Healthy migrants? Health selection of internal migrants in Germany

Introduction

In Germany, internal migration streams have substantially reshaped the population structure since reunification. Between 2001 and 2010, the population of eastern Germany decreased by 5%, from 17.1 million to 16.3 million; whereas the population of western Germany remained constant (Statistisches Bundesamt 2014). This population decline is attributable to massive outmigration streams from eastern Germany, especially from rural areas to urban areas in western Germany (Glorius 2010). Previous studies on east-west migration mainly examined the years immediately after reunification. These studies focused primarily on the reasons why eastern Germans were migrating, and on the effects of these migration streams on specific areas, including human capital (Brücker and Trübswetter 2004; Friedrich and Schultz 2005; Schultz 2009, 2004), labour market opportunities and economic prospects (Alecke et al. 2000; Kley 2013), public services and infrastructure (Daehre 2005; Sackmann et al. 2008; Neu 2009), and social consequences and future demographic prospects (e.g., fertility and family policy) (Christiane; Dienel and Schnieders 2005; Roloff 2005; Gerloff 2005; Farwick 2009). Except for one comparative study for Italy and Germany by Luy and Caselli (2007) that looked at regional differences in mortality, no study has focused explicitly on the interplay of internal migration and health. This is unfortunate, as selective migration can have substantial effects on the geographical distribution of health (Norman et al. 2005; Verheij et al. 1998; Lu 2008). While good health may foster the decision to move, bad health could be an impediment to migration. Moreover, the act of migration can affect the health of those who move (Carnein et al. 2015).

So far, however, only a few studies have analysed the link between internal migration processes and health. These studies provide empirical evidence that internal migrants are positively selected regarding their health status. Verheij et al. (1998), analysed selective migration between urban and rural settings in the Netherlands, and found that people who migrate from urban to rural areas do not differ in their health characteristics from people who migrated from rural to urban settings. However, they found that migrants were generally healthier than people who did not move. Norman et al. (2005) studied the area-level relationships between health and deprivation in England and Wales and found that migrants

are healthier than non-migrants at younger ages. They also showed that migrants who moved from more deprived settings to less deprived areas are healthier than those who moved in the opposite direction. Moreover, they found that migrants who move within less deprived areas are healthier than non-migrants, but that within deprived areas, migrants are less healthy than non-movers. Lu (2008) looked at internal migration streams in Indonesia and found that younger migrants were positively selected with respect to health, whereas older migrants were negatively selected. Nauman et al. (2015) compared the health status of young adult (aged 18-29) rural to urban migrants in Thailand, and found that the average migrant reported having a better a priori physical health status than return migrants and those who remained at the place of origin. However, the average migrant had a worse mental health status at the time of migration than those who stayed behind.

My aim in this study is to analyse whether internal migrants in Germany are selected with regard to their health status. I applied event history analysis to compare the health status of migrants with the health status of non-migrants, while controlling for other individual characteristics. To capture health selection, I used one health measure—i.e., self-rated contentment with health—and two established risk factors for poor health—i.e., smoking and overweight—as indicators of increased susceptibility to ill health (Verheij et al. 1998). In line with previous research findings I hypothesize that internal migrants in Germany are healthier than non-migrants i.e. they are more satisfied with their health and are less likely to smoke or being overweight or obese.

Background

The link between migration and health has not been fully understood yet and is mostly explored in the context of international migration. In general, the health of migrants is determined by the migration process itself as well as by the conditions in the sending and receiving regions (Spallek and Razum 2007). Several approaches which try to explain the relationship between health and migration focus on the discriminating socio-demographic characteristics of migrants, which put them on an increased risk for becoming ill or dying prematurely (Razum et al. 2008; Spallek and Razum 2007; Zeeb and Razum 2006). Yet, a number of studies show that migrants are healthier and have lower mortality rates than the

average population in both the country of origin and the country of destination (Razum et al. 2008; Razum et al. 1998; Schenk 2007; McKay et al. 2003). This paradox is also known as "healthy migrant effect". The explanation for this effect entails two components: The first is self-selection, suggesting that migration is a life experience requiring high levels of physical and mental health. Thus, it is assumed that migrants are more vigorous and less affected by sickness and chronic conditions, as being in poor health would be an impediment to migration. Moreover, it is hypothesized that migrants are more likely than those who stay behind to be endowed with the kind of physical and mental capabilities needed to cope with the burdens of migration. The second component is derived from the association between socioeconomic discrimination and mortality. Therefore, it is posited that this health advantage is only short-termed and decreases over time as a result of migration related strains (e.g. social disadvantages, bad working conditions, restricted access to health care) (Razum et al. 2008; Razum 2009).

However, the healthy migrant effect is also denied as an artefact resulting from erroneous migration statistics. Migration registration errors can mismatch risk and death populations, resulting in a denominator bias and, thus, an underestimation of migrant mortality. Unregistered return migration is a possible source of registration error, as many of these returns are likely to go unreported (Turra and Elo 2008). Yet, studies show that mortality among migrants is really lower, and not the result of a data artefact (Wallace and Kulu 2014).

Similarities and Differences between Internal and International Migration

Although internal migration flows are greater than international migration flows, researchers investigating the issues of health and migration have mainly focused on international migration (King et al. 2008), while implicitly assuming that the underlying mechanisms apply equally to internal migration processes. This makes sense, as international and internal migration flows are motivated by similar factors and follow similar patterns (Lu 2008; King et al. 2008; McKay et al. 2003). Both types of migration occur because people wish to gain access to better overall conditions in various spheres of life (Boyle et al. 1998), and involve the abandonment of familiar living environments (i.e., working environment, social ties) in order to move to a new

setting. The act of moving can bring success, and/or it can be a highly stressful and disruptive experience (Boyle et al. 1998; Spallek and Razum 2007). Hence, only individuals who are physically and psychically resilient are likely to migrate, as they have the necessary resources to adapt to the new setting. But there are also some marked differences between internal and international migration. Whereas international migration involves the relocation of people across state boundaries, internal migration entails the relocation of people within the boundaries of nation states. While internal migrants may have to adjust to regional peculiarities, they usually do not need to adapt to a completely new set of cultural practices, and they are unlikely to encounter language barriers. Moreover, internal migrants do not face controls and regulations related to citizenship, and are unlikely to have to struggle to gain access to education, employment, health care, and political participation (King et al. 2008). In addition, the distance covered by internal migration is often much shorter and is less likely to involve hazardous travel conditions. Finally, internal migrants are more likely than international migrants to have access to information concerning the new residence, and to have tight social networks at the destination. Hence, internal migration is often less stressful than migration across national boundaries, and factors that tend to discourage international migration might not apply to internal migration. Therefore, the characteristics of internal migrants might differ from those of international migrants. The following analyses aims to answer the question whether the assumptions of the healthy migrant hypothesis are applicable to internal migration processes in Germany.

Data and Methods

The analysis was based on the German Socio-Economic Panel (GSOEP). The GSOEP is a representative longitudinal survey of private households and persons and provides information on the living conditions of the German population aged 16 and above. A rather stable set of core questions are asked every year, which focus on several areas of interest, including population and demography, education, training and qualifications, labour market and occupational dynamics, earnings, income and social security, housing, health, household production, basic orientations (preferences, values, etc.), and satisfaction with certain aspects

of life. Additionally, the basic information in one of these areas is enlarged through responses to more detailed questions posed in yearly topical modules.

The panel study started in 1984 with 5,921 households (with a total of 12,245 individuals) in the former Federal Republic of Germany (FRG), comprising sample A (residents in the FRG) and B (foreigners in the FRG). In June 1990, the dataset was expanded to the territory of the German Democratic Republic (sample C). The GSOEP is conducted annually and has been extended further by the subsamples D (Immigrants 1994/95), E (Refreshment, new independently selected sample from the private household population in Germany in 1998), F (Innovation, independently selected sample from the private household population in Germany in 2000), G (Oversampling of private households with monthly income ≥ 3.835 euros in 2002) and H (Refresher sample of private households in Germany in 1996). The following analysis includes the samples A, B, C, E, F, and H. Detailed information about the objectives and design of the GSOEP can be found at the homepage of the DIW (Deutsches Institut für Wirtschaftsforschung; http://www.diw.de/de/soeplink) that hosts the GSOEP.

As information on smoking status and obesity has been collected on a biennial basis since 2002, the analysis was confined to every other year between 2002-2010. The initial study population contained 27,051 individuals aged 16 and older who were observed between 2002 and 2010. To determine the migration status of these respondents, it was necessary to observe them at least at two successive points in time during the observational period. A total of 625 respondents were excluded from the analysis because they were recorded only once between 2002 and 2010. Another 20 respondents were excluded because they provided no information at two successive points in time, or they provided incomplete migration histories. As the GSOEP is a survey of households I included only one male and one female household member into the study leaving out another 3,510 respondents. To ensure non-independence of the study population, the following analyses were performed separately for men and women.

Hence, the analytical sample included 10,882 men and 12,014 women, amounting to 60,471 and 68,325 person-years respectively. The respondents were followed from their first observation point until they migrated or were censored. Overall, 852 (373 men; 479 women) subjects migrated. Only the first move during the observational period was considered. As the

exact migration date was unknown, the average age between the two survey years when the migration was recorded was taken as age of migration. Meanwhile, 9,462 respondents were lost to follow-up due to attrition (8,093 individuals) or mortality (1,369 individuals). Next to mortality, individuals mainly dropped out of the study because they moved abroad, refused to reply or couldn't be traced anymore (Kroh 2014). These respondents were censored at their average age between the year of the last record and the year of survey exit. For example, if an individual aged 54 responded in 2008 for the last time and was lost to follow-up by 2010, he was censored at the age of 55. A further 12,718 subjects did not move during the observation period, and were censored at their age at the interview at the end of the observation period.

The variable of interest was internal migration. The GSOEP does not ask respondents directly about their internal migration history. But owing to the longitudinal design of the dataset, information about the respondent's place of residence was available for each survey year. Therefore, individuals were defined as internal migrants if they had changed their place of residence within Germany from one federal state to another between two successive survey years. As the exact migration date was unknown, it was assumed that the migration took place at the mid-point between the two survey years. Unfortunately, relocations within federal state boundaries or information on distances could not be considered, as they were not recorded in the dataset.

Applying event history analysis, the age to migration depending on health and other covariates was analysed, using a piecewise exponential model. The baseline hazard, which measures age until migration, was splitted into age intervals (16-24, 25-34, 35-44, 45-54, 55-64, 65+). Within these intervals the hazard rate is assumed to be constant, but it can vary between them. The model can be viewed as an exponential model that controls for age as a time-varying covariate. Left truncation is controlled for by including the respondents' age at their first observation.

Information about the respondents' gender was taken from the wave they entered the study period, and was included as time-independent variable, while all other information (self-rated contentment with health, smoking, BMI, region, living arrangement, educational status,

occupational status, children, satisfaction with household income, housing and leisure time, and general life satisfaction) was included in the form of time-dependent variables.

Health measures

Self-rated contentment with health was included as a health measure. Studies have shown that self-rated health is a good predictor of objective health (Subramanian et al. 2010; Miilunpalo et al. 1997). Respondents were asked to assess their health status based on a 10-point Likert scale. Those whose scores placed them among the least satisfied 30% of the respondents were classified as rather dissatisfied, while respondents who scored above this benchmark were classified as rather satisfied.

Smoking and overweight are the most important risk factors of poor health. Studies have shown that these factors play essential roles in the development of chronic health conditions (Cutler et al. 2007, Preston et al. 2014). Having a chronic and severe health condition may have a strong influence on an individual's decision to migrate, as the condition may lead to physical weakness; whereas having a health condition that is relatively minor may influence the decision to a lesser extent, as such a condition is less likely to impede normal life (Lu 2008). Hence, smoking and overweight were included in the analysis as indicators of an increased susceptibility to ill health (Verheij et al. 1998). According to the healthy migrant hypothesis, people with excess weight should have a lower propensity to migrate, as they are more vulnerable to adverse health conditions that lead to a deterioration in physical abilities. Information on overweight and obesity was based on self-reported measurements of weight and height. Body mass index (BMI) was calculated by dividing the weight in kilogrammes by the squared height in meters (kg/m^2). A BMI below 18.5 was classified as underweight. A BMI between 18.5 and 24.9 was considered normal weight. A BMI between 25 and 29.9 was categorised as overweight, and a BMI greater or equal to 30 was classified as obese.

The negative consequence of smoking do not become immediately apparent, but rather evolve already in childhood and adolescence, and progress into a more severe condition over the life course (Peto and Lopez 2004; Preston 2009). An early onset of smoking reduces the rate of lung growth and level of maximum lung function, causes shortness of breath, coughing spells, phlegm production and wheezing. Beyond, smoking hurts the physical fitness in terms of

both performance and endurance, and is associated with overall diminished physical performance (Sandvick 1995; U.S. Department of Health and Human Services 1994, 2004). Therefore, it seems reasonable to assume that smokers are less physically healthy, and thus, according to the healthy migrant hypothesis, less likely to migrate than non-smokers.
Based on their answers to a question about whether they currently smoke, the respondents were classified as smokers or as non-smokers.

Description of Confounders

Migration can be understood as a response to a perceived disequilibrium between individual aspirations and the subjective assessment of opportunity structures within regions (Fischer and Kück 2004; Gerloff 2004). The push-and-pull factor model distinguishes between stimuli in the sending region that encourage migration (*push*), and incentives that spring from the receiving region (*pull*), and thus trigger the migration decision multi-causally. These include employment opportunities, income levels, educational opportunities, housing, infrastructure, and the perceived quality of life (Gerloff 2004; Christiane Dienel 2005).
The dataset used here included information about several life parameters present at the time before migration, and thus allowed me to control for several factors that push migration. I therefore included a set of covariates intended to reflect how contented the respondents were with their living conditions. These included the respondents' satisfaction with their household income, their housing, and their leisure time; as well as their general life satisfaction. For each variable, respondents who scored below the 30% mark were classified as dissatisfied, while those who scored above that threshold were defined as satisfied. I hypothesized that those respondents who were satisfied with these areas of life should have been less likely to migrate than those who were dissatisfied.
Moreover, a set of demographic confounders was included in the analysis: e.g., gender, region of origin (east or west), living arrangement (married, living in a partnership, not living in a partnership), educational status (in education, no degree, vocational degree, university degree) employment status (fully employed, part-time employed, unemployed, in education, other), and children (children, no children). For a number of respondents there was missing

information on covariates for some of the waves. These were summarised in the category no answer (n.a.).

Table 1: Characteristics of the study population in person years

	Men							Women						
		Migration		Lost to Attrition		Lost to Mortality			Migration		Lost to Attrition		Lost to Mortality	
	person years	cases	rate	cases	rate	cases	rate	person years	cases	rate	cases	rate	cases	rate
Total	**60471**	**373**	**0,006**	**3883**	**0,064**	**759**	**0,013**	**68325**	**479**	**0,007**	**4210**	**0,062**	**610**	**0,009**
Age														
16-24	**2747**	**84**	**0,031**	**252**	**0,092**	**1**	**0,000**	**3432**	**159**	**0,046**	**240**	**0,070**	**1**	**0,000**
25-34	**7741**	**121**	**0,016**	**631**	**0,082**	**3**	**0,000**	**9716**	**134**	**0,014**	**653**	**0,067**	**3**	**0,000**
35-44	**13572**	**80**	**0,006**	**956**	**0,070**	**22**	**0,002**	**14839**	**81**	**0,005**	**1005**	**0,068**	**11**	**0,001**
45-54	**12127**	**36**	**0,003**	**791**	**0,065**	**48**	**0,004**	**13242**	**44**	**0,003**	**838**	**0,063**	**32**	**0,002**
55-64	**10644**	**25**	**0,002**	**544**	**0,051**	**103**	**0,010**	**10989**	**30**	**0,003**	**484**	**0,044**	**71**	**0,006**
65+	**13640**	**27**	**0,002**	**709**	**0,052**	**582**	**0,043**	**16107**	**31**	**0,002**	**990**	**0,061**	**492**	**0,031**
Region														
East	**16975**	**141**	**0,008**	**886**	**0,052**	**212**	**0,012**	**19027**	**203**	**0,011**	**956**	**0,050**	**172**	**0,009**
West	**43496**	**232**	**0,005**	**2997**	**0,069**	**547**	**0,013**	**49298**	**276**	**0,006**	**3254**	**0,066**	**438**	**0,009**
Living Arrangement														
married	**41471**	**116**	**0,003**	**2536**	**0,061**	**533**	**0,013**	**42321**	**123**	**0,003**	**2606**	**0,062**	**232**	**0,005**
partnership	**9528**	**130**	**0,014**	**762**	**0,080**	**58**	**0,006**	**10574**	**182**	**0,017**	**730**	**0,069**	**30**	**0,003**
no partnership	**8371**	**107**	**0,013**	**511**	**0,061**	**165**	**0,020**	**14325**	**145**	**0,010**	**797**	**0,056**	**341**	**0,024**
n.a.	**1101**	**20**	**0,018**	**74**	**0,067**	**3**	**0,003**	**1105**	**29**	**0,026**	**77**	**0,070**	**7**	**0,006**
Educational Status														
in education	**1322**	**44**	**0,033**	**113**	**0,085**	**1**	**0,001**	**1469**	**63**	**0,043**	**86**	**0,059**	**0**	**0,000**
no degree	**7022**	**46**	**0,007**	**583**	**0,083**	**121**	**0,017**	**14470**	**87**	**0,006**	**1016**	**0,070**	**239**	**0,017**
vocational degree	**37956**	**161**	**0,004**	**2351**	**0,062**	**526**	**0,014**	**40393**	**192**	**0,005**	**2431**	**0,060**	**322**	**0,008**
university degree	**12632**	**98**	**0,008**	**720**	**0,057**	**100**	**0,008**	**10193**	**98**	**0,010**	**534**	**0,052**	**39**	**0,004**
n.a.	**1539**	**24**	**0,016**	**116**	**0,075**	**11**	**0,007**	**1800**	**39**	**0,022**	**143**	**0,079**	**10**	**0,006**
Occupational Status														
full-time employed	**33921**	**183**	**0,005**	**2338**	**0,069**	**72**	**0,002**	**16433**	**131**	**0,008**	**1012**	**0,062**	**18**	**0,001**
part-time employed	**1243**	**15**	**0,012**	**86**	**0,069**	**6**	**0,005**	**12518**	**52**	**0,004**	**781**	**0,062**	**13**	**0,001**
no employment	**21770**	**113**	**0,005**	**1218**	**0,056**	**667**	**0,031**	**33242**	**217**	**0,007**	**2057**	**0,062**	**572**	**0,017**
in education	**698**	**11**	**0,016**	**58**	**0,083**	**1**	**0,001**	**698**	**25**	**0,036**	**49**	**0,070**	**0**	**0,000**
other	**2839**	**51**	**0,018**	**183**	**0,064**	**13**	**0,005**	**5434**	**54**	**0,010**	**311**	**0,057**	**7**	**0,001**
Children														
no children	**23974**	**222**	**0,009**	**1575**	**0,066**	**383**	**0,016**	**14086**	**274**	**0,019**	**1070**	**0,076**	**102**	**0,007**
≥ 1	**36497**	**151**	**0,004**	**2308**	**0,063**	**376**	**0,010**	**54239**	**205**	**0,004**	**3140**	**0,058**	**508**	**0,009**

Table 1 continued

	Men							Women						
		Migration		Lost to Attrition		Lost to Mortality			Migration		Lost to Attrition		Lost to Mortality	
	person years	cases	rate	cases	rate	cases	rate	person years	cases	rate	cases	rate	cases	rate
Total	**60471**	**373**	**0,006**	**3883**	**0,064**	**759**	**0,013**	**68325**	**479**	**0,007**	**4210**	**0,062**	**610**	**0,009**
Satisafaction with household income														
unsatisfied	**12209**	**85**	**0,007**	**948**	**0,078**	**142**	**0,012**	**13732**	**122**	**0,009**	**977**	**0,071**	**143**	**0,010**
satisfied	**46658**	**259**	**0,006**	**2816**	**0,060**	**605**	**0,013**	**52906**	**312**	**0,006**	**3107**	**0,059**	**457**	**0,009**
n.a.	**1604**	**29**	**0,018**	**119**	**0,074**	**12**	**0,007**	**1687**	**45**	**0,027**	**126**	**0,075**	**10**	**0,006**
Satisfaction with housing														
unsatisfied	**11118**	**99**	**0,009**	**911**	**0,082**	**116**	**0,010**	**12833**	**144**	**0,011**	**944**	**0,074**	**119**	**0,009**
satisfied	**48155**	**250**	**0,005**	**2877**	**0,060**	**636**	**0,013**	**54268**	**300**	**0,006**	**3192**	**0,059**	**486**	**0,009**
n.a.	**1198**	**24**	**0,020**	**95**	**0,079**	**7**	**0,006**	**1224**	**35**	**0,029**	**74**	**0,060**	**5**	**0,004**
Satifsfaction with leisure time														
unsatisfied	**14123**	**97**	**0,007**	**1080**	**0,076**	**132**	**0,009**	**16601**	**127**	**0,008**	**1161**	**0,070**	**115**	**0,007**
satisfied	**45116**	**254**	**0,006**	**2717**	**0,060**	**613**	**0,014**	**50438**	**323**	**0,006**	**2963**	**0,059**	**478**	**0,009**
n.a.	**1232**	**22**	**0,018**	**86**	**0,070**	**14**	**0,011**	**1286**	**29**	**0,023**	**86**	**0,067**	**17**	**0,013**
General life satisfaction														
unsatisfied	**12666**	**79**	**0,006**	**951**	**0,075**	**320**	**0,025**	**15412**	**92**	**0,006**	**1089**	**0,071**	**285**	**0,018**
satisfied	**46695**	**274**	**0,006**	**2852**	**0,061**	**431**	**0,009**	**51805**	**358**	**0,007**	**3044**	**0,059**	**317**	**0,006**
n.a.	**1110**	**20**	**0,018**	**80**	**0,072**	**8**	**0,007**	**1108**	**29**	**0,026**	**77**	**0,069**	**8**	**0,007**
Self-rated contentment with health														
unsatisfied	**18321**	**61**	**0,003**	**1183**	**0,065**	**517**	**0,028**	**22597**	**102**	**0,005**	**1446**	**0,064**	**449**	**0,020**
satisfied	**41030**	**291**	**0,007**	**2617**	**0,064**	**234**	**0,006**	**44627**	**349**	**0,008**	**2691**	**0,060**	**153**	**0,003**
n.a.	**1120**	**21**	**0,019**	**83**	**0,074**	**8**	**0,007**	**1101**	**28**	**0,025**	**73**	**0,066**	**8**	**0,007**
Smoking														
smoker	**19733**	**126**	**0,006**	**1375**	**0,070**	**204**	**0,010**	**16957**	**122**	**0,007**	**1126**	**0,066**	**77**	**0,005**
non-smoker	**39683**	**227**	**0,006**	**2434**	**0,061**	**552**	**0,014**	**50337**	**329**	**0,007**	**3014**	**0,060**	**528**	**0,010**
n.a	**1055**	**20**	**0,019**	**74**	**0,070**	**3**	**0,003**	**1031**	**28**	**0,027**	**70**	**0,068**	**5**	**0,005**
BMI														
underweight	**299**	**8**	**0,027**	**21**	**0,070**	**12**	**0,040**	**1767**	**34**	**0,019**	**114**	**0,065**	**39**	**0,022**
normal weight	**20967**	**197**	**0,009**	**1452**	**0,069**	**292**	**0,014**	**33860**	**308**	**0,009**	**2202**	**0,065**	**274**	**0,008**
overweight	**27445**	**118**	**0,004**	**1750**	**0,064**	**315**	**0,011**	**20085**	**75**	**0,004**	**1158**	**0,058**	**180**	**0,009**
obesity	**10497**	**29**	**0,003**	**556**	**0,053**	**130**	**0,012**	**10664**	**29**	**0,003**	**578**	**0,054**	**103**	**0,010**
n.a.	**1263**	**21**	**0,017**	**104**	**0,082**	**10**	**0,008**	**1949**	**33**	**0,017**	**158**	**0,081**	**14**	**0,007**

Source: GSOEP 2002-2010 N=128.796 person years

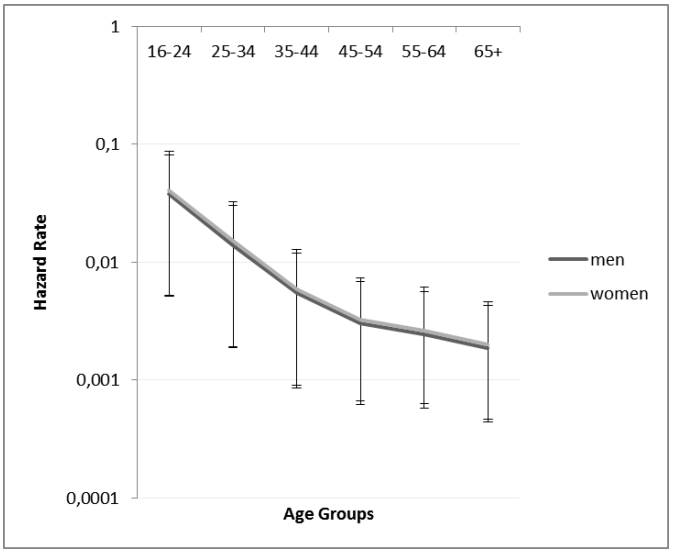
Characteristics of the Study Population

The distribution of person years by covariates for the migrant population, as well as the population lost to attrition and lost to follow-up is depicted in Table 1. Most striking is the different age distribution of migrants compared to the population lost to mortality. Whereas the migration rate is highest for the youngest age groups (16-24 and 25-34), the majority of the population lost to mortality is older than age 65. This suggests that migrants are typically in those ages, in which the risk of mortality is quite low. Therefore, it is reasonable to assume that mortality selection has no biasing effect on migration outcomes, as those who migrate are typically not yet in those ages in which the risk for mortality is high. However, as mortality is associated with bad health, subjects who become lost to mortality might have been in such a bad health state that prevented them from migration. Moreover, attrition rates are higher among the population of interest, i.e. smokers and overweight people. If they were migration related, these losses would be a potential source of bias.

Model Results

For the event history analysis, the baseline hazard was age. The propensity to migrate was highest among the youngest age group (16-25), and decreased steadily with increasing age for both sexes (Figure 1).

Figure 1: Empirical hazard rate of the risk of internal migration for men and women in Germany 2002-2010



Source: GSOEP 2002-2010

To evaluate the individual effect of the three health measures on migration, i.e. contentment with health, smoking and BMI, in a first step, each variable was fitted separately into one model only controlling for age (not depicted). For men, the propensity to migrate was significantly higher for those who were satisfied with their health (HR=1.33, p≤0.051). Non-smokers were more likely to migrate than smokers (HR=1.25, p≤0.046), and the propensity to migrate decreased with increasing weight, i.e. obese people had the lowest migration risk (HR=0.50, p≤0.001) when compared to the normal weight population. For women, health satisfaction was not related to migration (HR=1.08, p≤0.494), but smoking and overweight were. Non-smokers had a higher propensity to migrate (HR=1.36, p≤0.004), while overweight and obese people had the lowest migration risks ($HR_{overweight}$=0.64, p≤0.001, $HR_{obesity}$=0.48, p≤0.000).

In a second step, nested models were used to find out the extent to which the effect of health is related to the behavioural risk factors. For men (Table 2), smoking had no effect (LR chi^2 (2)= 3.68, p≤0.1591), but entering BMI improved the model significantly (LR chi^2 (4)= 20,75, p≤0.0004). Non-smokers were more likely to migrate while the propensity to move decreased with increasing weight. For women (Table 3), entering both smoking (LR chi^2 (2)= 9,67 p≤0.0079) and BMI (LR chi^2 (4)= 26.89, p≤0.0000) improved the model significantly. Female non-smokers were also more likely to move whereas overweight and obese women had the lowest migration risks.

When entering the demographic control variables into the model, for men the effect of the health measures persisted, although the effect of smoking became insignificant. For women, the influence of both smoking and BMI remained significant. In the final model including all covariates, contentment with health, smoking and BMI had a significant effect on the migration propensity of men. That is, men who migrated were more satisfied with their health, were more often non-smokers and less likely to be overweight or obese. A similar pattern was seen for women; however, the effect of health contentment was insignificant. For both sexes, the findings for the confounding demographic variables were consistent with previous research. In line with past population trends the migrants were more likely to come from eastern Germany than from western Germany. Marriage seems to have prevented people from moving, whereas respondents who were living in a partnership and those who were single had significantly higher migration risks. The results for education support the idea of a “brain drain,” as the migration risk was highest among respondents with a university degree. Unemployment was a strong predictor for migration, whereas being in part-time employment did not differ significantly from being in full-time employment. Respondents who were still in education had the lowest migration risk. Having children prevented only women from migration. Entering the contentment measures revealed that most of them were insignificant. However, respondents who were satisfied with their housing were less likely to migrate than those who were dissatisfied.

Discussion

This is the first study that analyses the influence of health on internal migration in Germany. The results show that the premises of the healthy migrant hypothesis are highly adoptable to internal migration processes in Germany. Self-rated contentment with health, which was included as a predictor for objective health status, was only associated with the migration status of men, but not of women. This finding partly confirms the earlier findings from other countries (Lu 2008; Nauman et al. 2015; Norman et al. 2005, Verheij et al. 1998), but suggests that health satisfaction is less important for internal migration processes in Germany. Yet, this analysis relied only on self-rated health, as no other objective health measure was available. Including a more objective health measurement might have led to different results regarding health status. By contrast, the risk factors smoking and BMI were clearly associated with migration, i.e. the propensity to migrate decreased significantly with increasing weight for both men and women. Smokers were less likely to migrate than non-smokers. This suggests that the higher vulnerability to adverse health conditions and associated limitations of physical performance caused by smoking and excess weight prevent people from migrating. My results showed that migrants are predominantly young; therefore, it is quite unlikely that they have already developed serious or chronic health conditions. In this respect, BMI and smoking seem to be a good indicator of increased susceptibility to ill health.

Table 2: Relative Risk and 95% confidence interval of internal migration for men depending on health and other covariates

	MODEL 1			MODEL 2			MODEL 3			MODEL 4			MODEL 5		
	HR		CI low - CI up	**HR**		CI low - CI up	**HR**		CI low - CI up	**HR**		CI low - CI up	**HR**		CI low - CI up
Age															
16-24	**1,00**		-- --	**1,00**		-- --	**1,00**		-- --	**1,00**		-- --	**1,00**		-- --
25-34	**0,53**	*	0,404 - 0,708	**0,53**	*	0,403 - 0,706	**0,59**	*	0,446 - 0,789	**0,73**	***	0,522 - 1,027	**0,73**	***	0,518 - 1,025
35-44	**0,21**	*	0,151 - 0,280	**0,20**	*	0,149 - 0,276	**0,24**	*	0,173 - 0,327	**0,38**	*	0,254 - 0,569	**0,38**	*	0,253 - 0,570
45-54	**0,11**	*	0,072 - 0,159	**0,10**	*	0,071 - 0,156	**0,13**	*	0,086 - 0,193	**0,20**	*	0,124 - 0,325	**0,20**	*	0,124 - 0,327
55-64	**0,09**	*	0,549 - 0,136	**0,08**	*	0,525 - 0,130	**0,10**	*	0,065 - 0,166	**0,14**	*	0,085 - 0,243	**0,15**	*	0,873 - 0,251
65+	**0,07**	*	0,048 - 0,115	**0,07**	*	0,441 - 0,108	**0,85**	*	0,054 - 0,134	**0,10**	*	0,058 - 0,170	**0,10**	*	0,605 - 0,180
Satisfaction with health															
unsatisfied	**1,00**		-- --	**1,00**		-- --	**1,00**		-- --	**1,00**		-- --	**1,00**		-- --
satisfied	**1,33**	***	0,999 - 1,742	**1,31**	***	0,987 - 1,741	**1,26**		0,950 - 1,681	**1,29**	***	0,970 - 1,724	**1,46**	**	1,074 - 1,984
n.a.	**2,47**	*	1,488 - 4,111	**2,49**		0,552 - 11,250	**2,63**		0,595 - 11,605	**2,48**		0,499 - 12,288	**1,52**		0,181 - 12,705
Smoking Status															
smoker				**1,00**		-- --	**1,00**		-- --	**1,00**		-- --	**1,00**		-- --
non-smoker				**1,24**	***	0,993 - 1,546	**1,26**	**	1,010 - 1,572	**1,21**		0,963 - 1,514	**1,24**	***	0,984 - 1,554
n.a.				**1,11**		0,241 - 5,132	**1,47**		0,181 - 11,949	**1,09**		0,077 - 15,483	**1,27**		0,877 - 18,494
Weight Status															
underweight							**1,79**		0,877 - 3,656	**1,67**		0,815 - 3,439	**1,65**		0,802 - 3,388
normal							**1,00**		-- --	**1,00**		-- --	**1,00**		-- --
overweight							**0,69**	*	0,543 - 0,872	**0,81**	***	0,634 - 1,023	**0,80**	***	0,633 - 1,022
obesity							**0,51**	*	0,339 - 0,753	**0,63**	**	0,419 - 0,938	**0,62**	**	0,418 - 0,935
n.a.							**0,60**		0,109 - 3,345	**0,77**		0,137 - 4,360	**0,81**		0,147 - 4,479

Table 2 continued

	MODEL 1			MODEL 2			MODEL 3			MODEL 4				MODEL 5			
	HR	CI low	CI up	**HR**	CI low	CI up	**HR**	CI low	CI up	**HR**		CI low	CI up	**HR**		CI low	CI up
Region																	
East										**1,32**	**	1,069	1,641	**1,32**	**	1,066	1,643
West										**1,00**		--	--	**1,00**		--	--
Living Arrangement																	
married										**1,00**		--	--	**1,00**		--	--
partnership										**2,31**	*	1,709	3,127	**2,29**	*	1,694	3,102
no partnership										**2,44**	*	1,753	3,403	**2,36**	*	1,692	3,295
n.a.										**0,95**		0,087	10,284	**1,10**		0,099	12,189
Educational Status																	
in education										**1,54**	**	1,005	2,359	**1,55**	**	1,012	2,387
no degree										**0,88**		0,612	1,268	**0,88**		0,611	1,264
vocational degree										**1,00**		--	--	**1,00**	*	--	--
university degree										**2,14**	*	1,647	2,783	**2,16**		1,662	2,813
n.a.										**1,48**		0,735	2,986	**1,50**		0,744	3,025
Occupational Status																	
full-time										**1,00**		--	--	**1,00**		--	--
part-time										**1,66**	***	0,973	2,845	**1,70**	**	0,989	2,919
no										**1,68**	**	1,240	2,271	**1,68**	*	1,221	2,304
education										**0,58**		0,278	1,195	**0,58**		0,278	1,208
other										**2,35**	*	1,543	3,579	**2,39**	*	1,557	3,664
Children																	
≥ 1										**1,13**		0,868	1,471	**1,13**		0,866	1,471
no children										**1,00**		--	--	**1,00**		--	--
Satisafaction with household income																	
unsatisfied														**1,00**		--	--
satisfied														**1,17**		0,879	1,553
n.a.														**1,24**		0,561	2,756
Satisfaction with housing																	
unsatisfied														**1,00**		--	--
satisfied														**0,75**	**	0,580	0,965
n.a.														**1,34**		0,386	4,671
Satifsfaction with leisure time																	
unsatisfied														**1,00**		--	--
satisfied														**0,90**		0,700	1,160
n.a.														**1,23**		0,220	6,865
General life satisfaction																	
unsatisfied														**1,00**		--	--
satisfied														**0,80**		0,593	1,075
n.a.														**0,43**		0,328	5,527
Likelihood-ratio-test				LR chi^2 (2) = 3,68 p ≤ 0,1591			LR chi^2 (4) = 20,75 p ≤ 0,0004			LR chi^2 (13) = 123,24 p ≤ 0,0000				LR chi^2 (8) = 11,69 p ≤ 0,1658			

Source: GSOEP 2002-2010 *p≤0.01 **p≤0.05 ***p≤0.1, CI 95%……

Table 3: Relative Risk and 95% confidence interval of internal migration for women depending on health and other covariates

	MODEL 1			MODEL 2			MODEL 3			MODEL 4			MODEL 5		
	HR	CI low	CI up	**HR**	CI low	CI up	**HR**	CI low	CI up	**HR**	CI low	CI up	**HR**	CI low	CI up
Age															
16-24	**1,00**	--	--	**1,00**	--	--	**1,00**	--	--	**1,00**	--	--	**1,00**	--	--
25-34	**0,31** *	0,243	- 0,385	**0,30** *	0,237	- 0,376	**0,32** *	0,251	- 0,401	**0,56** *	0,316	- 0,535	**0,56** *	0,421	- 0,738
35-44	**0,12** *	0,094	- 0,161	**0,12** *	0,092	- 0,157	**0,13** *	0,100	- 0,173	**0,34** *	0,175	- 0,345	**0,35** *	0,245	- 0,497
45-54	**0,08** *	0,054	- 0,106	**0,07** *	0,052	- 0,102	**0,08** *	0,060	- 0,120	**0,22** *	0,097	- 0,223	**0,23** *	0,152	- 0,349
55-64	**0,06** *	0,421	- 0,092	**0,06** *	0,039	- 0,087	**0,07** *	0,047	- 0,106	**0,16** *	0,694	- 0,171	**0,17** *	0,107	- 0,267
65+	**0,04** *	0,300	- 0,066	**0,04** *	0,027	- 0,060	**0,05** *	0,033	- 0,074	**0,07** *	0,029	- 0,071	**0,08** *	0,051	- 0,128
Satisfaction with health															
unsatisfied	**1,00**	--	--	**1,00**	--	--	**1,00**	--	--	**1,00**	--	--	**1,00**	--	--
satisfied	**1,08**	0,863	- 1,357	**1,05**	0,836	- 1,319	**1,00**	0,800	- 1,262	**1,07**	0,910	- 1,440	**1,15**	0,902	- 1,478
n.a.	**2,38** *	1,555	- 3,644	**1,09**	0,256	- 4,653	**1,07**	0,255	- 4,507	**0,69**	0,151	- 3,944	**0,47**	0,035	- 6,304
Smoking Status															
smoker				**1,00**	--	--	**1,00**	--	--	**1,00**	--	--	**1,00**	--	--
non-smoker				**1,36** *	1,102	- 1,683	**1,37** **	1,110	- 1,695	**1,41** **	1,259	- 1,933	**1,43** *	1,154	- 1,782
n.a.				**2,72**	0,640	- 11,571	**3,31**	0,667	- 16,396	**2,56**	0,481	- 16,482	**2,02**	0,259	- 15,767
Weight Status															
underweight							**1,21**	0,845	- 1,735	**1,03**	0,766	- 1,553	**1,05**	0,733	- 1,509
normal							**1,00**	--	--	**1,00**	--	--	**1,00**	--	--
overweight							**0,64** *	0,495	- 0,830	**0,72** **	0,497	- 0,844	**0,71** **	0,551	- 0,928
obesity							**0,48** *	0,327	- 0,708	**0,52** *	0,326	- 0,719	**0,52** *	0,350	- 0,764
n.a.							**0,73**	0,315	- 1,700	**0,80**	0,331	- 1,857	**0,82**	0,346	- 1,953

Table 3 continued

	MODEL 1			MODEL 2			MODEL 3			MODEL 4			MODEL 5		
	HR	CI low	CI up	**HR**	CI low	CI up	**HR**	CI low	CI up	**HR**	CI low	CI up	**HR**	CI low	CI up
Region															
East										**1,72** *	1,503	- 2,173	**1,70** *	1,408	- 2,052
West										**1,00**	--	--	**1,00**	--	--
Living Arrangement															
married										**1,00**	--	--	**1,00**	--	--
partnership										**2,19** *	1,751	- 3,029	**2,10** *	1,600	- 2,763
no partnership										**2,57** *	2,311	- 3,995	**2,46** *	1,864	- 3,236
n.a.										**2,92**	0,740	- 9,567	**2,63**	0,666	- 10,427
Educational Status															
in education										**0,96**	0,732	- 1,484	**0,95**	0,653	- 1,376
no degree										**1,13**	0,942	- 1,621	**1,09**	0,824	- 1,436
vocational degree										**1,00**	--	--	**1,00**	--	--
university degree										**1,80** *	1,402	- 2,324	**1,81** *	1,406	- 2,332
n.a.										**1,76**	1,157	- 3,170	**1,69**	0,993	- 2,871
Occupational Status															
full-time										**1,00**	--	--	**1,00**	--	--
part-time										**1,16**	0,828	- 1,631	**1,13**	0,809	- 1,588
no										**2,02** *	1,674	- 2,804	**1,93** *	1,475	- 2,513
education										**1,46**	1,065	- 2,910	**1,40**	0,833	- 2,363
other										**1,28**	0,948	- 2,153	**1,25**	0,811	- 1,922
Children															
≥ 1										**0,54** *	0,341	- 0,546	**0,51** *	0,400	- 0,652
no children										**1,00**	--	--	**1,00**	--	--
Satisafaction with household income															
unsatisfied													**1,00**	--	--
satisfied													**0,88**	0,696	- 1,121
n.a.													**1,11** **	0,603	- 2,040
Satisfaction with housing															
unsatisfied													**1,00**	--	--
satisfied													**0,62** *	0,500	- 0,773
n.a.													**1,05**	0,430	- 2,551
Satifsfaction with leisure time															
unsatisfied													**1,00**	--	--
satisfied													**0,98**	0,786	- 1,227
n.a.													**0,78**	0,122	- 4,980
general life satisfaction															
unsatisfied													**1,00**	--	--
satisfied													**1,14**	0,875	- 1,488
n.a.													**1,71**	0,379	- 7,746
Likelihood-ratio-test				LR chi^2 (2) = 9,67 p ≤ 0,0079			LR chi^2 (4) = 26,89 p ≤ 0,0000			LR chi^2 (13) = 197,87 p ≤ 0,0000			LR chi^2 (8) = 24,08 p ≤ 0,0022		

Source: GSOEP 2002-2010 *p≤0.01 **p≤0.05 ***p≤0.1, CI 95%……

Germany's population structure has been characterized by population ageing. Older populations tend to have higher rates of chronic diseases and to make greater use of medical and other care facilities, which implies an increased need for health-related resources and services (Patrick 1980). Selective migration is likely to reinforce this effect, as it has substantial effects on the geographical distribution of health. If migrants are predominantly young and healthy, they leave behind a population that diminishes in size and becomes older and less healthy (Christiane Dienel 2005; Verheij et al. 1998; Norman et al. 2005).

My results show that migrants are predominantly young and healthy, and suggest that smoking, as well as increased BMI are important influencing factors that prevent people from migration. This implies that the sending regions will be left with a population who have a greater susceptibility to chronic conditions and, thus to having disabilities. This, in turn, increases the demand for public health care provision. This might be of particular importance for regions characterized by outmigration.

Concerning demographic confounders, the results are in line with findings from other studies: i.e., the migrants are predominantly unmarried. This can be because married people are more prone to excess weight, which in turn decreases the likelihood of migration. Moreover, studies suggest that it is more difficult to make migration decisions within a stable partnership. In addition, the more intimately people are involved in their networks, the lower their risk of migration (Gerloff 2005). This idea is supported by the finding that having children lowers the propensity to migrate. However, running an interaction model (not depicted) showed that people with children who are in their middle ages (ages 25-44) have a lower risk to migrate, while older people (aged 55 and above) with children have a higher migration risk. This could reflect the fact that their children have mostly grown up and left home at these ages, which offers new possibilities and room for migration decisions for the parents.

This study's findings confirm the importance of economic and labour market conditions, particularly employment opportunities, for migration decisions. Economic considerations seem to be more important than the respondents' contentment with their living conditions. Studies have shown that the decision to migrate may be motivated not only by the relative levels of unemployment, but also by differences in the quality and the standards of the underlying

working conditions (Friedrich and Schultz 2005; Gerloff 2005): e.g., the work environment, the number of extra hours that must be worked without pay, the insecurity of the workplace, and the training opportunities. Furthermore, more highly educated people are the most likely to migrate, which results in a decline in human capital and a worsening of future prospects in the sending regions.

The strength of this study is that it uses data from a prospective panel, and is therefore not prone to recall bias. It is representative of the total German population, contains a sufficient number of internal migration cases, and includes a direct subjective health measure, as well as two established health risk factors that allowed me to make inferences about the individuals' susceptibility to ill health. Moreover, the dataset provides a set of control variables that are closely linked to migration.

This study has also a series of limitations. Regarding the longitudinal study design, the healthy migrant effect may be biased in several ways. First, the study population itself could be selected in that individuals with particularly bad health may have refused to participate in the study. In this case, the healthy migrant effect would be underestimated. Another potential source of bias is informative censoring due to mortality selection, as subjects in the lost to mortality group could have been in such a bad health that prevented them from migration. Moreover, smokers and overweight persons were more likely to be among the population lost to mortality. My results show that migrants were typically not yet in those ages in which the risk for mortality is high. In a sensitivity analysis a competing risk analysis was performed, which showed that the results for migration were not altered by the effect of mortality (see Appendix). Therefore it is unlikely that my findings are biased by mortality selection. Attrition rates in this study are higher than migration or mortality rates, i.e. my population of interest is more likely to be among the population lost to follow up. If this attrition was due to migration, our results could be biased, due to the excessive losses of smokers, overweight and obese people, as well as health contented people. Yet, even assuming that all of these attrition cases were migration related, the effect of the health indicator variables would remain, albeit attenuated (not depicted).

Furthermore, this study could be biased due to left truncation, as it provides no information about the migration behaviour and/or the health status of respondents before they entered the observation period. Hence, migration history and related health changes could not be considered. However, the goal of this study was not to analyse the effect of health on migration transitions over the life course, but rather to determine whether individuals who migrated during a certain time period were positively selected with regard to health. Moreover, it is likely that some respondents were lost to follow-up due to migration. As these respondents were included in the censored population, their health status could not be considered in this analysis.

Due to data restrictions, this study provides no information about migration that took place within federal states. Yet some of the migration activity may have occurred within the state boundaries of some of the larger federal states, such as Bavaria or North Rhine-Westphalia. If these migrants were selected on the basis of health as well, our results would underestimate the effect of selective migration. If, however, they were unselected, the results of this analysis would be unchanged. Moreover, this study disregards potential re-migrants. Studies have shown that re-migration occurs predominantly among people who failed to adapt to their new job or setting. (Friedrich and Schultz 2005). As unhappiness affects health satisfaction negatively (Graham 2008), including re-migrants in this analysis would have mitigated the healthy migrant effect.

Another drawback of this study is its use of self-reported BMI to reflect body composition, as this indicator fails to distinguish between lean and fat body mass. Moreover, as the BMI cut-off points are set regardless of sex or skeletal frame, some individuals may be wrong assigned to a weight category, which could lead to an underestimation of the extent of the overweight problem (Burkhauser and Cawley 2008). Furthermore, compared to objective measurements, a reliance on subjective information on weight and height tends to lead to an underestimation of body mass index (Glaesmer and Brähler 2002). Therefore, the number of overweight and obese people in this study could be underestimated. Despite these potential problems, I chose to include BMI in the analysis because it is a commonly used and widely available measure of excess weight.

My goal in this paper was to gain a better understanding of the influence of health on internal migration in Germany. Therefore, population ageing in Germany and the associated challenges for the health care system may be reinforced by selective migration, especially with regard to overweight and obesity. To provide us with a better understanding of the health consequences of selective migration, future research should attempt to analyse the effects of internal migration on small-scale regional health variations using suitable data. It would also be interesting to study whether health selection diminishes with spatial and/or cultural proximity. Moreover, future research is needed to detect whether selective migration has any long term-effects on population health.

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