Adiponectin and Hemoglobin Levels in Overweight and Obese Pregnant Mothers in Early Pregnancy

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Citation

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Abstract

Introduction: Body mass index (BMI) has constantly been associated with adverse health outcomes and, to a certain extent, adverse pregnancy outcome. The combination of increased maternal adiposity and reduction in insulin sensitivity influenced by hormonal products appears to be the causative factors in insulin resistance during gestational period. Adiponectin, which is one of the adipocyte-secreted hormones, was reported to possess insulin-sensitizing properties and appears to play a role in this metabolic syndrome. Accumulating literatures also suggested that high maternal hemoglobin level has an association with increased in incidence of adverse pregnancy outcomes which included the occurrence of gestational diabetes mellitus.Objective: The main objective of our study is to evaluate the relationship between patients' BMI, which is the risk factor for most metabolic disorders, with plasma adiponectin and hemoglobin levels among the antenatal subjects in the local population.Methods: This is a cross-sectional study involving 104 pregnant mothers that were recruited from the Bangi, Kajang and Seri Kembangan polyclinics, sosiodemografic and antenatal data were collected through a simple questionnaire after informed consent taken. All patients were in their first trimester of pregnancy. Patients were subcategorized according to their BMI into 4 categories: underweight, normal weight, overweight and obese. A volume of 3ml peripheral blood aspiration was taken by trained phlebotomist. Blood plasma was separated and stored at -80°C prior to tests. Plasma adiponectin level was measured using commercialized ELISA assay kit. Hemoglobin level was determined using Sysmex KX-21 Hematology Analyzer. Results were analyzed using SPSS version 15.Results: A total of 104 patients enrolled in the study, 12 patients (11.54%) were underweight; 57 patients (54.81%) were normal weight; 25 patients (24.04%) were overweight; and 10 patients (9.62%) were obese. A significant difference in hemoglobin level was found between underweight and obese pregnant mothers, as well as between normal weight and obese pregnant mothers. A significant difference in plasma adiponectin level was found between underweight and overweight pregnant mothers, as well as between underweight and obese pregnant mothers. Significant difference in plasma adiponectin level was also found between normal weight and obese pregnant mothers.Conclusion: We concluded that increased early pregnancy BMI, is highly associated with low plasma adiponectin level and increased hemoglobin level in our local population.

INTRODUCTION

Obesity is a disorder in which genetic predisposition is involved and interacts with environmental exposures to produce a heterogeneous phenotype. It appears to be a major contributing factor to the two most common medical risks in pregnancy: diabetes and hypertension (1). Body mass index (BMI) has constantly been associated with adverse health outcomes. Adverse pregnancy outcome such as congenital malformations including anencephaly, spina bifida and congenital heart defects were reported to be associated with prepregnancy BMI (2). The increased risk of type 2 diabetes in obese individuals has been well established, and accumulating literature also supports the notion of a higher risk of gestational diabetes mellitus associated with high BMI in prepregnancy and pregnancy stages. The combination of increased maternal adiposity and reduction in insulin sensitivity influenced by hormonal products appears to be the causative factors in insulin resistance during gestational period. It was hypothesized that increased maternal adiposity has adverse effect on some potential hormonal product produced by adipose tissue. The interest in adipose tissue as an endocrine organ has increased considerably since the discovery of several secreted proteins, termed adipokines. These proteins are currently being studied extensively, and several of them appear to play an important role in the pathophysiology of several diseases. Adiponectin, which is one of the adipocyte-secreted hormones, also named as Acrp30 (30 kDa adipocyte

complement-related protein), has 244 amino acids with an approximate size of 30 kDa consisting of four domains, namely a signal peptide, a variable domain, a globular C-terminal domain and a collagen-like N-terminal domain. The discovered multivalent functions of adiponectin include anti-atherogenic, insulin-sensitizing, lipid-oxidation enhancing, and vasodilatory activities (3), thus the customary function of adiponectin in relation to the development of metabolic syndrome is highly conceivable, even though the molecular basis of the metabolic syndrome is yet to be elucidated.

Evidence in literature is accumulating that high maternal hemoglobin has an association with increase in incidence of adverse pregnancy outcomes. High maternal hemoglobin has been associated with low birth weight and small-for-gestational-age newborns, pre-term birth, increased perinatal mortality, and pre-eclampsia (4). Lao and colleagues (4) found an association between increased hemoglobin concentration at initial visit to antenatal clinic and the subsequent development of gestational diabetes mellitus which had not been reported before.

Our study aimed to evaluate the relation between patients' BMI, which is one of the risk factors for metabolic disorder, with plasma adiponectin and hemoglobin levels among the antenatal subjects in the local population.

MATERIALS AND METHODS

PATIENTS

This is a cross-sectional study and the study protocol was approved by the ethics board at Faculty of Medicine and Health Sciences, University Putra Malaysia, and Ministry of Health. All participants gave written informed consent. A total number of 104 pregnant mothers attending Polyclinic Bangi, Polyclinic Kajang and Polyclinic Seri Kembangan from February 2008 to June 2008 were recruited randomly. Sociodemografic data and antenatal history were collected through a simple questionnaire. All patients recruited were in their first trimester of pregnancy and without family history of diabetes.

BODY MASS INDEX (BMI)

A volume of 3 ml peripheral blood was taken by trained phlebotomist. Blood plasma was centrifuged and stored at -80°C prior to tests. Patients' body mass index (BMI) was calculated as weight/height2 and presented in the unit of kg/m2. Data was presented as mean ± standard deviation. Patients were subcategorized into 4 groups: underweight (BMI < 18.5kg/m2); normal weight (BMI between 18.5kg/m2 to 24.9kg/m2); overweight (BMI between 25kg/m2 to 29.9kg/m2) and obese (BMI ≥ 30kg/m2).

HEMOGLOBIN AND PLASMA ADIPONECTIN LEVELS

Hemoglobin level was measured using EDTA- treated whole blood sample using the Sysmex KX-21 Hematology Analyzer. Data was presented as mean ± standard deviation. Plasma adiponectin level was measured using a commercialized ELISA assay kit from Mercodia, with sensitivity of up to 1.25 ng/ml, and assay range between 5 ng/ml to 300 ng/ml. Data was then presented as mean ± standard deviation.

STATISTICAL ANALYSIS

Data was analyzed using SPSS package version 15. Descriptive data was presented in mean ± standard deviation. Variables were analyzed using ANOVA and correlation between variables was determined through Pearson Correlation.

RESULTS

The clinical characteristics of the 104 patients enrolled in the study were as presented in Table 1.

Figure 1

Table 1: Clinical Characteristics of the Patients

Characteristics	Mean ± standard deviation
Age, years	28.7379 ± 0.4391
BMI at test day, kg/m2	23.5170 ± 0.4670
Gestational age, weeks	10.8835 ± 0.2655
Hb level, g/dL	11.7885 ± 0.0987
Adiponectin level, µg/ml	8.7813 ± 0.3377

BMI, body mass index; Hb, hemoglobin; Continuous variables, results are presented as mean ± standard deviation.

Patients were subcategorized into 4 groups according to their BMI. Of 104 patients enrolled in the study, 12 patients (11.54%) were underweight; 57 patients (54.81%) were normal weight; 25 patients (24.04%) were overweight; and 10 patients (9.62%) were obese. Clinical characteristics of the patients according to their BMI groupings were presented as in table 2.

Figure 2

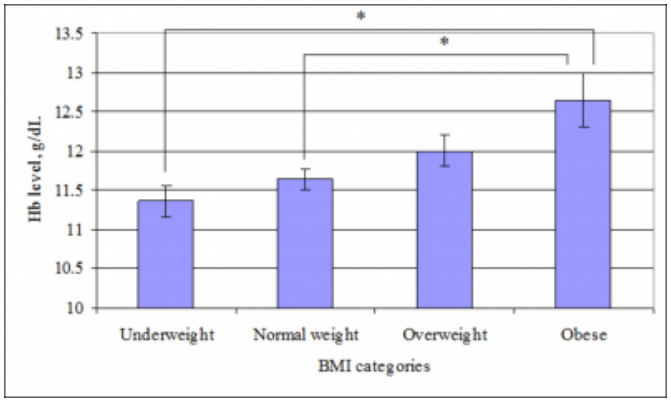
Table 2: Clinical Characteristics of the Patients Studied According to BMI

BMI categories	Underweight	Normal weight	Overweight	Obese
Patient, n	12 (11.54%)	57 (54.81%)	25 (24.04%)	10 (9.62%)
Hb level, g/dL	11.3583 ± 0.2013	11.6368 ± 0.1281	11.9960 ± 0.2003	12.6500 ± 0.3416
Adiponectin level, µg/ml	11.5380 ± 0.7124	9.0823 ± 0.5021	7.9965 ± 0.4433	5.7196 ± 0.5399

BMI, body mass index; Hb, hemoglobin; Continuous variables, results are presented as mean ± standard deviation.

Figure 3

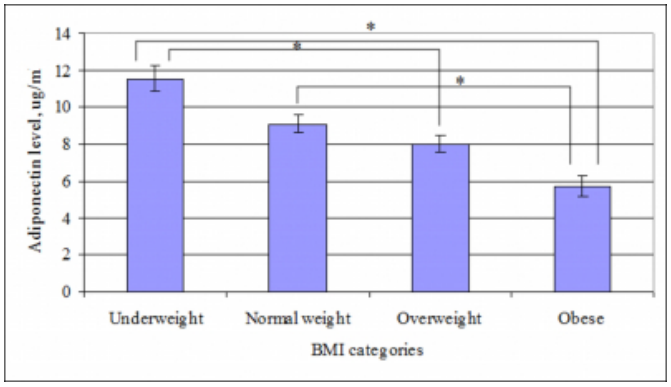
Fig 1: Hemoglobin Level of Different BMI Categories



A significant difference in hemoglobin level was found between underweight and obese pregnant mothers (P=0.012), as well as between normal weight and obese pregnant mothers (P=0.014). A difference in hemoglobin level between overweight and obese pregnant mothers was observed but it was not statistically significant. A significant positive correlation was found between patients' BMI with hemoglobin level (P=0.000), indicating increased BMI is correlated to increased hemoglobin level.

Figure 4

Fig 2: Adiponectin Level of Different BMI Categories



A significant difference in plasma adiponectin level was found between underweight and overweight pregnant mothers (P=0.011), as well as between underweight and obese pregnant mothers (P=0.000). Significant difference in plasma adiponectin level was also found between normal weight and obese pregnant mothers (P=0.014). A significant negative correlation was found between patients' BMI with plasma adiponectin level (P=0.000), indicating higher BMI correlated to lower level of plasma adiponectin level.

DISCUSSION

Obesity is a rapidly growing worldwide health problem, conferring substantial excess risk for mortality and morbidity, notably from type 2 diabetes mellitus and atherosclerotic cardiovascular disease (5). In pregnancy, obesity appears to be a major contributing factor to the 2 most common medical risks: gestational diabetes and hypertension. Indeed, gestational diabetes mellitus has been known for decades as a common metabolic disorder during the pregnancy period. Thomas (6) reported that the combination of increased maternal adiposity and the effects of insulin-desensitizing by hormonal products apparently contributed to insulin resistance during gestational period. The increased of interest in adipose tissues as an endocrine organ since several of the secreted proteins are being studied extensively; adiponectin which is one of the adipocyte-secreted hormones arise to play a role in relation to the development of this metabolic syndrome. Adiponectin was previously reported to possess anti-atherogenic, insulin-sensitizing and anti-inflammatory (7,8), lipid-oxidation enhancing, and vasodilatory activities (3). Our data showed that when the 104 antenatal patients were subcategorized into 4 groups according to their BMI, their plasma adiponectin level was decreased with increased BMI. A significant negative correlation was found and this finding was parallel to that of Berg (9), and Tsao (10), whose studies demonstrated that plasma adiponectin level is decreased in patients with obesity, type 2 diabetes mellitus, or coronary artery disease. The correlations between the adiponectin level and measures of insulin sensitivity in humans are well established (11), and these correlations have been reinforced by data obtained from animal models, in which, insulin resistance in lipoatrophic mice was reversed when treated with adiponectin (12), hepatic glucose uptake was increased during treatment with adiponectin (13), and there was increased activity of muscular fatty acid oxidation with adiponectin treatment (14). Moreover, diabetic animal models when treated with adiponectin, shows improved insulin sensitivity (13,15). These findings showed that adiponectin plays an important role in the

pathophysiological mechanism of metabolic disorder. However, there are accumulating studies which reported on the implication of low plasma adiponectin level in pregnant mothers on the integration and occurrence of gestational diabetes. Other than this, the inverse relation between plasma adiponectin level and body mass index, which is the most common risk factor for developing metabolic disorders is well established. Many reported findings indicate that low plasma adiponectin level is highly correlated to the occurrence of metabolic disorders and to the extent, the occurrence of gestational diabetes.

Evidence in the literature is accumulating that increased maternal hemoglobin has an association with increase in incidence of adverse pregnancy outcomes. Increased maternal hemoglobin has been associated with low birth weight and small-for-gestational-age newborns, pre-term birth, increased perinatal mortality, and pre-eclampsia (4). Lao and colleagues (4) found an association between high hemoglobin concentration at initial visit to antenatal clinic and the subsequent development of gestational diabetes mellitus which had not been reported before, at initial visit, Chinese women without any underlying hemoglobinopathies, but with hemoglobin level of more than 13 g/dL appears to be an independent risk factor of subsequent occurrence of gestational diabetes mellitus. In a cross-sectional study conducted on the association between serum ferritin, hemoglobin, iron intake, and diabetes in adults in Jiangsu, China, with no contrast, the findings revealed an inverse association between anemia and diabetes was revealed. Elevated hemoglobin and serum ferritin levels were both associated with high risk of developing diabetes mellitus, predominantly in women. The associations found were still observable even after adjusting for known risk factors such as sociodemographic characteristics, family history of diabetes mellitus, as well as life style factors. Our study observed that hemoglobin level was elevated with high BMI. A significant positive correlation was found, in which, increased maternal hemoglobin level was correlated to increased in maternal BMI. It has been postulated that patients with high BMI that correlated with low plasma adiponectin level have reduced insulin sensitivity, thus subsequently have poor glucose metabolic regulation that leads to increase in glycosylated hemoglobin level. Glycosylated hemoglobin has elevated affinity towards oxygen and, thus high level of glycosylated hemoglobin subsequently leads to tissue hypoxia, which in turn results in an increased in red cell count and hemoglobin level that eventuate from normal physiologic feedback. More data is required in order to evaluate the relation and the underlying mechanism of the physiological feedback discussed above.

LIMITATION

Our study aimed to indentify the underlying relation between plasma adiponectin level and body mass index in pregnant mothers as to date there are not much published reports on Malaysian patients yet. Our finding was parallel with the established relation between plasma adiponectin level and body mass index, in which increased body mass index was correlated to decrease in plasma adiponectin level. Thus, the results suggested that this inverse correlation between plasma adiponectin level and body mass index is not only seen in normal individuals regardless of gender, but also in pregnant patients. Nonetheless our data was limited to relate low plasma adiponectin level with the incidence of gestational diabetes mellitus, even though the role of adiponectin in metabolic disorder is highly conceived and many of its important functions in metabolism were established. In order to identify the relation between low plasma adiponectin level with the incidence of gestational diabetes mellitus, it is recommended to conduct a cohort study where the same pregnant subjects are to be followed up to term.

CONCLUSION

We concluded that high early pregnancy BMI, which is the risk factor for most metabolic disorder, are highly correlated to low plasma adiponectin level and increased hemoglobin level, which suggested subsequently susceptible to the development of metabolic disorder in our local population.

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