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Changes in immigrants' Body Mass Index with their duration of residence in Germany

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Abstract

This paper investigates how immigrants' Body Mass Index (BMI) changes with increasing years since migration in Germany. The data are drawn from three waves (2002, 2004, and 2006) of the German Socio-Economic Panel Study (SOEP). The results indicate a clear increase of the BMI with additional years in Germany for men and women.

Keywords: Body Mass Index, immigrants, SOEP

Jel-Classification: C23, I12

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I. Introduction

The so-called "healthy immigrant effect" (HIE) is one of the most striking theories concerning immigrants and their health status. This theory consists of two parts: According to the first part, immigrants are on average healthier than their native peers. This is mostly explained by a kind of self-selection among their origin population, in a way that healthier individuals are more likely to migrate. However, according to the second part, this health gap closes after a relatively short period of time, and thus the health of immigrants is converging to that of the natives or is getting even worse. This gradient of immigrants health has been found in many countries, see, for example, for Canada, Newbold and Danforth 2003, Deri 2004, or McDonald and Kennedy 2004; for Australia, Biddle et al. 2007 or Kennedy and McDonald 2006; for the US, Antecol and Bedard 2006 or Jasso et al. 2004, and for Germany, among others, Lechner and Mielck 1998 or Ronellenfitsch and Razum 2004.

The decline of immigrants' health is subject to ongoing research, but the underlying trajectories are not yet fully understood. In the literature, there are several different explanations discussed: the adoption of destination-country habits and lifestyles, the structural and material relationship between a low socio-economic status and health, additional stress due to the migration process, persistent barriers to access to health care due to cultural or language factors, as well as a kind of "statistical artefact" explanation due to return migration. As health is a rather complex concept one can assume that none of the proposed explanations can solely contribute to the decline in health, but rather that the decline in health is a result of different interacting causes.

This paper concentrates on the possible contribution of an adoptation of destination-country habits and lifestyles. The idea is that if health behaviour – associated with poor health (like smoking, alcohol consumption, poor dietary habits, or physically inactivity) – converges to the level of natives, this might contribute to the deterioration of immigrants' health with years since migration (ysm). Another common measure for immigrants' adoptation to the host countries lifestyle is the Body Mass Index (BMI) (see, among others, Cairney and Øsbye 1999 or Antecol and Bedard 2006). The BMI can be calculated from an individual's height and weight. It is furthermore assumed that the BMI is to a large part determined by dietary habits and physical activities. An increase in the BMI might therefore occur due to poor dietary habits and physically inactivity. The BMI is an important variable, because overweight and obese are widely recognized as risk factors for a great variety of health conditions (e.g. high blood pressure, cardiovascular disease, diabetes, arthritis, asthma, and some cancers). Hence, regarding the healthy immigrant effect the idea behind is that if the immigrants' BMI increases with their duration of residence in Germany, a decline in immigrants' health might follow. Hence, a contribution of this weight gain to the healthy immigrant effect might be possible. Therefore, the aim of this paper is to analyse the evolution of immigrants' BMI with years since migration in Germany.

The data used are drawn from three waves (2002, 2004, and 2006) of the German Socio-Economic Panel (SOEP). The availability of panel data offers the possibility to apply estimation methods for panel data and thus to control for time-constant individual-specific unobserved heterogeneity like genetic constitution.

The outline of the paper is as follows: Section II summarises previous empirical findings regarding the health behaviour, especially the BMI, of immigrants. The description of the data and the empirical methodology can be found in section III. Section IV discusses the empirical findings and section V concludes.

II. Literature review

The health behaviour of immigrants, or rather the convergence of immigrants' health behaviour to native levels, has been studied extensively for the United States and Canada, while there is only little empirical evidence for the European countries, especially for Germany.

One of the first and most influential studies was that of Marmot and Syme (1976). They investigated the prevalence of chronic heart disease among male immigrants from Japan to Hawaii and California. Their results showed that those immigrants who retained more of their traditional cultural practices had a lower prevalence of chronic heart disease than those immigrants who retained less of their traditional cultural practices. In a more recent study for the US, Singh and Siahpush (2002) analysed pooled data from the National Health Interview Survey (NHIS, data files from 1993 and 1994). They made use of logistic regressions and found that immigrants' risks of smoking, obesity, hypertension, and chronic conditions are significantly lower than for comparable native-born people, but increase with duration of residence in the US. Their results concerning obesity were confirmed by Goel et al. (2004), who used cross-sectional data from the NHIS 2000. Goel et al. (2004) found that residing in the US for ten years or more is associated with a significantly higher BMI for men and women as well as for all ethnic groups (with the exception of foreign-born blacks). Also Antecol and Bedard (2006) examined pooled data from the NHIS for the years 1989-1996 and found that female immigrants almost completely converge to the BMIs of natives within their first decade of residence in the US. For male immigrants, however, Antecol and Bedard (2006) showed that they close only one third of the initial BMI gap after fifteen years since arrival. Gordon-Larsen et al. (2003) used data from the National Longitudinal Study of Adolescent Health to investigate possible explanations for overweight (e.g. dietary habits and physical activity) among first- and second-generation US immigrants (Mexicans, Puerto Ricans, and Cubans). Their results showed a rapid acculturation with regard to obesity-related behaviours with first to subsequent generation of US residence, and – with the exception of Mexican-Americans – markedly higher rates of overweight in the group of second-generation immigrants. Using the 2003 cohort of another data set, namely the US New Immigrant Survey (NIS), Akresh (2007) analysed also dietary habits of immigrants in the years after arrival in the US. She found that immigrants' dietary habits change with years since migration yielding mostly in a higher consumption level of meat and junk food. Additionally, she showed that strong dietary changes are closely related to an increasing BMI. The National Latino and Asian American Survey (2002-2003) was used in a recent study by Bates et al. (2008) to analyse the evolution of the BMI among the first, second, and third generation Latinos and Asian Americans. Among most of the subgroups, they found an increase of the BMI in later generations, but the degree of changes in the BMI varied among Latinos and Asian Americans suggesting different patterns of adaptation.

For Canada, Cairney and Øsbye (1999) used data from the 1994/95 wave of the National Population Health Survey (NPHS) to examine the relationship between years since migration and excess weight. They concluded that the duration of residence is an important correlate of overweight and obese for immigrant women, and for men of Asian origin. However, the studies of Pérez (2002) and Ng et al. (2005) found only mixed evidence of convergence in the health behaviour of immigrants regarding smoking, inactivity, excess weight, and dietary habits. Pérez (2002) used data from Statistics Canada's cross-sectional 2000/01 Canadian Community Health Survey (CCHS). He found that the immigrants' health-related lifestyle behaviour varies with duration of residence in Canada. However, Pérez (2002) concluded that his results do not show that immigrants become more like native Canadians with respect to health behaviour with increasing years since migration. Additionally, he showed that health behaviour cannot generally explain the differences in health between immigrants and native-borns. Though, Pérez notes, "a longitudinal analysis in which immigrant respondents are followed over a period of time is needed to shed further light on these patterns." (p.: 10). Ng et al. (2005) used five cycles of longitudinal data of the NPHS (1994/95-2002/03) to investigate the risk to have a substantial weight gain for those European and non-European immigrants who have rated their health as either excellent, very good, or good in 1994/95. They found that while over time only very few non-European immigrants became daily smokers, they were a bit more likely than Canadians to become physically inactive, but the difference was not statistically significant. Hence, Ng et al. (2005) concluded that the initiation of smoking or becoming physically inactive is unlikely to contribute to the deterioration of health (p.: 4-5). In contrast, weight gain is found to be a possible contributor: Non-European immigrants are found to be twice as likely as Canadian borns to experience an increase in their BMI of 10% (p.: 5). This result supports that of Cairney and Øsbye (1999) concerning immigrants increasing BMI. Additionally, immigrants' "weight gain" with years since migration is sustained by the analysis of McDonald and Kennedy (2005). Combining different data sets (NPHS, wave 1996; CCHS, wave 2000-2001, and two Canadian Census files), they found that, on average, recent immigrants are less likely to be obese or overweight, but that these measures converge to native-born levels with years since migration. However, they found huge differences in the convergence pattern by the ethnicity of the immigrants, which they explained by different degrees of interaction with members of the same ethnic group residing in the same regional area. Hence, the existence of social network effects tempers the process of adjustment to Canadian lifestyle norms, and thus the incidence of becoming overweight or obese (see McDonald and Kennedy 2005).

As far as I know no study analysing the evolution of the BMI with immigrants' duration of residence in Germany exists. There is one study based on data of the German microcensus 1999 which compares the prevalence of overweight and obese among German and foreign men and women in different age groups (see Lampert et al. 2005: 132). According to this data, foreign women are to a larger percentage overweight or obese than German women, whereby the largest differences occur in the group of individuals age 60 and above. For men, in contrast, only little differences between foreigners and Germans can be shown for all age groups (see Lampert et al. 2005: 132).

III. Data and estimation method

Data source

The data used are drawn from the SOEP[2], a representative longitudinal survey of currently about 12,000 randomly selected private households with more than 20,000 individuals. The SOEP was started in 1984[3]. Since then, every year, each household member above 16 years is asked questions on a broad range of socio-economic indicators. One of the most important features of the SOEP is the over-sampling of immigrants, especially of two immigrants groups. On the one hand, there is an over-sampling of those households whose head is either from Italy, Greece, Spain, former Yugoslavia, or Turkey. Hence, this first group covers the so-called former 'guest workers' *(Gastarbeiter*) and their family members. And on the other hand, 'households in which at least one household member had moved from abroad to West Germany after 1984' are over-sampled since 1994/1995. Thus this second group covers to a broad extent the so-called ethnic Germans *(Aussiedler*).[4]

Additionally, the SOEP contains information about the region the household is living in. There are different regional levels available, federal states, regional policy regions, and the county level. This offers the possibility to merge macro-indicators provided by the 'Federal Office for Building and Regional Planning' (BBR). In this study, the share of foreigners on the county level is merged to the SOEP data.[5]

Dependent variable

Up to now, the weight and height questions, which are used to calculate the BMI, have been asked in three waves: 2002, 2004, and 2006.

The BMI is calculated as weight in kilograms divided by height in meters squared. It is constructed from two questions in the SOEP:

How tall are you? If you don't know, please estimate.

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[2] For more detailed information see Haisken-DeNew and Frick 2005; SOEP Group 2001; Wagner et al. 2007, and the references therein. The SOEP data are available as a "scientific user" file (see Wagner et al. 1993).

[3] The SOEP started in 1984 with approximately 6,000 households (Sample A and B). In 1990 – after the German reunification – the SOEP was expanded to the territory of the former German Democratic Republic by about 2,200 households (Sample C) (see Haisken-DeNew and Frick 2005; SOEP Group 2001).

[4] The term ethnic Germans is used for Germans, who moved into the former Soviet Union before the World War II. After the Second World War lots of these ethnic Germans and their offsprings had to suffer from forced resettlement and ethnic discrimination, and hence they were allowed to "remigrate" to Germany and they automatically received German nationality when entering Germany (see Dietz 1999; Kurthen 1995).

[5] According to data protection rules, this part of the research using regional information was carried out at the DIW Berlin. I thank the staff for making the information available.

How many kilograms do you currently weigh? If you don't know, please estimate.

Following the recommendations of the World Health Organisation (WHO), individuals with a BMI of less than 18.5 are considered underweight, between 18.5 and less than 25 they are considered normal weight, between 25 and less than 30 they are considered overweight, and a BMI index of 30 or greater is considered obese.

One should be aware that the information on height and weight is self-reported. There is evidence in the literature that a systematic downward bias of self-reported weight, especially among women, exists (see, for example, Ossiander et al. 2004 or Ezzati et al. 2006).

For SOEP data, it has been shown that especially data on the weight question is sensitive to the interview setting: The absence of an interviewer increases the reported body weight. However, this interviewer effect has been shown to occur only for men (see Kroh 2005). Kroh (2005) found that men reported a body weight of about one kilogram more in an anonymous interview setting compared to other interview settings. Hence, in the regression analysis, it should be controlled for the presence of an interviewer (following, for example, Cawley et al. 2005).

Figure 1 and figure 2 display a first descriptive approach to the evolution of overweight and obese with immigrants' duration of residence and compared to individuals born in Germany. Thereby it is distinguished between individuals born in Germany with German nationality (referred to as 'natives' in the following) and individuals born in Germany having no German nationality (referred to as 'second generation' in the following). Using such a cursory approach, it should be taken in mind, that in the group of 'natives' also naturalised second-generation immigrants are included.

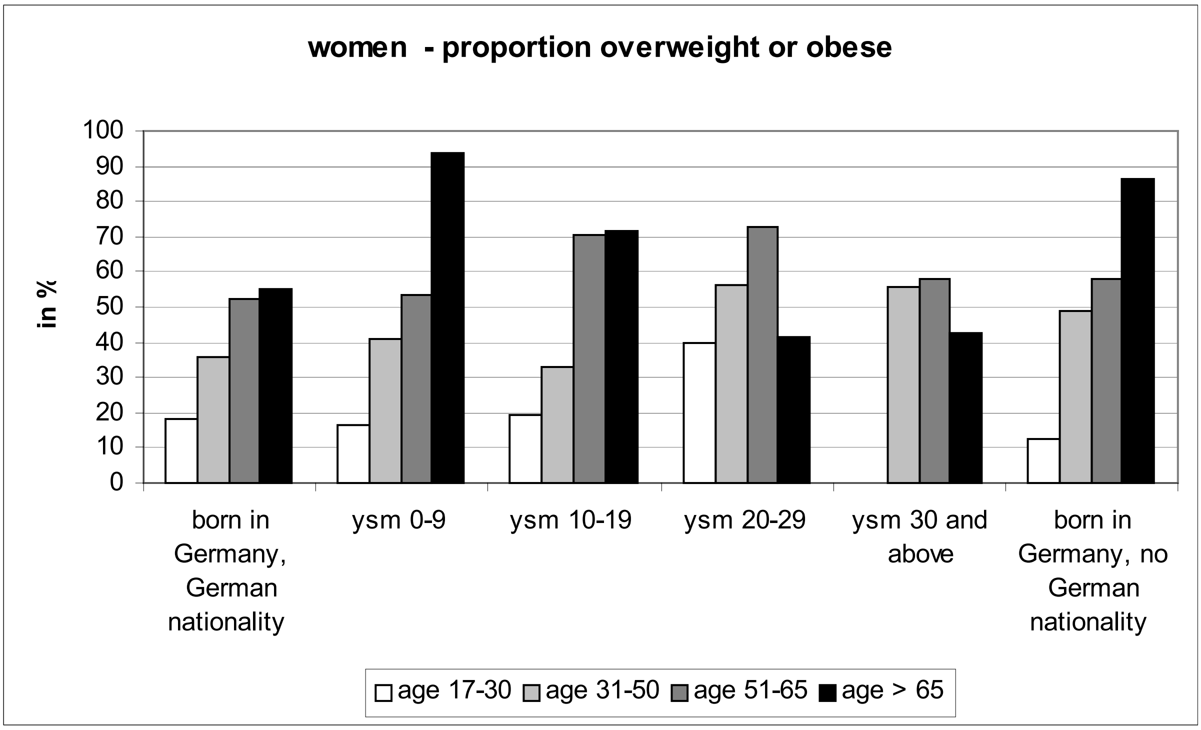
As overweight and obese are correlated to age, the figures summarise the proportion of overweight and obese by different age groups. Otherwise, the results would be largely influenced by differences in the mean age of the respective groups.

For men, figure 1 shows that for the group aged 17 to 30 years, there is a clear increase in the proportion of individuals being overweight or obese with duration of residence, whereby only 20.7% of recent immigrants (ysm between zero and nine years) are overweight or obese compared to 26% of natives, but with duration of residence between 20 and 29 years the proportion of immigrants being overweight or obese augments to 47.7% (see figure 1). For immigrants above the age of 66 this pattern does not appear with recent immigrants in this age group being to a higher degree overweight or obese. This is also found for female immigrants (see figure 2). This fits in the general findings for the HIE, namely that the initial health advantage does not exist for those immigrating at an age above 60 years. Furthermore, the proportion of overweight and obese in the second generation is remarkable, which is in every age group much higher than that of the natives: in the age group 31-50 (51-65) years 54.2% (68.6%) of the natives are overweight or obese compared to 81.4% (91.4%) of the second-generation (see figure 1). This pattern also arises for second-generation women with the exception of the youngest age group (see figure 2). Overall, a lower percentage of women are overweight or obese compared to men.

Figure 1: Distribution of overweight and obese according to age and years since migration for men

Note: overweight is defined as BMI > 25, obese is defined as BMI > 30; there are no observations for age group 17-30 and ysm 30 and above as well as for the second-generation older than 65 years
Source: SOEP, wave 2002, weighted

Figure 2: Distribution of overweight and obese according to age and years since migration for women



Note: overweight is defined as BMI > 25, obese is defined as BMI > 30; there are no observations for age group 17-30 and ysm 30 and above, and only few observations for the second-generation older than 65 years
Source: SOEP, wave 2002, weighted

In the empirical analysis the BMI is used as metric dependent variable, because not only being overweight or obese is relevant, but any change in the BMI might be interesting. Individuals for whom there is missing information on either height or weight are excluded from the analysis. Additionally, in line with the literature, individuals with extreme values of the BMI are excluded (BMI < 14 or BMI > 60).

Independent variables

The dependent variable is expressed as a function of different demographic and socio-economic variables. The following 'migration-related' variables are included: a set of four dummy variables for the *country of origin* (Eastern European countries, Turkey, other EU countries, and all other countries, with born in Germany acting as reference); a dummy for having *German citizenship*; two dummy variables for *German language skills* (one indicating that an individual speaks German either good or fair, and one indicating that an individual speaks German either poor or not at all, with very good German language skills acting as reference[6]; *years since migration* (following McDonald and Kennedy (2005: 2472) for any individuals born in Germany ysm is set equal to zero); *ysm²* (to capture any possible non-linear effects); a dummy for the *second-generation* (defined as being born in Germany, but having no German citizenship); and three dummy variables for the *arrival cohort* (immigrated between 1955 and 1972, immigrated between 1973 and 1989, immigrated between 1990 and 2006, with immigrated before 1950 or born in Germany acting as reference). Additionally, to control for possible network effects, the *share of foreigners* (according to the county level) is included.

In consistence with the literature, the following indicators were included as control variables in the multivariate regression analysis: a dummy variable for *sex* (taking the value one for males); three dummy variables for *age* (one for the age category 26-50 years, one for the age category 51-65 years, and one that takes the value one if the respondent is older than 66, with the age of 16-25 years acting as reference group); *marital status* (single, divorced or separated, and widowed with married acting as reference category); a dummy for having *children* in the household; *years of education*; *occupational status* (i.e. dummy variables covering the following possibilities: 'blue collar worker', 'white collar worker', 'training', 'self-employed', 'pensioner, or 'public servant' with 'non-working' or 'jobless' acting as reference group); logarithm of the pre-government *household income* and the logarithm of the *size of the household*[7]; *religious affiliation* (i.e. a dummy for Christian, and a dummy for other religious affiliation, with undenominational acting as reference group)[8]; and dummies for the year. As it has been shown that especially questions on weight are sensitive to the interview setting, a dummy variable indicating the *presence of an interviewer* is additionally included.

Empirical strategy

As panel data are available, this offers the possibility to control for time-constant individual-specific unobserved heterogeneity like genetic disposition or environmental exposition in the country of origin. For continuous dependent variables the two most used panel estimators are the random effects estimator and the fixed effects estimator, which are outlined in this section (see Baltagi 2001; Wooldridge 2002).

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[6] These dummies are constructed from a self-assessed question: "In your opinion, how do you speak German?", with five possibilities: very good, good, fair, poor, or not at all. All natives are assigned very good German language skills.

[7] Schwarze (2003) shows that the inclusion of the logarithm of income and the logarithm of household size is more flexible, because it is not necessary to make any assumptions about the equivalence scale.

[8] The question regarding religious affiliation was in the analysed timeframe only included in 2003. Hence, for all individuals, the answer to this question from 2003 is implemented for all other years.

Consider the following model:

$$y_{it} = x'_{it}\beta + e_{it} \qquad i = 1,....,n \text{ and } t = 1,....T \qquad (1)$$

whereby y_{it} is the value of the dependent variable for individual i at time t, x'_{it} is a vector of K explanatory variables including a constant, ß is the corresponding coefficient vector, and e_{it} is the error term. This error term e_{it} is supposed to consist of a time-constant individual-specific effect α_i and a common stochastic error term η_{it}:

$$e_{it} = \alpha_i + \eta_{it} \qquad (2)$$

whereby it is assumed that η_{it} is uncorrelated with the x_{it} and varies unsystematically across individuals and time:

$$E(\eta_{it}) = 0 \qquad (3)$$

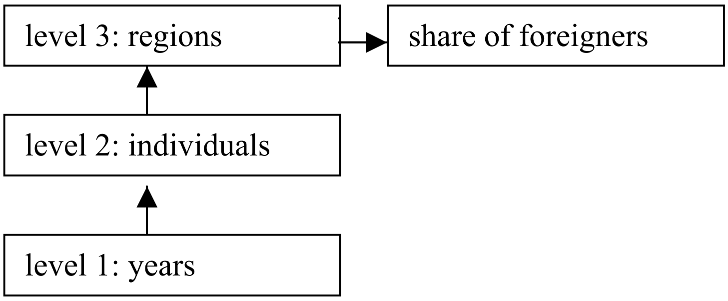
$$E(\eta_{it}\eta_{is}) = 0 \text{ for all } t \neq s \qquad (4)$$

The crucial distinction between the random effects model and the fixed effects model lies in the assumptions about the time-constant individual-specific effect α_i: Whereas in the random effects model it is assumed that α_i is uncorrelated with x_{it}, in the fixed effects model it is assumed that α_i is correlated with x_{it}.

In general, the assumption that the independent variables are uncorrelated with the individual-specific effect does not hold, which is an argument in favour of the fixed effects model. However, as the fixed effects model uses only the variation within an individual's set of observations, it is not possible to include time-invariant explanatory variables (like in the case at hand 'country of origin' and 'religious affiliation') in the estimation model (see Baltagi 2001; Wooldridge 2002). Another shortcoming of the fixed effects estimator lies in its inefficiency in the estimation of the effects of variables with small within variance (see Plümper and Troeger 2007). This is an important issue for the data at hand, because only data from three years are available, and therefore, the within variance is for most of the independent variables rather little.

Additionally, it should also be taken into account that the data at hand have a three-level structure, as information on the regional level (the share of foreigners on the county level) is included. Hence, not only longitudinal observations are nested within individuals, but also individuals are nested within regions (see figure 3). Ignoring the existence of such a hierarchical structure will generally underestimate the standard errors of the regression coefficient, and thus mislead inference (see Moulton 1990).

Figure 3: Hierachical structure of the data



Source: Own compilation

To account for the multilevel structure of the data the error term is extended by a regional-specific effect as follows:

$$e_{itk} = \alpha_{ik} + v_k + \varepsilon_{itk} \qquad (5)$$

whereby α_{ik} denotes the individual-specific effect and v_k captures the regional-specific effect. Both are assumed to be constant over time. ε_{itk} is the idiosyncratic error term. Furthermore, it is assumed that

$v_k \sim N(0, \sigma^2_v)$,

$\alpha_{ik} \sim N(0, \sigma^2_\alpha)$, and

$\varepsilon_{itk} \sim N(0, \sigma^2_\varepsilon)$.

Hence, a multilevel is estimated to take the hierarchical structure of the data into account. For the sake of comparison, the estimation results for the random effects model and the fixed effects model are also reported. The estimations are taken out with Stata MP/10.0.

IV. Estimation results

The final sample consists of 18,593 individuals of whom are 8,907 men and 9,686 women. All estimations are taken out for the whole sample (table 1), and separately for men and women (table 2 and table 3, respectively).

In the multilevel model, the estimated variance between regions is σ^2_v = 0.32 and the estimated variance between individuals within a given region is σ^2_α = 14.49 (table 1). The proportion of the total residual variation that is due to differences between regions and individuals, respectively, can be calculated in the following way:

$$\rho(region) = \frac{\sigma_v^2}{\sigma_v^2 + \sigma_\alpha^2 + \sigma_\varepsilon^2} \quad (6)$$

$$\rho(individual) = \frac{\sigma_\alpha^2}{\sigma_v^2 + \sigma_\alpha^2 + \sigma_\varepsilon^2} \quad (7)$$

Hence, the estimated intraclass correlation on the regional level is 1.83% and the estimated intraclass correlation on the individual level is 83.88%.

Comparing the random-effects model and the multilevel model using Akaike's information criterion (AIC), the random effects model is preferred, and hence, in the following interpretation and discussion of the estimation results it is only referred to the random effects model with individual-specific effects.

The country of origin shows only a significant effect for male immigrants from ‘other countries’: Men born in ‘other countries’ have a 4.23 points lower BMI than individuals born in Germany. Having German citizenship seems to have no influence on the BMI. Having poor German language skills yield a higher BMI for all groups, but the effect is only significant for the total sample and the women sample. This contradicts the idea that the BMI increases with acculturation, as having poor language skills hints towards lower acculturation and hence, on theoretical grounds of the acculturation theory, one would have expected a negative sign. The coefficient of years since migration is for all samples (and for all models) positive and significant. This indicates that the BMI increases with additional years in Germany and supports the idea that changes in lifestyle and environment might lead to a weight gain. This result is in line with the results found for the US and Canada (see section II). Years since migration squared has mostly a negative and significant coefficient, indicating a convex relationship between the BMI and ysm: The BMI increases with additional years in Germany, but to a decreasing degree. The higher the share of foreigners on the county level the lower the BMI in the random effects model for all samples. This is in accordance with the idea that the higher the concentration of foreigners in a region, the less likely immigrants are to adopt their health behaviour, and hence, in the case at hand, the lower is their BMI. For example, McDonald and Kennedy (2005) note, the extent of adaptation depends “on the concentration and behaviour of people in the same geographic area who are of similar ethnic background, culture and language to the immigrant” (p.: 2470). Assuming, for example, that the change in dietary habits depends on the higher availability and the lower price of certain food in the host country compared to the immigrants' home country. Then – as Chiswick and Miller (2002) suggest – it might be easier for the immigrants to retain traditional dietary habits in areas with a higher concentration of particular ethnic groups, because in these areas the market for traditional goods is large enough to allow the supply of these goods at reasonable prices. However, in the fixed effects model, none of the coefficient for the share of foreigners is significant.

Regarding the control variables, men are found to have a higher BMI, which was expected, as men are usually heavier due to physical circumstances involving more muscle mass. In comparison to individuals aged between 16 and 25 years, older individuals are found to have a higher BMI. Being widowed, single, or divorced is associated with a significantly lower BMI (being widowed is thereby only significant in the fixed effects model for the total sample and in the random effects model of the men sample). This is consistent with the literature, where it has been shown that married individuals have a higher BMI. This is often explained by eating habits which might change with marriage. The coefficient for children is also significant and negative in all samples. In the literature, the effect of children on the BMI is also explained by eating habits. A higher socio-economic status (higher household income, more years of education, being a house owner) is found to be associated with a smaller BMI. However, in the fixed effects model, the coefficient for years of education turns significantly positive for all samples. Regarding the occupational status, individuals in training or white collar workers have a significantly lower BMI than non-working or jobless individuals. For men, a significant effect is only found for being in training. Religious affiliation has only a significant impact on the BMI of women: being Christian lowers the BMI in comparison to being undenominational. As expected, the presence of an interviewer reduces the BMI, this effect is only found to be significant in the fixed effects model. The year dummies (which are not shown explicitly in the tables) are both positive and significant, indicating – as for example McDonald and Kennedy (2005) note – a secular trend in weight increase over time. The cohort dummies (which are also not shown explicitly in the tables) are positive for all models and samples, but they are not significant.

Table 1: Estimation results: BMI, total sample

variables	random effects model		fixed effects model		multilevel model	
Germany	-		-		-	
other EU-countries	-2.596	(1.928)			-2.760	(1.914)
Turkey	-1.852	(1.947)			-2.043	(1.933)
Eastern Europe	-2.050	(1.926)			-2.283	(1.912)
other countries	-3.219*	(1.947)			-3.444*	(1.931)
German citizenship	0.031	(0.174)	0.208	(0.224)	0.022	(0.174)
German very good	-		-		-	
German good/fair	0.133	(0.099)	0.006	(0.112)	0.125	(0.099)
German poor/not	0.377**	(0.169)	0.182	(0.190)	0.357**	(0.169)
ysm	0.092***	(0.029)	0.157***	(0.033)	0.099***	(0.029)
ysm^2	-0.001*	(0.001)	-0.001	(0.001)	-0.001*	(0.001)
second-generation	-0.142	(0.280)	0.487	(0.472)	-0.127	(0.275)
share of foreigners	-0.021***	(0.005)	-0.001	(0.011)	-0.022***	(0.009)
<u>control variables</u>						
male	1.325***	(0.060)	-		1.334***	(0.058)
aged 16-25	-		-		-	
aged 26-50	0.911***	(0.065)	0.575***	(0.074)	0.978***	(0.067)
aged 51-65	1.493***	(0.080)	0.964***	(0.096)	1.579***	(0.082)
above 66 years	1.475***	(0.094)	1.220***	(0.112)	1.562***	(0.095)
married	-		-		-	
widowed	-0.093	(0.094)	-0.279**	(0.132)	-0.070	(0.094)
single	-1.205***	(0.064)	-0.823***	(0.089)	-1.241***	(0.065)
divorced	-0.541***	(0.067)	-0.433***	(0.083)	-0.526***	(0.068)
children	-0.254***	(0.043)	-0.170***	(0.048)	-0.272***	(0.044)
years of education	-0.174***	(0.012)	0.112***	(0.034)	-0.175***	(0.012)
non-working	-		-		-	
training	-0.579***	(0.068)	-0.294***	(0.075)	-0.571***	(0.070)
self-employed	-0.070	(0.073)	-0.002	(0.083)	-0.050	(0.074)
pensioner	0.085	(0.055)	0.086	(0.061)	0.085	(0.055)
public servant	-0.094	(0.110)	-0.129	(0.140)	-0.073	(0.111)
white collar	-0.133***	(0.044)	-0.141***	(0.048)	-0.117***	(0.045)
blue collar	-0.049	(0.047)	-0.124**	(0.051)	-0.035	(0.047)
own dwelling	-0.125***	(0.041)	0.039	(0.051)	-0.124***	(0.042)
log hh income	-0.056***	(0.015)	-0.017	(0.017)	-0.059***	(0.015)
log household size	0.177**	(0.073)	0.016	(0.085)	0.201***	(0.075)
undenominational	-		-		-	
christ	-0.121*	(0.068)			-0.062	(0.071)
other religion	-0.251	(0.224)			-0.271	(0.222)
interviewer present	-0.030	(0.033)	-0.144***	(0.038)	-0.025	(0.034)
constant	26.614***	(0.264)	23.677***	(0.474)	26.496***	(0.270)
cohort dummies	yes		no		yes	
time dummies	yes		no		yes	
R^2 within	0.02		0.02			
R^2 between	0.13		0.04			
R^2 overall	0.12		0.03			
σ_v					0.563	(0.047)
σ_α	3.830				3.807	(0.021)
σ_ε	1.565				1.571	(0.007)
# observations	48,302		48,302		48,302	
# individuals	18,593		18,593		18,593	

Standard error in parentheses; *** significant at 1%, ** significant at 5%, *significant at 10%
Source: SOEP waves 2002, 2004, 2006, own calculations

Table 2: Estimation results: BMI, only men

variables	random effects model		fixed effects model		multilevel model	
Germany	-		-		-	
other EU-countries	-3.142	(2.272)			-2.936	(2.258)
Turkey	-2.927	(2.301)			-2.738	(2.286)
Eastern Europe	-3.072	(2.274)			-2.928	(2.258)
other countries	-4.234*	(2.330)			-4.101*	(2.310)
German citizenship	0.182	(0.234)	0.371	(0.295)	0.177	(0.234)
German very good	-		-		-	
German good/fair	0.127	(0.127)	0.122	(0.143)	0.140	(0.128)
German poor/not	0.149	(0.230)	0.326	(0.259)	0.161	(0.230)
ysm	0.108***	(0.039)	0.210***	(0.045)	0.107***	(0.039)
ysm^2	-0.001	(0.001)	-0.002*	(0.001)	-0.001	(0.001)
second-generation	-0.078	(0.374)	0.181	(0.686)	-0.127	(0.367)
share of foreigners	-0.024***	(0.007)	-0.018	(0.014)	-0.021**	(0.009)
control variables						
aged 16-25	-		-		-	
aged 26-50	0.932***	(0.089)	0.496***	(0.102)	0.972***	(0.091)
aged 51-65	1.328***	(0.109)	0.758***	(0.130)	1.373***	(0.110)
above 66 years	1.209***	(0.127)	0.905***	(0.152)	1.254***	(0.129)
married	-		-		-	
widowed	-0.333**	(0.164)	-0.372	(0.227)	-0.300*	(0.164)
single	-1.175***	(0.084)	-0.579***	(0.121)	-1.201***	(0.085)
divorced	-0.393***	(0.094)	-0.322***	(0.117)	-0.373***	(0.096)
children	-0.218***	(0.058)	-0.204***	(0.065)	-0.236***	(0.059)
years of education	-0.122***	(0.015)	0.107**	(0.045)	-0.125***	(0.015)
non-working	-		-		-	
training	-0.572***	(0.092)	-0.381***	(0.103)	-0.555***	(0.094)
self-employed	0.081	(0.096)	0.058	(0.109)	0.109	(0.096)
pensioner	0.076	(0.079)	0.102	(0.088)	0.086	(0.080)
public servant	0.028	(0.139)	-0.054	(0.183)	0.047	(0.140)
white collar	0.030	(0.072)	-0.038	(0.079)	0.066	(0.073)
blue collar	-0.017	(0.063)	-0.097	(0.067)	0.008	(0.064)
own dwelling	0.021	(0.054)	0.083	(0.068)	0.037	(0.056)
log hh income	-0.034	(0.021)	-0.034	(0.024)	-0.039*	(0.021)
log household size	0.224**	(0.095)	0.114	(0.112)	0.250**	(0.098)
undenominational	-		-		-	
christ	0.000	(0.086)			0.019	(0.088)
other religion	-0.358	(0.287)			-0.352	(0.282)
interviewer present	-0.059	(0.044)	-0.138***	(0.051)	-0.063	(0.045)
constant	26.959***	(0.349)	24.210***	(0.638)	26.880***	(0.353)
cohort dummies	yes		no		yes	
time dummies	yes		no		yes	
R^2 within	0.03		0.02			
R^2 between	0.11		0.02			
R^2 overall	0.09		0.02			
σ_v					0.489	(0.062)
σ_α	3.455				3.431	(0.028)
σ_ε	1.456				1.463	(0.009)
# observations	23,116		23,116		23,116	
# individuals	8,907		8,907		8,907	

Standard error in parentheses; *** significant at 1%, ** significant at 5%, *significant at 10%
Source: SOEP waves 2002, 2004, 2006, own calculations

Table 3: Estimation results: BMI, only women

variables	random effects model		fixed effects model		multilevel model	
Germany	-		-		-	
other EU-countries	-2.192	(3.261)			-2.205	(3.246)
Turkey	-0.850	(3.281)			-0.915	(3.268)
Eastern Europe	-1.140	(3.252)			-1.259	(3.238)
other countries	-2.324	(3.242)			-2.427	(3.228)
German citizenship	-0.114	(0.255)	0.029	(0.334)	-0.122	(0.255)
German very good	-		-		-	
German good/fair	0.144	(0.152)	-0.125	(0.174)	0.122	(0.152)
German poor/no	0.485**	(0.247)	0.031	(0.278)	0.446*	(0.246)
ysm	0.077*	(0.043)	0.114**	(0.049)	0.088**	(0.043)
ysm^2	-0.001	(0.001)	-0.001	(0.001)	-0.001	(0.001)
second-generation	-0.188	(0.411)	0.596	(0.657)	-0.123	(0.403)
share of foreigners	-0.020***	(0.007)	0.016	(0.016)	-0.028**	(0.011)
control variables						
aged 16-25	-		-		-	
aged 26-50	0.898***	(0.095)	0.631***	(0.106)	0.981***	(0.097)
aged 51-65	1.634***	(0.117)	1.143***	(0.139)	1.744***	(0.119)
above 66 years	1.712***	(0.137)	1.500***	(0.164)	1.824***	(0.139)
married	-		-		-	
widowed	-0.171	(0.120)	-0.269	(0.168)	-0.158	(0.120)
single	-1.241***	(0.097)	-1.031***	(0.130)	-1.280***	(0.098)
divorced	-0.661***	(0.095)	-0.522***	(0.118)	-0.650***	(0.100)
children	-0.294***	(0.064)	-0.139*	(0.072)	-0.317***	(0.065)
years of education	-0.225***	(0.019)	0.114**	(0.050)	-0.225***	(0.018)
non-working	-		-		-	
training	-0.559***	(0.100)	-0.184*	(0.111)	-0.562***	(0.104)
self-employed	-0.232**	(0.115)	-0.032	(0.126)	-0.233**	(0.116)
pensioner	0.127*	(0.077)	0.087	(0.084)	0.119	(0.077)
public servant	-0.247	(0.177)	-0.155	(0.216)	-0.214	(0.180)
white collar	-0.219***	(0.058)	-0.177***	(0.063)	-0.218***	(0.059)
blue collar	-0.051	(0.073)	-0.133*	(0.078)	-0.041	(0.074)
own dwelling	-0.260***	(0.060)	-0.006	(0.075)	-0.269***	(0.062)
log income	-0.073***	(0.021)	-0.007	(0.024)	-0.079***	(0.021)
log household size	0.143	(0.110)	-0.074	(0.128)	0.187	(0.114)
undenominational	-		-		-	
christ	-0.255**	(0.104)			-0.189*	(0.107)
other religion	-0.106	(0.341)			-0.111	(0.339)
interviewer present	0.001	(0.049)	-0.147***	(0.056)	0.012	(0.050)
constant	27.526***	(0.395)	23.229***	(0.699)	27.433***	(0.399)
cohort dummies	yes		no		yes	
time dummies	yes		no		yes	
R^2 within	0.03		0.02			
R^2 between	0.13		0.05			
R^2 overall	0.12		0.04			
σ_v					0.587	(0.071)
σ_α	4.106				4.093	(0.032)
σ_ε	1.657				1.664	(0.010)
# observations	25,186		25,186		25,186	
# individuals	9,686		9,686		9,686	

Standard error in parentheses; *** significant at 1%, ** significant at 5%, *significant at 10%
Source: SOEP waves 2002, 2004, 2006, own calculations

In a robust check, the random-effects model is re-estimated separately for the Turks, Eastern European immigrants, and immigrants from other EU-countries to avoid the confounding of possible ethnic differences with years since migration. Due to the small sample size, it is not possible to estimate the regression for the group of "other countries". Additionally, due to the small sample size, the estimation is taken out only for the total sample, and not separately for men and women. In order to avoid a large number of tables, I will only shortly discuss the results for years since migration. The estimation results are available upon request.
For the Turkish sample and for the sample of immigrants from other EU-countries, the coefficient for ysm is significantly positive; indicating that the BMI of Turks and immigrants from other EU countries is increasing with an additional year in Germany. For Eastern European immigrants, the effect of ysm is found to be positive, but not significant.

V. Conclusion and discussion

This paper concentrates on the possible contribution of an increase in the Body Mass Index with additional years in Germany to the decline of immigrants' health with their duration of residence. Using three waves from the SOEP (2002, 2004, and 2006), a random effects model, a fixed effects model, and a multilevel model is estimated to analyse the determinants of an individual's BMI.
The results show that the BMI increases with additional years in Germany for men and women. Thereby, the idea that changes in lifestyle and environment might lead to a weight gain can be supported. Additionally, it is found that the higher the share of foreigners on the county level, the lower is the BMI in the random-effects models for all samples. This is in accordance with the idea that the higher the concentration of foreigners in a region the less likely immigrants are to adopt their health behaviour, and hence, in the case at hand, the lower is their BMI. Furthermore, having poor German language skills yield a higher BMI for all groups, but the effect is only significant for the total sample and the women sample. This contradicts the idea that the BMI increases with acculturation, as having poor language skills hints towards lower acculturation and hence, on theoretical grounds of the acculturation theory, one would have expected a negative sign.

Regarding the potential influence of an increase in the BMI to the deterioration of immigrants' health with years since migration it can be concluded that a weight gain might indeed contribute to the decline in health. However, more studies are needed to shed light on the complex pattern behind the healthy immigrant effect. Also more accurate data on health behaviour is necessary, for example, on dietary habits (do they change in Germany and how do they change?) as well as on physical activity. Additionally, professional measured height and weight information would be essential to control for possible cultural influence on the self-reporting behaviour of height and weight.

Finally, it should be taken in mind that for women it is so far not controlled for pregnancy, which can be regarded as an important influence factor on the BMI.

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Appendix

Table A1: Summary statistics of table 1

variables	mean	std. dev.	min	max
male	0.479	0.499	0	1
age	48.98	16.64	18	99
Germany	0.894	0.308	0	1
other EU-countries	0.036	0.187	0	1
Turkey	0.025	0.157	0	1
Eastern Europe	0.040	0.196	0	1
other countries	0.004	0.066	0	1
German citizenship	0.925	0.263	0	1
married	0.639	0.480	0	1
widowed	0.069	0.254	0	1
single	0.196	0.397	0	1
divorced	0.096	0.295	0	1
children	0.260	0.439	0	1
years of education	11.83	2.51	7	18
non-working	0.147	0.354	0	1
training	0.049	0.215	0	1
self-employed	0.057	0.232	0	1
pensioner	0.260	0.438	0	1
public servant	0.036	0.186	0	1
white collar	0.279	0.448	0	1
blue collar	0.172	0.377	0	1
own dwelling	0.524	0.499	0	1
hh income	36737.61	35304.72	0	583196.40
household size	2.700	1.275	1	13
undenominational	0.304	0.460	0	1
christ	0.657	0.475	0	1
other religion	0.039	0.193	0	1
ysm	2.31	7.63	0	56
second-generation	0.014	0.117	0	1
German very good	0.920	0.271	0	1
German good/fair	0.069	0.253	0	1
German poor/not	0.011	0.105	0	1
share of foreigners	8.198	5.540	0.8	26.2
interviewer present	0.590	0.492	0	1

Number of individuals 18,593. Number of observations: 48,302
Source: SOEP, wave 2002, 2004, 2006.