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

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Reproducibility and Data Availability Statement

The main dataset used for these analyses, the German Socio-Economic Panel Study (SOEP), is available from the DIW Berlin subject to conditions. See: DIW Berlin: Data Access. The heights dataset used in this study is still under development and expansion. A finalized, publicly documented version will be made available in due course. In the meantime, a preliminary version of the dataset, along with the accompanying code, can be provided by the authors upon reasonable request.

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 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 positively selected immigrants enjoy better health throughout adulthood.

Introduction

There is a well-documented association between migration and health, with three commonly observed patterns, which were first documented among Hispanics in the United States, then extended to a wider range of origin groups, and are increasingly documented in European destinations (e.g. Markides & Rote 2019). First, those who emigrate are typically healthier than non-migrants in their place of origin: they are positively selected on health. This is true whether one looks at internal (Nauman et al. 2015; Westphal 2016) or international migrants (Akresh & Frank 2008; Riosmena et al. 2017).[1] 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 has also often been observed that, despite this general health advantage, many immigrants experience declines in health over an extended period in the destination country, and sometimes their initial advantage even reverses to a health deficit compared to the native-born at destination. This too is considered paradoxical, in that the improvement in socioeconomic status and better healthcare access that occurs with time spent at destination

[1] Note on terminology: we use the term migrants to cover those migrating internationally or internally. We use the term immigrant when specifically referring to those foreign-born 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.

should lead to improved health outcomes. It has been suggested that this erosion of the initial selectivity advantage arises due to exposure to discrimination and poor residential and working conditions (Boen & Hummer 2019), or to adoption of unhealthy behaviours prevalent in many rich Western receiving countries (e.g. Abraido-Lanza et al. 2005; Luthra et al. 2020).

In this paper, we assess an alternative hypothesis that links immigrant health selectivity to immigrant health decline over time since migration: namely that the erosion in health advantage impacts those who, while in good health at the time of migration, have poorer underlying health status, that is, who are less positively selected on health, rendering them more susceptible to health insults from discrimination or poor health behaviours. Such differences in the degree of underlying selectivity could help explain variation in the extent to which such decline in the immigrant health advantage is found in recent longitudinal studies (see for example health decline observed by Ferrara, Brunori and Grindel (2024) in Germany versus no decline in Lu et al. (2017) for the US).

To empirically assess the role of selectivity in both the immigrant health advantage and its possible decline requires observed variation in health selection that can be linked to variation in health outcomes both in general and over time since arrival. This is challenging because the data requirements for such analysis are high (Feliciano 2020). First, to properly capture migrant health selection 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 native-born 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 relatively 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 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 positively selected have better health outcomes and experience a health advantage relative to the native-born, 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. Third, we test whether relative height differentiates health outcomes between immigrants and drives the immigrant health advantage between immigrants and the native-born. Finally, we test whether greater selectivity offers protection against health decline or reduction in the immigrant-native health advantage 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 immigrants in Germany are on average positively selected in terms of relative height; but this selectivity varies substantially both within and across national origins 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 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 generally assumed that immigrants are selected; that is, that they 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 underlie 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. 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 positively selected experience better outcomes at destination compared to those negatively, or less positively selected. A related question is whether selection drives the commonly observed immigrant health advantage over non-migrants at destination.

Both questions thus require a comparison of emigrants to non-migrants at origin, ideally before or around the time of migration. Variation in post-migration health status may be the result of differences in experience of the migration journey itself, or in the destination country (Feliciano 2020; Jasso et al. 2004), both of which are liable to differ by motivation for migration and across sending and receiving countries. 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 degree 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; Ro, Fleischer and Blebu (2016) restrict to 5 years since arrival to assess selectivity and its impacts on self-rated health for 19 sending countries, 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, their findings cannot convincingly be extrapolated to international migrants.

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. We develop such a measure through our indicator of 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 during infancy and 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 (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 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 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 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 approximately 20 and 50, with shrinkage beginning in middle age (Sorkin et al. 1999). Height also differs significantly between adult men and women (Roser et al. 2021). 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.

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 construct 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 to test the general expectation:

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

Variation in Height Selectivity

Alongside the expectation that immigrants are on average positively selected on relative height, we also anticipate variation in selectivity (Riosmena et al 2017). First, 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. Second, since older individuals and women are more likely to migrate as part of a family move ('tied movers'), it is expected that they will be less selected on health (Ballarino and Panichella 2018; Gubernskaya 2015). Third, 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).

The level of selection is also expected to be greater where there are greater costs and challenges to overcome (Chiswick 1999; Jasso 2004; Donato et al. 2019). These comprise physical distance, accessibility (e.g. whether or not a visa is required to migrate), the restrictiveness of the immigration regime more generally, and financial costs, which will be relatively greater for those migrating from poorer countries (Belot & Hatton 2012). More restrictive migration regimes, which European countries have increasingly implemented 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 expect migrants to be more positively 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). 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 due to multiple biological mechanisms and socioeconomic interactions, many of which may be strongest in less developed countries (McEniry 2013). We therefore anticipate that those on the higher end of the relative height distribution – those who are positively selected on health – will have better health outcomes, leading to the following expectations:

H3a: Immigrants who are positively selected have better health outcomes than those negatively selected.
H3b: Positive selection results in an immigrant health advantage relative to the native-born.

The Impact of Height Selection Over Time

A body of research has extended the study of the immigrant health advantage close to the time since migration by examining how immigrant health changes over time since arrival. This question is approached through cross-sectional analysis that compares immigrants with different durations of time since migration to native-born population members of similar age and socioeconomic characteristics and, more recently, by comparing the health trajectories of immigrants to the native-born population using longitudinal analysis.

The cross-sectional evidence is largely unequivocal that the immigrant health advantage compared to the native-born decreases in earlier vs later arrival cohorts, often converging or sometimes even reversing after 20 years or more since arrival (for a review see Markides and Rote 2019). Increases in morbidity relative to the native-born over time since arrival is documented in studies of immigrants in a range of contexts, even as advantages in mortality often remain (see Yu and Zheng 2025 for the USA, or Wallace and Darlington-Pollock 2022 for the UK). One of the criticisms of these cross-sectional approaches is, however, that they cannot disentangle cohort or age at migration from age and duration of time at destination.

Longitudinal evidence offers opportunities for tracking experience over time and age separately for different cohorts, and for avoiding confounding through cohort differences. These advantages can be consequential. For instance, in Lu et al (2017), cross-sectional models that do not control for arrival cohort show a declining health advantage relative to natives with increased time since arrival; but this can be accounted for by controls for arrival cohorts, as more recent cohorts were healthier on average. Moreover, using longitudinal fixed effects models that subsume age, gender and other stable characteristics, these authors show that immigrants' self-reported health remains stable over a 4-year observation window, whereas the native comparison group declines, and that this advantage holds for immigrants of different arrival cohorts.

At the same time, longitudinal studies face challenges in providing sufficiently long observation windows to observe the long-run changes that we expect to develop at older ages. Moreover, longitudinal findings on the immigrant health advantage and its decline are mixed and vary across countries. Jatrana, Richardson, and Pasupuleti (2018) observe largely consistent gaps, both negative and positive, for different immigrant populations relative to

native-born Australians over time. However, a range of longitudinal analyses using the same data we use here document a steeper downward trajectory in health for immigrants as compared to those born in Germany, for instance in terms of self-rated health and disability (Loi, Li and Myrskala 2025) as well as subjective and mental health (Ferrara, Grindel, and Brunori 2024).

The literature offers two main explanations for the role of acculturation processes in immigrant health decline: the accumulation of exposure to discrimination and harsh working and living environments leading to steeper declines in health over time; or the adoption of unhealthier behaviours than those practiced in their home country in favour of those prevalent in the receiving country, such as higher rates of smoking (Abraído-Lanza et al. 2005). We propose a complementary hypothesis, which is a natural extension of these but which, to our knowledge, has not yet been assessed, and which may help to address the contrasting findings we observe in the longitudinal studies. We posit that even if, in 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 also experience less deterioration in health.

Our reasoning is as follows. First, it is well documented that migrants are unlikely to move if they are unwell (Baldassar 2014; van Dalen & Henkens 2008), a variation of the "healthy worker effect" (Palloni and Ewbank 2004). As a result, migration will be 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 (with greater or lesser degrees of relative height) are therefore expected to be healthier than their peers born in the receiving country at the time of their arrival. Thus, we expect that the health premium

accruing to those with higher health selectivity will be less observable immediately following migration.

However, we expect that those whose underlying health status is poorer will experience steeper deterioration in health over time. 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 negative 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' (Loi, Li and Myrskalä 2025); 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 those native-born 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 health gaps between immigrants and the native-born population 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). For our main analysis, we 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, especially given the observed greater variation in findings on decline across longitudinal and cross-sectional studies, we utilise the longitudinal data by following our 2014 sample until 2021, the latest available wave.

We additionally draw on a new dataset of height distributions from multiple countries 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 between the ages of 20 and 50. We trim heights for implausible outliers (adult heights 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. 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.[2]

Our analytical sample of immigrants comprises all individuals aged 20 to 50 present in the 2014 SOEP wave who migrated to Germany at or after the age of 18 (2,273 cases) for whom we have valid data on heights (N=2,269). Given that we are particularly interested in those with longer durations of stay, and that health tends to deteriorate with age, we supplement this sample with those aged 51-60 in the 2014 sample for whom we have valid height data collected when they were 50 or less from an earlier sweep. This adds 128 cases from this older age range to our sample.[3]

[2] We recognise that the measures of height in our survey do not necessarily correspond to the composition of the population present when our immigrant population migrated. This will be relevant if there have been substantial changes in emigration or immigration that have also affected the height distributions for their specific cohort or if longstanding patterns of immigration and emigration already impacted country height distributions. However, simulations based on assumptions of positively selected emigration and negatively selected immigration at levels of 5% or 10% (high for most of the countries in our data) indicated that our findings on selectivity were robust to such impacts (see Appendix Figures A1 and A2).

[3] We conducted sensitivity analysis excluding these additional cases and our results were robust to that exclusion though, in some cases less precisely estimated, consistent with having smaller number of cases with longer durations of stay. See Figure A3 for replication of main results excluding these cases.

We can match 89% of these 2,401 observations to our height dataset. While all the major sending countries to Germany across most birth cohorts are covered, we could not source height information for a number of countries providing smaller immigrant flows. The resulting sample is slightly less educated and less recently arrived than the total immigrant population.[4] While this may narrow the generalisability of our findings to the origin groups covered, it does not bias our results for the population we speak to, since these differences arise not from respondent characteristics or response behaviour but as a consequence of available measures of population height in existing accessible surveys. Listwise deletion resulted in the further loss of 17 (<1%) observations for whom we were missing data on one or more control variables (age, sex, education, West/East Germany, time since arrival), leading to the main sample for our selectivity analysis of 2,114 cases. Table A2 in the Appendix outlines the composition of the sample and how we reached this sample size.

This is the maximum sample for our analyses. As detailed in Table A2, in our analyses predicting selectivity we lose a further 77 cases largely due to lack of coverage of certain country-cohorts in the Barro-Lee data that give us our measure of educational selectivity. For our health outcomes (see the description below), we have no missing data on subjective health and one missing case on doctor visits; while for physical health we are missing 36 cases. Information on diagnosed health conditions was not collected in 2014, and thus our analyses of these is restricted to the subset of respondents still present in the 2015 wave; and we adjust for this by applying cross-sectional weights for 2015. Comparisons of each sub-sample to our

[4] A full list of country of origin and birth cohort non-coverage for our SOEP sample in the height database is provided in Appendix Table A3. Descriptive statistics for the full and matched samples are provided in Table A4.

main 2,114 cases shows that there are no significant differences in key variables (Tables A5 and A6).

To estimate immigrant-native-born health gaps we construct a comparison sample of 13,633 individuals corresponding to our main immigrant sample. This comprises those born in Germany, that is, the native-born population. For comparison on the specific health measures, we again use subsamples based on the availability of the measure.

Measures

As previously noted, we define immigrants as foreign-born individuals who arrived in Germany at age 18 or older. Those born in Germany constitute the native-born comparison sample.[5]

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 (median) 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). The overall distribution is close to normal, such that the cut-offs for each quartile are: Q1 [-3.8,-0.63], Q2 [-0.63,0.05], Q3 [0.05,0.71], Q4 [0.71,3.63]. This enables us to assess non-linearities and to compare differently selected immigrants with the German-born population.

[5] We replicated our analysis excluding native-born individuals with one or both foreign-born parents from this comparison group and our results remain unchanged. See Appendix Table A7 for a replication of main results.

We use five *outcome measures of health*, from more subjective to more objective, and including healthcare usage as well as reported conditions. These may not always move in parallel and may be affected by different biases in migrant populations. Subjective measures may be influenced by immigrant–native-born differences in the reference points individuals use to evaluate their health (Lu & Qin, 2014), while healthcare use and diagnosed health are shaped by differences in the use of preventive and emergency services (Lebano et al., 2020). Since the SOEP lacks direct biomarkers of health (e.g., cholesterol levels), and each available measure may be affected by some form of bias, we follow the literature's recommendation to include a broad set of health indicators based on what is available in our data (Ferrara et al. 2024).

We measure subjective health on a five-point scale, ranging from 1 "bad" to 5 "very good". Physical health is measured through six items that make up the Physical Component Score (PCS) of the Short Form 12 (SF-12). These items ask respondents about how their physical health affected their life in the prior four weeks (see Appendix Table A8 for the full set of items). Though also self-reported, the SF-12 builds a full picture of individuals' physical health and is an internationally recognized and reliable indicator of health across different populations (Ware et al., 1996). Scores are standardized by the data provider with a range from 0 to 100 (from worst to best health) and have a standard deviation of 10 points (Andersen et al., 2007).

Next, we use two measures of diagnosed health collected at the 2015 sweep: (1) a binary indicator for having ever been diagnosed with any of the health conditions surveyed in the SOEP (including asthma, diabetes, cancer, cardiac disease, depression, dementia, high blood pressure, migraine, stroke, or "other illness"); and (2) a count measure indicating the total

number of ever diagnosed conditions. The former captures overall disease prevalence, while the latter reflects cumulative disease burden. Finally, we include the total number of doctor visits in the survey year, which captures routine and preventative health care use. Note that, unlike the first two indicators (subjective health and the PCS), these latter measures are coded so that higher values (or a value of 1) indicate worse health.

To test the *correlates of selectivity* we first examine age at migration, since we expect that those who migrate at younger ages will be most highly selected. We isolate the half of our immigrant sample who arrived between 18-25, and we split the rest into two remaining categories of equal size (immigrated ages 26-30; and 31-50). We include migration cohort as we anticipate that migration has become more selective over time, and define three groups (1970-1990; 1991-2000 and 2001-2015) to provide approximately equal groupings while avoiding direct correlation with age at migration. In line with our hypotheses, we include 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, and educational attainment (3 categories based on the UNESCO (2006) International Standard Classification of Education: 0-2, 3-4, 5-6). These are included as they are expected to be associated with both health selectivity and health outcomes. We control for

region of residence (former East or West Germany), since health outcomes are poorer in the former and immigration less widespread. For immigrants, we control for country or region of birth (in models with migrants only; categories are reported in Table 1),[6] since more distant countries are likely to be associated with greater health selectivity; and for time since arrival (both continuous and categorical (0-10; 10-20; 20+ years) according to the model specification). Given that most of our sample arrived at a young age, the association between health selection and health deterioration should take time to become observable. We use ten-year cohorts therefore to ensure sufficient cases in each time since arrival category, while still allowing for non-linear effects at later periods.

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 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

[6] We report values for countries with at least 30 cases, and broader region otherwise.

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. Our unweighted sample comprises 59% women, reflecting wider patterns in survey response; but the weighted estimates provide a more balanced 54% female.

[TABLE 1]

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 five health measures. We estimate nested models including our suite of controls outlined above. This tells us whether selection is associated with better health among immigrants as expected (H3a). To further assess how far selection is driving an immigrant health advantage, we divide our immigrant sample into quartiles by degree of height selectivity and examine whether more positively

selected quartiles display a greater health advantage relative to comparative samples of native-born Germans (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 with increasing duration in Germany. For this analysis, time since migration is the central independent variable, which we expect to be *moderated* by health selectivity: more positively selected immigrants should experience less deterioration in health due to greater resilience to post-migration stressors or the consequences of acculturation to unhealthy behaviours (H4a). We first begin this analysis with a cross-sectional model that interacts selectivity with different durations since migration. This offers the benefits of greater sample sizes and is less impacted by longitudinal attrition. By controlling for age, we adjust for the fact that health is strongly age-related and that those with longer durations will tend to be older. However, we cannot distinguish the independent effects of time since migration, age and period of migration, as the third is necessarily a function of the other two, analogous to the classic age-period-cohort identification problem (Ferrara et al. 2024). We therefore supplement our cross-sectional analysis with a fixed effects model with a smaller subset of observations we observe longitudinally up to 2021. This allows us to absorb period and age at migration effects (as these are fixed characteristics) while splitting the sample to enable us to examine trajectories by quartiles of selectivity over time since migration. In supplementary analyses, to address whether these trajectories operate similarly for those immigrants who arrived at younger and older ages we further estimated fixed effects models splitting the sample between those who arrived between ages 18-29 and those who arrived between ages 30-40. We find these results are broadly consistent (see Appendix Figures A9 and A10) and refer to them at the relevant point in the text.

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).[7] For our analyses of health outcomes, we present models for pooled samples, but we also estimated the models separately by sex to assess whether the patterns hold for both men and women. We find that the results are consistent; and we supply these additional results in the Appendix (Figures A13 to A15) and refer to them at relevant points in the text.

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

[7] These analyses potentially confound time since migration with age and period of arrival for immigrants. Given the added complication of identifying a common "starting point" of observation for immigrants and the native-born (who have no time since arrival), we assess whether it is consequential for our reported results by conducting additional analyses following strategies developed in recent studies (Brunori 2024; Ferrara et al. 2024; Montazer and Wheaton 2017). First, we split the migrant sample in two subsamples defined by age at arrival (18-29, and 30-40). Second, we derive corresponding native-born subsamples defined based on their observed ages (those observed from age 18 onwards, and those observed from age 30 onwards). Third, within each subsample we create a time variable centred around the midpoint of the age at arrival windows – 25 for the first subsample and 35 for the second. These time variables roughly measure time since arrival for migrants and also capture ageing for both groups. By estimating heterogenous effects of this time variable by migration background, we can investigate immigrant-native-born gaps in the association between age and health, and interpret any differences as the effect of migrants' time since arrival. The migrant health trajectories we observe with this method are largely consistent with those in the main text, giving us confidence that our main analysis are not driven by such confounding. We do observe differences in precision driven by the fact that the time variable is no longer the exact time since arrival and larger confidence intervals due to smaller sample sizes. (Figures A11 and A12).

positively and negatively selected and there is overlap between the relative height of men and women (see Figure A4 in the Appendix).

[FIGURE 1]

These variations in degree of selection might reflect differences in the conditions of migration. We therefore estimated a model of the expected correlates of height selectivity (Figure 2, Table A9). 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 positively 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 relative height. All in all, this provides compelling evidence that greater relative height offers a robust measure of migrant selectivity.

[FIGURE 2]

Is Height Selectivity Associated with Better Health Outcomes?

We then turn to the question of whether such selectivity on relative height is associated with better health outcomes. We estimate sequential models for each of our health outcomes (see Appendix, Tables A10-A14). 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 health outcomes for immigrants in Germany, contradicting our expectation in H3a.

[FIGURE 3]

Does Selection Explain the Immigrant Health Advantage?

It follows that height selection should also not explain any immigrant health advantage relative to the German-born. Figure 4 (see Appendix Table A15) plots the health outcomes of immigrants relative to the native-born, from the lowest to the highest quartiles of health selectivity and including the full range of controls from Model 3. There is some evidence for a general immigrant health advantage: all immigrants have an advantage in terms of diagnosed conditions and all but the most negatively selected on height have a health advantage in terms of subjective health and extended hospitalizations. Consistent with our previous analysis, however, Figure 4 demonstrates 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 those born in Germany (on average) is therefore partially fulfilled, but this advantage is not driven by those with greater relative height, contra H3b.

[FIGURE 4]

Does the Association of Selection with Health Differ Over Time Since Arrival?

As we noted at the outset, aggregate differences in the health gaps between immigrants and the native-born 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 potentially diverging temporal trends for more and less positively selected immigrants over time. We thus turn to consider H4a, which posits that relative height moderates the relationship between time since migration and each of the five outcomes.

Figure 5 (see also Appendix Tables A9-A13) supports this contention: the association of health selectivity with health outcomes varies by time since arrival, such that those who are more positively 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.

We also disaggregated these analyses by sex and found that the pattern was consistent for men and women: see Appendix Figure A13.

[FIGURE 5]

This pattern could potentially be an artefact of the cross-sectional data capturing cohort differences in the relationship between health and selectivity rather than a true temporal (duration) effect. 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 A16 for full results). These results are consistent with the duration effect we see in Figure 5. That is, over time being more positively selected results in a positive health gap compared to those negatively selected.

[FIGURE 6]

Can Degree of Selectivity Help to Explain Decline in the Immigrant Health Advantage?

This suggests that it is the outcomes of the more negatively selected that follow the acculturation thesis. To assess this directly, we evaluate whether being positively (negatively) 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 A17 for full results). This figure shows that while both negatively and positively selected immigrants share an initial health advantage over (or parity with) native-born Germans at the time of arrival, those negatively 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 most positively selected, by contrast, while a slight advantage relative to native-born in subjective health disappears over time, they remain comparable 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. Separate analysis for men and women showed similar patterns for each (see Appendix, Figures A14 and A15). When we conducted separate analyses for those who

arrived aged 18-29 and those who arrived between ages 30-40, we again observed similar patterns, though they suggested that the selectivity gap in self-reported health may be driven more by those who arrived younger and that in diagnosed conditions by those who arrived older (see Appendix Figures A9 and A10). 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 from migrating.

[FIGURE 7]

Discussion and Conclusions

Despite general expectations that migrants are selected on health, health selectivity is rarely measured directly, and primarily among immigrants to the United States from a limited set of origins. Even then, explorations of immigrant health selectivity and its consequences 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 several advantages: we can produce a consistent individual-level measure 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 migrant health. 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.

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 positively selected than female immigrants. This variation gives us the leverage we need to test whether health selection is predicted by different routes to migration in theoretically plausible ways, and we found that it largely is: migrants from further, non-EU countries and recent arrivals (especially men) were more likely to be positively selected, while political or family reunification migrants and those migrating at older ages were less likely to be so.

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

A particular contribution of our study is that we examined not only whether migrants are selected on health, the question which has driven much of the literature, but also 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 trajectories 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 selectivity, 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), where data permits. Third, since we cannot assess relative height for those who migrated as children, such young immigrants are excluded from our analysis, but they may be included in other analyses of immigrant health, reducing the direct comparability of our findings with such studies.

Fourth, our main results derive from cross-sectional analysis of dynamic processes – the evolution of health status over time since migration. However, in such analysis we cannot disentangle age, cohort and time since migration effects. Given the emphasis in the literature on acculturation effects, and the focus on time since migration in the illustration and explication of the migrant health paradox, we focused on the role of time since migration, while controlling for age given its clear association with health. At the same time, our additional panel data analysis making use of the longitudinal dimension of the study not only supported these findings but indicated that our results could not simply be attributed to differences in age at migration. Our cross-section models have the advantage of enabling

large sample sizes, helping to avoid the uncertainty associated with attrition over time in longitudinal analyses, and more straightforwardly facilitating comparison with the native-born population. Using complementary cross-sectional and longitudinal analyses in this way offers a fruitful way to maximise the benefits of the data we have available. Finally, our analysis was contingent on being able to match our immigrant sample from Germany with data on heights for those of the same sex, birth cohort and country of origin. Despite using all the data sets available to us to create a high level of coverage of the immigrant sample, we lacked reference data for a small share of immigrants. Future work to further extend the height database would offer returns in terms of a more complete coverage of immigrant samples and across other destination contexts.

Despite these limitations, the insights from this paper into how the immigrant health advantage and health paradox are associated with underlying health have 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 those 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.

References

Abraído-Lanza, A. F., Chao, M. T., & Flórez, K. R. (2005). Do healthy behaviors decline with greater acculturation? Implications for the Latino mortality paradox. *Social Science & Medicine*, *61*(6), 1243–1255. https://doi.org/10.1016/j.socscimed.2005.01.016

Akresh, I. R., & Frank, R. (2008). Health selection among new immigrants. *American Journal of Public Health*, *98*(11), 2058–2064. https://doi.org/10.2105/AJPH.2006.100974

Andersen, H. H., Mühlbacher, A., & Nübling, M. (2007). *Die SOEP-version des SF 12 als instrument gesundheitsökonomischer analysen* (No. 6). SOEPpapers on Multidisciplinary Panel Data Research. https://EconPapers.repec.org/RePEc:diw:diwsop:diw_sp6

Arenas, E., Goldman, N., Pebley, A. R., & Teruel, G. (2015). Return migration to Mexico: Does health matter? *Demography*, *52*(6), 1853–1868. https://doi.org/10.1007/s13524-015-0429-7

Bakker, L., Dagevos, J., & Engbersen, G. Explaining the refugee gap: A longitudinal study on labour market participation of refugees in the Netherlands. *Journal of Ethnic and Migration Studies, 43*(1), 1775-1791.

Baldassar, L. (2014). Too sick to move: Distant 'crisis' care in transnational families. *International Review of Sociology*, *24*(3), 391–405. https://doi.org/10.1080/03906701.2014.954328

Ballarino, G., & Panichella, N. (2018). The occupational integration of migrant women in Western European labour markets. *Acta Sociologica, 61(2)*, 126–142. https://doi.org/10.1177/0001699317723441

Barker, D. J. P. (2004). The Developmental Origins of Adult Disease. *Journal of the American College of Nutrition*, *23*(sup6), 588S-595S. https://doi.org/10.1080/07315724.2004.10719428

Belot, M. V. K., & Hatton, T. J. (2012). Immigrant selection in the OECD. *The Scandinavian Journal of Economics*, *114*(4), 1105–1128. https://doi.org/10.1111/j.1467-9442.2012.01721.x

Boen, C. E., & Hummer, R. A. (2019). Longer—but harder—lives?: The Hispanic health paradox and the social determinants of racial, ethnic, and immigrant–native health disparities from midlife through late life. *Journal of Health and Social Behavior*, *60*(4), 434–452. https://doi.org/10.1177/0022146519884538

Borjas, G. J. (1987). Self-selection and the earnings of immigrants. *The American Economic Review*, *77*(4), 531–553. https://EconPapers.repec.org/RePEc:aea:aecrev:v:77:y:1987:i:4:p:531-53

Borjas, G. J. (1991). Immigration and self-selection. In *Immigration, trade, and the labor market* (pp. 29–76). University of Chicago Press.

Bostean, G. (2013). Does selective migration explain the Hispanic paradox? A comparative analysis of Mexicans in the US and Mexico. *Journal of immigrant and minority health*, *15*, 624-635. DOI: 10.1007/s10903-012-9646-y

Bozzoli, C., Deaton, A., & Quintana-Domeque, C. (2009). Adult height and childhood disease. *Demography*, *46*(4), 647–669. https://doi.org/10.1353/dem.0.0079

Case, A., & Paxson, C. (2008). Height, health, and cognitive function at older ages. *The American Economic Review*, *98*(2), 463–467. https://doi.org/10.1257/aer.98.2.463

Case, A., & Paxson, C. (2010). Causes and consequences of early-life health. *Demography*, *47*(1), S65–S85. https://doi.org/10.1353/dem.2010.0007

Chiswick, B. (1999). Are immigrants favorably self-selected? A*merican Economic Review*, *89*(2), 181–185.

Chiswick, B., Lee, Y., & Miller, P. (2008). Immigrant selection systems and immigrant health. *Contemporary Economic Policy, 26*(4), 555-578. **https://doi.org/10.1111/j.1465-7287.2008.00099.x**

Constant, A. F., García-Muñoz, T., Neuman, S., & Neuman, T. (2018). A "healthy immigrant effect" or a "sick immigrant effect"? Selection and policies matter. *The European Journal of Health Economics*, *19*(1), 103-121. DOI: 10.1007/s10198-017-0870-1

Crimmins, E. M., Soldo, B. J., Ki Kim, J., & Alley, D. E. (2005). Using anthropometric indicators for Mexicans in the United States and Mexico to understand the selection of migrants and the "hispanic paradox". *Social Biology*, *52*(3–4), 164–177. https://doi.org/10.1080/19485565.2005.9989107

Deaton, A. (2007). Height, health, and development. *Proceedings of the National Academy of Sciences*, *104*(33), 13232-13237. DOI:10.1073/pnas.0611500104

Donato, K. M., Hamilton, E. R., & Bernard-Sasges, A. (2019). Gender and health in Mexico: Differences between returned migrants and nonmigrants. *The ANNALS of the American Academy of Political and Social Science*, *684*(1), 165–187. https://doi.org/10.1177/0002716219857964

Dunlavy, A., Cederström, A., Katikireddi, S. V., Rostila, M., & Juárez, S. P. (2022). Investigating the salmon bias effect among international immigrants in Sweden: A register-based open cohort study. *European Journal of Public Health*, *32*(2), 226–232. https://doi.org/10.1093/eurpub/ckab222

Feliciano, C. (2020). Immigrant selectivity effects on health, labor market, and educational outcomes. *Annual Review of Sociology*, *46*(1), 315–334. https://doi.org/10.1146/annurev-soc-121919-054639

Ferrara. A & Cozzani, M. (2024). Explaining immigrant-native differences in health at birth: The role of immigrant selectivity in Spain. *SocArXiv* doi:10.31235/osf.io/2nea9.

Ferrara. A., Grindel, C., & Brunori, C. (2024). A longitudinal perspective to migrant health: Unpacking the immigrant health paradox in Germany. *Social Science & Medicine*, 351: 116976 DOI: 10.1016/j.socscimed.2024.116976

Ferrara, A., & Luthra, R. (2024). Explaining the attainment of the second-generation: When does parental relative education matter?. *Social Science Research*, *120*, 103016. https://doi.org/10.1016/j.ssresearch.2024.103016

Florian, S., Ichou, M., & Panico, L. (2021). Parental migrant status and health inequalities at birth: The role of immigrant educational selectivity. *Social Science & Medicine (1982)*, *278*, 113915. https://doi.org/10.1016/j.socscimed.2021.113915

Garcia, J., & Quintana-Domeque, C. (2007). The evolution of adult height in Europe: A brief note. *Economics & Human Biology*, *5*(2), 340–349. https://doi.org/10.1016/j.ehb.2007.02.002

Geronimus, A. T., Hicken. M., Keene, D., & Bound, J. (2006). "Weathering" and age patterns of allostatic load scores among blacks and whites in the United States. *American Journal of Public Health*, *96*(5), 826–833. doi: 10.2105/AJPH.2004.060749

Gubernskaya, Z. (2015). Age at migration and self-rated health trajectories after age 50: Understanding the older immigrant health paradox. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *70*(2), 279-290. DOI: 10.1093/geronb/gbu049

Goebel, J., Grabka, M. M., Liebig, S., Kroh, M., Richter, D., Schröder, C., & Schupp, J. (2019). The German Socio-Economic Panel (SOEP). *Jahrbücher Für Nationalökonomie Und Statistik*, *239*(2), 345–360. https://doi.org/10.1515/jbnst-2018-0022

Holz, M. (2022). Health inequalities in Germany: Differences in the 'healthy migrant effect' of European, non-European and internal migrants. *Journal of Ethnic and Migration Studies*, *48*(11), 2620–2641. https://doi.org/10.1080/1369183X.2021.1901675

Ichou, M. (2014). Who they were there: Immigrants' educational selectivity and their children's educational attainment. *European Sociological Review*, *30*(6), 750–765.

Ichou, M., & Wallace, M. (2019). The healthy immigrant effect: The role of educational selectivity in the good health of migrants. *Demographic Research*, *40*(4), 61–94. https://doi.org/10.4054/DemRes.2019.40.4

Jasso, G., Massey, D. S., Rosenzweig, M., & Smith, J. (2004). *Immigrant health: Selectivity and acculturation*. The Institute for Fiscal Studies WP04/23. https://doi.org/10.1920/wp.ifs.2004.0423

Jatrana, S., Richardson, K., Pasupuleti, S. S.R. (2017). Investigating the dynamics of migration and health in Australia: a longitudinal study. *European Journal of Population*, 34(4), 519-565. doi: 10.1007/s10680-017-9439-z.

Jones, N. L., Gilman, S. E., Cheng, T. L., Drury, S. S., Hill, C. V., & Geronimus, A. T. (2019). Life course approaches to the causes of health disparities. *American Journal of Public Health*, *109*(Suppl 1), S48–S55. https://doi.org/10.2105/AJPH.2018.304738

Kennedy, S., Kidd, M.P., McDonald, J.T. et al. (2015). The healthy immigrant effect: Patterns and evidence from four countries. *International Migration & Integration,* 16, 317–332. https://doi.org/10.1007/s12134-014-0340-x

Koch, D. (2011). Waaler revisited: The anthropometrics of mortality. *Economics & Human Biology*, *9*(1), 106–117. https://doi.org/10.1016/j.ehb.2010.04.001

Kogan, I., & Kosyakova, Y. (2023). Understanding immigrant labor market stratification: What can the case of recent refugee migration to Europe contribute?. In L.Platt, J. Polavieja, H. van de Werfhorst and M. Gangl (eds), *The Oxford Handbook of Social Stratification* (online edn, Oxford Academic, 20 Apr. 2023).

Lebano, A., Hamed, S., Bradby, H., Gil-Salmerón, A., Durá-Ferrandis, E., Garcés-Ferrer, J., ... & Linos, A. (2020). Migrants' and refugees' health status and healthcare in Europe: a scoping literature review. *BMC public health*, *20*(1), 1039. DOI: 10.1186/s12889-020-08749-8

Langie, S. A. S., Lara, J., & Mathers, J. C. (2012). Early determinants of the ageing trajectory. *Best Practice & Research Clinical Endocrinology & Metabolism*, *26*(5), 613–626. https://doi.org/10.1016/j.beem.2012.03.004

Loi, S., Li, P. and Myrskylä, M. (2025). Unequal weathering: How immigrants' health advantage vanishes over the life-course. *Journal of Migration and Health*, 11, 100303. https://doi-org.lse.idm.oclc.org/10.1016/j.jmh.2025.100303

Lu Y, Denier N, Wang JS, Kaushal N. (2017. Unhealthy assimilation or persistent health advantage? A longitudinal analysis of immigrant health in the United States. *Social Science and Medicine, 195:*105-114. doi: 10.1016/j.socscimed.2017.11.019.

Lu, Y., & Qin, L. (2014). Healthy migrant and salmon bias hypotheses: a study of health and internal migration in China. *Social Science & Medicine*, *102*, 41-48.

Luthra, R., Nandi, A., & Benzeval, M. (2020). Unravelling the 'immigrant health paradox': Ethnic maintenance, discrimination, and health behaviours of the foreign born and their children in England. *Journal of Ethnic and Migration Studies*, *46*(5), 980–1001. https://doi.org/10.1080/1369183X.2018.1539287

Luthra, R. & Platt, L. (2023). Do immigrants benefit from selection? Migrant educational selectivity and its association with social networks, skills and health. *Social Science Research*, *113*, 102887. https://doi.org/10.1016/j.ssresearch.2023.102887

Markides, K. S., & Rote, S. (2019). The healthy immigrant effect and aging in the United States and other western countries. *The Gerontologist*, *59*(2), 205-214. DOI: 10.1093/geront/gny136

Mayer, T. & Zignago, S. (2011), Notes on CEPII's distances measures : the GeoDist Database, *CEPII Working Paper*, 2011-25. http://dx.doi.org/10.2139/ssrn.1994531

McEniry, M. (2013). Early-life conditions and older adult health in low- and middle-income countries: A review. *Journal of Developmental Origins of Health and Disease*, *4*(1), 10–29. https://doi.org/10.1017/S2040174412000499

MacGregor-Fors, I., & Payton, M. E. (2013). Contrasting Diversity Values: Statistical Inferences Based on Overlapping Confidence Intervals. Plos One, 8(2), 1-4. https://doi.org/10.1371/journal.pone.0056794

Mehta, N. K., & Elo, I. T. (2012). Migrant selection and the health of US immigrants from the former Soviet Union. *Demography*, *49*, 425-447.

Morey, B. N., Bacong, A. M., Hing, A. K., de Castro, A. B., & Gee, G. C. (2020). Heterogeneity in migrant health selection: The role of immigrant visas. *Journal of Health and Social Behavior*, *61*(3), 359-376. DOI: 10.1177/0022146520942896

Moullan, Y., & Jusot, F. (2014). Why is the 'healthy immigrant effect' different between European countries?. *The European Journal of Public Health*, *24*(suppl_1), 80-86. DOI: 10.1093/eurpub/cku112

Nauman, E., VanLandingham, M., Anglewicz, P., Patthavanit, U., & Punpuing, S. (2015). Rural-to-urban migration and changes in health among young adults in Thailand. *Demography*, *52*(1), 233–257. https://doi.org/10.1007/s13524-014-0365-y

Nelson, C. P., Hamby, S. E., Saleheen, D., Hopewell, J. C., Zeng, L., Assimes, T. L., Kanoni, S., Willenborg, C., Burgess, S., Amouyel, P., Anand, S., Blankenberg, S., Boehm, B. O., Clarke, R. J., Collins, R., Dedoussis, G., Farrall, M., Franks, P. W., Groop, L., … Samani, N. J. (2015). Genetically determined height and coronary artery disease. *New England Journal of Medicine*, *372*(17), 1608–1618. https://doi.org/10.1056/NEJMoa1404881

Palloni, A., & Ewbank, D. C. (2004). Selection processes in the study of racial and ethnic differentials in adult health and mortality. In A. B. Anderson, R. A. Bulatao, & B. Cohen (Eds.), *Critical Perspectives on Racial and Ethnic Differences in Health in Late Life*. National Academies Press.

Perkins, J. M., Subramanian, S. V., Davey Smith, G., & Özaltin, E. (2016). Adult height, nutrition, and population health. *Nutrition Reviews*, *74*(3), 149–165. https://doi.org/10.1093/nutrit/nuv105

Polavieja, J. G., Fernández-Reino, M., & Ramos, M. (2018). Are migrants selected on motivational orientations? Selectivity patterns amongst international migrants in Europe. *European Sociological Review*, *34*(5), 570–588. https://doi.org/10.1093/esr/jcy025

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

Riosmena, F., Kuhn, R., & Jochem, W. C. (2017). Explaining the immigrant health advantage: Self-selection and protection in health-related factors among five major

national-origin immigrant groups in the United States. *Demography*, *54*, 175-200. DOI: 10.1007/s13524-016-0542-2

Ro, A., Fleischer, N. L., & Blebu, B. (2016). An examination of health selection among US immigrants using multi-national data. *Social Science & Medicine*, 158, 114-121. DOI:10.1016/j.socscimed.2016.04.023

Roser, M., Cameron A. & Ritchie H. (2021). Human Height. Published online at OurWorldInData.org. Retrieved from: https://ourworldindata.org/human-height

Rubalcava, L. N., Teruel, G. M., Thomas, D., & Goldman, N. (2008). The healthy migrant effect: New findings from the Mexican Family Life Survey. *American Journal of Public Health*, *98*(1), 78–84. **https://doi.org/10.2105/AJPH.2006.098418**

Samper, C. & Kreyenfeld, M. (2021). Marriage migration and women's entry into the German labour market. *Journal of Family Research, 33*(2), 439–466. **DOI:** https://doi.org/10.20377/jfr-491

Silventoinen, K. (2003). Determinants of variation in adult body height. *Journal of Biosocial Science*, *35*(2), 263–285. https://doi.org/10.1017/S0021932003002633

Sorkin, J.D., Muller, D.C., Andres, R. (1999). Longitudinal change in height of men and women: implications for interpretation of the body mass index: the Baltimore Longitudinal Study of Aging. *American Journal of Epidemiology*, *150*(9), 969-77. DOI: 10.1093/oxfordjournals.aje.a010106

Tarry-Adkins, J. L., & Ozanne, S. E. (2014). The impact of early nutrition on the ageing trajectory. *Proceedings of the Nutrition Society*, *73*(2), 289–301. https://doi.org/10.1017/S002966511300387X

Ullmann, S. H., Goldman, N., & Massey, D. S. (2011). Healthier before they migrate, less healthy when they return? The health of returned migrants in Mexico. *Social Science & Medicine*, *73*(3), 421–428. https://doi.org/10.1016/j.socscimed.2011.05.037

UNESCO (2006). International Standard Classification of Education, ISCED 1997. Reprinted May 2006. Available at: https://uis.unesco.org/sites/default/files/documents/international-standard-classification-of-education-1997-en_0.pdf

van Dalen, H. P., & Henkens, K. (2008). *Emigration Intentions: Mere Words or True Plans? Explaining International Migration Intentions and Behavior* (SSRN Scholarly Paper 1153985). https://doi.org/10.2139/ssrn.1153985

Wallace, M., & Darlington-Pollock, F. (2022). Poor health, low mortality? Paradox found among immigrants in England and Wales. *Population Space & Place*, 28(3), e2360. https://doi-org.lse.idm.oclc.org/10.1002/psp.2360

Ware, J. E., Kosinski, M., & Keller, S. D. (1996). A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Medical Care*, *34*(3), 220-233. DOI: 10.1097/00005650-199603000-00003

Westphal, C. (2016). Healthy migrants? Health selection of internal migrants in Germany. *European Journal of Population*, *32*(5), 703–730. https://doi.org/10.1007/s10680-016-9397-x

World Bank. (2024), World Development Indicators. GDP per capita in PPP and constant 2011 international dollars. Retrieved from: https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.KD

Yang, J., Bakshi, A., Zhu, Z., Hemani, G., Vinkhuyzen, A. A. E., Lee, S. H., Robinson, M. R., Perry, J. R. B., Nolte, I. M., van Vliet-Ostaptchouk, J. V., Snieder, H., Esko, T., Milani, L., Mägi, R., Metspalu, A., Hamsten, A., Magnusson, P. K. E., Pedersen, N. L., Ingelsson, E., … Visscher, P. M. (2015). Genetic variance estimation with

imputed variants finds negligible missing heritability for human height and body mass index. *Nature Genetics*, *47*(10), 1114–1120. https://doi.org/10.1038/ng.3390

Zheng, H., & Yu, W. (2022). Diminished advantage or persistent protection? A new approach to assess immigrants' mortality advantages over time. *Demography*, *59*(5), 1655–1681. https://doi.org/10.1215/00703370-10175388

Zuk, O., Hechter, E., Sunyaev, S. R., & Lander, E. S. (2012). The mystery of missing heritability: Genetic interactions create phantom heritability. *Proceedings of the National Academy of Sciences*, *109*(4), 1193–1198. https://doi.org/10.1073/pnas.1119675109

TABLES AND FIGURES

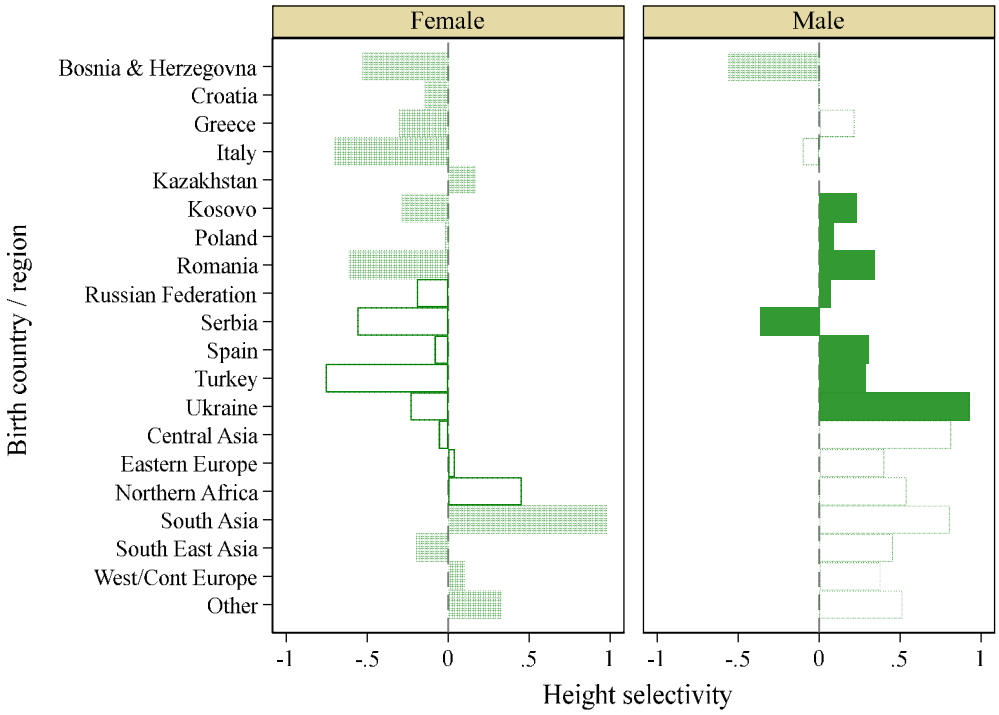
Table 1. Descriptive statistics

	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
Former East Germany	0.04	2114	0.04	1244	0.05	870
Origin country/region						
Bosnia & Herzegovina	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 GDP pc USD	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 (total)	1.66	1709	1.84	1010	1.44	699
Diagnosed condition (0-1)	0.53	1709	0.57	1010	0.48	699

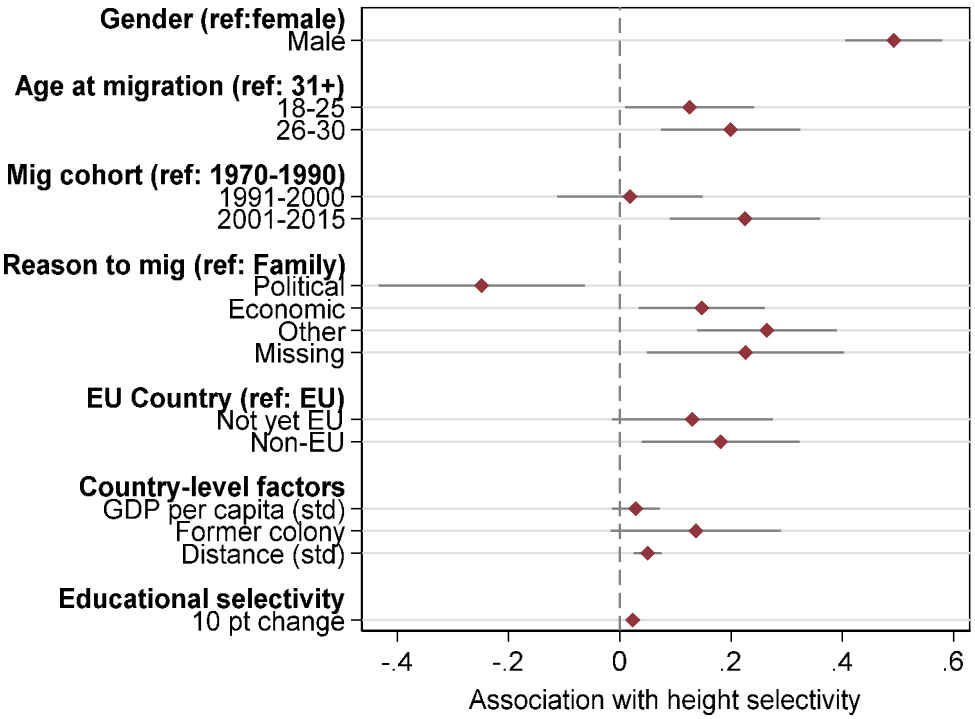
Notes: Weighted values, except for case numbers.
Source: GSOEP and height dataset, own calculations

Figure 1. Average height selectivity by gender and origin



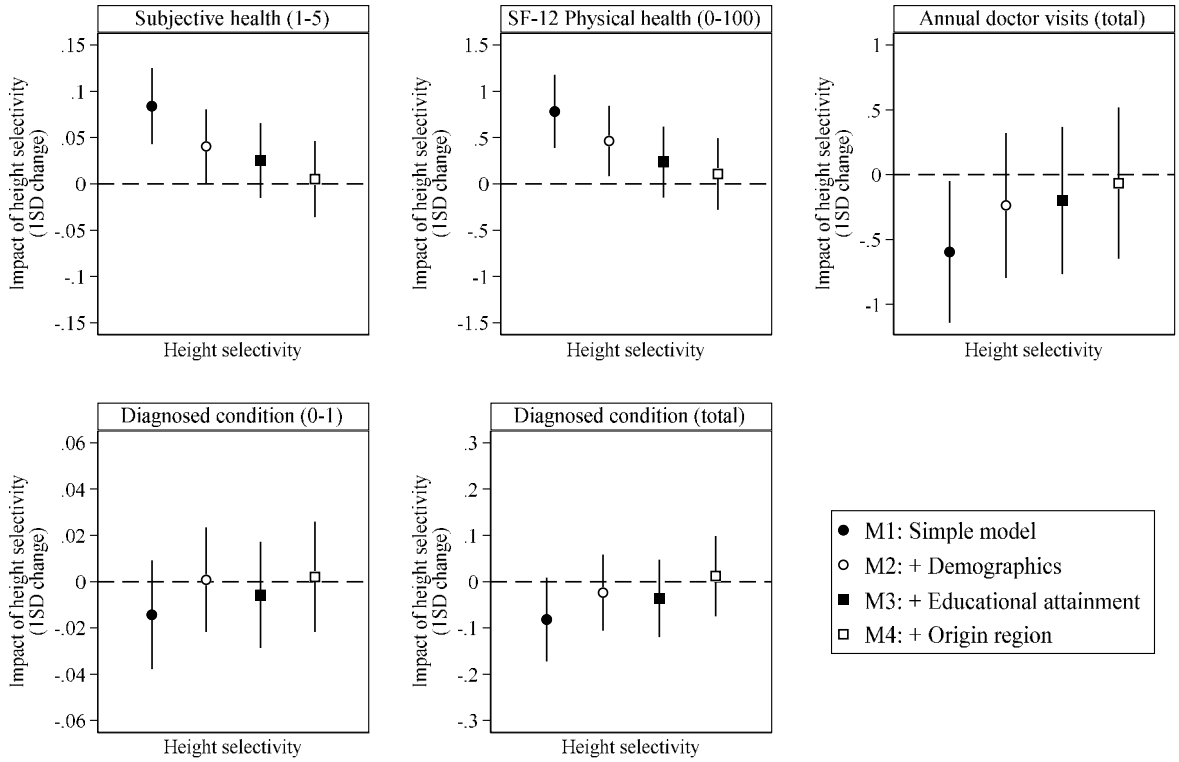
Notes: Weighted estimates.
Source: GSOEP 2014 wave and height dataset, own calculations

Figure 2. Predicting immigrant height selectivity



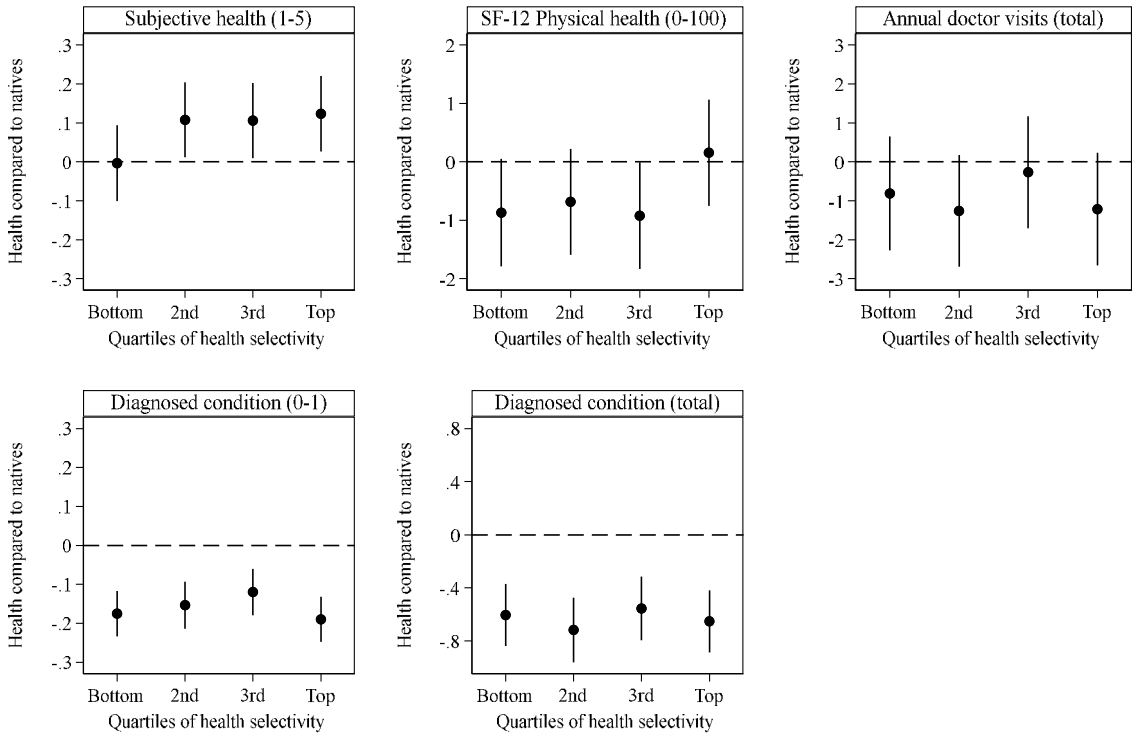
Notes: Weighted estimates with 95% confidence intervals obtained from a single OLS regression.
Source: GSOEP 2014 wave and height dataset, own calculations

Figure 3. Impact of selectivity on health outcomes



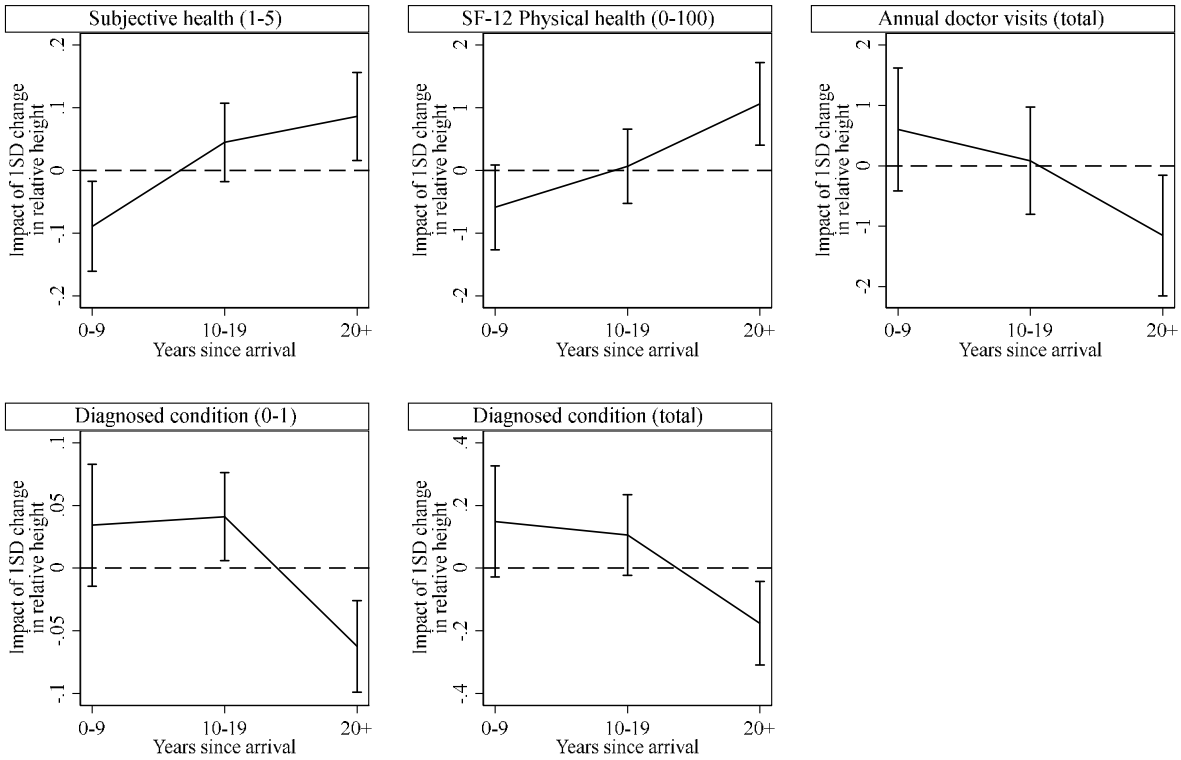
Notes: Weighted estimates with 95% confidence intervals from OLS regressions. M1 includes only height selectivity. M2 additionally controls for sex, age (linear and squared), time since arrival (categorical) and an indicator for living in East or West Germany. M3 additionally controls for educational attainment (3 categories), and M4 for origin region (see Table 1 for categories).
Source: GSOEP 2014 and 2015 waves and height dataset, own calculations

Figure 4. Differences in health between immigrants and native-born, by immigrant selectivity



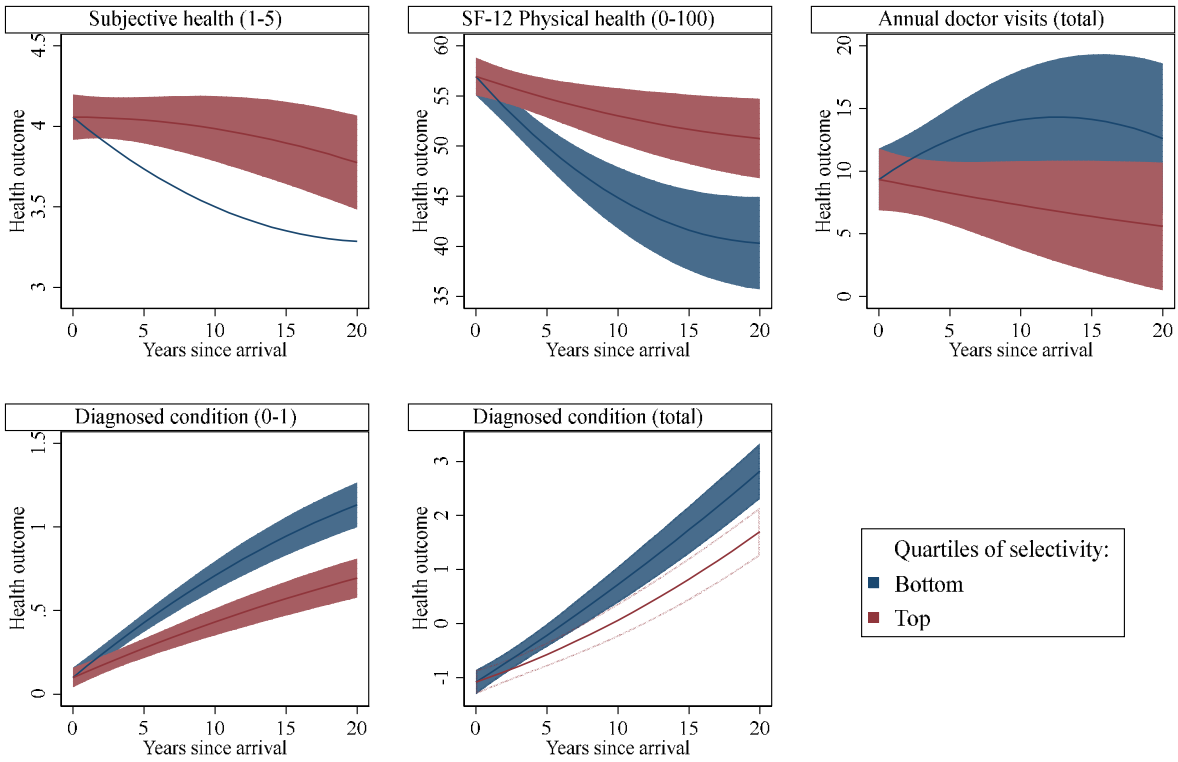
Notes: Weighted estimates with 95% confidence intervals from OLS regression. Controls include sex, age (linear and squared), an indicator for living in East or West Germany, and educational attainment (3 categories).
Source: GSOEP 2014 and 2015 waves and height dataset, own calculations

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



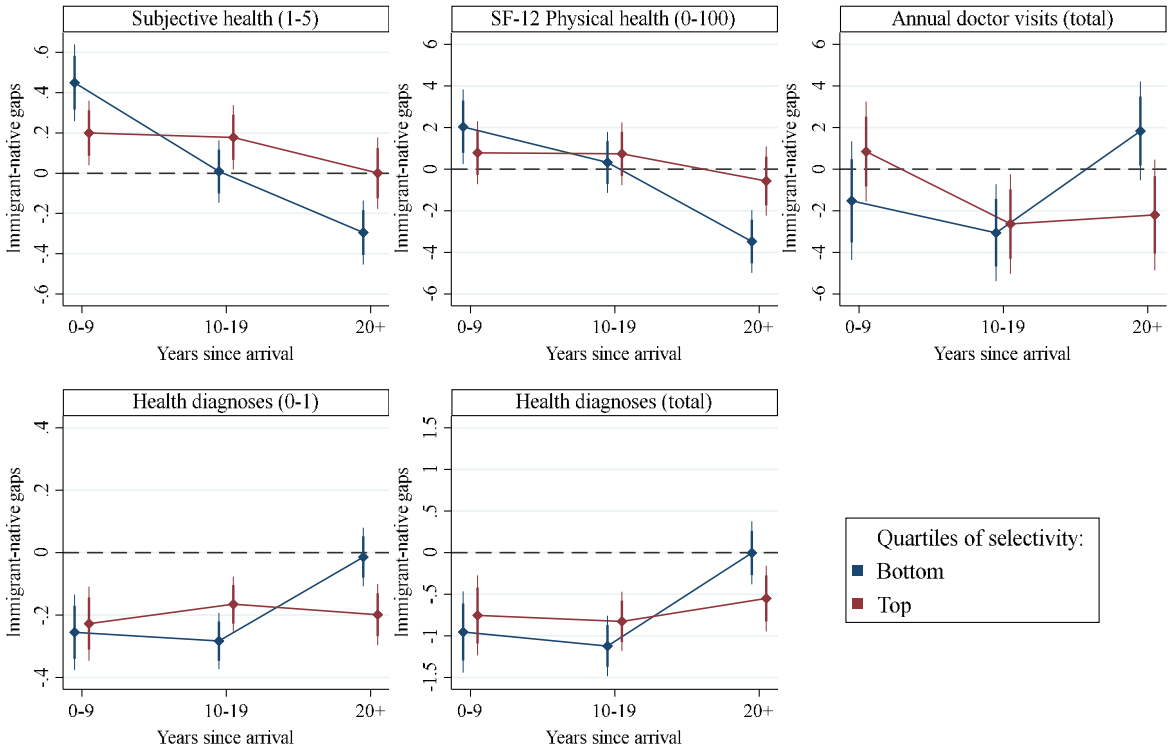
Notes: Weighted estimates with 95% confidence intervals from OLS model. Controls include sex, age (linear and squared), an indicator for living in East or West Germany, educational attainment (3 categories), and origin region (see Table 1 for categories).
Source: GSOEP 2014 and 2015 waves and height dataset, own calculations

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 2014 to 2021 and height dataset, own calculations

Figure 7. Immigrant-native-born 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 immigrant-native-born 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 and 2015 waves and height dataset, own calculations