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Are Immigrants Selected on Height? And Does this Bring a Health Premium in the Destination Country?

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Are Immigrants Selected on Height? And Does this Bring a Health Premium in the Destination Country?

Alessandro Ferrara, Renee Luthra, Lucinda Platt*

Abstract

Using a specially constructed international dataset of adult heights, we assess the extent, drivers and consequences of migrant selectivity, measured as relative height. This offers a measure of health selectivity that precedes emigration and is stable over time. Applying this measure to representative data from the German Socio-Economic Panel, we (i) evaluate whether it correlates with characteristics theoretically associated with migrant health selectivity, (ii) test the assumption that selectivity accounts for the commonly observed immigrant health advantage, and (iii) assess whether degree of selectivity sheds light on the paradox that immigrants' health deteriorates over time since arrival. We find that while, on average, immigrants are positively selected on health and have better health on average than non-migrant Germans, greater selectivity is not associated with better health. However, more positively selected immigrants experience less deterioration in their health, whether evaluated cross-sectionally across arrival cohorts or longitudinally within individuals, helping to explain the immigrant health paradox. Overall, our results i) confirm that migrants are selected on health, ii) support theoretical expectations relating to migrant selection that higher barriers to migration increase selectivity, and iii) demonstrate that while most immigrants are healthier upon arrival, only more selected immigrants enjoy better health throughout adulthood.

Keywords: migrant selectivity; healthy immigrant effect; immigrant health paradox

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Introduction

There is a well-documented association between migration and health, with three commonly observed patterns. First, those who emigrate are typically healthier than non-migrants in their place of origin. This is true whether one looks at internal (Nauman et al. 2015; Westphal 2016) or international migrants[1] (Akresh & Frank 2008; Riosmena et al. 2017). Those who move tend to be in better health than those they leave behind, due both to the physical strain of moving and the typically economic motivation for migration: good returns are less likely to accrue to those in poor health (Case & Paxson 2010). This *selectivity* of migrants has been used to account for the second pattern: that international immigrants are also often healthier than non-migrants in the destination country. This is sometimes considered paradoxical, in that many international migrants move from poorer to richer countries; but it becomes more explicable if we think of emigrants as being non-representative of the average health status in their countries of origin.

Third, it is also observed that despite this general health advantage, many immigrants experience declines in health with time in the receiving country. Their initial advantage often turns into a health deficit compared to non-migrants at destination. This too is considered paradoxical, in that the improvement in socioeconomic status that occurs with time spent at destination, as well as better healthcare access should lead to improved health outcomes. As a result, it has been suggested that the decline in their health over time is an erosion of the initial selectivity advantage, either due to exposure to discrimination and poor residential and working conditions (Boen & Hummer 2019; Luthra et al. 2020), or a related adoption of unhealthy behaviours prevalent in many rich Western receiving countries (e.g. Abraido-Lanza et al. 2005). An alternative reason is selective return migration: if healthier immigrants are more likely to return to their origins than those in worse health, we will appear to see a decline in health over time as the unhealthy are disproportionately represented among longer-standing immigrants (for the USA see Arenas et al. 2015; for Germany Sander 2007).

[1] Note on terminology: we use the term migrants to cover those migrating internally or both internally and internationally. We use the term immigrant when specifically referring to those living in the destination country, and when compared with the non-migrant population at destination, and we use the term emigrant when specifically referring to those leaving their origin country. When referring to movement across borders, and to processes which imply comparison with those at origin, we use the term migrant e.g. "migrant selectivity", but when focusing on what we know about the selectivity of those as measured at destination, as in this paper, we refer to the selection of immigrants.

These patterns were first documented among Hispanics in the United States, then extended to a wider range of origin groups, and are increasingly documented in European receiving countries as well (e.g. Markides & Rote 2019). However, while selective migration is often inferred as driving native-immigrant health differentials, it is challenging to demonstrate the expected relationships between observed variation in immigrant health selectivity and variation in the health outcomes of immigrants, whether on average or over time since arrival. This is largely because the data requirements for such an analysis are high (Feliciano 2020). First, to properly capture health selectivity on migration, we need a measure of selectivity that precedes the migration decision, is comparable across sending and receiving countries, and does not respond to changes in conditions following a move. Second, we need to observe immigrants from a wide range of sending countries and with varying motivations for migration, ensuring that we capture the necessary variation in selectivity – both positive *and* negative selection – to be able to measure its association with health outcomes in the receiving country. Finally, we need to observe immigrants from different migration cohorts, ideally tracking them longitudinally, to measure the influence of selectivity on the health trajectories of immigrants over time since arrival.

Multiple studies have benefited from data which meet at least some of these conditions; but none to date have met all. For instance, many studies include representative data on the health of immigrants in a receiving country, but do not contain information on health in the sending country, limiting their ability to estimate selectivity (Moullan & Jusot 2014). Studies also often focus on health outcomes, such as self-reported health or such distal outcomes as mortality, that change after the migration process (Bostean 2013; Constant et al. 2018). They thus potentially conflate change in health over time with initial health selection. Others succeed in comparing the health outcomes of both immigrants and non-migrants in their sending countries, but typically only cover a smaller subset of countries (Mehta & Elo 2012; Morey et al. 2020). Even when restricting their analysis to those fairly recently arrived – for instance within 10 years (Riosmena et al. 2017) – they still suffer from the fact that acculturation and selectivity cannot be fully disentangled. Perhaps the best data for the analysis of the relationship between selectivity and immigrant health outcomes comes from longitudinal binational data, such as the Mexican Migration Project (Ullmann et al. 2011) or the Mexican Family Life Study (Arenas et al. 2015; Rubalcava et al. 2008), which enable researchers to compare the health of migrants as they move across borders. But these are restricted to one or very few sending countries, and thus tend to lack the required variation in selectivity to measure its effects, in addition to lacking wider external validity.

In this paper we offer an analysis that can test whether immigrants are selected on health relative to their origin country counterparts, whether those who are more selected have better health outcomes and experience a health advantage relative to natives, and whether greater or lesser health selection is implicated in changes in health status with time since arrival. We first describe health selection across the full diversity of the immigrant population in a high-immigration context, Germany. We employ a measure of immigrant health selectivity, namely relative height, that is available for nearly all source countries, which is consistent between origin and destination contexts, is stable over prime adult life and can vary at the individual level. Second, we assess whether relative height is associated with well-developed theoretical predictors of health selectivity related to the conditions under which respondents migrated. Third, we capitalise on the variation in selectivity to test whether relative height differentiates health outcomes between immigrants and drives the immigrant health advantage between immigrants and natives. Finally, we test whether greater selectivity offers protection against health decline or assimilation in immigrants' health trajectories.

We construct an internationally standardised dataset of distributions of height and demonstrate the value of relative height – the location of an immigrant in the height distribution of similarly aged, same-sex peers from the same sending country – in providing a measure of health selectivity. We show that while migrants to Germany are on average positively selected in terms of relative height, this selectivity varies substantially both within and across immigrant origin groups in theoretically plausible ways. While we find some evidence of the immigrant health advantage, interestingly we do not find that individual-level selectivity is associated with better health outcomes overall. However, we do find that over time, being more positively selected is protective against the commonly observed paradox of deterioration in health. Our findings are consistent with existing research on the immediate health-related barriers to international migration combined with the expectation that better early life health should realise its benefits over time. They help to shed light on some of the inconsistent findings in the literature and invite validation or refinement by applying the measure to additional immigrant receiving countries.

Background

Immigrant Selectivity and Immigrant Health

It is a truism in the migration literature that immigrants are selected. That is, they have (or are assumed to have) educational, health, labour market, and cognitive and non-cognitive skill distributions that differ systematically from their non-migrant co-nationals (Borjas 1987; Feliciano 2020; Jasso et al. 2004). Theoretically, immigrants may be positively or negatively selected across these characteristics (Borjas 1987), and there are both theoretical expectations (Chiswick 1999) and empirical demonstrations of variation in immigrant selectivity across immigrant sending and receiving countries, arrival cohorts and ages at arrival (Borjas 1991; Ichou 2014; Polavieja et al. 2018; Zheng & Yu 2022). Applied specifically to health, however, *positive* selectivity is generally expected since the substantial financial and physical barriers to emigration limit international movement to the healthiest, who are most able to move and the most likely to reap economic returns from their movement (Chiswick et al. 2008; Feliciano 2020; Florian et al. 2021; Jasso et al. 2004; Markides & Rote 2019).

Two main questions underly the migrant selection literature: (a) whether and to what extent migrants are selected, and (b) to what extent selection explains the outcomes of immigrants in the destination country. The latter can be assessed in terms of how far selectivity differentiates between immigrants in their outcomes or in how far it accounts for immigrant-native gaps. Specifically, applied to health, the first question addresses whether emigrants are healthier than their non-migrant counterparts *at origin*, regardless of whether they are healthier than those at destination. The second question depends on measures derived from the first, and addresses whether those who are more selected experience better outcomes *at destination* compared to the less selected and whether those more selected drive the commonly observed immigrant health advantage.

Both questions thus require a comparison of emigrants to non-migrants at origin, ideally before or around the time of migration. Measures of post-migration health status may be confounded by the health effects of migration and of the time spent in the destination country (Feliciano 2020; Jasso et al. 2004), effects that are themselves liable to differ cross-nationally. The longer the outcomes of migrants are measured after migration, the more selection may be confounded with the time spent in the destination country. As a result, to answer the first question, studies tend to measure immigrants' health status relatively close to migration. For example, Akresh and Frank (2008) focused exclusively on migrants surveyed in the year they arrived in the US, finding evidence of health selection. However, selection is measured through migrants' own appraisal of their health relative to their non-migrant co-nationals, a sub-optimal indicator. Lu et al. (2017) also compare migrants who arrived in the previous year either to the US or Canada as a cross-national comparison of overweight and long-term conditions. However, as they do not compare the immigrants to non-migrants in their sending countries, their study cannot investigate the effect of *selectivity* relative to sending country distributions.

When attempting to gauge how selectivity is realised in health outcomes, studies use a longer time window but still limit their attention to 'new' migrants. For example, Riosmena et al. (2013) evaluate migrant selectivity across a variety of health outcomes, among older Mexican adults within 15 years of arrival; and Kennedy et al. (2015) use a 10-year window to compare selection in self-reported health and chronic conditions across the US, UK, Canada and Australia. These allow for conclusions about the relationship between immigrant selectivity and the immigrant health advantage, but only for a limited set of origin countries. Additional evidence comes from studies of health selection in datasets that follow immigrants from Mexico to the United States (Arenas et al. 2015; Rubalcava et al. 2008; Ullmann et al. 2011) but these also may not have wider applicability and lack the variation – and therefore the predictive potential – offered by multiple origins. Studies of *internal migrants*, whose health can be observed pre-migration in longitudinal national surveys (Nauman et al. 2015; Westphal 2016) can address both the extent of selectivity and its consequences. However, whether such findings apply to international migrants is unclear.

An alternative is to identify a *stable measure* of health that is both consistent across origin and destination contexts and is not susceptible to acculturation processes, comparable to the use of relative education as a stable marker of immigrant selectivity. Since educational selectivity can be relatively easily and reliably estimated, several studies have attempted to answer the second question by measuring the association between immigrants' *educational selectivity* and their health at destination. Findings are also mixed: some find a positive association (Florian et al. 2021; Ichou & Wallace 2019), others find an association only for some health outcomes (Ferrara & Cozzani 2024), while others find no association (Luthra & Platt 2023). Although relative education might be expected to be positively associated with health (Jasso et al. 2004; Kennedy et al. 2015) it is unclear to what extent educational selection can successfully proxy for health selection. Instead, a direct and stable measure of health selection can be offered by relative height.

Height and Health Selectivity

Adult height is the product of individuals' genetic endowment and their early life exposure to a range of environmental factors. The latter include disease, health care and nutrition both in utero and, importantly, during infancy as well as later childhood (Perkins et al. 2016; Silventoinen 2003). The relative importance of environmental factors compared to genetic influences in individual heights is estimated at between 20% and 40%, although a clear separation of genetic and environmental characteristics is contested in the literature (Yang et al. 2015; Zuk et al. 2012). Inherited height is itself partly a function of nutritional status and health shocks across prior generations. Within countries, height is positively associated with adult health and negatively associated with mortality, even net of socioeconomic status and genetic endowment (Koch 2011; Nelson et al. 2015; Perkins et al. 2016). Historically increases in population height, and the heights of children in particular, have been attributed to improvements in hygiene, reductions in child mortality, and increases in nutritional intake (and the reduction in stunting), which enables individuals to reach their underlying genetic potential (Case & Paxson 2008; Garcia & Quintana-Domeque 2007; Perkins et al. 2016).

Between countries, however, the patterns are more complicated. Not only are there longstanding genetic drivers of population height that differ across the globe (Roser et al. 2021), but, as Deaton (2007) has argued, differential survival may increase population heights if only the most robust survive, leading to greater heights in some poorer countries. Famines and other contextual health shocks may also impact the height development of specific generations, leading to different implications of height measured at different times. Therefore, height as a marker of underlying health, makes sense only relative to the comparator population – from the same historical period (or birth cohort) and country. Relative height thus offers a measure of advantaged health exposure within a sending country that can be compared across countries with different average levels of height.

Adult height is relatively stable between the ages of around 20 and around 40-50, with shrinkage beginning in middle age (Sorkin et al. 1999). Height also differs significantly between adult men and women (Roser et al. 2021) – and the gap between average men's and women's heights also varies across countries. Immigrants' relative height, measured as the extent to which they are taller than individuals from their same origin country, birth cohort and sex between ages 20 to 50 can therefore act as a stable measure of underlying health and enable the estimation of individual level variation in selectivity, its drivers and consequences.

Recognising this, prior studies have shown that Mexican immigrants to the US (Riosmena et al. 2013) and those from four other sending countries (Riosmena et al. 2017) tend to be positively selected in terms of height. A small number of studies have also found an association between such selection and health outcomes (Crimmins et al. 2005; Donato et al. 2019; Riosmena et al. 2013). However, we lack insights from the European context and for a more comprehensive range of origin countries. We therefore extend existing research by constructing a measure of relative height for a representative sample of immigrants to one of the main destination countries in Europe and for a diverse range of origin countries. This allows us to test the general expectation:

H1: Immigrants to Germany are positively selected in relative height on average.

Variation in Height Selectivity

Alongside the expectation that immigrants are on average selected on relative height, we also anticipate that there will be substantial variation in selectivity according to the conditions under which different immigrants migrated. The literature gives us some guidance on whom we might expect to be more or less selected. These expectations have been qualitatively assessed by comparing differential height selection across five origin groups in the USA (Riosmena et al 2017); but they have not yet been examined for a representative sample of the foreign born. We therefore test if height selectivity varies across immigrants facing different motivations for and barriers to international migration.

The degree to which immigrants are positively selected is likely to be associated with the extent to which they are moving for primarily economic reasons, as those who are pioneer migrants tend to reap the highest rewards in the labour market, consistent with them being more highly selected in general (Borjas 1987; Holz 2022). Those who migrate as marriage migrants, by contrast, tend to have less positive economic outcomes (Samper and Kreyenfeld 2021), consistent with the expectation that they are less highly selected. Since older individuals and women are more likely to migrate as part of a family move ('tied movers'), it is to be expected that they will be less selected on health (Ballarino and Panichella 2018; Gubernskaya 2015). This is likely to be the case even if their intentions are mixed, and their expressed reasons for migration are not solely family reunification. Similarly, the evidence shows that refugees have poorer economic outcomes, which is associated with them being less selected since their migration is not chosen but forced (Bakker et al. 2017; Kogan and Kosyakova 2023; Salikutluk et al. 2016).

The level of selection is also expected to be greater where there are greater barriers to overcome. Greater costs and challenges to migration are associated with greater selectivity (Chiswick 1999; Jasso 2004; Donato et al. 2019). These costs and challenges comprise physical distance, accessibility (e.g. whether or not a visa is required to migrate), the restrictiveness of the immigration regime more generally, which can of course vary for a given country over time, and financial costs, which will be greater for those migrating from poorer countries (Belot & Hatton 2012). More restrictive migration regimes, which countries across Europe have tended to adopt over time for non-EU migrants, tend to select more explicitly on skills, which are themselves likely to be correlated with health status (Chiswick et al. 2008).

Thus, we would expect migrants to be more selected, i.e. to have greater relative height, where they:

H2a) are actively seeking returns to migration as economic, rather than political or family migrants;

H2b) face greater challenges in migrating, that is, those from non-EU, more distant, and poorer countries;

H2c) are men and younger: since women and older migrants are more likely to be tied migrants, following spouse or family members.

Height Selectivity and Health Outcomes

If relative height offers a stable measure of early life health exposures, it follows that we would expect it to be positively associated with health outcomes in adulthood, with those more negatively selected facing worse health overall and over time. Previous papers in this journal have convincingly demonstrated that relative adult height is strongly associated with variation in early childhood health and health exposures, and that relative adult height is in turn predictive of economic and health outcomes throughout adulthood (Bozzoli et al. 2009; Case & Paxson 2010). Even among siblings with the same mother, children with better early life health (born longer and heavier, and where the mother received prenatal care during pregnancy) are taller on average (Case & Paxson 2010).

Individuals with better prenatal and early childhood health environments have better health across the life course, even in the medium- and long-term, due to multiple biological mechanisms and socioeconomic interactions, many of which may be strongest in less developed countries (McEniry 2013). For instance, epigenetic responses to malnutrition during gestation and early life may lead to earlier kidney development or more rapid weight gain during childhood, which is then a direct cause of early depletion of renal reserve and subsequently earlier onset of kidney failure or type 2 diabetes later in life (Barker 2004; Jones et al. 2019). Because of this, we would anticipate that those on the higher end of the relative height distribution – those who are positively selected on health – to have better health outcomes. Since there is no single measure of good health, we follow existing literature (e.g. Riosmena et al. 2013; Lu et al. 2017) in using multiple health measures, in our case, subjective, physical and behavioural, to test the following:

H3a: Immigrants who are positively selected have better health outcomes than those who are negatively selected.

H3b: Following from H1, there is an immigrant health advantage relative to the native-born population, some of which is explained by relative height.

The Impact of Height Selection Over Time

A body of research has extended the paradox of the immigrant health advantage by noting that immigrant health, rather than improving with time at destination as economic opportunities and access to healthcare increase, tends to decline. Research has generally assessed three complementary hypotheses to explain this phenomenon: acculturation stress, where the accumulation of exposure to discrimination and harsh working and living environments leads to steeper declines in health over time, a process also referred to as weathering among native minorities (Geronimus et al. 2006); unhealthy assimilation, whereby immigrants abandon healthier behaviours imported from the home country in favour of those prevalent in the receiving country, such as higher rates of smoking (Abraído-Lanza et al. 2005), and to a lesser extent selective return migration (see for instance for Germany Sander 2007).

We propose a complementary hypothesis for immigrant health decline over time which is a natural extension of the hypotheses already outlined above, but which to our knowledge has not been yet assessed. We posit that even if on aggregate, immigrants are both positively selected (on height) and face health decline over time, those who are more positively selected are not only healthier overall, but that they also experience less deterioration in health. Our reasoning is as follows. First, migration is physically taxing, and is therefore dominated by those in relatively good health *at the time of migration.* Immigrants who are *both* positively *and* negatively selected in terms of early childhood health exposures, and subsequently with greater or lesser degrees of relative height, are therefore expected to be healthier than similar receiving country natives or non-migrants at the time of their arrival. It is well documented that migrants, in particular economic migrants but even those joining family members or forced migrants, are unlikely to move if they are unwell (Baldassar 2014; van Dalen & Henkens 2008). Thus, we expect that the health premium accruing to those with higher health selectivity will be less observable immediately following migration.

However, those whose underlying health status is poorer, will reveal itself more over time: steeper deterioration in health among those more negatively selected is the interaction of poorer health conditions in early ages with the general ageing effects of molecular damage and delayed cell repair (Langie et al. 2012). Migration is most common among individuals in early adulthood: 75% of migrants in our sample migrated before age 30 (see Table 1 below).

However, many of the poor health conditions associated with early life health exposures, including diabetes, kidney disease, cardiovascular illness, and metabolic syndromes, are generally not observed until later in in the life course (Tarry-Adkins & Ozanne 2014). In terms of the specific routes that have been used to explain immigrants' health decline, those with poorer underlying health are by definition more likely to suffer from 'weathering'; they may also have fewer biological resources to withstand the impacts of the accumulation of stressors following migration, and may be more susceptible to negative consequences of changes in health behaviours.

We therefore posit that:

H4a: More negatively selected immigrants experience more negative health trajectories over time than more positively selected immigrants.

H4b: The immigrant health paradox of declining immigrant health relative to natives is driven by those more negatively selected

This paper attempts to solve some of the shortcomings in the literature we reviewed and rigorously test the two questions underlying the immigrant selection hypothesis. More concretely, our goal is to (a) reliably measure immigrant *health selectivity*, and (b) to test whether it varies in the ways we expect it should; before c) testing the association between our measure of selection and immigrants' health at destination, and (d) investigating if degree of selectivity can explain immigrant-native gaps and how they evolve over time (i.e. the immigrant health paradox).

Data and methods

Data and Sample

Our main data source is the German Socio-Economic Panel (SOEP), an annual longitudinal household panel survey covering a nationally representative sample of the German population (Goebel et al. 2019). The survey includes refreshment samples covering the German immigrant and refugee population. We primarily use the 2014 wave for three reasons. First, it enables us to maximize the numbers of immigrants in our sample, since it immediately follows a large migrant refreshment sample in 2013. Second, it contains measures of self-reported height and key health outcomes that were asked biennially. Third, it is relatively close in time to when most of our international height data was gathered (see below). To test the robustness of our cross-sectional results concerning time since arrival, we also follow our 2014 sample until 2021, the latest available wave (cf. Ferrara et al. 2024).

We additionally draw on a specially-constructed dataset of height distributions from multiple countries in order to calculate the relative height of immigrants in the SOEP. To construct this dataset, we compiled data from a range of surveys that use both self-reported and directly measured height. The largest, covering multiple countries are the WHO's World Health Survey (WHS), the EBRD's Life in Transition Surveys (LiTS), and the Demographic and Health Surveys (DHS). We also used country-specific surveys to cover additional countries, such as the Joint Canada/United States Survey of Health (JCUSH), the Swiss Household Panel, and the Household, Income and Labour Dynamics in Australia (HILDA) survey. For more information and references see Appendix, Table A1. Where we have height data on a country from more than one source, we prioritise the DHS, as it includes directly measured height, followed by the LiTS, as it has larger samples than the WHS.

To ensure that we measure adult height distributions before shrinkage sets in (Sorkin et al. 1999), we use height reported only between the ages of 20 and 50. We trim heights for implausible outliers, excluding those whose adult heights were below 130cm or above 210cm. We calculate average heights and standard deviations, adjusted by survey weights to be nationally representative, for men and women separately by 10-year birth cohort. We exclude values based on samples of fewer than 30 individuals. This results in the loss of six immigrant observations from our final SOEP sample. Note that since surveys were administered in different years (e.g. WHS in 2002 and the LiTS in 2016 – see Table A1), they cover slightly different birth cohorts.

Our analytical sample of immigrants comprises all individuals aged 20 to 60 present in the 2014 SOEP wave who migrated at or after the age of 18, and for whom we have a valid height observation (from 2014 or earlier) between the ages 20 and 50. We exclude those missing information that enables us to match them with our height dataset (country of birth, sex, birth cohort), as well as those coming from countries and birth cohorts for which we lack height information (about 11% of the remaining immigrant sample). Finally, we exclude cases with missing control variables, resulting in a sample of 2,114 immigrants. To estimate immigrant-native health gaps we construct a corresponding sample of 14,320 individuals aged 20-60 and born in Germany to two German-born parents.

Note that these are our maximum samples. Sample sizes vary slightly across the analyses due to differences in missingness in specific variables. Table 1 provides the case numbers for all variables – and hence analysis samples. The largest loss of cases is for our measure of diagnosed illness, which was not included in the 2014 wave, and so depends on information provided by those still present in the 2015 wave.

Measures

We construct our measure of *relative height* by matching individuals in the SOEP sample to values in the height dataset based on country of birth, 10-year birth cohort and sex. Since height is normally distributed, we can use immigrants' reported height from the SOEP along with the matched height averages and standard deviations from our height dataset to build a Z-score. This offers a continuous measure of height selectivity as the distance in standard deviations between immigrants' height and the average height of individuals from their same country, birth cohort and gender. We also split the continuous distribution into four quartile groups from the most negatively selected (1) to the most positively selected (4). This enables us to assess non-linearities and to compare differently selected immigrants with the native German population.

We use four *outcome measures of health*: subjective health, as measured on a five-point scale; physical health as measured by the SF-12, with a potential range from 0-100; respondents' number of doctor visits in the last year (continuous), and whether the respondent has ever been diagnosed with a health condition[2] (binary). These capture a variety of health measures, from more subjective to more objective, and including healthcare usage as well as reported conditions. These may not always move in parallel for migrant populations and thus benefit from being studied jointly (Ferrara et al. 2024).

To test the *correlates of selectivity* we use: age at migration (grouped into 18-25; 26-30; and 31-50); migration cohort (1970-1990; 1991-2000 and 2001-2015); reported reason for migration (political, economic, family, other, and "missing"); whether migration was from an EU or non-EU country or a country that subsequently joined the EU (e.g. Poland before 2004); origin country per capita GDP in PPP and constant dollars (World Bank 2024) in the year as close as possible to the time of migration; an indicator for whether the origin country had a colonial relationship to Germany; geographic distance (measured as air distance between the country capital and Berlin) (Mayer & Zignago 2011); and a measure of educational selectivity based on Ichou (2014).

We include the following *controls* in our models of health outcomes: current age (linear and squared), sex, educational attainment (3 categories based on the UNESCO (2006) International Standard Classification of Education (0-2, 3-4, 5-6), region of residence (former

[2] Conditions surveyed in the SOEP include: asthma, diabetes, cancer, cardiac disease, depression, dementia, high blood pressure, migraine, stroke, or "other illness". Unlike the other health outcome measures this was not collected in 2014 so we are using the values from 2015.

East or West Germany), country or region of birth[3] (in models with migrants only; categories are reported in Table 1) and time since arrival (continuous or categorical – 0-10; 10-20; 20+ years depending on the specification).

Since it is *relative* height that provides our indicator for early life health and health exposures within countries, given the wide variation in absolute heights cross-nationally, we do not include *absolute height* in our main models. There is no theoretical expectation for an advantage of absolute height independent of relative health for the health outcomes that are the focus of our paper (unlike, say, labour market outcomes); and, empirically, to do so risks introducing problems of collinearity into the estimates. For completeness, however, and to check for the sensitivity of our results, we estimated models of our main results including absolute height (see Appendix Figures A2-A5). We find no independent advantage of absolute height and, despite some increases in the standard errors, our conclusions are substantively unchanged.

Table 1 describes our immigrant sample. On average, immigrants are slightly taller – or positively selected – for their same birth cohort and origin country. This varies substantially by sex, however, with men a third of a standard deviation taller on average whereas women are an eighth of a standard deviation shorter than their country of origin counterparts of the same age. Men are more likely to be economic migrants than women and women are more likely to be family migrants. Our sample covers a wide range of recently arrived (0-10 years), and more established migrants (20+ years). As we would expect, they mostly come from Central Asian, Eastern European, and Mediterranean countries. The sex ratio in our unweighted sample comprises 59% women, reflecting wider patterns in survey response; but the weighted estimates provide a more balanced 54% female.

Table 1. Descriptive statistics

	All		**Female**		**Male**	
	Mean	N	Mean	N	Mean	N
Height selectivity	0.07	2114	-0.15	1244	0.32	870
Time since arrival						
0-9	0.33	2114	0.30	1244	0.36	870
10-19	0.36	2114	0.37	1244	0.35	870
20 or more	0.31	2114	0.33	1244	0.29	870
Educational attainment						
Primary or less	0.21	2114	0.23	1244	0.19	870
Secondary	0.47	2114	0.41	1244	0.55	870
Tertiary	0.31	2114	0.36	1244	0.26	870
Other controls						
Male	0.46	2114	0.00	1244	1.00	870
Age	40.93	2114	41.14	1244	40.69	870

[3] We report values for countries with at least 30 cases.

Former Eeast Germany	0.04	2114	0.04	1244	0.05	870
Origin country/region						
Bosnia & Herzegovna	0.02	2114	0.01	1244	0.02	870
Croatia	0.02	2114	0.03	1244	0.02	870
Greece	0.01	2114	0.01	1244	0.01	870
Italy	0.05	2114	0.04	1244	0.05	870
Kazakhstan	0.09	2114	0.09	1244	0.10	870
Kosovo	0.03	2114	0.03	1244	0.03	870
Poland	0.11	2114	0.12	1244	0.10	870
Romania	0.06	2114	0.07	1244	0.05	870
Russian Federation	0.07	2114	0.08	1244	0.07	870
Serbia	0.01	2114	0.02	1244	0.01	870
Spain	0.01	2114	0.01	1244	0.01	870
Turkey	0.13	2114	0.12	1244	0.15	870
Ukraine	0.02	2114	0.03	1244	0.01	870
Central Asia	0.02	2114	0.02	1244	0.02	870
Eastern Europe	0.05	2114	0.05	1244	0.06	870
Northern Africa	0.03	2114	0.02	1244	0.04	870
South Asia	0.02	2114	0.02	1244	0.03	870
South East Asia	0.04	2114	0.04	1244	0.03	870
West/Cont Europe	0.12	2114	0.12	1244	0.12	870
Other	0.07	2114	0.07	1244	0.07	870
Predictors of selectivity						
Educational selectivity	47.33	2037	50.14	1200	44.07	837
1k constant PPP US dlr	10.51	2037	10.14	1200	10.94	837
Prior colony	0.12	2037	0.12	1200	0.11	837
Distance (1k Km)	2.61	2037	2.61	1200	2.61	837
Migration age						
18-25	0.53	2037	0.56	1200	0.50	837
26-30	0.26	2037	0.25	1200	0.27	837
31+	0.21	2037	0.20	1200	0.24	837
Reason for migrating						
Political	0.06	2037	0.03	1200	0.10	837
Economic	0.24	2037	0.20	1200	0.28	837
Family	0.40	2037	0.47	1200	0.31	837
Other	0.24	2037	0.24	1200	0.23	837
Missing	0.07	2037	0.06	1200	0.07	837
EU country						
EU	0.26	2037	0.23	1200	0.30	837
Not yet EU	0.16	2037	0.21	1200	0.10	837
Non-EU	0.58	2037	0.56	1200	0.60	837
Health outcomes						
Subjective health (1-5)	3.55	2114	3.47	1244	3.65	870
SF-12 Physical health (0-100)	50.82	2078	50.16	1225	51.59	853
Annual doctor visits	7.88	2113	9.29	1243	6.25	870
Diagnosed condition (0-1)	0.54	1684	0.58	996	0.49	688

Notes: Weighted values, except for case numbers.
Source: GSOEP 2014 wave and height dataset, own calculations.

Analytical Approach

For ease of interpretation, we present our results graphically, with supporting tables in the Appendix. To address our first hypothesis that migrants are positively selected, we illustrate estimates of the degree of height selection for men and women from different national origins and for immigrants overall. To assess whether the degree of selectivity varies in predictable and expected ways (H2a-H2c) we regress our measure of relative height on key determinants outlined above and illustrate marginal effects of predictors.

To evaluate whether selection is associated with observed health outcomes, we employ relative health as a key independent variable for each of the four health measures. This tells us whether selection is associated with better health among immigrants as expected (H3a). We estimate nested models including our suite of controls outlined above. However, this does not shed light on how far selection is driving an immigrant health advantage. For that we draw on our comparative sample of native-born Germans and assess, for each of four quartile groups of selectivity, whether or not they are (increasingly) associated with a health gap (or immigrant health advantage) for each of the health outcomes (H3b).

Finally, we turn to the question of whether differential selection can help to shed light on the paradox of relatively good health on migration but declining health over time. We first interact selectivity with different durations since migration to assess whether any health declines are lower for those immigrants who are more highly selected (H4a). Given the potential confounding of cohort and temporal effects in such analysis (Ferrara et al. 2024), we supplement this with additional fixed effects analysis of a subset of our sample who are observed up to 2021, splitting between quartiles of selectivity. To shed light on whether differences in selectivity can also help to explain the paradox of relative declining health compared to the native-born we again compare immigrants across quartiles of health selectivity interacted with time since migration to our non-immigrant sample (H4b).

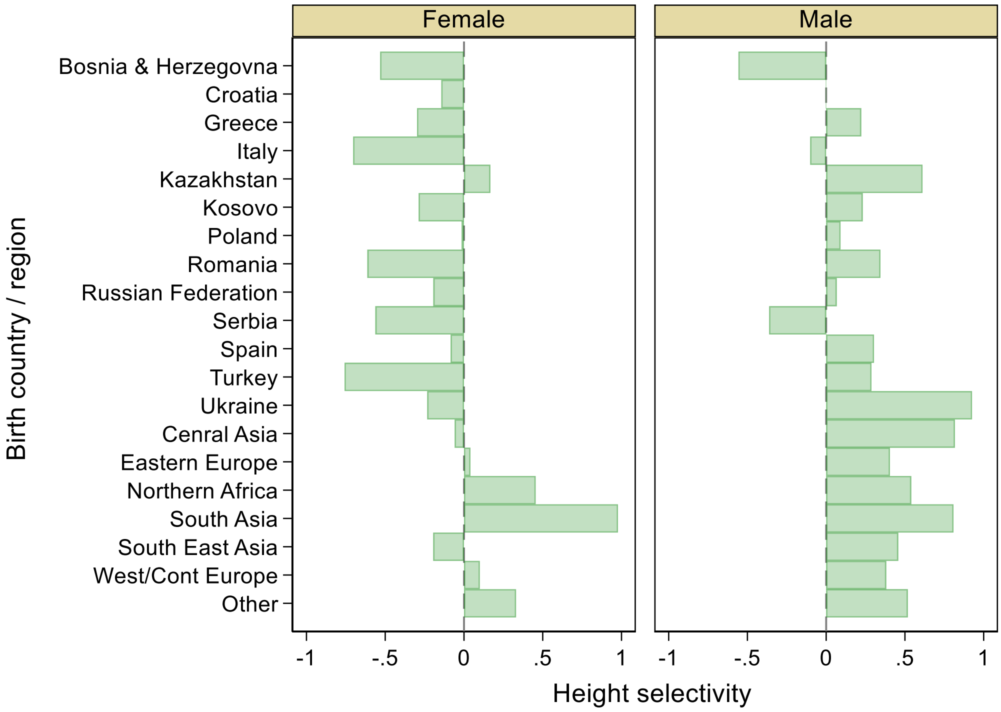
All of our models are weighted using SOEP cross-sectional weights.

Results

Are Migrants Selected on Height?

Table 1 showed that, in line with H1, migrants do indeed tend to be selected on relative height on average, but that this is driven by men in the sample. Figure 1 shows that there is also variation in both the degree and direction of selectivity by country of origin, though in general men are positively selected from most origin countries, whereas women tend to be on average negatively selected. Across all origins, however, there are those who are both positively and negatively selected and there is overlap between the relative height of men and women (see Figure A1 in the Appendix).

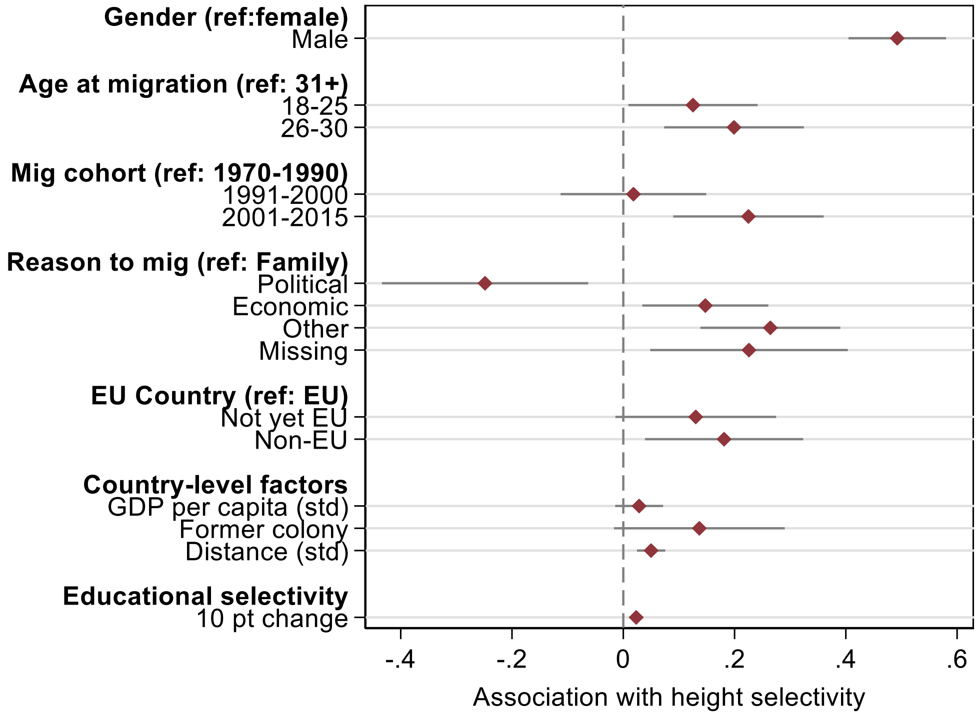
Figure 1. Average height selectivity by gender and origin



Notes: Weighted estimates.
Source: GSOEP 2014 wave and height dataset, own calculations

These variations in degree of selection might reflect differences in the conditions under which the more or less selected migrated. We therefore estimated a model of the expected correlates of height selectivity (Figure 2, Table A2). This shows that, consistent with expectations, those who migrated for political or family reasons tend to be less selected than economic migrants, once other characteristics are controlled (H2a). Those who migrated more recently are more highly selected, as are those migrating from a country outside the EU; and distance is also associated with selectivity as expected (H2b). However, GDP is positively associated with selectivity, which is in the opposite direction to that expected. Even net of reasons for migration and other predictors, men are much more likely to be selected on height than women as are those who were younger at migration (H2c). Consistent with inferences from previous research (e.g. Ichou and Wallace 2019; Ferrara and Cozzani 2024), educational selectivity is positively associated with contextual height. All in all, this provides compelling evidence that greater relative height offers a robust measure of migrant selectivity.

Figure 2. Predicting immigrant height selectivity

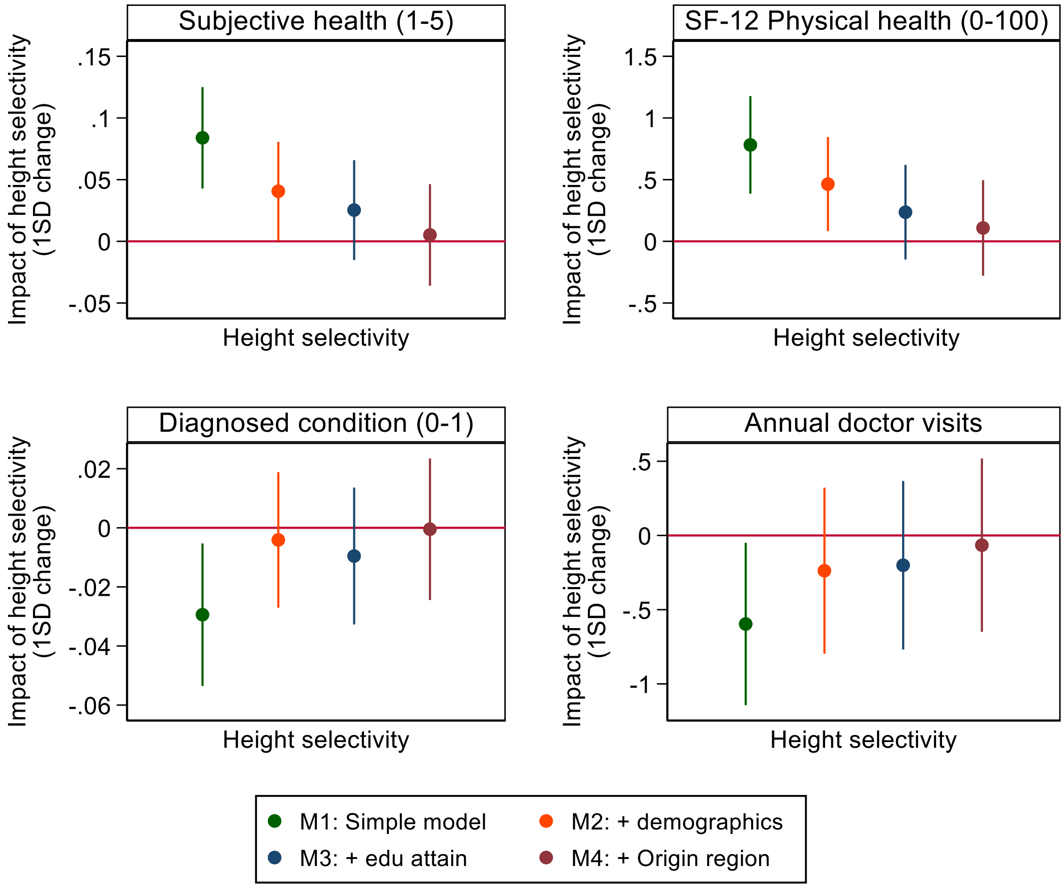


Notes: Weighted estimates with 95% confidence intervals obtained from a single OLS regression.
Source: GSOEP 2014 wave and height dataset, own calculations

Is Height Associated with Better Health Outcomes?

We then turn to the question of whether such selectivity on relative height is in fact associated with better health outcomes. We estimate sequential models for each of our health outcomes (see Appendix, Tables A3-A6). Since we are focusing on an immigrant sample, this does not tell us directly about the immigrant health advantage, but instead tests whether relative height distinguishes health outcomes among immigrants. Interestingly, as we see in Figure 3, once we control for other characteristics, any health advantage associated with greater selectivity dissipates. This suggests that, net of other characteristics with which health selection is associated, including educational attainment and demographic profile, selection on height is not associated with better health outcomes for immigrants in Germany, contradicting our expectation in H3a.

Figure 3. Impact of selectivity on health outcomes

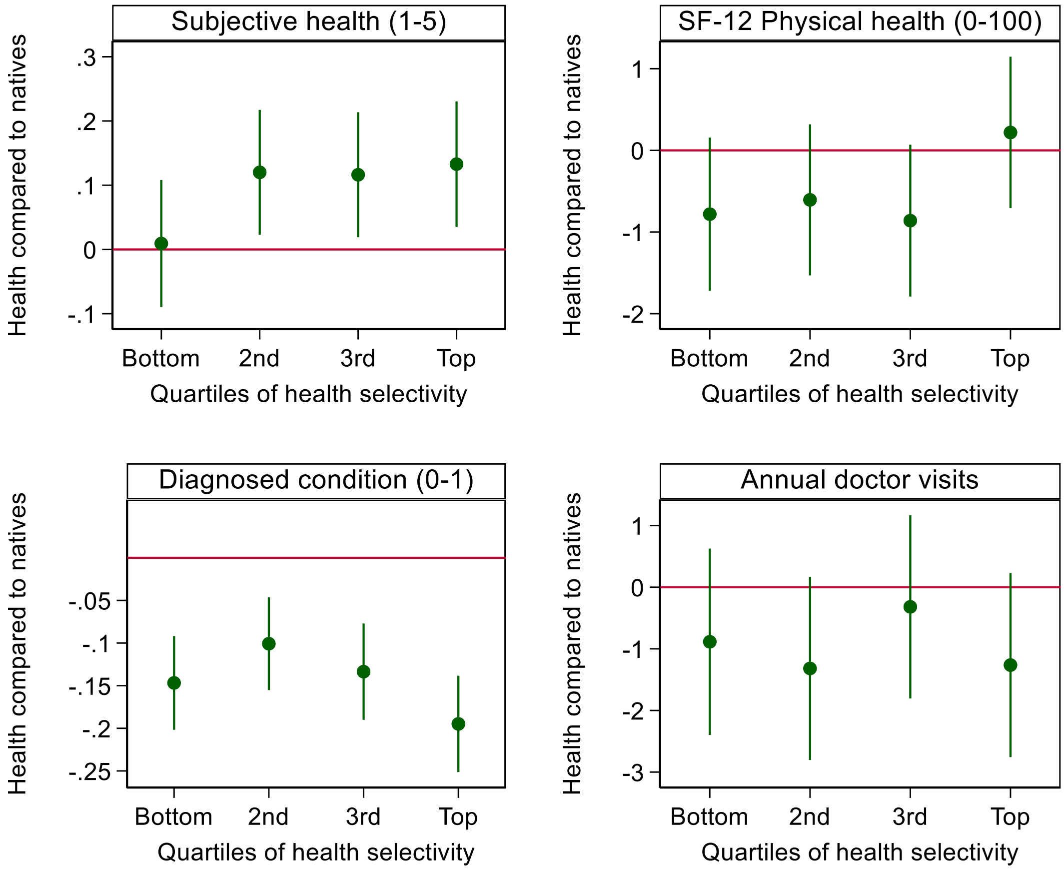


Notes: Weighted estimates with 95% confidence intervals from OLS regressions. M1 includes only height selectivity. M2 additionally controls for sex, age (linear and squared), time since arrival (categorical) and an indicator for living in East or West Germany. M3 additionally controls for educational attainment (3 categories), and M4 for origin region (see Table 1 for categories).
Source: GSOEP 2014 wave and height dataset, own calculations

Does Selection Explain the Immigrant Health Advantage?

It follows that height selection should also not explain any immigrant health advantage relative to the native born in Germany. Figure 4 (see Appendix Table A7) plots the health outcomes of immigrants relative to natives, from the lowest to the highest quartiles of health selectivity and including the full range of controls from Model 3. While there is some evidence for an immigrant health advantage – all immigrants have an advantage in terms of diagnosed conditions and all but those least selected on height have a health advantage in terms of subjective health – immigrants are not advantaged in terms of physical health or doctor's visits. Consistent with our previous analysis, Figure 4 demonstrate that there is no relationship between selectivity on height and any immigrant health advantage, with estimates statistically indistinguishable from one another across the quartiles. Our expectation of a health premium for immigrants relative to natives (on average) is therefore only partially fulfilled, and any advantage is not attributable to variation in relative height, contra H3b.

Figure 4. Immigrant-native differences in health, by immigrant selectivity



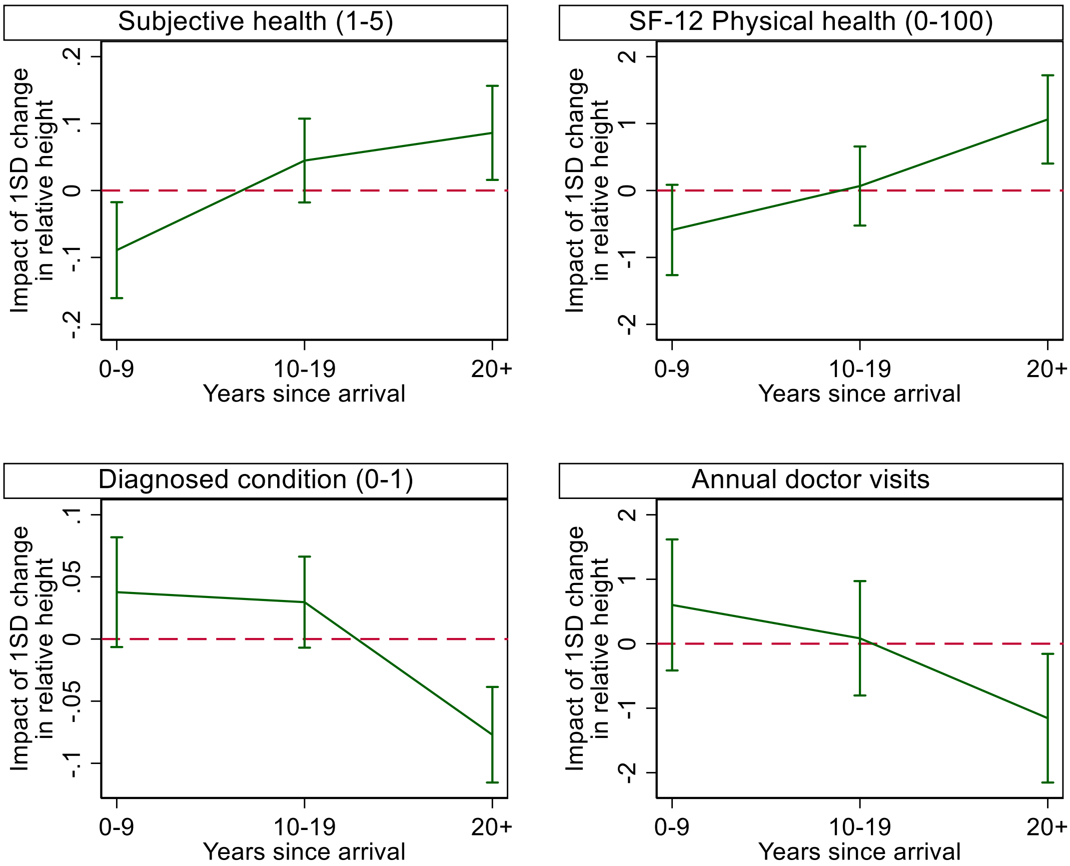
Notes: Weighted estimates with 95% confidence intervals from OLS regression. Controls include sex, age (linear and squared), an indicator for living in East or West Germany, and educational attainment (3 categories).
Source: GSOEP 2014 wave and height dataset, own calculations

Does the Effect of Selection Differ Over Time Since Arrival?

However, as we noted at the outset, aggregate differences in the immigrant-native health gaps may conceal variation among more and less recently arrived immigrants: the gaps observed in Figure 4 represent a combination of the impact of health selectivity immediately upon arrival as well as diverging temporal effects for more and less selected immigrants over time. Even if we do not observe a relationship between selectivity and health outcomes among immigrants as a whole, differences may reveal themselves across migrants' time since arrival. We thus turn to consider H4a, which posits that relative height moderates the relationship between time since migration and each of the four outcomes.

Figure 5 (see Appendix Tables A3-A6) supports this contention: the effect of health selectivity on health outcomes varies by time since arrival, such that those who are more selected demonstrate better health with longer durations of stay compared to those who are less so. Amongst immigrants who have resided in Germany for twenty years or more, those with higher levels of relative height are clearly healthier on all outcomes than those not.

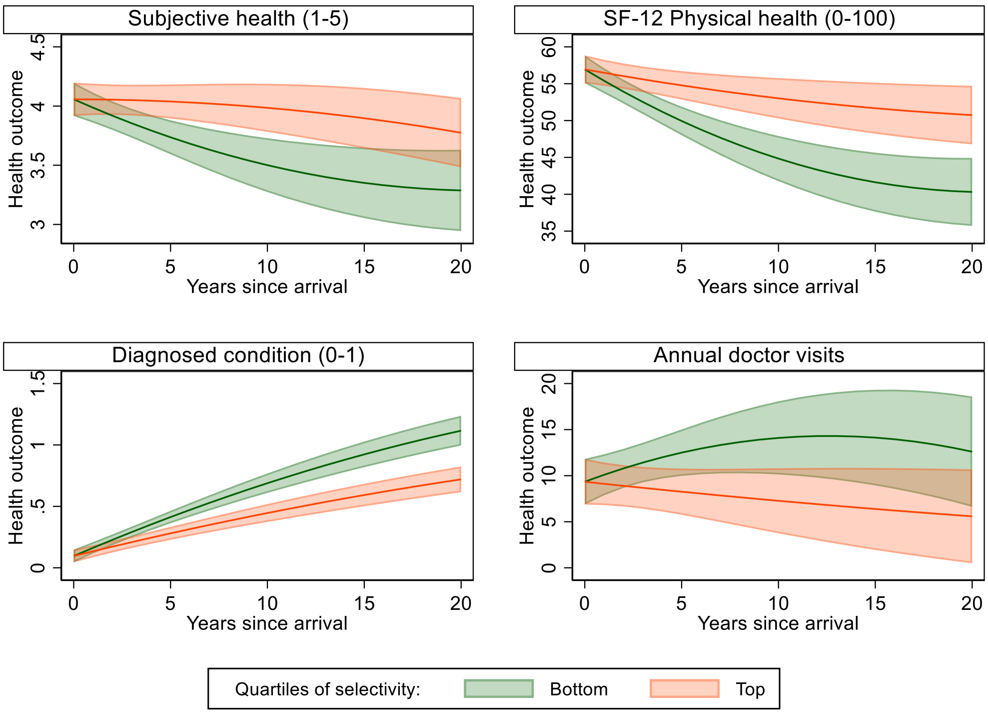
Figure 5. The impact of selectivity on immigrant health, by time since arrival



Notes: Weighted estimates with 95% confidence intervals from OLS model. Controls include sex, age (linear and squared), an indicator for living in East or West Germany, educational attainment (3 categories), and origin region (see Table 1 for categories).
Source: GSOEP 2014 wave and height dataset, own calculations

This pattern could of course be attributed to being an artefact of the cross-sectional data capturing cohort differences in the relationship between health and selectivity rather than a true temporal (duration) affect (Ferrara et al. 2024). We therefore conducted additional fixed effects analysis of those from the 2014 cohort who were observed up to 2021, thereby capturing within-individual impacts of the effect of duration on health outcomes. Figure 6 illustrates the results from this analysis, distinguishing, for ease of readability, those in the top quartile group of selectivity from those in the bottom quartile group (see Appendix Table A8 for full results). These results are consistent with the duration effect we see in Figure 5. That is, over time being more selected results in a positive health gap compared to those less selected.

Figure 6. Fixed effects estimates of immigrant health by time since arrival and height selectivity (top and bottom quartiles)



Notes: Margins obtained from fixed effects models interacting quartiles of immigrant selectivity with time since arrival. Weighted estimates with 95% confidence intervals. Note that the intercept represents the average of all fixed effects.
Source: GSOEP waves of 2014 to 2021 and height dataset, own calculations

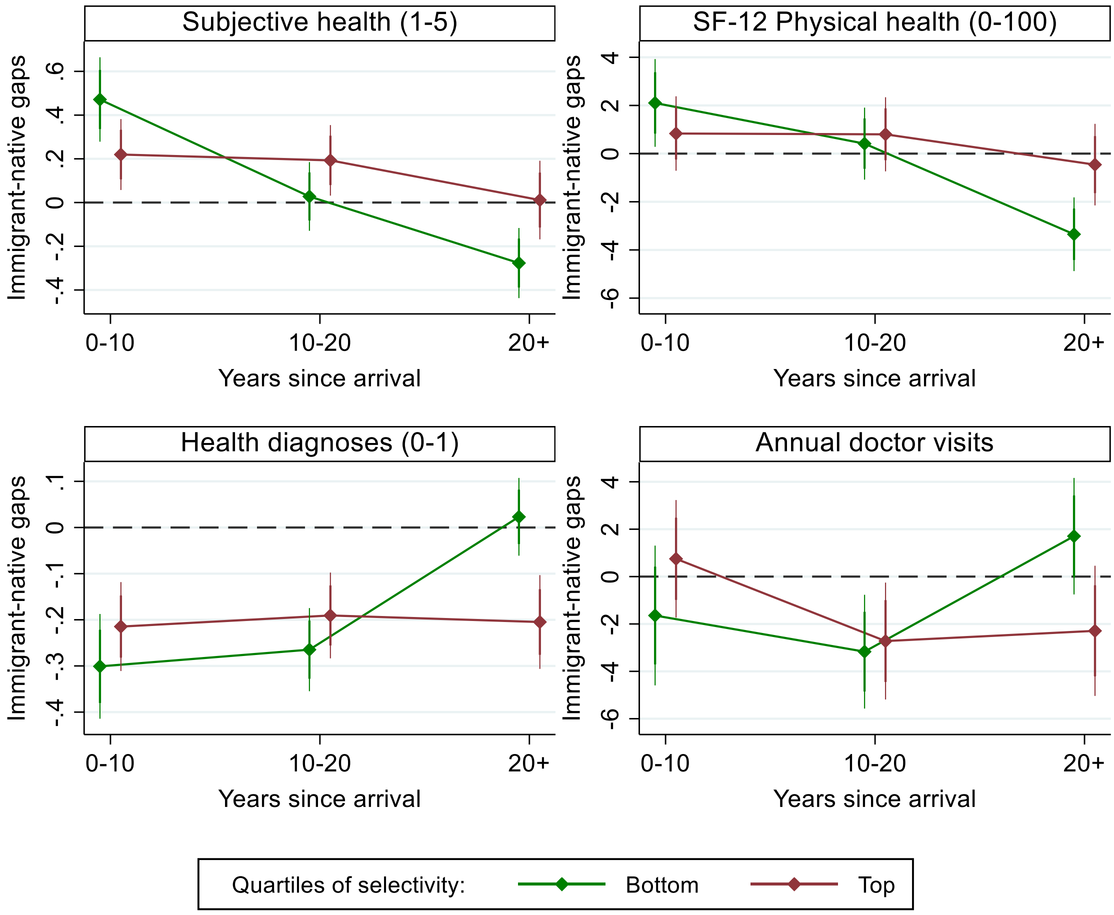
Can Degree of Selectivity Help to Explain Health Acculturation?

This suggests that the outcomes of the more negatively selected follow the acculturation thesis. To assess this directly, we evaluate whether being more (less) selected drives a growing positive (negative) health gap between migrants and native-born over time since arrival (H4b).

Figure 7 plots the immigrant-health gap by quartile groups of relative height over periods of time since migration, showing just the top and bottom quartile groups for clarity. (See Appendix, Table A9 for full results). This figure shows that while both negatively and positively selected immigrants share an initial health advantage over (or parity with) native Germans at the time of arrival, those less selected experience clear declines with duration of stay that result in negative gaps for physical and subjective health and wipe out the advantage in diagnosed conditions. For those positively selected, by contrast, while a slight advantage relative to native-born in subjective health disappears over time, they remain comparable to natives in physical health and retain a stable advantage in diagnosed conditions. In terms of doctor visits, they move from being similar to being advantaged relative to the native born.

This implies that the immigrant health paradox is not so paradoxical after all. Rather, it is a consequence of the emerging health status of those whose underlying health endowment predisposes them to poorer health, which, at the time of migration, had not materialised sufficiently to prevent them migrating.

Figure 7. Immigrant-native gaps in health by time since arrival and height selectivity (top and bottom quartiles)



Notes: Weighted estimates from OLS regression. Figure presents 95% confidence intervals (thin lines) for testing the significance of migrant-native gaps, as well as 83% confidence intervals (thick lines) for a visual test of significance of differences between the top and bottom quartile groups (cf. MacGregor-Fors & Payton 2013). Controls include sex, age (linear and squared), an indicator for living in East or West Germany, and educational attainment (3 categories).
Source: GSOEP 2014 wave and height dataset, own calculations

Discussion and Conclusions

Despite general expectations that migrants are selected on health, the literature remains focused largely on specific destination countries and a limited set of origins. Even then, explorations of immigrant health selectivity have produced mixed results, partly driven by the diversity of measures and the different time periods at which outcomes are assessed. We present new findings on the health selectivity of immigrants to a large, European immigrant destination country, Germany. We use a stable measure of health selection in the form of relative height. This has a number of advantages: we can produce consistent measures for a wide range of origin countries, we are able to evaluate if it varies in expected ways and we can assess how it performs as a predictor of a range of actual health outcomes for migrants at different points following migration. Given that health evolves over time and is specifically expected to vary in response to conditions at destination, through processes of acculturation, the ability to draw on a stable measure is both necessary and has the potential to shed light on this immigrant health paradox itself. While height has been employed in some existing studies of migration to the US as an indicator of immigrants' childhood nutrition and health status, we expand to a wider set of origin countries and a different destination, with fruitful results.

We showed that, overall, immigrants are selected on height, though there is substantial variation both within and between countries of origin, and male immigrants are much more likely to be selected than female immigrants. Such variation itself gives us the leverage we need to test whether it varies predictably with expected routes to migration, and we found that by and large it did: those from further, non-EU countries and more recent migrants (as well as men) were more likely to be positively selected, while political and family reunification and older (at time of migration) immigrants were less likely to be so.

While, interestingly, we found only a limited relationship between degree of selection and our four distinct health outcomes overall, we found a different pattern when looking over time. Here we identified clear evidence of health decline among less selected immigrants and stability, compared to the native-born, among those more highly selected.

A particular contribution of our study is that we engaged not only with the question of whether migrants are selected on health, which has driven much of the literature, but also with that of whether the degree of selectivity is important for (health) outcomes (Feliciano 2020). In relation to the latter issue, we were also able to test whether degree of selectivity can help us to understand the immigrant health paradox. Without a stable, independent indicator of health selectivity, the relationship between selection and health can only be inferred. In such studies, initial health advantage is taken to be evidence of selection and thus deterioration becomes a paradox – immigrants face deteriorating health *despite* their selected status. Instead, we show that health outcomes close to migration are generally good for both those negatively and positively selected, which plausibly follows from the demands of migration itself. We show that deterioration in health, however, primarily affects those less positively selected: their disadvantaged early life exposures as materialised in relative height predisposes them to worse health outcomes that accumulate over time.

Our study is not without its limitations. First, while relative height offers many advantages as a measure of stable health status in measuring migrant selection on health, it is not the only determinant of health outcomes that may distinguish the experience of immigrants. Second, while we use multiple measures of health outcomes, these are not exhaustive and may miss relevant aspects of immigrants' health and health behaviours that may in turn provide a more complete picture of the evolution of (differently selected) immigrants' health. Future work may benefit from exploring the relationship of relative height to directly measured health conditions / risks (such as blood pressure) and health stressors (such as allostatic load).

Nevertheless, the insights from this paper into how the immigrant health advantage and health paradox are associated with underlying health has potential to shed light on some of the mixed findings that have been observed in the literature. Since the extent to which the immigrant health paradox is observed will depend on the composition of the immigrant population in terms of more and less highly selected on underlying health, it can be expected to apply less or more in different contexts. Further analysis of other contexts and comparisons of the selectivity of their immigrant populations may help to show if this is indeed the case.

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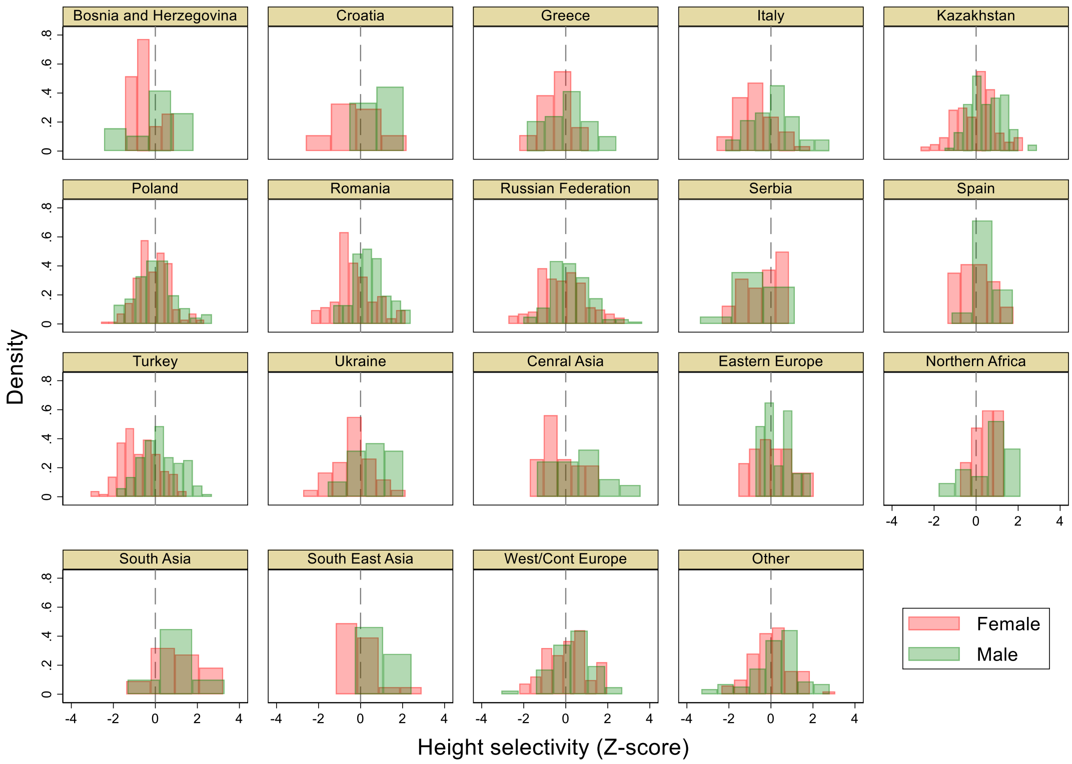
Appendix

Table A1. Summary of surveys used to construct dataset of height distributions across the world

Study	Survey year used	Countries covered	Reference
World Health Survey	2002	Austria, Bangladesh, Belgium, Bosnia & Herzegovina, Brazil, China, Croatia, Czech Republic, Denmark, Ecuador, Finland, France, Ghana, Greece, Hungary, Ireland, Israel, Italy, Kazakhstan, Kenya, Laos, Luxembourg, Malaysia, Mauritius, Mexico, Morocco, Netherlands, Norway, Pakista, Philippines, Portugal, Rusisa, Slovenia, South Africa, Spain, Sri Lanka, Sweden, Tunisia, Turkey, Ukraine, United Arab Emirates, United Kingdom, Uruguay, Vietnam	World Health Organization (WHO). *World Health Survey*. Retrieved from: https://apps.who.int/healthinfo/systems/surveydata/index.php/collections/whs
Life in Transition Survey (LiTS)	2016	Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Greece, Italy, Kazakhstan, Latvia, Lithuania, Macedonia, Montenegro, Poland, Republic of Moldova, Romania, Russia, Servia, Slovakia, Slovenia, Tajikistan, Turkey, Ukraine, Uzbekistan	European Bank for Recontruction and Development (EBRD). *Life in Transition Survey III*. Retrieved from: https://www.ebrd.com/what-we-do/economic-research-and-data/data/lits.html
Demographic and Health Studies (DHS)	2005-2016	Bangladesh, Ethiopia, Ghana, India, Nepal, Zimbabwe	ICF International. *The Demographic and Health Survey Program*. Retrieved from: https://dhsprogram.com/
Joint Canada/United States Survey of Health (JCUSH)	2003	Canada, United States	National Center for Health Statistics & Statistics Canada. *The Joint Canada/United States Survey of Health*. Retrieved from: https://www.cdc.gov/nchs/nhis/jcush.htm
Swiss Household Panel	2004	Switzeland	Tillmann Robin & Voorpostel Marieke & Antal Erika & Dasoki Nora & Klaas Hannah & Kuhn Ursina & Lebert Florence & Monsch Gian-Andrea & Ryser Valérie-Anne, 2022. "The Swiss Household Panel (SHP)," Journal of Economics and Statistics (Jahrbuecher fuer Nationaloekonomie und Statistik), De Gruyter, vol. 242(3). Retrieved from: https://forscenter.ch/projects/swiss-household-panel/
Household, Income and Labour Dynamics in Australia (HILDA)	2006	Australia	Watson, Nicole & Wooden, Mark. 2020. "The Household, Income and Labour Dynamics in Australia (HILDA) Survey", Journal of Economics and Statistics (Jahrbuecher fuer Nationaloekonomie und Statistik), De Gruyter, vol. 241(1). Retrieved from: https://melbourneinstitute.unimelb.edu.au/hilda

Figure A1. Distribution of height selectivity / relative height by origin group and gender



Notes: Weighted estimates.
Source: GSOEP 2014 wave and height dataset, own calculations.

Table A2. Predicting height selectivity / relative height

	Coefficient	S.E.
Male	0.492***	(11.01)
Mig age (ref: 31+)		
18-25	0.125*	(2.12)
26-30	0.199**	(3.11)
Mig cohort (ref: 1950-1970)		
1991-2000	0.0182	(0.27)
2001-2015	0.225**	(3.26)
Reason to migrate (ref: Political)		
Political	-0.248**	(-2.63)
Economic	0.147*	(2.55)
Other	0.264***	(4.12)
Missing	0.226*	(2.49)
From EU country at migration time (ref: EU cnt)		
Not yet EU	0.130	(1.77)
Non-EU	0.181*	(2.50)
Country-level factors		
GDP pc (standardized)	0.0285	(1.30)
Former colony	0.137	(1.75)
Geographic distance (standardized)	0.0500***	(3.87)
Educational selectivity	0.0233***	(3.68)
Observations	2037	

Notes: +=0.1 *=.05, **=.01, ***=.001. Weighted OLS estimates, t statistics in parentheses.
Source: GSOEP 2014 wave and height dataset, own calculations.

Table A3. The impact of height selectivity on subjective health (1-5)

	M1	M2	M3	M4	M5
Height selectivity	0.0839***	0.0406*	0.0254	0.00521	-0.0942**
	(4.00)	(1.99)	(1.23)	(0.25)	(-2.58)
Male		0.142***	0.162***	0.188***	0.184***
		(3.45)	(3.88)	(4.56)	(4.49)
Age		-0.0354	-0.0362	-0.0178	-0.0204
		(-1.55)	(-1.59)	(-0.78)	(-0.90)
Age squared		0.0000898	0.0000894	-0.000181	-0.000152
		(0.33)	(0.33)	(-0.66)	(-0.56)
Years since arrival (ref: ≤ 10)					
10-19		-0.135*	-0.101	-0.0463	-0.0598
		(-2.45)	(-1.82)	(-0.82)	(-1.06)
20 or more		-0.285***	-0.236***	-0.176*	-0.188**
		(-4.03)	(-3.31)	(-2.42)	(-2.59)
Former East Germany		0.0867	0.0790	0.119	0.119
		(0.90)	(0.82)	(1.24)	(1.25)
Educational attainment (ref: ≤ prim.)					
Secondary			0.109*	0.00298	0.00244
			(2.09)	(0.05)	(0.04)
Tertiary			0.253***	0.115	0.105
			(4.42)	(1.86)	(1.70)
YSA*height selectivity					
10-19 * Height selectivity					0.120*
					(2.53)
20 or more * Height selectivity					0.171***
					(3.40)
Constant	3.547***	4.912***	4.777***	4.513***	4.619***
	(167.59)	(10.76)	(10.47)	(9.41)	(9.63)
Adjusted R-squared	0.007	0.120	0.128	0.168	0.172
Origin Region FE	No	No	No	Yes	Yes
Observations	2114	2114	2114	2114	2114

Notes: +=0.1 *=.05, **=.01, ***=.001. Weighted OLS estimates, t statistics in parentheses.
Source: GSOEP 2014 wave and height dataset, own calculations.

Table A4. The impact of height selectivity on SF-12 physical health (0-100)

	M1	M2	M3	M4	M5
Height selectivity	0.782***	0.464*	0.236	0.109	-0.497
	(3.87)	(2.39)	(1.21)	(0.55)	(-1.45)
Male		0.848*	1.098**	1.476***	1.436***
		(2.15)	(2.78)	(3.81)	(3.71)
Age		0.451*	0.438*	0.609**	0.606**
		(2.08)	(2.04)	(2.87)	(2.85)
Age squared		-0.00905***	-0.00904***	-0.0115***	-0.0115***
		(-3.48)	(-3.51)	(-4.50)	(-4.50)
Years since arrival (ref: ≤ 10)					
10-19		-1.236*	-0.728	-0.0691	-0.119
		(-2.36)	(-1.39)	(-0.13)	(-0.23)
20 or more		-2.824***	-2.102**	-0.975	-1.000
		(-4.19)	(-3.11)	(-1.43)	(-1.46)
Former East Germany		1.654	1.557	1.506	1.532
		(1.81)	(1.72)	(1.69)	(1.72)
Educational attainment (ref: ≤ prim.)					
Secondary			1.680***	0.287	0.289
			(3.37)	(0.55)	(0.55)
Tertiary			3.582***	1.772**	1.660**
			(6.55)	(3.00)	(2.82)
YSA*height selectivity					
10-19 * Height selectivity					0.379
					(0.85)
20 or more * Height selectivity					1.501**
					(3.19)
Constant	50.77***	48.93***	47.02***	45.28***	45.94***
	(249.01)	(11.34)	(10.97)	(10.11)	(10.25)
Adjusted R-squared	0.007	0.143	0.160	0.209	0.213
Origin Region FE	No	No	No	Yes	Yes
Observations	2078	2078	2078	2078	2078

Notes: +=0.1 *=.05, **=.01, ***=.001. Weighted OLS estimates, t statistics in parentheses.
Source: GSOEP 2014 wave and height dataset, own calculations.

Table A5. The impact of height selectivity on the likelihood of having diagnosed conditions (0-1)

	M1	M2	M3	M4	M5
Height selectivity	-0.0294*	-0.00409	-0.00955	-0.000474	0.0380
	(-2.39)	(-0.35)	(-0.81)	(-0.04)	(1.70)
Male		-0.0627**	-0.0668**	-0.0684**	-0.0694**
		(-2.69)	(-2.84)	(-2.88)	(-2.94)
Age		0.0319*	0.0317*	0.0298*	0.0304*
		(2.52)	(2.51)	(2.33)	(2.39)
Age squared		-0.000139	-0.000142	-0.000136	-0.000142
		(-0.92)	(-0.95)	(-0.89)	(-0.93)
Years since arrival (ref: ≤ 10)					
10-19		-0.0366	-0.0283	-0.0291	-0.0254
		(-1.15)	(-0.88)	(-0.88)	(-0.77)
20 or more		0.0579	0.0776	0.0721	0.0730
		(1.46)	(1.93)	(1.73)	(1.75)
Former East Germany		-0.115*	-0.113*	-0.125*	-0.126*
		(-2.19)	(-2.14)	(-2.34)	(-2.37)
Educational attainment (ref: ≤ prim.)					
Secondary			0.116***	0.126***	0.127***
			(3.90)	(3.93)	(3.99)
Tertiary			0.0975**	0.0845*	0.0934**
			(3.01)	(2.38)	(2.63)
YSA*height selectivity					
10-19 * Height selectivity					-0.00577
					(-0.20)
20 or more * Height selectivity					-0.107***
					(-3.66)
Constant	0.542***	-0.506*	-0.584*	-0.632*	-0.689*
	(44.68)	(-1.99)	(-2.30)	(-2.33)	(-2.55)
Adjusted R-squared	0.003	0.160	0.166	0.183	0.192
Origin Region FE	No	No	No	Yes	Yes
Observations	1684	1684	1684	1684	1684

Notes: +=0.1 *=.05, **=.01, ***=.001. Weighted OLS estimates, t statistics in parentheses.
Source: GSOEP 2014 wave and height dataset, own calculations.

Table A6. The impact of height selectivity on the number of yearly doctor visits

	M1	M2	M3	M4	M5
Height selectivity	-0.596*	-0.238	-0.201	-0.0652	0.558
	(-2.14)	(-0.83)	(-0.69)	(-0.22)	(1.08)
Male		-2.753***	-2.739***	-3.149***	-3.105***
		(-4.77)	(-4.69)	(-5.40)	(-5.32)
Age		-0.371	-0.374	-0.348	-0.349
		(-1.16)	(-1.17)	(-1.08)	(-1.08)
Age squared		0.00391	0.00397	0.00426	0.00432
		(1.02)	(1.03)	(1.10)	(1.11)
Years since arrival (ref: ≤ 10)					
10-19		0.589	0.532	-0.112	-0.0535
		(0.77)	(0.69)	(-0.14)	(-0.07)
20 or more		3.521***	3.403***	2.385*	2.417*
		(3.56)	(3.40)	(2.31)	(2.34)
Former East Germany		-1.373	-1.367	-1.060	-1.080
		(-1.02)	(-1.01)	(-0.78)	(-0.80)
Educational attainment (ref: ≤ prim.)					
Secondary			-0.690	0.903	0.911
			(-0.94)	(1.16)	(1.17)
Tertiary			-0.623	1.433	1.555
			(-0.77)	(1.64)	(1.77)
YSA*height selectivity					
10-19 * Height selectivity					-0.401
					(-0.59)
20 or more * Height selectivity					-1.542*
					(-2.16)
Constant	7.921***	16.29*	16.87**	17.25*	16.65*
	(28.16)	(2.56)	(2.63)	(2.54)	(2.44)
Adjusted R-squared	0.002	0.022	0.022	0.048	0.049
Origin Region FE	No	No	No	Yes	Yes
Observations	2113	2113	2113	2113	2113

Notes: +=0.1 *=.05, **=.01, ***=.001. Weighted OLS estimates, t statistics in parentheses.
Source: GSOEP 2014 wave and height dataset, own calculations.

Table A7. Immigrant-native differences in health, by quartiles of height selectivity

	Subjective health (1-5)	SF-12 PCS (0-100)	Diagnosed condition (0-1)	Annual doctor visits
Quartiles of height selectivity (ref: natives)				
Bottom	0.00920	-0.781	-0.147***	-0.885
	(0.18)	(-1.63)	(-5.23)	(-1.15)
2nd	0.120*	-0.606	-0.101***	-1.319
	(2.42)	(-1.29)	(-3.63)	(-1.74)
3rd	0.116*	-0.860	-0.134***	-0.318
	(2.34)	(-1.81)	(-4.63)	(-0.42)
Top	0.133**	0.219	-0.195***	-1.264
	(2.66)	(0.46)	(-6.76)	(-1.66)
Male	0.0939***	0.807***	-0.0715***	-3.333***
	(6.32)	(5.71)	(-9.01)	(-14.67)
Age	0.00170	0.0575	0.000546	-0.0400
	(0.33)	(1.15)	(0.19)	(-0.50)
Age squared	-0.000315***	-0.00420***	0.000135***	0.00192
	(-4.83)	(-6.76)	(3.88)	(1.92)
Former East Germany	0.0126	-0.342	-0.00617	-0.938**
	(0.65)	(-1.85)	(-0.60)	(-3.17)
Educational attainment (ref: ≤ prim.)				
Secondary	0.317***	3.542***	-0.0533***	-1.346**
	(11.19)	(13.10)	(-3.48)	(-3.11)
Tertiary	0.504***	6.228***	-0.132***	-1.931***
	(17.19)	(22.23)	(-8.35)	(-4.31)
Constant	3.586***	52.28***	0.523***	9.952***
	(35.32)	(53.93)	(9.52)	(6.41)
Observations	14308	14059	12937	14270
Adjusted R-squared	0.101	0.155	0.092	0.025

Notes: +=0.1 *=.05, **=.01, ***=.001. Weighted OLS estimates, t statistics in parentheses.
Source: GSOEP 2014 wave and height dataset, own calculations.

Table A8. Fixed effects estimates of immigrant health by time since arrival and height selectivity

	Subjective health (1-5)	SF-12 PCS (0-100)	Diagnosed condition (0-1)	Annual doctor visits
Years since arrival (YSA)	-0.0728***	-1.590***	0.0675***	0.788*
	(-4.10)	(-6.65)	(10.91)	(2.55)
Years since arrival squared	0.00171***	0.0379***	-0.000825***	-0.0313***
	(3.91)	(6.31)	(-5.60)	(-4.06)
Height selectivity quartile * YSA				
2nd * YSA	-0.00818	0.849**	-0.0434***	-1.298**
	(-0.36)	(2.80)	(-5.54)	(-3.28)
3rd * YSA	0.0570*	1.967***	-0.00127	-0.719
	(2.48)	(6.15)	(-0.15)	(-1.75)
Top * YSA	0.0725**	1.114***	-0.0287***	-1.014*
	(3.15)	(3.59)	(-3.59)	(-2.53)
Height selectivity quartile * YSA squared				
2nd * YSA squared	-0.000615	-0.0282***	0.000825***	0.0422***
	(-1.05)	(-3.58)	(4.27)	(4.13)
3rd * YSA squared	-0.00189**	-0.0549***	-0.000160	0.0249*
	(-3.19)	(-6.62)	(-0.79)	(2.36)
Top * YSA squared	-0.00241***	-0.0297***	0.000446*	0.0332**
	(-4.08)	(-3.71)	(2.25)	(3.24)
Constant	4.057***	56.95***	0.0962***	9.341***
	(56.35)	(59.31)	(3.64)	(7.41)
Observations	9995	5479	6772	9454

Notes: +=0.1 *=.05, **=.01, ***=.001. Weighted FE estimates, t statistics in parentheses.
Source: GSOEP 2014 wave and height dataset, own calculations.

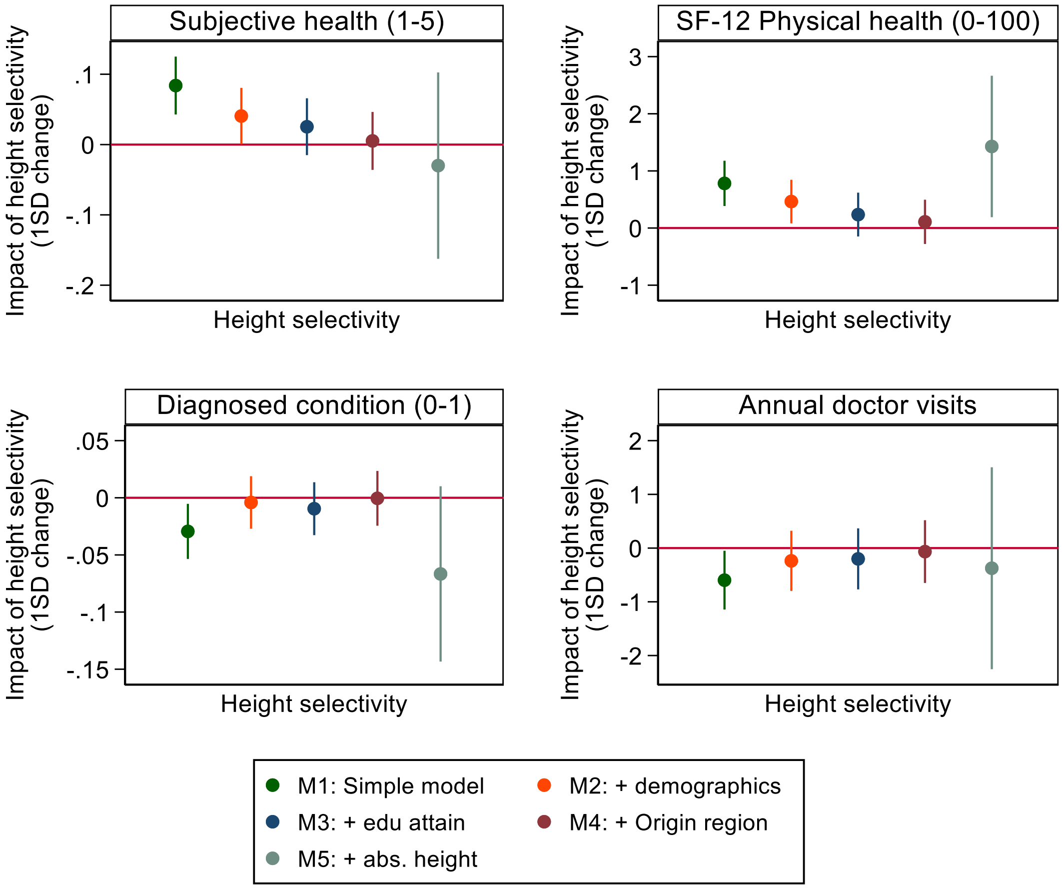
Table A9. Immigrant-native gaps in health by time since arrival and height selectivity quartiles

	Subjective health (1-5)	**SF-12 PCS (0-100)**	**Diagnosed condition (0-1)**	**Annual doctor visits**
Immigrant-native gaps (ref: native)				
YSA < 10 & Bottom height select quartile	0.471***	2.105*	-0.301***	-1.643
	(4.79)	(2.26)	(-5.20)	(-1.09)
YSA < 10 & 2nd height select quartile	0.183*	0.316	-0.129**	-2.424
	(2.21)	(0.40)	(-2.77)	(-1.91)
YSA < 10 & 3rd height select quartile	0.194*	-0.838	-0.252***	-0.954
	(2.38)	(-1.07)	(-5.07)	(-0.76)
YSA < 10 & Top height select quartile	0.220**	0.835	-0.215***	0.751
	(2.65)	(1.06)	(-4.37)	(0.59)
YSA < 20 & Bottom height select quartile	0.0278	0.415	-0.265***	-3.170**
	(0.35)	(0.54)	(-5.76)	(-2.59)
YSA < 20 & 2nd height select quartile	0.195*	0.837	-0.241***	-1.184
	(2.26)	(1.02)	(-4.70)	(-0.90)
YSA < 20 & 3rd height select quartile	0.0959	-0.664	-0.124**	-0.401
	(1.23)	(-0.88)	(-2.69)	(-0.34)
YSA > 20 & Top height select quartile	0.193*	0.803	-0.191***	-2.721*
	(2.34)	(1.02)	(-4.02)	(-2.16)
YSA > 20 & Bottom height select quartile	-0.277***	-3.348***	0.0231	1.706
	(-3.38)	(-4.29)	(0.54)	(1.36)
YSA > 20 & 2nd height select quartile	0.0286	-2.377**	0.0180	-0.588
	(0.34)	(-2.90)	(0.40)	(-0.45)
YSA > 20 & 3rd height select quartile	0.114	-0.190	-0.0373	0.267
	(1.16)	(-0.20)	(-0.71)	(0.18)
YSA > 20 & Top height select quartile	0.0114	-0.457	-0.205***	-2.290
	(0.12)	(-0.53)	(-3.95)	(-1.63)
Male	0.0926***	0.798***	-0.0710***	-3.322***
	(6.24)	(5.64)	(-8.95)	(-14.62)

Age	-0.0229***	-0.273***	0.0110***	0.111***
	(-33.50)	(-41.81)	(30.20)	(10.62)
Former East Germany	0.00962	-0.367*	-0.00424	-0.922**
	(0.50)	(-1.99)	(-0.41)	(-3.11)
Educational attainment (ref: ≤ prim.)				
Secondary	0.313***	3.541***	-0.0511***	-1.322**
	(11.06)	(13.07)	(-3.33)	(-3.05)
Tertiary	0.500***	6.238***	-0.129***	-1.915***
	(17.03)	(22.20)	(-8.14)	(-4.26)
Constant	4.029***	58.25***	0.333***	7.195***
	(104.88)	(158.22)	(16.02)	(12.24)
Observations	14308	14059	12937	14270
Adjusted R-squared	0.102	0.154	0.095	0.025

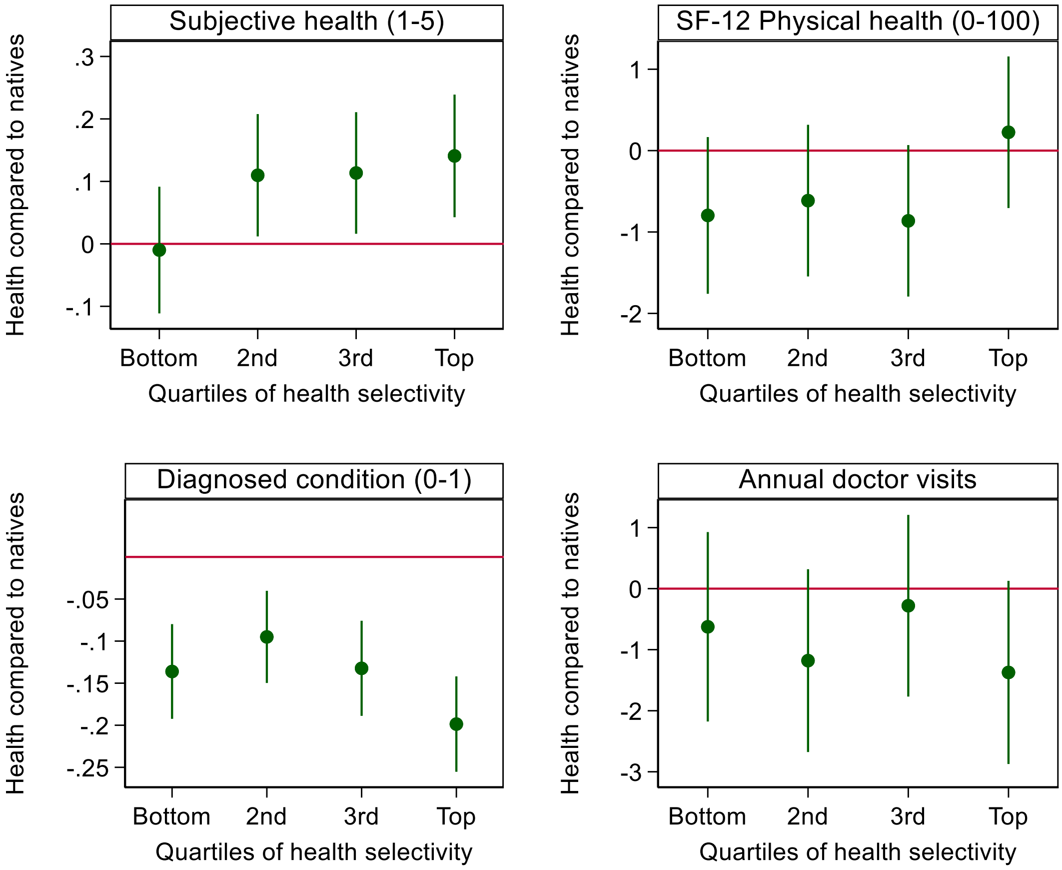
Notes: +=0.1 *=.05, **=.01, ***=.001. Weighted OLS estimates, t statistics in parentheses.
Source: GSOEP 2014 wave and height dataset, own calculations.

Figure A2. Impact of selectivity on health outcomes (controlling for absolute height)



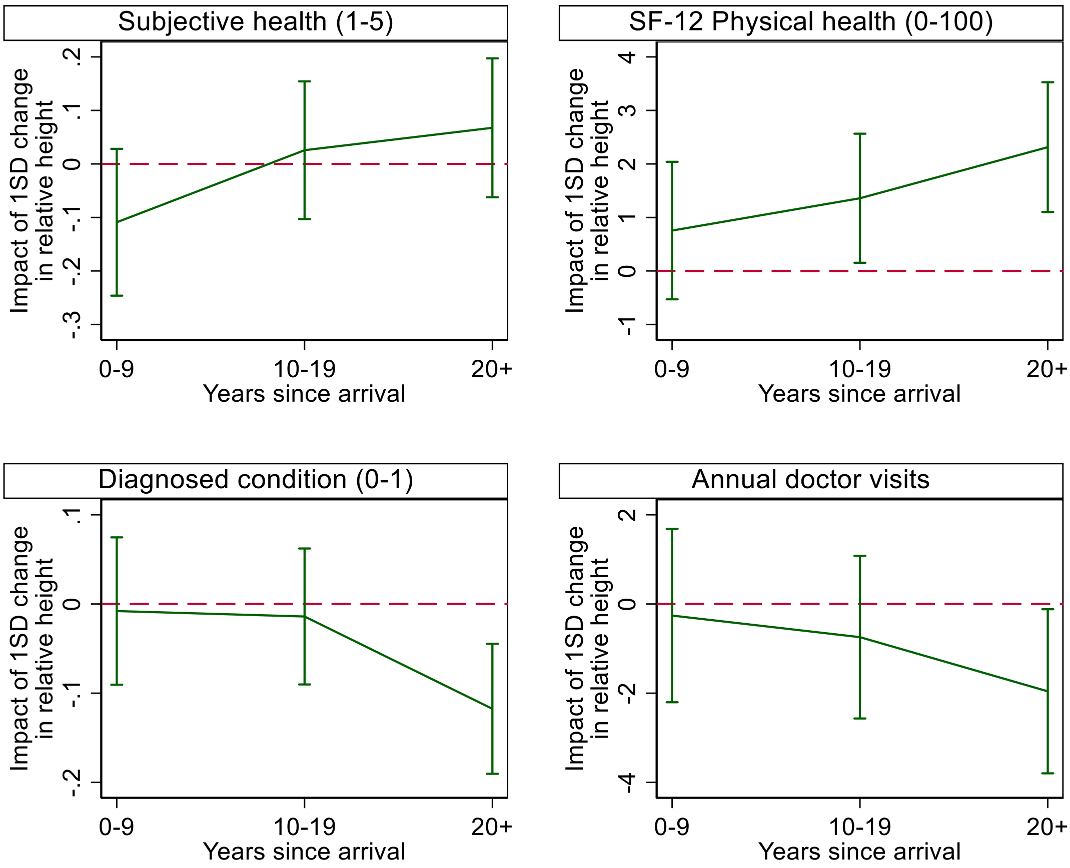
Notes: Weighted estimates with 95% confidence intervals from OLS regressions. M1 includes only height selectivity. M2 additionally controls for sex, age (linear and squared), time since arrival (categorical) and an indicator for living in East or West Germany. M3 additionally controls for educational attainment (3 categories), and M4 for origin region (see Table 1 for categories), and M5 for absolute height.
Source: GSOEP 2014 wave and height dataset, own calculations

Figure A3. Immigrant-native differences in health, by immigrant selectivity (controlling for absolute height)



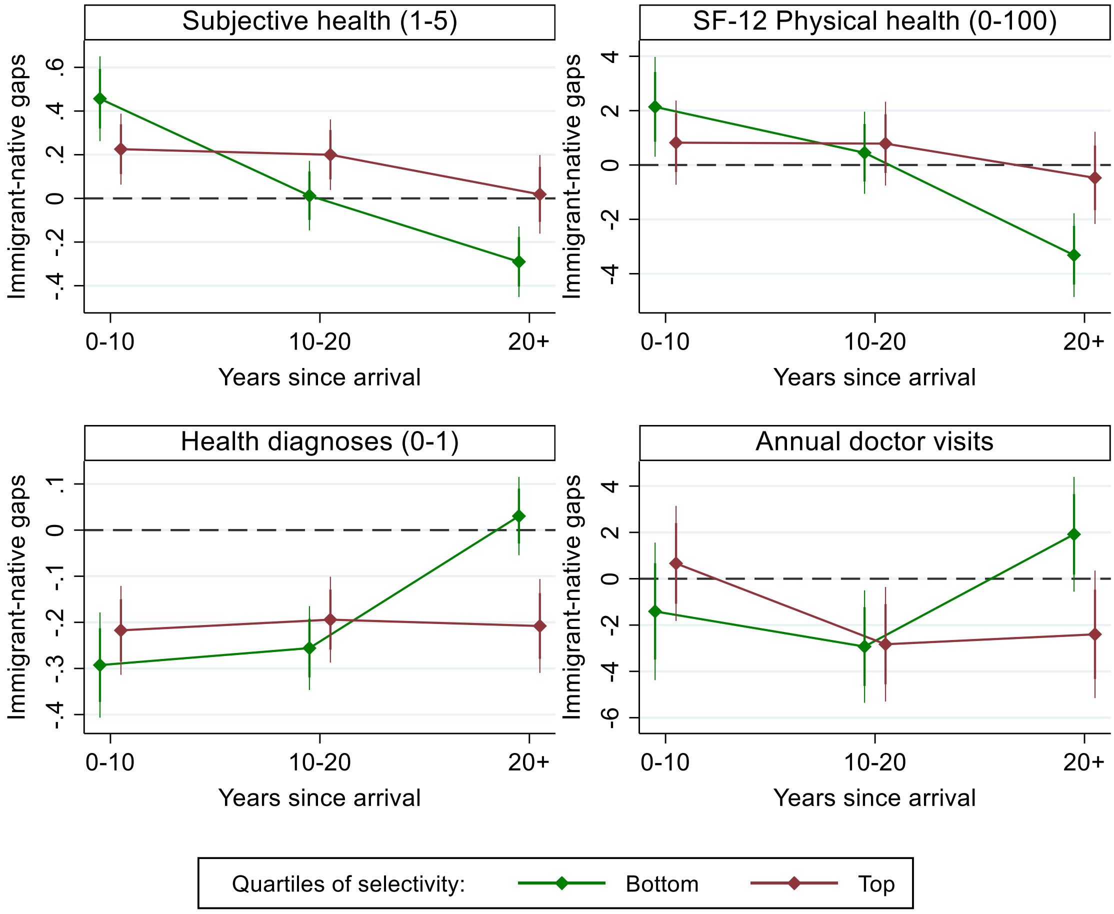
Notes: Weighted estimates with 95% confidence intervals from OLS regression. Controls include sex, age (linear and squared), an indicator for living in East or West Germany, educational attainment, and absolute height.
Source: GSOEP 2014 wave and height dataset, own calculations

Figure A4. The impact of selectivity on immigrant health, by time since arrival (controlling for absolute height)



Notes: Weighted estimates with 95% confidence intervals from OLS model. Controls include sex, age (linear and squared), an indicator for living in East or West Germany, educational attainment (3 categories), origin region (see Table 1 for categories), and absolute height.
Source: GSOEP 2014 wave and height dataset, own calculations

Figure A5. Immigrant-native gaps in health by time since arrival and height selectivity (controlling for absolute height)



Notes: Weighted estimates from OLS regression. Figure presents 95% confidence intervals (thin lines) for testing the significance of migrant-native gaps, as well as 83% confidence intervals (thick lines) for a visual test of significance of differences between the top and bottom quartile groups (cf. MacGregor-Fors & Payton 2013). Controls include sex, age (linear and squared), an indicator for living in East or West Germany, educational attainment (3 categories), and absolute height
Source: GSOEP 2014 wave and height dataset, own calculations