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Small-for-gestational age Portuguese babies: The effect of childhood social environment, growth and adult socioeconomic conditions

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ABSTRACT

Objective. We aimed to estimate the extent to which differences in small-for-gestational age (SGA) according to maternal socioeconomic position (SEP) and anthropometrics are accounted for childhood background.

Methods. Adult mothers of singletons (n = 6893) recruited in 2005/2006 in Porto, Portugal self-reported data on socio-demographics. Grandparents' education and social class were used to characterise childhood social environment. Maternal education and marital status were used as adult SEP indicators. Height was categorised according to the 10th and 90th percentiles. The odds of SGA according to adult SEP and height were stratified by childhood conditions.

Results. SGA (14.5%) was less likely in taller [vs. 10th–90th percentiles: 0.62 (95% confidence interval (CI): 0.46–0.83)], more educated [vs. low: 0.77 (0.65–0.90)] and in married women [vs. single: 0.64 (0.47–0.86)]. No association was found between childhood social conditions and SGA. The protection provided by maternal education was found in women from deprived childhood backgrounds but not in those with more advantage conditions. Shorter women were more likely to deliver SGA babies but the effect was stronger ($p_{interaction} < 0.001$) in those from least deprived childhood conditions.

Conclusions. Sufficient increase in education seems to overcome disadvantage earlier in life. Other pathological processes might impact physical development beyond social influence, having long lasting effects on SGA.

Introduction

Nutritional, behavioural and psychosocial factors are recognised determinants of intrauterine growth restriction (Kramer et al., 2000; Raisanen et al., 2013) which might explain the pervasive social inequalities in this outcome (Mortensen et al., 2008; Blumenshine et al., 2010). For several years, research suggests that more educated women (or those with higher income or socially-advantaged occupations) are more likely to seek prenatal care, to adopt healthier lifestyles during pregnancy and are less likely to be exposed to stressful events (Kramer et al., 2000).

The intergenerational transmission of social conditions and its impact on adult health may reflect a failure of modern societies in the discontinuation of social inequalities in health and emphasise the importance of focusing early in life (Graham and Power, 2004; Marmot et al., 2012). Most evidence suggests that childhood circumstances influence adult socioeconomic conditions and, consequently, adult health. Some authors argue that improving social status (upward mobility) may represent a protective exposure to health while individuals who fall in the social hierarchy may be at increased risk of disease (Poulton et al., 2002). Childhood background is also likely to influence cognitive and physical development and health behaviours' acquisition resulting in health differentials later in life (Graham and Power, 2004).

Childhood social environment has been described to affect pregnancy outcomes, namely the delivery of low birthweight or preterm infants (Astone et al., 2007; Collins et al., 2003, 2009; Colen et al., 2006; Emanuel et al., 1992; Hypponen et al., 2004; Lumey and Stein, 1997). Maternal birthweight and physical growth (possibly reflecting unfavourable early childhood conditions) are known to influence the next generation birthweight. Some studies show that the relation is independent of childhood economic conditions (Collins et al., 2011), others report maternal social environment when in-utero (Emanuel et al., 1992; Hypponen et al., 2004; Lu and Halfon, 2003; Lawlor et al., 2003), together with social trajectories (Colen et al., 2006) to be important to explain forthcoming inequalities.

Over the past 50 years impressive changes in the socioeconomic and cultural context were observed in Portugal. The country faced the longest-standing dictatorship in Europe (1926–1974), a period of nearly inexistent social mobility, of highly illiterate population and high infant mortality rates. After the 1960s, and particularly after the 1974 revolution, social conditions improved, compulsory schooling increased and

Abbreviations: SGA, small-for-gestational age; OR, odds ratio.

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the National Health Service was launched, guaranteeing free universal access to care. After few decades, Portugal remains one of the least educated countries in Europe (Albert and Davia, 2011) but with health indicators similar to or better than the most European countries (Barreto, 2011).

In a context of such transformations it is not known if the association of social conditions with pregnancy outcomes is still reflecting childhood environment.

We aimed to estimate the extent to which differences in small-for-gestational age (SGA) according to maternal socioeconomic position and anthropometrics are accounted for childhood social background.

Methods

This study is based in Generation XXI, a cohort of 8647 newborns recruited in 2005–2006 in Porto Metropolitan Area, north of Portugal (Alves et al., 2012; Larsen et al., 2013). Recruitment occurred at 5 public maternity units, responsible for 95% of all births in the region. During the hospital stay (within 72 h of delivery), resident women delivering live births were invited and 92% of mothers accepted to participate. Data on socio-demographic, lifestyles and pregnancy characteristics were collected in structured face-to-face interviews. Interviewers were part of the project staff, trained by the research team. Regular meetings were taken place to assure inter-observer consistency. Delivery- and newborn-related data were retrieved from medical records by the same interviewers. The study was approved by the University of Porto Medical School/Hospital S. João Ethics Committee and a signed informed consent was required for all participants.

Childhood, growth and adult social conditions

Childhood socioeconomic characteristics were reported by the mothers using their 12 years of age as reference. Three indicators were used as proxies of childhood social environment: grandparents' highest education, childhood social class and family structure. Grandparents' highest academic level was categorised as low (≤primary academic level), intermediate (secondary) and high (>secondary). Social class was previously defined considering maternal recall of grandparents' education and 11 family resources (house ownership, household heating, washing machine, television, telephone, housemaid, family car, bicycle, annual holidays, club membership and association affiliation) (Teixeira, 2013). By using latent class statistical modelling, three categories were obtained representing low/deprived (25%), intermediate (50%) or high/advantaged (24%) social class. Mothers reported if they were living with both, one or none of the grandparents.

Adult mothers' height was used as proxy of physical growth. Height was measured whenever possible, otherwise was copied from identity card. The 10th (<153.0 cm) and 90th (>169.0 cm) percentiles of the sample distribution were estimated to categorise women.

Mothers' education and marital status at delivery were used to characterise adult socioeconomic position. Other indicators were available but were found to be highly correlated with education. Educational achievement was categorised as low (≤primary level), intermediate (lower secondary) and high education (≥upper secondary). Marital status was grouped as married, cohabitant and single.

Small-for-gestational-age

SGA was classified using Kramer et al.'s (2001) reference curves, considering sex-specific birthweight below the 10th percentile for each gestational age. Birthweight is routinely measured within 24 h after delivery. Gestational age is registered in medical files based on the biometric measurement of the ultrasound or, if not performed/available (15%), on the last menstrual period.

Confounding variables

Maternal age and the number of previous pregnancies (gravidity) – 0, 1 and 2 or more – were used as confounders. Pre-pregnancy weight was reported by the mothers and was used as a confounder of the association between height and SGA. Potential mediating variables, such as smoking during pregnancy or pregnancy complications, were excluded from the models. Adjusting for mediators could introduce confounding where none existed before resulting in biased estimates (Robins and Greenland, 1992). Still, their distribution according to education and height is available in Supplementary Table 1.

Data analysis

Women over 20 years, reporting other occupation than being a student and delivering singletons were eligible (n = 7588). Those with missing data on the above-mentioned variables were excluded, resulting in 6863 women (Fig. 1). Additionally, 362 mothers were also excluded for the grandparents' education analysis because of unknown data. Included newborns were more likely to have more educated mothers (high: 47% vs. 42%; $p = 0.009$) and less educated grandparents (low education: 65% vs. 60%, $p < 0.001$).

Proportions were compared using Chi-squared test. The association between each childhood socioeconomic indicator and adult education, marital status and height was estimated by fitting logistic regression models and presented as odds ratios (OR and 95% confidence intervals). Maternal age was included as a confounder; for the association between childhood environment and adult education it was included as an interaction term (significant interaction for $\alpha = 10\%$).

The odds of SGA according to each adult and childhood indicator were estimated using logistic regression analysis adjusted for maternal age and gravidity (age and gravidity interactions were also tested). Because no association was found between family structure and adult conditions or between SGA and marital status, subsequent analyses were conducted for the remaining indicators. The association between maternal height and maternal education with SGA was evaluated for each stratum of childhood social environment. To analyse the independent effect of each mechanism, models were mutually adjusted. The association between height and SGA was also adjusted for pre-pregnancy weight. All models showed adequate fit, assessed by the Hosmer–Lemeshow goodness-of-fit test statistic (p-value > 0.05).

Results

In this study 14.5% of the newborns (n = 997) were SGA. Almost 47% of the mothers completed upper secondary or higher education level while 31% only achieved primary education. About 2/3 were married and 22% were cohabiting. Almost half were primigravidae and 13% were aged above 35 years. Nearly 68% of the grandparents only achieved primary or lower academic level. In childhood, 1/4 of the mothers were from high social class and 85% were living with both parents (Table 1). More educated and taller mothers were more likely to be primigravidae, married, and normal/underweight and to use private prenatal care. More educated women were less likely to smoke (Supplementary Table 1).

In Table 2 the association between childhood conditions and adult education, marital status and height is presented. Mothers with intermediate and high educated parents (vs. low educated parents) were, respectively, 2 and 4 times more likely to present high education. The association between childhood social class and maternal education was even stronger. When compared to women from low childhood social class, those in intermediate or high levels were, respectively, 1.6 and 2.0 times more likely to be taller. Family structure was not related with adult conditions or maternal height. No childhood social indicator was related with marital status.

Independently of maternal age and gravidity, SGA was less likely to be present in taller [vs. 10th–90th percentiles: OR = 0.62 (95% CI: 0.46–0.83)], more educated [vs. low: 0.77 (0.65–0.90)] and in married women [vs. single: 0.64 (0.47–0.86)]. The association with marital status did not change after the adjustment for education [OR = 0.67 (95% CI: 0.49–0.90)]. Childhood social conditions were not associated with SGA (Table 3).

In Table 4 the association between SGA and maternal education and height is presented, stratified by childhood social environment. Mothers that increased to the highest education (vs. low education), but not those that moved to intermediate levels, showed lower risk of SGA: 32% less if they were from low social class; 21% if considering low grandparents' education. A non-significant decreased risk was found if mothers were from intermediate or high social class. Shorter women