diabetic and non-diabetic groups. Statistically significant difference was only found between values of adiponectin levels in Group I and Group II (Table 2). No difference was found between means of age of participants, BMI or gestational age.

Table 2: Differences between variables between Group I and Group II:

	Group	N	Mean	SD	p-value
Age (years)	Non-diabetic	100	21.90	2.67	-------
	Diabetic	100	21.35	2.89	
Gestational age (weeks)	Non-diabetic	100	30.60	6.05	-------
	Diabetic	100	30.81	5.40	
B.M.I (kg/m^2)	Non-diabetic	100	30.43	6.58	-------
	Diabetic	100	28.88	5.84	
Adiponectin (µg/mL)	Non-diabetic	100	9.93	4.81	0.000
	Diabetic	100	2.17	1.84	

Chi-square tests were run between BMI, diabetes-based groups, gestational age groups, and adiponectin categories. No relationship of BMI was found with diabetes-based groups, gestational age groups, or adiponectin categories. Only one significant relationship was found; a moderately strong relationship was present between the diabetic group and low serum adiponectin levels (Table 3).

Table 3: Fisher's exact test

Variable 1	Variable 2	p-value	Correlation
BMI	Diabetes-based groups	0.748	---------
	Gestational age	1.000	-------
	Adiponectin	1.000	-------
Adiponectin	Diabetes-based groups	0.000	- 0.73
	Gestational age	1.000	-------

Binary logistic regression analysis was done to find out the predictive strength of BMI on gestational diabetes, as well as on adiponectin levels. Regression analysis showed that BMI was neither a predictor of diabetes nor of low adiponectin levels. However, adiponectin levels were found to be a predictor of diabetes in pregnancy, even after adjusting with the patient's age, gestational age, and BMI. Similarly, diabetes could predict hypoadiponectinemia (Table 4), after adjusting with the patient's age, gestational age, and BMI.

Table 4: Binary regression analysis.

Model 1: Dependent variable=Diabetic and non-diabetic groups, p-value=0.000				
Variables:	p-value:	OR:	95% Confidence interval:	
			Lower	Upper
Age (years)	0.456	-----	-----	-----
Gestational age (weeks)	0.892	-----	-----	-----
BMI (kg/m²)	0.457	-----	-----	-----
Adiponectin ((µg/mL)	0.000	0.61	0.52	0.70
Model 2: Dependent variable=Adiponectin levels, p-value=0.000				
Age (years)	0.952	-----	-----	-----
Gestational age (weeks)	0.704	-----	-----	-----
Diabetes-based groups	0.000	0.01	0.00	0.03
BMI (kg/m²)	0.619	-----	-----	-----

DISCUSSION

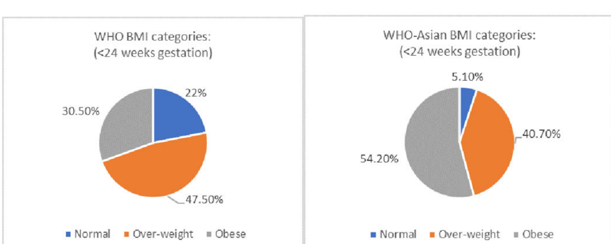
Fifty percent of our study population comprised diabetic patients. Most of these patients were in their last trimester of pregnancy. BMI of almost all patients fell in the overweight and obese categories. Hypoadiponectinemia was present in the diabetic group only.

Mother's body composition changes throughout pregnancy. Only small changes occur in maternal fat mass during early pregnancy, whereas much larger changes occur in the latter part of gestation.[8] In the initial months of gestation, the uterus and breast tissue grow, and the blood volume expands. In the later part of pregnancy, the fetus, amniotic fluid, and placenta grow to a larger extent, along with the growth of maternal tissues and expansion of blood volume.[8] Fetus, placenta, and amniotic fluid contribute to about a third of the total GWG. Due to the lack of repeated assessment of body composition, there is limited data on fat gain during pregnancy.[8] It was difficult to assess the fat gain in this group due to various reasons. Firstly, it was a cross-sectional study, and the weight and height were measured at the time of taking samples for serum adiponectin levels. Some patients were already registered in antenatal records, but their earliest weight was not noted, because data for the rest of the group participants were not available. In order to avoid confusion in the BMI data, only weight data recorded at the time of conduction of the study was utilized. Secondly, about 30% of the participants were in their second trimester of pregnancy, and 70% of the patients were in their third trimester of pregnancy, and it was not possible to assess maternal fat gain by merely performing simple anthropometric measurements. In our study, about 38% of the participants were overweight, and about 58% were obese, according to WHO-Asian criteria (Fig 1B), and about 50% of the participants were overweight, and about 30% were obese, according to WHO world criteria (Fig 1A). This meant that the pre-pregnancy weight of most of these patients might already have been high. As most of these patients were in their last trimester of pregnancy, they were expected to have a large BMI owing to GWG. In our study, BMI was the parameter used to assess the adiposity of the group, but no significant difference was found between the BMI of the diabetic and non-diabetic groups. There was also no significant difference in BMI between the second and third trimesters of pregnancy. In our study, BMI was also unable to predict diabetes in pregnancy.

Adipose tissue increases during pregnancy due to metabolic changes of gestation. These changes are actually meant to meet the energy requirements of fetal development.[9]Adiponectin is an adipokine. Its level normally falls in overweight and obese.[10]Hence, with a high BMI in pregnancy, a decline in adiponectin levels was expected. But in our study, no relationship of BMI could be found with adiponectin levels. BMI failed to predict adiponectin levels also.

The adiposis of pregnancy is followed by an increased lipolytic activity, which is facilitated by a decline in insulin sensitivity.[9]This reduction in insulin sensitivity can lead to gestational diabetes. Adiponectin levels also fall as pregnancy progresses.[10]Adiponectin levels could also predict diabetes in pregnancy.[11,12] In our study, adiponectin levels were significantly lower in the diabetic group. Low adiponectin levels could predict gestational diabetes in our study. Conversely, gestational diabetes could also predict low adiponectin levels in our study.

In one study, patients were recruited from primary and secondary care hospitals of Karachi, Sindh Province, Pakistan.[13] These women were in their first trimester of pregnancy. There were about 21% underweight, 43% normal weight, and 36% overweight women in the study (Fig 2). Findings were consistent with the pre-pregnancy weights of women from Sindh Province, according to Pakistan's latest National Nutritional Survey.[14] However, during a household survey in small cities in Sindh, during all three trimesters of pregnancy, about 22% of women were found to be underweight, 69% women were normal, and about 9% were overweight or obese.[15] GWG seemed to be minimal in these women because if they had gained weight according to IOM recommendations, their weight should have fallen at least in the overweight category. In yet another study done in a tertiary care hospital, Lahore, Punjab Province, Pakistan, pre-pregnancy and/or first trimester BMI data showed 4% underweight, 47% normal, 33% overweight, and 16% obese women (Fig 2).[16] These findings were also close to National Nutritional Survey, 2018 findings from Punjab, Pakistan. These studies showed that underweight was more pronounced in smaller cities, and these findings were consistent with NNS, 2018. According to the National Nutrition Survey 2018, Pakistan, about 10% of non-pregnant women of Khyber Pakhtunkhwa Province, aged 15-49 years, were underweight, about 45% had normal BMI, about 30% of women were overweight, and 15% women were obese. According to WHO world criteria, about 50% of our study population fell in the overweight category, and about 30% population fell in the obese category (Fig 2). It has to be kept in mind that 30% of our study population was in their second trimester of pregnancy, and had not reached the maximum weight gain yet. However, our analysis showed that even in the second trimester of pregnancy, more than 75% of the participants fell into overweight and obese categories, according to both WHO and WHO-Asian criteria (Fig 1). The comparison of BMI data of pregnant women from Punjab, and Sindh urban cities and our study showed that at least 36% of participants of the former two studies were overweight and obese even at the beginning of pregnancy. As our study data was from later trimesters of pregnancy, the majority of the participants were overweight/obese (Fig 2).



(A) (B)

Figure 1: Distribution of BMI in 2nd trimester of pregnancy (according to WHO and WHO-Asian BMI criteria).

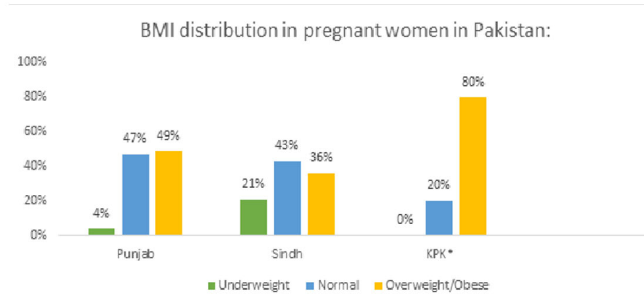


Figure 2: Distribution of BMI in pregnant women in Pakistan (*Data collected in 2nd and 3rd trimesters).

Both undernutrition and obesity are hazardous for health. Risks of poor outcomes of pregnancy, for both mother and baby, increase if the mother is underweight or overweight. Although the proportion of underweight in Pakistani women has reduced, the proportion of overweight and obese women has drastically increased.[14] The dietary habits of the Pakistani population include the consumption of energy-dense foods such as carbohydrates, sugar, and ghee.[17]These habits lead to overweight and obesity. Westernization has also struck the urban areas of Pakistan, leading to obesity. But women in low and middle-income countries suffer from malnutrition and they face considerable barriers in reaching optimum nutritional goals.[18] Pregnant women from small districts from all over Pakistan were found to be less likely to consume any iron and folic acid supplements. They had no education, their husbands were uneducated, and the household belonged to the lowest socioeconomic status. Also, no antenatal services were used by these women.[18,19] Hence, both undernutrition and obesity can be found in mothers in the Pakistani population, and strategies should be sought in order to take care of this population, on which the health and life of our future generation depend.

CONCLUSION

Our population was from an urban area of Pakistan, which had already reported a prevalence of overweight and obesity in non-pregnant women. The study population had a high BMI, but this BMI could not predict hypoadiponectinemia or gestational diabetes. However, low adiponectin levels could predict gestational diabetes.

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Dr. Akhtar Y: Concept, Design, Data collection

Dr. Fatima K: Design, Data analysis

Dr. Mehtab M: Manuscript writing, Literature search

Dr. Kashif S: Data analysis, Manuscript editing

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