The impact of obesity and glycemic control on birth weight in gestational diabetes

Obesidad y control glucémico: efecto sobre el peso del recién nacido en la diabetes gestacional

Endocrinology and Nutrition Service. University Hospital “La Paz”. Madrid

Abstract
The aim was to evaluate the effect of glycemic control and obesity on birth weight in 1,960 women with gestational diabetes. Different birth weight parameters were considered: macrosomia, large-for-gestational-age (LGA) and foetal ponderal index. Foetal ponderal index was higher in obese and poor-glycemic-control groups. The LGA rate was higher in obese women compared to non-obese (OR= 2.16; CI of 95%: 1.44-3.25%) and in patients with poor glycemic control compared to good-glycemic-control group (OR= 1.88; CI of 95%: 1.35-2.63). In the latter, an increase in foetal ponderal index and LGA rate was observed in obese women. The LGA attributable risk percentage was 53.7% for obesity and 46.8% for bad-glycemic-control. In conclusion, obesity and poor glycemic control are associated with a higher foetal ponderal index and a higher risk of LGA newborn in gestational diabetic women. There is an increase in the foetal ponderal index of the obese subgroup independently of glycemic control. And obesity could explain the excess of LGA newborns despite mother’s good glycemic control during pregnancy.

Keywords: obesity, birth weight, gestational diabetes.

Introduction
At present, the obesity and gestational diabetes (GD) are highly prevalent in women in fertile age. The exponential increase of both pathologies in this group is a reality that is being proved globally. In Spain, the obesity affects the 8% of the women between 25 and 44 years of age,¹ and the prevalence of GD increase up to 12%.²

In the pregnant women, the obesity and the hyperglycemia cause common deleterious effects that affect the mother and the newborn. At short-term, the obesity and the hyperglycemia entail a wide range of pre/perinatal complications. The hypertensive stages of pregnancy and the excessive number of caesarean sections are the most common obstetrics complications. In the peripartum period, the obese mother has a higher risk of throm-
boembolism, hemorrhage and surgical wound infection. The recurrence of GD in successive gestations is more frequent after delivery, as well as the persistence or development of glucose intolerance, T2D and several components of the metabolic syndrome.

Moreover, both factors suppose a higher risk of abortions, fetal and neonatal mortality and congenital malformations, and points out the highest frequency of large weight of the newborn with the consequent dystocia and associated metabolic disorders. Additionally, the inadequate increase of weight during the fetal period seems to imply a higher risk of children obesity and metabolic syndrome in the descendant.

The confluence of obesity and GD is more and more frequent. The pregestational obesity and the GD are implied in the large weight of the newborn. Multiple studies are focused on the negative effect of obesity in mothers on several perinatal variables. However, the contributions are scarce as regards to the impact of the obesity in the specific group of women with diabetes during pregnancy.

The aim of this study is to assess the repercussion of the glycemic control and the obesity on the weight of the newborn in women with GD.

**Material and methods**

A study of historic cohorts has been started, in which 1,960 women with GD were included according to the criteria stated by the National Diabetes Data Group, followed at the Diabetes Unit between 1987 and 2006, whose mean age was of 33 ± 4 years, with a mean body mass index (BMI) previous to the gestation of 24.8 ± 4.7. We define the obesity as a BMI ≥30 kg/m². We obtained the mean of the glycosylated hemoglobin (HbA₁c) of at least two determinations in the third quarter, measured by high resolution liquid chromatography (HPLC BioRad, Richmond, CA). We consider an adequate metabolic control an HbA₁c <5.4% (range: 4-6), corresponding to the P₇₀ of the distribution for the sample. The ponderal variables evaluated in the newborn have been: macrosomia (weight ≥4 kg), large weight for the gestational age (LGA) (weight ≥P₉₀ of the Spanish tables) and fetal ponderal index (FPI) (weight of the newborn/P₅₀ of the weight according to the gestational age). We compare the ponderal variable of the newborn among the non-obese and obese mothers, among pregnant women with an adequate and inadequate control, and finally among four groups (adequate control non-obese, adequate control obese, inadequate control non-obese and inadequate control obese) compared two by two according to the presence of obesity. For the LGA frequency it has been estimated the percentage of attributable risk (AR%) to the obesity and to the inadequate metabolic control in the group exposed to the respective factors. The data have been analyzed by means of SPSS version 11.0 for Windows. The t Student tests have been applied in the statistical analysis for the comparison of means applied to independent samples and the χ² for the comparison of validity conditions. We consider the statistically relevant association with a value of p <0.05.

**Results**

The demographic characteristics of the pregnant women and the newborns are depicted in table 1. The characteristics of the subgroups stated according to the obesity and the glycemic control are depicted in table 2. The age was similar in the considered subgroups. The ponderal gain was lower in previously obese women and the gestation term was earlier.

The FPI was higher both in the obese pregnant women compared to the non-obese (1.02 ± 0.14 versus 0.98 ± 0.12; p= 0.000) as well as in the pregnant women with an inadequate glycemic control compared to the ones with an adequate control (1 ± 0.14 versus 0.98 ± 0.12; p= 0.005). The mean FPI in the four defined groups is depicted in table 3. The LGA frequency was higher in
obese women than in the non-obese (12.2 versus 6.1%; odds ratio [OR]= 2.16; confidence interval [CI] of 95%: 1.44-3.25). The AR% of LGA was of 53.7% for the mothers’ obesity (figure 1). The LGA frequency was higher in the pregnant women with inadequate control versus the pregnant women with an adequate control (10.5 versus 5.9%; OR= 1.88; CI of 95%: 1.35-2.63). For the inadequate glycemic control, the AR% of the LGA was of 46.8% (figure 1). The comparative LGA frequency in the four defined groups is depicted in table 3. In women with an adequate control, the obesity increased the FPI significantly and the frequency of the LGA (OR= 2.03; CI of 95%; 1.08-3.79). In women with an inadequate control, the obesity increased the FPI and there have not been relevant differences in the LGA frequency among obese and non-obese women (OR= 1.71; CI of 95%: 0.92-3.16).

**Discussion**

The pregestational obesity and the GD are implied in the large weight of the newborn. To elucidate which is the relative contribution of obesity and diabetes on the neonatal result it is important regarding the efficient prevention of the inadequate ponderal increase during the fetal period and its complications derived at short and long-term.

This present analysis stands out the impact that supposes the obesity in the mother added to the GD in the women of our environment. We observe an excess of LGA newborns of mothers that were obese, in spite of the adequate maintained glycemic control. Likewise, there has been an increase of FPI in all groups with obesity, regardless of the glycemic control. Similarly, the results of Langer at al.11,12 revealed an increase of newborns with macrosomia and LGA among the women with GD that also had a high BMI previous to gestation, especially when exceeding 30 kg/m², depending on the glycemic control. However, it is difficult to extrapolate the results of such study to the Spanish population, as the referred population showed highly marked indexes of overweight and obesity. In the same way, the inadequate glycemic

### Table 2. Basal characteristics of the subgroups stated according to the presence of obesity and mother glycemic control

<table>
<thead>
<tr>
<th></th>
<th>Non-obese, adequate control</th>
<th>Obese, adequate control</th>
<th>Non-obese, inadequate control</th>
<th>Obese, inadequate control</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>1,239</td>
<td>135</td>
<td>476</td>
<td>108</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>33 ± 4</td>
<td>32 ± 5</td>
<td>33 ± 4</td>
<td>33 ± 4</td>
<td>0.125</td>
</tr>
<tr>
<td>Ponderal gain (kg)*</td>
<td>10.1 ± 3.8</td>
<td>6.2 ± 4.5</td>
<td>10.8 ± 4</td>
<td>6.3 ± 4.6</td>
<td>0.000</td>
</tr>
<tr>
<td>Gestational age at term (weeks)*</td>
<td>38.9 ± 1.1</td>
<td>38.7 ± 1.4</td>
<td>38.8 ± 1</td>
<td>38.6 ± 1.1</td>
<td>0.012</td>
</tr>
</tbody>
</table>

*Media ± desviación estándar.

### Table 3. Mean FPI and frequency of newborn LGA according to the presence of obesity and mother glycemic control

<table>
<thead>
<tr>
<th></th>
<th>Non-obese</th>
<th>Obese</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FPI</td>
<td>0.97 ± 0.12</td>
<td>1 ± 0.13</td>
<td>0.048</td>
</tr>
<tr>
<td>LGA</td>
<td>5%</td>
<td>9.6%</td>
<td>0.042</td>
</tr>
<tr>
<td>Inadequate control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FPI</td>
<td>0.99 ± 0.13</td>
<td>1.03 ± 0.15</td>
<td>0.009</td>
</tr>
<tr>
<td>LGA</td>
<td>9.2%</td>
<td>14.8%</td>
<td>0.112</td>
</tr>
</tbody>
</table>

FPI: fetal ponderal index (mean ± standard deviation); LGA: large weight for gestational age.
control was more frequent among the patients included in the mentioned study. On the other hand, a previous analysis carried out to the Spanish population explained a higher risk of perinatal complications associated to the increasing prevalence of mother obesity.6

The ethnic group and the maternal age seem not to predict different results in the study of Langer.12 There have not been differences in our sample among groups as regards to the age. The birth weight is also conditioned by other factors, as the ponderal gain during pregnancy.5 The ponderal gain was lower in the subgroup with previous obesity, and the gestation term of these women was slightly early. However, should they have an effect in the results; these differences would underestimate the impact of the obesity on the weight of the newborn. Additionally, it is worth mentioning that the patients included in the several sub-groups did not show differences compared to the follow-up jointly performed by the obstetrician and the diabetologist.

The pregnant woman with obesity and/or GD has a higher risk of showing adverse mother-fetal results. In the GD context, we prove the impact both of the glycemic control and the mother obesity on the weight of the newborn. Though what is more outstanding was the relative influence of the pregestational BMI, which expressed in the form of attributable risk has even exceeded the one exerted by the GD inadequate control. The therapeutic intervention on the GD has probably performed a role, but not the obesity control previous to the gestation. However, Ricart et al.6 considered this explanation insufficient. In fact, these authors pointed out the relevance of the pregestational BMI in women with or without concomitant GD on the risk of perinatal complications in our population.

Another known matter is the insufficient efficiency of the adequate glycemic control of the GD to reduce the newborn overweight indexes up to values comparable to the described ones in the general population.8 In this sense, the maternal obesity would be responsible, at least partially, of such risk excess notwithstanding the adequate control.

It has to be pointed out that the exposed preliminary data are subject to revision and consideration of potential confusion factors that should be taken into account in further analysis.

To summarize, both the obesity and the inadequate control of the GD increase the FPI and the LGA risk, though the impact of the obesity might be higher. The FPI in the newborns of obese mothers is higher, regardless of the glycemic control, and the obesity might explain the LGA of the newborns as regards to the pregnant women with an adequate control. Therefore, the obesity supposes an added risk to the risk inherent to the GD for the large weight of the newborn.

At present, the evidence about the risk associated to the ponderal excess and the increasing impact on the population generate the precise need of a preventive approach. During the pre-conception phase, an approximation would include adequate information for women in fertile age, the evaluation of the overweight determinations and the diet advice added to the usual supplementation of folic acid. Complementary, it would be desirable to perform a follow-up of these women by means of a physical activity program, and provide psychological assistance in the cases of associated diet behavior disorders. Additionally, the performance of a careful follow-up of weight is required during gestation, as well as of blood pressure, glycemia and fetal biometry. A post-delivery evaluation is recommended to be carried out with the aim of preventing and detecting the ponderal gain and the onset of T2D.14 Therefore, this clinical approach of the obesity during the reproduction age would contribute to minimize the risk both in women and in the descendants during the gestation and peripartum delivery periods, as well as at long-term.

Declaration of potential conflict of interests
B. Barquiel, L. Herranz, P. Martín-Vaquero, I. Castro, J.A. Rosado, M. Jáñez, A. González and L.F. Pallardo state that there are no conflicts of interest as regards to the content of this article.

References