ORIGINAL ARTICLE

Maternal metabolic diseases related to pre-pregnancy overweight and obesity in Mexican women with high risk pregnancy

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Received 30 July 2015; accepted 7 October 2016
Available online 18 August 2017

KEYWORDS
High risk pregnancy; Pre-pregnancy obesity; Gestational diabetes; Pregnancy hypertensive disorders

Abstract
Introduction: Pre-pregnancy obesity has been proposed as a risk factor related to gestational diabetes and hypertensive disorders during pregnancy.
Objectives: Identify pregnancy related diseases associated with pre-pregnancy obesity as a risk factor in a high risk pregnancy patient population.
Methods: 600 patients whose pre-pregnancy obesity had been assessed as a high risk factor were included in the study. The means, standard deviation, median, interquartile intervals, Pearson and Spearman correlation and logistic regression to estimate risk with the odds ratio and 95% confidence intervals were calculated.
Results: The mean pre-pregnancy body mass index was 29.59±6.42 kg/m². The mean for recommended pregnancy weight gain was 2.31±1.03 kg, but the mean of real weight gain was 8.91±6.84 kg. A significant correlation between pre-pregnancy obesity and family history of
Introduction

The worldwide prevalence of overweight and obesity has reached epidemic proportions and also includes women of reproductive ages, who are a vulnerable group and for whom this phenomenon has become more common. According to the World Health Organisation, the percentage of the population with obesity has doubled since 1980. In 2008, over 1400 million adults over 20 were overweight or obese, which amounts to 35% of the worldwide population being overweight and 11% being obese and of these, over 300 million are women of childbearing age.

At present, 65% of the worldwide population is overweight and the presence of overweight or obesity has been found to be related to a higher number of deaths than low weight. 42 million children under 5 are obese. Obesity is a potentially predictable risk factor.

Up until 2008, the year in which comparative data became available, 72.3% of the population in the United States of American (U.S.A.) was overweight and 32.2% was obese. In Brazil, the combined prevalence of overweight-obesity was 42.8% and 16.1% of the population was obese (national 2006–2007 data). In Mexico, according to the 2006 National Survey of Health and Nutrition (ENSANUT), the prevalence of overweight-obesity was 66.7%, 42.5% of whom were overweight and 24.2% were obese. This ranked Mexico as the country with the second highest rate of obesity in the continent of America.

According to 2012 ENSANUT data, from 1999 an epidemic of obesity in adult women was detected. In 2006, overweight and obesity increased its percentages in all age groups, regions and socio-economic groups in Mexico. In 2012, the combined prevalence of overweight and obesity in teenage women was 35.8%, of whom 14.5% were reported
as obese. In adult age women the combined prevalence was
73%. In childbearing age women, the pattern of combined
overweight-obesity is as follows: women aged between 20
and 29: 30.6% overweight, 24% obese; aged between 30 and
39: 38.1% overweight and 37.3% obese, and aged between
40 and 49: 37.6% overweight and 46.1% obese. Previous
figures show the raised probability that pre-pregnancy over-
weight and obesity continue to be present during pregnancy
in Mexican women.

Maternal overweight and obesity are associated with sev-
eral obstetric and perinatal complications, such as gesta-
tional diabetes, preeclampsia, and foetal macrosomia and
a higher risk of a non-natural birth through a caesarean
section.

Whilst this phenomenon in pre-pregnancy obesity may be
observed, so too may excessive weight gain during preg-
nancy confer a similar risk profile associated with a high-risk
of adverse maternal and foetal outcome, and the birth
of babies which are oversized for their gestational age.

The previously described situation coincides with the out-
come observed in women of childbearing age who were from
Latin or Brazilian backgrounds.

Pre-pregnancy overweight and obesity increases the
probabilities of excessive weight gain during pregnancy
and this is associated with perinatal complications in the
foetal-maternal interaction, such as obstetric haemorrhag-
ing, macrosomia and hypoglycaemia in the newborn, etc.
There are also medical and metabolic complications for the
pregnant woman during the postpartum period, such as: gesta-
tional diabetes, hypertension, preeclampsia-eclampsia,
and postpartum overweight or obesity.

Factors associated with pre-pregnancy overweight and
obesity have been identified in these women and include:
being a mother over 35, high blood pressure, diabetes mellitus,
consumption of alcohol, low educational level, African ascen-
dancy, overeating and sedentary lifestyle.

In 2011, in U.S.A. 23.4% of mothers in one area of 23
states and the District of Columbia (DC) were obese (body
mass index [BMI] ≥ 30 kg/m²) prior to pregnancy and inter-
vals were 18–28.6%; women over 20 were obese more often
and it is of note that those who presented this situation more
often were women of Hispanic origin.

Despite the fact that metabolic changes are relatively
uncommon amongst young women, they may increase with
obesity. In one study carried out in the Danish population
associations between BMI and the risk of diabetes, hyper-
tension and dyslipidemia were analysed in 292,847 young
apparently healthy women, who had given birth between
years 2004 and 2009, and who had no history of cardio-
vascular disease, kidney failure, metabolic changes related
to pregnancy, diabetes, hypertension or dyslipidemia. Of
those women studied, 2029 patients developed diabetes,
3133 hypertension and 1549 dyslipidemia. The relative risks
for (RR) for diabetes were: 0.84 (95% confidence interval
[CI]: 0.62–1.14) if low weight, 2.63 (2.36–2.93) if over-
weight, 4.83 (4.27–5.47) if obese grade I, 7.17 (6.1–8.48)
if obesity grade II and 6.93 (5.47–8.79) if obesity grade III.
For hypertension it was 0.86 (0.69–1.09), 1.82 (1.67–1.98),
2.81 (2.52–3.13), 3.92 (3.36–4.56) and 5.69 (4.71–6.89),
and for dyslipidemia 1.18 (0.85–1.65), 2.01 (1.75–2.31),
3.11 (2.61–3.70), 4.64 (3.66–5.87) and 3.72 (2.53–5.48),
respectively. In this study BMI was strongly associated with
an increase in the risk of diabetes, hypertension and dyslipi-
demia to 5.5 years after the birth of the babies.

Our study presents frequency and estimates the risks of
metabolic complications of pregnancy related with over-
weight or obesity in Mexican women who had high risk
pregnancies and who were treated in a high specialty obstet-
ric hospital in West Mexico.

Objectives

To identify pregnancy pathologies associated with pre-
pregnancy obesity as a risk factor in a patient group who
had high-risk pregnancies.

Methods

Design

Analytical transversal study.

Sample population

The data from 600 women with high-risk pregnancies
attended by the Clinical Department of Perinatal Medicine
of the Speciality Medical Unit (UMAE) of the Hospital de
Gineco-Obstetricia del Centro Médico Nacional de Occidente
(CMNO) del Instituto Mexicano del Seguro Social (IMSS) were
analysed. All pregnant patients with at least one hospi-
tal stay organised by the Clinical Department of Perinatal
Medicine were selected. Postpartum patients were not taken
into consideration, nor those with cognitive deficit or those
in a critical condition. Patients who were unaware of their
bodyweight and/or increase in weight during pregnancy
were excluded from the study.

Ethical standards

The project was authorised by the Local Research and
Ethics in Health Research Committee 1310 with its head
office in the UMAE, Hospital de Gineco-Obstetricia del CMNO
(IMSS, with registry number R-2014-1310-35). Patients were
assessed nutritionally as part of the standard process of
attention and data was treated confidentially.

Statistical methods

Statistical analysis was carried out in 2 stages: analysis with
descriptive statistical analysis which included: averages,
standard deviation, medians and quantitative variables, as
well as proportions and percentages in the case of qualita-
tive variables. The second stage included analysis of Pearson
correlation for quantitative variables and Rho de Spearman
for ordinal variables, with which the association between
variables considered as prognostic factors was determined.
Logistic regression was carried out for the calculation of
odds ratio (OR) and 95% confidence intervals, as risk asses-
sors.

Analysis was complemented with the obtainment of sta-
tistical significance (p ≤ 0.05), using the Chi-square test for
qualitative variables and the Student’s t-test for quantitative variables.

Procedures

Hospitalised patients were assessed nutritionally by the Clinical Department of Perinatal Medicine of the Hospital de Gineco-Obstetricia, CMNO, as were their hospital records, during the period between February 2013 and December 2014. All assessments made and data obtained from the patients’ hospital records were the result of standard patient care in the said division. Blood pressure was expressed in terms of mean blood pressure (MBP), which was obtained from registered systolic blood pressure (SBP) values and diastolic blood pressure (DBP) values, in accordance with the following formula: \((SBP + 2 \times [DBP])/3\).\(^{12}\)

Results

The cases of high-risk pregnancy women studied were classified according to primary and most common comorbidities in the female Mexican population of women of childbearing age. These included: pregestational diabetes mellitus, type 1 (DM1) and 2 (DM2), hypertension and alterations to kidneys which, due to their risk profile were treated in second and third level hospitals, as was the case of the 600 patients studied, whose mean age was 31, with an interquartile interval (IQI) from 26 to 36.

Out of the total patients assessed 23.6% (142) had an ideal weight and 1% (6) were underweight. However, out of the 75.3% of the remaining patients (452), 201 patients were overweight and 172 suffered from grade I obesity (Table 1).

With regard to family history backgrounds, 73% of the patients had a relative with diabetes mellitus and 60% with high blood pressure. Furthermore, 24% of patients presented with a history of obesity in first-degree relatives (Table 2).

In accordance with the records assessed, 54% of patients (384) had gestational diabetes, DM1 or DM2; hypertensive disorders as a whole represented 53% \((n = 318)\) of pathologies in the patient group who had high-risk pregnancies (Table 3), with 2 pathologies coinciding in 202 women.

Regarding nutritional and infectious disorders associated with pregnancy, nausea ranked first in frequency, which affected 66% of patients, followed by heartburn (58%), urinary infections (56%) and oedema (55%). The median of MBP in patients was 86.66 (interquartile interval [IQI]: 66–100) mmHg, fasting blood sugar median of 83.00 (IQI: 66–100) mg/dL and post-meal blood sugar median of 126 (IQI: 105–172).

Pre-pregnancy BMI was at a median level of 28.67 (IQI: 25.15–33.15) kg/m\(^2\). The recommended weighted gain for pre-pregnancy BMI was a median of 6 (IQI: 6.00–8.7 kg), whilst the median weight effectively gained by the group of women was 9.00 kg (IQI: 5.00–13.00 kg).

There was a statistically significant correlation between the presence of obesity and a family history of diabetes mellitus \((p = 0.000)\), systemic hypertension \((p = 0.003)\), cardiopathy \((p = 0.000)\), dyslipidemia \((p = 0.000)\) and background of obesity \((p = 0.000)\). The association of obesity with a pre-pregnancy background of diabetes in previous pregnancies \((p = 0.278)\) was not significant (Table 4). Pre-pregnancy obesity was also identified as a risk factor for the development of gestational diabetes (OR: 1.95; 95% CI: 1.39–2.76; \(p = 0.000\)) in this patient group (Table 5).

Discussion

The pre-pregnancy BMI median in women with a high-risk pregnancy was found to be within the parameters considered for overweight (28.67 kg/m\(^2\) SC), which is very close to the obesity limit. When analysing pre-pregnancy BMI in this context we observe that the 25 percentile limit is in a BMI of 25.15 kg/m\(^2\) SC and the 75 percentile limit in 33.15 kg/m\(^2\) SC. This means that at least 75% of the women with a high-risk pregnancy become pregnant when they are overweight or obese at very early ages in their lives, since the average age of the sample population was 30.8±6.31 years. These figures coincide with the findings published.

### Table 1  Classification according to percentages regarding body mass index.

<table>
<thead>
<tr>
<th></th>
<th>Underweight</th>
<th>Normal weight</th>
<th>Overweight</th>
<th>Obesity I</th>
<th>Obesity II</th>
<th>Obesity III</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>6</td>
<td>142</td>
<td>201</td>
<td>172</td>
<td>67</td>
<td>12</td>
</tr>
<tr>
<td>Percentage</td>
<td>1</td>
<td>23.66</td>
<td>33.5</td>
<td>28.66</td>
<td>11.16</td>
<td>2</td>
</tr>
</tbody>
</table>

### Table 2  Family history of the women with high-risk pregnancies.

<table>
<thead>
<tr>
<th></th>
<th>(n)</th>
<th>%</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes mellitus</td>
<td>437</td>
<td>73</td>
<td>71–79%</td>
</tr>
<tr>
<td>High blood pressure</td>
<td>361</td>
<td>60</td>
<td>60–65%</td>
</tr>
<tr>
<td>Cardiopathies</td>
<td>115</td>
<td>19</td>
<td>12–26%</td>
</tr>
<tr>
<td>Obesity</td>
<td>142</td>
<td>24</td>
<td>18.3–29.7%</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>18</td>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>Nephropathy</td>
<td>67</td>
<td>11</td>
<td>4–18%</td>
</tr>
<tr>
<td>Cancer</td>
<td>147</td>
<td>25</td>
<td>18–32%</td>
</tr>
<tr>
<td>Others</td>
<td>17</td>
<td>3</td>
<td>–</td>
</tr>
</tbody>
</table>
### Table 3  High risk pathological disorders in pregnancy.

<table>
<thead>
<tr>
<th>Pathological disorder associated with pregnancy</th>
<th>n</th>
<th>Percentage</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes and changes to intermediate metabolism</td>
<td>384</td>
<td>54</td>
<td>49.1–58.9%</td>
</tr>
<tr>
<td>Gestational diabetes</td>
<td>202</td>
<td>34</td>
<td>27.5–40.5%</td>
</tr>
<tr>
<td>DM1</td>
<td>19</td>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>DM2</td>
<td>98</td>
<td>16</td>
<td>8.8–23.2%</td>
</tr>
<tr>
<td>Hypertensive conditions and pregnancy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gestational hypertension</td>
<td>60</td>
<td>10</td>
<td>2.4–17.6%</td>
</tr>
<tr>
<td>Preeclampsia-eclampsia</td>
<td>189</td>
<td>32</td>
<td>25.4–38.6%</td>
</tr>
<tr>
<td>Chronic hypertension</td>
<td>69</td>
<td>12</td>
<td>–</td>
</tr>
<tr>
<td>Other alterations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hepatopathy</td>
<td>4</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>Nephropathy</td>
<td>24</td>
<td>4</td>
<td>–</td>
</tr>
<tr>
<td>Thyroid alterations</td>
<td>71</td>
<td>12</td>
<td>4.5–19.5%</td>
</tr>
<tr>
<td>Immunological alterations</td>
<td>9</td>
<td>2</td>
<td>–</td>
</tr>
<tr>
<td>Haematological alterations</td>
<td>11</td>
<td>2</td>
<td>–</td>
</tr>
<tr>
<td>Peripheral vascular alterations</td>
<td>10</td>
<td>2</td>
<td>–</td>
</tr>
<tr>
<td>Slowed interuterine growth</td>
<td>10</td>
<td>2</td>
<td>–</td>
</tr>
<tr>
<td>Threat of preterm birth</td>
<td>36</td>
<td>6</td>
<td>–</td>
</tr>
<tr>
<td>Abortion/foetal death in uterus</td>
<td>8</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>Uterine fibroids</td>
<td>3</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>History of infertility</td>
<td>7</td>
<td>1</td>
<td>–</td>
</tr>
</tbody>
</table>

### Table 4  Correlation of pre-pregnancy obesity with other variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Rho Spearman</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family history of diabetes mellitus</td>
<td>0.153</td>
<td>0.000</td>
</tr>
<tr>
<td>Family history of systemic hypertension</td>
<td>0.122</td>
<td>0.003</td>
</tr>
<tr>
<td>Family history of cardiopathy</td>
<td>0.186</td>
<td>0.000</td>
</tr>
<tr>
<td>Family history of dyslipidemia</td>
<td>0.224</td>
<td>0.000</td>
</tr>
<tr>
<td>Family history of gestational diabetes</td>
<td>–0.044</td>
<td>0.278</td>
</tr>
<tr>
<td>Family history of obesity</td>
<td>0.224</td>
<td>0.000</td>
</tr>
</tbody>
</table>

As part of the ENSANUT in Mexico from 2012, which only represented the non-pregnant female population.

In accordance with the BMI classification and ideal weight increase, it was found that the suggested average of the weight increase of patients assessed was 7.3±2.5 kg, whilst effective weight gain was 8.91±6.8 kg. This was more than a 2 kg increase over that recommended, but there was a standard deviation of 6.8 kg. Total recommended weight gain in 75% of the population was 8.7 kg. However, 50% of the population had an increase in total weight over 9 kg, including 25% whose weight increase was over 13 kg.

These findings coincide with those observed in the U.S.A., a country which, according to reports from the World Health Organisation, ranks first in obesity in its adult population. Mexico also has high rates of overweight and obesity and ranks second worldwide. However, there is an important contrast here where, according to reports of its vital statistics, only 23.4% of its pre-pregnancy population are obese. What is striking is that the women who mostly present with obesity are of Latin origin.

Weight increase during pregnancy leads to 40% of American women being overweight or obese when they give birth. In our study this was surpassed, as 63% of the women were classified as overweight and grade I obese.

### Table 5  Pre-pregnancy obesity as a cardiometabolic risk factor.

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. For gestational diabetes in high-risk pregnancy</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-pregnancy Obesity (non-adjusted)</td>
<td>1.95</td>
<td>1.39–2.76</td>
<td>0.000</td>
</tr>
<tr>
<td>Pre-pregnancy obesity pregestational + family history of obesity</td>
<td>2.038</td>
<td>1.44–2.90</td>
<td>0.000</td>
</tr>
<tr>
<td>Pre-pregnancy obesity pregestational + family history of dyslipidemia</td>
<td>2.035</td>
<td>1.44–2.89</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>B. For diabetes mellitus 2 and gestational hypertension</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obesity and risk of DM2</td>
<td>1.58</td>
<td>0.48–5.2</td>
<td>0.453</td>
</tr>
<tr>
<td>Obesity and gestational hypertension</td>
<td>1.146</td>
<td>0.64–2.04</td>
<td>0.644</td>
</tr>
<tr>
<td>Obesity and preeclampsia</td>
<td>0.898</td>
<td>0.64–1.28</td>
<td>0.553</td>
</tr>
</tbody>
</table>
In Mexico the study published in 2012 by the Reyes et al. group assessed the impact of pre-pregnancy weight gain in an urban population of pregnant Mexican women who presented with pre-pregnancy overweight or obesity. A cohort of 546 women underwent an intensive obstetric and nutritional programme, 201 (36.81%) of whom presented with normal pre-pregnancy weight, 171 (31.32%) with overweight and 174 (31.87%) with obesity. These preliminary findings show us that there is a combined prevalence of overweight-obesity in the population of Mexico City of 63.19%, compared with that of 75.32% in the sample population with high-risk pregnancy in West Mexico. This accounts for a difference of 12.13 percentage points more between the 2 Mexican regions.33

Current figures of metabolic diseases associated with pre-pregnancy overweight and obesity and overweight and obesity during pregnancy in women with high-risk pregnancy in West Mexico exceed the figures given in the national and worldwide literature. We should thus enhance preconception consultations with educational interventions aimed at achieving a healthy lifestyle prior to conception with a programme of appropriate detection and nutritional advice for our obstetric population who present with cardiometabolic risk factors.

Activities should focus on the identification of cardiometabolic risk factors in pre-conception consultation with measurement of waist circumference, determination of blood pressure and baseline blood sugar levels, cholesterol levels, and triglycerides. Measures should be taken during this period to reduce insulin resistance through improving levels of physical activity, elasticity, strength and resistance through an exercise programme, with emphasis on self-care. Specific objectives prior to pregnancy should be aimed at.33

Conclusions

75.32% of the 600 patients in the study who had high-risk pregnancies in the specialised hospital in West Mexico presented with overweight or obesity when they became pregnant.

The women who presented with overweight or obesity developed associated metabolic conditions including diabetes mellitus (pregestational, types 1 and 2), systemic hypertension, cardiopathies and kidney changes. As a result of this there is an urgent need to implement epidemiological measures, to make women of childbearing ages more aware about the importance of having a healthy lifestyle and weight, prior to, during and also after pregnancy.

These changes should be established in the population of childbearing ages and at the pre-pregnant stage, with strategies designed to modify dietary habits, together with changes in physical activity. As a result, the short and midterm impact of them may be assessed with regards to metabolic diseases and other changes to health during pregnancy.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments in human beings or animals were performed for this research.

Confidentiality of data. The authors declare that they followed the protocols of their centre of work regarding the publication of patient data.

Right to privacy and informed consent. The authors declare that no patient data appear in this paper.

Conflict of interests

The authors have no conflict of interests to declare.

Acknowledgements

The authors would like to thank the women with high-risk pregnancies for their collaboration in nutritional evaluation and also the nutrition graduate interns, Martha Uribe Manzano, Sandra Patricia Orozco López, Laura Lizeth Escobedo Sánchez, and Laura Noemi Patiño Rodríguez.

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