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# A longitudinal perspective to migrant health: Unpacking the immigrant health paradox in Germany

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ABSTRACT

Previous research finds that recent immigrants are healthier than the native-born, while more established immigrants exhibit worse health, suggesting a process of unhealthy assimilation. However, previous literature is mostly based on cross-sectional data or on longitudinal analyses similarly failing to disentangle individual-level variation from between-individual confounding. Moreover, previous longitudinal studies are often limited in their study of different health outcomes (few and mostly subjective health), populations (sometimes only elderly individuals), time periods (short panels) and geographical contexts (mostly Australia, Canada and USA). We address these limitations by comparing the health trajectories of adult immigrants and natives in Germany over extended periods, using data from years 2002–2021 of the German Socio-Economic Panel (SOEP), and investigating a wide range of health outcomes, including self-assessed physical and mental health measures, diagnosed illnesses, and health behaviors. We employ a longitudinal approach that stratifies immigrants by age at arrival, and compares them to natives of the same age. This allows us to estimate both Hierarchical Linear Models and more rigorous Fixed Effects models to further address confounding. Cross-sectionally, we confirm previous literature's findings: recent immigrants are healthier than natives and established immigrants. Longitudinally, we find support for the unhealthy assimilation hypothesis concerning subjective health and mental health, but not for the others health indicators or behaviors. We interpret these findings as possible evidence of immigrants' reduced access to timely health care and emphasize the need for greater longitudinal research investigating migrant gaps in various health outcomes.

## 1. Introduction

A large literature documents that, relative to native-born individuals, immigrants tend to exhibit better health despite usually having a lower socio-economic standing – the so-called "Healthy Immigrant Effect" (HIE) (Lariscy et al., 2015; Markides and Rote, 2019). The HIE is often found to be largest among recent immigrants, whereas longer established immigrants tend to have more similar or even worse health compared to natives (Acevedo-Garcia et al., 2010; Akresh, 2007; Riosmena et al., 2017) - what we refer to as the "Immigrant Health Paradox" (IHP). This pattern has been generally interpreted as reflecting immigrants' *individual-level deterioration in health* with time since arrival, which we label as the "Unhealthy Assimilation Hypothesis" (UAH).

Evidence on the IHP mostly comes from Australia, Canada and the United States, while research on European countries is relatively scarce and its findings inconsistent (Markides and Rote, 2019; Nielsen and Krasnik, 2010). This is partly because of differences in immigrant and native population composition and in immigration policies across European countries (Moullan and Jusot, 2014). However, results are often inconclusive even *within countries*. In the case of Germany, which is the focus of this research, some studies confirm the IHP (Holz, 2022; Razum et al., 1998; Ronellenfitsch and Razum, 2004), while others find no or mixed evidence (Maskileyson et al., 2019; Nesterko et al., 2019; Wengler, 2011).

A key limitation of the European literature and the wider research on the IHP is that results are mainly based on cross-sectional evidence (Lu et al., 2017; Zheng and Yu, 2022). These studies could not test whether the difference in health between recent and established immigrants

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described by the IHP is due to individual-level deterioration (i.e. the UAH) or to other causes. In cross-sectional tests of the UAH, the effects of length of stay are confounded by the effects of age at arrival and differences between immigration and birth cohorts, which are known to correlate with health (Gubernskaya, 2015; Hamilton et al., 2015). Recent studies recognize these issues and have begun to address them using longitudinal data (Boen and Hummer, 2019; Gubernskaya, 2015; Lu et al., 2017; Montazer and Wheaton, 2017; Zheng and Yu, 2022). Many of these find limited evidence of the UAH, casting doubt on prior results based on cross-sectional analyses (e.g. Boen and Hummer, 2019; Lu et al., 2017; Nesterko et al., 2019; Zheng and Yu, 2022; Brunori, forthcoming). However, the evidence is far from conclusive and further research is required to build more longitudinal evidence.

With notable exceptions, existing research is limited in *either* their study of different health outcomes (few indicators and often only subjective health); populations (often only elderly individuals) *or* time periods (often short panels). Furthermore, most adopt methods which conflate between- and within-individual variation, such as random effects regressions, which may still lead to some unaddressed confounding (e.g. by differences between immigration cohorts) or selection bias (e.g. from selective remigration). Finally, these advances in IHP research have not extensively diffused to the European context and studies are almost exclusively based on Australia, Canada and the USA.

We address these limitations in a single study by using longitudinal data from the German Socio-Economic Panel (SOEP) to investigate immigrant-native gaps in various health outcomes over the life course. Specifically, we test whether the IHP holds for the German case and, if so, whether the difference in health between recent and established immigrants reflects individual-level health deterioration over time (i.e. the UAH). We contribute to the growing literature investigating the IHP longitudinally in different ways. First, we provide novel longitudinal evidence on the IHP in Germany using a long-running panel (up to 19 years) with a large sample of adult respondents (aged 18 to 60). Second, we investigate a wide range of health outcomes, including subjective health, SF-12 mental and physical health scales, disability, reported diagnoses of specific health conditions, as well as health behaviors that are commonly cited mechanisms of the UAH, including smoking, eating and sleep habits. Third, we contribute methodologically to the literature by adopting a method developed in Brunori, forthcoming to test the UAH using Fixed Effects (FE) panel regressions in addition to Hierarchical Linear Models. FE models provide a more rigorous test of the UAH because they only take individual-level variation into account.

## 2. Background

### 2.1. The Healthy Immigrant Effect and the Unhealthy Assimilation Hypothesis

A vast literature documents health advantages for foreign-born individuals, despite other disadvantages they may face (Antecol and Bedard, 2006; Fenelon, 2013; Lariscy et al., 2015). This "Healthy Immigrant Effect" (HIE) is usually explained in three main ways. First, according to the *selectivity hypothesis*, immigrants may be positively selected in terms of health or other variables, like their pre-migration socioeconomic status, which positively influence their current health (Feliciano, 2020; Florian et al., 2021). Second, according to the *cultural hypothesis*, immigrants may have favorable health practices and habits, such as lower smoking, which may positively affect their health (Fenelon, 2013; Riosmena et al., 2017). Third, migrant health advantages could be the result of biases in data gathering, such as the "salmon bias" which refers to the tendency of less healthy individuals to return to their home country (Palloni and Arias, 2004).

Most studies find the HIE to be strongest among recently arrived immigrants, with longer established immigrants having similar or worse health conditions as natives (Acevedo-Garcia et al., 2010; Riosmena et al., 2017), a pattern that we refer to as the "Immigrant Health Paradox" (IHP). This is generally taken as evidence for an accelerated individual-level health decline experienced by immigrants as they spend time in the destination country – what we call the "Unhealthy Assimilation Hypothesis" (UAH). This decline is usually explained through immigrants' adoption of unhealthy habits from the destination country or their greater exposure, compared to natives, to stress from acculturation, discrimination, poor economic and social conditions, and polluted neighborhoods (Antecol and Bedard, 2006; Finch et al., 2002; Gee et al., 2009; Lersch, 2013; Riosmena et al., 2017).

### 2.2. Confounding in cross-sectional designs

The evidence for the IHP is typically based on cross-sectional studies finding that immigrants' health decreases with their length of stay in the destination country (Antecol and Bedard, 2006; Fenelon, 2013; Giuntella, 2017). However, some recent scholarship recognizes that this may not be interpreted as evidence of an UAH, because duration of stay effects are potentially confounded with arrival cohort, birth cohort and age at arrival effects in cross-sectional designs [e.g. see Lu et al. (2017) or Zheng and Yu (2022) for a detailed discussion]. This is shown in formulas (1), (2) and (3) below:

$$\text{Duration of stay} = \text{current year} - \text{arrival year} \quad (1)$$

$$\text{Duration of stay} = \text{current age} - \text{arrival age} \quad (2)$$

$$\text{Duration of stay} = \text{current year} - \text{birth year} - \text{arrival age} \quad (3)$$

In studies based on a single cross-section, the current year is fixed by design, while in studies based on pooled cross-sections, it is usually controlled for to account for period effects. Moreover, since age strongly affects health, it is always controlled for when modelling health outcomes. Because of these constraints and equations (1)–(3), cross-sectional studies cannot measure the health impacts of duration of stay net of arrival cohort, birth cohort and age at arrival effects without running into identification problems (Zheng and Yu, 2022). As a result, the estimated impact of duration of stay is confounded with these three factors.

There are reasons to expect that this confounding will be consequential. Average health could be improving across birth and migration cohorts because of improvements in life conditions and healthcare quality, especially in less developed countries (Lu et al., 2017). The composition of immigration cohorts can also vary significantly over time because of changes in push-and-pull factors and in destination countries' immigration policies (Hamilton et al., 2015). These factors can affect the relative costs of migration and the selectivity of immigration cohorts in terms of health and related characteristics (Zheng and Yu, 2022). Finally, observed health differences by time since arrival might be due to selective remigration: established immigrants are a selected subset of their immigration cohort, since return and onward migration are common (Dustmann and Görlach, 2015) and influenced by factors such as pre-migration characteristics, socioeconomic conditions in the destination country (e.g. Caron and Ichou, 2020), and health (e.g. Arenas et al., 2015). Age at arrival is also associated with immigrant selectivity and health: immigrants arriving as young adults should be the most positively selected because they move in search of better work and life opportunities (Gubernskaya, 2015).

### 2.3. Additional gaps and contributions

Recent studies have increasingly employed longitudinal data designs, and often found that cross-sectional findings on the IHP and conclusions about the UAH are driven by confounding (e.g. Boen and Hummer, 2019; Lu et al., 2017; Nesterko et al., 2019; Zheng and Yu, 2022). However, several of these studies are still affected by some limitations that have been recognized in the literature and which we address in this study.

First, there are additional sources of bias from selective re-migration, mortality, panel attrition, and unobserved confounding more generally, which are overlooked in existing studies. The likelihood of individuals migrating, dropping out of surveys and dying is affected by their health and may vary across migration backgrounds (Banks et al., 2011; Lu and Qin, 2014). Existing longitudinal studies of the IHP employ models conflating within- and between-individual differences in health, so their estimates could be biased by between-individual unobserved confounding. A more rigorous test of the UAH would require comparing only within-individual changes in health.

A solution is to exploit only within-individual variation in health using FE models. These models partial out all time-constant individual-level observed characteristics (e.g. age at arrival, immigration and birth cohort), as well as those that are unobserved. Therefore, they can provide more rigorous estimates to complement those from methods that also model between-individual differences. However, FE models are rarely employed in this literature [see Brunori, forthcoming or Montazer and Wheaton (2017) for exceptions], because they also pose a key problem, which is that duration of stay in the destination country and age are perfectly collinear within individuals. We overcome this problem by following a method developed by Brunori, forthcoming to disentangle duration of stay and age effects within individuals. As a result, we are able to rigorously test the UAH, which is the first main contribution of our paper.

A second limitation with existing studies on the IHP concerns the outcomes considered. Health indicators are imperfect proxies and are likely to produce some bias, especially when comparing culturally diverse immigrant and native populations. Most longitudinal studies focus on subjective health (Gubernskaya, 2015; Hamilton et al., 2015; Jatrana et al., 2018; Lu et al., 2017), although its value as a health indicator has been criticized. Immigrants' subjective health could decrease without an underlying worsening in their objective health. For example, their subjective health could deteriorate because they change their reference point as they spend more time in the destination country (Lu et al., 2017). A decrease may also reflect immigrants' greater awareness of their health from increased use of health services and better diagnoses – arguably *an improvement* in their health (Zheng and Yu, 2022).

Few studies adopt more objective health measures, including diagnosed health conditions (Boen and Hummer, 2019; Jatrana et al., 2014). These measures are also not ideal because, although most immigrants should have access to health insurance in Germany, they may de facto still face barriers to health care services and timely diagnoses due to language difficulties or discrimination (Lebano et al., 2020). Others have focused on mortality because it overcomes these biases (Zheng and Yu, 2022), but it does not capture all aspects of poor health. Finally, most studies using longitudinal data do not investigate gaps in the adoption over time of unhealthy behaviors, such as smoking or drinking, despite their hypothesized relevance for the UAH (Antecol and Bedard, 2006; Riosmena et al., 2017). Ultimately no health measure is perfect, so we should consider several indicators simultaneously when studying immigrant health (Gubernskaya, 2015) This is our second major contribution: we longitudinally investigate immigrant-native gaps in a wide range of health outcomes, including subjective health, SF-12 mental and physical health components, reported diagnoses of health conditions, as well as the propensity to smoke, be obese and under-sleep.

A third critique that has been raised about IHP longitudinal studies is that they often have limited observational windows and age ranges [see Zheng and Yu (2022) for an exception]. They usually observe individuals for less than 10 years (Lu et al., 2017; Nesterko et al., 2019), which may not be enough to adequately capture immigrants' health declines (Riosmena et al., 2013). Additionally, some focused on individuals above age 50 (Boen and Hummer, 2019; Gubernskaya, 2015). As most migrations and remigrations happen during early-to mid-adulthood, these studies cannot observe immigrants' health trajectories from arrival, and can only observe the selected group of long-term immigrants. We contribute to the literature by providing a more comprehensive picture of the IHP, observing individuals in a wide age range (18–60) and for an extended time period (up to 19 years).

A final critique of the literature investigating the IHP with longitudinal data is that it is almost exclusively from Australia, Canada, and the United States. The few longitudinal European studies suffer from important limitations: Lubbers and Gijsberts (2019) do not compare immigrants' trajectories to a natives control group, and Brunori, forthcoming only explores mental health trajectories. The only longitudinal study on the IHP in Germany (Nesterko et al., 2019) only focuses on two health measures (SF-12 mental and physical health), for a relatively short period of time (10 years), and only employs random effects models on a balanced panel of individuals, ignoring potential biases from attrition and selective remigration (Jatrana et al., 2014). In this paper, we contribute to the scarce European literature looking at the IHP longitudinally and, more specifically, to the inconclusive German literature on the topic (Holz, 2022; Maskileyson et al., 2019; Nesterko et al., 2019; Ronellenfitsch and Razum, 2004).

## 3. Data and methods

### 3.1. Data

We use data from the German Socio-Economic Panel (SOEP) (IAB-SOEP, 2023; SOEP Group, 2023), a representative longitudinal household survey of the German population that has been running yearly since 1984 [see SOEP Group (2022) for detailed information on survey instruments]. Every year approximately 30,000 individuals in 15,000 households are surveyed. Except for subjective health, which is asked yearly as of 1984, other health variables have been introduced later in the survey and are asked less regularly (see Table A1 in the appendix). We restrict our analytical sample to survey years 2002 up to 2021 to obtain a relatively homogeneous sample in terms of survey years across different outcome variables. We ran robustness checks excluding COVID-19 pandemic years (2020–2021) and our results were unchanged.

We exclude individuals (1) aged below 18 or above 60; (2) observed only once; (3) with missing information on the relevant variables (see Section 3.2); (4) belonging to highly targeted samples in the SOEP (e.g. the "2019 Top shareholder sample"); (5) born in Germany but with at least one foreign-born parent (the second and 2.5 generations); and (6) refugees. We drop the latter because they are mostly observed in years after 2015 and greatly oversampled, which limits our ability to draw on long panels for our longitudinal analyses. The survey years considered in our analyses (and hence sample sizes) vary across outcome variables and are summarized in Table A1 in the Online Appendix.

### 3.2. Variables

We consider a wide range of health outcomes. First, we look at self-assessed health measures, including subjective health (ranging from 1 – "bad" – to 5 – "very good") and the SF-12 physical (PCS) and mental (MCS) component summaries. The SF-12 is a battery of 12 items asking respondents to rate how different aspects of their health (6 more physical and 6 more mental) have impacted their recent daily life. Scores are added and normalized separately in the PCS and MCS, which range from 0 to 100, with a mean score of 50 and a standard deviation of 10. Higher values indicate better health. Subjective health is available yearly in the SOEP, while MCS and PCS were asked biyearly starting in 2002.

The second set of indicators measure whether individuals were affected by certain health conditions. We consider these more "objective" than the previous measures since they refer to specific conditions, some of them diagnosed. However, we wish to stress that they are self-reported and depend on access to healthcare and diagnosis. These include: (1) having been hospitalized for more than ten days in the last year; (2) currently suffering from a "chronic health condition"; (3)

having been officially assessed as being severely disabled or (partially) incapable of work; having *ever been* diagnosed with (4) depression, (5) another illness (including sleep disorder, diabetes, asthma, cardiac diseases, and/or high blood pressure), or (6) cancer/stroke.

Outcomes (4)–(6) are based on a battery of items asking individuals biyearly whether they had been ever diagnosed with a certain disease starting in 2009. Because of the left-censoring in this measure and problems in determining the exact timing of diagnoses or recovery from conditions, we use the items to build indicators of whether individuals *have ever been* diagnosed with each condition. We smoothen our indicator across survey years in which the items were not included by carrying information backward (at the cost of anticipating some diagnoses by one year).

Finally, we consider three measures of health behaviors: whether individuals currently report (1) being a smoker, (2) being obese (BMI >30), and (3) sleeping less than 8 h on average per night. Data on the first two were gathered biyearly from 2002, while the third was asked from 2008.

The main independent variable is nativity, distinguishing immigrants (born abroad) and natives (born in Germany with two German-born parents). We define a set of control variables based on detailed self-reported information in the SOEP. These include age (linear term and squared term), gender (binary), German state of residence, and highest educational attainment (low, low vocational, medium, medium vocational, and high). For immigrants, we also compute age at first arrival and duration of stay (in years) in Germany. Table 2 presents descriptive statistics for the subjective health analytical samples (see next section for details on their construction).

### *3.3. Analytical strategy*

Our strategy is two-fold. First, we replicate cross-sectional analyses that are common in the literature to describe the IHP and provide a benchmark for our longitudinal approach. This is especially relevant for the German case, which is understudied even cross-sectionally, particularly for the variety of health outcomes we consider. We pool SOEP waves and run OLS regressions of health outcomes on immigrants' duration of stay using natives as the reference group. We control for respondents' age, age squared, gender, educational attainment, state of residence, and survey wave. We cluster standard errors at the individual level to account for repeated observations.

Next, we apply an approach proposed by Brunori, forthcoming to study the IHP longitudinally and rigorously test the UAH. We define three different populations (A, B, C) based on individuals' age and immigrants' age at migration (see Table 1 below). Within each set, we center our age variable around the bottom age cutoff (as shown in Column 3), so that age roughly coincides with the number of years since migration for immigrants. This allows us to investigate immigrant-native gaps in the association between age and health, and interpret any differences as the effect of migrants' time since arrival.

Our choice of age ranges for the three sets are dictated by some constraints we face. Ideally, we would restrict the ranges further so that age and time since migration would perfectly overlap for immigrants, but this would greatly reduce sample sizes for analyses. We ran models with smaller sets based on 5-year ranges and our results are robust as discussed in our results section. Another issue is that our three sets exclude immigrants arriving after age 45 (4% of the sample) and those arrived before age 18 (28% of the sample) - i.e. the 1.5 generation. The latter is dictated by the fact that SOEP adult surveys are answered only from age 18, so early health after migration could not be observed for the 1.5 generation. We ran robustness checks excluding them also from our cross-sectional OLS analyses and results were substantively the same. We return to this issue in the discussion.

**Table 1**
Defining the three analytical sets.

| Sample | Native | Immigrant | Centered age variable |
|---|---|---|---|
| A | 18 ≤ Age | 18 ≤ Age & 18 ≤ Migration Age <25 | Age - 18 |
| B | 25 ≤ Age | 25 ≤ Age & 25 ≤ Migration Age <35 | Age - 25 |
| C | 35 ≤ Age | 35 ≤ Age & 35 ≤ Migration Age ≤45 | Age - 35 |

In our longitudinal analyses, we follow the existing literature and model health trajectories over age using Hierarchical Linear Models (HLMs) with random intercepts and random slopes for age. The advantage of HLMs over traditional OLS is that they model health trajectories accounting for both between- and within-person change over time. By estimating both an immigrant intercept and age slope, they provide a full longitudinal description of the IHP. Thanks to our partitioning of the sample, we are also able to fit FE models, which consider *only within-individual change,* and allow us to specifically test the UAH net of all between-individual confounding.

We include quadratic age terms and interact linear and quadratic age terms with nativity in all our models. In the HLMs, we fit parsimonious models to avoid over-controlling and only include controls for respondents' birth cohort, sex, educational attainment and German state of residence. In the FE models these time-constant characteristics are absorbed by individual fixed effects.

To provide results representative of the German population, SOEP data should be analyzed using survey weights. However, the utility and feasibility of weighting in this type of longitudinal analyses is debated (Boen and Hummer, 2019). This is especially complicated in our data since we analyze long and unbalanced panels with individuals entering and exiting the survey in different years. Focusing only on balanced panels could be a solution, but this would force us to lose substantively relevant cases (e.g. migrants who remigrate). The SOEP also includes several refreshment samples, which makes it hard to establish a reference population for weighting. In line with prior studies using similar designs and data (Gubernskaya, 2015; Nesterko et al., 2019) we report results from unweighted models. However, we address the issue of representativity by excluding some highly selective samples in the SOEP (e.g. the "Top shareholder sample") and refugees, who were oversampled in the 2016 survey wave. We also ran models using individuals' entrance-year and exit-year survey weights (Boen and Hummer, 2019) and results were substantively unchanged.

## 4. Results

We begin by commenting on results from the pooled OLS models presented in Fig. 1. Recent immigrants (0–4 years in Germany) have better health outcomes (all measures except extended hospitalization) and healthier behaviors (except for smoking) than natives. These health advantages over natives are smaller for longer established immigrants, with the most established immigrants (20+ years in Germany) having similar (subjective health, MCS, chronic illness/disability, depression, other diagnosed illness, obesity, under-sleeping) or worse (PCS) outcomes and behaviors compared to natives. The health differences between recent and established immigrants are substantively large, e.g. the mental health gap between the most recent and the most established immigrants corresponds to one third of a standard deviation. These results overall support the IHP for Germany.

In additional analyses, we found that our results were robust to the inclusion of birth cohort controls. Moreover, for the sake of comparability with our longitudinal results, we tested whether the IHP result held when we investigate the interaction between migration background and age (rather than time since arrival). Results presented in online appendix Fig. A1 are largely comparable to those in Fig. 1.

Next, we comment on our longitudinal analyses. Tables 3 and 4 present, respectively, estimates from the HLMs and the FE models for the three analytical samples (A, B, and C). The full models are presented in

**Table 2**
Descriptive statistics (current health sample).

| | Native-born | | | Migrant-born | | | |
|---|---|---|---|---|---|---|---|
| | All (set A) | Set B | Set C | All | Set A | Set B | Set C |
| **Birth cohort** | | | | | | | |
| 1924–1955 | 0.14 | 0.16 | 0.20 | 0.07 | 0.09 | 0.05 | 0.11 |
| 1956–1960 | 0.13 | 0.14 | 0.18 | 0.07 | 0.04 | 0.05 | 0.15 |
| 1961–1965 | 0.12 | 0.14 | 0.18 | 0.08 | 0.04 | 0.09 | 0.12 |
| 1966–1970 | 0.13 | 0.15 | 0.18 | 0.11 | 0.08 | 0.11 | 0.15 |
| 1971–1975 | 0.10 | 0.12 | 0.13 | 0.13 | 0.13 | 0.13 | 0.21 |
| 1976–1980 | 0.10 | 0.11 | 0.08 | 0.15 | 0.17 | 0.15 | 0.18 |
| 1981–1990 | 0.16 | 0.13 | 0.05 | 0.24 | 0.23 | 0.31 | 0.08 |
| 1990–2000 | 0.11 | 0.04 | 0.00 | 0.15 | 0.22 | 0.11 | 0.00 |
| **Migration cohort** | | | | | | | |
| N.A. | 1.00 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1950–1989 | 0.00 | 0.00 | 0.00 | 0.21 | 0.21 | 0.10 | 0.05 |
| 1990–1999 | 0.00 | 0.00 | 0.00 | 0.25 | 0.26 | 0.20 | 0.20 |
| 2000–2009 | 0.00 | 0.00 | 0.00 | 0.23 | 0.25 | 0.26 | 0.25 |
| 2010–2020 | 0.00 | 0.00 | 0.00 | 0.31 | 0.27 | 0.44 | 0.50 |
| **Age first observation** | 36.81 | 39.42 | 42.97 | 36.19 | 33.60 | 37.29 | 45.90 |
| **Age at migration** | N.A. | N.A. | N.A. | 23.93 | 21.35 | 28.82 | 39.03 |
| **Length of stay (last obs.)** | | | | | | | |
| N.A. | 1.00 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0–5 years | 1.00 | 1.00 | 1.00 | 0.21 | 0.19 | 0.31 | 0.34 |
| 6–10 years | 0.00 | 0.00 | 0.00 | 0.15 | 0.15 | 0.19 | 0.22 |
| 11–15 years | 0.00 | 0.00 | 0.00 | 0.14 | 0.14 | 0.15 | 0.16 |
| 16–20 years | 0.00 | 0.00 | 0.00 | 0.16 | 0.17 | 0.14 | 0.19 |
| 20+ years | 0.00 | 0.00 | 0.00 | 0.34 | 0.34 | 0.21 | 0.09 |
| **Male** | 0.49 | 0.49 | 0.49 | 0.47 | 0.42 | 0.48 | 0.50 |
| **Educational attainment** | | | | | | | |
| Low | 0.10 | 0.06 | 0.05 | 0.25 | 0.27 | 0.20 | 0.23 |
| Low vocational | 0.20 | 0.22 | 0.24 | 0.18 | 0.18 | 0.15 | 0.20 |
| Medium | 0.08 | 0.04 | 0.02 | 0.12 | 0.15 | 0.10 | 0.11 |
| Medium vocational | 0.40 | 0.43 | 0.43 | 0.19 | 0.18 | 0.17 | 0.18 |
| High | 0.22 | 0.25 | 0.25 | 0.25 | 0.22 | 0.39 | 0.28 |
| **Obs. Per person** | | | | | | | |
| 1 to 5 | 0.52 | 0.46 | 0.44 | 0.69 | 0.66 | 0.72 | 0.76 |
| 6 to 10 | 0.25 | 0.26 | 0.25 | 0.24 | 0.26 | 0.22 | 0.21 |
| 11+ | 0.24 | 0.27 | 0.31 | 0.07 | 0.08 | 0.05 | 0.03 |
| Individuals | 31043 | 27089 | 21834 | 11007 | 2568 | 3504 | 1588 |
| Individual x Years | 215331 | 190654 | 151139 | 47649 | 11755 | 13716 | 5450 |

Source: SOEP 2002–2021

Tables A3–A14 in the online appendix. In the HLMs, we are interested in the immigrant intercept, which represents health gaps upon arrival in Germany, and the interaction coefficient between being an immigrant and the age slope, which represents differences in health trajectories over time. In the FE models we can only observe the latter, since health gaps upon arrival are absorbed by the fixed effects.

Starting with the immigrant intercepts in Table 3, we find evidence that immigrants are generally healthier than natives upon arrival to Germany, confirming the HIE. This varies significantly across health outcomes and immigrants' arrival age. Upon arrival, immigrants arriving at a younger age (set A) exhibit smaller health advantages over natives compared to immigrants arriving at older ages (sets B and C). Compared to natives, immigrants in set A reported a higher subjective health and mental health, and were less likely to report suffering from a chronic health condition, having a diagnosed illness, and to be under sleeping. In sets B and C immigrants additionally reported better physical health and were less likely to report a disability, be diagnosed with depression, and to be obese. We do not find any immigrant-native gaps upon arrival in terms of extended hospitalization, cancer and stroke diagnosis, and smoking behavior across the three sets.

Next, we comment on the immigrant-native gaps in the age slopes in Tables 3 and 4 to investigate whether immigrants' health deteriorates more steeply than natives' over time, as suggested by the UAH. Our first result is that in both HLM and FE specifications, immigrants' *subjective health* decreases faster than natives' across the three groups. The estimated interactions of nativity and age are mostly consistent across HLM and FE models. We present these patterns graphically in Fig. 2, which plots immigrant and native health trajectories from HLM (top row) and FE models (bottom row) across the three analytical samples (A, B, and C). In all three groups, the subjective health of immigrants converges to the one of natives over time. Immigrants who arrived at a younger age (set A), have a small health advantage upon arrival, which decreases gradually until it becomes a small disadvantage around age 50. By contrast, immigrants who arrived at a later age (sets B and C) have a larger health advantage upon arrival, but their health deteriorates faster and also reaches the level of natives around age 50.

For all other health outcomes and behaviors, our results on immigrant-native gaps in health trajectories are less clear-cut and we find limited evidence of the UAH. Gaps in the age slopes are mostly not statistically significant, with some exceptions. Focusing on the FE (Table 4), we find that the mental health of immigrants who arrived after age 25 (sets B and C) deteriorated more steeply with age than natives'. In set B (arrival age 25–35), we also find that immigrants' physical health (PCS) deteriorated faster and their likelihood of being diagnosed with an illness grew more steeply, compared to natives. In set C (arrival age 35–45) immigrants' likelihood of becoming obese grew more steeply. In contrast with the UAH, we find that immigrants' likelihood of reporting a disability in set A and their likelihood of being diagnosed with depression in set B increased *less steeply* with age compared to natives.

We find some inconsistencies between results from HLMs and FE models, suggesting some between-individual confounding in the former. The main difference concerns mental health trajectories in sets B and C. While the FE models support the UAH for this outcome, finding a much

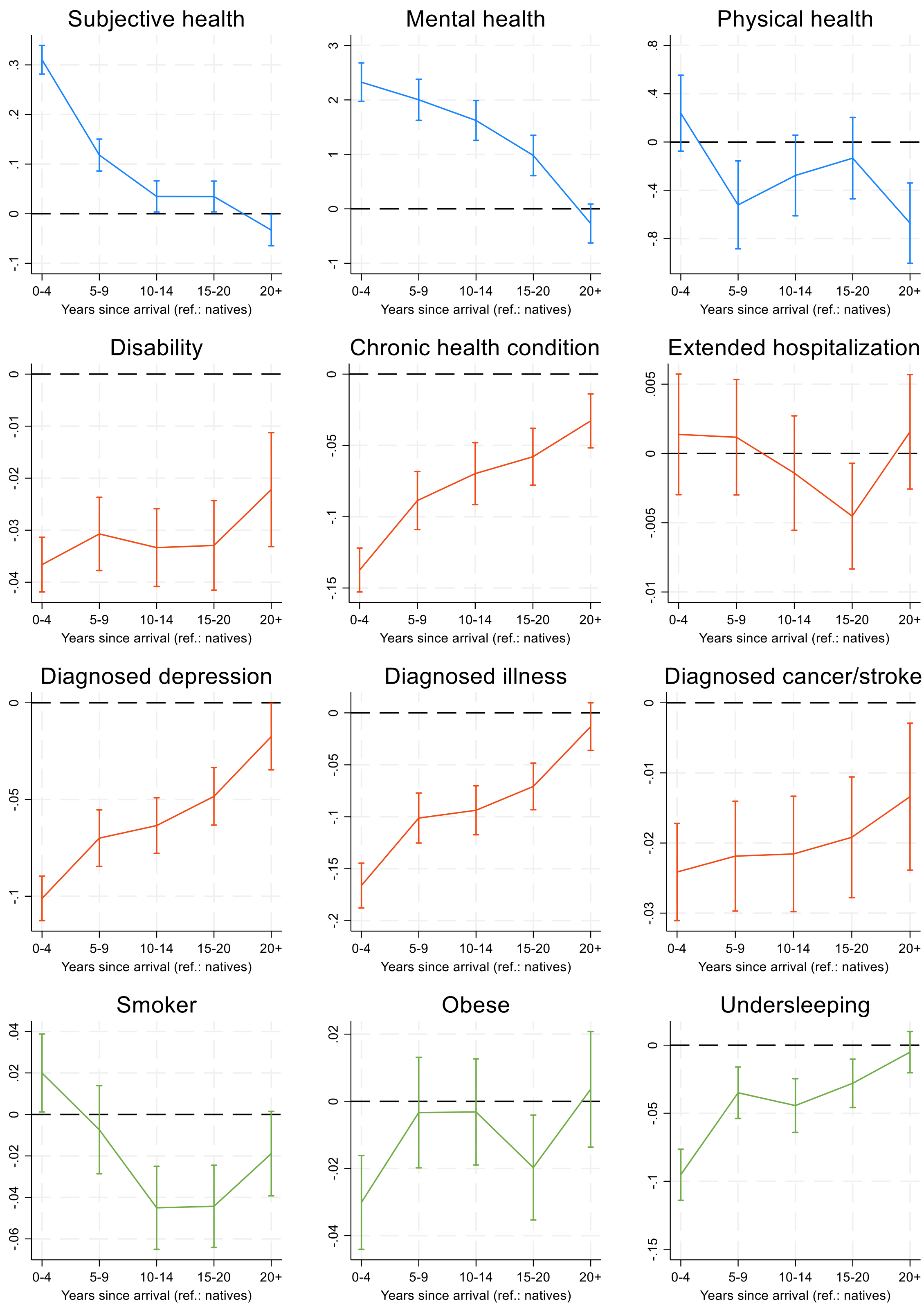


**Fig. 1.** Immigrant-native gaps in health outcomes, by length of stay estimated from pooled OLS models
Notes: Estimates and 95% confidence intervals from pooled survey waves and OLS regressions with individual-level clustered standard errors, controlling for age, age squared, educational attainment, gender, and German state.
Source: SOEP 2002–2021

**Table 3**
Estimated health trajectories by age and migration status from Hierarchical Linear models.

| | Subjective Health | Mental health | Physical health | Extended hospital | Chronic health condition | Disability | Diagnosed depression | Diagnosed illness | Diagnosed cancer or stroke | Smoker | Obesity | Under-sleeping |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SET A (age ≥18) | | | | | | | | | | | | |
| Age | −0.023[c] | −0.042[b] | −0.146[c] | −0.000[a] | 0.007[c] | −0.001[c] | 0.013[c] | 0.022[c] | −0.000 | −0.002[c] | 0.010[c] | 0.016[c] |
| | (0.001) | (0.015) | (0.012) | (0.000) | (0.001) | (0.000) | (0.001) | (0.001) | (0.000) | (0.001) | (0.000) | (0.001) |
| Age (squared) | 0.000 | 0.002[c] | −0.003[c] | 0.000[c] | 0.000[c] | 0.000[c] | 0.000 | 0.000[c] | 0.000[c] | −0.000[c] | −0.000[c] | −0.000[c] |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Immigrant | 0.383[c] | 1.347[a] | −0.965[a] | 0.005 | −0.121[c] | −0.001 | −0.021 | −0.110[a] | 0.016 | 0.040 | −0.033 | −0.078[a] |
| | (0.045) | (0.631) | (0.481) | (0.008) | (0.030) | (0.013) | (0.031) | (0.048) | (0.021) | (0.029) | (0.020) | (0.030) |
| Immigrant [a] age | −0.020[c] | 0.043 | 0.130[b] | −0.001 | 0.001 | −0.002 | −0.005 | −0.001 | −0.002 | −0.006[a] | 0.001 | 0.000 |
| | (0.004) | (0.063) | (0.050) | (0.001) | (0.003) | (0.001) | (0.003) | (0.004) | (0.002) | (0.003) | (0.002) | (0.003) |
| Immigrant [a] age (squared) | 0.000 | −0.003 | −0.004[c] | 0.000 | 0.000 | 0.000 | 0.000[b] | 0.000 | 0.000 | 0.000 | −0.000 | 0.000 |
| | (0.000) | (0.001) | (0.001) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Individuals | 33611 | 30,154 | 30,154 | 33,191 | 24,253 | 33,600 | 23,316 | 23,317 | 23,316 | 30,341 | 30157 | 26417 |
| Individual x Years | 227086 | 108,781 | 108,782 | 225,672 | 81,389 | 226,715 | 122,882 | 124,577 | 122,296 | 110,888 | 109618 | 119065 |
| **SET B (age ≥25)** | | | | | | | | | | | | |
| Age | −0.022[c] | 0.047[b] | −0.161[c] | −0.001[c] | 0.006[c] | −0.001 | 0.012[c] | 0.025[c] | 0.001 | −0.008[c] | 0.009[c] | 0.012[c] |
| | (0.001) | (0.017) | (0.013) | (0.000) | (0.001) | (0.000) | (0.001) | (0.001) | (0.000) | (0.001) | (0.001) | (0.001) |
| Age (squared) | 0.000 | 0.001[a] | −0.004[c] | 0.000[c] | 0.000[c] | 0.000[c] | 0.000 | 0.000[c] | 0.000[c] | 0.000[a] | −0.000[c] | −0.000[c] |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Immigrant | 0.591[c] | 2.606[c] | 1.096[a] | −0.010 | −0.176[c] | −0.025[a] | −0.043 | −0.176[c] | 0.006 | −0.004 | −0.059[b] | −0.087[c] |
| | (0.039) | (0.543) | (0.429) | (0.007) | (0.026) | (0.011) | (0.024) | (0.037) | (0.016) | (0.025) | (0.019) | (0.025) |
| Immigrant [a] age | −0.046[c] | −0.058 | −0.158[b] | 0.002[a] | 0.008[a] | −0.001 | −0.000 | 0.007 | −0.002 | −0.002 | 0.005[a] | 0.002 |
| | (0.005) | (0.067) | (0.054) | (0.001) | (0.003) | (0.001) | (0.002) | (0.004) | (0.002) | (0.003) | (0.002) | (0.003) |
| Immigrant [a] age (squared) | 0.001[c] | −0.001 | 0.003[a] | −0.000[a] | −0.000 | 0.000 | −0.000 | −0.000 | 0.000 | 0.000 | −0.000 | 0.000 |
| | (0.000) | (0.002) | (0.002) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Individuals | 30,593 | 27,255 | 27,255 | 30,030 | 22,358 | 30,579 | 21,215 | 21,239 | 21,205 | 27,439 | 27269 | 24261 |
| Individual x Years | 204,370 | 97,467 | 97,467 | 202,340 | 74,377 | 204,048 | 112,620 | 114,240 | 112,052 | 99,337 | 98214 | 108202 |
| **SET C (age ≥35)** | | | | | | | | | | | | |
| Age | −0.023[c] | 0.051[b] | −0.229[c] | −0.000 | 0.009[c] | 0.002[c] | 0.014[c] | 0.034[c] | 0.003[c] | −0.005[c] | 0.010[c] | 0.005[c] |
| | (0.001) | (0.020) | (0.017) | (0.000) | (0.001) | (0.000) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Age (squared) | 0.000 | 0.001 | −0.004[c] | 0.000[c] | 0.000[b] | 0.000[c] | −0.000 | 0.000 | 0.000[c] | −0.000[b] | −0.000[c] | −0.000[b] |
| | (0.000) | (0.001) | (0.001) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Immigrant | 0.697[c] | 2.369[b] | 0.935 | 0.013 | −0.187[c] | −0.069[c] | −0.106[b] | −0.138[a] | −0.013 | 0.016 | −0.119[c] | −0.143[c] |
| | (0.063) | (0.909) | (0.761) | (0.013) | (0.047) | (0.019) | (0.034) | (0.055) | (0.024) | (0.039) | (0.032) | (0.041) |
| Immigrant [a] age | −0.053[c] | 0.071 | 0.006 | −0.002 | 0.002 | 0.002 | 0.004 | −0.005 | −0.003 | −0.000 | 0.016[b] | −0.000 |
| | (0.009) | (0.141) | (0.119) | (0.002) | (0.008) | (0.003) | (0.004) | (0.007) | (0.003) | (0.006) | (0.005) | (0.006) |
| Immigrant [a] age (squared) | 0.001[a] | −0.005 | −0.005 | 0.000 | 0.000 | −0.000 | −0.000 | 0.000 | 0.000 | −0.000 | −0.000[a] | 0.000 |
| | (0.000) | (0.005) | (0.004) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Individuals | 23,422 | 21,204 | 21,204 | 23,111 | 17,079 | 23,413 | 16,675 | 16,684 | 16,664 | 21,338 | 21200 | 18570 |
| Individual x Years | 156,589 | 75,455 | 75,455 | 155,590 | 56,313 | 156,322 | 88,249 | 89,638 | 87,821 | 76,939 | 76056 | 83035 |

Notes.
[a] $p < .05$.
[b] $p < .01$.
[c] $p < .001$. Estimates from Hierarchical Linear Models controlling for individuals' gender, educational attainment, German state, and birth cohort. Source: SOEP 2002–2021.

stronger deterioration for immigrants than for natives, the corresponding coefficients in the HLMs are closer to zero and not statistically significant, which could indicate that the latter are biased from cohort differences and/or selective remigration or attrition. In the HLMs, we also find some evidence of immigrants' steeper increase in the likelihood of being obese (set B), experiencing extended hospitalization (set B) and suffering from a chronic health condition (set B). For the latter two, the corresponding FE coefficient sizes are in line but not statistically significant, while for obesity the FE interaction coefficient goes in the opposite direction and is not statistically significant. HLM results also suggest that immigrants' likelihood of smoking declines faster with age compared to natives (Set A), but this is not confirmed in FE models, again implying some confounding.

Additional analyses are presented in the online appendix. First, as a robustness check, we split our three sets into several smaller groups (6 instead of 3) based on narrower age and migration age definitions, so that age and time since migration would match more closely for immigrants. Our results are in line with those reported in the main text (see online Tables A15 and A16 ). Next, we focused on subjective health and investigated heterogeneity by country of origin, gender, and educational attainment. Results in Table A17 confirm the HIE for recently arrived immigrants from most national origin groups. In terms of the UAH, the signs of coefficients suggest steeper health declines for most migrant groups compared to natives, but results are statistically significant only for immigrants from EU-13 countries, the Former Soviet Union, Turkey, Middle East and North Africa, and the Balkans (with some differences across age sets). Moreover, immigrant-native gaps in subjective health upon arrival and in negative trajectories are slightly larger for men compared to women in set B, but comparable in sets A and C (online Table A18). Lastly, across all age groups, both the HIE and the UAH are most marked for those without tertiary education compared to those with tertiary education (online Table A19).

**Table 4**
Estimated health trajectories by age and migration status from Fixed Effects regressions.

| | Subjective Health | Mental health | Physical health | Extended hospital | Chronic health condition | Disability | Diagnosed depression | Diagnosed illness | Diagnosed cancer or stroke | Smoker | Obesity | Under-sleeping |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SET A (age ≥18) | | | | | | | | | | | | |
| Age | −0.020[c] | −0.053[b] | −0.105[c] | −0.002[c] | 0.004[b] | −0.002[c] | 0.011[c] | 0.018[c] | −0.001[a] | −0.005[c] | 0.009[c] | 0.016[c] |
| | (0.001) | (0.017) | (0.014) | (0.000) | (0.001) | (0.000) | (0.000) | (0.001) | (0.000) | (0.001) | (0.000) | (0.001) |
| Age2 | −0.000[b] | 0.002[c] | −0.004[c] | 0.000[c] | 0.000[c] | 0.000[c] | 0.000[c] | 0.000[c] | 0.000[c] | −0.000[a] | −0.000[b] | −0.000[c] |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Immigrant [a] Age | −0.020[b] | −0.150 | 0.167 | −0.001 | 0.010 | −0.003[a] | −0.005 | −0.002 | −0.001 | 0.003 | −0.000 | 0.006 |
| | (0.006) | (0.117) | (0.093) | (0.002) | (0.007) | (0.001) | (0.003) | (0.004) | (0.002) | (0.004) | (0.003) | (0.006) |
| Immigrant [a] Age2 | 0.000 | 0.001 | −0.004 | 0.000 | −0.000 | 0.000 | 0.000[a] | 0.000 | 0.000 | −0.000 | 0.000 | −0.000 |
| | (0.000) | (0.002) | (0.002) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Individuals | 33611 | 30,154 | 30,154 | 33,191 | 24,253 | 33,600 | 23,316 | 23,317 | 23,316 | 30,341 | 30157 | 26417 |
| Individuals x years | 227086 | 108,781 | 108,782 | 225,672 | 81,389 | 226,715 | 122,882 | 124,577 | 122,296 | 110,888 | 109618 | 119065 |
| **SET B (age ≥25)** | | | | | | | | | | | | |
| Age | −0.022[c] | 0.011 | −0.158[c] | −0.002[c] | 0.004[b] | −0.001[c] | 0.010[c] | 0.020[c] | 0.001[b] | −0.009[c] | 0.008[c] | 0.012[c] |
| | (0.001) | (0.018) | (0.015) | (0.000) | (0.001) | (0.000) | (0.000) | (0.001) | (0.000) | (0.001) | (0.001) | (0.001) |
| Age2 | −0.000 | 0.001 | −0.004[c] | 0.000[c] | 0.000[c] | 0.000[c] | 0.000[c] | 0.000[c] | 0.000[c] | 0.000[c] | −0.000 | −0.000[c] |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Immigrant [a] Age | −0.041[c] | −0.491[c] | −0.312[b] | 0.001 | 0.009 | −0.001 | −0.008[b] | 0.011[b] | −0.004[a] | 0.001 | −0.002 | −0.004 |
| | (0.007) | (0.136) | (0.110) | (0.002) | (0.007) | (0.002) | (0.002) | (0.004) | (0.002) | (0.004) | (0.004) | (0.006) |
| Immigrant [a] Age2 | 0.001[c] | 0.008[a] | 0.005[a] | −0.000 | −0.000 | 0.000 | 0.000[b] | −0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | (0.000) | (0.003) | (0.003) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Individuals | 30,593 | 27,255 | 27,255 | 30,030 | 22,358 | 30,579 | 21,215 | 21,239 | 21,205 | 27,439 | 27269 | 24261 |
| Individuals x years | 204,370 | 97,467 | 97,467 | 202,340 | 74,377 | 204,048 | 112,620 | 114,240 | 112,052 | 99,337 | 98214 | 108202 |
| **SET C (age ≥35)** | | | | | | | | | | | | |
| Age | −0.023[c] | 0.007 | −0.243[c] | −0.001[a] | 0.008[c] | 0.001[a] | 0.009[c] | 0.025[c] | 0.002[c] | −0.005[c] | 0.008[c] | 0.005[c] |
| | (0.001) | (0.021) | (0.017) | (0.000) | (0.001) | (0.000) | (0.000) | (0.001) | (0.000) | (0.001) | (0.001) | (0.001) |
| Age2 | −0.000 | 0.001 | −0.004[c] | 0.000[c] | 0.000[b] | 0.000[c] | 0.000[c] | 0.000[c] | 0.000[c] | −0.000[b] | −0.000 | −0.000[a] |
| | (0.000) | (0.001) | (0.001) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Immigrant [a] Age | −0.072[c] | −0.934[b] | −0.225 | 0.003 | 0.009 | 0.005 | 0.001 | −0.001 | −0.001 | 0.005 | 0.017[a] | 0.020 |
| | (0.014) | (0.285) | (0.232) | (0.004) | (0.016) | (0.004) | (0.005) | (0.007) | (0.004) | (0.008) | (0.008) | (0.013) |
| Immigrant [a] Age2 | 0.002[c] | 0.021[a] | 0.004 | −0.000 | −0.000 | −0.000[a] | 0.000 | 0.000 | 0.000 | 0.000 | −0.000 | −0.000 |
| | (0.000) | (0.008) | (0.007) | (0.000) | (0.001) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Individuals | 23,422 | 21,204 | 21,204 | 23,111 | 17,079 | 23,413 | 16,675 | 16,684 | 16,664 | 21,338 | 21200 | 18570 |
| Individuals x years | 156,589 | 75,455 | 75,455 | 155,590 | 56,313 | 156,322 | 88,249 | 89,638 | 87,821 | 76,939 | 76056 | 83035 |

Notes.
[a] $p < .05$.
[b] $p < .01$.
[c] $p < .001$ Estimates from Fixed Effects regressions. Source: SOEP 2002–2021.

## 5. Conclusion and discussion

This study investigated the existence of an IHP in Germany and whether it reflects immigrants' faster individual-level declines in health over time (i.e. the UAH). We did this within the relatively understudied European context, for a wide range of health outcomes, through high quality and extended panel data, and with both HLMs and FE models. In cross-sectional results, we find evidence for the IHP across almost all health outcomes. In contrast, our longitudinal analyses generally support the HIE but find limited evidence for the UAH. Immigrants experience steeper declines in subjective health and, to a large extent, in mental health, but their trajectories in other health outcomes are mostly not distinguishable from those of natives. In line with prior literature, we also find that immigrants' initial health advantages and (when we find them) health declines differ by age at arrival (Gubernskaya, 2015).

Our results contribute to the literature on the IHP in different ways and provide policy relevant insights on immigrant health. First, we confirm the IHP in Germany cross-sectionally, which contradicts prior inconclusive evidence (Maskileyson et al., 2019), and implies greater similarities between the German context and the more studied North American and Australian ones (Markides and Rote, 2019). This is a particularly interesting finding, given that health insurance is mandatory in Germany and barriers to healthcare access are lower than in the North American context. Nonetheless, migrants still face barriers in terms of language difficulties or discrimination and may lack access to culturally sensitive healthcare (Lebano et al., 2020). Two migrant categories that still face significant barriers to health care and have reduced (or no) health insurance in Germany are refugees and undocumented immigrants. However, we excluded the former from our analyses and could not observe the latter in our data.

Second, similarly to other recent studies revisiting the IHP, our longitudinal analyses suggest that immigrants' apparent health deterioration with duration of stay documented in cross-sectional analyses mostly results from confounding and not from individual-level variation (Lu et al., 2017; Zheng and Yu, 2022). We have argued, like others before us, that cross-sectional studies are unfit to investigate the UAH, as the effect of duration of stay is confounded by age, birth- and immigration-cohort and age at arrival. In addition, we have shown that some longitudinal analytical approaches such as HLMs still produce biased estimates when trying to assess individual-level variation to test the UAH. This was highlighted by the fact that our more rigorous FE analyses contradicted several of the HLM results, most notably concerning mental health. Our findings suggest that issues like selective remigration may be a serious concern in models that consider between-individual differences, and that future research should be more careful when interpreting results from cross-sectional models or HLMs, and aim to focus on within-individual changes in health when specifically targeting the UAH.

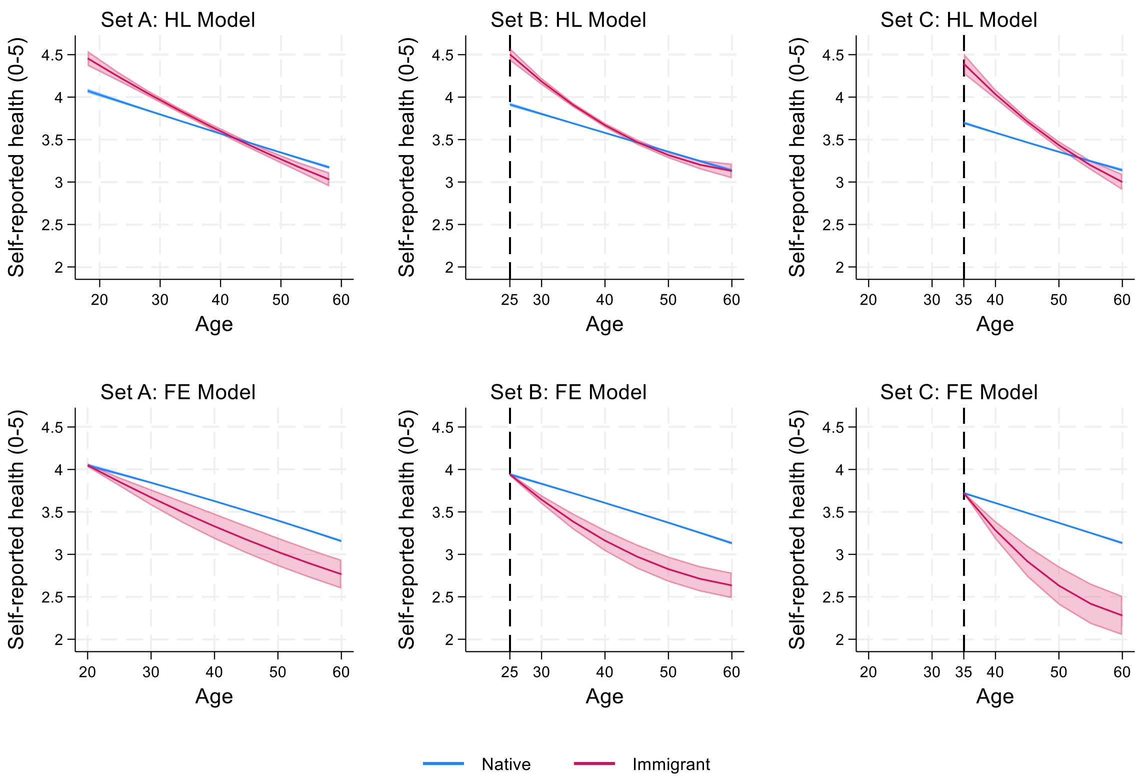


**Fig. 2.** Self-reported current health by migration background and analytical set (A, B, C) estimated from Hierarchical Linear and Panel Fixed Effects models
Notes: Estimates and 95% confidence intervals from Fixed Effects (FE) regressions and Hierarchical Linear Models (HLMs) with random intercepts and random slopes controlling for individuals' gender, educational attainment, German state and birth cohort.
Source: SOEP 2002–2021

Third, considering several health indicators allowed us to uncover some contrasting patterns across outcomes. Previous longitudinal studies mostly found evidence of an unhealthy assimilation in terms of subjective health (Gubernskaya, 2015; Jatrana et al., 2018), but not in terms of more objective health measures (Jatrana et al., 2018; Zheng and Yu, 2022). Unlike prior research, which is based on different contexts, age groups and observation periods, we confirm these findings within a single sample of individuals. Therefore, the variation in immigrant-native gaps across health outcomes is not a simple artefact of studying different populations, but a substantively and policy-relevant relevant result. Our findings stress the need for more research investigating immigrant-native gaps in various health indicators and investigating discrepancies across them.

We found that immigrants experience severe drops in their subjective health and their mental health as they reside in Germany, which are not accompanied by an increasing likelihood of being diagnosed with specific health conditions (their likelihood of being diagnosed with depression, for example, increases *more slowly* with age compared to natives'). While this could partly be explained by changes in immigrants' reference point when assessing their own health (Lu and Qin, 2014), these results are likely to reflect immigrants' difficulties in accessing timely diagnosis and health care, which has been widely documented in previous studies (Lebano et al., 2020). Our results suggest that immigrants' limited access to healthcare might be particularly severe concerning mental health. While more research is needed to identify the reasons for immigrants' subjective and mental health deterioration, policy makers have to address the known issues limiting immigrants' access to (mental) healthcare, such as discrimination, language barriers, and lack of cultural sensitivity training for healthcare workers. One hypothesis that our results strongly discredit is the one that immigrants' declining health is explained by their progressive adoption of unhealthy behaviors.

This study does not come without limitations. First, although we tested the mechanism of unhealthy behavior adoption, we could not test others, such as discrimination or acculturative stress. Second, because of our design and data, we could not investigate the health trajectories of the 1.5 generation. However, based on prior literature (Gubernskaya, 2015), this group should contribute the least to immigrant-native differences in health trajectories, since they are less likely to be positively selected in terms of health. Another limitation concerns our analytical setup. Although we are able to successfully disentangle variation with length of stay from variation with age and from differences in levels of health between cohorts, our method does not account for potential period effects. We partially addressed this by excluding the COVID-19 pandemic years as a robustness check – without substantial changes in the results – but future research should replicate these analyses on different context and periods to check whether our results are generalizable.

Our study has shown that the IHP may be a more complex phenomenon than previously understood in studies adopting cross-sectional designs and analyzing few health indicators. These concerns are increasingly recognized in the international literature on the topic, although less so in the European one, which may explain some of the contrasting results within the latter. Future research should aim to address these limitations by employing more longitudinal data and analyzing more health outcomes across different destination countries.

## Ethics approval/Statement EA not required

We hereby confirm that our study did not require any Ethics Approval as it was entirely based on secondary data gathered and approved by the DIW Berlin.

## CRediT authorship contribution statement

**Alessandro Ferrara:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Data curation, Conceptualization. **Carla Grindel:** Writing – original draft, Visualization, Investigation, Formal analysis, Data curation, Conceptualization. **Claudia Brunori:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization.

## Data availability

The authors do not have permission to share data.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2024.116976.

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