ABSTRACT
Objectives: To evaluate the effect of excessive body mass index gain (BMIG) on labor progress and its maternal outcome.

Patients & Methods: The study included 554 pregnant women fulfilling the inclusion criteria. At time of booking, body height and weight were determined and body mass index (BMI) was calculated. At expected date for delivery, BMI was determined and the percentage of excess BMI gain (%EBMIG) was calculated. Maternal outcomes included the frequency of postdated (PD) labor, defined as pregnancy prolonged beyond 294 days, frequency of women required induction of labor, labor augmentation, instrumental labor and/or cesarean section (CS). The relation between %EBMIG and maternal outcomes was determined and the probable cutoff points of %EBMIG for prediction of labor-associated outcomes were determined.

Results: Distribution of enrolled women among BMI grades significantly changed at expected time of delivery with significantly higher BMI compared to booking time. At expected time of delivery, all women got higher BMI with a mean %EBMIG of 19.8±7.1; range: 8-38%. Majority of women (n=286; 51.6%) got increased BMI in range of 10-20%, while 183 women (33%) had increased BMI in range of 20-30% and 64 women had %EBMIG of more than 30%. Forty-nine women had PD labor for a frequency of 8.8%. Two hundred and sixty-one (47.1%) women received induction of labor that resulted in spontaneous unaided vaginal delivery in 83 women, 96 women had instrumental delivery, while 82 had CS. There was positive significant correlation between %EBMIG during pregnancy and development of PD, requirement for labor induction, and augmentation and rate of CS. Kaplan-Meier analysis defined %EBMIG during pregnancy of 32.7, 25.2, 27.6 and 31.6% as the cutoff points for prediction of PD, need for induction of labor, need for labor augmentation and CS.

Conclusion: Pregnant women with excessive weight gain during pregnancy are at a risk of postdated delivery by a frequency of 8.8% and requiring induction and augmentation of labor with high frequency. Failure to achieve vaginal delivery and need for CS is a frequent event. Labor-related complications are positively related to
the extent of BMI gain during pregnancy. The %EBMIG of ≥25% could be a cutoff level for prediction of high frequency of labor-related complications.

INTRODUCTION

Obesity is a condition of excessive body fat, an individual must be considered obese when the amount of fat tissue is increased to an extent that affects physical and mental health and reduced life expectancy (NIHCD, 1985). Obesity is a worldwide epidemic with escalating progress (Wang et al., 2014) up to a fact that the number of overweight and obese people in the world overtook the number of malnourished (Demerath et al., 2009). Obesity is associated with multiple comorbidities, (Wang et al., 2014), both overall and abdominal adiposity are established risk factors for cardiovascular disease and mortal events (Gast et al., 2015).

Dietary energy density was directly associated with risk of excess adiposity and higher weight change (Rouhani et al., 2016) and visceral adipose tissue contributed beyond overall adiposity, particularly in women (Gast et al., 2015). The marked variations in outcomes of obese individuals may reflect genetic basis for responses to adiposity (Glastonbury et al., 2016).

Obesity during pregnancy affects fetal weight and is associated with large for gestational age and fat distribution (Wong et al., 2017). Infants born to obese women had increased body fat mass especially abdominal fat (Carlsen et al., 2014) and increased sugar consumption during pregnancy promotes shifts in fetal body composition (Whisner et al., 2015). Maternal fat distribution may be a more important determinant of gestational weight gain and breastfeeding behavior than BMI alone and thus affecting neonatal general wellbeing and growth (Kirkegaard et al., 2015). Moreover, maternal weight prior and/or during pregnancy affects neonatal oncoming health status and is associated with neonatal cardiometabolic makers independent of neonatal adiposity (Lemas et al., 2015).

Hypothesis

This study supposed a deleterious effect of excessive gestational weight gain (GWG) on labor progress and its maternal outcome.

Design

An observational prospective study constructed on survey basis

Setting

Benha University Hospital

PATIENTS & METHODS

The study protocol was approved by the Local Ethical Committee and all enrolled women signed a written fully-informed consent to participate in the study. All women attending the antenatal care unit at Department of Obstetrics and Gynecology, Benha University Hospital for assurance of being pregnant were eligible to evaluation. Diagnosis of pregnancy relied on positive serum pregnancy test and was assured using TVU. Gestational age (GA) was defined as the number of weeks since the last menstrual period. All women had complete history taking and full clinical examination including body height and weight determination and body mass index (BMI) was calculated as weight (kg)/height (m²) (Bray, 1992). Obesity grades were defined after the WHO expert consultation (WHO, 2004) as BMI <24.9 as average,
25-<30 kg/m² as overweight, BMI ≥30-<35 kg/m² as obese and BMI ≥35 kg/m² as morbid obese.

Inclusion criteria included attendance for pregnancy assurance (Booking time), attending for monthly follow-up for diagnosis of pregnancy-related complications and giving birth at Benha University Hospital. Exclusion criteria included multiple pregnancy, manifest diabetes mellitus, previous or development of gestational DM or pre-eclampsia, escape of follow-up or of giving birth at hospital, abnormal presentation during labor, premature rupture of membrane, preterm labor, or presence of indications for cesarean section, as previous CS, abnormal placental location.

Study outcome

Excess BMI gain and its relation to BMI determined at booking time and expressing it as percentage of booking BMI (%EBMIG).

Frequency of postdate (PD) defined as pregnancy prolonged beyond 294 days; i.e. 42 weeks of gestation (Le Ray & Anselem, 2011).

Frequency of women required induction of labor, irrespective of having postdated or at expected date (ED) labor.

Frequency of women required amniotomy for labor augmentation, instrumental labor and/or cesarean section (CS).

The relation between %EBMIG and the frequency of PD, induction, augmentation of labor and CS.

The probable cutoff point of %EBMIG for prediction of labor-associated outcomes

Statistical analysis

Obtained data were presented as mean±SD, numbers and percentages. Results were analyzed using paired t-test and Chi-square test (X² test). Possible relationships were investigated using Spearman's linear regression. Sensitivity & specificity of estimated parameters as predictors were evaluated using the receiver operating characteristic (ROC) curve analysis judged by the area under the curve (AUC) compared versus the null hypothesis that AUC=0.05. Statistical analysis was conducted using the IBM SPSS (Version 23, 2015) for Windows statistical package. P value <0.05 was considered statistically significant.

RESULTS

During the study period 1183 pregnant women were eligible for evaluation; 629 were excluded for not fulfilling the inclusion criteria and 554 were enrolled in the study (Fig 1). At time of booking, mean age of enrolled women was 27.9±2.4; range: 22-34 years. Distribution of enrolled women among BMI grades was significantly (p<0.001) changed at time of delivery (Fig 2) with significantly (p=0.001) higher BMI at time of delivery compared to at time of booking (Fig 3). At time of delivery, all enrolled women got higher BMI with a mean %EBMIG of 19.8±7.1; range: 8-38%. Majority of women (n=286; 51.6%) got increased BMI in range of 10-20%, while 183 women (33%) had increased BMI in range of 20-30% and 64 women had %EBMIG of more than 30% (Fig. 4).

At expected time of delivery, 505 women had delivery (ED), while 49 women had post-date (PD) for a frequen-
efficiency of 8.8%. Two hundred and ninety-one women had spontaneous unaided vaginal delivery, while all of PD women and 214 of ED women received induction of labor that resulted in spontaneous unaided vaginal delivery in 83; 10 PD (20.4%) and 73 ED (34.1%) women. All of the remaining 178 women required augmentation of labor and 96 women had instrumental delivery, while 82 had CS (Fig 1).

![Study Flow Chart](image-url)
Fig. (2): Women distribution among BMI grades at time of booking and delivery

Fig. (3): Mean (+SD) of BMI of studied determined at time of booking and delivery (+: significant difference)
There was positive significant correlation between %EBMIG during pregnancy and development of PD (Rho=0.306, p<0.001), requirement for labor induction (Rho=0.363, p<0.001), need for amniotomy and augmentation (Rho=0.307, p<0.001) and rate of CS (Rho=0.197, p<0.001).

In trial to define a helpful guide for prediction of complicated progress of labor, Kaplan-Meier analysis defined % EBMIG during pregnancy of 32.7, 25.2, 27.6 and 31.6% as the cutoff points for prediction of PD (Fig. 5), need for induction of labor (Fig. 6), need for labor augmentation (Fig. 7) and CS (Table 1, Fig. 8).
Table (1): Kaplan-Meier analysis for cutoff points of %EBMIG for prediction of complicated progress of labor

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean</th>
<th>SE</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-date delivery</td>
<td>32.723</td>
<td>0.476</td>
<td>31.79-33.656</td>
</tr>
<tr>
<td>Induction of labor</td>
<td>25.243</td>
<td>0.369</td>
<td>24.52-25.966</td>
</tr>
<tr>
<td>Amniotomy and labor augmentation</td>
<td>27.639</td>
<td>0.422</td>
<td>26.813-28.465</td>
</tr>
<tr>
<td>Cesarean section</td>
<td>31.623</td>
<td>0.521</td>
<td>30.602-32.645</td>
</tr>
</tbody>
</table>

SE: Standard error; CI: Confidence interval

Fig. (5): Cumulative hazard plot showing EBMIG% of 31.6% of booking BMI as cutoff point for developing post-date delivery
Fig. (6): Cumulative hazard plot showing EBMIG% of 31.6% of booking BMI as cutoff point for requiring induction of labor

Fig. (7): Cumulative hazard plot showing EBMIG% of 31.6% of booking BMI as cutoff point for needing augmentation of delivery progress
**DISCUSSION**

The current study detected increased BMI gain during pregnancy, despite may be physiological, a high percentage of women had %EBMIG in range of 10-30% of their booking BMI and more than 10% of women got %EBMIG by >30% of their booking BMI. Forty-nine women had post-date delivery for a frequency of 8.8% and development of PD showed positive significant correlation with the %EBMIG at time of delivery in relation to booking BMI. Similarly, Roos et al., (2010) reported a PD frequency among their survey of 8.94% and found the risk of PD pregnancy in obese women was almost doubled compared to normal weight women.

Among studied women, 291 women had spontaneous unaided delivery without induction for a frequency of 52.5%, while 263 women (47.5%) required induction of labor that resulted in spontaneous delivery in only 83 women. Similarly, Morken et al., (2013) detected a significantly increased risk of forceps and vacuum extraction among women with a gestational weight gain (GWG) of $\geq 16$ kg. Also, Vinturache et al., (2014) reported spontaneous onset of labor in 71.2% of women with normal pre-pregnancy BMI, whereas 39.3% of overweight and 49% of obese women had their labor induced. Collectively, Hung & Hsieh (2016) found GWG has a differential effect on the rates of adverse pregnancy outcomes between women of different pre-gestational BMI categories, but all were affected. Furthermore,
Knight-Agarwal et al., (2016) documented that inter-pregnancy weight gain, regardless of parity and baseline BMI increases various adverse outcomes and so effective weight management strategies are needed.

Eighty-two women had operative delivery for a frequency of 14.8% and the need for operative delivery, also showed positive significant correlation with %EBMIG. In line with these Takimoto et al., (2011) reported that maternal pre-pregnancy overweight and BMI gains of more than 0.13 per week were independent factors positively related to large-for-gestational-age infants and independently increased the odds ratios for CS. Also, Bogaerts et al., (2013) documented that the adjusted odds ratio for CS in overweight and obese women was 2.04 for an inter-pregnancy weight retention of 2 or more BMI units. Moreover, Graham et al., (2014) using stratified analyses, found the obesity-CS association persisted and remained statistically significant among all maternal weight gain categories.

Thereafter, Hermann et al., (2015) detected elevated risks of prelabor CS for obese multiparous women and attributed the higher prevalence of previous CS to obesity and documented higher risks of prelabor CS for multiparous women with no previous cesarean delivery after adjustment for medico-obstetric factors. Also, Kwon et al., (2016) found inadequate and excessive weight gain in obese women was highly associated with an increased risk of emergency CS than in normal BMI women, while there was no significant difference between normal BMI and obese women with adequate weight gain.

Recently, Dude et al., (2017) detected that inter-delivery weight gain was significantly associated with CS and remained significant in multivariable analysis for women with BMI increase of at least 2 kg/m² and women who gained ≥2 kg/m² were significantly more likely to have CS specifically for arrest of dilation or descent. Also, Nilges et al., (2017) found weight gain during pregnancy above recommended levels of Institute of Medicine (IOM) increased the risk for CS for women with normal weight, overweight or obesity.

In support of the hypothesis of the current study, Wang et al., (2017) tested the efficacy of regular exercise in early pregnancy on pregnancy-related complications and outcome and found exercise at the beginning of pregnancy decreases GWG before the mid-second trimester and reduced the frequency of complications with significantly reduced frequency of aided-labor or CS.

The reported increased %EBMIG during pregnancy may be attributed to the bad medical knowledge concerning the effect of pregnancy on maternal reserves that need to be compensated, low-educational status, bad dietary habits especially high carbohydrate intake (Whisner et al., 2015) and the decreased physical activity so as not to have disturbed pregnancy which is a bad oriental habit. In line with these attribution, O’Brien et al., (2017) conducted systematic review and documented that low educational attainment is likely to be associated with women gaining outside the IOM recommendations for GWG. Also, Babanezhad et al., (2017) detected increased risk of CS by 2.15 and 2.62-fold in urban and rural areas, respective-
ly with increased risk of macrosomia from 47% to 96% and 58% to 2.35-fold in urban and rural areas, respectively, among obese than normal weight women who gained above median GWG.

CONCLUSION

Pregnant women with excessive weight gain during pregnancy are at a risk of postdated delivery by a frequency of 8.8% and requiring induction and augmentation of labor with high frequency. Failure to achieve vaginal delivery and need for CS is a frequent event. Labor-related complications are positively related to the extent of BMI gain during pregnancy. The %EBMIG of ≥25% could be a cutoff level for prediction of high frequency of labor-related complications.

REFERENCES


زيادة مؤشر كتلة الجسم أثناء الحمل تؤثر سلبًا على عملية الولادة

عمرو علي محمد شرف الدين
قسم التوليد وأمراض النساء-كلية الطب- جامعة بنها

الهدف من البحث: تقييم تأثير زيادة مؤشر كتلة الجسم المفرطة (EBMIG) على تقدم الحمل وآثاره على الأمهات.

المترشحات والاساليب: شملت الدراسة 55 إمرأة حامل تحتوي في نفس معايير الاختلاس وتم تحديد طول وزن الجسم لحساب مؤشر كتلة الجسم، ثم في التاريخ المتوقع للولادة، تم إعداد تحديد مؤشر كتلة الجسم وحساب نسبة الزيادة في مؤشر كتلة الجسم. تم تحديث معدلات حدوث طول فترة الحمل لتجاوز 294 يومًا، الاجتهاد لتعريض المخاض وتشخيص عملية الولادة، واستخدام الأدوات المساعدة للولادة أو الالتجاه للعملية الفيبرسرعة. كذلك تم تحديد العلاقة بين EBMIG وهذه النتائج.

النتائج: توزعت النساء بين درجات مؤشر كتلة الجسم بشكل متساوي عند الولادة مقررة بتكع عند بداية الدراسة بثلاثة ذو دلالات إحصائية. ارتفع مؤشر كتلة الجسم لجميع النساء بمعدل حوالي 19.8. تجاوزت فترة الحمل 294 يومًا عند 4 إمرأة. احتاجت مائتان وستة وستون إمرأة لاستخدام الأدوات المساعدة للولادة، وتمت الولادة بالعملية الفيبرسرعة في 2 إمرأة. كان هناك ارتباط كبير موجب بين % أثناء الحمل وحدوث طول فترة الحمل لتجاوز 294 يومًا، والاجتهاد لتعريض المخاض، وزيادة معدل الولادة بالعملية الفيبرسرعة. حدد ميل كابلان ماير % أثناء الحمل عند 36.3 % 27.6 % 26.0 % 11.4 % كنقطة توقف للتنبيه بهذه الأحداث.

الخاتمة: النساء الحوامل ذات الوزن الزائد أثناء الحمل معرضات لخطر طول فترة الحمل لتجاوز 294 يومًا الولادة اللازمة بتوفر % ونطبق زيادة لمعدلات تجريم المخاض، والنشال في تحقيق الولادة المهبلية والحالة إلى الولادة بالعملية الفيبرسرعة.

Egypt. J. Med. Sci. 38 (1) 2017
القيصرية. ترتبط المضاعفات المرتبطة بالحمل ارتباطًا إيجابيًا بمدى اكتساب مؤشر كتلة الجسم أثناء الحمل، يمكن أن يكون %25% مستوى قطع للتورم EBMIG بالكترار العالمي للمضاعفات المرتبطة بالحمل.