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## Female offspring birth weight is associated with Body Mass Index, waist circumference and metabolic syndrome in Latin American women at 10-years postpartum

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### ABSTRACT

**Aims:** We aimed to assess whether female offspring birth weight (BW) is associated with anthropometric and metabolic outcomes in Chilean mothers at 10-years postpartum.

**Methods:** We assessed data from 396 Chilean mother-daughter pairs participating in the longitudinal Chilean Growth and Obesity Cohort (GOCS) and Determinants of Breast Cancer Risk (DERCAM) studies. Multivariate linear and logistic regression models were performed to associate female offspring BW with maternal Body Mass Index (BMI), waist circumference, type 2 diabetes mellitus, metabolic syndrome and its components at 10-years postpartum.

**Results:** At 10-years postpartum, 69% of mothers were overweight, 65% had central adiposity and 26% had metabolic syndrome. Adjusted linear regression models showed associations between female offspring BW and (1) maternal BMI (% $\Delta$  GM = 4.46; 95% CI 0.25–8.85); and (2) waist circumference (% $\Delta$  GM = 3.25; 95% CI 0–6.60). Adjusted logistic regression models showed associations between female offspring BW and (1) maternal metabolic syndrome (OR = 3.48; 95% CI 1.50–8.11); (2) central adiposity (OR = 2.37; 95% CI 1.08–5.22); and (3) hypertriglyceridemia (OR = 3.19; 95% CI 1.40–7.23).

**Conclusions:** Female offspring BW was associated with maternal anthropometric and metabolic outcomes at 10-years postpartum. Our findings add to the emerging evidence that offspring BW might be a potential indicator for future maternal anthropometric and metabolic risks.

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## 1. Introduction

The associations between birth weight (BW) and future adulthood risk for cardiovascular and metabolic diseases have been well studied. These associations can be linked to genetic factors [1] as well as environmental exposures during pregnancy [2–4] that possibly trigger epigenetic modifications [5,6]. Studies have also shown that parental body composition has a significant impact on offspring BW [7,8], especially maternal height and weight [9–11].

Recently, there is growing interest in the associations between offspring anthropometric characteristics as risk factors of future parental morbidity and premature death. Research findings suggest a U-shaped relationship between offspring BW and parental insulin sensitivity, type 2 diabetes mellitus and cardiovascular risk [12–16]. Moreover, there seem to be associations between increased offspring BW and risk of obesity as well as mortality in the parents postpartum [17,18].

Until now, research assessing the associations between offspring anthropometry and future parental morbidity focused on Asia, Europe and North America [12,14–19]. Thus, little is known about parents and their offspring in Latin America, despite known differences in lifestyle and genetic predispositions. Chile is an upper-middle income country that has undergone a rapid nutritional transition [20]. According to the Chilean National Health Survey, Chilean women in their reproductive years have a high prevalence of overweight (64%), type 2 diabetes mellitus (10%) and cardiovascular risk factors (37%) [21].

Early identification of risk factors in women – such as possibly offspring anthropometry – for future metabolic morbidity, is of great interest for targeted prevention strategies. The aim of this study was to assess whether offspring BW is associated with adverse anthropometric and metabolic outcomes in Chilean mothers at 10-years postpartum.

## 2. Subjects

In 2006, 594 male and 601 female children born between 2001 and 2002, were recruited for the Chilean Growth and Obesity Cohort Study (GOCS) [22]. All of these children (1) came from six low and middle-income districts from the southern area of Santiago de Chile; (2) were singleton births with a gestational age of 37–42 weeks; and (3) had a BW within the range of 2.5–4.5 kg. The objectives of GOCS are to assess growth trajectories, maturation and early risk factors for future obesity and adverse metabolic outcomes [22].

In 2010, 476 mothers of the GOCS girls were contacted to participate in the longitudinal Determinants of Breast Cancer Risk Study (Determinantes De Riesgo De Cáncer de Mama; DERCAM) to study breast cancer risk factors in mothers and their daughters (mothers of male offspring were not eligible). Of these 476 mothers, 405 mothers met the inclusion criteria and participate in the ongoing DERCAM study [23]. Data for the 2011–2012 DERCAM follow-up were available for 396 women.

## 3. Materials and methods

For the present longitudinal analysis, data of these 396 women were merged with data of their female offspring to study the associations between female offspring BW and maternal anthropometric (BMI; waist circumference) and metabolic outcomes (type 2 diabetes mellitus, metabolic syndrome and its components) at 10-years postpartum.

### 3.1. Exposure variables

Data on female offspring BW (kg) were taken from clinical records, where quality was assessed previously, indicating <1% implausible values and plausible variance (GOCS protocol) [24].

### 3.2. Outcome variables

#### 3.2.1. Anthropometric outcomes

During the 2011–2012 DERCAM follow-up, data on maternal height (cm), weight (kg) and waist circumference (cm) were taken by two trained nutritionists. Women were measured bare-footed and wearing light clothing. Data on the following two anthropometric outcomes were used for the present study:

1. BMI ( $\text{kg}/\text{m}^2$ ): Maternal weight was assessed using the SECA balance platform (Madison, WI, USA), with increments of 0.10 kg. Height was measured advising the women to stand in upright position, and by using the stadiometer Harpenden 603 (Holtain Ltd., Wales, UK) with increments of 0.10 cm. Height was assumed to have remained constant over the 10-year postpartum period. BMI was classified according to the WHO classification scheme: underweight (BMI < 18.5  $\text{kg}/\text{m}^2$ ), normal weight (BMI 18.5–24.9  $\text{kg}/\text{m}^2$ ); overweight (BMI 25–29.9  $\text{kg}/\text{m}^2$ ); and obese (BMI > 30  $\text{kg}/\text{m}^2$ ) [25].
2. Waist circumference (cm): Maternal waist circumference was measured with the woman standing in upright position, just above the iliac crest, using SECA tape measure 201 (Madison, WI, USA).

#### 3.2.2. Metabolic outcomes

A 10 ml fasting venous sample was collected during the 2011–2012 DERCAM follow-up. Glycemia and lipid levels were measured. Analyses were conducted at the Institute of Maternal and Child Research (Instituto de Investigaciones Materno Infantil; IDIMI) of the University of Chile. Serum glucose concentrations were measured by using enzymatic colorimetric techniques (HUMAN; Gesellschaft für Biochemica und Diagnostica mbH, Wiesbaden, Germany). Triglycerides were measured by using enzymatic colorimetric techniques (HUMAN). HDL cholesterol was isolated by precipitation with a sodium phosphotungstate and magnesium chloride solution.

The following two metabolic outcomes were studied:

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