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Unhealthy sleep assimilation

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Migrant health advantages, the 'healthy immigrant effect', erode over time, leading to what is known as unhealthy assimilation. Health-related behaviours are central to unhealthy assimilation, and here we focus on an understudied and central part of our daily time: sleep. Building on diverse streams of literature, we conceptualize and empirically study the sleep assimilation patterns of immigrants. With data from Germany, we demonstrate that immigrants sleep significantly more than natives upon arrival, while their sleep 'advantage' dissipates with years spent in the host country. We also explore the heterogeneity of the sleep assimilation process by gender, education, wages, work schedules, and job physical intensity.

Introduction

Immigrant assimilation has long been seen as a central part of the process of social integration of migrants in the country of destination (Warner and Srole, 1945; Waters and Jiménez, 2005). During the last few decades, this broadly positive view of immigrant assimilation has been amended and, in some cases, criticized. Some scholars have pointed out that assimilation may also lead to socially undesirable effects, in particular regarding health-related behaviours and outcomes (Rumbaut, 1997). A wide range of literature has conceptualized and documented the 'healthy immigrant effect': immigrants tend to be healthier than natives upon arrival (Palloni and Arias, 2004; Feliciano, 2020), but their health deteriorates with the time spent in the destination country (Gordon-Larsen *et al.*, 2003; Feliciano, 2005). Antecol and Bedard (2006) coined the term 'unhealthy assimilation' to describe the fact that, in the United States (US), the initial immigrant advantage in BMI (body mass index) is eroded over time, converging toward the BMI of non-immigrants in the 10–15 years after their arrival to the US. For Antecol and Bedard (2006), this 'suggests that the new cultural or environmental factors that immigrants are exposed to alter their behaviors'.

Sleep occupies about a third of human lives. Lewis and Weigert (1981) define the *daily round* as 'marked by the two organic events of waking in the morning and falling asleep at night. A modern industrialized and rationalized society can function only if most of its members follow a highly patterned and dependable daily round'. Despite the importance of sleep time in our daily round, the role of sleep time in shaping social inequalities in health, and the wide availability of time use data for studying it (Bianchi, Robinson and Milke, 2006; Basner *et al.*, 2007; Chatzitheochari and Arber, 2009), sleep time has been vastly understudied from a social science perspective (e.g., Williams, Meadows and Arber, 2010; Pepin, Sayer and Casper, 2018).

In our study, we focus on the sleep assimilation of immigrants, bridging three streams of the social science literature: migrant integration and health, time use and sleep, and social stratification and health. We build on these streams to conceptualize sleep assimilation and empirically analyze the trajectories of immigrant sleep assimilation using longitudinal data from Germany.

Empirically, we contribute to the literature by studying the assimilation in sleep patterns of (first-generation) immigrants over the years spent in the destination country.[1] Moreover, we extend prior research by

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introducing social stratification within the context of the country of destination. While the contextual relevance of the country of origin on immigrant effects has been conceptualized and documented, for instance, by Feliciano and Lanuza (2017), assimilation processes are significantly shaped by the socio-economic context and ethnic stratification in the country of destination. Finally, while previous studies on ethnic disparities in sleep duration have mostly analyzed US data, we focus on Germany, a country characterized by stricter employment protection legislation and a different immigration history.

Framework and hypotheses

In classical social theory, assimilation has been regarded as a crucial aspect of migrants' social integration in the host country (Warner and Srole, 1945). The assimilation process is influenced by two time clocks: the historical clock, which tracks the years since the arrival of the first generation of immigrants, and the generational clock (Portes and Rumbaut, 2001). Extensive literature has explored the long-term patterns of assimilation by studying the integration of immigrants across generations in the host country (Alba *et al.*, 2002; Alba and Nee, 2003).

However, the assimilation perspective has faced criticism and discussion (Rumbaut, 1997), with Glazer (1993) even proclaiming the 'death' of assimilation theory. It has been argued and empirically demonstrated that assimilation does not always lead to advantageous outcomes. Negative and segmented consequences of assimilation have been observed, particularly in educational outcomes across successive migrant generations (Portes and Zhou, 1993; Feliciano and Lanuza, 2017). The phenomenon of 'unhealthy assimilation' and the immigrant health paradox are well-known in public health research (Antecol and Bedard, 2006). Despite an increase in earnings and socioeconomic status over time, health outcomes often deteriorate. Immigrants, due to selectivity processes and healthier behaviours in their country of origin, tend to start with a health advantage over their native counterparts (Palloni and Arias, 2004; Shor and Roelfs, 2021). Therefore, assimilation, or acculturation, can have negative health consequences, resulting in the deterioration of health outcomes for immigrants (Gordon-Larsen *et al.*, 2003; Feliciano, 2005; Lopez-Gonzalez, Aravena and Hummer, 2005; Antecol and Bedard, 2006; Kennedy *et al.*, 2015; Giuntella, 2016, 2017; Giuntella and Stella, 2017).

Paradoxically, as immigrants assimilate socioeconomically, their health declines. As suggested by previous studies on ethnic penalties (Kogan, 2011; Reyneri and Fullin, 2011), the labour market disadvantages experienced by immigrants upon arrival, such as worse working conditions in terms of safety, risk, health, and schedules, may play a significant role in explaining the health trajectories of immigrants over time (Ballarino and Panichella, 2015).

Ultimately, the literature on unhealthy immigrant assimilation identifies three key social mechanisms that may contribute to the convergence of migrants' health outcomes with those of natives: 'acculturative stress' resulting from the process of adapting to the host society; exposure to 'hazardous environments' characterized by precarious work conditions often associated with dirty, difficult, and dangerous (3-D) jobs; and the adoption of 'unhealthy assimilation' behaviours (Hill *et al.*, 2012). These mechanisms are relevant to our focus on sleep duration within the context of Germany.

Sleep time and assimilation

A vast and recent literature on the intersection between social behaviour and health has demonstrated that sleep, and in particular the lack of it, has adverse health consequences (Gallicchio and Kalesan, 2009; Cappuccio *et al.*, 2011; Youngstedt and Jean-Louis, 2011; Matricciani *et al.*, 2017). The 'medical model of sleep' considers poor sleep quality a behavioural risk factor for health (Maume, Sebastian and Bardo, 2009). Poor sleep in particular interferes with circadian rhythms, and more than a third of the US adult population reports sleeping less than the recommended amount (Liu *et al.*, 2016). Sleep deprivation has been linked to many chronic diseases, including, for instance, type 2 diabetes, heart disease, obesity, and depression (Knutson *et al.*, 2006; Taheri, 2006; Zimmerman *et al.*, 2006). Additionally, insufficient sleep is linked to motor vehicle crashes and occupational mistakes (Lyznicki *et al.*, 1998; Barger *et al.*, 2005; Smith, 2016), and poor sleep quality is also linked to the precarity associated with non-standard work schedules (Schneider and Harknett, 2019). To sum up, there is increasing evidence of the health and socioeconomic costs of poor sleep (Giuntella, Han and Mazzonna, 2017; Gibson and Shrader, 2018; Giuntella and Mazzonna, 2019; Jin and Ziebarth, 2020).

Immigrants in an effort to quickly enter the labour market may accept jobs that involve poorer working conditions or worse schedules (see, for instance, Ballarino and Pannichella, 2015; Bond *et al.*, 2022). Given this background, it is surprising that the study of immigrants' time use and sleep duration, and of its role in assimilation, has been underdeveloped (Hamermesh and Trejo, 2013; Hamermesh, 2019). Related to this, some studies have shown significant racial and ethnic disparities in short sleep duration (Hale and Do, 2007; Seicean *et al.*, 2011; Jackson *et al.*, 2013, 2014). For example, Seicean *et al.* (2011) document that Mexican

immigrants have better sleep quantity and quality. However, US-born Mexican Americans are more likely to be short-sleepers than Mexican immigrants, which may be consistent with a process of behavioural assimilation in the sleep domain. Similarly, Hale *et al.* (2014) found that US-born Hispanics and Chinese and Japanese immigrant descendants are more likely to report sleep complaints than their first-generation ethnic counterparts. The evidence reported in these studies suggests the presence of a 'sleep immigrant effect', an advantage in sleep duration that deteriorates as immigrants integrate into the US culture. As highlighted by Ballarino and Panichella (2015) and Kogan (2007, 2011), immigration history and labour market institutions play a crucial role in explaining migrants' experiences in the labour market and variation in the ethnic penalty across countries. Strict employment protection legislation increases the cost of firing and may deter employers from hiring immigrants, thereby leading to stronger statistical discrimination. As mentioned above, most studies have focused on generational differences in sleep duration and their analyses lack longitudinal data. Given the differences in the labour market institutions and in the experiences of migrants in the United States and Europe (Cantalini *et al.*, 2023), we believe our study provides insights into how these different experiences may affect the sleep trajectories of migrants. Thus, our first empirical hypothesis is as follows:

H1 (Sleep assimilation): Immigrants to Germany initially sleep longer with respect to natives in the destination country, but their initial sleep advantage erodes over time.

Gendered sleep assimilation

A stream of research has emphasized gender differences in sleep, also focusing on the sleep-related consequences of caregiving (Maume, Sebastian and Bardo, 2009; Burgard, 2011; Burgard and Ailshire, 2013; Pepin, Sayer and Casper, 2018). Burgard and Ailshire (2013) explained the gender gap in sleep duration favouring women using gendered time tradeoffs, work, and family responsibilities. Men's sleep time is seen as more dependent on the life course stage and conditioned by the amount of time spent in paid and unpaid work (Henry *et al.*, 2008). There is also evidence that in the health domain assimilation matters differently for men and women (Lopez-Gonzalez, Aravena and Hummer, 2005). Health-related behaviours of more acculturated immigrant women are less healthy than those of less acculturated women, while differences among more and less acculturated men are negligible. Thus, if, on the one hand, we expect women to assimilate faster, consistent with more rapid assimilation in other health behaviours; on the other hand, the gendered responsiveness to occupational conditions may imply faster assimilation among men. Ultimately, whether the patterns in sleep assimilation are gendered remains an empirical question. The gendered assimilation in health behaviours may be offset by the gendered responsiveness to labour market structure and working arrangements. Therefore, we formulate two contrasting hypotheses on the comparison of immigrant and native women, and immigrant and native men with respect to their sleep patterns:

H2a (Gendered sleep assimilation): Consistent with what is observed for other health behaviours, women's sleep assimilation is faster than men's.

H2b (Men's occupational sleep assimilation): Men's sleep assimilation patterns are more linked to occupational assimilation than women's.

Stratified sleep assimilation: education

The social stratification of migrant assimilation processes has been studied, with educational attainment playing the most important role (Feliciano, 2020). The literature on immigrant health assimilation (Giuntella, 2016) has found evidence of a negative association between cultural and socioeconomic assimilation and health behaviours (i.e., smoking). Sleep time, and, in particular, the lack of adequate sleep, is also socially stratified (Williams, 2005). For instance, social class has been demonstrated to be a significant predictor of sleep deprivation. Chatzitheochari and Arber (2009) documented that individuals on either end of the class spectrum are more likely to be sleep-deprived. Prior research also suggests that sleep-deprived individuals consider work the primary reason behind their sleep problems (Henry *et al.*, 2008). Arber, Bote and Meadows (2009) highlighted how sleep duration might be one potential mechanism through which social class is related to health inequalities. Structural disadvantages, the psychological stress associated with it, and less knowledge about sleep hygiene practices or strategies to improve sleep may contribute to explaining the socioeconomic gradient in sleep. Low-skilled and unstable occupations can contribute to poor health outcomes, while higher education can still have a positive impact on health regardless of the migrants' occupational condition. On the other hand, the economic literature suggests that the higher opportunity cost of time and high returns to education may shape the allocation of time to sleep, indicating an inverse social stratification of sleep in which the higher educated sleep less (Biddle and Hamermesh, 1990; Hamermesh, 2019). We expect these effects to be socially stratified by education and to depend on the relative returns to

education in the destination country. It is also worth noting that if on the one hand, low-skilled, unstable, and dangerous occupations may represent a disadvantageous factor in themselves; on the other hand, education can have a beneficial effect on health over and above the migrants' occupational condition. The most educated migrants may experience the greatest disadvantage from migration due to the segmentation of the European labour market that pushes many immigrants into low-skilled occupations, regardless of their education (Prokic *et al.*, 2016; Larsen *et al.*, 2018). At the same time, having a higher level of education may still serve as a protective factor concerning health outcomes (Cutler and Lleras-Muney, 2012), and also when migrants are employed in the secondary labour market. We put forward two contrasting hypotheses:

H3a (Inversely stratified sleep assimilation): Immigrants with higher levels of education have relatively higher opportunity costs of sleeping, and will therefore sleep less.

H3b (Stratified sleep assimilation): Immigrants with lower levels of education are more likely to experience the psychological stress associated with structural disadvantage, and will therefore sleep less.

Occupation and health inequalities are strictly related to each other. Several studies have highlighted the ethnic penalty and its effects on the socio-economic integration processes of the host country (Kogan, 2007, 2011; Reyneri and Fullin, 2011). Foreign workers often experience lower wages, higher unemployment rates, and limited access to high-skilled occupations. These ethnic penalties may be influenced by discriminatory practices from employers, differences in human capital, and the lack of social networks (Kogan, 2011). Low-skilled migrants tend to face more significant disadvantages in terms of job quality and wages compared to high-skilled migrants (Reyneri and Fullin, 2011). Ballarino and Panichella (2015) shed light on the role of occupational segregation in Europe, underscoring the importance of examining not only wage differentials but also the distribution of foreign workers across different occupations and their access to higher-status jobs. This evidence is consistent with other works suggesting that immigrants tend to self-select into more physically intensive occupations and are more likely to work in non-standard scheduled jobs (Orrenius and Zavodny, 2009; Giuntella and Mazzonna, 2015; Giuntella *et al.*, 2019; Bond *et al.*, 2022), thereby reflecting their relatively high endowments of health capital and relatively low levels of human and financial capital upon arrival in the destination country. There is extensive empirical evidence relating to physically intensive jobs and health (Fletcher and Sindelar, 2009; Fletcher *et al.*, 2011). Based on these previous studies, we hypothesize the following:

H4 (Physically intensive jobs): Immigrants in highly physically intensive jobs will exhibit a faster rate of sleep assimilation.

Data and methods

The data employed to test our hypotheses come from the German Socio-Economic Panel (SOEP). The SOEP is a representative longitudinal dataset, which surveys households and individuals in Germany since 1984. A detailed description of the survey can be found in Wagner, Frick and Schupp (2007). One major advantage of the SOEP is that, since the initiation of the survey, the resident migrant population has been over-sampled, making it an ideal source for investigating the assimilation process of immigrants across several dimensions. A second reason for using the SOEP is that, in addition to a range of individual and household characteristics, the survey contains detailed self-reported information on the quantity and quality metrics of sleep. Since 2008, the respondents were asked the following questions: 'How many hours do you sleep on average on a normal day during the working week?' and 'How many hours on a normal weekend day?'. We use sleep duration in hours, as well as indicators for whether individuals slept less than 6 or 8 hours. Furthermore, we also use self-reported satisfaction with sleep, which is defined on an 11-point Likert scale ranging from 0 (very dissatisfied) to 10 (very satisfied). Finally, the SOEP allows us to exploit the longitudinal dimension of the data by controlling for time-invariant individual characteristics.

In our working sample, we consider the survey years 2008–2015, and individuals aged 18–59 at the time of the interview.[2] We analyze observations with non-missing data on sleep outcomes and our covariates. Moreover, we removed individuals who reported sleeping less than 2 or more than 16 hours per night. After these restrictions, we obtained a final longitudinal sample that contains 118,233 person-years from 33,143 individuals. For the purpose of our analysis, approximately 97 per cent of the sample have complete (non-missing) data.

The descriptive statistics are reported in Supplementary Table SA.1 in Appendix. Individuals report sleeping on average about 6.8 hours per night during the workweek. Approximately 9 per cent of individuals in our sample sleep less than 6 hours, and 74 per cent sleep less than 8 hours. The average satisfaction with sleep is 6.9. Approximately 13 per cent of the sample is foreign-born, and the immigrants had resided for about 20 years in Germany. On average, they are 40 years old, approximately 57 per cent have

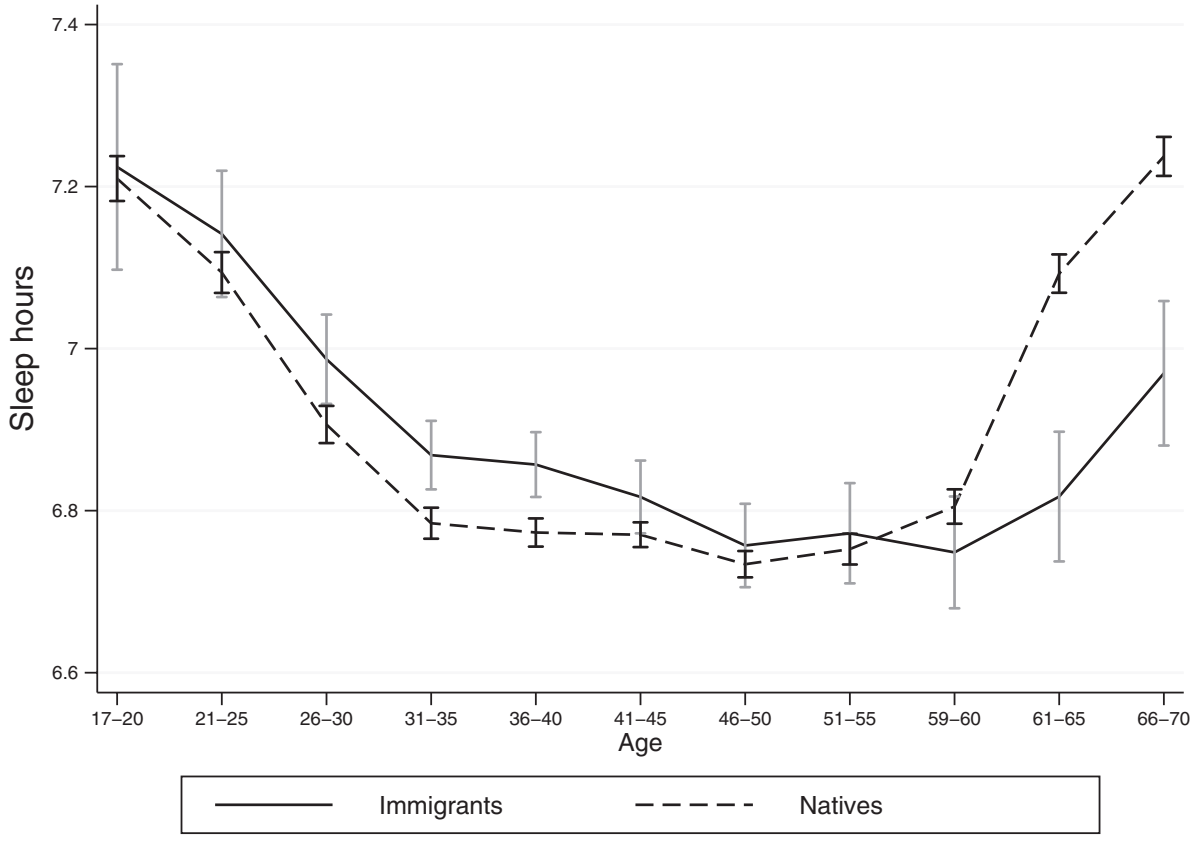

Figure 1 Sleep hours by age and immigrant status.

Note: Data are drawn from the SOEP version 33. The figure illustrates the sleep-age relationship by nativity status. Vertical lines indicate 95 per cent confidence intervals.

received a high school education, and about 29 per cent have obtained a college degree. Supplementary Table SA.2 reports the same statistics by immigrant status. On average, immigrants have a higher number of children, are more likely to be married, and are less educated compared to German natives. Figure 1 and Supplementary Figures SA.1 and SA.2 in Appendix report the sleep-age profile by immigrant status, for the entire sample, and by gender, respectively. Similarly, Supplementary Figures SA.3–SA.5 in Appendix repeat the analysis considering sleep satisfaction.

The main limitation of the SOEP is that sleep duration is reported in hours (see the distribution in Supplementary Figure SA.6 in Appendix) and is therefore more prone to measurement error. As shown in Supplementary Table SA.3 in Appendix, another limitation of the SOEP data is the relatively small sample of recently arrived immigrants (i.e., those who arrived within the last 5 years).

Empirical strategy

In our analyses, after describing the general patterns of migrant assimilation over time, we investigate the sleep differences between immigrants and natives using standard linear panel data models. Formally, we estimate equations of the following form:

$$Y_{it} = \alpha_i + \beta FB_i + \sum_{j=1}^{3} \gamma_j D_{itj} + \lambda X_{it} + \mu_t + \varepsilon_{it} \quad (1)$$

where the index *it* denotes an individual *i* (immigrant or native) aged 18–59 in year *t*. Y_{it} represents four types of sleep outcomes (during the workweek): (i) sleep hours; (ii) a binary variable for whether the individual sleeps less than 6 hours; (iii) a binary variable for whether the individual sleeps less than 8 hours; and (iv) a measure of sleep satisfaction. α_i are time-invariant individual effects. Our main explanatory variables are: FB_i, a binary variable equal to 1 for foreign-born, and 0 for native respondents; and D_{itj}, a set of three binary variables indexed by *j* (*j*=1,…, 3), which account non-linearly for the number of years the immigrant has resided in the destination country, i.e., 6–10, 11–15, and 16 or more years since migration (the reference category for immigrants refers to those arrived at most 5 years before). In practice, our model includes a binary variable

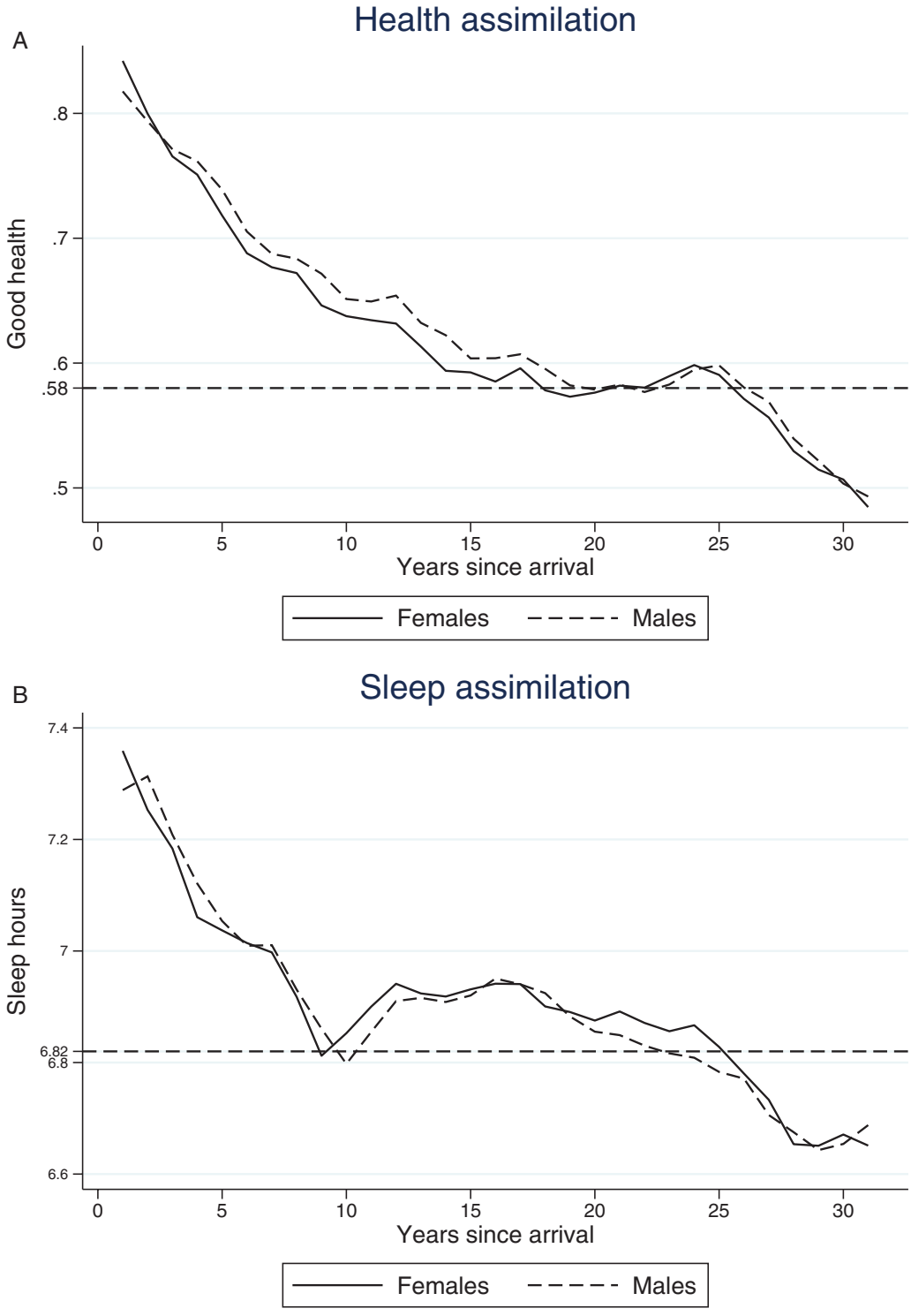

Figure 2 Health and sleep assimilation by gender.

Note: Data are drawn from the SOEP version 33. The horizontal dashed lines represent the respective mean outcomes for natives.

Table 1 Estimates of nativity status and time spent in Germany on sleep

Dep. var.:	(1)	(2)	(3)	(4)
	Sleep hours	Sleep hours < 6	Sleep hours < 8	Sleep satisfaction
Immigrant	0.382**	−0.050**	−0.289**	0.962**
	(0.069)	(0.017)	(0.028)	(0.140)
6–10 years since arrival	−0.236**	0.025*	0.114**	−1.042**
	(0.051)	(0.013)	(0.021)	(0.104)
11–15 years since arrival	−0.280**	0.024*	0.105**	−0.796**
	(0.052)	(0.014)	(0.021)	(0.108)
16 or more years since arrival	−0.431**	0.044**	0.183**	−0.837**
	(0.050)	(0.013)	(0.020)	(0.103)
Mean of dep. var.	6.832	0.0944	0.737	6.871
Std. dev. of dep. var.	1.108	0.292	0.440	2.243
Observations	118,233	118,233	118,233	115,751

Note: Data are drawn from the SOEP version 33. Standard errors are reported in parentheses. All models include controls for gender, indicators for age groups (in 5-year intervals), number of children, education, and marital status. All regressions further include state, survey years, and country of origin fixed effects. In all our specifications, we use the SOEP survey weights.
*Significant at 10 per cent; ** significant at 1 per cent.

for foreign-born status and three dummy variables for immigrants who have been in Germany for 6–10 years, 11–15 years, and 16 or more years. The excluded category is represented by immigrants who have resided in Germany for less than 5 years (including those who have just arrived in the host country).[3] Accordingly, the coefficients of interest are β, which indicates whether, around arrival (up to 5 years afterwards), immigrants are more or less likely to be short sleepers than otherwise similar natives, and γ_j, which captures the effect of assimilation on sleep behaviour. X_{it} is a vector of individual control variables, including gender, dummies for age groups (in 5-year intervals), indicators for marital status, number of children, and indicators for college-level education or a high school diploma. The model also includes country of origin and state-fixed effects.[4] μ_t are survey year fixed effects, and ε_{it} is an idiosyncratic error term. To account for the presence of individual heterogeneity, Model (1) is estimated using the random effect estimator, which assumes α_i to be a random variable not correlated with the other covariates in the model. All estimates are weighted using survey weights. We relax this assumption in a secondary analysis, where we estimate Model (1) using a fixed effects strategy. Since the results are very similar, we report the estimates obtained using the random effects estimator in the main text, as it allows us to recover the key parameter β, namely, the immigrant effect upon arrival.

Results

In this section, we present our main empirical results, starting from the descriptive evidence on unhealthy assimilation. In Figure 2, we document the (unhealthy) assimilation trajectories for both subjective health (self-reported health status) and hours of sleep in Germany. The convergence of migrants to natives is evident for both types of health outcomes. Specifically, after 10 years of residence in the host country, the initial sleep advantage of immigrants declined by about 20–30 minutes.[5]

The estimated coefficients of the panel data model described in Equation (1) and reported in Table 1 reveal that immigrants have significantly better sleep outcomes than natives at the time of entry to Germany. For example, immigrants upon arrival sleep about 23 (0.382*60) minutes longer (see column 1), are approximately 52 per cent (0.05/0.094) less likely to sleep less than 6 hours with respect to the mean of the dependent variable (see column 2) and 39 per cent (−0.029/0.074) less likely to sleep less than 8 hours (see column 3), and are 14 per cent (0.962/6.871) more likely to be satisfied with their sleep (see column 4). However, we find evidence of a reduction of the immigrant sleep advantage with time spent in Germany. In particular, over their first 10 years in Germany, the initial advantage is reduced up to approximately 60 per cent (−0.236/0.382, see column 1 of Table 1).

The share of individuals sleeping less than 6 hours (or less than 8 hours) increases substantially (see, respectively, columns 2 and 3), and the advantage in sleep satisfaction (0.962 percentage points) is completely eroded declining by −1.042 percentage points (see column 4). This convergence trend generally continues with more time spent in the host country. As shown in Supplementary Table SA.4 in Appendix, the average marginal effects obtained using a Probit or a Logit model

for the binary sleep outcomes are similar. In Appendix, we replicate the main results including individual fixed effects in our analysis (see Supplementary Table SA.5), at least partially mitigating the concern of a selection based on unobservable factors and a possible selective return migration. Reassuringly, the effects of years since migration on sleep hours remain significant and similar to the benchmark specification (see Table 1).

Figure 2 illustrates the assimilation patterns of men and women with respect to self-reported health and sleep duration. Overall, the assimilation trajectories in self-reported health and sleep among men and women follow a very similar path. However, there are some differences in the estimated sleep advantage upon arrival in Germany (see Table 2). Male immigrants report a larger initial sleep advantage (both for sleep hours and sleeping less than 6 hours), whereas female immigrants display a larger sleep satisfaction at the time of arrival.

Figures 3 summarizes the relationship between sleep duration by education and immigrant status, distinguishing between natives, recent immigrants (arrived during the last 5 years), and earlier cohorts of immigrants (arrived 6 or more years before the interview). Overall, there is no evidence of a clear educational gradient in sleep duration, although, if anything, low-educated Germans are significantly more likely to report poor sleep (10.7 per cent, see Table 3, Panel B, column 2) than high-educated individuals (6.3 per cent, see Table 3, Panel A, column 2).

In Table 3, we estimate Equation (1) separately for different educational levels, namely, less-educated individuals (i.e., people having at most secondary education) and high-educated individuals (i.e., people having tertiary education). Results suggest that the sleep advantage at the time of arrival is larger among less-educated individuals, but it also declines more rapidly the longer less-educated immigrants remain in Germany

Table 2 Estimates of nativity status and time spent in Germany on sleep—stratified by gender

Dep. var.:	(1)	(2)	(3)	(4)
	Sleep hours	Sleep hours < 6	Sleep hours < 8	Sleep satisfaction
Panel A: Females				
Immigrant	0.274**	−0.033	−0.271**	1.051**
	(0.097)	(0.024)	(0.036)	(0.201)
6–10 years since arrival	−0.270**	0.024	0.150**	−0.978**
	(0.061)	(0.016)	(0.026)	(0.125)
11–15 years since arrival	−0.265**	0.036*	0.097**	−1.031**
	(0.064)	(0.016)	(0.027)	(0.133)
16 or more years since arrival	−0.392**	0.035*	0.179**	−1.041**
	(0.062)	(0.015)	(0.025)	(0.128)
Mean of dep. var.	6.873	0.0961	0.713	6.755
Std. dev. of dep. var.	1.135	0.295	0.453	2.301
Observations	64,942	64,942	64,942	63,604
Panel B: Males				
Immigrant	0.422**	−0.060*	−0.295**	0.813**
	(0.102)	(0.026)	(0.043)	(0.209)
6–10 years since arrival	−0.133	0.026	0.039	−1.178**
	(0.089)	(0.024)	(0.036)	(0.182)
11–15 years since arrival	−0.264**	0.007	0.100**	−0.462*
	(0.088)	(0.023)	(0.035)	(0.180)
16 or more years since arrival	−0.434**	0.051*	0.168**	−0.553**
	(0.083)	(0.022)	(0.032)	(0.171)
Mean of dep. var.	6.782	0.0923	0.768	7.013
Std. dev. of dep. var.	1.073	0.290	0.422	2.162
Observations	53,291	53,291	53,291	52,147

Note: Data are drawn from the SOEP version 33. Standard errors are reported in parentheses. All models include controls for indicators for age groups (in 5-year intervals), number of children, education, and marital status. All regressions further include state, survey years, and country of origin fixed effects. In all our specifications, we use the SOEP survey weights.
* Significant at 5 per cent; ** significant at 1 per cent.

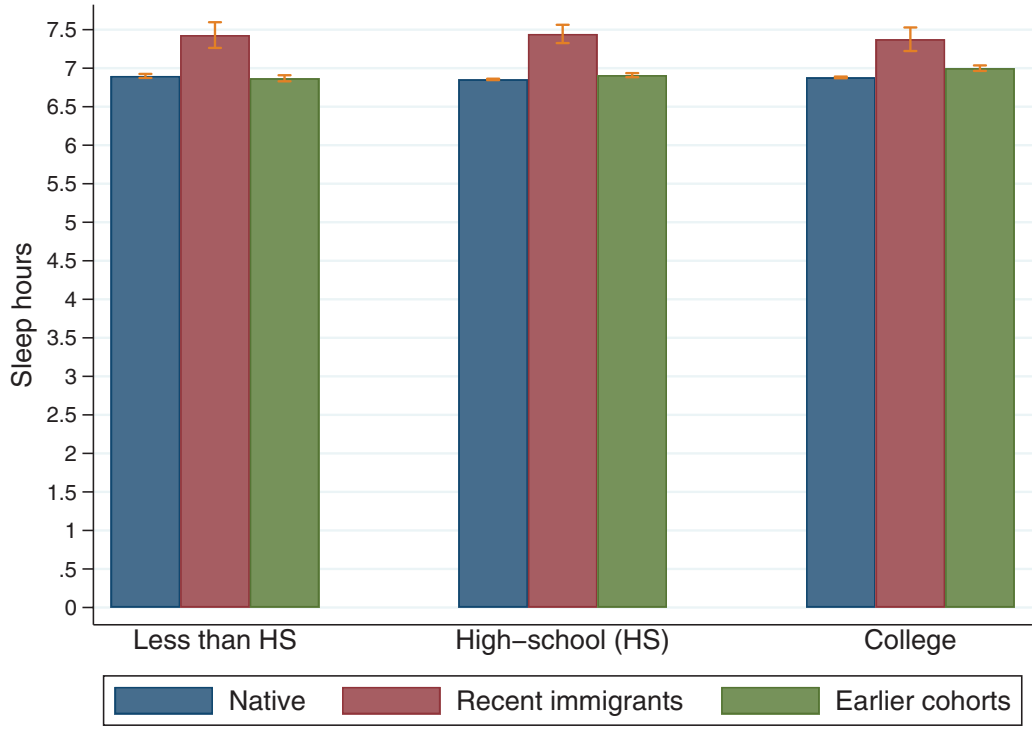

Figure 3 Sleep hours and education by immigrant status.

Note: Data are drawn from the SOEP version 33. This figure illustrates the average sleep hours by education and immigration status in Germany. Recent immigrants include immigrants who arrived up to 5 years before the interview date, while earlier cohorts are those who arrived 6 years or more before the interview. Vertical lines indicate 95 per cent confidence intervals.

(see Panels A and B). Patterns are similar when considering separate regression by other measures of socioeconomic status. Table 4 shows that even when comparing individuals with low and high wages, individuals with a wage below the median exhibit more rapid assimilation in sleep, particularly when examining sleeping less than 6 or 8 hours.

Job amenities and work schedules may contribute to explaining the stratified assimilation in sleep by education. Low-educated individuals in Germany are more likely to work early-scheduled jobs (i.e., starting before 6:30 a.m.) than the high-skilled (18 per cent vs. 8 per cent, P value < 0.001). Relatedly, immigrants are more likely to work early-scheduled jobs than natives (20 per cent vs. 13 per cent, P value<0.001). Early schedules can directly affect sleep patterns (Giuntella and Mazzonna, 2019). As shown in Supplementary Table SA.6 in the Appendix, starting to work before 6:30 a.m. is associated with a 20-minute shorter sleep duration, a 6-percentage-point higher likelihood of sleeping less than 6 hours, a 10-percentage-point higher likelihood of sleeping less than 8 hours, and lower sleep satisfaction.

In Table 5 we investigate the relationship between early working schedules and sleep assimilation patterns, finding that the decline in sleep duration and sleep satisfaction among immigrants in Germany is largely driven by workers with early schedules, i.e., those who start working between 4 a.m. and 6:30 a.m. (see Panel A). This is true in particular when focusing on sleep hours, sleeping less than 8 hours, and sleep satisfaction, while there is no significant trend when focusing on sleeping less than 6 hours. Interestingly, we find no evidence of a significant decline in sleep duration among individuals starting work after 6:30 a.m. (see Panel B). However, even workers starting work after 6:30 a.m. exhibit a significant decline in sleep satisfaction with time spent in Germany (see column 4). We also find that sleep assimilation is more marked among workers in physically intensive jobs (see Supplementary Table SA.7 in Appendix). These jobs are often characterized by early schedules. As time passes, the sleep assimilation among workers employed in physically demanding jobs becomes more pronounced (see Panels A and B).

A natural concern is that time spent in the host country might be correlated with some specific cohort of immigrants.

To dispel this concern, we show that our results are robust to the inclusion of arrival cohort dummies (see Supplementary Table SA.8 in Appendix).[6] Furthermore,

Table 3 Estimates of nativity status and time spent in Germany on sleep—stratified by education

Dep. var.:	(1)	(2)	(3)	(4)
	Sleep hours	Sleep hours < 6	Sleep hours < 8	Sleep satisfaction
Panel A: High-educated				
Immigrant	0.205*	−0.004	−0.257***	−0.023
	(0.122)	(0.030)	(0.054)	(0.274)
6–10 years since arrival	−0.209***	0.001	0.140***	−0.684***
	(0.074)	(0.020)	(0.034)	(0.171)
11–15 years since arrival	−0.222***	−0.005	0.113***	−0.400**
	(0.078)	(0.020)	(0.035)	(0.180)
16 or more years since arrival	−0.322***	0.030	0.153***	−0.577***
	(0.074)	(0.019)	(0.033)	(0.171)
Mean of dep. var.	6.851	0.0630	0.773	6.993
Std. dev. of dep. var.	0.950	0.243	0.419	2.119
Observations	34,180	34,180	34,180	33,553
Panel B: Less-educated				
Immigrant	0.440***	−0.068***	−0.293***	1.315***
	(0.084)	(0.021)	(0.033)	(0.168)
6–10 years since arrival	−0.247***	0.038**	0.101***	−1.225***
	(0.065)	(0.017)	(0.026)	(0.129)
11–15 years since arrival	−0.311***	0.039**	0.103***	−1.018***
	(0.067)	(0.017)	(0.026)	(0.133)
16 or more years since arrival	−0.474***	0.055***	0.191***	−1.019***
	(0.063)	(0.016)	(0.025)	(0.127)
Mean of dep. var.	6.825	0.107	0.723	6.821
Std. dev. of dep. var.	1.167	0.309	0.448	2.290
Observations	84,053	84,053	84,053	82,198

Note: Data are drawn from the SOEP version 33. Standard errors are reported in parentheses. All models include controls for gender, indicators for age groups (in 5-year intervals), number of children, education, and marital status. All regressions further include state, survey years, and country of origin fixed effects. In all our specifications, we use the SOEP survey weights.
* Significant at 10 per cent; ** significant at 5 per cent; *** significant at 1 per cent.

we demonstrate that our main results are substantially robust by including linear state-specific time trends (see Supplementary Table SA.9 in Appendix) and alternative classifications of the age groups in the working-age population (see Supplementary Table SA.10 in Appendix). As displayed in Supplementary Table SA.11 in Appendix, our main results still hold when we control for employment status. A further concern regards the sensitivity of our findings with respect to the exclusion of Eastern Germany because it lacked a history of immigration. To address this concern, Supplementary Table SA.12 in Appendix reports the estimated coefficients when we restrict the analysis to individuals residing in West Germany: the main results remain substantially unchanged relative to the benchmark specification (see Table 1). Finally, we examine the assimilation pattern of sleep hours during weekends. As illustrated in Supplementary Table SA.13 in Appendix, the estimated coefficients are now much smaller in magnitude than those obtained using sleep duration during the workweek as the dependent variable (see column 1 in Table 1). This result highlights the role of workweek constraints on wake-up times, which is consistent with previous studies analyzing sleep (Giuntella and Mazzonna, 2019).

Discussion and conclusion

Sleep is a central activity of our lives, with paramount health implications, but it has been understudied in the social sciences. A wide range of studies have focused on the immigrant health advantage and on the deterioration of immigrant health over the time spent in the destination country and across generations. There is also extensive research that has analyzed inequalities in time use and assimilation between natives and immigrants in the allocation of time.

Table 4 Estimates of nativity status and time spent in Germany on sleep—stratified by wage

Dep. var.:	(1)	(2)	(3)	(4)
	Sleep hours	Sleep hours < 6	Sleep hours < 8	Sleep satisfaction
Panel A: High wages (above the median)				
Immigrant	0.348**	−0.013	−0.201***	1.081***
	(0.139)	(0.039)	(0.062)	(0.313)
6–10 years since arrival	−0.271**	0.022	0.092	−1.151***
	(0.132)	(0.039)	(0.057)	(0.301)
11–15 years since arrival	−0.253*	−0.004	0.071	−0.939***
	(0.130)	(0.038)	(0.056)	(0.294)
16 or more years since arrival	−0.341***	0.027	0.126**	−1.008***
	(0.124)	(0.036)	(0.053)	(0.281)
Mean of dep. var.	6.745	0.0793	0.807	6.990
Std. dev. of dep. var.	0.941	0.270	0.395	2.102
Observations	41,699	41,699	41,699	40,853
Panel B: Low wages				
Immigrant	0.454***	−0.072***	−0.348***	1.408***
	(0.102)	(0.026)	(0.040)	(0.208)
6–10 years since arrival	−0.379***	0.027	0.194***	−1.322***
	(0.077)	(0.020)	(0.032)	(0.158)
11–15 years since arrival	−0.434***	0.040**	0.171***	−1.320***
	(0.077)	(0.020)	(0.031)	(0.159)
16 or more years since arrival	−0.494***	0.051***	0.208***	−1.195***
	(0.073)	(0.019)	(0.029)	(0.152)
Mean of dep. var.	6.867	0.0947	0.717	6.868
Std. dev. of dep. var.	1.120	0.293	0.451	2.251
Observations	42,737	42,737	42,737	41,845

Note: Data are drawn from the SOEP version 33. Standard errors are reported in parentheses. All models include controls for gender, indicators for age groups (in 5-year intervals), number of children, education, and marital status. All regressions further include state, survey years, and country of origin fixed effects. In all our specifications, we use the SOEP survey weights.
* Significant at 10 per cent; ** significant at 5 per cent; *** significant at 1 per cent.

In this study, we built on three streams of literature to conceptualize the sleep assimilation of migrants in Germany and cast empirically testable hypotheses. We then used data from the SOEP to analyze sleep patterns by foreign-born status and years since migration, and empirically tested our hypotheses on immigrant sleep assimilation, including gender, occupational, and educational stratification.

We documented a pattern of assimilation in sleep among immigrants in Germany. Immigrants sleep longer than natives upon their arrival in Germany and report higher satisfaction with sleep. However, over time spent in the destination country, the initial sleep advantage of immigrants erodes. We find no evidence of differences in the estimated effects by gender. We argue that the lack of significant gender difference in sleep assimilation may result from the opposite effects of the gendered assimilation in health behaviours and the gendered responsiveness to the labour market structure and institutional contexts. When examining sleep assimilation by education, we find that less-educated individuals sleep longer upon arrival. This is consistent with the hypothesis that immigrants with high levels of education may have higher opportunity costs of sleeping. At the same time, less-educated immigrants also exhibit a faster rate of convergence. This pattern is consistent with the hypothesis that immigrants with lower levels of education may sleep less as a result of the higher levels of psychological stress associated with structural disadvantage and is consistent with previous studies on ethnic penalties in the labour market. Finally, our results are consistent with our conjecture that immigrants employed in more physically intensive jobs will exhibit a faster rate of sleep assimilation.

As mentioned earlier, we documented patterns of deterioration in the health trajectories of immigrants in

Table 5 Estimates of nativity status and time spent in Germany on sleep—stratified by early workers

Dep. var.:	(1)	(2)	(3)	(4)
	Sleep hours	Sleep hours < 6	Sleep hours < 8	Sleep satisfaction
Panel A: Early workers (4–6.30 a.m.)				
Immigrant	0.285	0.130	−0.585**	1.470*
	(0.295)	(0.099)	(0.107)	(0.635)
6–10 years since arrival	−1.113**	0.156	0.590**	−2.398**
	(0.282)	(0.097)	(0.098)	(0.609)
11–15 years since arrival	−0.754**	0.132	0.514**	−2.178**
	(0.253)	(0.089)	(0.088)	(0.545)
16 or more years since arrival	−0.837**	0.071	0.570**	−1.664**
	(0.246)	(0.084)	(0.085)	(0.531)
Mean of dep. var.	6.498	0.142	0.847	6.746
Std. dev. of dep. var.	1.039	0.349	0.360	2.210
Observations	3,595	3,595	3,595	3,532
Panel B: Late workers				
Immigrant	0.098	−0.012	−0.042	1.066**
	(0.142)	(0.036)	(0.064)	(0.310)
6–10 years since arrival	0.188	−0.031	−0.120*	−0.743*
	(0.138)	(0.035)	(0.061)	(0.304)
11–15 years since arrival	−0.024	−0.037	−0.059	−0.774**
	(0.132)	(0.033)	(0.058)	(0.292)
16 or more years since arrival	−0.061	−0.023	−0.026	−0.975**
	(0.125)	(0.032)	(0.055)	(0.278)
Mean of dep. var.	6.879	0.0681	0.750	7.033
Std. dev. of dep. var.	0.990	0.252	0.433	2.110
Observations	20,483	20,483	20,483	20,211

Note: Data are drawn from the SOEP version 33. Standard errors are reported in parentheses. All models include controls for gender, indicators for age groups (in 5-year intervals), number of children, education, and marital status. All regressions further include state, survey years, and country of origin fixed effects. In all our specifications, we use the SOEP survey weights.
* Significant at 5 per cent; ** significant at 1 per cent.

Germany and evidence of similar assimilation patterns in sleep duration. A natural question, then, is the extent to which sleep trajectories may contribute to explaining both the initial advantage and the subsequent convergence of immigrant health toward lower natives' health levels. Because of the dynamic nature of health assimilation, it is empirically challenging to capture the contribution of sleep deprivation to the erosion of the initial healthy immigrant advantage.

Nonetheless, exploiting the longitudinal dimension of the SOEP data for Germany, we can partially account for unobserved time-invariant characteristics and test whether the speed of assimilation is different across individuals with different sleep histories.[7] We document that the erosion of the initial health advantage is strongly associated with the (observed) immigrants' sleep history (see Supplementary Figure SA.8 in Appendix). For instance, the initial health advantage disappears within 5 years among immigrants who consistently reported sleeping less than 6 hours throughout the years, i.e., those chronically sleep deprived. On the contrary, among immigrants consistently reporting sleeping at least 6 hours, the estimated convergence occurs more slowly, in about 15 years. While these patterns are at best suggestive, they call for more work using longitudinal data on sleep and health to investigate the complex relationship between sleep and health assimilation with time spent in the host country.

This study has a few empirical limitations. First, we used self-reported measures of sleep, which may result in substantial measurement error (Lauderdale *et al.*, 2008). However, unless the measurement error is systematically correlated with education and immigration status, this limitation should not bias our results. Second, the estimated effect of the years spent in the host country on sleep behaviour might be biased if the

immigrants who stay longer in the destination country are different from those who decide to leave the country after a few years (Abraido-Lanza *et al.*, 1999). In particular, those who decide to stay might have sleeping habits closer to those prevalent in the host country, which might partially explain the estimated convergence to the natives' sleep norm. However, the evidence from the German longitudinal data, which allows us to follow individuals over time, substantially alleviates this concern.

Notes

1. Previous studies have concentrated on the comparison of sleep habits among first- and second- or higher-order generation of immigrants, without examining the process of assimilation among first-generation immigrants as time passes in the destination country.
2. We did not include 2014 and 2016, as information on sleep was not collected in these 2 years.
3. There are only 14 observations in our sample who reported to have arrived in Germany less than a year before being surveyed. The results are robust to the use of years since migration, or alternative categorizations of the intervals.
4. We examine the following nationality groups: Turkey, Mediterranean countries (i.e., Italy, Greece, and Spain), ex-Yugoslavia, and Eastern Europe.
5. In Supplementary Figure SA.7 in Appendix, we document that the residualized relationship between sleep hours and years since migration (i.e., after controlling for dummies for age groups, the other socio-economic covariates, country of origin, state, and year fixed effects, as in our regressions) closely resembles the unconditional assimilation pattern for sleep duration in Figure 2.
6. Specifically, we substituted the foreign-born indicator with three dummies that divided the immigrants into three (equally sized) groups based on their year of arrival.
7. We used a random effects estimator augmented with group means of the observable time-variant characteristics, as in Mundlak (1978). Unlike a fixed-effect estimator, this approach allows us to estimate the effect of time-invariant regressors, such as the immigrants' initial sleep advantage.

Supplementary data

Supplementary data are available at *ESR* online.

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