The social gradient in infant health from a couple-level perspective: Revisiting the heterogamy penalty hypothesis

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Abstract

This study examines the consequences of educational assortative mating for infant health. Although the positive relationship between maternal education and infant health is well-established, less is known about the impact of both parents' absolute and relative education. Yet, the heterogamy penalty hypothesis suggests that couples with dissimilar educational status face greater stressors than their homogamous counterparts, potentially resulting in unequal gestational outcomes between pairings. Using Austrian birth register data (N=455,191 singleton births; n=355,119 different-sex couples), we apply Diagonal Reference Models to disentangle the independent association of educational dissimilarity with infant health from each parent's educational levels to test this assumption. Results indicate a pronounced couple-level educational gradient, with substantially better birth outcomes among higher-educated homogamous parents, as well as a relatively balanced contribution of maternal and paternal education in shaping infant health. While hypogamy shows no significant disadvantages for infant health, we find hypergamy to be associated with higher risks of excessive birth weight and atypical growth compared to homogamy. However, these heterogamy penalty patterns remain small when compared with the large couple-level gradient. Overall, this study provides new evidence on how parents' educational pairing and combined resources are associated with neonatal health, highlighting a pathway linking couple-level characteristics to early-life health inequalities. The next step in this study is to determine whether these results reflect causal heterogamy effects or endogenous selection processes using an instrumental variable design that addresses non-random selection into heterogamous unions in Austria.

Keywords: Assortative mating; Infant health; Health inequalities; Register data; Austria

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1 Introduction

Infant health, including in-utero development and birth outcomes, is a key life course predictor of cognitive and behavioral child development as well as life-long adult health and socioeconomic outcomes such as educational attainment and labor market income (Aizer et al., 2016; Almond et al., 2018; Baranowska-Rataj et al., 2023; Conley & Bennett, 2000; Gluckman et al., 2008). Understanding the full range of factors that shape birth outcomes is therefore crucial for both population health and the study of social inequalities. Among the socioeconomic determinants of early-life health, parental education has been shown to play a central role in predicting pregnancy and infant health outcomes. The educational gradient in infant health, particularly by maternal education, is well established, with higher maternal education consistently associated with more favorable birth outcomes (Mortensen et al., 2008). However, less is known about the joint impact of both parents' educational levels on infant health. This study, therefore, examines inequalities in infant health outcomes from a couple-level perspective, integrating both the level of education of each partner as well as the partners' educational sorting status.

Educational expansion in recent decades has shifted the educational composition of the population, particularly among women, who became more educated, leading to changing partnership formation patterns driven by the educational sorting into partnerships (Van Bavel et al., 2018). Research has examined how these shifts in educational attainment and assortative mating affect broader social inequalities and the intergenerational transmission of (dis)advantage (Breen & Andersen, 2012; Schwartz, 2013). A key concern is that assortative mating results in an increasing concentration of resources and educational advantages within couples where both partners are highly educated, whereas the opposite occurs for couples in which both partners share low educational attainment, potentially widening gaps between families over time across socioeconomically determined outcomes, including children's health. Despite this, the role of educational sorting in shaping infant health inequalities remains underexplored. Yet, the prenatal environment and, by extension, infant health at birth, are likely to be influenced by the parental educational pairing and partnership configuration beyond each parent's educational level.

Specifically, heterogamous parents, that is, parents with dissimilar education levels, may face greater challenges arising from interpersonal and social tensions linked to mismatched educational backgrounds compared to homogamous couples who share the same educational status and higher levels of congruence (Keizer & Komter, 2015). Such tensions, disagreements, and conflicts, as well as economic or social divergence between partners, may heighten maternal stress, which has been shown to affect gestational development and birth conditions (Aizer et al., 2016; Hobel, 2004; Hobel et al., 2008). Because these dynamics are more likely in heterogamous couples, it is understood that there is a *homogamy premium* and *heterogamy penalty* in birth-related outcomes, hypothesized to (at least partially) originate from differing levels of persisting maternal stress across parental educational pairings (Butler & Behrman, 2007). Additionally, following normative arguments, this negative pathway should be particularly pronounced among hypogamous pairings (she has higher education than he), as these challenge established gender-based educational dominance. This may incur greater psychosocial penalties, leading to higher *hypogamy costs* within the heterogamy penalty.

To date, only very few studies have examined the association between assortative mating and infant health outcomes, with diverse analytical approaches and mixed findings. Although homogamy is generally found to be beneficial for infant health, it is still unclear whether that is in contrast to the disadvantageous effects of either hyper- or hypogamy, or both, as methods and conclusions differ across studies (Abufhele et al., 2022; Pesando, 2022; Rangel & Rauscher, 2024; Rauscher, 2020). Moreover, prior research has not systematically differentiated between the effects of each parent's *absolute* level of education and their *relative* educational standing within the couple. This shortcoming stems from the methodological limitations of conventional regression approaches that do not allow partners' educational sorting configuration to be isolated from their individual educational attainment due to the linear dependencies between these three components (i.e., the educational pairing is defined by his and her education). As a result, the model estimates tend to conflate the impact of parental educational sorting with that of educational attainment by omitting one of the three interdependent factors for statistical operability, leading to inaccurate conclusions. Consequently, it remains unclear whether the observed effects of educational homogamy and heterogamy reflect the (mis)match between partners' education levels or are rather driven by one or both parents' education.

This study addresses this limitation by employing Diagonal Reference Models (DRMs) to analyze the association between parental educational sorting and infant health. Originally developed in social mobility research to separate mobility effects from origin and destination status, DRMs have been established as the best way to separate the distinct effects of two dyadic characteristics and the difference between them (Eeckhaut et al., 2013; Sobel, 1981, 1985; van der Waal et al., 2017). DRMs disentangle the effect of educational sorting from each partner's educational level by modeling outcomes as a non-linear weighted combination of maternal education, paternal education, and the couple's educational pairing. Additionally, DRMs allow quantifying the relative influence of maternal versus paternal education in predicting infant health within the same model. In demographic research, DRMs have been applied to study how assortative mating is related to fertility (Billingsley et al., 2018; Sorenson, 1989), marital quality and stability (Eeckhaut et al., 2013), division of labor within couples (Eeckhaut et al., 2014; Steiber & Siegert, 2024), as well as couples' well-being (Wang, 2025; Zhao & Sun, 2022). To the best of our knowledge, DRMs have not yet been applied to address questions linking assortative mating with health. In this study, we show how DRMs allow isolating the association between infant health outcomes and assortative mating, net of both parents' actual education.

Using novel, high-quality Austrian birth register data from 2015 to 2021 (N=455,191 births), we first examine how parents' joint educational levels relate to infant health and quantify a couple-level social gradient across a range of indicators, including preterm birth, low birth weight, and asymmetrical intrauterine growth. We apply Diagonal Reference Models to (1) assess the influence of maternal versus paternal education in predicting infant health, (2) disentangle the contribution of each parent's education from the effect of their educational (mis)match to estimate the independent association of educational sorting with infant health, (3) contrast the outcomes of hyper- and hypogamous couples to homogamous couples to assess any unequal effects between these configurations, and (4) compare the size of educational sorting estimates with the couple-level educational gradient to evaluate the relative importance of these two predictors for infant health.

Overall, this study contributes new evidence on how couples' educational pairings shape neonatal health. This question is particularly relevant given the rise in highly educated homogamous and hypogamous couples following women's educational expansion in recent decades (Erát, 2021; Esteve et al., 2016; Han, 2022). If children born in heterogamous – and especially hypogamous – couples face health disadvantages compared to children in homogamous couples, this may lead to widening future health inequalities across the population that need to be taken into account. To approach our research question, we use a recent, register-based dataset covering the whole population within a novel methodological framework. In doing so, our study showcases the use of methods that help disentangle the role of maternal and paternal educational attainment from the educational (mis)match within pairings.

2 Background

2.1 Educational gradient in infant health at the couple level

The educational gradient in infant health is well-documented in previous research. Meta-analyses reveal that the relationship between parental educational attainment and various infant health outcomes is one of the most consistently found associations in the literature on social inequalities in health at birth (Blumenshine et al., 2010). Maternal education is associated with lower risk of low birth weight in different types of welfare states (Panico et al., 2024; Wehby & López-Camelo, 2017), as well as across regions and time periods with diverging institutional setups (Jackson et al., 2022; Paul et al., 2022; Song & Burgard, 2011). While paternal education has been much less studied as a risk of poor infant health, existing studies suggest that, at least in some population subgroups, the role of the father's education may be at least as important as that of the mother (Blumenshine et al., 2011; Breierova & Duflo, 2004).

Less attention has been given to the combined level of parental education, despite the possibility that considering both parents' education may amplify the observed educational gradient in prenatal and birth outcomes. According to Oppenheimer's (1977, 1988) resource pooling model, the expansion of female education and labor force participation has led couples to form with the aim of maximizing and pooling both partners' resources to enhance and stabilize household economic security. The model assumes a preference for symmetrical contributions, whereby both individuals work towards the household's overall advantage and share similar socioeconomic status and access to resources. Following this reasoning, couples in which both partners are highly educated (high-high pairings) have the greatest resource pooling potential, while those in which both partners have low education (low–low pairings) are most limited in their ability to pool resources, placing them at the most disadvantaged position relative to other couple configurations. This implies that homogamous unions can represent either the most or the least economically, socially, and culturally advantaged educational pairing, with heterogamous unions falling in between. These compounded (dis)advantages within union types may translate into corresponding differences in their children's health, shaping the distribution of social inequalities in infant health across parental educational pairings that may be underestimated when not jointly considering parents' education and partnership characteristics.

Additionally, beyond the effects of each partner's level of education and their pooled educational levels *per se*, the degree of educational similarity or dissimilarity between partners (i.e., homogamy vs. heterogamy) may constitute an adjacent but distinct determinant of infant health outcomes (Batyra et al., 2023). The interaction between partners' educational backgrounds may influence pregnancy- and birth-related outcomes through unique social or behavioral dynamics, especially when there is friction arising from status differences. Yet only a few studies have examined the joint effect of both parents' education, as well as aimed to tease out whether specific parental educational pairings affect infant health outcomes.

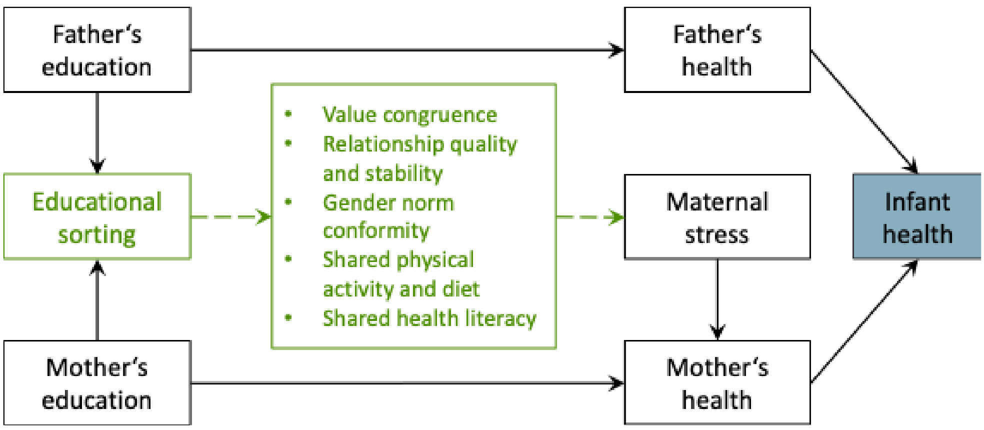
2.2 Educational sorting and infant health outcomes: *Homogamy premium* vs. *heterogamy penalty*

Educational sorting is hypothesized to influence pregnancy and birth outcomes through mechanisms related to maternal well-being, which may differ between homogamous and heterogamous couples. Maternal well-being, and particularly stress, has been shown to affect prenatal and neonatal outcomes negatively (Beijers et al., 2014). Maternal stress can impact the gestational process through neuroendocrine responses. Elevated cortisol levels may trigger the release of excessive corticotropin-releasing hormone (CRH) in the placenta, which can accelerate fetal maturation and stimulate uterine contractions, potentially leading to earlier labor (Hobel, 2004; Hobel et al., 2008; Kramer et al., 2000). The relationship between stress exposure and adverse birth outcomes has been clearly established, but may further depend on the type of stress experienced and the examined outcome. Recent studies have identified causal effects between prenatal exposure to environmental-related stressors, such as natural disasters or large-scale violence (e.g., earthquakes, wildfires, or terrorist attacks), and infant health. However, the effect of such acute stress on low birth weight tends to be fully mediated by gestational age in these studies, suggesting that the main impact concentrates on premature delivery rather than restricted fetal growth (Cozzani et al., 2022; Rauscher & Cao, 2024; Torche, 2011; Torche & Nobles, 2024; Torche & Shwed, 2015).

By contrast, chronic stress may exert more sustained effects throughout gestation. Ongoing stressors, including perceived stress, anxiety, and social strain, may be more predictive of poor infant health outcomes than a singular acutely stressful event (Butler & Behrman, 2007; Kramer et al., 2000). Accumulated psychosocial stress over the course of pregnancy can disrupt hormonal regulation and contribute to unhealthy behaviors, both of which may impair fetal development and nutrition. Such processes may then be more likely to result in poor birth outcomes linked to longer adverse gestational processes, such as low birth weight associated with intrauterine growth restriction (IUGR), as opposed to low birth weight caused by premature birth.

Homogamous and heterogamous couples differ across a range of characteristics that may influence maternal psychosocial stress during pregnancy. Homogamous couples who share similar levels of education and social background are more likely to align in values, attitudes, and lifestyle preferences, and to make decisions collaboratively (Gaunt, 2006; Luo, 2017). This often results in less conflictual, more harmonious and stable relationships and contributes to higher relationship quality and satisfaction (Kalmijn & Monden, 2012; Keizer & Komter, 2015; Schwartz & Han, 2014). In contrast, heterogamous unions may exhibit lower congruence and compatibility, increasing the potential for conflict and tension between partners. Shared educational backgrounds are also associated with greater agreement on health beliefs, behaviors, and practices, such as diet, physical activity, medical visits, and the use of prenatal care. Educational differences, on the other hand, may lead to diverging views on health and pregnancy-related behaviors, which could undermine consistency in health practices and increase stress during pregnancy. Figure 1 summarizes the theorized mechanisms linking educational sorting to infant health through factors potentially affecting maternal stress levels.

Figure 1. Schematic representation of the theorized mechanisms linking educational sorting to infant health



Note: Dashed lines represent the theorized mechanisms related to parents' educational sorting.

Educational dissimilarity may further have uneven implications for maternal stress across the different heterogamous configurations. The rapidly growing prevalence of hypogamy has driven interest in its specific social and economic consequences, with research pointing out the greater disadvantages associated with this pairing. Although recent educational expansions have made hypogamous pairings more common, they still challenge existing gender norms in societies that do not anticipate women having status dominance in different-sex couples more so than other union constellations (Erát, 2021; Esteve et al., 2016). Deviating from this expectation may therefore affect the male partner through perceived threats to his masculinity, while the female partner may face social penalties for 'partnering down' in terms of socioeconomic status. As a result, both partners may experience social disapproval, reduced support, and heightened psychosocial stress. To compensate for this gender norm violation, research suggests that hypogamous women often engage in gender-restorative behaviors, such as avoiding economic dominance, taking on a disproportionate share of domestic labor, or, more symbolically, adopting their husband's surname at higher rates than homogamous women (Bertrand et al., 2015; Eeckhaut et al., 2014; Torche et al., 2025). However, these compensatory strategies can undermine hypogamous women's household bargaining power, require effort, lead to feelings of financial insecurity, and contribute to greater emotional and physical burden (Dribe & Nystedt, 2013; Klesment & Van Bavel, 2017; Potarca & Rossier, 2021), all of which may (in)directly affect birth-related outcomes when such stressors are present during gestation.

In the context of this study, chronic strain and prolonged psychosocial stress are considered key mechanisms through which educational dissimilarity within couples affects maternal and fetal health. As such, hypogamous unions, given the increased exposure to relational, social, and financial strain due to their lower normative acceptance, are expected to be more stressful over time than other configurations. As a result, they may contribute disproportionately to the heterogamy penalty in gestational and birth outcomes. Overall, we anticipate a *homogamy premium* for infant health with a *heterogamy penalty* driven more largely by higher *hypogamy costs* than hypergamy costs.

2.3 Previous research

2.3.1 Summary of previous studies

Taken together, most theoretical arguments point to heterogamous unions presenting disadvantages compared to homogamous pairings, which may be exacerbated within hypogamous couples. To date, few empirical studies have examined the effect of assortative mating on infant health outcomes. The seminal study by Rauscher (2020), using a causal approach to identify educational sorting effects on infant health in the US, finds a small *homogamy premium* for birth weight, prenatal care uptake and visits against a hypergamy penalty in these outcomes. Meanwhile, hypogamy only has very limited effects on poor infant health outcomes. In Chile, Abufhele et al. (2022) find evidence for a *homogamy premium* against hypogamous configurations only, and that this negative association between hypogamy and child outcomes increases in municipalities with high female labor force participation, i.e., in contexts of greater work-life balance penalties for women. Comparing four low- and middle-income countries (LMIC; Ethiopia, India, Peru, and Vietnam), Pesando (2022) finds evidence for the homogamy premium hypothesis for several very-early childhood outcomes in Peru and Vietnam, but homogamy penalties in India and Ethiopia (although estimates for birthweight are not statistically significant, likely due to low data quality), pointing to variations linked to status prevalence, educational expansion, cultural and socioeconomic heterogeneity between LMIC contexts. Similarly, Rangel and Rauscher (2024) find within-country variation in educational sorting effects across racial and ethnic populations in the US, with improved birth outcomes concentrated among homogamous Latin- and Asian-American women compared to hypergamous women.

Overall, previous findings suggest a *homogamy premium* for infant health outcomes. However, whether this beneficial association appears when contrasted to hypo- or hypergamous unions depends on the examined context, limiting evidence on the hypothesized *hypogamy penalty*. In the US, the homogamy premium appears against hypergamy, while it appears against hypogamy in Chile. In LMICs, the existing study only permits concluding that homogamy benefits are present compared to heterogamy (hypo- and hypergamy pooled). However, these existing studies were conducted in national contexts with low state welfare support, which could impact the conclusions that can be drawn from these results so far, as that factor may play a significant role in shaping perinatal health outcomes (Baranowska-Rataj et al., 2024). Moreover, previous studies present methodological limitations that arise when modeling educational sorting effects, which we lay out in the following section.

2.3.2 Methodological gaps and limitations of previous research

Previous research has inconsistently modeled the consequences of educational sorting, largely due to the methodological challenge of disentangling the effect of each partner's level of education from the effect of the educational pairing *in and of itself*. This difficulty arises because the educational pairing is, by definition, a function of both partners' educational levels. As a result, attempting to isolate the net effect of educational sorting from educational level in a conventional linear regression model typically leads to either of two major problems: (a) Model over-identification when estimating educational sorting effects while simultaneously controlling for each partner's education levels. This specification attempts to exploit variation in the pairing to estimate its effect while holding constant the variables that define the pairing itself, which is statistically inoperable; (b) omitted variable bias when estimating educational sorting while holding constant only one partner's education and omitting the other partner's. Although this avoids an over-identified model, it leads to the model conflating the effect of educational sorting with the unmeasured educational level of the other partner. Another option is to construct a compound categorical variable that captures all possible educational pairings (e.g., a 3×3 table of maternal and paternal education levels), which is equivalent to interacting maternal and paternal education to obtain all pairings. However, while this allows both individual education levels and their joint configuration to be present in the model, it still does not resolve the ambiguity about whether observed effects in each category reflect the level of education, the pairing *per se*, or both.

An alternative approach is to use Diagonal Reference Models for modeling educational sorting. Diagonal Reference Models (DRM) were originally developed to address a similar issue in mobility research, given that social mobility is defined by both parental educational attainment (origin social status) and one's own educational attainment (destination social status). Teasing out the effect of the actual social mobility, net of origin and destination effects, was solved by applying non-linear regression models that allowed for the simultaneous inclusion of origin, destination, and mobility components. This is achieved by defining the non-mobile groups (same origin and destination status) as the reference groups to model mobile individuals as a non-linear, weighted combination of their differing origin and destination statuses. That is, applied to educational sorting, homogamous couples (same maternal and paternal education) are set as the reference for each educational attainment level group (e.g., low, medium, high). Consequently, the heterogamous pairings' effect on the outcome is modeled as a weighted sum of the estimated effects associated with his and her respective educational level group. This approach assumes that non-mobile individuals (or, in our case, homogamous couples) form the core of that educational group and accurately reflect its typical characteristics, and can therefore serve as anchors to characterize any other combination. Importantly, the DRM structure allowing the non-linear inclusion of both educational levels as well as the educational difference solves the issue of over-identification and omission bias (all three components can be included, and the model remains identifiable) found in standard regression approaches. An additional feature of DRMs is that the estimated weights of the nonlinear combination of the origin and destination components serve as an indicator of the relative influence of the factors on the outcome. In our application, the weights estimated as a model parameter indicate the relative importance of maternal versus paternal education in predicting infant health at birth.

Yet, despite these advantages, DRMs have rarely been applied to research questions examining the effects of educational sorting and infant health. The existing studies on educational sorting and infant health outcomes have all employed different analytical strategies for educational sorting estimations, each presenting limitations. Rauscher (2020), as well as Rangel and Rauscher (2024), test linear OLS and 2SLS specifications that control for maternal and paternal educational level and specifications controlling for average parental education (in years). This latter specification is also used in Abufhele et al. (2022), while Pesando (2022) includes two dummies indicating whether the mother and father attained secondary education, respectively. As explained above, these strategies cannot disentangle the effects of the levels of educational attainments of parents from the effects of heterogamy, i.e., the difference between the educational attainments of parents (Eeckhaut et al., 2013; Sobel, 1981, 1985; van der Waal et al., 2017). The present study is therefore the first to apply DRM models to examine infant health as an outcome in order to accurately control for both parents' precise educational attainment levels.

2.4 The Austrian context

The Austrian context of this study markedly differs from that of previous studies conducted in the United States and LMICs, particularly in terms of social welfare, population health, and family norms. Austria is a high-income country with a high GDP per capita and comparatively low levels of social inequality. It maintains an extensive welfare state characterized by strong social and income security, and ranks among OECD countries with the highest per capita health expenditure and universal health coverage, including a high physician-to-population density (*OECD Health Statistics*, 2025). A key institutional feature supporting maternal and child health is the *Eltern-Kind-Pass* ('parent–child pass'), introduced in 1974 and subsequently expanded. This program provides free and frequent medical examinations for pregnant women and their children up to the age of five, including early detection and treatment of conditions and monitoring of the child’s developmental progress. Medical examinations during pregnancy (five gynecological check-ups, two ultrasounds, and gestational diabetes screening) and until the child's first 14th months are mandatory in order to receive the full amount of childcare allowance, thereby incentivizing consistent uptake of perinatal health services. As a result of this scheme, along with the large investments in public health systems and universal health care coverage, Austria presents favorable birth and infant health outcomes (Erasun et al., 2021; *WHO Newborn Health*, 2025). In 2022, the infant mortality rate (post-22-week gestation) was 2.2 per 1,000 live births (compared to 4.6 in the United States), overall preterm birth prevalence was 7.3% (10% in the US) of all births, and 6% of live births were classified as low birth weight (against 8.6% in the US).

However, Austria also retains conservative gender norms and family culture. Parental gender roles remain fairly specialized, with strong maternal caregiving expectations, very limited use of parental leave by fathers, and pervasive breadwinner or 1.5-earner models (Berghammer, 2014; *OECD Family Database*, 2025). Despite its advantageous social and perinatal health context, Austria therefore displays persistently low fertility rates (1.3 in 2023; *OECD Family Database*, 2025), comparable with other conservative contexts (e.g., Germany, Switzerland). Within this social context, educational heterogamy, and particularly hypogamy, where women are more educated than their male partners, may have distinct implications for maternal well-being during pregnancy. Specifically, the discrepancy between increasing dissimilar educational pairings driven by rising female educational attainment and the persistence of traditional gender norms may amplify psychosocial stress in non-traditional partnerships, which could in turn affect perinatal outcomes through these pathways more so than in contexts where hypogamous unions are more common and socially accepted (Han, 2022).

3 Methods

3.1 Data

We use Austrian birth register data from 2015 (first available records) to 2021, provided by the Austrian Micro Data Center. The dataset covers the entire population of births during this period and provides a comprehensive set of infant and maternal health indicators as well as family context information (Fuchs et al., 2024). The included medical characteristics of mother and child are assessed and recorded by midwives or hospital staff at the time of birth, along with a range of basic sociodemographic information on the parents (residence, union status and cohabitation, number of previous children). Additional information is obtained through linkage with other administrative registers, including both parents' socioeconomic characteristics. The initial dataset comprises 580,649 live birth observations. We restrict the data to singleton births (N = 563,096) of at least 22 (the earliest viable gestational age) and no more than 43 completed weeks of gestation (N = 559,195). We further limit the data to different-sex cohabiting couples with a registered residence in Austria and complete information on all model variables (case deletion details are provided in the Supplementary Material), resulting in a final analytical sample of 455,191 births from 355,119 distinct couples. Parents who have multiple births during the observation period appear in the sample multiple times, as do individuals who separate and subsequently have a child with a new partner.

Table 1 presents descriptive statistics for all model variables by educational sorting group. In the pooled analytical sample, the prevalence of preterm birth, low birth weight, and small-for-gestational-age is 5.4%, 4.2%, and 9.9%, respectively. These outcomes are slightly less common among hypogamous births. In contrast, excessive birth weight and large-for-gestational-age, at 9% and 9.9%, respectively, are more prevalent among hypergamous births.

Table 1. Sample description by educational sorting

	Educational sorting						Total sample	
	Homogamy		Hypergamy		Hypogamy			
	%/M	(SD)	%/M	(SD)	%/M	(SD)	%/M	(SD)
Parity								
1st child	44		41.9		48.7		45	
2nd child	37.8		37.7		37.1		37.6	
3rd+ child	18.2		20.4		14.2		17.4	
Gender: Girl	48.6		48.6		48.5		48.6	
Age, mother	30.6	(5.0)	30.6	(5.1)	30.9	(4.7)	30.7	(4.9)
Age, father	33.5	(6.0)	34	(6.4)	33.7	(5.9)	33.6	(6.1)
Parental age gap	2.9	(4.4)	3.4	(4.9)	2.8	(4.4)	3	(4.5)
Maternal height (cm)	166	(6.2)	165.7	(6.2)	166.4	(6.1)	166.1	(6.2)
Education, mother								
Compulsory	20.9		47.8				19.9	
Vocational	45		34.7		20.8		35.7	
Secondary	9		17.5		38.9		19.7	
Tertiary	25				40.2		24.7	
Education, father								
Compulsory	20.9				32.5		20.3	
Vocational	45		36.1		51.1		45.1	
Secondary	9		29.7		16.4		15.3	
Tertiary	25		34.3				19.3	
Preterm birth	5.4		5.4		5.3		5.4	
Low birth weight	4.3		4.2		4		4.2	

Small-for-gestational age	10.1	9.8	9.7	9.9
Excessive birth weight	8.8	9.3	9	9
Large-for-gestational age	9.7	10.4	9.9	9.9
N	228,314	89,994	136,883	455,191

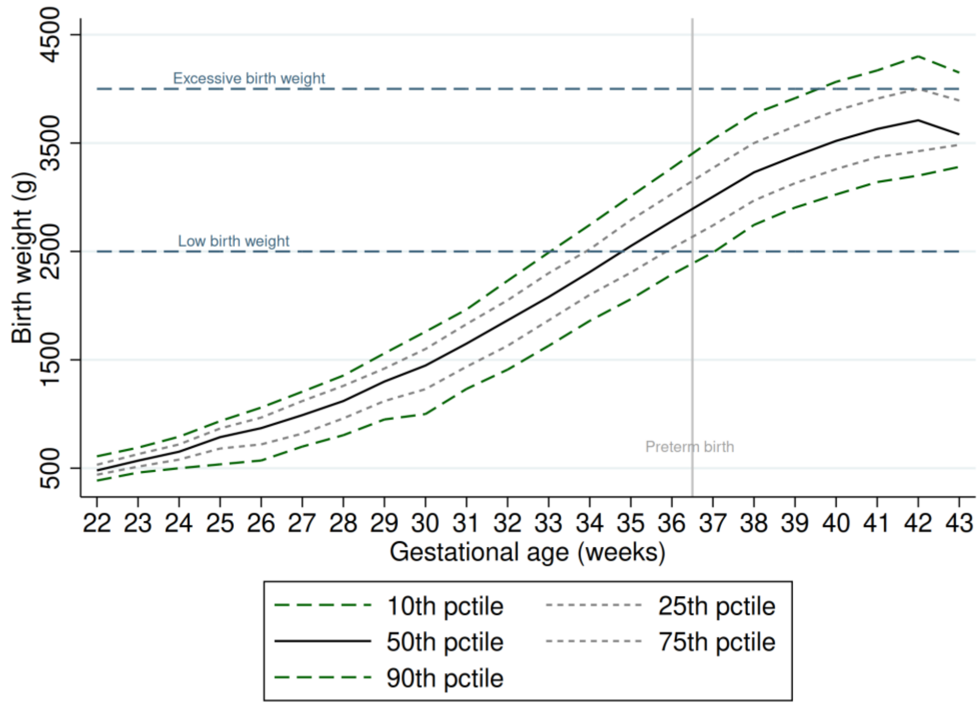
Note: M = Mean, SD = Standard deviation.
Source: Austrian birth registers, 2015-2021.

3.2 Variables

3.2.1 Dependent variables: Infant health indicators

We construct a set of binary indicators of poor infant health, focusing on birth weight- and gestational age-related outcomes, which are commonly used markers shown to be sensitive to disparities in socioeconomic and prenatal conditions and, more specifically, to maternal stress (Hobel, 2004; Hobel et al., 2008; Kramer et al., 2000; Rondó et al., 2003; Torche, 2011). *Preterm birth* (PTB) is defined as a birth occurring before 37 completed weeks of gestation, following the World Health Organization (WHO) definition. *Low birth weight* (LBW) refers to infants weighing less than 2,500 grams at birth, while *excessive birth weight* (EBW) is defined as a birth weight strictly above 4,000 grams (also referred to as macrosomia). However, these absolute cut-off-based measures do not account for gestational age, which may conflate growth-restricted and premature birth outcomes. For example, low birth weight can result from either preterm birth or fetal growth restriction, two conditions that share some overlapping but also distinct biological and social determinants (Butler & Behrman, 2007). To address this, we also construct indicators of *small-for-gestational-age* (SGA, which is also used as a proxy for intrauterine growth restriction) and *large-for-gestational-age* (LGA), defined respectively as birth weights below the 10th percentile and above the 90th percentile of a given gestational week. These measures better account for fetal growth conditional on gestational age and allow us to capture potential intrauterine growth restrictions or excesses that may be distinct from high or low birth weight thresholds. Figure 2 summarizes graphically all five outcome measures.

Figure 2. Infant health outcomes



Source: Austrian birth registers, 2015-2021.
Note: Excessive birth weight refers to weight over 4,000g; Low birth weight refers to births below 2,500g; Preterm birth refers to gestational ages below 37 weeks; 10th percentile refers to the upper threshold of small-for-gestational-age (SGA) infants; 90th percentile refers to the upper threshold of large-for-gestational-age (LGA) infants.

3.2.2 Independent variables: Educational attainment and sorting

We define three predictor variables: (1) *Maternal and paternal education levels*, which are grouped into the following four categories based on the highest achieved completed education at the time of birth: Low (compulsory schooling, ISCED 0–2), Medium-low (vocational training, ISCED 3), Medium-high (post-secondary general and vocational education, ISCED 4–5), and High (tertiary education, ISCED 6–8); (2) a combined variable of *parental educational pairing* resulting in 16 different values (4 maternal × 4 paternal education levels); and (3) a measure of *educational sorting* distinguishing between homogamy (same educational level), hypergamy (father more educated than mother), and hypogamy (mother more educated than father), based on the four educational levels.

Table 2 shows the distribution of the educational pairings for all births in the analytical sample. Half of total births are from homogamous unions, with vocational-vocational couples being the most common pairing (22.6%). Around 30% of births are from hypogamous unions, most frequently involving a mother with secondary and a father with vocational education (9.5%). The remaining 20% are from hypergamous unions, the most common configuration of which is her having completed only compulsory education and him having vocational qualifications.

Table 2. Joint distribution of parents' education

		Maternal education				
		Compulsory	Vocational	Secondary	Tertiary	Total
Paternal education	Compulsory	47,762 10.5%	28,500 6.3%	10,000 2.2%	5,946 1.3%	92,208 20.3%
	Vocational	32,452 7.1%	102,774 22.6%	43,306 9.5%	26,651 5.9%	205,183 45.1%
	Secondary	6,832 1.5%	19,861 4.4%	20,633 4.5%	22,480 4.9%	69,806 15.3%
	Tertiary	3,751 0.8%	11,386 2.5%	15,712 3.5%	57,145 12.6%	87,994 19.3%
	Total	90,797 20.%	162,521 35.7%	89,651 19.7%	112,222 24.7%	455,191 100.%

Note: Cells indicate (i) the number of cases of each pairing and (ii) the overall proportion of that pairing in the analytical sample.
Source: Austrian birth registers, 2015-2021.

3.2.3 Control variables

All models are adjusted for the child's gender and birth order, as well as for the mother's height and age. Adjustment for the child's gender accounts for sex-based differences in birth outcomes, while birth rank accounts for the tendency of firstborns to experience poorer outcomes than later-born children. Maternal height is controlled for due to its association with the infant's length and birth weight, while maternal age is included, given its potential influence on gestational age and the increased risk of adverse birth outcomes among older mothers. We do not control for potential mediators such as household income or each partner's earnings, as we aim to estimate the total effect of education, educational pairing, and educational sorting on infant health, without removing financial and economic pathways linked to these key predictors. All models further include regional fixed effects (at the political district level) to account for systematic inter-regional differences in birth outcomes and education.

3.3 Analytical strategy

3.3.1 Linear probability models

In a first step, we use linear probability models (LPM, linear OLS regression models with a binary outcome) to examine the effect of assortative mating on infant health using different specifications. First, we specify stratified LPMs to examine the effect of educational sorting on infant health outcomes across maternal education groups, i.e., by holding constant maternal education through stratification and assessing the effect of different relative educational pairings on infant health outcomes, omitting paternal education to avoid over-identification. To illustrate the omitted variable bias appearing in this type of specification, we also run this model stratified by paternal instead of maternal education.

Second, we define an LPM to predict the probability of poor infant health across all possible educational combinations (equivalent specification to interacting maternal and paternal education). This specification allows us to estimate a couple-level educational gradient, which we present in heatmaps that show which parental pairings display the lowest/highest probabilities as well as the gradient among homogamous couples. All models are run with family-clustered standard errors.

3.3.2 Diagonal Reference Models

In a second step, we apply a DRM framework (Eeckhaut et al., 2013; Sobel, 1981, 1985; van der Waal et al., 2017). DRMs allow us to determine (a) whether couples' joint education level is a predictor of infant health, (b) *which* partner's education matters most in determining infant health outcomes, and (c) whether there is a significant *additional* effect associated with parental educational dissimilarity, i.e., whether hypergamous and/or hypogamous couples' infant health outcomes significantly differ from homogamous couples (set as the reference) beyond the effect of each parents' education.

We define two DRM models. The first includes only the educational groups of both parents:

$$Y_{ijk} = w \cdot \mu_{ii}^{m} + (1 - w) \cdot \mu_{jj}^{f} + \boldsymbol{\gamma}' \cdot \boldsymbol{X_k} + \epsilon_{ijk} \text{ with } 0 \leq w \leq 1 \text{ and } i, j = 1,\ 2,\ 3,\ 4$$

Where Y_{ijk} is the outcome for each infant k with a mother who has education i and a father who has education j, μ_{ii} and μ_{jj} are the mean scores of infant health outcomes in the homogamous group of educational level i (i.e., the group where both partners have the same education level i) and in the homogamous group of educational level j, respectively. That translates into the homogamous unions being used as the reference group for heterogamous configurations. This is consistent with the fact that homogamy is both the preferred and the most common type of union (51% of all distinct couples in the analytical sample are homogamous). Infant health outcomes are then modeled as the weighted combination of both average scores. The weights are given by the estimated coefficients w and $1-w$ which denote the relative effect strength of maternal and paternal education level on infant health outcomes, based on each of their educational group. For example, in our case, $w \gg 0.50$ (i.e., $1-w \ll 0.50$) means that the mother's education is more strongly predicting infant health than the father's education. In other words, the estimated effect of non-homogamous educational pairings on infant health outcomes is modeled to lie between the averages of *her* and *his* educational reference group.

When educational sorting effects are added to that baseline model, its association with the infant health outcome can be interpreted net of maternal and paternal education levels:

$$Y_{ijk} = w \cdot \mu_{ii}^{m} + (1-w) \cdot \mu_{jj}^{f} + \beta_{ES} \cdot EducSort + \boldsymbol{\gamma}' \cdot \boldsymbol{X_k} + \epsilon_{ijk}$$
$$\text{with } 0 \leq w \leq 1 \text{ and } i,j = 1,\ 2,\ 3,\ 4$$

We determine whether the model benefits from the inclusion of educational sorting by using the Akaike Information Criterion (AIC) to compare model fit between the two specifications. All DRM models are run using the *drm* package in Stata 18.5 MP (Kaiser, 2018).

Note that we use the term 'effect' in this methodological section, as it is the predominant term within the DRM framework. However, the Diagonal Reference Model estimates (partial) associations between educational sorting and infant health outcomes, but cannot identify causal effects (Breen & Ermisch, 2024). The term 'effect' should therefore be read in that context, and we revert to non-causal language for results interpretation.

4 Results

4.1 Results from standard linear regression models

4.1.1 Educational sorting effects on infant health outcomes across stratified parental educational groups

Table 3 presents the results from OLS linear probability models estimating the association between educational sorting, stratified by maternal educational group (Model A) and by paternal educational group (Model B). This approach illustrates the inconsistent results obtained when fixing only one parent's educational level to avoid an over-identified specification. Full results tables are shown in the Supplementary Material.

When women's education is held constant (Model A), hypergamy is generally not associated with better infant health outcomes compared to homogamy, indicating no clear advantage of upward educational pairing except among women with vocational education (the largest subgroup) where hypergamy is linked to lower probabilities of preterm birth, low birth weight, and growth restriction (i.e., small-for-gestational-age, SGA). In contrast, hypogamy is either unrelated or negatively associated with infant health, particularly for excessive birth weight (EBW) and large-for-gestational-age (LGA). Among tertiary-educated mothers, these detrimental associations are especially pronounced, suggesting that the higher the mother's educational attainment, the more negative the implications of hypogamy tend to be.

However, when we hold fathers' education constant (Model B), the associations between educational pairing and infant health reverse. Hypergamy shows no or adverse associations with all outcomes compared to homogamous unions, whereas hypogamy is linked to more favorable outcomes across most birth indicators, particularly among lower-educated fathers. These reversed patterns of hypergamy and hypogamy, compared to the models stratified by maternal education, suggest substantial omitted variable bias that is captured by the educational sorting variable. In other words, whether the mother's or the father's education is used as the anchor, hypergamy tends to appear beneficial when it implies having a more educated partner, while hypogamy appears detrimental when it indicates having a less educated partner. This suggests that the estimated negative effects (relative to homogamy) reflect a combination of both the impact of one partner's unmeasured lower educational attainment as well as (potentially) the effect of heterogamy *per se*.

Table 3. Results from linear probability models predicting poor infant health outcomes by educational sorting stratified by maternal and paternal education levels

		Model A: Stratified by maternal education		**Model B: Stratified by paternal education**	
		Homo vs.		Homo vs.	
	Education strata	Hyper	Hypo	Hyper	Hypo
Preterm birth	Compulsory	0			-0.005**
	Vocational	-0.009***	0.002	0.004**	-0.007***
	Secondary	-0.004	0.002	0.002	-0.003
	Tertiary		0.002	0.003	
Low birth weight	Compulsory	0			-0.005**
	Vocational	-0.010***	0.002	0.006***	-0.010***

	Secondary	-0.001	0.002	0.003	-0.003
	Tertiary		0.003*	0.004**	
Small-for-gestational age	Compulsory	-0.002			-0.005*
	Vocational	-0.011***	-0.001	0.004*	-0.013***
	Secondary	0.003	0.007**	0.009***	0.003
	Tertiary		0.001	0	
Excessive birth weight	Compulsory	-0.001			0
	Vocational	0	0.007***	0.004*	0
	Secondary	0	0.002	0.004	-0.001
	Tertiary		0.006**	0.004*	
Large-for-gestational age	Compulsory	0			0
	Vocational	-0.003	0.011***	0.008***	-0.003*
	Secondary	-0.001	0.003	0.008**	-0.004
	Tertiary		0.008***	0.008***	

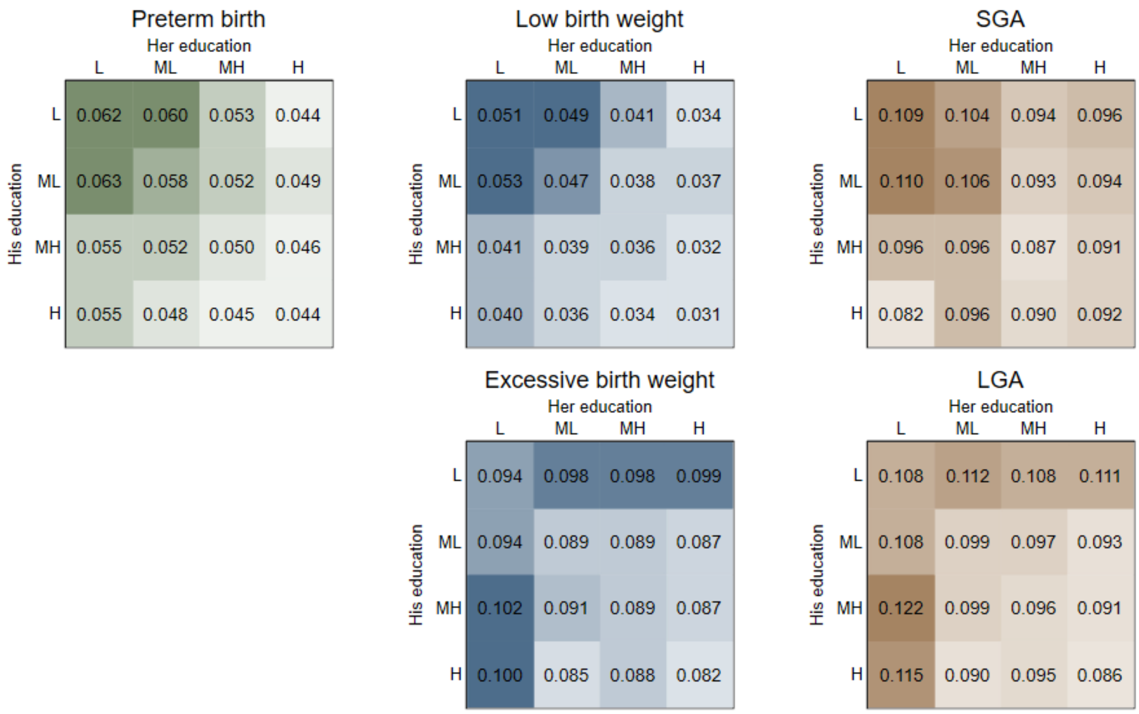
Note: Stratified linear probability models with family-clustered standard errors. Model controls include child gender, parity, maternal age, and maternal height.
Source: Austrian birth register, 2015-2021.

4.1.2 Educational gradients in infant health outcomes across parental educational pairings

Based on OLS models that use the combined variable of parental educational pairing as the main predictor, Figure 3 displays heatmaps of the predicted probability of poor infant health outcomes across the 16 possible educational combinations (with maternal education across columns and paternal education across rows). These heatmaps allow us to visually assess whether systematic patterns emerge in outcome probabilities across heterogamous pairings (values below and above the diagonal represent hypergamous and hypogamous unions, respectively), as well as read off the social gradient in these outcome probabilities across homogamous unions (diagonal values). Higher color intensities reflect higher predicted probabilities of adverse outcomes.

The heatmaps suggest that higher probabilities of adverse birth outcomes are concentrated in the upper left corners, which corresponds to parental pairings with lower education. These patterns are more pronounced for preterm birth, low birth weight, and SGA, while the LGA heatmap suggests higher probabilities across all low-educated groups (among both mothers and fathers), but excessive birth weight (EBW) shows only weak patterns by parental pairing. In terms of homogamous pairings, low-low couples have a 6.2% probability of having a preterm birth compared to 4.4% for high-high couples; the respective probabilities for low birth weight are 5.1% versus 3.1%, for SGA 10.9% versus 9.2%, for EBW 9.4% versus 8.2%, and for LGA 10.8% versus 8.6%. Middle-low and middle-high pairings fall in between these values, which supports that resource pooling leads to low-low homogamous pairings to be the most disadvantaged, while high-high pairings are the least disadvantaged. The size of the gradient between high–high and low–low pairings ranges from 1.2 to 2.2 percentage points, which represents a substantial difference relative to the low overall prevalence of these outcomes. Overall, results show that risks of poor birth outcomes vary along both maternal and paternal education. However, it is not possible to detect any association between homogamy or heterogamy and infant health based on these patterns.

Figure 3. Heatmaps of predicted infant health outcomes by parents' educational pairing



Note: Linear probability models with family-clustered standard errors. Model controls include child gender, parity, maternal age, and maternal height. Vertical = her education; Horizontal = his education. L = Low (Compulsory); ML = Medium-low (Vocational); MH = Medium-high (Secondary); H = High (Tertiary); SGA = Small-for-gestational-age; LGA = Large-for-gestational-age.
Source: Austrian birth register, 2015-2021.

4.2 Results from Diagonal Reference Models

Table 4 shows the DRM results for the specifications without educational sorting (Model A) and with educational sorting (Model B). Full results tables are included in the Supplementary Material. The weight parameters (w and $1 - w$) represent the relative influence of the mother's and the father's education on poor birth outcome probabilities and sum up to 1. Weights close to 0.50 denote an equal influence from each parent's educational level on the outcome. The diagonal intercepts represent the predicted probabilities of each birth outcome among homogamous couples across educational levels. These values then serve as reference points from which the predicted probabilities of heterogamous couples are estimated. In this table, we present the educational gradient of predicted probabilities and test whether these probabilities statistically differ across homogamy levels with the low-low category set as the reference. Educational sorting in Model B indicates the remaining effect of educational differences (either hyper- or hypogamy) between parents compared to homogamy, net of each parent's education.

The baseline model (Model A) shows large educational gradients between the lowest and highest homogamous pairings, which are similar in size to those shown in the heatmaps. They range from 1.4 for EBW (lowest) to 2.6 percentage points of the predicted probability for LGA (highest). In terms of weights, mothers' education is moderately more influential in predicting poor birth outcomes than the father's for preterm birth (w = 0.58), low birth weight (w = 0.59), and SGA (w = 0.59). For EBW, i.e., the probability of weighing more than 4,000g, the father's education plays a larger role ($1 - w$ = 0.60), while both parents' education has equal influence on the probability of the infant being LGA. These patterns suggest that parents' education plays a more balanced role in determining adverse infant health than can be inferred from previous studies (Mortensen et al., 2008).

Model B estimates the association of educational sorting over and above each parent's educational level. The AIC indicates a better fit for low birth weight, EBW, SGA, and LGA in Model B compared to Model A (i.e., lower AIC). Consistent with Model A showing a better fit for preterm birth, we do not find any significant effects of educational sorting for this outcome (β=0.001, p>.05). For low birth weight and SGA, we find statistically significant effects of hypogamy reducing the probability of having a low birth and growth-restricted infant (β=-0.003, p<.05). In contrast, we find that hypergamy significantly increases the probability of having a very heavy (β=0.004, p<.01) and large-for-gestational-age infant (β=0.006, p<.001).

Given the baseline risk of low birth weight at the level of 5.4% and of restricted growth (SGA) at 4.2%, the association of these outcomes with hypogamy amounts to 6% and 7%, respectively. Hypergamy increases excessive growth and birth weight probabilities by 0.6 and 0.4 percentage points, respectively. Relative to the overall prevalence of EBW at 9.9% and LGA at 9%, these effects correspond to 6% and 4% of the average probability of each outcome. Thus, heterogamy contributes to the prevalence of adverse birth outcomes overall but is substantially less sizeable than the effect of joint parental education on outcome probabilities.

4.3 Sensitivity analyses

We replicate the DRM results for different subsamples and model specifications to test the robustness of the association of homo- and heterogamy with infant health (see Supplementary Material for full results). To check for potential bias linked to selectivity in parity progression based on the health outcomes of the first birth (i.e., if only parents of healthier firstborns progress to a second child, and that decision differs between educational pairing types), we run the models for (a) first births only and (b) two-child families only. Results are broadly consistent with the main findings, though some hypogamy coefficients lose statistical significance and slightly weaken for low birth weight and SGA in both restricted samples. We further replicate models controlling for maternal smoking during gestation to adjust for detrimental health behaviors that could mediate the relationship between education, educational sorting, and infant health. These models again show largely comparable results, but the previously observed advantages of hypogamy diminish and become statistically insignificant; no changes for hypergamy.

Finally, we test whether the *degree* of educational difference between partners matters by replacing the three-category heterogamy variable with a two-step measure distinguishing between close (1 level difference) and large (2-3 level difference) heterogamy. Results suggest some effect of educational distance. The protective association of hypogamy disappears for low birth weight while remaining for SGA but is limited to large hypogamy gaps (β=-0.004, p<.05). By contrast, the association between hypergamy, excessive birth weight, and LGA shows a clearer pattern. Close hypergamy (he has 1 education level more than she) increases the probability of excessive birth weight (EBW) by 0.4 percentage points (p<.05) and large hypergamy by 0.7 pp (p<.05). Similarly, close hypergamy raises the probability of LGA by 0.6 pp (p<.01) and large hypergamy by 1.2 pp (p<.001). Large hypergamy also lowers the risk of SGA by 0.6 pp (p<.05), likely reflecting the flipside of increased EBW and LGA.

Overall, these analyses suggest that the adverse association of hypergamy with excessive birth weight and LGA is the most robust finding, while the advantageous effect of hypogamy for low birth weight and SGA appears more inconsistent. This suggests that hypergamy is associated with factors that increase children's birth weight that are unrelated to the actual education of each parent, and that this association becomes stronger the more relative education he has compared to her.

Table 4. Results from Diagonal Reference Models predicting poor infant health outcomes

	Model A: Without educational sorting					Model B: With educational sorting				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
	PTB	LBW	SGA	EBW	LGA	PTB	LBW	SGA	EBW	LGA
Diagonal: Homogamy levels										
Ref: Compulsory										
Vocational	-0.004**	-0.005***	-0.002	-0.008***	-0.013***	-0.004**	-0.005***	-0.002**	-0.008***	-0.013***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	0.001	0.002	0.002	0.002
Secondary	-0.014***	-0.018***	-0.022***	-0.006**	-0.015***	-0.014***	-0.018***	-0.021***	-0.008***	-0.016***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	0.001	0.002	0.002	0.002
Tertiary	-0.019***	-0.021***	-0.017***	-0.014***	-0.026***	-0.019***	-0.021***	-0.017***	-0.014***	-0.026***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	0.001	0.002	0.002	0.002
Weights										
Her education (w)	0.581***	0.590***	0.585***	0.402***	0.504***	0.545***	0.467***	0.510***	0.273	0.383**
	(0.051)	(0.037)	(0.048)	(0.094)	(0.057)	(0.136)	(0.075)	(0.073)	(0.176)	(0.127)
His education ($1-w$)	0.419***	0.410***	0.415***	0.598***	0.496***	0.455***	0.533***	0.490***	0.727***	0.617***
	(0.051)	(0.037)	(0.048)	(0.094)	(0.057)	(0.136)	(0.075)	(0.073)	(0.176)	(0.127)
Educational sorting										
Ref: Homogamy										
Hypergamy						-0.001	0.001	-0.001	0.004**	0.006***
						(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Hypogamy						-0.001	-0.003*	-0.003*	0.002	0.002
						(0.002)	(0.001)	(0.001)	(0.001)	(0.002)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AIC	-65581	-176636	179235	137582	175038	-65579	-176638	179233	137573	175022
N	455,191	455,191	455,191	455,191	455,191	455,191	455,191	455,191	455,191	455,191

Note: Diagonal reference models with family-clustered standard errors. Model controls include child gender, parity, maternal age, and maternal height. PTB = Preterm birth, LBW = Low birth weight, SGA= Small-for-gestational-age, LGA = Large-for-gestational-age. * p<0.05, ** p<0.01, *** p<0.001

Source: Austrian birth register, 2015-2021.

5 Discussion

This study examined the associations between assortative mating with infant health outcomes at birth using Austrian birth register data from 2015 to 2021. The role of educational pairings for birth outcomes is increasingly relevant for population health, given the growing proportion of highly educated homogamous and hypogamous couples following women's educational expansion in recent decades (Esteve et al., 2016; Han, 2022; Pesando, 2022).

The main results of our study can be summarized as follows. First, there is a large social gradient in infant health at the couple level in Austria across all outcomes. For instance, the probability of low birth weight differs by 2.1 percentage points between the highest and the lowest parental education groups (homogamous couples). This represents a very substantial difference relative to the 4.2% overall prevalence. Second, results indicate a balanced role between maternal and paternal education in shaping the association with infant health outcomes. The relative weights of his and her education in determining birth outcomes range at most between 0.40 and 0.60, respectively, and 2-dimensional heatplots show that risks of poor birth outcomes vary along both maternal and paternal education. Taken together, our results call for moving beyond the predominant focus on maternal determinants that often neglects the paternal pathway to infant health inequalities (Rangel & Rauscher, 2021). Third, when contrasting heterogamous with homogamous pairings, we find only small and heterogeneous associations with infant health net of each parent's actual education level. While hypogamy is linked to reduced risks of low birth weight and restricted intrauterine growth (i.e., infants being too small for their gestational age weight distribution), hypergamy is associated with higher risks of excessive birth weight and large-for-gestational-age infants. Neither hypo- nor hypergamy showed any significant associations with premature birth compared to homogamy. When compared with the joint parental educational gradient, the additional independent effect of parental educational pairing appears minimal (e.g., having tertiary educated parents reduces the risk of low birth weight by 2.1 percentage points, while having hypogamous parents reduces the risk by 0.3 percentage points). Sensitivity analyses further suggest that the associations for hypogamy are not always robust to more restrictive specifications. However, the negative associations of hypergamy with infant health persist and may grow larger with increased hypergamous educational gaps between partners. Overall, these results do not align with the expectation that *hypogamy costs* outweigh hypergamy costs within the heterogamy penalty due to greater maternal psychosocial stress, but align with a *homogamy premium* when homogamy is compared to hypergamy.

Our results for Austria align with previous findings from the US, despite the stark differences in maternal and infant health care policy contexts. Similar to Rauscher (2020) and Rangel and Rauscher (2024), we observe hypergamy penalties relative to homogamy, but find weak evidence of some protective effects of hypogamy for low birth weight and restricted fetal growth, as opposed to the clear adverse hypogamy associations reported in Chile (Abufhele et al., 2022). Although exact comparisons are limited by differences in modeling strategies and specifications, our effect sizes are broadly consistent with prior studies. Rauscher (2020), Rangel and Rauscher (2024), and Abufhele et al. (2022) all report very small heterogamy associations with infant health outcomes.

Next to the substantial findings summarized above, our study provides a new methodological contribution. Empirical research on the consequences of assortative mating for infant health has been limited due to the linear dependency between maternal education, paternal education, and their educational pairing (i.e., whether he or she has relatively more or less education). To overcome this challenge, we use Diagonal Reference Models (DRMs), a method developed to handle such dependencies but rarely applied in (infant) health studies so far. By comparing conventional linear regressions with DRM results, we demonstrate the importance of jointly examining both parents' educational attainment level and their educational pairing to disentangle their roles for birth outcomes. Our results illustrate that the use of appropriate methods matters for the interpretation of the results. We show that naïve approaches using standard linear regressions confuse the role of heterogamy with the impact of the unmeasured contribution of the partner's education, making it impossible to assess whether heterogamy p*er se* adds to or reduces the benefits of a couple's educational attainment. In other words, it cannot be conclusively established that heterogamy is negatively linked to infant health, as its hypothetical effects would be blended with the effect of the combination of disparate education levels.

Despite its methodological strengths, our study is subject to the following limitations. First, although DRMs allow us to disentangle the independent associations of parental education levels from their educational pairing configuration, these associations may still be affected by selection bias if individuals self-select into homo- or heterogamous unions based on characteristics that also influence infant health. For example, if there is matching into hypergamous unions based on physical and genetic attributes (e.g., if women selecting into hypergamous partnerships also tend to select taller men) or specific health-related behaviors and preferences (e.g., if individuals selecting into hypergamous unions also tend to prefer richer diets) that affect infant size, this could explain the observed associations between hypergamy and heavier/larger infants. Whether and how selection into heterogamy explains these associations with infant health should be explored in future research within a robust causal framework. Second, while our theoretical background carefully considers diverse mechanisms that could potentially explain the role of assortative mating for infant health, measuring the specific contributions of these mechanisms is beyond the scope of this study due to data limitations. Finally, our study focuses on birth outcomes and does not consider any potential long-term consequences of parental assortative mating for the health of children (Batyra et al., 2023). We acknowledge that the consequences of some forms of family (dis)advantage take time to materialize, hence future research could take a longer-term perspective to examine that crucial aspect.

Our study presents small associations between educational sorting and birth outcomes, which raises the question of whether the observed relationship between assortative mating and infant health is meaningful at the population level. Yet, epidemiological research shows that even small disadvantages at birth can compound over time, as early health conditions interact with subsequent risks across the life course, e.g., high birth weight has been linked to Type II diabetes, among other comorbidities (Gluckman et al., 2008). However, the lack of consistent findings across studies still calls for future clarification to develop clear policy recommendations addressing emerging health inequalities at birth across family types. Nevertheless, this study shows that large social gradients in infant health remain in contemporary Austria across different educational backgrounds, despite its comprehensive health system. Our findings underscore the ongoing importance of identifying couples with limited resources, including low educational resources, to mitigate disadvantages affecting children from less privileged families from birth onwards (Aizer et al., 2016).

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