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Research Article

Differences in perinatal health between immigrant and native-origin children: Evidence from differentials in birth weight in Spain

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Abstract

OBJECTIVE
This paper explores perinatal inequality between migrants and natives in Spain, or, more specifically, differences in birth weight.

BACKGROUND
We re-examine the logic of the ‘healthy immigrant paradox’, according to which the children of immigrant mothers have superior birth outcomes.

DATA
Using the universe of births in Spain in 2013, we go beyond the standard approach of using a dichotomous variable for estimating the risk of low birth weight (LBW) and high birth weight (HBW).

METHODS
We estimate quantile regression to explore migrant-native differentials in their children’s birth weight across the range of observed values and also focus on the impact of migrant status among babies weighing more than 4,000 and 4,500 grams – two thresholds which, in a similar way to LBW, are associated with certain pathological characteristics and problematic future development.

RESULTS
Our paper not only confirms that the well-known epidemiological regularity of immigrant-origin babies having an advantage in avoiding LBW applies to Spain, but also, at the other extreme, it shows that when birth weight is above 4,000 or 4,500 grams, migrant-origin babies weigh significantly more than those of native origin.

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CONTRIBUTION
In sum, we contribute to the literature by showing that the higher average weight of newly born babies from immigrant mothers is not always a source of perinatal advantage. We provide access to the data and the syntax used, so that our results can be replicated (our dataset is publicly available).

1. The relevance of birth weight, and its determinants in the Spanish context

Birth weight has been the object of extensive research in various fields of scientific enquiry, from medicine to social epidemiology, sociology, and demography. The study of the adverse consequences of unhealthy weights at birth (<2,500 and >4,000/4,500 grams) has mainly focused on health and educational outcomes. Because of the huge amount of evidence linking Low Birth Weight (LBW) to adverse health and cognitive outcomes, social epidemiology has tried extensively to assess the prevalence of LBW in different settings and different subsamples of the population (see, for instance, Reichman 2005, Teitler et al. 2007, Buekens et al. 2013). Although scholars have traditionally privileged the study of Low Birth Weight (LBW), research on High Birth Weight (HBW) is gaining momentum. In this review we briefly summarize both the determinants and consequences of deviation from healthy weights.

On the one hand, the World Health Organisation defines LBW as less than 2,500 grams, irrespective of the gestational age of the infant. In the specialized literature it is interpreted as one of the most straightforward indicators of perinatal health and of infant health more generally. According to the American Academy of Paediatrics, LBW has different origins, ranging from the most obvious – those associated with genetic factors (foetal chromosomal abnormalities), the mother's health (high blood pressure, heart or kidney disease), and the mother's lifestyle (incorrect nutrition during gestation, smoking, and the consumption of other substances) – to problems with the development of the placenta (intra-amniotic infection, placental abruption, and placental insufficiency).

LBW correlates with infant morbidity and mortality. Smaller babies are more likely to experience severe health risks after birth, and the effects of this early disadvantage are long-lasting: they are more prone to report general worse health later in life (Johnson and Schoeni 2007) and to suffer from a higher incidence of specific conditions such as diabetes, asthma, coronary disease, metabolic syndrome, and high blood pressure (Barker 1995, Johnson and Schoeni 2011). The negative impact of LBW on cognitive development and educational outcomes (Hack et al. 1995) has been shown to be similarly enduring. These children show poorer school readiness (Reichman 2005), evidence of increased school difficulties and hyperactivity until the age of 18 (McCormick et al. 1990), lower chances of completing high school at the standard age, lower educational attainment (Conley and Bennet 2000), and even lower earnings as adults (Black et al. 2007).

However, socio-economic factors tend to mediate these relationships. Large differences in the incidence of LBW have consistently been reported across socio-economic groups in different countries (Kramer et al. 2000). Whereas more maternal resources – whether a higher educational level (Boardman et al. 2002), social class (Pattenden et al. 1999), or a supportive social and emotional climate (Hohmann-Marriott 2009) – all tend to improve birth outcomes, pregnancy later in life (Luke and Brown 2007) and non-marital birth (Castro-Martín 2010) are associated with an increased risk of LBW. Interestingly, according to the literature, in a number of affluent countries immigrant women tend to experience better birth outcomes than native women (see Guendelman et al. 1999), a result that will be discussed in the next section.

Spain is no exception in this general picture. There are significant traces of inequality in perinatal health according to social background. Castro-Martín (2010) showed that the children of unmarried mothers suffer a higher risk of low birth weight, suggesting that the health disadvantage of children of non-marital couples is significant, even though recent social acceptance of non-marital unions and the selection of couples into this new form of cohabitation have helped to reduce it over time. Juárez and Revuelta Eugercios (2013) showed that the risk of low birth weight is more pronounced among children born in more vulnerable households, both in terms of occupation and education. In addition, Spain's incidence of LBW is systematically higher than either the OECD or European average, and, although the prevalence of LBW has intensified in most European nations since the mid-1990s, Spain has experienced an increase in LBW unmatched by any country for which data are available (OECD 2009, 2014). The increase in the proportion of births to mothers at older ages due to postponement of maternity (Luque Fernández 2008), the spread of fertility treatments and the consequent higher incidence of multiple births (Blondel et al. 2002), and the increased survival of vulnerable babies resulting from improved technology are surely factors accounting for this remarkable trend. Other factors promoting the aggregate result of higher LBW rates are the larger proportion of unmarried women in the population (Castro-Martín 2010), the increased labour participation of women, and the expansion of occupations that might entail risk during pregnancy (Ronda et al. 2005).

HBW is defined as the weight of a newborn of either less than 4,000 grams or less than 4,500 grams at any gestational age (see Frank et al. 2000 for a discussion of the various thresholds used), and is also known medically as 'macrosomia'. HBW has not received as much attention as LBW. Similarly to LBW, the range of determinants of excessive foetal growth include genetic factors (such as the Beckwith-Wiedemann syndrome), lifestyles (insufficient pre-gestational physical activity), some maternal characteristics such as advanced age or obesity, and conditions such as diabetes and hypertension.

Analysis of the consequences of HBW has also tended to focus on health and educational outcomes. In the health domain, children born with high birth weight give rise to more complications during delivery for both mother and baby. Mothers of large babies are exposed to increased rates of caesarean section, infections such as chorioamnionitis, perineal lacerations, and postpartum haemorrhage (Stotland et al. 2004), and tend to need longer hospitalization periods (Weissmann-Brenner et al. 2012). Heavy babies are more prone to experience conditions related to oxygen deprivation during delivery (Hawdon 2011), shoulder dystocia, neonatal hypoglycemia (Weissmann-Brenner et al. 2012), and higher risks of morbidity and mortality compared to those within the healthy range of weights (Zhang et al. 2007). They are also more prone to suffer from a number of conditions in the mid- and long-term. Recent research has shown that HBW is associated with increased probability of experiencing type-2 diabetes in young male adults, and obesity in both men and women (Johnsson et al. 2015). The link with some types of cancer like leukaemia has also been documented for the Nordic countries (Hjalgrim et al. 2004). However, as regards cognitive outcomes, previous consensus on the lower IQ of children born with heavy weights (see, for instance, the early contribution by Record et al. 1969) has been recently disputed in research using sibling analysis with adult samples, supporting the interpretation that most of the association conventionally found is actually due to confounders from family characteristics (Kristensen et al. 2014).

The socio-economic determinants of HBW have also been addressed less often. Advanced (35+) maternal age and lower levels of education appear to be associated with increased likelihood of macrosomia (Frank et al. 2000). Clearly more research is needed to examine the role of other maternal and family characteristics, including ethnic origin and migrant status, a task that we undertake in this paper.

At least four factors make Spain an appropriate test case for our research objectives. First, the unparalleled rise in low birth weight, documented above. Second, the very high incidence of overweight and obesity, both for the adult population – one of the highest in Europe (World Health Organization 2013) – and for infants (National Institute of Statistics 2012). Third, the specificities of immigration to Spain, which took place in a very short period of time, at unprecedentedly high rates, and with a very homogeneous age profile. These features suggest that the vast majority of the children in our analyses are first-generation, or so-called 1.5 generation. Fourth, the increase in total births of the share of births to mothers of immigrant origin, a status that has traditionally been associated with superior birth outcomes, which our findings challenge.

2. The healthy immigrant paradox in birth outcomes re-assessed

There is ample evidence of an epidemiologic regularity suggesting that the children of immigrant families have better health outcomes upon birth or arrival. This regularity has been described as further proof of the ‘healthy immigrant paradox’, most often referring to the adult population: that despite the low average socio-economic status of many immigrant groups, the risks and loss of human capital associated with migration, and their inferior access to health care, immigrants in advanced societies are generally healthier than natives in the host country. This phenomenon has been researched in many countries and migrant groups, and there is extensive research on the mortality gap between North Americans and Hispanics in the US (Palloni and Arias 2004). Different explanations have been given for this phenomenon (Abraído-Lanza et al. 1999). Health behaviours, genetic factors, and culture and more protective social networks have been used ex post to account for this regularity. However, a large body of the literature has questioned the very existence of such a paradox by focusing on migratory aspects (Palloni and Morenoff 2001), specifically on two processes (see Jasso et al. 2004). The first is the positive selection of migrant populations, an argument that suggests that migrants are not a representative sample of the population of origin from which they came, but rather are selected and, consequently, more able and predisposed to success in different realms. The second is selective return rates, known in the literature as the ‘salmon bias’. The testing of this hypothesis is hindered by data quality issues, which result in an underestimation of certain conditions and the associated mortality rates. The literature on mortality has found conflicting evidence regarding the existence of the ‘salmon bias’ effect and therefore the validity of the Hispanic mortality paradox. Palloni and Arias (2004) argue that return migration exists among Mexicans but is not so evident among other foreign-born Hispanics.

This paradox has been documented – and in some cases challenged – not only among adult migrants but also among their children (Mendoza 2009). In parallel with the discussion of adult mortality among Hispanic-origin migrants, Hummer et al. (2007) confirmed the lower mortality rates of babies born to Mexican mothers, a research setting in which outmigration is likely to be negligible. Internationally, scholars specifically analysing perinatal inequalities by migrant status have concluded that immigrant children are at lower risk of having LBW. More broadly speaking, there is systematic evidence suggesting superior birth outcomes (lower incidence of pre-term birth [<37 weeks] and LBW [<2,500 grams]) among immigrants in the US regardless of their ethnic and racial background. In the US this has been labelled the 'Mexican Paradox' because migrant Mexican mothers appear to have better birth outcomes than immigrant-origin Mexican mothers born in their host country (Cervantes et al. 1999). Comparisons of African Americans with those born outside the US have also concluded that migrant status represents a source of advantage in terms of birth outcomes. Howard et al. (2006) found substantial variation in risks of premature birth and LBW, with US-born African Americans exhibiting worse outcomes than the foreign-born. Comparisons between the US and European countries have confirmed the finding that immigrant-origin newborns experience superior birth outcomes (Guendelman et al. 1999). The perinatal status of children born to immigrants in Spain has also been reported to be generally better than that of children born to native mothers (Varea et al. 2012, but see Fuster et al. 2014 for counter evidence using stillbirths). This occurs despite the lower socio-economic profile of migrants settling in Spain (Cebolla-Boado and González Ferrer 2013). Differences by migrant status as regards high birth weight have only more recently started to be addressed. One of the first contributions assessing differentials in the prevalence of macrosomia across a large number of ethnic origins in the United States showed that the only group with a higher risk of HBW than non-Hispanic Whites were Native Americans (Frank et al. 2000).

Explanations for this early childhood advantage are diverse, just like those for general differentials in birth weight: migrant mothers are known to have healthier lifestyles, smoke less, and tend to be generally healthier (Reichman et al. 2008). Yet immigrant mothers are less likely to start prenatal care during the first term of pregnancy, although the impact of prenatal care on this indicator is much disputed (Green 2012). As regards the impact of residence in the country on perinatal health, evidence suggests that the relationship tends to be curvilinear, i.e., low birth weight declines in the first few years after migration and then increases. Interestingly, time of residence is not related to increased alcohol or drug consumption or smoking, which suggests that convergence with the natives' lifestyle does not account for the subsequent decline in the perinatal health gap (Teitler et al. 2012).

Following these previous findings, in this paper we look at differences in birth weight between children born to immigrant and native mothers in Spain. We have a twofold objective. Firstly, we intend to update existing evidence for Spain using the most recent available empirical material (data from 2013). Secondly, we seek to use more innovative research techniques in order to evaluate the impact of migrant status on birth weight. More specifically, we use quantile regression to explore whether the better perinatal health status of children of immigrant mothers that has been consistently documented for a number of countries actually applies all along the range of values of our dependent variable (birth weight). Quantile regression allows us to explore the effect of migrant status not only on the risk of avoiding unhealthily low birth weight but also at the right end of the distribution. By doing so, we contribute both methodologically and substantively to the existing literature. Although the literature on birth weight has tended to focus on LBW, large babies experience more complications during delivery, increased morbidity and mortality (Boulet et al. 2003), and associated conditions later in life.

3. Data and method

In this paper we used data from the Population Movement Statistics (Estadística del Movimiento Natural de la Población, EMNP) in the Childbirth Statistics Bulletin (Boletín Estadístico del Parto) provided by the National Statistics Office (Instituto Nacional de Estadística) for the most recent available year, 2013. The data is easily accessible online.[3] For the sake of transparency, the Appendix includes the Stata syntax, elaborated for the replication of our results. This is a longstanding dataset, available since 1996, compiling information for the universe of births registered in Spain. Parents are asked to fill in an administrative questionnaire at the time they register their babies in the civil registers. The parents or other relatives registering the child are obliged by law to provide information about the delivery and the context of the birth and are also asked to provide basic socio-economic information about the parents. The dataset does not use a probabilistic frame but instead includes the universe of births occurring in Spain in every single year.

In 2013 our dataset contained information from 417,999 individuals across all areas of Spain. Since our analysis focuses on the risks of low and high birth weight, we restricted the sample by excluding multiple birth deliveries and stillbirths. We include both pre-term and full-term births in order to account for the possibility that the relationship between pre-term and birth weight might be mediated by migrant status. In other words, ignoring pre-term births in this context might overestimate native-migrant differentials in birth weight if these groups have different probabilities of having pre-term babies or if pre-term is a more common route to LBW for one of the subsamples. In 2013, 409,008 mothers gave birth to a single baby, 23,278 of which were premature. Out of this initial sample of valid births for our analysis, which excludes multiple births and stillbirths (1,264), 22.42% correspond to children born to immigrant mothers (90,870).

[3] The data set is downloadable from http://www.ine.es/jaxi/menu.do?type=pcaxis&path=/t20/e304/&file=inebase.

Table 1 below provides descriptive information, the distribution of the variables used, and the number of cases available in the analytic sample.

Table 1: Descriptive statistics of the variables used in the analysis

	Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Dependent variable	Weight	358,911	3253.79	506.91	400	6580
	LBW	358,911	0.06	0.24	0 (2501/max)	1(min/2500)
	LBW2	356,810	0.06	0.24	0 (2501/4500)	1 (min/2500)
	LBW3	339,431	0.06	0.25	0 (2501/4000)	1 (min/2500)
	HBW	337,855	0.06	0.23	0 (2500/4000)	1 (4001/max)
	HBW2	337,855	0.01	0.08	0 (2500/4500)	1 (4501/max)
Migrant mother		358,911	0.20	0.40	0	1
Maternal characteristics	No education	358,911	0.13	0.34	0	1
	Primary	358,911	0.30	0.46	0	1
	Secondary	358,911	0.20	0.40	0	1
	University	358,911	0.37	0.48	0	1
	Age	358,911	32.15	5.29	13	55
	Old mother (>35 yrs)	358,911	0.27	0.44	0	1
	N. of children	358,911	1.61	0.79	1	12
Child characteristics	Female	358,911	0.48	0.50	0	1
	China	358,911	0.01	0.08	0	1
	Ecuador	358,911	0.01	0.11	0	1
	Colombia	358,911	0.01	0.11	0	1
	Morocco	358,911	0.05	0.23	0	1
	Romania	358,911	0.03	0.16	0	0
	Pre-term birth	358,911	0.06	0.30	0	1

Source: our estimation from EMNP.

The migrant status of the mother is a dummy variable, adopting the value of 1 if the mother was born outside Spain and 0 otherwise. Since we also want to allow for some within-variation in the migrant group due to biological differences in the various origins that correlate with the mothers' and children's health, we also used the mother and father's country of birth to build each of the five (0/1) nativity categories, namely Chinese, Colombian, Ecuadorean, Moroccan, and Romanian. Note that we separate Ecuadorean and Colombian origins because of the radically different shares of indigenous population in the two countries and the well-known differences in important factors that correlate with health and birth outcomes, such as the prevalence of certain conditions, mortality rates, and response to illness in indigenous versus non-indigenous communities (Montenegro and Stephens 2006).

The models also control for three maternal characteristics known to be determinants of birth weight: education, which has been transformed into four broad levels (0 No education; 1 Primary; 2 Secondary; 3 University degree), age, and number of children born by the mother prior to the observed delivery. Finally, the model also considers whether the newborn is male or female (since boys are known to be larger than females). Unfortunately, our register-based dataset contains no information about the mother's lifestyle, which would allow controlling for other behavioural determinants of our outcome of interest.[4]

The literature on perinatal health has extensively used dichotomous recodifications of birth weight, using the consensual threshold of weight <2,500 grams as an indicator of LBW. Other meaningful thresholds include weight <1,500 (very low birth weight) and weight <1,000 grams (extremely low birth weight). Although there is less consensus on the cut-off points for HBW, the convention is to use either the 4,000 or the 4,500 thresholds. Table 2 presents the distribution of birth weight, expressed in grams, separately for migrants and natives, together with the average age of mothers in each cell. Native mothers in Spain, as in other advanced democracies, have been increasingly putting off motherhood, and maternal age is associated with increased risks of adverse birth outcomes in a U-fashion, with the youngest (under 15) and oldest (over 40) mothers experiencing higher risks (Reichman and Pagnini 1997).

Table 2: Weight at birth by migrant status and average maternal age

Weight at birth (categories)		Native mother	Immigrant mother	Total
Extremely low birth weight (<1,000 grs.)	Age	32.76	31.62	32.46
	%	(0.19)	(0.27)	(0.21)
	N	551	194	745
Very low birth weight (1,001/1,500 grs.)	Age	33.06	31.19	32.64
	%	(0.46)	(0.54)	(0.48)
	N	1334	388	1722
Low birth weight (1,501/2,500 grs.)	Age	32.42	30.41	32.06
	%	(5.77)	(4.98)	(5.61)
	N	16558	3574	20132
Normal birth weight (2,501/4,000 grs.)	Age	32.59	30.26	32.13
	%	(88.77)	(86.28)	(88.28)
	N	254917	61915	316832
High birth weight (>4,001 grs.)	Age	32.83	30.70	32.23
	%	(4.34)	(6.85)	(4.84)
	N	12464	4915	17379
High birth weight (>4,500 grs.)	Age	32.71	31.09	32.11
	%	(0.46)	(1.08)	(0.59)
	N	1329	772	2101
Total	Age	32.59	30.31	32.14
	%	(100)	(100)	(100)
	N	287153	71758	358911

Source: our estimation from EMNP.

Descriptively, immigrant mothers are more likely to have children at the extremes of the birth weight distribution, and slightly less likely to have children with a normal

[4] The Appendix includes a cross tabulation estimated from the National Health Survey (National Institute of Statistics 2012) showing the lower propensity to smoke among foreign born females in Spain aged 18–45 compared to similar native females (see Table A-4.)

weight (88.8% among native mothers versus 86.3% among migrant mothers). In addition, they tend to be younger than their native counterparts in all birth weight categories. Besides, as Table 3 shows, among those cases falling into the LBW category, pre-term births are much more frequent among immigrant mothers (60.8%) than they are among native mothers (52.3%). In fact, and interestingly, pre-term birth appears to be the most usual reason for newborns of migrant-origin women falling into the LBW category.

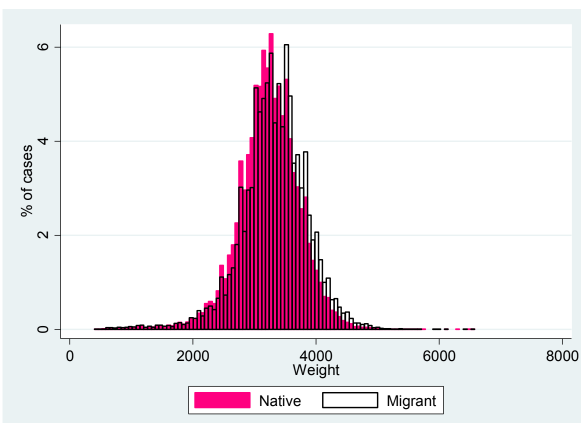
Table 3: Pre-term births of native and immigrant mothers with LBW babies

		Birth at term	Pre-term	Total
Native mother	Weight	2,274.58	1,989.77	2,125.62
	%	(47.70)	(52.30)	(100)
	N	8,797	9,646	18,443
Immigrant mother	Weight	2,246.20	1,952.07	2,067.36
	%	(39.20)	(60.80)	(100)
	N	1,629	2,527	4,156
Total	Weight	2,270.14	1,981.9455	2,114.90
	%	(46.13)	(53.87)	(100)
	N	10,426	12,173	22,599

Source: our estimation from EMNP.

Figure 1 presents overlapped histograms for the two populations under scrutiny in order to provide additional descriptive information about the unconditional differences in the distribution of weights of the newborn children of migrant and native mothers.

Figure 1: Histogram: Birth weight by migrant status



Source: our estimation from EMNP.

The two most salient differences between the two distributions are a slightly more pronounced incidence of very low birth weights and a notably more intense concentration of births above the median in the immigrant group. These differences, however, might not be statistically significant once relevant factors for perinatal outcomes other than the native vs. migrant status of mothers are controlled for in a multivariate context.

In our analysis we use a continuous version of our dependent variable: birth weight. As an innovation in the literature, we propose estimating the effect of being born to an immigrant mother using quantile regression (Hao and Naiman 2007) rather than logistic regression, the standard way of estimating native-migrant gaps in birth weight. Logistic regression is usually applied in order to estimate the average association between being the child of an immigrant mother and the risk of being born with a weight below 2,500 grams and above 4,000/4,500 grams (the most often used thresholds to define LBW and HBW, respectively). This standard procedure does not allow us to consider whether this differential might vary in size (and even sign) across different ranges of the dependent variable. The same holds for other relevant covariates. Alternatively, quantile regression allows us to consider the relationship between our main regressor and the outcome of interest (birth weight) using the following conditional median function:

$$y_q(y|x)=\beta_0 + \beta_n x_n + \varepsilon$$

where the median is the quantile q of the empirical distribution. The quantile q ranges from 0 to 1 (0 to 100, if expressed as percentiles), and results from splitting the data into equal shares of the distribution. Quantile regression produces estimates for the effect of each regressor on the specific range of values of the dependent variables delimited by quantiles. Table 4 shows the average birth weight for the entire analytic sample (selected percentiles) and some basic descriptives of our outcome variable.

Table 4: Distribution of birth weight

Percentiles		**Statistics**	
1%	1,730	N	386,860
5%	2,430	Mean	3,252.89
10%	2,665	Std. Dev.	508.83
25%	2,970	Variance	258,906.80
50%	3,266	Skewness	–0.54
75%	3,570	Kurtosis	5.17
90%	3,850		
95%	4,030		
99%	4,400		

Source: our estimation from EMNP.

Since our substantive interest lies in measuring the differentials between immigrants and natives in the extremes of the distribution of the birth weight variable, where the consensus has set the threshold for defining LBW (<2,500 grams) and HBW (>4,000 and 4,500 grams), we selected percentiles corresponding to these benchmark values, namely percentiles 5.87, 94.10, and 99.34. As a robustness check, the Appendix also includes standard logistic regression models exploring the impact of being born to a migrant mother on the specific risk of a baby being below and above these three theoretically relevant thresholds. Our quantile regression also allows for more variation in the effect of migrant status in the range of the dependent variable comprised by those benchmark values, by specifying in addition the effects for percentiles 25%, 50%, and 75%.

Since we use the entire universe of births in 2013 (excluding stillbirths and multiple births), we estimated our standard errors using bootstrapping. Specifically, our estimates are the average effect obtained from a set of 20 repetitions of the estimating protocol on subsamples of our dataset. By so doing, we allow variation in our estimates and provide meaningful significance tests.

4. Results

The results of our main estimation are presented in Table 5. For each percentile (5.87, 25, 50, 75 94.10, and 99.34) we present the effect of our regressors. Note that the constant term in each panel reflects average birth weight in each quantile when all the independent variables and controls adopt the value of 0 (thus native mothers with no formal education having a male baby). It is for this reason that the intercept in Q5.87 is slightly below the threshold of 2,500 grams. Similarly, the constant term for Q94.10 is a few grams below 4,000.

The results in Table 5 confirm the well-known regularity of female babies having lower average weights (Ellis et al. 2008). In our results this gap increases as we move towards higher values of our distribution. Older mothers (above the age of 35) have a greater chance of having a baby with adverse birth weight at the two extremes (with the exception of Q94.19, where differences are not significant). The mother's socio-economic status (reflected by her level of education) is consistently related to birth weight: within the LBW category, less-educated mothers tend to have smaller babies than those with more education, while at the other extreme they have, on average, heavier babies in the highest quantile that is specified in the regression (Q99.34). Education is therefore a source of systematic advantage. The children of more-educated mothers are heavier even when categorized as LBW, and they maintain a positive differential with the reference category in all other quantiles except Q99.34, where more-educated mothers are associated with smaller babies. Having had more children before the observed delivery is associated with consistently larger babies. The graphic illustration of the effects of these controls is shown in Figure A-1 in the Appendix. However, in our estimation the most important finding is the changing size of the immigrant effect across different parts of the distribution of the dependent variable. Migrant origin is associated with an advantage of 29 grams when the baby falls into the group considered to have LBW. In other words, immigrant babies, even when their weight is below 2,500 grams (in Q5.87), have a relative advantage compared to children born to native mothers. The size of the immigrant mother effect grows larger at Q25, Q50, and Q75. Within the limits set by the distribution of weights in these percentiles, immigrant babies have some systematic advantage, since they are 63, 75, and 88 grams heavier, respectively, than native children. Importantly, the higher the average weight of the newborn, the larger the immigrant mother effect becomes. This also applies to babies born above the threshold of 4,000 grams where the impact of our variable of interest grows to 104 grams, and above 4,500 grams, with a migrant-native differential of 140 grams in favour of the former. In other words, and crucially – as large babies suffer from a number of risks associated with their birth weight – the advantage in terms of heavier babies born to immigrant mothers turns into a marked disadvantage among the largest babies.

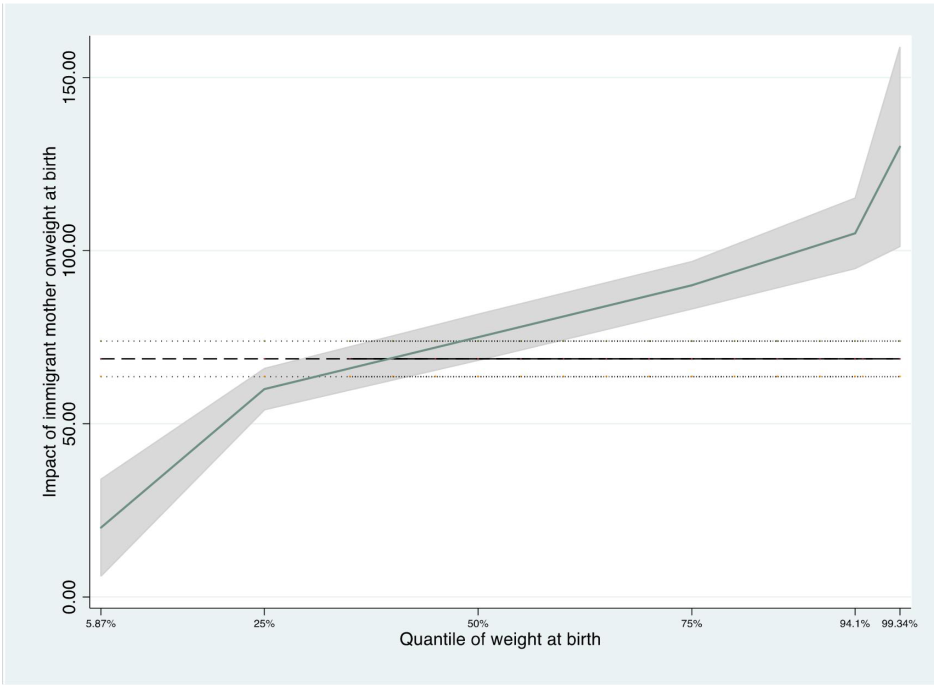
A summary of this changing impact of migrant origin across quantiles is provided in Figure 2. This representation further allows for the comparison of this effect with the impact of the migrant status of the mother on birth weight when estimated using a standard OLS regression (dashed horizontal line). Note that the estimates of OLS and quantile regression overlap in the median of the distribution of weight, where the immigrant mother effect represents an average weight gain of some 69 grams. In all other cases, the children of immigrants surpass the average birth weight of the children of natives.

Table 5: Simultaneous quantile regression (bootstrap: 20) SEs

		Coef.	Std. Err.	Coef.	Std. Err.
Quantile		**Q5.87** ***(<2,500 grs)***		**Q25**	
Migrant mother (ref. nat)		29***	(8.44)	63***	(2.65)
Maternal characteristics	Primary (ref. no educ)	88***	(8.35)	60***	(4.84)
	Secondary	157***	(11.19)	93***	(3.88)
	University	207***	(9.41)	123***	(4.44)
	Mother >35 yrs	-81***	(5.13)	-33***	(2.89)
	N. of children	58***	(2.82)	46***	(1.57)
Female baby		-69***	(5.86)	-106***	(2.92)
Origin	China	198***	(23.87)	76***	(10.60)
(ref. Spanish)	Ecuador	32	(17.27)	30***	(8,26)
	Colombia	44*	(18.84)	10	(8.45)
	Morocco	109***	(15.34)	90***	(4.58)
	Romania	-20	(21.54)	2	(9.22)
Constant		2,314***	(7.66)	2,860***	(4.79)
Quantile		**Q50**		**Q75**	
Migrant mother (ref. nat)		75***	(3.28)	88***	(3.57)
Maternal characteristics	Primary (ref. no educ)	50***	(3.61)	38***	(3.77)
	Secondary	75***	(3.59)	52***	(3.47)
	University	85***	(3.49)	58***	(3.59)
	Mother >35 yrs	-25***	(3.59)	-13***	(3.13)
	N. of children	50***	(0.73)	53***	(1.81)
Female baby		-125***	(2.73)	-140***	(1.51)
Origin	China	55***	(12.29)	32*	(14.06)
(ref. Spanish)	Ecuador	20	(6.59)	-12	(8.70)
	Colombia	0	(7.11)	-15***	(7.84)
	Morocco	85***	(7.32)	78***	(4.19)
	Romania	0	(5.43)	-2	(5.66)
Constant		3,175**	(3.42))	3,488***	(5.34)
Quantile		**Q94.10** ***(<4,000 grs)***		**Q99.34** ***(<4,500 grs)***	
Migrant mother (ref. nat)		104***	(5.80)	140***	(17.88)
Maternal characteristics	Primary (ref. no educ)	24***	(5.17)	10	(18.65)
	Secondary	30***	(5.01)	-10	(18.83)
	University	23***	(4.63)	-50***	(17.74)
	Mother >35 yrs	-3	(3.93)	20*	(8.89)
	N. of children	60***	(3.40)	70***	(5.39)
Female baby		-152***	(2.17)	-160***	(5.98)
Origin	China	35	(20.58)	110	(69.48)
(ref. Spanish)	Ecuador	-11	(11.21)	10	(40.46)
	Colombia	-60***	(13.37)	10	(54.64)
	Morocco	69***	(8.22)	100***	(20.80)
	Romania	-6	(9.73)	-50	(26.28)
Constant		3,910***	(5.98)	4,440***	(18.79)
Number of cases		358,911			

Source: our estimation from EMNP.
Legend: Estimates in grams are rounded. Standard errors provided in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Figure 2: Changing effect of immigrant mother on birth weight (size of the differentials between immigrant and natives)



Source: our estimation from EMNP.
Legend: Effect estimated from the model shown in Table 5. The dashed line reports the OLS estimate (and associated confidence intervals). The upward sloping line corresponds to the changing effect of immigrant mothers across pre-defined quantiles (and confidence intervals).

The results shown visually in this figure confirm our interpretation. Immigrant babies are better off when they fall into the category of low birth weight. They are also systematically heavier than native newborns in the healthy weight groups (quantiles 25, 50, and 75). However, this consistent advantage turns into a substantial disadvantage at the highest quantiles, where immigrant babies are also larger than babies born to native mothers. These results support Hamilton and Choi's conclusion (2015) that broadening the scope of the examined indicators of infant health provides more nuanced evidence than conclusions taking a narrow approach and focusing only on LBW and mortality.

Finally, note that according to our evidence some origin residuals remain unexplained. Babies of Chinese origin are importantly advantaged. They appear to be systematically better off (198 grams more) than the average baby born weighing below

2,500 grams and their advantage remains significant at quantiles 25, 50, and 75. Interestingly, children of Chinese mothers do not appear to be additionally overweight compared to those born to Spanish mothers when they fall above the HBW thresholds (differences with natives are non-significant). Ecuadorean and Colombian babies exhibit a very similar pattern relative to natives, as do children born to Romanian mothers. Finally, the children of Moroccan mothers are larger than native-born children across all selected quantiles. Further research to explain these differences should be pursued in the future.

As a robustness check, one further analysis shown in the Appendix confirms the validity of our findings using the more standard approach of estimating the risk of LBW and, at the other extreme, of having babies with high birth weight (using both the 4,000 and the 4,500 grams thresholds) versus children within a healthy range of birth weights using logistic regressions (see Table A-1). In order to ease the interpretation of the immigrant mother estimate, we have also plotted the specific impact that immigrant and native mothers have on each of these two risks (Figures A-2 and A-3).

5. Discussion

Birth weight is known to be a very powerful indicator of perinatal health, as well as a strong predictor of mid- and long-term health-related outcomes and, especially in the case of LBW, cognitive development and behavioural problems. Immigrants in Spain, in line with the pattern in other affluent countries, tend to occupy positions in the labour structure that are more vulnerable than those enjoyed by natives. However, there is no consistently significant disadvantage in terms of their health status. The estimation of differences between native and immigrant-born babies in terms of birth weight shows that the latter have a systematically higher weight across all levels of average weight. The gains obtained from having an immigrant mother are larger as we move towards higher average birth weights. The use of quantile regression has allowed us to decipher that as this higher weight for the children of immigrants also holds among the category of large babies, what appears to be general advantage turns into a marked disadvantage at the highest end of the weight distribution, a finding that conventional OLS and logistic regression would disregard. This result represents a substantive contribution to the literature on differentials in perinatal health between natives and migrants, as it shows that there are instances in which migrant status is not advantageous, and it demonstrates that the use of quantile regression is a methodological improvement in the study of the determinants of birth weight.

These results are evidence of the inadequacy of the 'healthy immigrant paradox' in the case of Spain, a paradox that would have been clearly confirmed had we not analysed the whole range of the weight distribution (see, for instance, Farré 2016, who obtains results consistent with the paradox). Our paper thus lends support to the idea that HBW should be considered more in analyses of perinatal health, since disregarding it actually biases the substantive interpretations of native-migrant health differentials. Fortunately, research showing the crucial relevance of both ends of the weight distribution has become more common recently, and the implications of the re-examined evidence for debates on public health have started to emerge (Hamilton and Choi 2015). The higher prevalence of macrosomia in certain ethnic groups and/or specific migrant communities, together with the well-known health-related risks such as metabolic disease and obesity associated with HBW, have recently led to increased awareness of the potential role of migration processes in the spread of infant and adult obesity in both sending and receiving countries (Riosmena et al. 2013).

Finally, we need to stress that our findings, even if drawn from analyses using the universe of cases and not a random sample of births, are subject to important limitations. Unfortunately, our register data do not allow us to directly measure the effect of lifestyle. In a country where health, including prenatal care, is universally available and state-funded, the possibility that the higher weight at birth of migrant-origin children might be due to lifestyle cannot be ruled out (the last tables and figures in the Appendix, using evidence on body mass index and smoking habits from the National Health Survey, show mixed evidence regarding the healthier lifestyles of migrants). Nor does the data allow accounting for unobservable characteristics affecting non-random selection, which is likely to be behind the higher propensity of immigrant mothers to somehow promote the transmission of HBW to their babies. Selectivity, which would be one of the most straightforward explanations of the slight advantage immigrant mothers have in preventing LBW in their children, is only presented as an ex-post explanation. Future research needs to explore the explanations of the regularities that we detect here.

6. Acknowledgement

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References

Abraído-Lanza, A.F., Dohrenwend, B.P., Ng-Mak, D.S., and Turner, J.B. (1999). The Latino mortality paradox: A test of the "salmon bias" and healthy migrant hypotheses. *American Journal of Public Health* 89(10): 1543–1548. doi:10.2105/AJPH.89.10.1543.

Barker, D.J. (1995). Fetal origins of coronary heart disease. *British Medical Journal* 311(6998): 171–174. doi:10.1136/bmj.311.6998.171.

Black, S.E., Devereux, P.J., and Salvanes, K.G. (2007). From the cradle to the labor market? The effect of birth weight on adult outcomes. *The Quarterly Journal of Economics* 122(1): 409–439. doi:10.1162/qjec.122.1.409.

Blondel, B., Kogan, M.D., Alexander, G.R., Dattani, N., Kramer, M.S., Macfarlane, A., and Wen, S.W. (2002). The impact of the increasing number of multiple births on the rates of preterm birth and low birth weight: An international study. *American Journal of Public Health* 92(8): 1323–1330. doi:10.2105/AJPH.92.8.1323.

Boardman, J.D., Powers, D.A., Padilla, Y.C., and Hummer, R.A. (2002). Low birth weight, social factors, and developmental outcomes among children in the United States. *Demography* 39(2): 353–368. doi:10.1353/dem.2002.0015.

Boulet, S.L., Alexander, G.R., Salihu, H.M., and Pass, M.A. (2003). Macrosomic births in the United States: Determinants, outcomes, and proposed grades of risk. *American Journal of Obstetrics and Gynaecology* 188(5): 1372–1378. doi:10.1067/mob.2003.302.

Buekens, P., Canfield, C., Padilla, N., Lara Lona, E., and Lozano, R. (2013). Low birthweight in Mexico: A systematic review. *Maternal and Child Health Journal* 17(1): 129–135. doi:10.1007/s10995-012-0956-4.

Castro-Martín, T. (2010) Single motherhood and low birth weight in Spain: Narrowing social inequalities in health? *Demographic Research* 22(27): 863–890. doi:10.4054/DemRes.2010.22.27.

Cebolla-Boado, H. and González Ferrer, A. (eds.) (2013). *Inmigración: ¿Integración sin modelo?* Madrid: Alianza Editorial.

Cervantes, A., Keith, L., and Wyshak, G. (1999). Adverse birth outcomes among native-born and immigrant women: Replicating national evidence regarding Mexicans at the local level. *Maternal and Child Health Journal* 3(2): 99–109. doi:10.1023/A:1021805427469.

Conley, D. and Bennet, N.G. (2000). Is biology destiny? Birth weight and life chances. *American Sociological Review* 65(3): 458–467. doi:10.2307/2657467.

Ellis, L., Hershberger, S., Field, E., Wersinger, S., Pellis, S., Geary, D., Palmer, C., Hoyenga, K., Hetsroni, A., and Karadi, K. (2008). *Sex differences: Summarizing more than a century of scientific research*. New York: Psychology Press.

Farré, L. (2016). New evidence on the healthy immigrant effect. *Journal of Population Economics* 29(2): 365–394. doi:10.1007/s00148-015-0578-4.

Frank, R., Frisbie, W.P., and Pullum, S.G. (2000). Race/ethnic differentials in heavy weight and cesarean births. *Population Research and Policy Review* 19(5): 459–475. doi:10.1023/A:1010656522963.

Fuster, V., Zuloaga, P., and Román-Busto, J. (2014). Stillbirth incidence in Spain: A comparison of native and recent immigrant mothers. *Demographic Research* 31(29): 889–912. doi:10.4054/DemRes.2014.31.29.

Green, T. (2012). *Black and immigrant: Exploring the effect of ethnicity and foreign-born status on infant health*. Washington: Migration Policy Institute.

Guendelman, S., Buekens, P., Blondel, B., Kaminski, M., Notzon, F.C., and Masuy-Stroobant, G. (1999). Birth outcomes of immigrant women in the United States, France and Belgium. *Maternal and Child Health Journal* 3(4): 177–187. doi:10.1023/A:1022328020935.

Hack, M., Klein, N.K., and Taylor, H.G. (1995). Long-term developmental outcomes of low-birthweight infants'. *Future of Children* 5(1): 176–196. doi:10.2307/1602514.

Hamilton, E.R. and Choi, K.H. (2015). The mixed effects of migration: Community-level migration and birthweight in Mexico. *Social Science and Medicine* 132: 278–286. doi:10.1016/j.socscimed.2014.08.031.

Hao, L. and Naiman, D.Q. (2007). *Quantile regression*. Thousand Oaks: Sage Publications.

Hawdon, J.M. (2011). Babies born after diabetes in pregnancy: what are the short- and long-term risks and how can we minimise them? *Best Practice & Research Clinical Obstetrics and Gynaecology* 25(1): 91–104. doi:10.1016/j.bpobgyn.2010.10.005.

Hjalgrim L.L., Rostgaard, K., Hjalgrim, H., Westergaard, T., Thomassen, H., and Forestier, E. (2004). Birth weight and risk for childhood leukemia in Denmark, Sweden, Norway, and Iceland. *Journal of the National Cancer Institute* 96(20): 1549–1556. doi:10.1093/jnci/djh287.

Hohmann-Marriott, B. (2009). The couple context of pregnancy and its effects on prenatal care and birth outcomes. *Maternal and Child Health Journal* 13(6): 745–754. doi:10.1007/s10995-009-0467-0.

Howard, D.L., Marshall, S.S., Kaufman, J.S., and Savitz, D.A. (2006). Variations in low birth weight and preterm delivery among Blacks in relation to ancestry and nativity: New York City, 1998–2002. *Pediatrics* 118(5): 1399–1405. doi:10.1542/peds.2006-0665.

Hummer, R.A., Powers, D.A., Pullum, S.G., Gossman, G.L., and Frisbie, W.P. (2007). Paradox found (again): Infant mortality among the Mexican-origin population in the United States. *Demography* 44(3): 441–457. doi:10.1353/dem.2007.0028.

Jasso, G., Massey, D., Rosenzweig, M.D., and Smith, J. (2004). Immigrant health: Selectivity and acculturation. In: Anderson, N.B., R.A. Bulatao, and B. Cohen (eds). *Critical perspectives on racial and ethnic differences in health in late life*. Washington: The National Academies Press National Research Council: 227–266.

Johnson, R.C. and Schoeni, R.F. (2007). The influence of early-life events on human capital, health status, and labor market outcomes over the life course. Ann Arbor: University of Michigan (Population Studies Center Research Report 07-616)

Johnson, R.C. and Schoeni, R.F. (2011). Early-life origins of adult disease: National longitudinal population-based study of the United States. *American Journal of Public Health* 101(12): 2317–2324. doi:10.2105/AJPH.2011.300252.

Johnsson, I.W., Haglund, B., Ahlsson, F., and Gustafsson, J. (2015). A high birth weight is associated with increased risk of type 2 diabetes and obesity. *Pediatric Obesity* 10(2): 77–83. doi:10.1111/ijpo.230.

Juárez, S. and Revuelta Eugercios, B.A. (2013). Socioeconomic differences in low birth weight: Revisiting epidemiological approaches. *Revista Española de Investigaciones Sociológicas* 144: 73–96.

Kramer, M.S., Séguin, L., Lydon, J., and Goulet, L. (2000). Socio-economic disparities in pregnancy outcome: why do the poor fare so poorly? *Paediatric and Perinatal Epidemiology* 14(3): 194–210. doi:10.1046/j.1365-3016.2000.00266.x.

Kristensen, P., Susser, E., Irgens, L.M., Mehlum, I.S., Corbett, K., and Bjerkedal, T. (2014). The association of high birth weight with intelligence in young adulthood: A cohort study of male siblings. *American Journal of Epidemiology* 18(9): 876–884. doi:10.1093/aje/kwu241.

Luke, B. and Brown, M.B. (2007). Elevated risks of pregnancy complications and adverse outcomes with increasing maternal age. *Human Reproduction* 22(5): 1264–1272. doi:10.1093/humrep/del522.

Luque Fernández, M.A. (2008). Evolución del riesgo de mortalidad fetal tardía, prematuridad y bajo peso al nacer, asociado a la edad materna avanzada, en España (1996–2005). *Gaceta Sanitaria* 22(5): 396–403. doi:10.1157/13126919.

McCormick, M.C., Gortmaker, S.L., and Sobol, A.M. (1990). Very low birth weight children: Behavior problems and school difficulty in a national sample. *Journal of Pediatrics* 117(5): 687–693. doi:10.1016/S0022-3476(05)83322-0.

Mendoza, F.S. (2009) Health disparities and children of immigrant families: A research agenda. *Pedriatrics* 12(Suppl. 3): S187–S195. doi:10.1542/peds.2009-1100f.

Montenegro, R.A. and Stephens, C. (2006). Indigenous health in Latin America and the Caribbean. *The Lancet* 367(9525): 1859–1869. doi:10.1016/S0140-6736(06)68808-9.

National Institute of Statistics (2012). *Encuesta Nacional de Salud de España 2011/12. Tablas* [Spanish National Health Survey 2011/12. Tables]. Madrid, Ministry of Health, Social Services and Equality. http://www.msc.es/estadEstudios/estadisticas/encuestaNacional/encuestaNac2011/DeterminantesSalud_DistribucionPorcentual.pdf

OECD (2009). *Health at a Glance 2009: OECD Indicators*. OECD Publishing.

OECD (2014). *Health at a Glance: Europe 2014*. OECD Publishing. doi:10.1787/health_glance_eur-2014-en.

Palloni, A. and Arias, E. (2004). Paradox lost: Explaining the Hispanic adult mortality advantage. *Demography* 41(3): 385–415. doi:10.1353/dem.2004.0024.

Palloni, A. and Morenoff, J.D. (2001). Interpreting the paradoxical in the Hispanic paradox: Demographic and epidemiologic approaches. *Annals of the New York Academy of Science* 954: 140–174. doi:10.1111/j.1749-6632.2001.tb02751.x.

Pattenden, S., Dolk, H., and Vrijheid, M. (1999). Inequalities in low birth weight: Parental social class, area deprivation, and "lone mother" status. *Journal of*

Epidemiology and Community Health 53(6): 355–358. doi:10.1136/jech.53.6.355.

Record, R.G., McKeown, T., and Edwards J.H. (1969). The relation of measured intelligence to birth weight and duration of gestation. *Annals of Human Genetics* 331: 71–79. doi:10.1111/j.1469-1809.1969.tb01631.x.

Reichman, N.E., Hamilton, E.R., Hummer, R.A., and Padilla, Y.C. (2008). Racial and ethnic disparities in low birthweight among urban unmarried mothers. *Maternal and Child Health Journal* 12(2): 204–215. doi:10.1007/s10995-007-0240-1.

Reichman, N.E. (2005). Low birth weight and school readiness. *The Future of Children* 15(1): 91–116. doi:10.1353/foc.2005.0008.

Reichman, N.E. and Pagnini, D.L. (1997). Maternal age and birth outcomes: Data from New Jersey. *Family Planning Perspectives* 29(6): 268–272, 295. doi:10.1363/2926897.

Riosmena, F., Wong, R. and Palloni, A. (2013). Migration selection, protection, and acculturation in health: A binational perspective on older adults. *Demography* 50(3): 1039–1064. doi:10.1007/s13524-012-0178-9.

Ronda, E., Regidor, E., García, A.M., and Domínguez, V. (2005). Association between congenital anomalies and paternal exposure to agricultural pesticides depending on mother's employment status. *Journal of Occupational and Environmental Medicine* 47(8): 826–828.

Stotland, N.E., Caughey, A.B., Breed, E.M., and Escobar, G.J. (2004). Risk factors and obstetric complications associated with macrosomia. *International Journal of Gynaecology and Obstetrics* 87(3): 220–226. doi:10.1016/j.ijgo.2004.08.010.

Teitler, J.O., Hutto, N., and Reichman, N.E. (2012). Birthweight of children of immigrants by maternal duration of residence in the United States. *Social Science and Medicine* 75(3): 459–468. doi:10.1016/j.socscimed.2012.03.038.

Teitler, J.O., Reichman, N.E., Nepomnyaschy, L., and Martinson, M. (2007). A cross-national comparison of racial and ethnic disparities in low birth weight in the United States and England. *Pediatrics* 102(5): e1182–e1189. doi:10.1542/peds.2006-3526.

Varea, C., Bernis, C., and González, A. (2012). Maternal characteristics and temporal trends in birth outcomes: Comparison between Spanish and migrant mothers. *International Journal of Population Research* 2012(ID 412680). doi:10.1155/2012/412680.

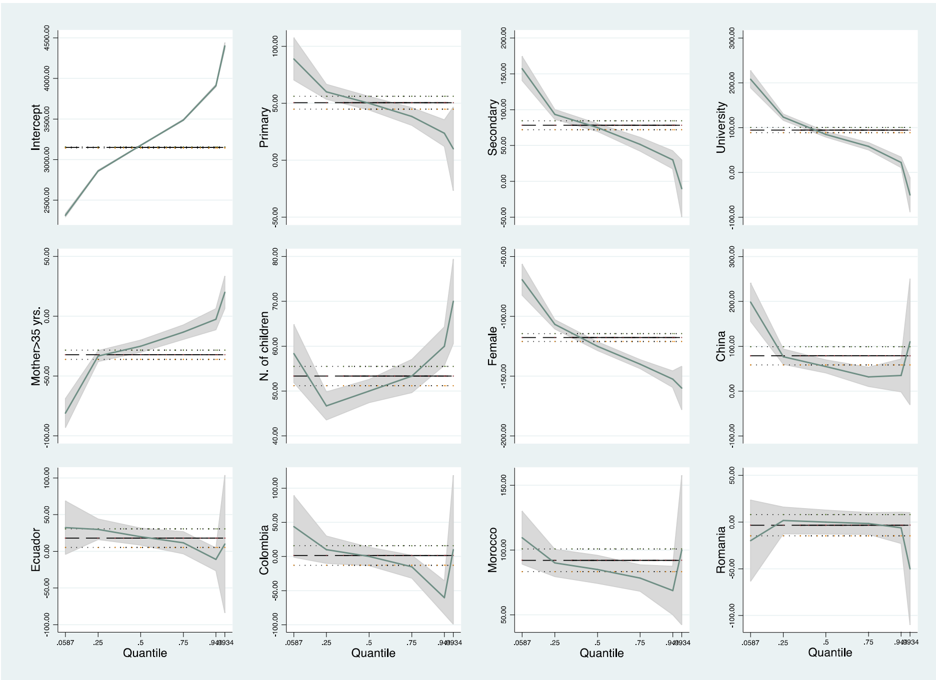
Weissmann-Brenner, A., Simchen, M.J., Zilberberg, E., Kalter, A., Weisz, B., Achiron, R., and Dulitzky, M. (2012). Maternal and neonatal outcomes of macrosomic pregnancies. *Medical Science Monitor* 18(9): 77–81. doi:10.12659/MSM.883340.

World Health Organization (2013). *Nutrition, Physical Activity and Obesity: Spain*. http://www.euro.who.int/__data/assets/pdf_file/0020/243326/Spain-WHO-Country-Profile.pdf

Zhang, X., Decker, A., Platt, R.W., Kramer, M.S. (2007). How big is too big? The perinatal consequences of fetal macrosomia. *American Journal of Obstetrics and Gynecology* 198(5): 517e1–517e6. doi:10.1016/j.ajog.2007.12.005.

Appendix

Figure A-1: Summary of effects from quantile regression (results from Table 5)



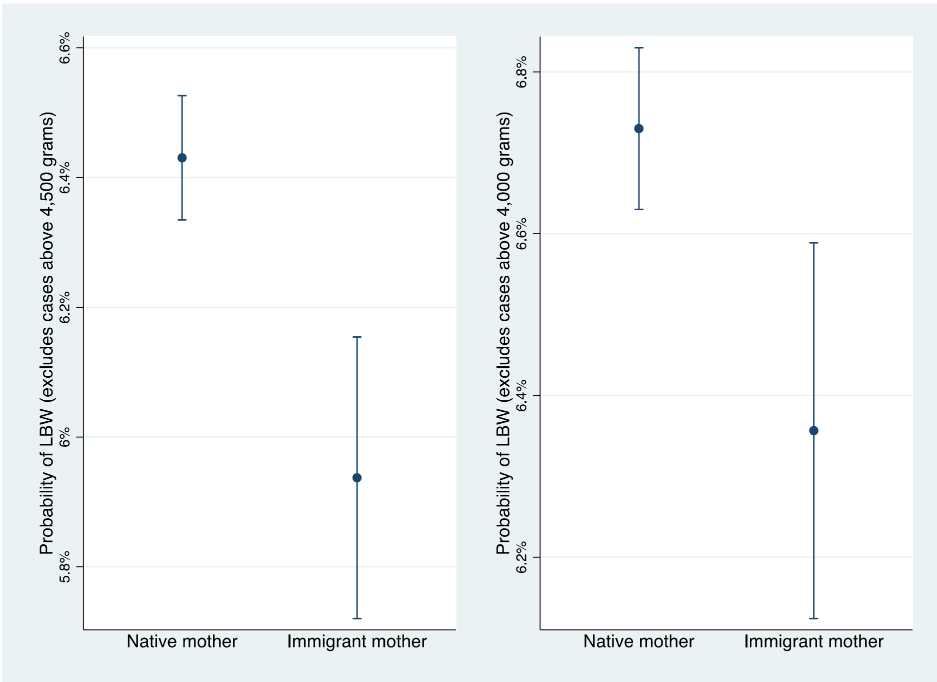
Source: our estimation from EMNP.
Estimated from model in Table 5.

Table A-1: Logistic regression models

		Model 1: LBW (excludes >4,500)	Model 2: LBW (excludes >4,000)	Model 3: HBW (excludes <2,500; HBW>4,000)	Model 4: HBW (excludes <2,500; HBW>4,500)
Migrant mother		-0.085*	-0.061*	0.45*	0.65*
(ref. natives)		(0.023)	(0.023)	(0.022)	(0.061)
Mothers' Characteristics	Primary	-0.29*	-0.28*	0.10*	0.060
	(ref. no educ.)	(0.022)	(0.022)	(0.025)	(0.068)
	Secondary	-0.49*	-0.49*	0.092*	-0.070
		(0.025)	(0.025)	(0.027)	(0.077)
	University	-0.66*	-0.66*	0.053*	-0.27*
		(0.023)	(0.023)	(0.026)	(0.075)
	Mother>35 yrs	0.26*	0.26*	-0.0020	0.068
		(0.016)	(0.016)	(0.017)	(0.052)
	N. of children	-0.20*	-0.19*	0.20*	0.23*
		(0.010)	(0.01)	(0.0084)	(0.022)
Female baby		0.21*	0.17*	-0.68*	-0.73*
		(0.014)	(0.014)	(0.016)	(0.047)
Origin	China	-0.70*	-0.70*	0.022	0.14
(ref. Spanish)		(0.11)	(0.11)	(0.078)	(0.20)
	Ecuador	-0.13*	-0.14*	-0.068	-0.016
		(0.056)	(0.056)	(0.052)	(0.13)
	Colombia	-0.15*	-0.17*	-0.30*	0.017
		(0.064)	(0.064)	(0.064)	(0.15)
	Morocco	-0.32	-0.30*	0.24*	0.30*
		(0.039)	(0.039)	(0.033)	(0.086)
	Romania	0.022	0.022	-0.030	-0.25
		(0.047)	(0.047)	(0.046)	(0.14)
Constant		-2.10*	-2.06*	-3.04*	-5.33*
		(0.026)	(0.026)	(0.029)	(0.079)
Model information	Chi^2	1593.5	1457.7	3641.1	754.9
	N	356,810	339,431	337,855	337,855

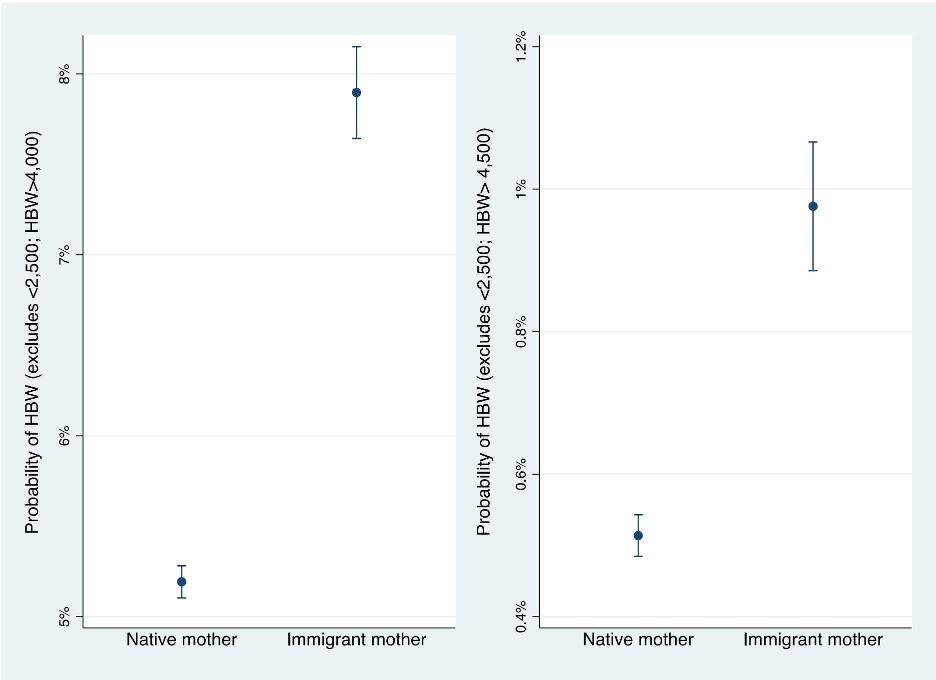
Source: our estimation from EMNP.
Standard errors in parentheses; p<0.05, ** p<0.01, *** p<0.001.
Model 1: Probability of healthy baby (0) versus LBW (1). Excludes all cases above 4,500 grams
Model 2: Probability of healthy baby (0) versus LBW (1). Excludes all cases above 4,000 grams
Model 3: Probability of healthy baby (0) versus HBW>4,000 (1). Excludes all cases below 2,500 grams
Model 4: Probability of healthy baby (0) versus HBW>4,500 (1). Excludes all cases below 2,500 grams

Figure A-2: Probability of LBW by immigrant status (with 95% confidence intervals)



Source: our estimation from EMNP.
Estimated from models 1 and 2 in Table A.1.

Figure A-3: Probability of HBW by immigrant status (with 95% confidence intervals)



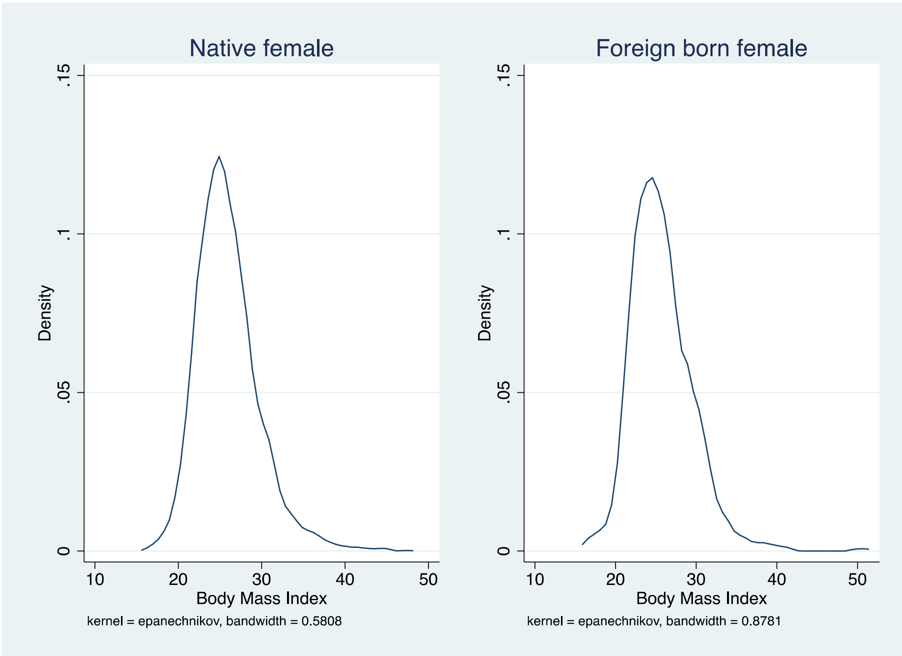
Source: our estimation from EMNP.
Estimated from models 3 and 4 in Table A.1.

Table A-2: T-test of differences in body mass index by migrant status for females aged between 18 and 45

	N	Std. Error	Mean	Std. Deviation
Native mother	3,281	0.07	25.93	3.77
Immigrant mother	513	0.17	25.74	3.70
Difference (mean native - mean migrant)		0.18	0.19	

Source: our elaboration from 2011 National Health Survey (Encuesta Nacional de Salud).
t = 1.0362; Ha: diff != 0; Pr(|T| > |t|) = 0.3002

Figure A-4: Kernel density distribution of body mass index for native and foreign-born females



Source: our elaboration from 2011 National Health Survey (Encuesta Nacional de Salud).

Table A-4: Cross tabulation; smoking behaviour by migrant status

	Native	Migrant	Total
Daily	1,181	160	1,341
	(35.16)	(29.96)	(34.45)
Not daily	126	35	161
	(3.75)	(6.55)	(4.14)
Smoked in the past	498	75	573
	(14.83)	(14.04)	(14.72)
Never smoked	1,554	264	1,818
	(46.26)	(49.44)	(46.70)
Total	3,359	534	3,893
	(100)	(100)	(100)

Source: our elaboration from 2011 National Health Survey (Encuesta Nacional de Salud).
Legend: frequencies and column percentages.
Pearson Chi2(3) = 13.55 Pr = 0.004
Cramer's V = 0.06

Stata code for replication of results

```
****************
*Migrant status*
****************

gen motherimm=PAISNXM
recode motherimm 108=0 .=. *=1

**********
*Controls*
**********

*Education: mother
gen educmother=ESTUDIOM
recode educmother 1=0 2=0 3=0 4=1 5=2 6=1 7=2 8=3 9=3
10=3 0=.
label define educ 0"No educ" 1"Primary" 2"Secondary"
3"University"
label values educmother educ
ta educmother, gen(educm)
rename educm1 noeduc
rename educm2 primary
rename educm3 secondary
rename educm4 university

*Sex of baby
gen female=SEXO1
recode female 6=1 1=0

*Number of children
gen nchildren=NUMHVT

*Mother's age
gen agem=EDADM

*Old mothers (<35), old mothers (>35+)
gen oldm=agem
recode oldm min/35=0 36/max=1
```

```
* Origin
gen Romania= PAISNXM
gen Morocco= PAISNXM
gen Ecuador= PAISNXM
gen Colombia= PAISNXM
gen China= PAISNXM
recode Romania 128=1 *=0
recode Morocco 228=1 *=0
recode Ecuador 345=1 *=0
recode Colombia 343=1 *=0
recode China 407=1 *=0
replace Romania=1 if PAISNXP==128
replace Morocco=1 if PAISNXP==228
replace Ecuador=1 if PAISNXP==345
replace Colombia=1 if PAISNXP==343
replace China=1 if PAISNXP==407

************************
**Dependent variable(s)*
************************

*Weight (cont)
gen weight= PESON1

*Low birth weight
gen LBW= weight
recode LBW .=. min/2500=1 2501/max=0
*
gen LBW2= weight
recode LBW2 .=. min/2500=1 2501/4500=0 4501/max=.
*
gen LBW3= weight
recode LBW3 .=. min/2500=1 2501/4000=0 4001/max=.

*High birth weight
gen HBW= weight
recode HBW min/2499=. 2500/4000=0 4001/max=1
```

```
gen HBW2= weight
recode HBW2 min/2499=. 2500/4500=0 4501/max=1

*******************
*Sample definition*
*******************

*Multiple birth
gen multiple=MULTIPLI
keep if multiple==1

*Alive
gen alive=NACVN1
recode alive 2=0 1=1
keep if alive==1

*Restriction to analytic sample
mark nomiss
markout nomiss weight motherimm primary secondary
university oldm nchildren female China Ecuador ///
Colombia Morocco Romania

********
*Results*
*********

*descriptives
*************
*weight by migrant status
sum weight, detail
twoway (histogram weight if motherimm ==0 & nomiss==1,
percent bin(100) color(pink))(histogram weight if
motherimm ==1 & nomiss==1, percent bin(100)fcolor(none)
lcolor(black)), name(histog, replace) xtitle(Weight)
ytitle(% of cases) legend(order(1 "Native" 2 "Migrant"))

*Share of LBW due to preterm by migrant status
*Preterm
gen preterm=INTERSEM
```

```
recode preterm 1=0 2=1
*
ta motherimm preterm if LBW==1 & nomiss==1, sum(weight)
ta motherimm preterm if LBW==1 & nomiss==1, row

*Detailed classification of BW
gen birthweight=weight
recode birthweight 0/1000=1 1001/1500=2 1501/2500=3
2501/4000=4 4001/4500=5 4501/8000=6
label define birthweight 1"<1000grs." 2"1001/1500grss"
3"1501/2500grs." 4"2501/4000grs." 5"4001/4500grs."
6">4500grs."
label values birthweight birthweight
*
ta birthweight motherimm if nomiss==1, col
ta birthweight motherimm if nomiss==1, sum(agem) nofreq
ta birthweight motherimm if nomiss==1, sum(weight)

*Quantile regression weight
***************************

*Identification of quantiles
ta weight if nomiss==1
*
sqreg weight motherimm primary secondary university
oldm nchildren female China Ecuador ///
Colombia Morocco Romania, quantile(.0587 .25 .5 .75
.9410 .9934)
est store M1
grqreg motherimm, cons ci ols olsci reps(20)
name(Gsqreg)
est restore M1
grqreg primary secondary university oldm nchildren
female China Ecuador ///
Colombia Morocco Romania, cons ci ols olsci reps(20)
name(GsqregAP)

*Robustness checks
*****************
```

```
*LBW2 (excludes >4500)
logit LBW2 i.motherimm primary secondary university
oldm nchildren female China Ecuador Colombia Morocco
Romania
est store M2
margins i.motherimm
marginsplot, name(GLBW1)
*
*LBW3 (excludes >4000)
logit LBW3 i.motherimm primary secondary university
oldm nchildren female China Ecuador Colombia Morocco
Romania
est store M3
margins i.motherimm
marginsplot, name(GLBW2)
*
graph combine GLBW1 GLBW2

*HBW (excludes <2500; HBW>4000)
logit HBW i.motherimm primary secondary university oldm
nchildren female China Ecuador Colombia Morocco Romania
est store M4
margins i.motherimm
marginsplot, name(GHBW1, replace)
*HBW2  (excludes <2500; HBW>4500)
logit HBW2 i.motherimm primary secondary university
oldm nchildren female China Ecuador Colombia Morocco
Romania
est store M5
margins i.motherimm
marginsplot, name(GHBW2)
*
graph combine GHBW1 GHBW2

*********************************
*Tables & Figures shown in paper*
*********************************

*Summary of variables
```

```
   graph combine gnathist ginmhist
   sum weight LBW LBW2 HBW HBW2 motherimm noeduc primary
secondary university agem oldm nchildren female China ///
   Ecuador Colombia Morocco Romania preterm if nomiss==1

   *Quantile regression
   esttab   M1, b(a2) se(a2) star(* 0.05) legend label
varlabels(_cons Constant) stats(F chi2 N r2)
   graph combine Gsqreg
   graph combine GsqregAP

   *Logistic regressions
   esttab  M2 M3 M4 M5, b(a2) se(a2) star(* 0.05) legend
label varlabels(_cons Constant)  stats(chi2 N aic)
   graph combine GLBW1 GLBW2
   graph combine GHBW1 GHBW2
```