RESEARCH ARTICLE

THE RELATIONSHIP BETWEEN FETAL GENDER AND NEONATAL BIRTH WEIGHT WITH MATERNAL WEIGHT GAIN DURING PREGNANCY IN A SAMPLE OF IRAQI WOMEN

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INTRODUCTION

Maternal nutrition and health are considered as the most important regulators of human fetal growth and wellbeing. A healthy mother can produce a healthy child (Anisa M. Durrani and Anjali Rani, 2011; Sahoo and Panda, 2006). A woman’s normal nutritional requirement increases during pregnancy in order to meet the needs of the growing fetus and of the maternal tissues associated with pregnancy. Proper dietary balance is necessary to ensure sufficient energy intake for adequate growth of the fetus without drawing on the mother’s own tissues to maintain her pregnancy (Anisa M. Durrani and Anjali Rani, 2011; Mridula et al., 2003). In 2009, the Institute of Medicine IOM recommended a weight gain of 25 to 35 lb (11.5 to 16 kg) for women with a normal pre-pregnancy body mass index (BMI). (Elizabeth M. Ward, 2009; Liu et al., 2012) Women who are underweight (BMI of less than 18.5), should gain between 12.7–18 kg (28–40 lbs), while those who are overweight (BMI of 25–29.9) are advised to gain between 6.8–11.3 kg (15–25 lbs) and those who are obese (BMI>30) should gain between 5–9 kg (11–20 lbs) (American College of Obstetricians and Gynecologists, 2013). Women should start the pregnancy with a BMI in the normal weight category and limit their gestational weight gain (GWG) to the range specified for their pre-pregnancy body mass index BMI to improve pregnancy outcome. (Li et al., 2013) The correlation of a mother’s gestational weight gain and the sex of her child are unclear (Sarah Bruyn Jones, 2014). Sex differences in fetal growth have been reported, but how this happens remains to be described. It is unknown if fetal growth rates, a reflection of genetic and environmental factors, express sexually dimorphic sensitivity to the mother herself. Sex modified the effects of maternal height and weight on fetal growth rates and birth weight (Michelle Lampl et al., 2010). Male embryos start life with higher rates of cell division and higher metabolic rates compared to females (Michelle Lampl et al., 2010; Burgoyne, 1983). These differences appear to extend through the second trimester, as male fetuses exhibit faster growth rates prior to the third trimester, after which the sex differences in growth rates appear to even out (de Zegher et al., 1999).
The result is a nearly 100 g weight difference between male and female newborns (Tamimi et al., 2003). This disparity in growth rates between males and females indicates that nutritional requirements should also be sex-specific. Indeed, women carrying boys had 10% higher energy intake compared to those carrying girls (Tamimi et al., 2003; Kristen J. Navara, 2014). Women with diseases that lower food intake or nutritional absorption such as anorexia, bulimia, and celiac disease, produce lower percentages of male offspring (Bulik et al., 2008; Khashan et al., 2010). Further, during times of famine, the sex ratio at birth declines, becoming female biased (Hernaández-Julián et al., 2013; Song, 2012), Ethiopian women that were in a better nutritional state according to body mass and muscle indices had a higher percentage of male births, and Italian women who were thinner produced a lower percentage of boys (Cagnacci et al., 2004). On the other hand, women with binge-eating disorders produced significantly higher percentages of males (Bulik et al., 2008) and rich individuals who likely have access to larger amounts of nutritious food also produce more male babies (Cameron and Dalerum, 2009; van Bodegom et al., 2013). The calorie intake per capita is also related to sex ratios at birth; countries with lower caloric intakes produce lower percentages of males at birth, likely due to higher rates of male fetal death (Williams and Glister, 1992). These studies suggest that extreme decreases in energy intake are detrimental to the survival of male fetuses (Kristen J. Navara, 2014; Barbara Abrams et al., 2000).

MATERIALS AND METHODS

A population-based study aiming to determine whether there is a significant relationship between maternal weight gain during pregnancy and the newborn sex ratio and neonatal birth weight. Deliveries occurred during the years 2013 to the end of 2014. The data was collected from women who attend the outpatient clinics in different areas of Baghdad including Hay Aljameea and Alharthya from the beginning of 2013 to the end of 2014, information include the pre-pregnancy BMI, maternal at time of delivery and neonatal weight at time of delivery, also information about gestational age at delivery and any complication during pregnancy whether medical or surgical were recorded. All 560 case had term births (>=37 weeks) and neonatal weight (>=2500 grams), Sex ratios were calculated by dividing the number of male newborns by those of female newborns, and calculated for each maternal weight gain group during pregnancy.

Statistical methods

All 560 cases were divided into 5 groups according to their weight gain (< 5 kg , 5.1 – 9 kg , 9.1 – 13.6 kg , 13.7 -18 kg , >18.1 kg ) (<11 lb, 11-20 lb, 21-30 lb , 31-40 lb and >40 lb ). The association between sex ratio and maternal weight gain during pregnancy was estimated by Odds ratios with 95% confidence intervals which were calculated by unconditional logistic regression analysis with adjustments for maternal and infant characteristics. The association between neonatal weight and maternal weight gain during pregnancy was estimated for each weight gain group by using P-value and the relationship between pre-pregnancy BMI and maternal weight gain was described also.

Strengths and limitations

The major strength of our study was the population-based design, suggesting that the results from this study are generalizable to other settings. Although one of the potential limitation is small study population, but we were able to stratify the exposure by dividing the sample into 5 groups according to their weight gain and also to study other variables for each group and comparing the result to find a significant association.

RESULTS

Total number of 560 cases ,number of male fetuses = 292 and female fetuses = 268. Sex ratio (for total) =male / female ratio= 292/268 = 1.0895 and calculated for each maternal weight gain group during pregnancy. In this table we find that the percentage of male/total increased with increasing maternal weight gain during pregnancy as with low weight gain < 5 kg the of male/total ratio is (40%) while in those with higher weight gain the ratio reaches (63.15%)in mothers gaining >18.1kg , so male/female ratio increase from (0.67) in those gaining < 5kg to (1.71) in the largest weight gaining group. In this table we see that most of women gaining < 5 kg during pregnancy (53.3%)delivered neonates weighting 2.5-3 kg, while the largest % of women gaining = > 18.1kg during pregnancy (31.6)(26.3%)delivered neonates weighting 4000 – 4499 and > 4.5 kg respectively , most of women gaining 9-13.6 kg during pregnancy (45.1%) delivered neonates weighting 3.5-4 kg, women gaining 5.1-9 kg during pregnancy (44.6%) delivered neonates weighting 3-3.5 kg and finally women gaining 13.7- 18.1 kg during pregnancy (36.8%) delivered neonates weighting 3.5-4 kg.

Figure 1. Show the line of percentage of male/total increasing with increase weight gain

Figure 2. Show the number of neonates in each group of neonatal weight distributed according to each maternal weight gain group
Finally in this descriptive table we see the distribution of weight gain during pregnancy as we see in Table 2; most of women gaining < 5 kg were have BMI of 25-30 about (31.6%) (33.8) respectively, while mothers who gained 9.1 – 13.6 kg and mothers who gained 13.7 – 18 kg were have BMI of 28.2 and 23.9 respectively.

**Table 1. Effect of fetal sex on maternal weight gain**

<table>
<thead>
<tr>
<th>Weight gain during pregnancy</th>
<th>Male/total (%)</th>
<th>Male/female sex ratio</th>
<th>Total OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;11 lb= &lt;5 kg</td>
<td>15</td>
<td>2.68</td>
<td>6/15= (40)</td>
</tr>
<tr>
<td>11-20 lb= 5.1 – 9 kg</td>
<td>65</td>
<td>11.61</td>
<td>30/65= (46.15)</td>
</tr>
<tr>
<td>21-30 lb= 9.1 – 13.6 kg</td>
<td>344</td>
<td>61.42</td>
<td>180/344= (52.32)</td>
</tr>
<tr>
<td>31-40 lb= 13.7 -18 kg</td>
<td>117</td>
<td>20.89</td>
<td>64/117= (54.7)</td>
</tr>
<tr>
<td>&gt;40 lb= &gt;18.1 kg</td>
<td>19</td>
<td>3.39</td>
<td>12/19= (63.15)</td>
</tr>
</tbody>
</table>

This table shows the number of women who gained weight in different ranges and the proportion of male children they delivered. The numbers are represented as percentages of the total number of women in each category. For example, 26.7% of women who gained < 11 lb produced male children.

**DISCUSSION**

As predicted, women who gained high amounts of weight during gestation produced a significantly higher proportion of male offspring compared with those who gained low amounts of weight. It is possible that this relationship results from the fact that male embryos and fetuses have higher metabolic rates, and likely need more caloric energy to develop successfully (Ray et al., 1995; Tamimi et al., 2003). In Table 1, Effect of fetal sex on maternal weight gain we see that male/female ratio increase with the increase of amount of maternal weight gained during pregnancy. The results in this study are in accordance with the hypothesis of most of previous studies for example a study done by bo möller et al. (2011), they found that Gestational weight gain and the proportion of male births were positively correlated; a lower proportion of males was produced by women who gained less weight and this strong pattern was exhibited in four human races. (Kristen J. Navara, 2014)
REFERENCES


