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Research Article

The Healthy Immigrant Effect: The role of educational selectivity in the good health of migrants

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The Healthy Immigrant Effect: The role of educational selectivity in the good health of migrants

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Abstract

BACKGROUND
The Healthy Immigrant Effect (HIE) refers to the fact that recent migrants are in better health than the nonmigrant population in the host country. Central to explaining the HIE is the idea that migrants are positively selected in terms of their socioeconomic and health characteristics when compared to nonmigrants in their country of origin. However, due to a lack of reliable and comparable data, most existing studies rely on socioeconomic and health measures as collected in the host country after migration and do not actually measure selection.

OBJECTIVE
We directly test selection as an explanation of the HIE among migrants living in France.

METHODS
Using the French Trajectories and Origins (TeO) survey and Barro–Lee dataset, we construct a direct measure of migrants' educational selectivity. We then test its effect on health differences between migrants and nonmigrants using measures self-rated health, health limitations, and chronic illnesses, by fitting logistic regression and Karlson–Holm–Breen (KHB) decompositions.

RESULTS
After demonstrating that migrants in France experience an HIE, especially males, we also show that educational level as measured in the host country cannot account for the HIE. By contrast, we provide important evidence that educational selectivity constitutes a significant factor in explaining health disparities between migrant and nonmigrant populations.

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CONTRIBUTION

Capitalizing on a novel measure of migrants' educational selectivity, we give credit to the oft-cited but rarely tested theory that the HIE is a consequence of migrants' positive selection.

1. Introduction

The Healthy Immigrant Effect (HIE) posits that recent migrants are in better health than the host population and other migrants who have lived in the host country for a long time (Domnich et al. 2012). One of the most intriguing features of this phenomenon is the socioeconomic paradox by which migrants have a lower socioeconomic status (SES) than nonmigrants in the host country, but nonetheless experience a health advantage (Palloni and Arias 2004). Researchers theorize that the HIE and SES paradox could be explained by selection; that is, the idea that migrants are not simply a random sample of their origin population but rather a select group who are healthier, wealthier, and more highly educated than the population they leave behind (Feliciano 2005).

Ideally, to capture this selection, one would compare migrants' characteristics to those of nonmigrants in the origin country just before migration. However, this would require two harmonized national data sources that can follow migrants between countries. Due to these stringent demands, many studies instead compare migrants to nonmigrants in the host country. Such a comparison tells us little about the level and effects of selection into migration. On the contrary, SES as measured in the host country likely underestimates migrants' previous social standing in the origin country (Ichou 2014). Thus, when such characteristics are used to try to explain migrant versus nonmigrant health differentials in the host country, they may actually be exacerbating them.

To rectify this, we investigate the effect of selection on the health of migrants in France using one of the most powerful determinants of health: the level of educational attainment. We use a unique measure previously developed for migrants by Ichou (2014) and recently extended to nonmigrants by Feliciano and Lanuza (2017). This measure of relative educational attainment contrasts an individual's level of educational attainment with that of the population in their country of birth. For migrants, this measure is a direct indicator of their educational selectivity (Feliciano 2005; Ichou 2014; van de Werfhorst and Heath 2018). We examine the effect of this measure on migrant versus nonmigrant differences in three health outcomes (self-rated health, chronic illnesses, and health limitations). We show that relative educational attainment explains a large part of the HIE in France. Our analysis provides strong support for the

often cited but rarely tested expectation according to which the HIE is partly a product of migrants' positive selection.

2. Background

2.1 The Healthy Immigrant Effect (HIE)

The HIE is a widely accepted phenomenon in the social science literature, which has been investigated in (typically) high-income host countries using a diverse range of different health outcomes including – but not limited to – self-rated health (Akresh and Frank 2008; Bostean 2013; De Grande et al. 2014; Dinesen et al. 2011; Newbold 2005; Riosmena, Wong, and Palloni 2013; Vaillant and Wolff 2010), chronic illnesses (Kotwal 2010; McDonald and Kennedy 2004; Newbold 2006), health limitations (Bostean 2013; Hofmann 2012; Thomson et al. 2013; Wallace and Kulu 2014), smoking patterns (Blue and Fenelon 2011; Fenelon 2013; Hosper et al. 2007; Reiss et al. 2014), and all-cause/cause-specific mortality (Abraido-Lanza et al. 1999; Anikeeva et al. 2015; Anson 2004; Boulogne et al. 2012; Deboosere and Gadeyne 2005; Hajat et al. 2010; Palloni and Arias 2004; Razum et al. 1998; Vandenheede et al. 2015; Wallace and Kulu 2015).

A recent review of the migrant health and mortality literature in France (Khlat and Guillot 2017) finds that the HIE is largely limited to studies of mortality. Most of the studies of health are in line with the representation of migrants as vulnerable populations, though there is more evidence of a disadvantage in self-rated health than in chronic diseases or health limitations (Khlat and Guillot 2017). Additionally, an important attenuating effect of duration of stay is often found (Attias-Donfut and Tessier 2005; Hamel and Moisy 2012; Jusot et al. 2009). These patterns are consistent with a systematic review of the Canadian literature (Vang et al. 2017). This convergence is generally interpreted as the "wearing off" of initial positive selection effects, combined with the acculturation to the beliefs, attitudes, and behaviors of the host society with time spent in the host country (Razum 2008).

Lastly, important gender differences were noted in the relative advantage enjoyed by males in contrast to the disadvantage experienced by females (Khlat and Guillot 2017). This is because, traditionally, females move for reasons of family reunification rather than work and so are less subject to selection in the "healthy worker effect" (Khlat and Guillot 2017). Women can arrive as either "dependent" and "independent" migrants that are integrated into the workforce (Llacer et al. 2007). Thus, any interpretation needs to be carefully considered in the context of the country of origin

(gender norms) and year of arrival (given growing female empowerment over time and increasing access to education and the labor market in the origin country).

2.2 Migrant socioeconomic mortality paradox

A closely related phenomenon to the HIE is the so-called socioeconomic paradox in migrant health. It is often referred to as the 'Hispanic paradox' as the paradox was first documented among Hispanics in the United States by Markides and Coreil (1986), and nearly all of the research since has focused on the same origin group (Bostean 2013; Goldman et al. 2006; Kimbro et al. 2008; Markides and Eschbach 2011; Medina-Inojosa et al. 2014; Palloni and Arias 2004; Ro et al. 2016; Ruiz, Steffen, and Smith 2013; Teruya and Bazargan-Hejazi 2013; Turra and Goldman 2007). It describes the seemingly paradoxical situation in which some migrant groups are in similar or better health than nonmigrants even though their socioeconomic status is significantly lower. In one of the few articles not focusing on Hispanic migration to the United States, Zufferey (2016) investigates the SES gradient among migrants aged 25–64 living in Switzerland. Consistent with US research, this study shows that the HIE is strongest in the lowest socioeconomic groups.

One of the most popular explanations of the paradox is that it may arise because migrants are positively selected, but this is not reflected in their comparatively lower SES profiles in the host country (Ichou 2014). Truly understanding health inequalities between population subgroups requires an approach that considers SES throughout the life course (Lynch et al. 1994). This is particularly pertinent for migrants, whose current health is a combination of their previous life experiences in the country of origin and current life situation in the host country (Anson 2004). If we only consider the latter we are ignoring a crucial formative part of the life course in which migrants could have accumulated such high levels of health, generating the paradox in the host country.

2.3 Selection in migration

Selection in migration is a well-established notion that refers to the fact that migrants are not a representative sample of their origin population (Lee 1966), so their characteristics are likely to differ from nonmigrants in their country of birth. The processes that lead to this selection are not fully understood but are believed to occur on several interrelated levels, including self-selection (only certain individuals want to move or have the necessary resources), emigration policies in origin countries, immigration policies in host countries, political and economic conditions in origin and

host countries, and the historical relationship between the two countries (Feliciano 2005).

Migrant selection may occur on many observable and unobservable traits, including – but not limited to – SES characteristics (such as their education level and income) and health. These characteristics are positively associated with one another. People in ill health are less likely to be able to attain a given level of education or skill set, while people who attain higher levels of education or skills are more likely to be efficient health producers (Grossman 1972; Palloni and Ewbank 2004). Expectedly, unobserved characteristics (like being ambitious and forward-looking) are also linked with positive selection on SES and health (Chiswick, Lee, and Miller 2008).

Specifically, the positive association between education and health is well established, if not completely understood. Higher educational attainment improves health directly and indirectly through work and economic conditions (highly educated people have lower unemployment and tend to be wealthier), psychosocial resources (they have greater perceived control), and health lifestyle (they will make better-informed health-related decisions) (Ross and Wu 1995). Education level is strongly related to health behaviors such as smoking practices, physical activity, and diet (Lynch, Kaplan, and Salonen 1997). It has been posited that migrants who have received a higher level of education in the origin country are able to generate a higher level of health before migration and better maintain their health after moving (Chiswick, Lee, and Miller 2008; Grossman 1972; Pol and Thomas 1992).

2.4 A lack of studies on the health effect of migrant selection

Despite being one of the most common explanations of the HIE, there have been few empirical studies of the effect of selection on migrants' health. Most have focused on Mexicans in the United States. The one cited most often is by Rubalcava et al. (2008), who use the Mexican Family Life Survey, a multi-sited longitudinal survey interviewing Mexicans living in Mexico and Mexican migrants in the United States. The authors observe weak support for selection across a diverse range of health measures (height, weight, blood pressure, and general health) and educational attainment (using years of education) (Rubalcava et al. 2008). Bostean (2013) finds that Mexican migrants are positively selected in some outcomes (health limitations), negatively selected in others (self-rated health), or not selected at all (chronic conditions) relative to nonmigrants in Mexico. Two other studies make a similar comparison and find that Mexican migrants are taller than nonmigrants of the same age in Mexico (a general indicator of better nutrition in childhood that may translate into better health) (Crimmins et al. 2005; Riosmena et al. 2013).

Some studies take the United States as the host country but investigate different migrant groups. Mehta and Elo (2012) focus on the health selection of migrants from the former Soviet Union and find that Russian migrants report lower levels of disability compared with Russians living in Russia, which suggests that they are positively selected. In one of the most recent studies, Ro, Fleischer, and Blebu (2016) include a wider range of migrant streams by combining health information from the origin countries with comparable data from the United States. The authors find that migrants from South American countries display the largest degrees of positive health selection, while the two largest sending countries, Mexico and China, display the lowest levels.

Finally, one study pools national cross-sectional datasets from the United States, Canada, Australia, and the United Kingdom and compares the health of migrants moving between these four countries to both their host and origin populations (Kennedy et al. 2014). The authors observe a health advantage of migrants relative to the origin populations in all four destination countries (Kennedy et al. 2014).

The above studies share three limitations. First, their focus is largely restricted to the United States and Hispanics. Second, they use varying definitions of 'recent' migrants (10 years or less since arrival in Kennedy et al. (2014), 15 years or less in Riosmena et al. (2013), with no distinction between recent and established migrants in Mehta and Elo (2012)). These cut-offs make it difficult to discount the possibility that some of the current health status of migrants is a result of their current life conditions in the host country rather than their selection into migration. Finally, these studies focus on direct selection on health (i.e., difference in health status between those who migrate and those who stay in the origin country) and tend to leave in the background the effect of SES characteristics upon migrants' health. Indeed, in a relatively young population, even if the health of migrants might not differ much from that of nonmigrants, they could still be selected on educational attainment, which could later have consequences for their health after migration.

2.5 Contribution and hypotheses

The main contribution of our study is to capture selection by considering the role of relative educational attainment (i.e., an individual's relative position in the distribution of educational attainment in their country of birth) on health differences between migrants and nonmigrants in France.

We frame our analysis around three hypotheses:

Hypothesis 1: We initially expect to observe an HIE among migrants living in France, at least among those who arrived most recently. Based upon the previous

French literature, we believe that an HIE is more likely to be observed in chronic illnesses and health limitations than self-rated health.

Hypothesis 2: We then expect the size of the HIE to increase when adjusting for the absolute level of educational attainment. This is because migrant populations in France, on average, are likely to have lower absolute levels of education than nonmigrants and because absolute educational attainment is likely to be strongly positively correlated with the three health outcomes under investigation.

Hypothesis 3: Once we adjust for migrants' relative education level compared to the origin population (to better capture their selectivity) and provide a truer image of migrants' socioeconomic status over the life course, we expect that observed health differences between migrants and the nonmigrant French population will vastly reduce, and may in some cases disappear.

3. Data and variables

3.1 TeO and Barro–Lee

This paper uses the Barro–Lee Educational Attainment dataset (2013) and the Trajectoires et Origines (Trajectories and Origins, or TeO) survey from France (INED-INSEE 2008–2009). The Barro–Lee dataset (2013) compiles international data assembled by UNESCO, Eurostat, and several other data sources. It contains harmonized distributions of educational attainment in the adult population (aged 15+) by gender and 5-year age groups in seven categories (no formal education, incomplete and complete primary, incomplete and complete secondary, and incomplete and complete tertiary) in almost 150 countries between 1950 and 2010 in 5-year periods.

The TeO survey, conducted by the French Institute for Demographic Studies (INED) and the National Institute for Statistics and Economic Studies (INSEE) in 2008–2009, focuses on migrants and children of migrants in France. With respect to its representativeness and sample size, TeO constitutes the best available survey data on migrants and their children carried out in France (Beauchemin, Hamel, and Simon 2015). The sample of 21,761 respondents includes representative over-samples of more than 8,000 migrants and 8,000 children of one or two migrants.

After combining these two data sources we remove from analysis individuals under the age of 22 who are likely to still be in education (3,247; weighted: 11.2%), individuals for whom we cannot determine their migrant status (65; weighted: 0.4%), migrants who completed their education in France and not in their country of origin

(3,025; weighted: 3.7%), those with missing education attainment data in the TeO survey (2,930; weighted: 8.5%), and those whose country of birth could not be matched to the Barro–Lee data (1,053; weighted: 2.0%). This results in an analytical sample of 12,938 individuals, with a gender ratio very similar to that in the original sample. Table 1 provides basic sample descriptive statistics; the variables are discussed below.

Table 1: Sample descriptive statistics

Variable	Nonmigrants	G1				G2				Total	
		North Africa	South Europe	Other	Total	North Africa	South Europe	Other	Total	% or (mean)	N
Gender											
Male	49.2	47.1	53.7	39.5	45.2	49.2	52.5	49.1	50.2	49.1	6,015
Female	50.8	52.9	46.3	60.5	54.8	50.8	47.5	50.9	49.8	50.9	6,923
Age											
Mean	42.4	46.9	47.4	43.2	45.6	35.9	40.3	42.9	39.1	(42.2)	
Duration of stay											
< 5-years		10.3	10.1	17.0	12.7						
≥ 5-years		89.7	89.9	83.0	87.3						
Years of education											
Mean	15.8	13.1	8.7	14.8	13.1	16.9	15.9	16.1	16.4	(15.7)	
Relative educational attainment											
Mean	54.2	71.6	35.2	71.1	66.3	50.3	48.2	57.0	51.5	(54.8)	
Self-rated health											
Very good	31.8	34.0	20.0	38.2	33.6	43.1	33.8	38.2	39.0	33.0	4,637
Good	51.5	38.6	44.9	39.0	39.6	44.4	47.2	42.8	44.8	49.6	5,926
Moderate	13.2	21.1	28.7	18.9	21.4	10.5	16.6	16.4	14.0	14.0	1,914
Poor	2.8	5.6	5.1	3.4	4.8	1.7	2.2	2.4	2.0	2.8	364
Very poor	0.7	0.6	1.3	0.5	0.7	0.3	0.2	0.2	0.2	0.6	80
Chronic illness											
No	75.7	78.1	75.8	77.3	77.5	83.0	78.5	78.2	80.3	76.6	10,200
Yes	24.3	21.9	24.2	22.7	22.5	17.0	21.5	21.8	19.7	23.4	2,718
Health limitations											
No	84.0	80.3	79.7	81.8	80.8	88.6	85.3	82.1	85.8	84.0	11,086
Yes	16.0	19.7	20.3	18.2	19.2	11.4	14.7	17.9	14.2	16.0	1,846
Total	3,139	1,184	595	2,133	3,912	2,027	2,142	1,718	5,887		12,938

Note: percentages are weighted and should be read in columns; frequencies are unweighted.

3.2 Variables used

We define migration status by combining three types of information: migrant generation (nonmigrant, G1, G2), region of origin (Southern Europe, North Africa, other regions), and duration of stay.

3.2.1 Migrant generation

To define our groups of interest we use two variables from the TeO survey: the respondent's country of birth and their parents' country of birth. The reference group, French nonmigrants, is defined as individuals who are born in France to two parents born in France (including overseas territories). First-generation migrants (G1) are defined as being born abroad (i.e., outside of France). The second generation (G2) is defined as those born in France to at least one parent born abroad (approximately 60% of G2 have two parents born abroad).

3.2.2 Region of origin

Our two main regions of interest, Southern Europe (Italy, Spain, and Portugal) and North Africa (Algeria, Morocco, and Tunisia), represent the two largest regions of origin for migrants in France. We also include the group 'other' (which is a diverse group of migrants originating from sub-Saharan Africa, European countries, Turkey, and Southeast Asia). The older age structure of the South European G1 and G2, and comparatively younger age structure of the North African and other G1 and G2, reflects the earlier arrival in France of Southern Europeans compared to North Africans and other regions (see Table 1 for some descriptive information).

The G2 serves, to a large extent, as a second reference group for their respective G1 groups of the same geographic origin. On the one hand, the G2 are more similar to the nonmigrant reference group because they did not migrate (so cannot be 'selected') and experience their formative years, and education, in France. On the other hand, they are raised by migrant parents and may adopt some cultural norms and behaviors from the country of origin (Wallace 2016).

3.2.3 Duration of stay

We construct the migration status variables used in the analyses by combining duration of stay with the migrant groups. We use two migration status variables: one that does not make any distinction between regions of origin and one that does. In models that do not distinguish the region of origin of migrants we use a three-category indicator of duration of stay (less than or equal to 5 years, 6 to 10 years, and more than 10 years). In models with more detailed migration status that identifies regions of origin we use a binary duration indicator identifying migrants who have lived in France for more than or less than 5 years. We include duration of stay because it has been proposed that the healthy immigrant effect and the positive effect of migrant selection on their health are most pronounced just after they arrive in the host country.

3.2.4 Relative education level

Respondents' relative level of education (similar to what Feliciano and Lanuza (2017) named "contextual attainment") constitutes the key variable in the analysis. Using a methodology developed for migrants by Ichou (2014) and extended to nonmigrants by Feliciano and Lanuza (2017), the Barro–Lee and TeO datasets are combined to construct this measure. Initially, each respondent from TeO is matched with the distribution of educational attainment (measured in six categories in both data sources using the International Standard Classification of Education, ISCED) of individuals of the same gender and year of birth. The educational attainment of each respondent from the TeO survey is then positioned within this distribution. The resulting variable, measured as a percentile, shows the percentage of individuals from the same country of birth and of the same gender and age who have a lower level of educational attainment, plus half the percentage of individuals with the same level of education[3] (see Appendix for a fictional example).

Essential to the contribution of this paper is the fact that, for migrants, relative educational attainment functions as a direct indicator of migrants' educational selectivity (i.e., how each migrant in a given host country compares in terms of educational attainment to nonmigrants in the origin country). This measure places migrants' education in the context in which it was attained, which helps capture broader dimensions of education and SES including cultural dimensions (Feliciano and Lanuza 2017) that are crucial in determining the health status of migrants before arrival.

[3] This calculation is closely aligned with the definition of ridits (Bross 1958), a standard way of transforming a categorical distribution into a continuous variable.

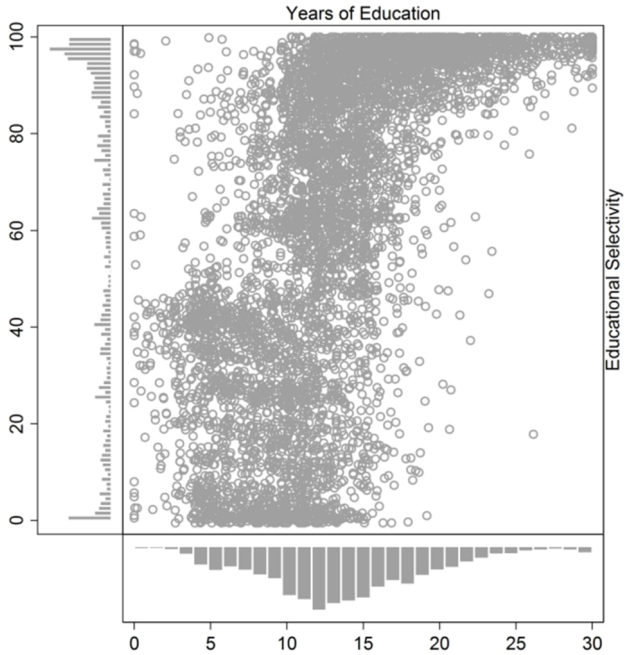
Henceforth, we refer to relative educational attainment as educational selectivity when it is measured only among migrants, as in Figures 1 and 2. However, in the regression models, when the variable is also measured for nonmigrants, we refer to it as "relative educational attainment," as nonmigrants do not experience this migration selection (Feliciano and Lanuza 2017).

3.2.5 Absolute education level

Respondents' absolute level of education is measured using number of years of education. This variable is derived from existing information in the French TeO survey. Figure 1 shows absolute education level on the x-axis (the number of years of education) plotted against educational selectivity on the y-axis for G1 only. The frequency distributions of the two variables are displayed on corresponding axes. There is a moderate positive correlation between these two measures. However, absolute number of years of education does not always translate to the same position in the educational distribution of the origin country. We show this with two examples.

Males A and B both completed 10 years of education in Algeria; A is 58 years old while B is only 31. A is positively selected (77th percentile), while B is negatively selected (9th percentile). This is because A received 10 years of education at a time when the education system in Algeria was less developed. Now consider females C and D, who are the same age (48 years old) but from different countries: Morocco (C) and Spain (D). Both complete 10 years of education. C is positively selected (83rd percentile), but D is neither positively nor negatively selected (49th percentile). This is because at the time in Spain the education system was more developed than in Morocco.

Figure 1: Bivariate and univariate distributions of migrants' absolute (number of years of education) and relative (educational selectivity) education levels

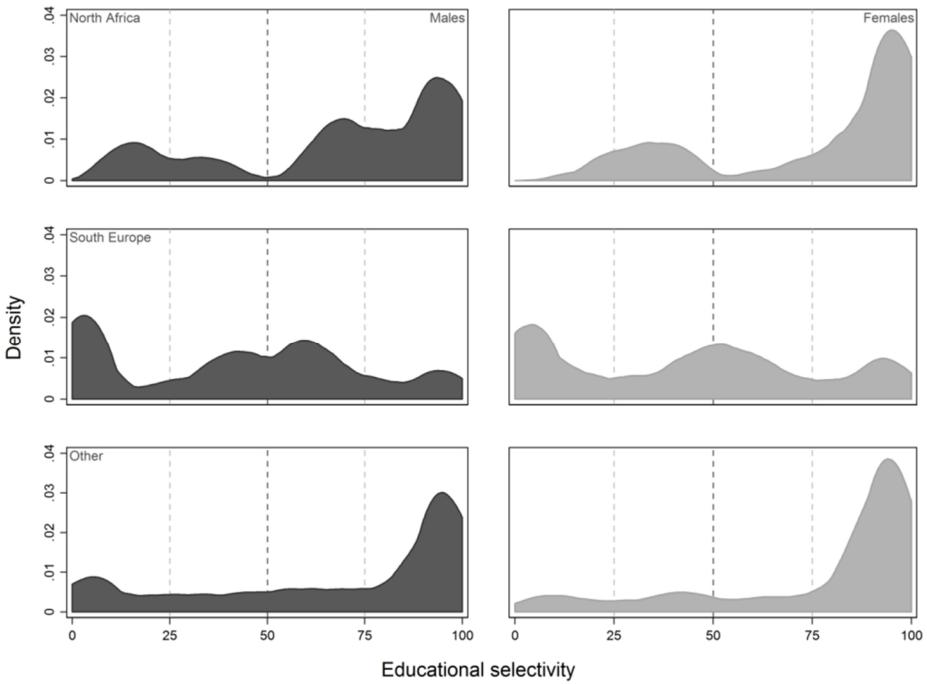


We can also observe from the univariate distribution of the educational selectivity variable in Figure 1 that, while migrants tend to be positively selected (i.e., above the 50th percentile in the educational distribution of the origin country), some originate from the lower-middle region of the distribution (slightly negative selection). We provide a more nuanced look at this by presenting the smoothed distributions of educational selectivity by region of birth and by sex in Figure 2.

Figure 2 shows three shapes. The first, observed among North Africans, shows a bimodal distribution with selection from both the upper end and, to a lesser extent, lower-middle part of the distribution. North African females differ from males in that there is a greater selection from the top of the distribution (75–100) and less from the lower end of the distribution (0–25). The second, observed among Southern Europeans, shows a largely negative selection. Both males and females are likely to come from the lower half of the distribution, particularly between 0 and 15. The two largest migrant groups in France thus possess markedly different educational selectivity profiles. Therefore, it will be fascinating to observe whether this difference in selectivity

between North Africans and Southern Europeans manifests itself in the three health outcomes.[4]

Figure 2: Distribution of migrant educational selectivity by region of birth and sex



3.2.6 Health outcomes

We analyze three standard health outcomes: self-rated health, limiting health problems, and chronic illness. For self-rated health, respondents were asked, "What is your overall state of health?" on a 5-point scale from "very good" to "very poor." For health limitations, respondents were asked, "Have you been limited in your normal activities for at least six months because of a health problem?" Respondents could answer "yes, very limited," "yes, limited but not severely," and "no." For chronic illnesses

[4] Further descriptive analyses reveal that educational selectivity distributions vary very little by duration of stay within each regional groups.

respondents were asked, "Do you currently have one or more chronic illnesses? A chronic illness is one that lasts (or will last) a long time or regularly reappears (or will reappear)." Respondents could answer "yes" or "no."

We study these outcomes because we believe that they capture different health problems. The chronic illness and health limitations questions should capture longer-term, permanent, or reoccurring issues, while the question on self-rated health should additionally capture shorter-term, temporary illnesses, alongside general perceptions of one's own health. Moreover, the chronic illness outcome is arguably the most objective (in that to report one requires a prior diagnosis or specific knowledge of illnesses). Yet if migrants are not well integrated into the health care system, they are less likely to be able to report a chronic illness. However, such illnesses should be captured through the health limitations or self-rated health questions. Our three outcomes have pairwise linear correlations ranging from .48 to .50 and Cramer's V ranging from .49 to .56. These moderately strong positive relationships suggest that all three indicators tap into respondents' health but that it is still relevant to analyze them as separate indicators.

4. Methods

We use logistic regression to examine health differences between migrants and nonmigrants. For limiting health problems and chronic illnesses we fit binary logistic regression models (we combine answers "yes, very limited" and "yes, limited but not severely" for limiting health problems). The model is below, where $P(Y_i=1)$ is the estimated probability of having, e.g., a chronic illness for person i, α is a constant, X_{ik} is the value of variable X_k for individual i, with K explanatory variables, and β_k is the logistic regression coefficient associated with the variable X_k.

$$\ln\left(\frac{P(Y_i=1)}{1-P(Y_i=1)}\right) = \alpha + \sum_{k=1}^{K} \beta_k X_{ik}$$

For the self-rated health outcome we fit ordinal logistic regression models (proportional odds models) where Y is now a response variable with J ordered categories; in this case the five categories are "very good," "good," "average," "poor," and "very poor"; α_j are category-specific constants, while the β_k coefficients are the same across values of Y; X_{ik} is the value of variable X_k for individual i, with K explanatory variables. The equation models the logit of the probability of being at or below category j. The standard interpretation of the coefficients X_{ik} is that for a one unit increase in the predictor (or a change between 0 and 1 for dummies) the response

variable will be estimated to change by the value of X_{ik} in the ordered log-odds scale, the other variables in the model being held constant. Consistent with the other outcomes, lower values of this variable indicate better health.

$$\ln\left(\frac{P(Y_i \leq j)}{1-P(Y_i \leq j)}\right) = \ln\left(\frac{P(Y_i \leq j)}{P(Y_i > j)}\right) = \alpha_j - \sum_{k=1}^{K} \beta_k X_{ik}$$
$$\text{where } j = 1,2 \ldots., J,$$

Our analytical strategy consists in comparing the coefficients assessing migrants' health advantages across nested models, successively adding our independent variables of interest. A series of methodological papers warn researchers against comparing coefficients from nested non-linear probability models (Allison 1999; Karlson, Holm, and Breen 2012; Mood 2010), such as the logit models we use. Consequently, we use a recent method to avoid this problem and achieve a more rigorous comparison of the same coefficient across logit models (Karlson, Holm, and Breen 2012). This is implemented in Stata through the KHB program (for Karlson–Holm–Breen decomposition) (Kohler, Karlson, and Holm 2011). We present the results of the decomposition of the regression coefficients associated with migrant status for our health outcomes. Importantly, the Karlson–Holm–Breen method lets us test the statistical significance of the difference in the values of coefficients across models. It will therefore allow us to test whether relative educational attainment plays a significant role in explaining migrants' health advantages (Hypothesis 3).[5]

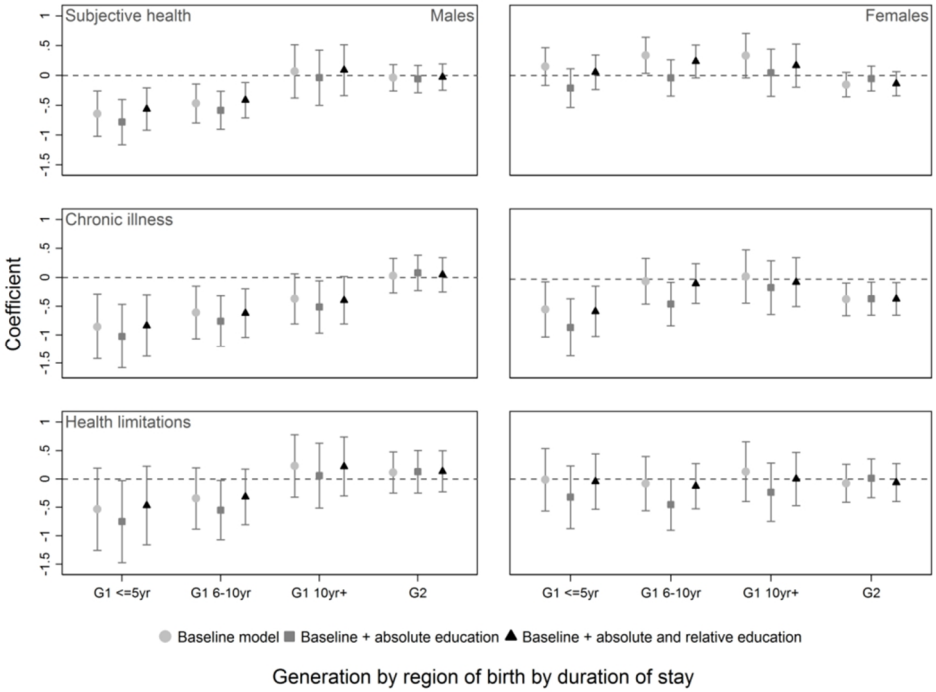
5. Results

Figure 3 shows the results from three sex-specific nested logistic models (with the Karlson–Holm–Breen correction) for the G1 by duration of stay and G2 (full results shown in numerical form in Tables A-1 to A-3 of the Appendix). Model 1 (M1) is our baseline model, adjusting for age, age^2, and migration status. Model 2 (M2) adds respondents' absolute education level to the baseline model. Model 3 (M3) includes our main independent variable of interest: relative educational attainment.[6] In all models the nonmigrant French population acts as the reference category.

[5] We note from additional analyses that we would have reached similar conclusions without the KHB corrections, but would not have been able to test the differences in the values of coefficients across models as rigorously without using the KHB method.

[6] An alternative specification of Models 2 and 3 was also fitted including additional measures of socioeconomic status: occupational status and income. The results were very similar to those presented in the text. However, because of the strong correlations between absolute educational attainment, occupational

Figure 3: KHB logistic regression coefficients for migration status (generation and duration of stay) across nested logistic models predicting three outcomes



Note: The reference group is always the nonmigrant French population. On all three outcomes, lower values indicate better health.

From males in M1 we observe clear evidence of an HIE among the G1 in self-rated health and chronic illnesses. Consistent with Hypothesis 1, the HIE is strongest among recent arrivals and weaker among males who have lived in France for longer.[7] The self-rated health of males who have lived in France for at least 10 years is no different from that of nonmigrants and their HIE in chronic diseases is only marginally

status, and income, this alternative specification lacked statistical power. Thus, the more parsimonious specification described in the text was favored. These supplementary results are available upon request.

[7] We fitted models stratified into 15-year age intervals to ensure that convergence in duration of stay persisted, and it did. We tested this because in models using duration of stay as an explanatory variable for open-ended age groups, any convergence in health over duration of stay could equally be attributed to the older age composition (and thus decreasing health variability) among migrants with longer durations, even when age is simply controlled for. Interested readers can refer to Eikemo, Skalicka, and Avendano (2009) and Houweling et al. (2007) for more information on this topic.

significant. We observe the same gradient for duration of stay across health limitations among males, but these differences are not statistically significant in M1.

Evidence for an HIE among females is substantially weaker, consistent with the French literature. The only evidence of an HIE is in the lower prevalence of chronic illnesses for the most recent arrival cohorts (≤5 years). For the remaining two health outcomes, female migrants do not differ from nonmigrants and there is even marginal evidence of a slight disadvantage in self-rated health.

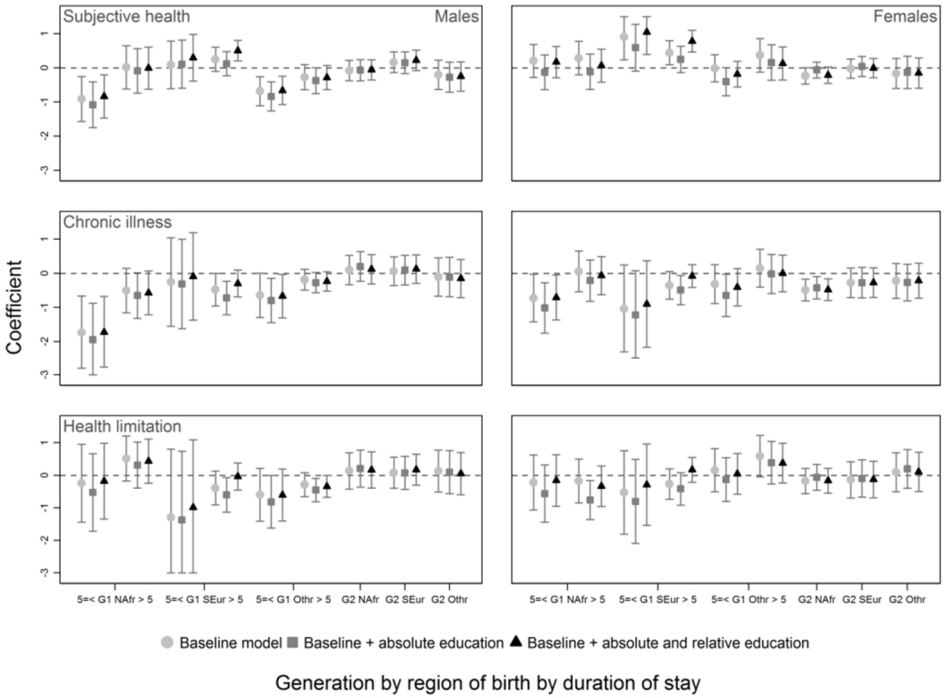
We will not consider the G2 results in detail, since, except for a slightly lower incidence of chronic illnesses among females, the G2's health never differs from the reference population in any of the models. The inclusion of the education variables in Models 2 and 3 do not affect this finding.

Figure 4 shows results from the same models using a different migration status variable which distinguishes between G1 groups of different regions of birth and duration of stay (full results shown in numerical form in Tables A-4 to A-6 of the Appendix). The HIE in self-rated health and chronic illnesses is found for G1 North African males only. Interestingly, G1 from Southern Europe never exhibit a statistically significant HIE in any of the three health outcomes. G1 Southern European females even report worse self-rated health than the reference group. The absence of an HIE among Southern European migrants, contrary to North Africans, could be linked to the fact that they are a more negatively selected migrant group in terms of education (see Figure 2).

Importantly, an expectation stated in Hypothesis 2 is verified in Figures 3 and 4, where adjusting for absolute educational attainment (M2) increases the magnitude of the existing migrant health advantages or generates statistically significant ones when they did not initially exist in the baseline model (M1). This pattern stems from a combination of two bivariate relationships: migrants, on average, tend to have lower absolute levels of education than nonmigrants; and absolute educational attainment is positively correlated with the three health outcomes.

Central to testing our main hypothesis (H3) is the change in health differences between migrants and nonmigrants between M2 and M3, i.e., before and after the inclusion of relative educational attainment. In all cases where an HIE was observed in M2, its magnitude decreases in M3. Adjusting for relative educational attainment sometimes renders migrants' health advantages no longer statistically significant. In Figure 3, we find this for G1 < 5-year (for males) and 6–10-years (males and females) in health limitations and in G1 6–10-years (for females) in chronic illnesses. This tendency becomes more prevalent in Figure 4 when we differentiate by region of birth. This is key because it shows educational selectivity to be a crucial factor in explaining the HIE.

Figure 4: KHB logistic regression coefficients for migration status (generation, region of birth, and duration of stay) across nested logistic models predicting three outcomes



Note: The reference group is always the nonmigrant French population. On all three outcomes, lower values indicate better health.

Finally, to clarify the inclusion of respondents' relative educational attainment in explaining migrants' health advantages, we show three tables (2, 3, and 4). Table 2 shows the statistical significance (p-values) of the KHB coefficient comparisons for the G1 groups between Models 2 and 3. The top part of the table corresponds to models shown in Figure 3, the bottom half to models shown in Figure 4. For every G1 group in the generation by duration variable, adjusting for relative educational attainment causes a statistically significant decrease in the value of coefficients, to a $p<0.01$ level among females and a $p<0.05$ level among males. For the generation by region by duration variable a similar tendency can be seen for females, but among males there are fewer significant differences in the values of the coefficients. Including relative education produces significant changes in the health differences between nonmigrants and recent North African male migrants in terms of health limitations and chronic illness. No such

differences could be detected among Southern European migrants, males or females, at the $p<0.05$ level.

Table 2: KHB tests of difference in migration status coefficients between Model 2 and Model 3

Variable	Self-rated health		Chronic illness		Health limitation	
	Males	Females	Males	Females	Males	Females
Generation by duration						
G1 ≤5 years	0.046	0.000	0.042	0.009	0.029	0.002
G1 6–10 years	0.044	0.000	0.041	0.009	0.027	0.002
G1 >10 years	0.051	0.000	0.047	0.012	0.033	0.004
Generation by region by duration						
North Africa ≤ 5-years	0.091	0.005	0.084	0.035	0.060	0.023
North Africa >5-years	0.127	0.005	0.120	0.035	0.097	0.022
South Europe ≤ 5-years	0.326	0.024	0.322	0.667	0.310	0.052
South Europe >5-years	0.142	0.135	0.135	0.177	0.112	0.164
Other ≤ 5-years	0.129	0.006	0.122	0.038	0.098	0.025
Other >5-years	0.162	0.057	0.156	0.102	0.134	0.087

Note: p≤0.05 is black p>0.05 is grey.

Tables 3 and 4 are derived from the same statistical models but focus on effect size by gauging how much of the HIE is explained by relative educational attainment. Specifically, the tables display the predicted differences in each health outcome between migrants and nonmigrants (average marginal effects) before and after adjusting for relative educational attainment (Models 2 and 3). Most importantly, for each migrant group the two tables provide the percentage of their HIE explained by their educational selectivity. Both tables confirm that migrants' health advantages are smaller for women for than men, but show that educational selectivity tends to explain a larger part of the gaps for females. Among women, adjusting for relative educational attainment sometimes completely explains away migrants' health advantages, and often reduces them by at least 30%. Among men, relative educational attainment typically explains between $1/10^{th}$ and $1/3^{rd}$ of health advantages identified in Model 2.

Table 3: Average marginal effects of migration status (duration of stay) in Models 2 and 3, and percentage explained by the inclusion of relative educational attainment

	Model 2 (AME) Males	Model 3 (AME)	Percentage of health advantage explained	Model 2 (AME) Females	Model 3 (AME)	Percentage of health advantage explained
Subjective health						
G1 ≤5yr	–0.17	–0.15	8.9%	–0.06	0.00	100.0%
G1 6-10yr	–0.16	–0.14	10.2%	–0.03	0.03	100.0%
G1 10yr+	–0.10	–0.08	13.0%	–0.05	0.00	100.0%
Chronic illness						
G1 ≤5yr	–0.12	–0.11	11.1%	–0.12	–0.08	28.0%
G1 6–10yr	–0.10	–0.08	17.8%	–0.05	–0.01	87.0%
G1 10yr+	–0.07	–0.05	23.9%	–0.03	0.01	100.0%
Health limit						
G1 ≤5yr	–0.07	–0.05	22.6%	–0.04	0.00	96.6%
G1 6–10yr	–0.06	–0.04	35.9%	–0.05	–0.01	80.4%
G1 10yr+	0.01	0.03	No advantage	–0.02	0.02	100.0%

Note: Nonmigrants are always the reference group. Contrasts between nonmigrants and second generations are not presented for sake of brevity.

Table 4: Average marginal effects of migration status (duration of stay by region of origin) in Models 2 and 3, and percentage explained by the inclusion of relative educational attainment

	Model 2 (AME) Males	Model 3 (AME)	Percentage of health advantage explained	Model 2 (AME) Females	Model 3 (AME)	Percentage of health advantage explained
Subjective health						
G1 NAfr < 5	–0.25	–0.23	7.1%	–0.06	0.01	100.0%
G1 NAfr ≥5	–0.13	–0.11	10.6%	–0.06	0.01	100.0%
G1 SEur < 5	0.04	0.05	No advantage	0.22	0.24	No advantage
G1 SEur ≥5	0.03	0.04	No advantage	–0.01	0.02	100.0%
G1 Othr < 5	–0.17	–0.16	7.9%	–0.10	–0.03	69.4%
G1 Othr ≥5	–0.14	–0.12	8.7%	–0.04	0.00	100.0%
Chronic illness						
G1 NAfr < 5	–0.18	–0.17	5.1%	–0.14	–0.11	21.3%
G1 NAfr ≥5	–0.09	–0.07	19.5%	–0.03	0.01	100.0%
G1 SEur < 5	–0.05	–0.04	22.2%	–0.17	–0.15	11.3%
G1 SEur ≥5	–0.08	–0.07	18.0%	–0.08	–0.06	21.2%
G1 Othr < 5	–0.10	–0.09	13.4%	–0.09	–0.05	40.0%
G1 Othr ≥5	–0.05	–0.03	37.9%	0.00	0.03	100.0%

Table 4: (Continued)

	Model 2 (AME) Males	Model 3 (AME)	Percentage of health advantage explained	Model 2 (AME) Females	Model 3 (AME)	Percentage of health advantage explained
Health limitation						
G1 NAfr < 5	–0.05	–0.03	49.0%	–0.07	–0.03	58.8%
G1 NAfr ≥5	0.04	0.07	No advantage	–0.06	–0.02	64.3%
G1 SEur < 5	–0.10	–0.10	5.7%	–0.08	–0.06	28.7%
G1 SEur ≥5	–0.05	–0.04	26.1%	–0.05	–0.03	32.0%
G1 Othr < 5	–0.07	–0.06	18.4%	–0.02	0.02	100.0%
G1 Othr ≥5	–0.05	–0.03	35.4%	0.05	0.09	No advantage

Note: Nonmigrants are always the reference group. Contrasts between nonmigrants and second generations are not presented for sake of brevity.

6. Discussion

In this study we have investigated the role of migrants' relative educational attainment in explaining their health advantages over nonmigrants using three health outcomes: self-rated health, chronic illness, and health limitations. We set out to test three hypotheses. In the first hypothesis, we expected to observe a large HIE for migrants in France, which decreased with length of stay. This expectation was met among males, but less so among females. Such findings are in line with a recent systematic review of the HIE literature in France (Khlat and Guillot 2017). By region of origin, at least among males, the existence of an HIE was consistent with the direction of their educational selectivity. G1 North Africans and G1 from other regions were positively selected and experienced an HIE. G1 South Europeans, on the other hand, were negatively selected and did not experience an HIE. Despite similar educational selectivity, an HIE was not found among females. Khlat and Guillot (2017) ascribe this difference to men arriving primarily as workers and women arriving as "dependents" to reunify with their family. This assertion probably applies more to older migrant cohorts, which arrived at a time when gender norms and the position of women in the labor market in the origin and host countries were less egalitarian than they are now. For more recent arrival cohorts, this balance should be shifting favorably. Indeed, this could be reflected in the chronic illness advantage we observed among female migrants. Future research should try to investigate this possible trend with more recent data.

The overall pattern of results is similar across all three health outcomes. The main difference was observed in women's self-rated health, where a migrant disadvantage is clearly visible. On the one hand, this could be because self-rated health is the most

subjective of the three outcomes (women might perceive symptoms differently and be more willing to report them) (Verbrugge 1989). Such differences may also be enhanced by social isolation or hardship (Berchet and Jusot 2012). Women may also be more likely to report poor self-rated health due to the double discrimination they face in the host country, both as women and as ethnic minorities (Llacer 2007). One the other hand, chronic diseases and health limitations are more susceptible to being under-reported; migrants who are not well integrated into the health care system may find the concept of chronic illness and health limitations difficult to comprehend and report (Khlat and Guillot 2017).

With respect to the second and third hypotheses, we stated that the HIE would increase when adjusting for absolute educational attainment and then decrease or disappear when adjusting for relative educational attainment. The two expectations were well supported. This is important as it suggests that if we were to rely on absolute measures of SES when conducting analyses we would introduce bias into our estimates, inflating health disparities between migrants and natives.

Unfortunately, sample size did not allow us to analyze the full extent of the heterogeneity of France's foreign-born population (Beauchemin et al. 2015). In particular, the present study uses broad regions of origin within which the health outcomes (Hamel and Moisy 2012) and levels of educational attainment (Ichou, Goujon, and DIPAS 2017) vary substantially. This study is also limited to a single dimension of migrant selection: education. Educational selection is correlated with many other – observed and unobserved – sources of migrant selection, such as occupation and motivation, and future research could seek to produce a more systematic analysis of the health consequences of migrant selection by incorporating additional dimensions of selection. Finally, although not the focus of our paper, the role of migrants' duration of stay was examined using a cross-sectional survey. Future studies could improve this analysis by relying on longitudinal data sufficiently large to allow analyses to be stratified into narrow age groups.

By considering the relative educational attainment of migrants in their origin countries, we have provided a more accurate reflection of their educational selectivity and thus social class advantages during the pre-migration part of their life course. Consequently, we have produced more reliable estimates of migrant versus nonmigrant health differentials. In the future, researchers should incorporate these relative measures of SES in studies of migrant health. If this is not possible, researchers should keep in mind how education and social class matter in determining health, why selectivity is important, and how this might introduce bias when only adjusting for absolute SES measures in investigations of health and mortality differentials between migrants and nonmigrants.

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Appendix

Fictional example of the educational selectivity measure

Let us illustrate this measure using an example. Imagine a male migrant born in 1950 in country X who completed upper secondary school before emigrating to France. In country X, among the male population born in 1950, educational attainment is distributed as follows: 20% have no education, 15% have some primary school education, 25% completed primary school, 20% attended lower secondary school, 15% attended upper secondary school, and 5% received higher education. In this case, the migrant in question would have a relative educational attainment of (20+15+25 20) + 15/2 = 87.5%. For individuals who are born in France (i.e., G2 and nonmigrants), the reference group used to construct the relative education measure is the French population of the same sex and birth cohort.

Table A-1: KHB logistic regression coefficients for migration status (generation and duration of stay) across nested logistic models predicting self-rated health

Self-rated health	Model 1		Model 2		Model 3	
	Male	Female	Male	Female	Male	Female
G1 ≤5yr	–0.563***	0.056	–0.758***	–0.211	–0.641***	0.149
G1 6–10yr	–0.415***	0.236*	–0.596***	–0.028	–0.470***	0.339***
G1 10yr+	0.091	0.168	–0.033	0.044	0.068	0.334**
G2	–0.026	–0.137	–0.026	–0.120	–0.038	–0.153
Absolute educ. attainment			–0.0571***	–0.0717***	–0.0288*	–0.00767
Relative educ. attainment					–0.00464**	–0.0117***
Observations	6,006	6,915	6,006	6,915	6,006	6,915

Note: Age and age squared are also included as controls. *** p<0.01, ** p<0.05, * p<0.1.

Table A-2: KHB logistic regression coefficients for migration status (generation and duration of stay) across nested logistic models predicting chronic illness

Chronic illness	Model 1		Model 2		Model 3	
	Male	Female	Male	Female	Male	Female
G1 ≤5yr	–0.841***	–0.541**	–1.009***	–0.737***	–0.855***	–0.508**
G1 6–10yr	–0.620***	–0.074	–0.776***	–0.268	–0.610***	–0.035
G1 10yr+	–0.398*	–0.049	–0.504**	–0.139	–0.371*	0.046
G2	0.045	–0.330**	0.045	–0.318**	0.029	–0.339**
Absolute educ. attainment			–0.0479***	–0.0537***	–0.0120	–0.0123
Relative educ. attainment					–0.00609**	–0.0074***
Observations	6,008	6,910	6,008	6,910	6,008	6,910

Note: Age and age squared are also included as controls. *** p<0.01, ** p<0.05, * p<0.1

Table A-3: KHB logistic regression coefficients for migration status (generation and duration of stay) across nested logistic models predicting health limitation

Health limitation	Model 1		Model 2		Model 3	
	Male	Female	Male	Female	Male	Female
G1 ≤5yr	–0.466	–0.045	–0.747**	–0.343	–0.532	–0.011
G1 6–10yr	–0.314	–0.124	–0.575**	–0.418*	–0.342	–0.080
G1 10yr+	0.220	0.000	0.043	–0.138	0.228	0.129
G2	0.136	–0.063	0.137	–0.044	0.115	–0.075
Absolute educ. attainment			–0.0778***	–0.0802***	–0.0300	–0.0216
Relative educ. attainment					–0.00854**	–0.0107***
Observations	6,011	6,921	6,011	6,921	6,011	6,921

Note: Age and age squared are also included as controls. *** p<0.01, ** p<0.05, * p<0.1.

Table A-4: KHB logistic regression coefficients for migration status (generation, region of birth and duration of stay) across nested logistic models predicting self-rated health

Self-rated health	Model 1		Model 2		Model 3	
	Male	Female	Male	Female	Male	Female
G1 NAfr < 5	–0.838***	0.168	–1.056***	–0.167	–0.913***	0.201
G1 NAfr ≥5	–0.009	0.065	–0.095	–0.092	0.015	0.284
G1 SEur < 5	0.294	1.046***	0.033	0.637*	0.088	0.904***
G1 SEur ≥5	0.503***	0.780***	0.149	0.285	0.252	0.443**
G1 Othr < 5	–0.665***	–0.188	–0.795***	–0.375*	–0.686***	–0.014
G1 Othr ≥5	–0.285	0.131	–0.365**	0.118	–0.272	0.367
G2 NAfr	–0.061	–0.216*	–0.063	–0.184	–0.078	–0.235*
G2 SEur	0.219	–0.007	0.189	0.005	0.163	–0.022
G2 Othr	–0.252	–0.153	–0.211	–0.151	–0.203	–0.165
Absolute educ. attainment			–0.0549***	–0.0710***	–0.0271	–0.00745
Relative educ. attainment					–0.00457**	–0.0116***
Observations	6,006	6,915	6,006	6,915	6,006	6,915

Note: Age and age squared are also included as controls. *** p<0.01, ** p<0.05, * p<0.1.

Table A-5: KHB logistic regression coefficients for migration status (generation, region of birth and duration of stay) across nested logistic models predicting chronic illness

Chronic illness	Model 1		Model 2		Model 3	
	Male	Female	Male	Female	Male	Female
G1 NAfr < 5	–1.724***	–0.704**	–1.918***	–0.961***	–1.731***	–0.723**
G1 NAfr ≥5	–0.571*	–0.067	–0.647**	–0.187	–0.503	0.058
G1 SEur < 5	–0.090	–0.900	–0.323	–1.213*	–0.250	–1.040
G1 SEur ≥5	–0.296	–0.077	–0.613***	–0.453**	–0.477**	–0.351*
G1 Othr < 5	–0.667**	–0.408***	–0.783**	–0.550*	–0.640*	–0.316
G1 Othr ≥5	–0.236	0.000	–0.307**	–0.009	–0.185	0.152
G2 NAfr	0.120	–0.478	0.118	–0.454***	0.099	–0.486***
G2 SEur	0.127	–0.270	0.100	–0.260	0.066	–0.278
G2 Othr	–0.153	–0.213	–0.117	–0.212	–0.106	–0.220
Absolute educ. attainment			–0.0477**	–0.0552***	–0.0125	–0.0135
Relative educ. attainment					–0.00599**	–0.0075***
Observations	6,008	6,910	6,008	6,910	6,008	6,910

Note: Age and age squared are also included as controls. *** p<0.01, ** p<0.05, * p<0.1.

Table A-6: KHB logistic regression coefficients for migration status (generation, region of birth and duration of stay) across nested logistic models predicting health limitation

Health limitation	Model 1		Model 2		Model 3	
	Male	Female	Male	Female	Male	Female
G1 NAfr < 5	–0.178	–0.160	–0.518	–0.557	–0.242	–0.220
G1 NAfr ≥5	0.435	–0.337	0.302	–0.522	0.515	–0.177
G1 SEur < 5	–0.989	–0.289	–1.395	–0.773	–1.288	–0.528
G1 SEur ≥5	–0.037	0.169	–0.589**	–0.413*	–0.389	–0.268
G1 Othr < 5	–0.605	0.047	–0.808**	–0.172	–0.597	0.158
G1 Othr ≥5	–0.342**	0.374	–0.466***	0.359	–0.286	0.586*
G2 NAfr	0.168	–0.167	0.164	–0.129	0.137	–0.176
G2 SEur	0.176	–0.130	0.129	–0.115	0.079	–0.141
G2 Othr	0.052	0.106	0.115	0.108	0.132	0.095
Absolute educ. attainment			–0.0807***	–0.0833***	–0.0317	–0.0262
Relative educ. attainment					–0.00883**	–0.0106***
Observations	6,011	6,921	6,011	6,921	6,011	6,921

Note: Age and age squared are also included as controls. *** p<0.01, ** p<0.05, * p<0.1.