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## Original Research Article

## Association of pre-pregnancy body mass index to gestational weight gain, diabetes mellitus and hypertension

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## ABSTRACT

**Background:** The body mass index (BMI) before pregnancy and gestational weight gain (GWG) may have an association with the outcome of pregnancies. Preeclampsia, gestational diabetes, macrosomia show an association with the BMI.

**Materials and Methods:** A retrospective analysis of the data collected from 720 pregnant mothers during the period from January 2017 to January 2019 in a tertiary health care centre. The chi-square test was done to assess the categorical data.

**Results:** Gestational hypertension was significant in overweight women and those who gained weight above recommended range. (22.4% Vs. 0%;  $p < 0.001$ ) GDM was noted in a significant percentage of pregnant women within the recommended weight gain group. (12.4% Vs. 0%;  $p < 0.001$ ).

**Conclusion:** Pre-pregnancy dietary counselling, physical and lifestyle modifications have a role in bringing down the incidence of GDM and gestational hypertension.

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## 1. Introduction

The body mass index (BMI) before pregnancy and gestational weight gain (GWG) may have an association with the outcome of pregnancies.<sup>1</sup> Preeclampsia, gestational diabetes, macrosomia show an association with the BMI.<sup>2,3</sup> Small-for-gestational age (SGA) infants and preterm births are more seen with mothers with low BMI.<sup>4-7</sup> Obese women are likely to benefit from low GWG. Both BMI and GWG are closely related to lifestyle, and genetic traits and other medical conditions.<sup>6-8</sup>

Physiologic weight gain in pregnancy is contributed to by the foetus (3.2-3.6 kg), fat deposition (2.7-3.6 kg), increased blood volume (1.4-1.8 kg), increased extravascular fluid volume (0.9-1.4 kg), amniotic fluid volume (0.9 kg), breast enlargement (0.45-1.4 kg), uterine hypertrophy (0.9kg), and

placenta (0.7kg).<sup>9</sup> Obesity is one of the most serious global health concern according to the World Health Organization (WHO).<sup>10</sup> Based on the BMI, obesity is graded as Class I (30.0–34.9); class II (35.0–39.9), and class III or morbid obesity (BMI  $\geq$  40).<sup>11</sup>

In pregnancy obesity is considered at the first prenatal visit if BMI  $\geq$  30 kg/m<sup>2</sup>.<sup>11,12</sup> Further, based on weight categories, the recommended weight gain in was decided on standard parameters.<sup>13</sup> Obesity in pregnancy can predispose to metabolic, neurodevelopmental and immunologic conditions.<sup>14-17</sup> Obese mothers also have more caesarean sections and are less likely to lactate than women with a normal BMI.<sup>18-21</sup> Further there is an increased risk of maternal mortality in obese mothers.<sup>21,22</sup>

Glucose intolerance of first onset in pregnancy or first recognition during pregnancy is considered as gestational diabetes mellitus (GDM).<sup>23</sup> GDM is a known risk factor for perinatal complications, and later development of type

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2 diabetes mellitus.<sup>24–26</sup> The pregnancy related weight gain can contribute to fat deposition and insulin resistance and it is usually in the second trimester.<sup>27,28</sup> Insulin resistance is more if there is a rapid or disproportionate increase of weight.<sup>29</sup> This study aimed to study the effect of pre-pregnancy BMI with other risk factors.

## 2. Materials and Methods

The study, was a retrospective analysis conducted during the period of 1<sup>st</sup> January 2017, to 1st January 2019. The data was collected from case records, and electronic medical registers. All relevant socio-demographic and obstetric and clinical details were collected via semi-structured questionnaire. The cases with chronic hypertension, and overt diabetes mellitus were excluded. Weight was recorded using electronic digital scale on all antenatal visits and at the time of delivery.

The outcomes looked for were gestational hypertension, and GDM. Gestational hypertension and GDM was quantified based on standard references.<sup>30,31</sup> The data entry was done in a manner protecting all identifying information of the patients. An institutional ethical committee approval was obtained before data accessing and analysis. The data was analysed using the chi-square test. All analysis were conducted using SPSS (Statistical Package for Social Services) version 16.

## 3. Results

The study screened 1043 patients who reported to the department. 218 patients were excluded due to missing data. And 105 were excluded as the inclusion criteria was not satisfied. Finally, 720 pregnant women were studied, the weight distribution is summarized. (Table 1)

**Table 1:** Distribution of body weight

BMI	N =720	Percentage
Under weight	54	7.5%
Normal	569	79%
Over weight	75	10.4%
obese	22	3.1%

None of the underweight women achieved adequate weight gain with 78.7% showing weight gain below the IOM range. Of the underweight women, 2.8% had excessive weight gain. Overweight and obese mothers had excessive GWG (66.4%). All women with normal pregestational BMI had normal weight gain. (Tables 2 and 3)

Women with recommended GWG had significantly more GDM (12.4%,  $p < 0.001$ ). Gestational hypertension was significantly more in mothers with greater than recommended weight gain (22.4%;  $p = 0.005$ ). (Table 4)

**Table 2:** Weight gain among different groups

Weight gain	N=720	Percentage
Recommended weight gain	505	70.1%
Less than recommended weight gain	108	15%
More than recommended weight gain	107	14.9%

## 4. Discussion

Obesity in pregnancy ranges from 1.8% to 25.3%.<sup>1</sup> In our study, we had 75 (10.4%) overweight women and 22 (3.1%) obese women. Our results show that both obesity and overweight are high-risk factors for gestational hypertension. Our results showed that 78.7% of pre-pregnancy underweight, 4.6% normal weight, and 16.7% overweight had inadequate GWG. All women with normal pre-pregnancy BMI had adequate GWG. Further excessive GWG was seen most in pre-pregnancy overweight women (66.4%) than those with normal weight (30.8%) or underweight (2.8%).

GWG was higher in higher BMI groups, showing that overweight and obese women are more likely to have more than recommended GWG. Excessive and inadequate GWG both can lead to adverse pregnancy outcomes. This is echoed by several studies which show that women with weight gain outside the recommended range have a higher incidence of pregnancy complications.<sup>32,33</sup>

Our study also showed that excessive weight gain was associated with hypertensive disorders in pregnancy. An earlier study also showed that increased GWG was associated with an increased risk of preeclampsia.<sup>34</sup> In our study group no mother with recommended weight gain showed pre-eclampsia. An earlier study showed that those with more than IOM recommended weight gain had 1.92 fold increase in hypertensive disorders.<sup>35</sup>

In our study 12.4% of the recommended weight gain group developed GDM. 5% of Women with less than recommended weight gain also developed GDM. No mothers in more than recommended weight gain had GDM which was statistically significant. Studies done earlier also had similar results.<sup>33,34</sup> Liu et al. also showed that adequate GWG was associated with reduced incidence of GDM, while inadequate GWG increased the risk of GDM.<sup>35</sup>

## 5. Conclusions

About three fourth of the antenatal patients had normal weight gain. All patients with normal BMI had recommended weight gain. Most women with low pre-pregnancy BMI, had low GWG and most women with high BMI had more GWG.

Gestational hypertension was associated with high pre-pregnancy BMI and more than recommended GWG. No mothers with recommended weight gain developed

**Table 3:** Comparison of total weight gain to BMI

BMI	Total Weight Gain		
	Recommended n=505	Less than recommended n=108	More than recommended n=107
	n %	n %	n %
Under weight	0 0%	85 78.7%	3 2.8%
Normal weight	505 100%	5 4.6%	33 30.8%
Over weight	0 0%	18 16.7%	71 66.4%

**Table 4:** Comparison of GDM and gestational hypertension to weight gain

Medical complications observed	Recommended weight gain N=505	Less than recommended weight gain N=108	More than recommended weight gain N=107	P value
GDM	63(12.4%)	5 (5%)	0 (0%)	<0.001
GHT	0 (0%)	15 (13.6%)	24 (22.4%)	0.005

gestational hypertension. Both Women with recommended and less than recommended GWG developed GDM, while no women in more than recommended GWG group had GDM.

Pre-pregnancy dietary counselling, physical and lifestyle modifications have a role in bringing down the incidence of gestational diabetes mellitus and gestational hypertension. Efforts should be taken to reduce weight before pregnancy and control excessive GWG during pregnancy to reduce such complications.

## 6. Source of Funding

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## 7. Conflict of Interest

None.

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