Research Article

Dynamics of Gestational Weight Gain in Women with Different Pre-pregnancy Body Weight

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Abstract

International and national guidelines regulate the gestational weight gain (GWG), depending on the pre-pregnancy body mass index (BMI). Insufficient weight gain increases rate of delivery of small weight babies, and excessive GWG is associated with macrosomia, postpartum weight retention and obesity. **Objective:** Our objective was to assess the dynamics of GWG in women of different pre-pregnancy body weight.

**Material and methods:** 219 pregnant women with different pre-pregnancy BMI were examined. In 45 ((20.5±2.7) %) patients were diagnosed insufficient, in 100 ((45.7±3.4) %) – normal and in 74 ((33.8±3.2) %) – excessive weight gain during pregnancy period. BMI was calculated by using the standard formula of person’s weight in kilograms divided by the square of her height in meters (kg/m²). Total weight gain was calculated by subtracting the pre-pregnancy weight from the last measured weight before delivery. Statistical analyses were carried out using Statistical program “Statistica 5.5”.

**Results:** It has been established that the women with higher pre-pregnancy BMI have the lower weight gain during the gestation period r = -0.25 (p < 0.001). Normal weight women have the highest level of GWG, while pregnant women with obesity have minimal level. However, underweight patients are in the higher risk of pathologically low GWG while overweight and obese women have greater risk of excessive GWG. The dynamics of weight gain during pregnancy shows that deficiency or absent weight gain in the first trimester is associated with an insufficient weight gain to the end of pregnancy r=0.58 (p<0.001). Conversely, rapid onset of excessive weight gain up to 12 weeks of gestation leads to further excessive GWG r = 0.77 (p<0.001).

**Conclusions:** Body weight before pregnancy is an independent determinant of GWG. Adequate weight gain during pregnancy does not lead to obesity in women of all groups, while pathologically low and high GWG leads to inadequate accumulation of adipose tissue, which has negatively affects on the metabolism of maternal and fetal organisms.

**Keywords**

pregnancy; body mass index; gestational weight gain

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**Problem statement and analysis of the recent research**

Obesity is among the most significant health issues of the 21st century. According to the WHO data, the prevalence of overweight among women over the age of 18 years in Ukraine is 58.5 %, obesity is 28.4 %, and BMI is 26.1 (24.3-28.0) kg/m2 (normal limits 18.5-24.9 kg/m2) [3, 6]. Excessive weight gain during pregnancy leads to accumulation of adipose tissue, postpartum weight retention, is a strong predictor of overweight, obesity and metabolic syndrome in reproductive age women, contributes to the pathology of fetal metabolism and is a significant risk factor for obesity of children [7]. According to international cohort studies, the pathological GWG occupies from 20 to 40 % of underweight women, 35-40% with normal weight and over 40 % of overweight and obesity [2].

According to all researchers, the pre-pregnancy body weight is a strong determinant of GWG. This statement is the basis for the classification of the recommended weight gain during pregnancy [1, 5]. However, the dynamics of GWG, especially pathological, during pregnancy, depending on the pre-pregnancy BMI, is not well studied.

**Objective:** Our goal was to assess the dynamics of GWG in women of different pre-pregnancy body weight.

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**1. Materials and Methods**

We examined 219 pregnant women who were under our supervision during the whole gestation period in antenatal clinics and in the city maternal hospital in Ivano-Frankivsk. Women were over 18 years old with single pregnancy who were agreed to take part in a clinical study. The exclusion criteria were age below 18 years, multiple pregnancy, severe chronic somatic diseases and diabetes mellitus. All pregnant women agreed on addition instrumental research methods that were free for patients, and signed an “Informed consent to participate in the study”. The design of the scientific work is approved by the Ethics Committee of Ivano-Frankivsk National Medical
University (No. 93/16; 01.12.2016).

133 ((60.7±3.3) %) patients were nulliparous and 86 ((39.3±3.3) %) – multiparous. Women were 28.7 ± 2.4 (95% CI 24.0-33.4) years old and did not differ significantly in the groups with different pre-pregnancy BMI (p>0.05).

The height of the patients was 164.2±2.3 cm (95% CI 159.7-168.7) and also did not differ between women of different pre-pregnancy BMI (p>0.05). The pre-pregnancy BMI body weight was 60.6±14.3 kg (95% CI 58.7-62.5).

BMI was calculated by using the standard formula of person’s weight in kilograms divided by the square of his height in meters (kg/m²). Total weight gain was calculated by subtracting the pre-pregnancy weight from the last measured weight before delivery. The women were categorized into four groups with respect to their BMI as per the standard of Institute of Medicine as underweight (BMI <18.5 kg/m²), normal (BMI 18.5-25 kg/m²), overweight (BMI 25-30 kg/m²), and obese (BMI ≥ 30 kg/m²). Optimal weight gain ranges were categorized in each trimester and in general due to international and national guidelines [1, 5]. Information about pre-pregnancy body weight of women was taken from patients interviewing. Statistical analyses were carried out using Statistical program "Statistica 5.5".

2. Results of the study and their discussion

Among 219 consecutive women included in this analysis, 153 ((69.9±3.1) %) were categorized as normal weight, 18 ((8.2±1.9) %) as underweight, 23 ((10.5±2.1) %) overweight, and 25 ((11.4±2.1) %) with different stages of alimentary-constitutional obesity. The average weight of patients in each group is shown in Table 1.

It has been established that the women with higher pre-pregnancy BMI have the lower weight gain during the gestation period r=-0.25 (p<0.001). And this association increases (r=-0.37 p<0.001) among normal weight and overweight women. Normal weight women have the highest level of GWG, while pregnant women with obesity have minimal level.

However, in a more detailed analysis, we found that over than half of underweight women GWG was lower than the recommended one and was presented in 2.7 times higher than in patients with normal pre-pregnancy BMI (OR 9.92, 95% CI 1.79-13.50, p<0.01) (Table 2). Among normal weight pregnant only half shows GWG in reference values, (20.3±3.2) % of patients have an insufficient and almost every third of pregnant woman have excessive weight gain, which coincides with the world trends [4].

The worst situation is found in overweight women, in which only (21.7 ± 8.6) % were with normal GWG. The pathological weight gain in this group reached (78, 3 ± 8, 6) % patients, which was in 3.6 times (OR 12.96, 95% CI 3.19-52.62, p<0.001) higher than the number of women with reference values.

We observed that (40.0±9.8) % obese women had recomended GWG. However, the percentage of pregnant women with excessive weight gain remained significantly higher in comparison with normal pre-pregnancy BMI patients (OR 2.6, 95% CI 1.1-6.1, p<0.05).

We have proven that underweight patients are in the higher risk of pathologically low GWG while overweight and obese women have greater risk of excessive GWG.

The dynamics of GWG in women with different pre-pregnancy BMI is the following (Fig. 1). Underweight and obese patients demonstrate identical weekly body weight gain, which are pathological for both groups (Table 3). In normal weight and overweight women we observed the similar rates of GWG, which was pathological high for the last group of patients.

The study of dynamics of GWG in women with different pre-pregnancy BMI suggests that deficiency or absent weight gain in the first trimester is associated with an insufficient weight gain to the end of pregnancy r=0.58 (p<0.001). Conversely, rapid onset of excessive weight gain up to 12 weeks of gestation leads to further excessive GWG r=0.77 (p<0.001). (Fig. 2). A pathological weight gain in the second trimester can also serve as a marker of an inadequate increase in body weight to the end of pregnancy.

3. Conclusions

Pre-pregnancy body weight is an independent predictor of GWG. Adequate weight gain during pregnancy does not lead to obesity in women of all groups. Underweight patients are in the higher risk of pathologically low GWG while overweight and obese women have greater risk of excessive GWG.

The major changes that later lead to pathological GWG occur in the first trimester. Deficiency or absent weight gain in the first trimester is associated with an insufficient weight gain to the end of pregnancy. Conversely, rapid onset of excessive weight gain up to 12 weeks of gestation leads to further excessive GWG. A pathological weight gain in the second trimester can also serve as a marker of an inadequate increase in body weight to the end of pregnancy.

Knowledge of obstetricians about the peculiarities of the dynamics of weight gain during pregnancy is a guarantee of adequate antenatal care to prevent maternal and perinatal complications.

4. Prospects of further research

Additional research on the body weight in the postpartum period in women with different GWG is warranted.

References

Table 1. GWG in women of different pre-pregnancy body weight (Mean±SD), kg

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Pre-pregnancy body weight (n=219)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Underweight (n=18)</td>
</tr>
<tr>
<td></td>
<td>Mean ± SD, kg</td>
</tr>
<tr>
<td>Pre-pregnancy body weight (Mean±SD), kg</td>
<td>44.5±3.9</td>
</tr>
<tr>
<td>GWG (Mean±SD), kg</td>
<td>10.1±2.9</td>
</tr>
<tr>
<td>95% CI</td>
<td>8.8-11.4</td>
</tr>
<tr>
<td>Reference values GWG, kg</td>
<td>12.5-18</td>
</tr>
</tbody>
</table>

Table 2. Pregnant women depending on pre-pregnancy BMI and GWG (Mean±SD)

<table>
<thead>
<tr>
<th>GWG</th>
<th>Pre-pregnancy BMI, kg/m^2</th>
<th>Underweight (n=18)</th>
<th>%</th>
<th>Normal weight (n=153)</th>
<th>%</th>
<th>Overweight (n=23)</th>
<th>%</th>
<th>Obesity (n=25)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient</td>
<td>55.6±11.7*</td>
<td>55.6±3.2</td>
<td>2</td>
<td>8.7±5.9</td>
<td>2</td>
<td>8.0±5.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>44.4±11.7</td>
<td>50.3±4.1</td>
<td>5</td>
<td>21.7±8.6*</td>
<td>10</td>
<td>40.0±9.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excessive</td>
<td>-</td>
<td>29.4±3.7</td>
<td>16</td>
<td>69.6±9.6*</td>
<td>13</td>
<td>52.0±10.0*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes.
* - p<0.05 vs. normal weight
** - p<0.05 vs. normal GWG

Figure 1. Weekly of GWG in women with different pre-pregnancy BMI, kg

Table 3. Weekly GWG in women with different pre-pregnancy BMI

<table>
<thead>
<tr>
<th>Pre-pregnancy BMI</th>
<th>Weekly GWG in II trimester, kg/w.</th>
<th>Weekly GWG in III trimester, kg/w.</th>
<th>Recomended weekly GWG in II-III trimester, kg/w.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>0.29 (0.26-0.32)</td>
<td>0.37 (0.33-0.42)</td>
<td>0.51 (0.44 – 0.58)</td>
</tr>
<tr>
<td>Normal weight</td>
<td>0.39 (0.37-0.41)</td>
<td>0.5 (0.47-0.52)</td>
<td>0.42 (0.35 – 0.50)</td>
</tr>
<tr>
<td>Overweight</td>
<td>0.36 (0.32-0.40)</td>
<td>0.47 (0.32-0.63)</td>
<td>0.28 (0.23 – 0.33)</td>
</tr>
<tr>
<td>Obesity</td>
<td>0.28 (0.23-0.34)</td>
<td>0.33 (0.27-0.39)</td>
<td>0.22 (0.17 – 0.27)</td>
</tr>
</tbody>
</table>


Figure 2. Weekly weight gain in women with different GWG, kg

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