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New birthweight charts according to parity and type of delivery for the Spanish population



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ABSTRACT

Objective: Birthweight by gestational age charts enable fetal growth to be evaluated in a specific population. Given that maternal profile and obstetric practice have undergone a remarkable change over the past few decades in Spain, this paper presents new Spanish reference percentile charts stratified by gender, parity and type of delivery. They have been prepared with data from the 2010–2014 period of the Spanish Birth Statistics Bulletin.

Methods: Reference charts have been prepared using the LMS method, corresponding to 1,428,769 single, live births born to Spanish mothers. Percentile values and mean birth weight are compared among newborns according to gender, parity and type of delivery.

Results: Newborns to primiparous mothers show significantly lower birthweight than those born to multiparous mothers ($p < 0.036$). Caesarean section was associated with a substantially lower birthweight in preterm births ($p < 0.048$), and with a substantially higher birthweight for full-term deliveries ($p < 0.030$). Prevalence of small for gestational age is significantly higher in newborns born by Caesarean section, both in primiparous ($p < 0.08$) and multiparous mothers ($p < 0.027$) and, conversely, the prevalence of large for gestational age among full-term births is again greater both in primiparous ($p < 0.035$) and in multiparous mothers ($p < 0.007$).

Conclusions: Results support the consideration of establishing parity and type of delivery-specific birthweight references. These new charts enable a better evaluation of the impact of the demographic, reproductive and obstetric trends currently in Spain on fetal growth.

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Nuevas curvas de peso al nacer por paridad y tipo de parto para la población española

RESUMEN

Objetivo: Las tablas de peso al nacer por edad gestacional permiten evaluar el crecimiento fetal en una población específica. Dado que el perfil materno y la práctica obstétrica han experimentado un sustancial cambio en las últimas décadas en España, este trabajo propone nuevas tablas de referencia de percentiles estratificadas por sexo, paridad y tipo de parto, elaboradas con los datos del periodo 2010-2014 del Boletín Estadístico de Partos.

Métodos: Las curvas de referencia han sido elaboradas mediante el método LMS, correspondientes a 1.428.769 nacidos vivos de partos simples y madres españolas. Se comparan los valores por percentiles y la media del peso al nacer, por sexo, paridad y tipo de parto.

Resultados: Los nacidos de madres primíparas muestran un peso menor que los nacidos de múltiparas ($p < 0,036$). Los nacidos pretérmino por cesárea tienen un peso menor que los nacidos pretérmino por parto vaginal ($p < 0,048$), mientras que ocurre lo contrario en los nacidos a término ($p < 0,030$). La prevalencia de nacidos pequeños para la edad gestacional es mayor entre los nacidos por cesárea de madres tanto primíparas ($p < 0,08$) como múltiparas ($p < 0,027$), y la prevalencia de nacidos grandes para la edad gestacional es mayor entre los nacidos a término de madres tanto primíparas ($p < 0,035$) como múltiparas ($p < 0,007$).

Conclusiones: Los resultados apoyan establecer referencias de peso al nacer por paridad y tipo de parto. Estas nuevas curvas permiten una mejor evaluación del impacto de las actuales tendencias demográficas, reproductivas y obstétricas en España sobre el crecimiento fetal.

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Palabras clave:

Desarrollo fetal

Perfil materno

Parto por cesárea

Peso medio al nacer

Pequeño para la edad gestacional

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Introduction

Fetal growth and birth outcome are associated with perinatal survival and health, with the patterns of postnatal growth, and with differential risk for cognitive, metabolic and cardiovascular disease later in life.¹ Birthweight and gestational age are the main perinatal indicators that support this relationships between fetal and postnatal stages, as both variables (i.e. reduced birthweight and/or preterm births) have been associated with epigenetic, hormonal and metabolic regulation mechanisms affecting health throughout life cycle.² Birthweight for gestational age charts allow assessing the prevalence of small for gestational age (SGA) newborns, those born with a birthweight under 10th percentile for their gestational age. However, fetal growth charts prepared for one specific population are not appropriate for evaluating growth in different populations as clinically important differences in both the mean birthweight and percentile values may be found.³ These differences are due to biosocial characteristics of the population used as the reference and the study methodology. Thus, it is important to differentiate between reference growth curves and standard growth curves, as Rao and Tompkins⁴ remember: reference curves show the fetal growth of a particular population at a specific time, while standard curves show how a newborn should grow according to an ideal healthy growth, and hence are of prescriptive nature.

Different growth charts by gestational age and sex have been designed for Spanish newborns based on hospital data.^{5–9} Some of these charts are still widely used in the Spanish public health system for assessing birth outcome and infant growth although Spain has officially adopted the new WHO standards for term births and up to five years old children.¹⁰ Most recently, Ramos et al.¹¹ and González-González et al.¹² have proposed models for calculating optimal fetal and neonatal weight curves from population and hospital data respectively, and García-Muñoz Rodrigo et al.¹³ have published the first growth standards for very preterm Spanish newborns (22–28 weeks) using data from 62 hospitals. Most of these charts were prepared without differentiating parity and type of delivery. However, parity is a well-recognized predictor of infant birthweight, with infants born to primiparous women registering significantly lower birthweight and higher prevalence of intrauterine growth restriction (IUGR).¹⁴ At the same time, the increasing rates of induced deliveries and Cesarean sections (CS) before week 37 has been associated with the increased prevalence of preterm births with extremely low weight in developed countries.^{15,16}

The profile of Spanish (national) mothers has undergone a significant change over the past decades, with a sustained increase in the percentage of mothers who start reproducing at later ages, as well as in the rates of obstetric interventions in general, and CS deliveries in particular.¹⁷ From 2008 onwards the economic crisis is strengthening these trends,¹⁸ specifically the growing predominance of primiparous mothers of ever-increasing age. According to the latest available data,¹⁹ 54.3% of Spanish mothers are primiparous with an average age for first maternity of 31.06 years, while the rate of CS is 25.2%—a figure that is double that recommended by WHO²⁰—, with higher rates in private hospitals and in public hospitals with a lower technological level.²¹ As proposed for other European countries,²² these trends in maternal profile and obstetric practices might be contributing towards trends of lowering mean birthweight and increasing prevalence of low birth weight (LBW: birthweight under 2,500 grams) described in Spain.¹⁷ In this context, to establish and compare charts of birthweight by parity and type of delivery may contribute both to a fitter evaluation of the impact of these trends on gestational growth and birth outcome in Spain, and to a greater understanding of the causes underlying the sustained increase in the rate of CS in the country.

With these aims, using data from the Spanish Birth Statistics Bulletin for the period 2010–2014, the aim of this study is to prepare

new reference charts of birthweight by gestational age in Spain, stratified by sex, parity and type of delivery.

Methods

Data and final sample

The percentile tables and charts presented in this study have been prepared with cross-sectional data from the period 2010–2014 of the Spanish Birth Statistics Bulletin (BEP, *Boletín Estadístico de Partos*), the compulsory civil registration of all births whatever the nationality or legal status of residence of the parents provided annually by the Spanish National Institute of Statistics as micro-data files. The process of data collection and its implications both for the quality and interpretation of the epidemiological results derived from this source have been evaluated by Juárez,^{23,24} and Río et al.²⁵ Validation studies have concluded that data provided by the Spanish Birth Statistics Bulletin are quite reliable ($\kappa = 0.74$ for gestational age, and $\kappa = 0.88$ for birthweight) when compared with hospital birth data, although misreporting was significantly higher among immigrants.²³ Besides this problem, newborns from immigrant mothers ($n = 419,161$, 18.9% of all live births) have been excluded due to their relevant contribution to national natality as well as to the notorious differences in origin, lifestyles, reproductive behaviour and birth outcome among the main groups of foreign mothers in Spain.²⁶ Therefore, percentile tables and charts proposed should apply only to Spanish mothers. 4.1% ($n = 71,435$) of the Spanish mothers were originally immigrants that obtained the Spanish citizenship, and 2.9% ($n = 50,098$) have a foreign husband or steady partner.

Figure 1 shows the process of selection of final sample. First, among newborns from Spanish mothers, stillbirths ($n = 419,161$, 18.8%) were excluded. Among live births, newborns without data on gestational age and birthweight ($n = 295,882$, 13.3% of all live births) were also eliminated, as well as those born at gestational ages before 24 and after 42 weeks ($n = 858$, 0.0%), and from multiples pregnancies ($n = 35,781$, 1.6%). Finally, implausible data were also eliminated with outlier limits set at ± 1.5 standard deviation (SD). Final sample includes 1,428,769 live births from singleton deliveries of Spanish mothers (74.4%, $n = 1,062,319$ by vaginal delivery, and 25.6%, $n = 366,450$ by CS delivery), corresponding to 64.2% ($n = 2,224,844$) of the total live births born in Spain in 2010–2014, and to 79.8% ($n = 1,789,372$) of those from Spanish mothers. Final sample does not differ from the excluded data in maternal profile (age at birth, and educational level and occupation), although the rate of primiparity is slightly higher (54.9% compared to 52.5%, respectively; $p < 0.001$) and the rate of CS deliveries slightly lower (25.6% and 26.5, respectively; $p < 0.001$).

Statistical analysis

Percentile tables and curves by sex, parity (primiparous or multiparous mothers) and type of delivery (vaginal or by CS delivery) were prepared according to the LMS method.²⁷ The LMS method provides three curves for each percentile chart. The first is curve L (λ), which results from non-linear transforming of birthweight, so this variable follows a normal distribution. The second curve, M (μ), corresponds to the median (percentile 50) or average as the distribution of the variable of interest now has a Gaussian distribution due to adjustment for curve L. The last curve, S (σ), corresponds to the coefficient of variation. To obtain parameters λ , μ and σ , L, M and S curves were adjusted by polynomial regression thus the curves obtained are those which best represent an adjustment of these parameters that allow a graphic representation of percentile charts

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