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Explaining immigrant–native differences in health at birth: The role of immigrant selectivity in Spain

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Evidence shows that immigrants are often in better health than the native born—the so-called ‘immigrant health paradox’—and this advantage may extend to their children’s health. A commonly cited but rarely tested explanation is the ‘selectivity hypothesis’, positing that immigrants are healthier due to selection at origin based on health or socio-economic status (SES). Using 2007–19 Spanish birth registries, we investigate immigrant–native gaps in health at birth and whether they are explained by immigrants’ educational selectivity. We find that babies born to immigrants are less likely to be low birthweight (LBW) but are disadvantaged in terms of macrosomia and gestational age. Selectivity is associated with reduced LBW even after accounting for parental SES, explaining the lower risk among children of Northern African and Latin American immigrants but not across other parental country-of-birth groups. Selectivity is not associated with other birth outcomes. We confirm the selectivity hypothesis but question its universality across groups and health outcomes.

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Keywords: immigrant health paradox; healthy immigrant effect; selectivity; birth outcomes; migrant inequalities; low birthweight; Spain

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Introduction

A large literature documents immigrant advantages in health (Palloni and Arias 2004; Ichou and Wallace 2019; Markides and Rote 2019). This finding is often referred to as the ‘healthy immigrant effect’ or ‘immigrant health paradox’ (IHP), because immigrants are healthier despite being on average socio-economically disadvantaged (Bostean 2013; Juárez et al. 2017; Luthra et al. 2020). A key question is whether and how these health advantages are transmitted from one migrant generation to the next. Studies, mostly from the United States (US), suggest that the IHP may extend to the second generation very early on, as they have found that children of immigrants are also more likely to be in better health at birth (e.g. less likely to be low

birthweight) compared with children of the native born (Teitler et al. 2012; Giuntella 2016; Martinson et al. 2017; Dello Iacono et al. 2024). These are impactful differences, since birth outcomes are crucial predictors of socio-economic and health outcomes across the life course (Härkönen et al. 2012; Almond et al. 2018; Cozzani and Härkönen 2023), which in turn may influence migrants’ integration opportunities.

European research on the IHP among adults and especially among their children is lagging and less conclusive (Nielsen and Krasnik 2010; Juárez et al. 2017; Markides and Rote 2019; Florian et al. 2021; Florian et al. 2023). Studies have found contrasting results both across and within European countries and also across birth outcomes and immigrant groups (Juárez and Revuelta-Eugercios 2014, 2016;

Milewski and Peters 2014; Florian et al. 2023). In Spain, the context of this study, there have been opposing findings on immigrant–native gaps in health at birth across different outcomes (e.g. low or high birthweight) and different migrant groups (e.g. North African vs South Asian immigrants) (Cebolla-Boado and Salazar 2016; Juárez et al. 2017). These contrasting patterns remain unexplained, partly because studies on the topic are mostly descriptive and have rarely tested the mechanisms behind the IHP (Gagnon et al. 2009; Juárez and Revuelta-Eugercios 2016).

A commonly cited explanation for the IHP is that immigrants could be positively selected in their origin countries in terms of health, socio-economic status (SES), or other relevant characteristics, and this should positively affect their own health and that of their children (Giuntella 2016; Ichou and Wallace 2019; Feliciano 2020; Florian et al. 2021). However, despite its popularity, the selectivity hypothesis is rarely rigorously tested (Feliciano 2020). Although some studies have shown that immigrants are positively selected compared with individuals in their birth countries who do not migrate, they rarely link this empirically with immigrants' (or their children's) better health in their destination countries (Riosmena et al. 2013; Feliciano 2020). Studies that have attempted to explain immigrants' (or their children's) health advantages directly through their selection at origin have produced mixed results on the selectivity hypothesis (Fenelon 2013; Martinez et al. 2015; Ichou and Wallace 2019; Florian et al. 2021; Luthra and Platt 2023). This could be, for instance, because they studied different countries of immigration or tested the selectivity hypothesis using different methods and for different health outcomes.

We address these gaps by analysing differences in children's health at birth by parental migrant status in Spain and investigating whether these differences are explained by immigrant selectivity, specifically in terms of educational attainment. We use 2007–19 vital statistics data covering all births in Spain and estimate immigrant–native gaps in key indicators related to birthweight and gestational age: low birthweight (LBW), high birthweight (HBW), and preterm and post-term births. We estimate the impact of immigrant selectivity on children's health at birth and examine whether immigrant–native gaps are mediated by it. In line with the prior literature, we capture immigrants' educational selectivity using an indicator of *relative education* (contextual attainment), which measures individuals' rank in the educational attainment distribution of their

country of birth (Ichou 2014; Feliciano and Lanuza 2017; Florian et al. 2021). By placing immigrants' individual level of education within the distribution in their origin country, this relative education measure directly captures the extent to which migrants are positively selected at origin in terms of educational attainment. Educational selectivity should be associated with positive selection in other dimensions, including health itself (Chiswick et al. 2008; Ichou and Wallace 2019) and health correlates, such as higher pre-migration social status and economic resources (Ichou 2014; Engzell and Ichou 2020).

Our study makes several new contributions to the literature. First, we provide novel evidence on the IHP and the health of second-generation immigrants in Europe by investigating differences in birth outcomes by migration status in a European country experiencing recent immigration. Second, we contribute to the literature on the selectivity hypothesis, by investigating whether educational selectivity explains immigrant–native gaps in health at birth. Third, unlike most studies, thanks to the large size of our data set we are able to investigate our research questions thoroughly across the varied national-origin groups in the Spanish migrant population. Fourth, we test the impact of educational selectivity more rigorously, compared with previous studies, by accounting for its confounding with parents' absolute education and country-of-birth characteristics (Engzell 2019). Fifth, we investigate heterogeneity in its impact across immigrants' educational attainment and country of birth and their children's birth cohort. Finally, we also focus on birth outcomes such as macrosomia (weighing more than 4.5 kgs) and post-term births (gestational age > 41 weeks), which are rarely studied (Torche and Conley 2016).

Background

The immigrant health paradox and health at birth

A large literature finds health advantages for foreign-born individuals, in spite of their lower SES and other disadvantages they may face (Antecol and Bedard 2006; Fenelon 2013; Lariscy et al. 2015). A key question is whether and how this advantage extends to their descendants. Early health outcomes, such as birthweight and gestational age, strongly affect health status over the life course (Härkönen et al. 2012; Cozzani and Härkönen 2023). Moreover, research has shown that these outcomes are strongly socially stratified and thus represent a

key mechanism for intergenerational transmission of (dis)advantage (Aizer and Currie 2014; Almond et al. 2018; Cozzani 2023). For these reasons, research attention has been directed towards immigrant–native gaps in early-life health and whether an IHP also exists for these outcomes.

Studies from the US (and to some extent other Anglo-Saxon countries) have confirmed an IHP in birth outcomes for the children of immigrants (Wingate and Alexander 2006; Teitler et al. 2012; Giuntella 2016; Martinson et al. 2017). European research on the topic is less developed and has produced more mixed results (Juárez et al. 2017; Florian et al. 2021). For example, a recent comparative study across European countries found that LBW deliveries were less common among immigrants than the native born in France but more common among immigrants than the native born in the Netherlands and the UK (Florian et al. 2023). Also, findings within countries have been mixed and vary across health outcomes and immigrant groups (Pedersen et al. 2012; Juárez and Revuelta-Eugercios 2014, 2016; Milewski and Peters 2014).

In Spain, the children of immigrants are less likely to be born with LBW but also more likely to be born with HBW (Cebolla-Boado and Salazar 2016; Juárez et al. 2017). Immigrant–native gaps in gestational age also vary, with some immigrant groups experiencing a higher likelihood of preterm birth than Spanish-born parents and others experiencing a lower likelihood (Juárez and Revuelta-Eugercios 2014). Some national-origin groups have an advantage at one tail of the birthweight or gestational age distribution and a disadvantage at the other (e.g. a lower LBW and a higher HBW prevalence compared with children of the native born), suggesting that there may be significant unexplored heterogeneity within the migrant population (Juárez and Revuelta-Eugercios 2014).

These outcome- and origin-specific immigrant–native gaps in health at birth are still unexplained, partly because most studies lack information on mechanisms (Gagnon et al. 2009; Juárez and Revuelta-Eugercios 2016). The literature on the IHP has identified immigrant selectivity as a key theoretical mechanism behind immigrant–native gaps in health (Jasso et al. 2004; Feliciano 2020). However, this theory has rarely been rigorously tested in practice and never in the Spanish case (Feliciano 2020; Florian et al. 2021).

Explaining the paradox: Immigrant selectivity

According to the selectivity hypothesis, the IHP could be explained by the fact that immigrants are

positively selected in terms of observable and/or unobservable characteristics compared with individuals who do not migrate from their countries of origin (Jasso et al. 2004; Feliciano 2020; Luthra and Platt 2023). For example, immigrants could be directly selected in terms of health, since sick or fragile individuals are less likely to migrate (Jasso et al. 2004; Akresh and Frank 2008; Chiswick et al. 2008; Giuntella 2017). They could also be positively selected based on SES (e.g. education, wealth, or social standing), which is associated with both adult health and children's health at birth (Link and Phelan 1995; Ichou and Wallace 2019; Feliciano 2020; Panico et al. 2024). In particular, mothers from higher socio-economic backgrounds are less likely to engage in unhealthy behaviours during pregnancy (e.g. smoking), which are major determinants of poor birth outcomes in high-income countries (Kramer et al. 2000; Härkönen et al. 2018).

Despite its popularity, the immigrant selectivity hypothesis is rarely tested as an explanation for the IHP (Feliciano 2020), as repeated measures of health prior to and post migration are seldom available. Several studies have established that immigrants are healthier than non-migrants in their countries of origin (Akresh and Frank 2008; Riosmena et al. 2013; Riosmena et al. 2017). However, this provides only indicative evidence for selectivity as the mechanism behind immigrant health advantages (Feliciano 2020). Few studies have empirically linked health selection at origin with subsequent health at destination to establish whether and to what extent selectivity could explain the IHP (Feliciano 2020). Some recent studies represent notable exceptions, but they have produced contrasting evidence on the selectivity hypothesis (Fenelon 2013; Martinez et al. 2015; Ro et al. 2016).

A promising alternative for testing the selectivity hypothesis is to investigate the role of immigrants' *educational selectivity*, measured through a widely used indicator of *relative education* developed in Ichou (2014). It is computed, for each migrant, as the percentage of people (aged 0–100) of the same country of origin, sex, and age group whose level of educational attainment is lower, plus half of the percentage of people with the same level of education. Unlike absolute education, immigrants' relative education measures their position in the educational distribution of *their country of origin* and hence captures the extent to which they are selected. For example, a migrant with a relative education higher than 50 would be considered positively selected, because they are more educated than most people in their origin country.

Educational selectivity can be associated with better health for migrants and their children through different channels. First, given the established association between SES and health, educational selectivity can proxy for immigrants' *health selectivity* (Link and Phelan 1995; Marmot 2005; Mackenbach et al. 2018; Ichou and Wallace 2019), which would directly affect their children's health at birth (Conley and Bennett 2000; Currie and Moretti 2007). Second, higher (relative) education is associated with better health behaviours, such as less smoking and drinking (Pampel et al. 2010; Fenelon 2013; Florian et al. 2021), which also positively affect health at birth (Kramer et al. 2000; Panico et al. 2024). Third, educational selectivity should also proxy for selection in other pre-migration SES factors, such as wealth and economic resources (Engzell 2019; Luthra and Platt 2023), which are also positively associated with health at birth (Cozzani 2023; Panico et al. 2024).

Three studies have attempted to test the effect of immigrants' educational selectivity on their own health and that of their children (Ichou and Wallace 2019; Florian et al. 2021; Luthra and Platt 2023). The results of these studies are somewhat supportive of the selectivity hypothesis but not fully consistent. Florian et al. (2021) and Ichou and Wallace (2019) found that educational selectivity explained part of immigrants' and their descendants' health advantages in France. By contrast, Luthra and Platt (2023) found that immigrants' educational selectivity was not associated with their health advantage in the UK.

These inconsistencies could be driven by different factors. First, results could vary because studies have investigated different destination countries. Second, studies have varied in the rigour with which they test the selectivity hypothesis. Florian et al. (2021) compared immigrant–native differences in children's health at birth net of parents' relative *or* absolute education separately, and interpreted differences as the role of selectivity. However, the health impact of parents' relative education (their educational rank at origin) was partly confounded with their absolute education (i.e. their actual academic certificates) and other factors, especially at the country-of-origin level (Engzell 2019). Ichou and Wallace (2019) accounted for this by estimating the impact of parents' relative education net of their absolute education. However, they fitted their models on the full sample of migrants and native born, which may have led to collinearity issues, since absolute and relative education are almost perfectly collinear for the native born (Ferrara and Luthra 2024). Luthra and

Platt (2023) have provided the most stringent test so far by measuring the impact of relative education net of absolute education and country-of-origin fixed effects in a sample of immigrants only. This has been a standard approach in studies of migrant inequalities in educational attainment, where the indicator of educational selectivity was first developed (Ichou 2014; Engzell 2019; Brunori et al. 2020). However, Luthra and Platt (2023) obtained null results using that approach.

We address some of these limitations by investigating the immigrant selectivity hypothesis in a new context and testing it more rigorously. Spain is a relatively recent destination country for immigrants, with a different migrant population and reception conditions compared with France and the UK. Moreover, Spain is an interesting case because of its unexplained immigrant–native gaps in health at birth across outcomes as well as within and across origin countries (Juárez et al. 2017), as we address in this study. We test the selectivity hypothesis more rigorously than prior studies by following the approaches of both Florian et al. (2021) and Luthra and Platt (2023). Moreover, we are able to investigate the hypothesis across immigrants' country-of-birth groups thanks to the large size of our data set. Finally, we address heterogeneity in the impact of educational selectivity across three key dimensions: parental education, income in parental country of birth, and children's birth cohort.

Previous studies on immigrant educational selectivity have shown that its impact on socio-economic outcomes may vary across immigrants' educational attainment and the income level of their origin countries (Ichou 2014; Brunori et al. 2020; Luthra and Platt 2023). However, results are not always consistent, partly because hypotheses on these effects are sometimes contrasting. On the one hand, immigrants from low-income countries or with lower educational attainment may face greater barriers in terms of the extent to which their selectivity can be translated into better health for them and their children. For example, they may face a higher level of discrimination or greater barriers to gaining stable residency status and accessing medical care. On the other hand, relative education could be more impactful for such immigrants because their absolute education is likely to be a poorer indicator of their true socio-economic resources (Heath et al. 2008). This is because the relative value of less prestigious academic qualifications varies more across countries than the relative value of tertiary degrees (Ichou 2014). Furthermore, the value of educational qualifications is likely to vary more within low-income

countries, as they are likely going through fast educational expansions (Luthra and Platt 2023). We test these contrasting hypotheses by investigating whether there is a heterogeneous impact of educational selectivity on birth outcomes across both the educational attainment and country of birth of immigrants.

Another relevant dimension for heterogeneity is immigrants' length of stay. Studies have found that the health advantage of immigrants declines as they spend more time in the destination country, as they may be exposed to socio-economic disadvantage, discrimination, and unhealthy behaviours (Acevedo-Garcia et al. 2010; Giuntella 2017; Riosmena et al. 2017; Ichou and Wallace 2019). Unfortunately, our data lack information on immigrants' time since arrival for testing this hypothesis directly. However, we provide an indirect test by estimating the impact of immigrant selectivity on the health of children born in different time periods (pre-2011 and 2011 onwards). We exploit the fact that the bulk of immigration in Spain started in the 2000s (Juárez and Revuelta-Eugercios 2014) and assume that pre-2011 births will have been mostly to immigrants who had lived in Spain for less than 10 years, while the share of longer-staying immigrant parents will be higher among births from 2011 onwards. We therefore expect a larger impact of educational selectivity on health at birth for pre-2011 births.

Data and methods

Data

We use Spanish vital statistics data from the Spanish Statistical Institute (Instituto Nacional de Estadística; INE), covering all births in Spain between 2007 and 2019 ($N = 5,629,620$). From these, we exclude multiple births and stillbirths (2 per cent of the sample), births outside Peninsula Spain (1 per cent of the sample), and teenage births (2 per cent of the sample). We exclude cases with missing information on any of our explanatory or control variables (9 per cent of the sample). Out of the remaining cases, about 5 per cent are missing birthweight and 15 per cent are missing gestational age. We define separate analytical samples for the two outcome variables (birthweight: $N = 4,729,762$; gestational age: $N = 4,190,996$).

To address missingness in gestational age, we ran some robustness checks using a variable imputing preterm births (provided by INE). We refrained

from using this variable in our main specifications because it does not impute post-term births, which vary by migration background (as shown later). Results were robust and are available on request.

To build our measure of relative education, we use the Barro–Lee data set, which comprises the distribution of educational attainment in the adult population by sex and five-year age group in 146 countries from 1950 to 2010 (Barro and Lee 2013).

Measures

We study two indicators derived from distributions of birthweight and gestational age. The first identifies LBW babies (birthweight < 2.5 kg), HBW babies (birthweight > 4.5 kg), and babies with birthweight lying between these two extremes. The second indicator identifies preterm births (henceforth PTBs; gestational weeks < 37), post-term births (gestational weeks > 41 ; POTBs henceforth), and babies born at gestational ages between these extremes. We follow this approach to identify a reference category (i.e. normal weight or term) that excludes both extremes of the weight or term distribution, in line with prior Spanish studies (Juárez and Revuelta-Eugercios 2014).

Our main independent variable is children's migration background, based on whether their parents are international immigrants (i.e. foreign-born). We define four groups based on parents' country of birth: native-origin children (with two Spanish-born parents); 2.5-generation children with a foreign-born father (and a Spanish-born mother); 2.5-generation children with a foreign-born mother (and a Spanish-born father); and second-generation children (with two foreign-born parents). We also define a variable detailing parents' specific country or region of birth. We identify the 15 most common birth countries in our sample (covering about 75 per cent of the sample of migrant parents), and we group the remaining observations into six macro regions defined in the Barro–Lee data set. For 2.5-generation children, we assign them the country/region of birth of the immigrant parent. For second-generation children of mixed-origin immigrant couples, we assign the birth country/region of the parent with the higher relative education (in line with Florian et al. 2021), but results are robust to simply assigning the mother's country or region of birth.

Our second set of key variables is parents' *absolute* and *relative* educational attainment. We convert parents' absolute educational attainment into

Barro and Lee's (2013) categories (no formal education, incomplete primary, complete primary, lower secondary, upper secondary, and tertiary education). To build the relative education variable, we match our data with information on educational distributions from the Barro–Lee data set. Following Ichou (2014), we define relative education for each parent as the percentage of individuals from the same country of birth, same sex, and same five-year birth cohort with a lower educational attainment, plus half the percentage of individuals with the same level of education. For Spanish-born parents we follow the same procedure, comparing their educational attainment with the Spanish educational distribution. The measure we obtain is an indicator of individuals' relative education (contextual attainment) in their birth country. In the case of immigrant parents, it also captures their educational selectivity at origin (Ichou 2014; Feliciano and Lanuza 2017). In line with prior studies (e.g. Florian et al. 2021), we apply the dominance criterion for native-origin and second-generation children, using the higher value of the two parents' absolute and relative education, while for 2.5-generation children we always use the relative education of the immigrant parent (Florian et al. 2021). Our results are robust to using both parents' education together and to using maternal education only.

Finally, we create a set of control variables that we include in all our models: the child's sex, birth year, birth month, and whether they were firstborn, and also Spanish province fixed effects, mother's age at birth (20–29, 30–34, 35+), and mother's relationship status (married, single, divorced, widowed).

Table 1 describes our analytical sample of births by children's migration background. Our descriptive estimates suggest a lower prevalence of LBW among second-generation children and 2.5-generation children of a migrant mother and a native-born father. However, all immigrant-origin children are disadvantaged in terms of the other outcomes we consider: they show a higher prevalence of HBW, PTBs, and POTBs. Table 1 also shows some other compositional differences. For example, among babies with at least one immigrant parent, those born to two Moroccan immigrants are the largest group (28 per cent of births). Immigrant mothers are more likely to be younger (aged 20–29 on giving birth), especially those who are partnered with immigrant fathers. Our estimates also show that second-generation immigrant children are strongly disadvantaged in terms of parents' absolute education, while 2.5-generation children are less disadvantaged, especially those with a Spanish-born

father. Among children with two foreign-born parents only 16 per cent have a tertiary-educated parent, against 46 per cent of those with two native-born parents.

The picture is different when we look at parents' *relative education*. We find that immigrant parents' relative education is, on average, higher than 50 per cent, suggesting that they are more educated than the median for comparable individuals in their countries of birth (i.e. they are positively selected in terms of educational attainment). On average, immigrant mothers of 2.5-generation children are more educated than 70 per cent of comparable individuals in their birth countries, while immigrant parents of second-generation children are more educated than 59 per cent of their counterparts. Importantly, in terms of parents' *relative education*, 2.5-generation children are advantaged compared with native-origin children, and second-generation children are only marginally disadvantaged, a major change compared with their disadvantage in terms of *absolute education*. Although immigrants are positively selected on average, Figure S1 (supplementary material) shows that immigrant parents from all national/regional origin groups are drawn from the entire educational distribution.

Methods

We use multinomial logistic regressions and compute average marginal effects (Mood 2010) to model birthweight (LBW and HBW vs normal weight) and gestational age (PTB and POTB vs normal gestational age). We run our first set of analyses on the full sample, estimating immigrant–native gaps in the likelihood of children being LBW, HBW, PTB, and POTB using a series of nested models. We follow the approach proposed in Florian et al. (2021). In Model 1, we estimate gaps net of our set of control variables. In Model 2a, we additionally control for parents' *absolute* educational attainment, whereas in Model 2b we instead control for their *relative* education. We run models comparing native-origin children with immigrant-origin children by migrant generation (2.5 and second generation) or by their country/region of birth. We compute the average marginal effects of having an immigrant background on the likelihood of being born with an extreme birthweight or gestational age and compare them across models, specifically between Models 2a and 2b.

In a second set of analyses, we test the selectivity hypothesis more rigorously, following the approach

Table 1 Descriptive statistics for births in Spain, 2007–19 (percentages)

	Child's migration background			
	Native-born parents	2.5-generation (immigrant father)	2.5-generation (immigrant mother)	Second generation (two immigrant parents)
<i>Parental country/region of birth</i>				
Native	100.0	–	–	–
<i>Country</i>				
Morocco	–	8.5	4.1	28.3
Romania	–	4.3	8.1	13.5
Colombia	–	4.7	8.5	5.3
Argentina	–	9.6	7.2	3.7
Bolivia	–	1.0	2.9	5.0
France	–	10.4	7.5	1.0
China	–	0.3	0.8	4.2
Venezuela	–	4.8	5.4	2.5
Dominican Republic	–	3.5	3.8	2.9
Peru	–	2.5	4.4	3.0
Germany	–	7.6	6.2	0.8
Brazil	–	2.2	5.8	1.7
United Kingdom	–	4.2	3.1	1.3
Paraguay	–	0.4	3.1	1.9
Italy	–	4.6	1.9	0.9
<i>Region</i>				
Latin America and the Caribbean	–	13.4	16.0	13.8
Advanced economies	–	13.8	10.2	1.9
Sub-Saharan Africa	–	2.3	0.3	2.9
South Asia	–	0.7	0.2	2.8
Middle East and North Africa	–	1.2	0.3	2.2
East Asia	–	0.2	0.4	0.6
<i>Birthweight</i>				
Normal	93.5	93.2	93.5	93.3
Low	6.0	6.2	5.6	5.4
High	0.5	0.7	0.9	1.4
<i>Gestational age</i>				
Normal	92.4	91.8	91.5	91.1
Preterm	5.6	5.9	6.1	6.3
Post-term	2.1	2.3	2.5	2.5
<i>Parents' absolute education</i>				
No schooling	0.1	0.1	0.1	1.6
Incomplete primary	0.3	0.4	0.4	6.3
Complete primary	3.6	4.4	3.8	16.7
Incomplete secondary	17.4	17.5	18.6	28.9
Complete secondary	18	21.5	24.4	26.4
Incomplete tertiary	14.1	11.3	11.4	4.3
Complete tertiary	46.4	44.9	41.4	15.8
<i>Parents' relative education indicator</i>	66.8	70.2	69.6	59.0
<i>Female</i>	51.6	51.4	51.6	51.6
<i>Firstborn</i>	53.7	54.8	53.2	42.4
<i>Relationship status</i>				
Married	63.1	51.1	51.7	64.9
Single	33.6	43.0	41.2	32.0
Divorced	3.2	5.7	6.9	3.0
Widowed	0.1	0.2	0.2	0.2

(Continued).

Table 1 Continued.

	Child's migration background			
	Native-born parents	2.5-generation (immigrant father)	2.5-generation (immigrant mother)	Second generation (two immigrant parents)
<i>Maternal age</i>				
20–29	22.7	28.3	28.9	47.0
30–34	40.6	33.9	34.7	30.0
35+	36.7	37.8	36.4	23.0
Number of observations	3,590,855	185,895	221,559	670,415

Source: 2007–19 Spanish vital statistics from the Spanish Statistical Institute (INE).

of prior studies on educational selectivity (Ichou 2014; Engzell 2019; Luthra and Platt 2023). We restrict these analyses to children with one or two immigrant parents and test the role of educational selectivity net of parents' absolute education and other controls. We exclude children with two native-born parents, because parents' relative and absolute education are almost perfectly collinear for this population ($r=0.97$) and should not be considered simultaneously in a regression. The correlation between the two measures is much lower for immigrant parents ($r=0.69$), meaning that regression analyses are suitable.

Using multinomial logistic regressions, we test the impact of parents' relative education (i.e. immigrant educational selectivity) on health at birth in a series of nested models. In Model 3, we include our set of control variables. In Model 4 we additionally include controls for immigrants' country/region of birth as a set of fixed effects and a measure of average years of completed education in immigrants' country of birth. These variables are meant to account for unobserved country-of-birth characteristics related to parental education and children's outcomes. In Model 5, we additionally control for parents' absolute educational attainment. We also ran some additional models accounting for parental occupational attainment, which we refrained from using in the main specification because of the degree of missingness in the data. Results were robust and are available on request.

Third, we run additional analyses to address heterogeneity in the impact of parental educational selectivity in the sample of children of immigrants. We split our sample by parents' highest educational attainment (primary or less, secondary, and tertiary), the income level of their birth countries ('high-income countries' and 'low-middle-income countries', as defined in the Barro–Lee data set), and birth cohort (pre-2011 births and births from 2011 onwards) and run Model 5 separately on each group.

Results

Native-immigrant gaps

We start by reporting estimated immigrant–native gaps in birth outcomes from our multivariate models (Figure 1; see also Tables S1 and S2, supplementary material, for the full list of coefficients). In line with prior evidence from Spain (Juárez and Revuelta-Eugercios 2014), we find that babies born to immigrants are less likely to be LBW but more likely to be HBW than babies with two native-born parents. In contrast with some prior studies, we also find that they are more likely to be PTB and POTB. Overall, we find migrants showing both an advantage (fewer LBW babies) and disadvantages (more HBW babies, PTBs, and POTBs). Migrant advantages and disadvantages are largest for second-generation children, followed by 2.5-generation children with a foreign-born mother, and finally 2.5-generation children with a foreign-born father. Differences are substantively large: in the model including basic controls (M1), second-generation children are between 0.3 per cent less and 1.1 per cent more likely to be in the tails of the birth-weight and gestational age distributions, which correspond to about 15 per cent of the overall prevalence of these outcomes in the population. Overall, a 15 per cent increase or decrease (less than one percentage point in absolute terms) is not a particularly large change. However, it is comparable with other gradients. For example, in terms of LBW, the migrant advantage ranges from half the advantage to the full advantage observed among children of highly educated mothers in the UK, France, Spain, and the US (Cozzani 2023; Panico et al. 2024; Seiz et al. 2024).

Focusing on LBW, we find that the migrant advantage grows significantly when we additionally control for absolute educational attainment (Model 2a). In other words, the IHP is more evident once we account for immigrants' more disadvantaged

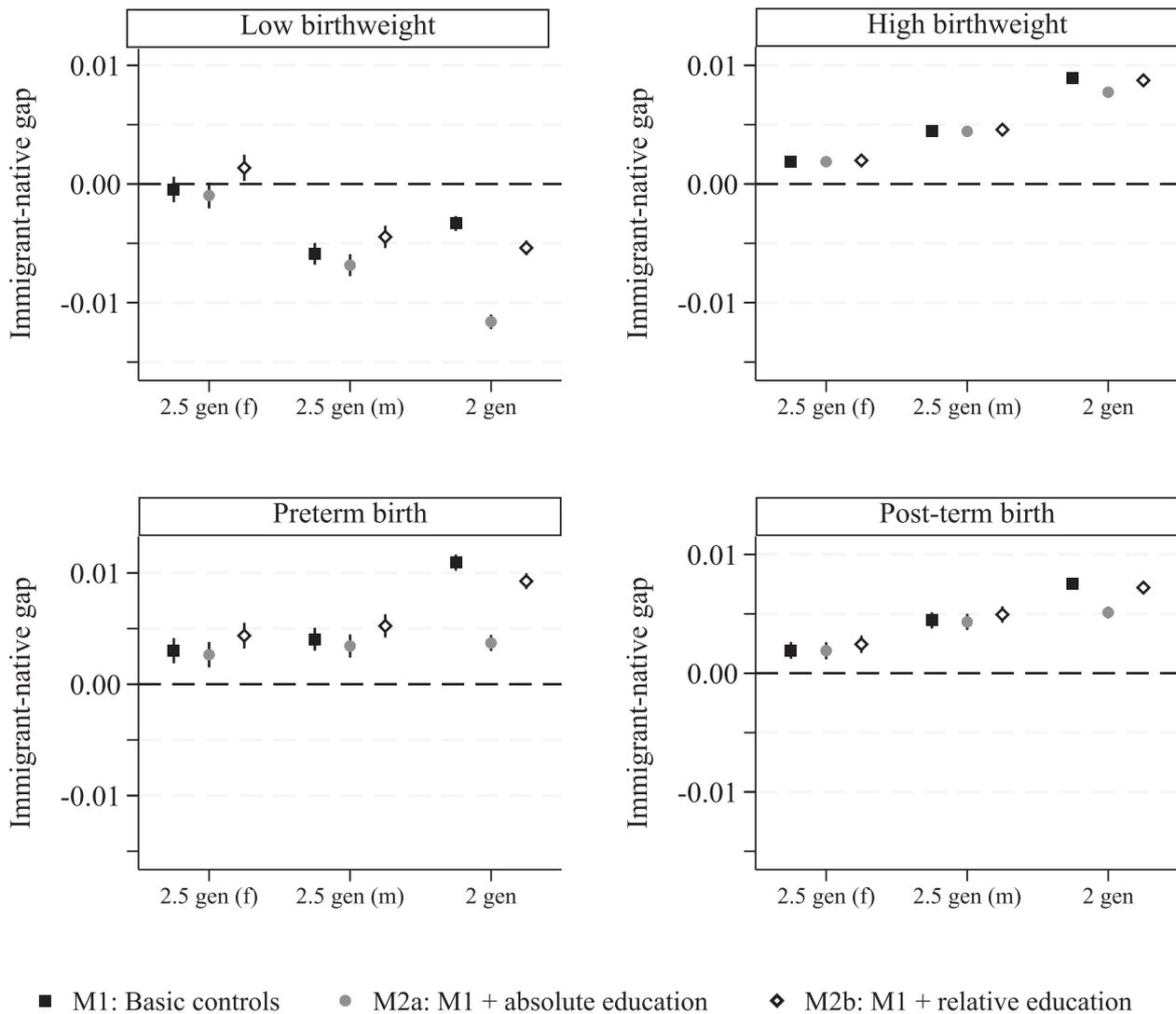


Figure 1 Immigrant–native-origin gaps in health at birth by child’s migrant generation: 2.5-generation and second generation children born in Spain, 2007–19

Notes: The figure shows gaps in the likelihood of low birthweight, high birthweight, preterm, and post-term births compared with the children of two native-born parents (the dashed line). The labels indicate the following groups: ‘2.5 gen (f)’ are 2.5-generation children with a foreign-born father, ‘2.5 gen (m)’ are 2.5-generation children with a foreign-born mother, and ‘2 gen’ are second-generation children (with two foreign-born parents). Estimates and 95 per cent confidence intervals are obtained from multinomial logistic models predicting birthweights and gestational ages at the tails of the distributions compared with middle range values. Model 1 controls for the child’s sex, birth year, birth month, whether they were firstborn, Spanish province of birth, mother’s age at birth, and mother’s relationship status. Model 2a additionally controls for parents’ highest absolute educational attainment. Model 2b controls for parents’ highest level of relative education instead of their absolute educational attainment.

Source: 2007–19 Spanish vital statistics from the Spanish Statistical Institute (INE).

background in terms of absolute educational attainment. For second-generation children, who are particularly disadvantaged, the gap in LBW is approximately tripled between Models 1 and 2a. When we replace parents’ absolute educational attainment with parents’ relative education in Model 2b, immigrant–native gaps are greatly reduced. For second-generation children the gap is more than halved and returns to a similar amount

as in M1, while for 2.5-generation children with immigrant mothers, the gap is even smaller than in Model 1. Absolute education does not capture immigrants’ positive selection in terms of SES, leading us to overestimate immigrant–native gaps in LBW in Model 2a compared with Model 2b. These results suggest that immigrant selectivity explains a significant part of the IHP in terms of LBW.

Figure 1 shows that the second-generation disadvantage in PTB is strongly reduced when controlling for immigrants' disadvantage in absolute education in Model 2a. However, the disadvantage is *increased* relative to Model 2a when we account for parents' relative education in Model 2b, suggesting that selectivity is associated with PTB and that immigrants are especially disadvantaged in terms of PTB, given their educational selectivity (see also coefficients in Table S2). We find that the immigrant disadvantages in HBW and POTB vary only slightly between Models 1, 2a, and 2b, suggesting that these birth outcomes are not strongly influenced by factors related to parental education nor by immigrant selectivity (see also coefficients in Tables S1 and S2).

Next, we present results by parental country/region of birth, from Models 2a and 2b. Figure 2 displays differences in the risks of being born with LBW and HBW between children with native-born parents and second-generation children by parental country of birth. Consistent with prior research, we find significant differences across national-origin

groups, underlining the importance of going beyond broad comparisons between immigrants and the native born. In terms of LBW (left-hand panel), immigrant parents from most national/regional origin groups are significantly advantaged compared with native-born parents when controlling for parents' absolute education (M2a). The children of Bolivian, Chinese, Moroccan, and Peruvian parents are at least two percentage points less likely to be born LBW than the children of two Spanish parents. Children from most immigrant groups from Latin America and the Caribbean and from MENA are also less likely to be born LBW. By contrast, children of immigrants from Sub-Saharan Africa, South Asia, and East Asia are one to three percentage points *more likely* to be born LBW.

When we account for immigrant selectivity by controlling for parents' relative education instead of absolute education (M2b vs M2a), migrant advantages in LBW are largely reduced. This is especially the case for the children of Moroccan immigrants,

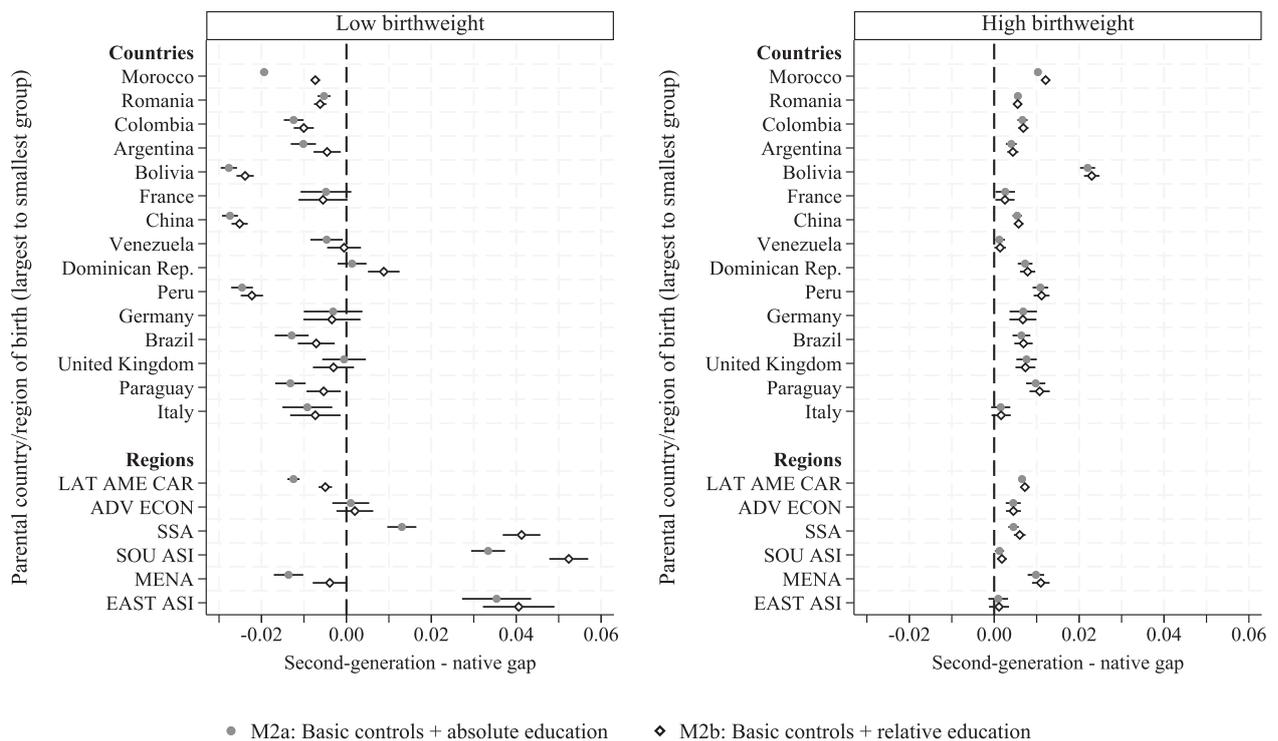


Figure 2 Gaps between second-generation and native-origin children in low and high birthweight, by parental country/region of birth, Spain, 2007–19

Notes: The figure shows gaps in the likelihood of low birthweight and high birthweight compared with the children of two native-born parents (the dashed line). Estimates and 95 per cent confidence intervals are obtained from multinomial logistic models predicting birthweights at the tails of the distributions compared with middle range values. Model 2a controls for the child's sex, birth year, birth month, whether they were firstborn, Spanish province of birth, mother's age at birth, mother's relationship status, and parents' highest absolute educational attainment. Model 2b controls for parents' highest level of relative education instead of their absolute educational attainment. See Table 1 for full names of regions.

Source: As for Figure 1.

who make up almost 30 per cent of second-generation children in Spain (see Table 1) and whose advantage is reduced by about two-thirds. Interestingly, the large advantages of the children of Bolivian, Chinese, and Peruvian immigrants are reduced by much smaller amounts, suggesting that these advantages are less related to parental educational selectivity. Overall, we find that the LBW advantage of children born to most Latin American immigrant groups is to some extent related to parental educational selectivity. By contrast, we find that the LBW disadvantage of children born to Sub-Saharan African and South Asian immigrants is greatly increased when we control for parents' relative education in Model 2b. This suggests that the prevalence of LBW children is remarkably high in these groups, despite them being highly positively selected.

In terms of HBW (right-hand panel), our results suggest that children of immigrant parents show an overall higher prevalence of HBW, which does not

vary greatly across national-origin groups nor by parents' relative (or absolute) educational attainment. The children of immigrants from most groups are between one-half and one percentage point more likely to be born HBW than the children of native-born couples, with some exceptions. For example, the children of Bolivian parents are two percentage points more likely to be born HBW compared with the children of two Spanish-born parents, while the children of French, Italian, and Venezuelan parents display a similar likelihood as the children of Spanish-born parents. We do not find major differences between Models 2a and 2b, suggesting that relative education (or immigrant selectivity) does not significantly impact the risk of HBW.

Figure 3 presents results for preterm and post-term births by country/region of birth. Starting with PTBs (left-hand panel), in Model 2a, we find that children only of immigrants from Italy, Morocco, and the MENA region are less likely to be born preterm compared with children of two

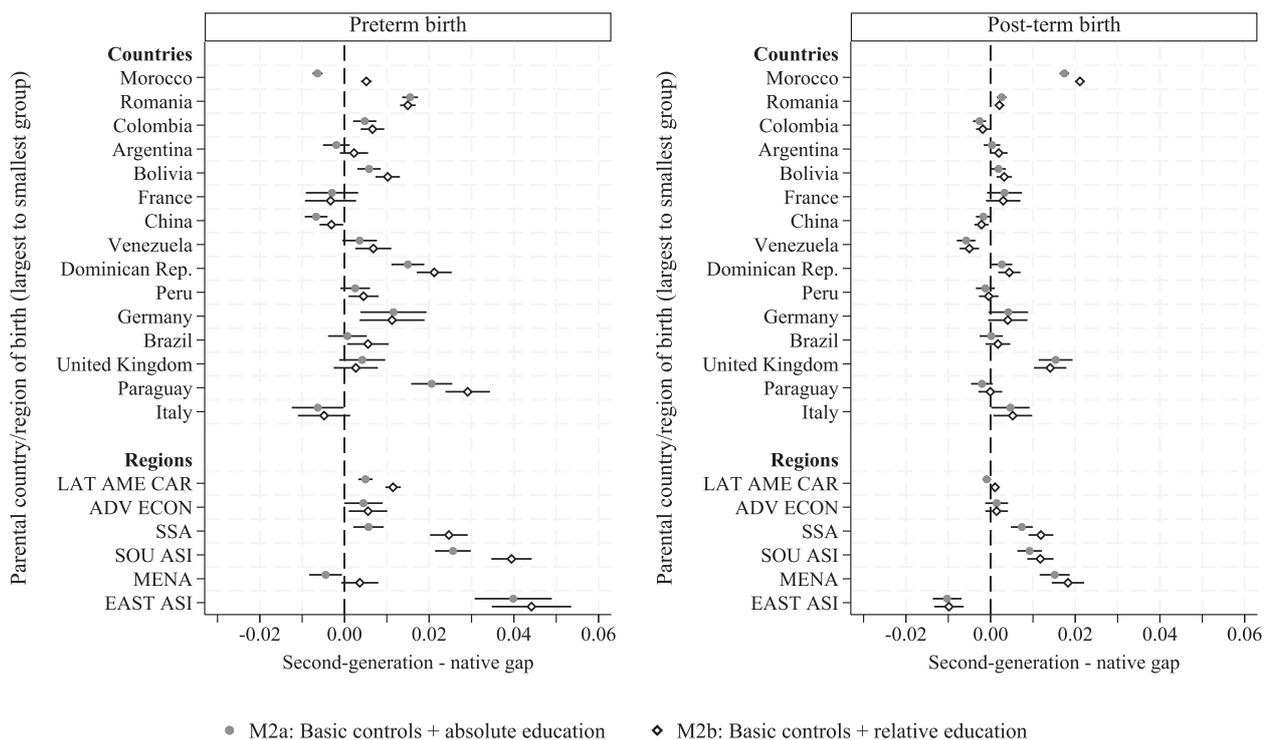


Figure 3 Gaps between second-generation and native-origin children in preterm and post-term births, by parental country/region of birth, Spain, 2007–19

Notes: The figure shows gaps in the likelihood of preterm births and post-term births compared with the children of two native-born parents (the dashed line). Estimates and 95 per cent confidence intervals are obtained from multinomial logistic models predicting gestational age at the tails of the distributions compared with middle range values. Model 2a controls for the child's sex, birth year, birth month, whether they were firstborn, Spanish province of birth, mother's age at birth, mother's relationship status, and parents' highest absolute educational attainment. Model 2b controls for parents' highest level of relative education instead of their absolute educational attainment. See Table 1 for full names of regions.

Source: As for Figure 1.

Spanish-born parents. Our results from Model 2b suggest that this advantage is explained by parental educational selectivity, since all three estimates are reduced to statistically non-significant or actually reversed in sign when we control for parents' relative education. However, for most other groups, there is no major difference between Models 2a and 2b. In terms of POTBs (right-hand panel), most groups display a similar risk to the children of native-born parents. However, children of immigrants from Morocco, the UK, Sub-Saharan Africa, South Asia, and the MENA region are more likely to be born post-term than children of two native-born parents. There are only slight differences between Models 2a and 2b, suggesting no major role of immigrant selectivity across groups.

Results for birthweight and gestation by national/regional origin for 2.5-generation children, presented in Figures S2 and S3 (supplementary material), are similar but are less marked and less precisely estimated than those for second-generation children.

Testing the selectivity hypothesis for the children of immigrants

Next, we report on our more rigorous test of the selectivity hypothesis within the sample of children of immigrants. Figure 4 reports the estimated impact of a 10-percentage-point increase in immigrant educational selectivity on the likelihood of our four health outcomes across a series of nested models. Estimates from Model 3 show that immigrants' educational selectivity is associated with better health at birth for their children. The effect is largest for LBW and PTB: a 10-percentage-point increase in immigrant selectivity is associated with an approximately 0.2-percentage-point reduction in the likelihood of a child being LBW or a PTB. This is a substantively large effect, since the gap in the likelihood of LBW between native-origin and second-generation children is about 1.2 percentage points (see Model 2a in Figure 1). The effect is also significant for HBW and POTB but with a reduction of only around 0.05 percentage points. Estimates are robust to the inclusion of country-of-birth fixed effects and controls in Model 4.

However, as predicted, controlling for parents' absolute education in Model 5 reduces the estimated impact of immigrant selectivity significantly across all outcomes. The associations with PTB and HBW become statistically non-significant, which does not support the selectivity hypothesis for these

outcomes. The impact on POTB is barely significant at conventional levels and is quantitatively small. By contrast, the impact of educational selectivity on the likelihood of LBW remains statistically significant and substantively large: a 10-percentage-point increase in selectivity is associated with an 0.11-percentage-point reduction in the likelihood of LBW. Overall, our findings suggest that immigrants' educational selectivity strongly reduces the risk of a child being LBW, over and above parents' absolute educational attainment, but we find scarce evidence for the other health outcomes.

The heterogeneity of immigrant selectivity: Education, income level of country of birth, and birth cohort

Finally, we investigate heterogeneity in the impact of educational selectivity and report results in Table 2. We find that the impact of selectivity on LBW is statistically significant and substantially large only for immigrants with lower educational attainment (especially primary education or less) and from less developed countries. This is consistent with the hypothesis that relative education may be a stronger health predictor for these groups of immigrants because absolute education is a relatively weaker measure of their actual resources and selectivity. We also find that the impact of immigrant selectivity on reducing LBW is more than twice as large for pre-2011 births as for births from 2011 onwards (statistically significant difference), which is in line with our hypothesis based on immigrants' unhealthy assimilation and the reduced protective value of selectivity with time in the destination country. The impact of selectivity on the other three outcomes is mostly statistically insignificant or small.

Conclusion and discussion

A health advantage has often been found for immigrants and their descendants, especially in Anglo-Saxon countries (Giuntella 2017; Markides and Rote 2019; Luthra et al. 2020). The European literature on the topic is inconclusive, especially when it comes to the health of *children* of immigrants (Milewski and Peters 2014; Juárez et al. 2017; Florian et al. 2023). Moreover, although this immigrant health advantage is often attributed to immigrants' positive selection at origin, this theory is rarely tested empirically (Feliciano 2020). We used data for all births in Spain to

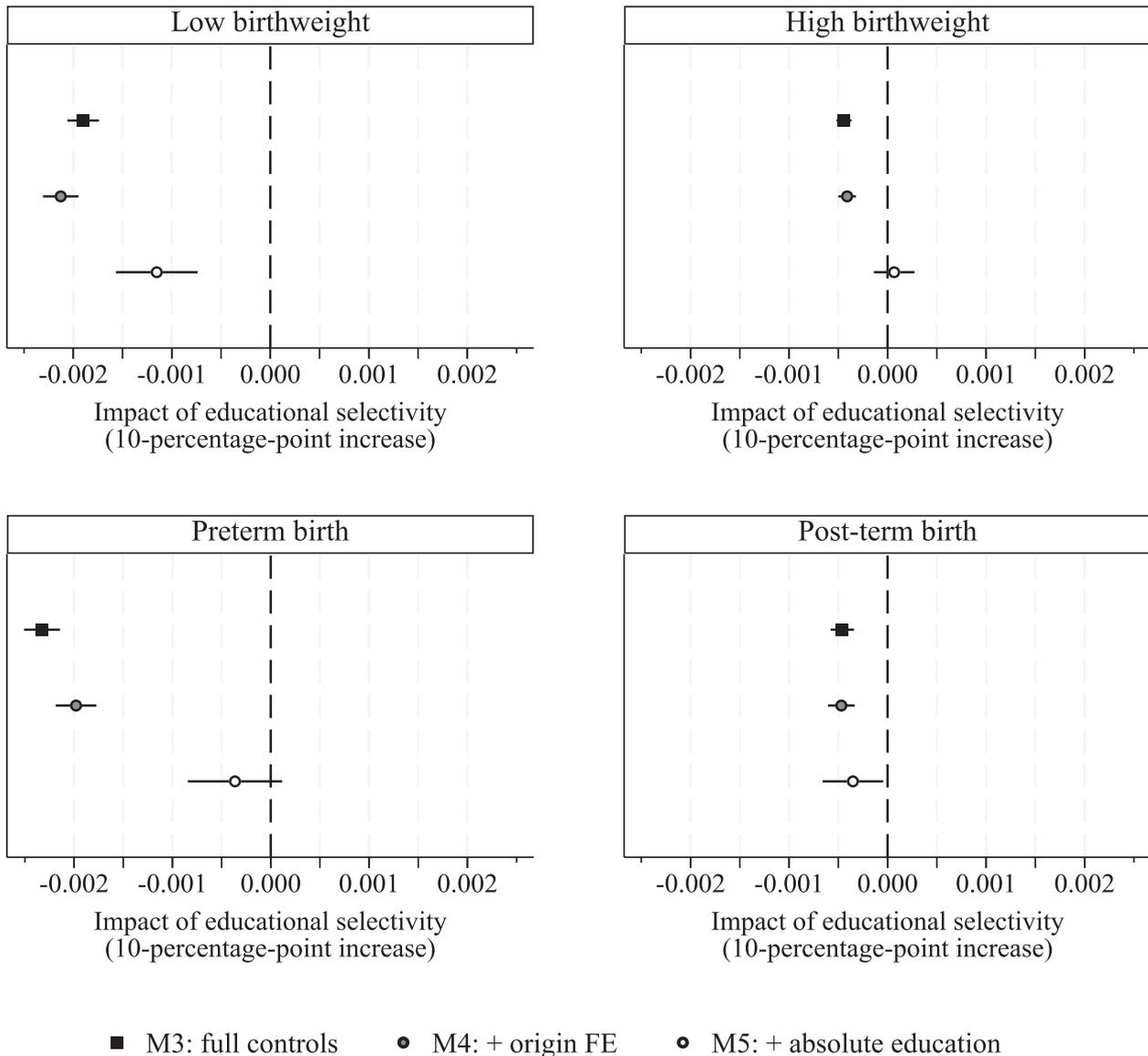


Figure 4 Estimated impact of immigrants' educational selectivity on second- and 2.5-generation children's health at birth, Spain, 2007–19

Notes: Figure shows estimates and 95 per cent confidence intervals from multinomial logistic models predicting birthweights and gestational ages at the tails of the distributions compared with middle range values in the sample of 2.5- and second-generation children. Model 3 estimates the impact of a 10-percentage-point increase in educational selectivity net of the child's sex, birth year, birth month, whether they were firstborn, Spanish province of birth, mother's age at birth, mother's relationship status. Model 4 additionally controls for immigrants' country/region of origin as a set of fixed effects (FE) and a measure of average years of completed education in immigrants' country of origin. Model 5 additionally controls for parents' highest absolute educational attainment.

Source: As for Figure 1.

investigate immigrant–native gaps in health at birth and to test the role of immigrant educational selectivity in explaining these gaps.

Our results show mixed evidence of an immigrant paradox in health at birth. In line with other studies on European countries, we found outcome- and origin-specific immigrant–native gaps in health at birth (Juárez and Revuelta-Eugercios 2014, 2016; Milewski and Peters 2014; Stanek et al. 2021). On

average, the children of immigrants were less likely to be born LBW but more likely to be born with disadvantageous outcomes in terms of HBW, PTB, and POTB. When we accounted for parents' absolute educational attainment, the advantage of having migrant parents was especially large in terms of LBW, but the other disadvantages persisted. In other words, we found evidence of an IHP only in terms of LBW. However, there was significant

Table 2 Heterogeneity in the impact of immigrants' educational selectivity (10-percentage-point increase) on health at birth by parents' absolute education, birth-country income level, and children's birth cohort, Spain, 2007–19

	<i>By parental educational attainment</i>			<i>By birth-country income level</i>		<i>By children's birth cohort</i>	
	Primary or less	Secondary	Tertiary	High income	Low–middle income	Pre-2011	2011 onwards
Low birthweight	–0.0018**	–0.0008**	–0.0005	–0.0001	–0.0008***	–0.0019***	–0.0007**
	(–2.92)	(–2.66)	(–0.70)	(–0.20)	(–3.49)	(–5.29)	(–2.93)
High birthweight	0.00001	–0.0001	0.00043	–0.0006*	0.0001	0.0002	–0.0001
	(0.02)	(–0.91)	(1.47)	(–2.36)	(0.49)	(1.36)	(–0.02)
Preterm birth	–0.0009	–0.0006	0.0014	0.0001	–0.0002	–0.0013*	–0.0003
	(–1.16)	(–1.73)	(1.88)	(0.15)	(–0.62)	(–2.30)	(–0.88)
Post-term birth	0.0006	–0.0002	–0.0003	0.0003	–0.0004*	–0.0004	–0.0003
	(1.06)	(–0.85)	(–0.56)	(0.65)	(–2.35)	(–1.29)	(–1.63)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Notes: Table shows estimates and t -statistics from multinomial logistic models predicting birthweights and gestational ages at the tails of the distributions compared with the middle range in the sample of 2.5- and second-generation children. All models control for child's sex, birth year, birth month, whether they were firstborn, Spanish province of birth, mother's age at birth, mother's relationship status, and parental educational attainment.

Source: As for Table 1.

heterogeneity across national-origin groups. For example, we found that children of immigrants from Sub-Saharan Africa, East Asia, and South Asia were significantly *more likely* to be LBW than children with Spanish parents. Conversely, children of immigrants from China, Morocco, and the MENA region were *less likely* to be PTBs. There was also significant unexplored heterogeneity *within groups*, since children of some migrant groups (e.g. from Sub-Saharan Africa and South Asia) were more likely to be LBW *and* more likely to be HBW.

These patterns have been recognized previously but remain unexplained (Juárez and Revuelta-Eugercios 2014). We addressed this gap by investigating the explanatory role of a commonly cited explanation: immigrant selectivity. We found that immigrants' educational selectivity was strongly associated with a reduced risk of children being LBW, also net of immigrants' absolute educational attainment and country-of-birth fixed effects. This was especially the case for immigrants with lower educational attainment, from low–middle-income countries, and who had had children before 2011 (who we assumed had had a child sooner after their arrival). Selectivity explained a large part of immigrants' advantage over the native born in terms of a lower risk of LBW children, especially for immigrants from Morocco, MENA, and Latin American countries. However, some migrant groups were highly disadvantaged in terms of LBW, despite their overall high selectivity.

Educational selectivity was weakly associated with other birth outcomes and moderately associated with lower risks of PTB for some immigrant groups. However, these associations were not robust to controlling for parents' absolute education.

Our findings partly support the immigrant selectivity hypothesis and corroborate evidence from prior studies (Florian et al. 2021). However, in line with other studies they also challenge its universality and underline the need for it to be nuanced in future research (Martinez et al. 2015). On the one hand, we found a robust relationship between immigrant educational selectivity and LBW and can confirm that this association explains part of the immigrant advantage in LBW in Spain. On the other hand, we were able to test the selectivity hypothesis in detail and show that it may not be supported across all birth outcomes and immigrant groups. This is a major contribution of our work.

We found that selectivity was a stronger predictor of lower LBW for children of immigrants with lower educational attainment and from low–middle-income countries: an encouraging result for the intergenerational reduction of inequalities. However, we also found that some groups that were highly positively selected in terms of education (e.g. Sub-Saharan African and South Asian immigrants) experienced some of the worse health outcomes for their children, including for LBW. This suggests that for some groups, the benefits of selectivity may be offset by larger health disadvantages due to discrimination, adverse living conditions, and other

barriers (Finch and Vega 2003; Gee et al. 2009; Lersch 2013). Individual-level selectivity may also be offset by group-level habits and health practices, as proposed by the so-called ‘cultural hypothesis’ (Fenelon 2013; Riosmena et al. 2017). Unfortunately, our data did not include enough information to test the selectivity hypothesis against the cultural hypothesis.

Beyond LBW, selectivity did not predict differences in other birth outcomes, especially when we tested its impact net of parents’ absolute education. This is in line with prior studies documenting outcome-specific effects of immigrant selectivity (Martinez et al. 2015; Feliciano 2020). Our results suggest that educational selectivity may be more related to mechanisms linked to LBW. Previous studies have shown that the relationship between parents’ relative education and LBW is mediated by maternal smoking and drinking during pregnancy (Florian et al. 2021). We propose that similar intervening variables are operating in the Spanish case. The literature on perinatal health suggests that the risk factors and health behaviours associated with macrosomia and gestational age could be different from those for LBW, and in general they are much less studied and understood (Torche and Conley 2016). Moreover, a recent study showed that the risk of macrosomia was not related to migrant mothers’ length of stay in the destination country (Dello Iacono et al. 2024), suggesting that selectivity is an unlikely determinant. However, given the limited literature on this topic, we call for further investigation into the association between migrant status and HBW. The link between immigrant selectivity and these factors could not be addressed in our study due to a lack of data on potential mechanisms.

Beyond the lack of data to test mechanisms in greater detail, our study was affected by other limitations. First, missing gestational age and the fact that this missingness was more likely for the children of immigrants could have affected our results. We addressed this issue by running robustness checks with imputed information on preterm births from the Spanish vital statistics, and our results were robust. Missingness in birthweight was much less common and less concerning for our results. Second, we lacked information on immigrants’ age at arrival and were only able to provide suggestive evidence that the protective effect of selectivity dissipated with immigrants’ length of stay. Third, our study investigated the role of immigrant selectivity only in terms of education, although other dimensions could be addressed: for example, immigrants’ health selection at origin. However, educational

selectivity is likely to be correlated with selectivity in terms of health and other socio-economic resources (Jasso et al. 2004; Ichou 2014). Future research should also aim to address immigrants’ health selectivity directly, through improved data collection efforts in sending countries.

We have shown that the impact of immigrants’ educational selectivity has a wide reach, also affecting the health at birth of their children, including in less established immigrant-receiving countries. However, immigrant selectivity does not affect all outcomes and groups equally, and future research should further explore these differences and investigate additional mechanisms behind immigrant-native differences in health.

Notes

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Disclosure statement

No potential conflict of interest was reported by the authors.

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