Sample attrition and physical health of immigrants in the UK

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SUMMARY

This thesis contains three papers on immigrants, i.e. foreign-born people, in the UK. The first paper is methodological, the other two papers focus on physical health. All papers use data from the UK Household Longitudinal Study (UKHLS) which started in 2009 and includes an Ethnic Minority Boost sample, providing large enough sample sizes to study the immigrant population in detail.

The first paper analyses sample attrition of immigrants at wave 2 of the UKHLS. We find that non-contact of immigrants is mainly determined by characteristics related to high residential mobility. However, it is also predicted by poor cooperation at the first interview. This suggests that for some immigrants non-contact could constitute a hidden refusal. Interview refusal of immigrants is predicted by similar characteristics than for UK-born.

The second paper investigates the Healthy Immigrant Effect (HIE) in the UK. The HIE is understood as a health advantage of recent immigrants compared to the native-born population, which gets smaller with increasing length of residence. The cross-sectional analysis finds that immigrants have a health advantage in the first years after immigration, which decreases the longer immigrants have been in the country. The magnitude of the HIE depends on the measure of poor health: poor self-rated health and diagnosed chronic condition yield much larger HIE than poor physical health functioning (Short-Form 12) which is arguably more suitable to this immigrant-native comparison.

The last paper considers one possible explanation for the duration effect, i.e. why immigrants lose their initial health advantage: Immigrants tend to have poorer work conditions than native-born employees. We find that physical work conditions explain some of the excess deterioration of immigrants' health, while psychosocial work conditions only play a minor role. Health deterioration among less educated immigrants is better explained with work conditions than that among degree-educated immigrants.

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DECLARATION

All work in this thesis is my own. No part of this thesis has been submitted for another degree.

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1 Introduction

This thesis contains three papers on immigrants in the UK. It presents new findings in an important area of research not previously addressed for the immigrant population in the UK: the physical health of immigrants and how that changes over time (Chapters 3 and 4). A serious methodological challenge in studying immigrants is the issue of non-response and attrition among this potentially mobile population. The second important contribution of this thesis is in this area (Chapter 2). All analyses use data from Understanding Society: the UK Household Longitudinal Study (UKHLS), a national household panel survey which started in 2009 and contains an Ethnic Minority Boost sample, providing a large enough sample size to study the immigrant population in UK in detail for the first time.

The UK has a longstanding history of immigration. In 2013 12.4% of the UK population were immigrants, a similar proportion of foreign-born population as the United States though well below that in countries such as Canada and Australia (United Nations 2013). UK immigration policies and entrance criteria have changed over time, resulting in distinct cohorts arriving from different regions and bringing with them a variety of socio-economic and individual characteristics.

The historic ties are an important feature in British immigration and shaped immigration in the first decades after the Second World War. From the 1950s onwards large numbers of immigrants arrived in the UK from the newly independent former colonies (New Commonwealth), first from the Caribbean, later from South Asia (Hatton and Wheatley Price 1999). Immigration from India peaked in the 1960s, followed by immigration from Pakistan (1970s) and Bangladesh (1980s). Differentials in wages and economic growth made the UK an attractive destination for citizens from New

Commonwealth countries as they were free to come to the UK. This changed with the 1971 Immigration Act that restricted access for immigrants from New Commonwealth countries so that immigration from these regions was then mainly limited to family re-unification, leading to a higher share of female immigrants. From the 1980s net immigration from former colonies declined (Hatton and Wheatley Price 1999).

From the 1990s onwards sources of immigration were increasingly diverse. From the early 2000s the UK government pursued a selective immigration policy to attract skilled workers, introducing the Highly Skilled Worker programme from 2002 which was replaced by a points-based system from 2008 (Kennedy, Kidd et al. 2014). Another trend in the new century is the increased influx of EU immigrants, especially after the accession Eastern European countries into the EU in 2004 (Nazroo and Williams 2006). Involuntary migration plays only a minor role in the UK; only 5% of the foreign-born population resident in the UK in 2012-13 originally came as asylum seekers (Cooper, Campbell et al. 2014).

As a result of these diverse flows, the foreign-born population in the UK is very heterogeneous, with a large number of countries of origin and ethnic groups represented, along with different languages, legal statuses, socio-demographic and socio-economic characteristics. The impact of migrant status on behaviours and health is therefore increasingly complex and diverse, as reflected in frameworks such as superdiversity (Vertovec 2007).

While there is a significant intersection between ethnicity and immigration (Becares, Shaw et al. 2012; Viruell-Fuentes, Miranda et al. 2012) there are specific issues relating to someone's status as a migrant. Migration status can affect health through factors that are specific to having lived part of one's life in another country, such as childhood exposure, cultural processes and also continuing ties to the home country (Acevedo-

Garcia, Sanchez-Vaznaugh et al. 2012). Many immigrants belong to an ethnic minority group, and not all ethnic minorities are immigrants as some live in the UK in the second or third generation. In this thesis we understand immigrants as anyone born outside UK and throughout the thesis we use the terms immigrants, migrants and foreign-born interchangeably. We refer to those who are born in the UK as UK-born or native-born.

The increasing nonresponse to surveys has been a challenge for social data collection in recent years. Foreign-born sample members, and equally ethnic minority sample members, are a group with disproportionately high levels of nonresponse (Groves and Couper 1998). While this thesis can exploit a very large household panel with an ethnic minority boost sample, we still find that attrition limits the possibilities of longitudinal within-group analyses. Importantly, attrition not only reduces the available sample size, but systematic differences can introduce bias to the sample (Nathan 1999).

Chapter 2 examines sample attrition of foreign-born sample members at the second wave of the UKHLS. Attrition of immigrants may limit the usefulness of UKHLS as a source that can be used for sub-group analyses of both immigrants and ethnic minority members in the UK. Nonresponse and attrition of immigrants is not well researched. This chapter aims to identify which factors are associated with the attrition of immigrant sample members at the second wave, in comparison to characteristics associated with the attrition of UK-born sample members.

There are two stages in the survey process, establishing contact and gaining cooperation. We model these separately with two logit models. First, we estimate the probability of living in a non-contact household in wave 2 conditional on having provided a full interview at wave 1. Then we estimate the probability of refusing interview, conditional on contact in wave 2. We estimate separate models for immigrants, and as comparison, for UK-born.

Chapters 3 and 4 examine aspects of immigrant health for which relatively little work has been done in the UK. Chapter 3 investigates the Healthy Immigrant Effect (HIE) in the UK. The HIE is understood as a health advantage of recent immigrants compared to the UK-born population. This results from positive selection and healthier behaviours that immigrants bring from their home countries and decreases with increasing length of residence (e.g., Jasso, Massey et al. 2004; McDonald and Kennedy 2004).

For the UK, there is some evidence of the HIE but most data sources cannot distinguish immigrants by length of residence. This analysis uses data from wave 1 of the UKHLS to estimate the HIE at the first year of arrival, and how it decreases for immigrants who have been in the UK for longer. We employ two commonly used measures of health, poor self-rated health and diagnosed chronic condition, as well as a measure of physical functioning, the SF-12 Physical Component Summary (SF-12 PCS). Using SF-12 PCS avoids potential problems that the other two measures have for immigrant-native comparisons, and we compare how far the estimated HIE differs across these different measures.

Relying on cross-sectional data from wave 1 means we cannot distinguish between cohort and duration effects, but it allows an analysis by ethnic group, for which sample sizes in later waves are reduced. The magnitude of the HIE depends on individual characteristics of immigrants as well as characteristics of their countries of origin, both of which determine the degree of selectivity (Jasso, Massey et al. 2004). We therefore consider the HIE for immigrants by region of origin and by ethnicity. We also use age stratified models to gauge in how far the effect of duration of residence is distinct from the aging effects that are confounded (Raftery, Jones et al. 1990; Gray, Harding et al. 2007).

With increasing length of residence in the host country, immigrants tend to lose their initial health advantage over the native-born population (Sam, Jasinskaja-Lahti et al. 2016). For older immigrant cohorts, who settled in the UK before 1971, the health decline with increasing length of residence has also been documented for Caribbean and South Asians (Harding 2003; Harding 2004). A variety of reasons for this convergence or negative duration effect have been put forward in the literature, mainly centred on the concept of acculturation. Theories on acculturation consider effects of cultural integration on migrants' attitudes, beliefs and behaviours and can explain post-migration health patterns (Sam, Jasinskaja-Lahti et al. 2016).

Acculturation can be linked to health in a number of ways. For example the model of acculturative stress (Berry, Kim et al. 1987) emphasizes that the effort that immigrants have to put into adapting to their new environment can be experienced as stressful life events which can have a detrimental effect on mental health and may indirectly also affect physical health (Bhui, Lenguerrand et al. 2012).

Berry's framework of acculturation (1997; 2001) takes a different angle and distinguishes four acculturative strategies that migrants can adopt. These differ in the degree to which their own cultural traditions are maintained, and the extent to which relationship with the majority culture are sought. These two dimensions are orthogonal, so adaptation outcomes can be affected by a complex mix of attitudes, beliefs and behaviours that incorporate both aspects from the culture of origin and the host country's culture. Those strategies that involve increasing contact with the host culture, especially integration, are associated with the best long-term outcomes (Schmitz 1992; Berry 1997). However when considering physical health as adaptation outcome, increasing Westernization – which the acculturation strategies of integration and assimilation imply – is also associated with taking up unhealthy behaviours that increase the risk of chronic conditions such as cardiovascular disease (Sam, Jasinskaja-

Lahti et al. 2016). Studies of physical health indeed mostly tend to use a lifestyle model which equates acculturation with Westernisation (Salant and Lauderdale 2003) and views the host country environment as disease factor (Dressler 1993; Hunt, Schneider et al. 2004). The potential for a Western environment as disease factor through exposing immigrants to sedentary lifestyles and energy-dense diets is the larger the larger the difference to the country of origin is in these factors. At a country level these can be expressed as differences in socio-economic level (such as Gross Domestic Product per head) as Vandenheede, Deboosere et al. (2012) do. They find that across Europe, migrants originating from the poorest regions tend to have the highest diabetes mortality.

Overall, the conceptualisation of acculturation and how it relates to health remains unclear and the measurement often relies on imprecise proxies (Salant and Lauderdale 2003; Lara, Gamboa et al. 2005; Thomson and Hoffman-Goetz 2009). Also, there is usually no distinction between health effects as a consequence of the acculturation process and other aspects of the migration experience such as poor social and economic resources (Palinkas and Pickwell 1995)

Chapter 4 considers one such aspect of the migrant experience as a possible explanation of the negative health trajectories of immigrants, namely immigrants' work conditions in the UK. This is a possible channel of deterioration of immigrants' health as immigrants have on average poorer physical and psychosocial work conditions than native-born employees both of which have adverse health effects (Karasek and Theorell 1990). Physical work conditions affect health due to physical exertion or environmental hazards. Psychosocial work conditions, namely high psychological demands including lack of autonomy and control over work and low social support are thought to affect physical health (Karasek and Theorell 1990). In particular there are increased risks of coronary heart disease, via neuroendocrine responses to stressors, or indirectly through affecting people's health behaviours (Chandola, Britton et al. 2008).

Using waves 1 to 5 of the UKHLS we use a multilevel growth curve approach to first confirm the negative duration effect with longitudinal data, and then investigate in how far this excess deterioration of immigrants' health can be explained by their poorer work conditions. For reasons explained in chapter 3 we use a measure of physical functioning, the SF-12 PCS, for this analysis. We make use of external job indices (Kroll 2011) that provide measures of physical and psychosocial work conditions by occupational title. In addition, for psychosocial work conditions we use a self-reported measure of work autonomy.

This analysis also helps alleviate a limitation of chapter 3. Due to its cross-sectional nature that analysis cannot fully disentangle the effects of ageing and spending longer time in the host country. The longitudinal analysis in chapter 4 demonstrates that there is a true negative duration effect in the health trajectory of immigrants with increasing length of residence.

2 Non-response and attrition among immigrants in Understanding Society

2.1 Introduction

Survey nonresponse is of increasing concern for survey organisations. Both nonresponse to cross-sectional surveys and attrition, i.e. nonresponse in the second or later wave of a longitudinal survey, have increased over time, in the UK and abroad (Smith 1995; De Leeuw and de Heer 2002; Bethlehem, Cobben et al. 2011).

Attrition is nonresponse of sample members in the case of longitudinal surveys. Nonresponse and attrition cause two problems: First, they reduce sample size and thus lead to less precise estimates. The key feature of a longitudinal survey is its ability measure change which is compromised as attrition accumulates over time. Second, assuming that we start with a representative sample, these phenomena are likely to adversely affect the representativeness of the sample if those who responded are systematically different from those who did not (Lepkowski and Couper 2002). In addition, and perhaps more importantly, this will introduce the risk of biased population estimates. This is the case when the nonresponse is non-random with respect to the variable of interest (Groves and Couper 1998; Nathan 1999).

When small subgroups such as immigrants in a household survey are of interest, there is increased potential to cause bias (Nathan 1999). International migrants, from here onwards referred to as migrants (or immigrants), inherently have an increased risk of attriting from a panel survey due to their higher geographic mobility (which means they are more difficult to track and locate) compared to the native population. However, nonresponse and attrition patterns for migrants are not well researched, both in the cross-sectional and longitudinal case. In the cross-sectional case this is largely due to lack of individual-level background information on nonrespondents (i.e., not being able to identify migrant status of nonrespondents). In the case of attrition this information is usually known, but sample sizes for migrants are mostly too small for analysis.[1]

This paper identifies factors associated with attrition of migrants at wave 2 of a national panel survey and compares how these differ from non-migrants. It uses data from Understanding Society: the United Kingdom Household Longitudinal Study (UKHLS) that started in 2009 as it is the only longitudinal survey in UK that has large enough sample size of migrants to allow this kind of analysis. The analysis focuses specifically on attrition between waves 1 and 2 of the study as this is when the greatest attrition occurs on any longitudinal study.

The main findings of the analysis are that firstly, non-contact of migrants is mainly determined by residential mobility. This is particularly relevant for recent migrants who have a high chance of moving between interviews. Non-contact of immigrants differs widely with individual characteristics that differ between migrant cohorts and which are mainly linked to residential mobility. Secondly, residential mobility aside, lack of cooperativeness in the past interview predicts not only refusal, but also non-contact, and this possibly more so for migrants than UK-born. Thirdly, migrants' refusal is associated with similar characteristics as for UK-born, reflecting nonresponse theory on social engagement and exchange and with past cooperativeness of the individual and household. To some extent for migrants past cooperativeness seems culturally patterned.

[1] In addition, for migrants, higher mobility also involves a higher chance of (return or onward) migration. As most panel surveys aim to represent only the resident population of the country migrants who move abroad become out-of-scope and are not followed. Attrition in this case only reflects the change in the target population itself. Sample loss due to moving out of scope does not make the sample less representative; however, it still reduces the sample size.

The remainder of this paper is structured as follows. Section 2.2 reviews the literature on factors impacting contact and cooperation stages of the survey participation process. Section 2.3 then describes the data, methodology and presents results of the analysis. Section 2.4 concludes.

2.2. Background

2.2.2 Nonresponse process in longitudinal surveys

In their theoretical framework for nonresponse in panel surveys, Lepkowski and Couper (2002) distinguish between "three conditional processes: location, contact given location, and cooperation given contact" (Lepkowski and Couper 2002, p. 261). Nonresponse occurs as the negative result of any of these stages. All three stages, location, contact and cooperation are influenced by survey design features and characteristics of the respondent or household (Lepkowski and Couper 2002). In a panel survey these tasks can be made easier or harder by the fact that panel members know what to expect from their past experience (Lepkowski and Couper 2002).

2.2.3 Location and Contact – theory and evidence

Groves and Couper (1998) divide influences on the likelihood of contacting a sample household into three main groups. Social environmental and socio-demographic attributes of the household can influence contactibility via two different paths: they can be linked to the likelihood of physical barriers to the household (e.g., locked gates in multi-unit structures are more commonly found in urban areas) and to at-home patterns of the household (e.g., via commuting times that differ between urban and rural areas, night-time crime incidence in areas, and via economic activity that affects daily routines). Thirdly, interviewers' attributes (e.g., does the interviewer work full-time or only at evenings/weekends) affect contact chances through the number and timing of calls.

From the second wave onwards, making contact presents different challenges than in cross-sectional studies or in the first wave of a panel survey because sample members have already been located and contacted for the previous wave. Contact as such is not a major hurdle because at-home patterns are known, but locating respondents who might have moved is problematic (Lepkowski and Couper (2002)). If respondents notified the fieldwork office of their move, locating them at the new address is usually unproblematic. However, that is not always the case. Generally this involves a long and involved process of tracking and tracing by the interviewer followed by a tracking and tracing team if they fail (Laurie, Smith et al. 1999).[2]

Migrant status

Few of the studies that examine the main determinants of non-contact in panel studies (usually wave 2 conditional on response in wave 1; pooled data of waves 2-3 in the case of Nicoletti and Buck (2004)) include migrant status or covariates indicative of migrant status in their analysis. Exceptions are Watson and Wooden (2004; 2009), Lepkowski and Couper (2002), Uhrig (2008), O'Muircheartaigh and Campanelli (1999) and Feskens (2009)[3]. Although using different direct and indirect measures of migrant status, all these studies find that migrants are more difficult to contact. Additionally, analysing Australian household panel survey data Watson and Wooden (2004, 2009) find that non-contact rates are higher for migrants from a non-English speaking country and O'Muircheartaigh and Campanelli (1999) and Uhrig (2008) find that in the British Household Panel Survey (BHPS) households with English language problems are more likely to be non-contacts.

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[2] In the early 1990s only a small percentage of British Household Panel Survey (the predecessor of the UKHLS) sample households could not be traced at all (Laurie, Smith et al. 1999) but there is evidence the tracing process has become more difficult in recent years.

[3] This study of cross-sectional Dutch data with linked administrative data includes migrant indicators. But the analysis is cross-sectional, i.e. it analyses contactibility at first interview.

Some studies include ethnic group indicators. While ethnic minorities are not necessarily migrants, a large proportion of some groups are. For example, in the US a large proportion of Hispanics are migrants. Analysing two longitudinal US datasets, the American's Changing Lives and the National Election Study, Lepkowski and Couper (2002) do not find that Hispanics are harder to contact than whites in either survey. In a UK context, Plewis, Ketende et al. (2008) include an ethnic group indicator in their analysis of attrition among the main carers (i.e. parents) of the sample members of the Millennium Cohort Study which is a sample of children born in 2000/2001. We expect a large proportion of these ethnic minority parents to be migrants. [4] They find that black or black British respondents and 'other' ethnicities have a higher risk of being 'other unproductive' at wave 2[5]. Indian, Pakistani and Bangladeshi do not have a significantly different risk of non-contact from that of the white reference group. Uhrig's (2008), analysis of attrition in the BHPS finds that non-white respondents are harder to contact than white respondents; the effect is significant even after accounting for a multitude of other covariates.

Mostly, one would expect that factors indicative of non-contact for non-migrants are equally likely to have an effect on migrants' contact propensity, although migrants and non-migrant groups are expected to differ in terms of these characteristics. For example, migrants are generally younger and more likely to live in areas of higher

[4] We find that in a comparable sample in the first wave of Understanding Society (that is, 18 to 35 year old ethnic minorities with at least one child in the household), 71% are foreign-born (though this varies considerably across ethnic groups).

[5] They distinguish in their analysis between refusals, other unproductive (non-contact, untraced movers, other non-response, language problems, ill health, data loss), and productives and have two binary models, for refusal vs. productive and other unproductive vs. productives, respectively.

material deprivation. The factors that have been found to be associated with non-contact in longitudinal studies in the general population are discussed below[6].

Individual characteristics

Most studies find a linear effect of age on non-contact propensities. With increasing age sample members are easier to contact (e.g. in the BHPS O'Muircheartaigh and Campanelli 1999 and Uhrig (2008); in the European Community Household Panel (ECHP) for the UK and Germany, for the BHPS and the German Socio-Economic Panel (GSOEP) Nicoletti and Buck 2004; Watson and Wooden 2004; the Household, Income and Labour Dynamics in Australia Survey (HILDA) Watson and Wooden 2009), though in Watson and Wooden's (2004) study this effect was curvilinear. The association between *gender* and contact propensity is equally clear. Studies find female respondents easier to contact though this association is not statistically significant in all cases (Lepkowski and Couper 2002; Nicoletti and Buck 2004; Watson and Wooden 2004; Uhrig 2008; Durrant and Steele 2009; Feskens 2009; Watson and Wooden 2009).

The impact of young children in the household on respondents' contactibility varies between studies. Most studies find that children in the household make contacting respondents easier (Nicoletti and Buck 2004, for GSOEP; Nicoletti and Peracchi 2005; Durrant and Steele 2009). This is usually explained by the higher chances of at least one adult in the household spending more time at home when there are young children. There is also evidence for the opposite effect, where children in the household decrease contact chances (Uhrig 2008, for 0-2 year olds; Watson and Wooden 2009). These contradictory results and various inconclusive or non-significant results in other studies can partly be attributed to differences in definitions (for example, the age range used to

[6] One study that analyses several UK cross-sectional studies, Durrant and Steele 2009, is also included in these discussions as it pertains to UK surveys.

define young children), other controls included in the model, and also differences across countries covered by these studies.

Studies that include dwelling type in their models find that compared to respondents living in (detached) houses, respondents living in flats (and sometimes also those living in semi-detached/terraced houses, and in other accommodation such as bedsits) are harder to contact (Watson and Wooden 2004 (though the effect was non-significant here); Uhrig 2008; Durrant and Steele 2009; Watson and Wooden 2009). Living in an urban region is also associated with increased probability of non-contact (Watson and Wooden 2004; Feskens 2009). For the UK, Uhrig (2008) and Durrant and Steele (2009)find that compared to London respondents in all other regions are easier to contact (though in the former case this effect is not significant in the full model).

Contrary to the usual expectation that working respondents spend more time outside the home and are therefore harder to contact than unemployed or inactive people, most studies that look at economic activity in a panel context find that people who work are easier to contact, compared to people not in the labour force (Nicoletti and Buck 2004, for GSOEP, BHPS and ECHP UK, though not significant for BHPS and ECHP-D; Watson and Wooden 2004; Watson and Wooden 2009) and sometimes also compared to the unemployed (Nicoletti and Buck 2004, for BHPS and GSOEP). This is possibly because employed people are easier to trace if they move (Watson and Wooden (2009), and at-home patterns are known after the first interview, so it is easier to plan interview times to suit the employed (which is different from the cross-sectional case). The only exception is Uhrig (2008) who finds that unemployed people are significantly harder to contact than employed people, while retired and long-term sick/disabled respondents are easier to contact.[7]

One person households are found to be harder to contact than other households, especially couple households (Watson and Wooden 2004; Uhrig 2008; Durrant and Steele 2009). However, when looking at the number of adults in the household in general, an increasing number of adults is more often associated with decreasing probability of contact than with an increased probability, or is not statistically significant, depending on which survey the analysis is based on (Nicoletti and Buck 2004; Nicoletti and Peracchi 2005). Analogous to the effect of household type, married respondents tend to be easier to contact than other respondents (Uhrig 2008; Watson and Wooden 2009), while respondents living without a spouse are harder to contact (Nicoletti and Buck 2004).

Residential mobility in the recent past is associated with decreased probability of contact (Lepkowski and Couper 2002; Uhrig 2008; Durrant and Steele 2009) and non-mobility with increased contact chances (Nicoletti and Peracchi 2005). This suggests past mobility patterns reflect current (unobserved) mobility propensities. Watson and Wooden (2004; 2009) use information on actual moves since the last wave and find those who moved are harder to contact. Uhrig (2008) also finds that moving preferences are indicative of non-contact as people who said in the previous wave's interview that they would like to move are harder to contact. Analysing attrition in another UK study, the MCS, Plewis, Ketende et al. (2008) find that residential mobility between the first and second wave (conducted two years later) is associated with being unproductive (excluding refusal) at the second wave. They also find that when untraced movers are excluded, residential mobility is not statistically significant. In other words,

[7] In Lepkowski and Couper's (2002) analyses employment status also predicts non-contact, however it is not possible to determine the categories/baseline, and hence the direction of the effect, for categorical variables in their model from the presented table.

residential mobility is more about not being able to locate than not being able to contact. Being a tenant instead of an owner occupier can also be seen as an indicator of higher propensity to move and is usually associated with decreased contact probability (Lepkowski and Couper 2002; Nicoletti and Buck 2004; Nicoletti and Peracchi 2005; Uhrig 2008; Watson and Wooden 2009). The only exception to this was found for GSOEP (Nicoletti and Buck 2004).

Some studies include measures of socio-economic status, such as income, access to a car, or a self-assessed measure of financial well-being. Quite often, these measures do not have a statistically significant effect on probability of contact in the presence of other control variables (Watson and Wooden 2004; Nicoletti and Peracchi 2005; Durrant and Steele 2009). For the BHPS, Uhrig (2008) finds most indicators of low socio-economic status (low household income, no car access) linked to increased risk of non-contact, but he also finds that respondents in households with incomes in the top quartile of the income distribution to have a higher risk of non-contact.

Interviewer and survey characteristics

Nicoletti and Buck (2004) find for all four UK surveys they analyse that contact chances are better if the same interviewer as in the previous wave is assigned the case, but these interviewer continuity effects should be considered with caution as interview continuity can be endogenous given that staff turnover can vary across regions systematically (Nicoletti and Buck, 2004).

Several studies also include indicators relating to the past survey experience, such as missing data rate, respondent enjoyment or understanding (Lepkowski and Couper 2002), whether the respondent had ever been proxied (Uhrig 2008) or was from a partially responding household (Watson and Wooden 2009) in order to explain probability of contact. While not all these studies find a statistically significant effect of such measures on contact probability, these variables are all associated with a decreased probability of contact, suggesting respondents that do not cooperate very well at an interview are also at increased risk of non-contact at future interviews. This could be due to unobserved factors being related with both non-contact and lack of cooperation in the interview; alternatively, it is possible that this is evidence of a form of soft refusal.

2.2.4 Theories of survey cooperation/refusal

Unlike location and contact which are the result of respondent and interviewer characteristics, cooperation is the result of respondent choice so many theories have developed explaining the rationale behind this specific respondent behaviour. As there may be cultural differences between migrants and non-migrants such issues also need to be considered.

Heuristic principles

Most nonresponse theory primarily regards survey requests as a one-off request, typically put forward by an interviewer at the doorstep. The interview request is therefore often regarded as something that implies a relatively small burden for the potential respondent i.e. limited opportunity cost in terms of time and other burden and therefore does not deserve much time to consider. Groves and Couper (1998) argue most survey requests are decided on the basis of heuristic principles, following Cialdini's six principles of compliance -reciprocation, authority, liking, social validation, consistency and scarcity - rather than an extensive cost-benefit analysis. Some of these heuristic principles of compliance are less relevant in a longitudinal survey from the second wave as the individual has already complied in the first wave (the focus of this paper).

The principle of r*eciprocation* suggests that a sample member is more likely to cooperate if the request is perceived as a 'repayment' for a received favour, either directly from the survey organisation, or in a broader sense from society. Other principles suggest that requests from institutions that are perceived as legitimate and approved by the society are more successful than others (*authority)* and that the respondent is more likely to participate if they think people similar to them would do the same (*social validation*).

Some principles are particularly relevant in the context of panel surveys. The principle of *liking* suggests that survey cooperation is influenced by whether the requestee likes the person asking for the interview. This may play an important role in panel surveys if the interviewer is known to the respondent from the previous year's interview. The principle of *consistency*, that is the need to be consistent with previous behaviour, is particularly relevant for cooperation in an ongoing panel for previously cooperative panel members. The principle of *scarcity* which states that people are more likely to take part in a survey if it is perceived as a rare opportunity, is arguably more easily perceived as a scarce opportunity when put forward to existing panel members than at the first wave where any member of the public could have been interviewed (disregarding that, of course, with a random sample this is not actually the case), they can feel part of a 'special' group.

Rational Choice Theory

Lepkowski and Couper point out with regard to heuristic principles that it "... is not clear whether this emphasis on current situational factors is also true in later waves of a longitudinal survey" (Lepkowski and Couper 2002, p.262). In panel surveys, the cost of participation involved is arguably higher, and the panel member has a much clearer idea of it, due to their previous experience. Therefore, in a panel context the decision to participate in a survey can be seen as a well-considered decision, where panel members weigh up costs (e.g., time) and benefits (e.g. financial incentive).

If the respondent found the first interview more tedious or intrusive than expected when agreeing to the initial request, he or she might reconsider participation at the next request. Other factors that may affect cooperation in a longitudinal context within the rational choice theory framework are language or health problems that make an interview more burdensome. For migrants that are not native speakers of English, the additional effort required, or the use of interpreters, could increase the cost in the sense of rational choice theory. While poor health is also a factor that can increase the cost for a sample member and make an interview less likely, this does not necessarily result in refusal as non-interviews of sample members whose health is judged by the interviewer as too poor to allow an interview are not classified as refusals (Schnell 1997; AAPOR 2011).

Social exclusion and social isolation

Social exclusion and social isolation are other factors that have been theorised to affect survey participation and that are particular relevant to migrant sample members. If people do not feel part of the society they live in they can feel less obliged to take part in surveys (Groves and Couper, 1998). The concept of social exclusion has been used to explain low cooperation of ethnic minorities, who might feel disadvantaged compared to the majority population and therefore feel no obligation to comply with a survey request. People who feel cheated by society do not feel obliged to give anything back, i.e. the reciprocation principle does not work (Groves and Couper 1998). However, this view is mainly based on the situation of black Americans in the United States. In the UK, most ethnic minorities, including those foreign-born, identify even more strongly as British than the white majority population (Nandi and Platt 2014) which implies that they do not feel excluded from British society. In the UK, belonging to an ethnic minority group can therefore not simply be equated with social exclusion.

People living in urban areas are particularly prone to social isolation, which again affects migrants more than others. People who are better integrated in society (e.g., they have children, or take part in social activities) are expected to be more open to survey requests (Groves and Couper 1998). Related to this concept is the notion of civic duty which implies that people act out of a feeling of obligation to society, which is more likely to be the case for people well integrated in their communities (Groves, Singer, Corning, 2000). Migrants, especially recent ones, might often be considered less well integrated than natives as they do not have family and social networks to the same extent as people who always lived in the same country. In addition, even if migrants have extensive networks, these might be in ethnic minority communities that are not closely linked to the majority group in the host society.

Social exchange theory

Dillman (1978) and Goyder (1987) both frame survey participation behaviour in terms of social exchange. Social exchange theory explains social behaviour as motivated by expected benefits, which are weighed against expected costs. These costs and rewards, unlike in economic exchange theory, can be vague and the return is often uncertain at the time of the decision so that a certain level of trust is involved (Dillman 1978). Ideas of social exchange are useful in the context of ongoing relationships, such as in panel studies (Groves and Couper, 1998). Social exchange theory is hard to test empirically because the notion of what constitutes an exchange is quite vague, and it may vary between respondents (particularly for the very heterogeneous group of migrants).

Cultural differences in nonresponse behaviour

Studies of response rates often show differential response rates for ethnic minority or migrant sample members compared to sample members from the majority-group, usually with minorities exhibiting lower response rates (e.g., Johnson et al., 2002, Feskens et al., 2007, Bronner, 1988). Studies of response behaviour in cross-national surveys also display greatly differing response rates (e.g., Couper and de Leeuw, 2003). Even though part of these differences can be explained by differences in characteristics of ethnic group members (younger, more mobile etc.), differences in fieldwork procedures and survey designs, some variation between countries remains unexplained (Johnson et al., 2002, Billet et al 2007). This has led to the suggestion that a single non-response theory cannot be applied across different cultural groups, including ethnic groups or countries.

Differences in response behaviour of migrants can not only arise from their migrant status in the country (e.g., social isolation leading to refusal) but could also be a behaviour that the sample member would have potentially displayed when confronted with a similar survey request in their country of origin. A nonresponse analysis of migrants has to acknowledge that migrants are a heterogeneous group with regard to characteristics such as their values, norms, preferred behaviour and communication styles, which are all theorised as being central to response behaviour. For example, social exchange theory draws on social-psychological concepts that have an individualistic perspective and cannot be applied regardless of cultural background (Triandis 2001). Theories based on the assumption of an individualistic society do not necessarily reflect the decision process regarding a survey request equally well for all migrant groups.

Johnson et al. (2002) review theoretical concepts from various disciplines that can be used to explain cultural influences on nonresponse. The concepts illustrate how norms and expected behaviours differ across cultures. They suggest a conceptual model in which respondent culture interacts with socioeconomic opportunities, social participation patterns and communication styles and thus indirectly impacts on respondent accessibility and cooperation.

2.2.5 Empirical findings regarding survey cooperation/refusal in longitudinal surveys

Existing studies of survey cooperation/refusal generally include a measure of ethnic background and very few include a migrant status measure. There is little evidence in multivariate analyses in support of nonresponse theory that associates ethnic minorities with a higher propensity to refuse (social exclusion theory). Several cross-sectional US-American government surveys find black Americans are more cooperative than white Americans, though this effect is not stable, and Hispanics are no more likely to refuse than whites (Groves and Couper, 1998). Lepkowski and Couper (2002) come to a similar conclusion with both minority groups being slightly more cooperative than whites, though this is just marginally significant in only one of the two US panel studies they analyse. Feskens (2009) also finds 'non-Western foreigners' to be more cooperative than Dutch natives and Western foreigners. However, the study has a very high non-contact rate amongst non-Western foreigners and also a large proportion of non-interviews due to language problems, both of which could partly hide refusals.

For the UK, the picture is a little different. Plewis, Ketende at al. (2008) find some evidence of ethnic differences in the propensity to refuse. Respondents of 'other' ethnic background are significantly more likely than white respondents to refuse the second interview but this is a very heterogeneous group. Indian, Pakistani and Bangladeshi sample members have an increased risk but this is not statistically significant. Uhrig (2008) also finds non-white individuals less cooperative than white ones in the BHPS, however this not significant once other variables are controlled for.

The mixed results can partly be explained by the fact that the ethnic composition of migrants and the host countries differ across studies. Some of the findings for ethnic minorities can also be explained by language issues. Language problems should be associated with a higher probability of refusal due to the greater effort required by the participant. As discussed earlier while ethnic minorities are not synonymous with migrant status, those with language problems are more likely to be migrants. Watson and Wooden (2004) also find migrants from non-English speaking countries, but not other migrants, to be less cooperative than Australian natives. This could be due to language problems, though other interpretations are also possible. A follow-up study finds that respondents from non-English speaking countries with language problems are more likely to refuse than those without language problems (Watson and Wooden 2009). Watson and Wooden (2004) also find that needing assistance for language reasons decreases the probability of interview compared to respondents with no assistance or language problems (while neither having language difficulties but not needing assistance, nor needing assistance for other reasons have a significant effect on interview probability). Uhrig (2008) and O'Muircheartaigh and Campanelli (1999) find that language problems have only a non-significant adverse effect on cooperation amongst BHPS sample members.

Most characteristics of the respondent or of the interview situation should apply to refusal behaviour of migrants as for respondents in general. These relationships are not expected to differ by migrant status, but the factors may still explain some of the observed differences in cooperation propensity between migrants and non-migrants due to distributional differences. Empirical findings with respect to these general characteristics are discussed in the following.

Respondent characteristics

There is evidence for a curvilinear relationship between age and propensity to refuse in panel studies (Nicoletti and Buck 2004; Watson and Wooden 2004; Plewis, Ketende et al. 2008; Watson and Wooden 2009), with young people and very old people being more likely to refuse, although their reasons for doing so may be different. While young people are likely to refuse due to not feeling obliged to make the effort very old people may refuse due to ill-health and frailty. The middle-aged tend to be more cooperative possibly due to a higher sense of civic duty.[8]

With respect to gender, Groves and Couper (1998) find in their review of (mainly cross-sectional) nonresponse studies usually no effect on cooperation, in cases where there is any, male cooperation is lower. The same can be said for the more recent, mainly longitudinal studies (Nicoletti and Buck 2004; Durrant and Steele 2009; Watson and Wooden 2009).

Respondents living without a spouse (that is, single, separated, widowed) or 'not living as a couple' are consistently more likely to refuse than those with a spouse or living as a couple (Nicoletti and Buck 2004; Nicoletti and Peracchi 2005). However, some studies that differentiate more finely between different types of non-partnership statuses find that separated and widowed people are more cooperative than others: Uhrig (2008) finds this compared to single people, while Watson and Wooden (2009) find the same compared to married people.

[8] Some studies find age effects that do not fit this pattern, but these are mostly studies at household level and/or the effects are not statistically significant (O'Muircheartaigh, C. and P. Campanelli (1999). "A multilevel exploration of the role of interviewers in survey non-response." Journal of the Royal Statistical Society: Series A (Statistics in Society) **162**(3): 437-446, Durrant, G. B. and F. Steele (2009). "Multilevel modelling of refusal and non-contact in household surveys: evidence from six UK Government surveys." Ibid. **172**(2): 361-381.

Most studies find that likelihood of cooperation increases with level of education (Watson and Wooden 2004; Plewis, Ketende et al. 2008; Uhrig 2008; Durrant and Steele 2009; Watson and Wooden 2009). The effect of income on refusal propensity is not consistent. Uhrig (2008) and Groves and Couper (1998) find that propensity to refuse increases with income and house value (as proxied by housing cost). Other studies find the opposite, that low socio-economic status is linked to an increased refusal propensity. Plewis, Ketende et al. (2008) find that individuals on very low incomes more likely to refuse, while respondents with average or higher earnings are less likely to refuse. Some studies using other measures of wealth, such as access to a car (Uhrig 2008; Durrant and Steele 2009), or deprivation index of the area (Watson and Wooden 2004; Watson and Wooden 2009) also find that less well-off people are more reluctant to cooperate.

Respondents living in more urban areas are less cooperative than those in more rural areas (e.g., measured by population density (Groves and Couper 1998), an urban-rural classification (Kalwij 2010) or London indicator (Durrant and Steele 2009)). Contrary to expectations relating to social integration (lack of integration in neighbourhood), individuals that have recently moved are usually found to be more cooperative than those living in more settled households (Lepkowski and Couper 2002; Plewis, Ketende et al. 2008; Durrant and Steele 2009). Lepkowski and Couper (2002) explain this effect with the fact that young people, especially young families are more likely to move than other people, and these people have other characteristics that mean they tend to be more cooperative.

Respondents in households with (young) children are consistently more cooperative than others. All studies where presence of children is significantly related to the probability to refuse find that such respondents are more cooperative (Groves and Couper 1998; Uhrig 2008; Durrant and Steele 2009). A reverse direction is only found in some studies where the coefficient does not reach levels of statistical significance (Nicoletti and Buck 2004; Watson and Wooden 2004).

People who are well integrated into society, as measured by being active in organisations or doing voluntary work, attending religious services regularly and having frequent social contact or are politically interested, are more likely to cooperate, as expected, than respondents not falling into these categories (Lepkowski and Couper 2002; Nicoletti and Peracchi 2005; Uhrig 2008). Benefit receipt could be interpreted as an indicator of social isolation (in which case one would expect a positive effect on probability to refuse) or in terms of social exchange, in which case benefits recipients would feel more obliged to 'return something' to society and therefore would be more likely to participate. Groves and Couper (1998) find no effect and Watson and Wooden (2004) find a positive but non-significant effect of benefit receipt on probability to refuse.

Characteristics of interview situation

Various indicators of respondents' commitment and cooperativeness are commonly associated with the probability of future refusal in a panel survey. For example, in surveys where proxy interviews and telephone interviews (as alternative to the default mode of face-to-face) are offered to reluctant participants, having ever completed such interviews is associated with increased probability of refusal in the future (Nicoletti and Peracchi 2005; Uhrig 2008; Watson and Wooden 2009). The number of contact attempts necessary for first contact either at the previous or current wave (a proxy for reluctant participation) is also indicative of higher probability of refusal (O'Muircheartaigh and Campanelli 1999; Nicoletti and Buck 2004; Watson and Wooden 2004; Watson and Wooden 2009). Lack of (full) cooperation of the respondent during the interview (either recorded as an interviewer observation, high degree of item-missingness or not returning self-completion questionnaires), and indications that the respondent is suspicious about the survey, are associated with increased probability to refuse in the next wave (O'Muircheartaigh and Campanelli 1999; Nicoletti and Buck 2004; Watson and Wooden 2004; Uhrig 2008; Watson and Wooden 2009).

Other features of the previous wave survey situation are sometimes also predictive of refusal. Watson and Wooden (2009) find a curvilinear relationship for length of interview while others find none. Uhrig (2008) finds respondents are more likely to refuse if the previous interview was influenced by another household member. Having the same interviewer than in the previous wave is often associated with increased probability to cooperate although there may be confounding area effects (Nicoletti and Buck 2004; Watson and Wooden 2009).

2.2.6 Expectations for non-contact and refusal amongst migrants

From the review of the literature we conclude that nonresponse predictors should apply to migrants as they do to UK-born sample members. The factors associated with non-contact and refusal propensity are expected to differ for migrants only in as much as the distributions of characteristics for migrant populations differ from those of the majority or where cultural differences might affect how migrants respond to the survey request.

Among migrants we expect that the more recent migrants are particularly hard to contact as they are young, they might more often have irregular at-home patters, live in dwelling types that are hard to access (flats) and their mobility should be above-average.

With respect to refusal we expect also differences between migrants by length of residence, reflecting compositional differences. More likely to refuse should be the young and the very old, single individuals, individuals with low education and those living in urban areas. Also, panel members with a poor survey experience in the first wave and a different interviewer in the second wave. Socially well integrated migrants and those to whom ideas of social exchange apply should be more cooperative.

Survey cooperation (or refusal) is a decision of the sample member that depends on an individual's attitudes and norms which differ between cultures. Given the discussion of possible cultural influences on the survey participation decision, we expect cultural background to be associated with migrants' refusal propensity. Although evidence of an effect of ethnic group membership as such on the probability of refusal is mixed, when using ethnic group membership amongst foreign-born sample members as a proxy of cultural background this is expected to be related to refusal propensity.

Given that respondents have given interviewed before, and given the great effort UKHLS puts into offering the survey in different languages and offering bilingual interviewers language should be no major hurdle for migrant sample members.

The following section describes the data and methods used to analyse non-contact and refusal propensities for migrants.

2.3 Data and methods

We use data from *Understanding Society*, the UK Household Longitudinal Study (UKHLS; University of Essex. Institute for Social and Economic Research. 2015), which started with a sample of 50,994 persons in 30,169 private households in the UK who were interviewed for the first time in 2009/10 (Knies 2015). Panel members are interviewed annually face-to-face; the first wave was fielded over a 24-month period starting in January 2009. The sample comprises of the General Population Sample (GPS), a random sample of addresses, stratified and clustered (except for the Northern Ireland sub-sample which was a simple random sample) and, in order to facilitate analysis of ethnic minority groups, the Ethnic Minority Boost sample (EMB). EMB sample members are screened in from high ethnic minority concentration areas and aiming to deliver 1,000 adult sample members for each of five ethnic groups: Indian, Pakistani, Bangladeshi, black Caribbean, black African (Lynn 2009).[9]

Changes in the UK resident population that the UKHLS aims to represent are mainly automatically reflected in the panel, due to changes in existing panel households such as births and deaths. In the case of migrants however, only moves out of scope (moves abroad) are captured by the panel. Migrants newly arriving in the UK cannot enter the sample unless they happen to move into an existing panel household (and become temporary sample members)[10]. Hence, the number of migrants in the sample will decrease faster than other groups.

2.3.1 Analysis sample

This analysis focuses on non-response among adult household members (16+ year old sample members are considered to be adults for survey purposes) at wave 2. The analysis uses data from the first two waves of Understanding Society, conducted in 2009/10 and 2010/11. Sample members are eligible for interviews every year as long as they live in the UK. Only adult sample members who gave a full adult interview at

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[9] Households in the EMB sample were selected from addresses in areas with an ethnic minority population of 5% or more on the basis of their response to a screening question. The screening question asked whether anyone in the household or their parents or grandparents were from any one of the ethnic minority groups in the question and if they responded yes, the household was eligible. Only members of the targeted ethnic minorities were included as Original Sample Members, all other household members become Temporary Sample Members. Ethnic minorities living in areas with very low proportions of ethnic minorities were not considered for the EMB sample but could be selected into the GPS (Lynn, 2009).

[10] Generally in household panel surveys, in order to achieve the dual goal of maintaining the representativeness of the original sample and collect information about the household context certain following rules are implemented: anyone who is part of the original sample (often referred to as the Original Sample Member, OSM) are followed wherever they move as long as it is within scope, anyone who joins the households of an OSM from onwards the second wave (often referred to as Temporary Sample Members, TSM) and are only interviewed as long as they are co-resident with an OSM. In case of UKHLS, all white British OSMs in EMB households were also considered to be TSMs. So, any new migrant who joins an OSM household will be a TSM and only followed as long as they are living with the OSM.

wave 1 and who are assumed to be eligible at wave 2 are included in the analysis. Members of the joining BHPS sample, who are eligible for Understanding Society interviews from wave 2 onwards, are excluded from the analysis sample. Once sample members turn 16 they are also eligible for adult interviews. But these rising 16 year olds are also excluded as they do not have a full adult interview in wave 1.

Individuals in wave 1 responding households (and children of women in these households) are considered to be Original Sample Members (OSM). An exception to this are respondents who live in EMB sample households and who do not belong to one of the five targeted ethnic groups for the EMB sample; these are Temporary Sample Members (TSM) and are only followed as long as they live together with an OSM (Berthoud, Fumagalli et al. 2009). We therefore exclude TSMs from the analysis. Cases where the interview outcome (the dependent variable) or migrant status could not be determined were also excluded (see below). This results in an analysis sample of 41,999 observations including 6,377 migrants (15.2 percent).

The non-contact model uses the Index of Multiple Deprivation, information which is not comparable across countries of the UK. Therefore, the non-contact analysis is restricted to England which covers 94.2 percent of migrants in the sample. Note 91.4 percent of all migrants living in the UK in 2009/10 were in England (based on design-weighted estimates). This leaves an analysis sample of 38,207 cases, 7,832 of which are migrants (20.5 percent). In both cases, numbers of observations in the multivariate models are smaller depending on missing covariate information.

2.3.2 Response outcome variables

The dependent variables are the (negative) outcomes of the two stages in the survey participation process, non-contact and refusal. The definition of the interview outcome variables follows the standard definitions for final dispositions of codes for in-person household surveys by the American Association for Public Opinion Research (AAPOR 2011), with some changes detailed below.

Non-contact

In order to contact a sample member the interviewer has to first establish contact with the household, and then within the household with each individual sample member. In the case of one person households these are combined. In bigger households it is possible to have within household non-contact, i.e. some sample members of the household are contacted while others are not, however this is not very common. The main obstacle to contacting a sample member is to successfully contact the household the individual lives in.

For the non-contact model we therefore consider whether a wave 1 respondent eligible at wave 2 lives in a non-contacted household (coded as 1 if living in a non-contact household, coded 0 if living in a contacted household). This can be determined with the final outcome for household interview (variable b_outcome). By household contact we understand that an interviewer visited an address and made contact with at least one eligible individual of the household. Conversely, where the interviewer attempted to establish contact but failed (e.g., because no-one opened the door, or because the household moved and no follow-up address could be established) this is classified as household non-contact. Cases where the interviewer did not attempt to contact the household, e.g. because the household refused to participate before fieldwork start, the household will be excluded from the analysis sample.

The AAPOR classification does not define contact explicitly; rather, refusal and interview codes imply contact (AAPOR 2011). Given our definition of household contact this is not always appropriate because some refusal codes include situations where the interviewer did not attempt to contact a household even though it was issued to field. Therefore, a number of cases were excluded because the interviewer did not attempt contact, or it is unclear whether contact was attempted. Cases with the final household interview outcome codes “office approval only: Not issued to interviewer” or “office approval only: Other unproductive” were excluded from analysis. Cases with final household interview “office approval only: Issued/not attempted/ transferred to other interviewer” were only excluded if the interviewer made no call attempt as these codes are assigned both in situations where no contact attempt at all is made as well as where the interviewer repeatedly attempts to contact the household but ultimately they receive approval to abandon pursuing this household further.

Office refusals are another category where it is unclear if the interviewer had successfully contacted the household before the household refused. If a sample member contacts ISER before the start of fieldwork (e.g. after receiving the letter announcing that an interviewer will call shortly) and refuses to participate in wave 2, then no contact with the household will be attempted. Again, cases where no call attempts were recorded are excluded from the analysis sample, while cases with at least one call are included.

Refusal

For the refusal model we consider the individual interview outcome (variable b_ivfio), for those wave 1 respondents who were contacted (i.e. individual contact, not just household contact) in wave 2. Eligible wave 1 respondents, who were contacted but not interviewed at wave 2 were considered to have refused (coded as 1, 0 otherwise). Following the AAPOR definition of ‘other’ non-interviews, those who were not interviewed due to language problems or ill health were excluded from analysis (AAPOR 2011). All cases with (household or individual) office refusal where considered as contacted and hence included in the analysis. Note this is different from the non-contact model where households with (household) office refusal were only included if at least one call had been made (see above).

2.3.3 Immigrant measure

For this analysis, migrants are defined as foreign-born UK residents, while non-migrants are UK-born. The few sample members with no information on whether they were born in the UK or abroad (missing, refused or don't know) are excluded.

Migrants are heterogeneous with respect to many socio-demographic and socio-economic characteristics that can be related to the nonresponse process. The heterogeneity stems mainly from two reasons. First, people tend to immigrate as young adults; hence migrants from more recent cohorts are on average younger than migrants who have come to the UK some decades ago. Second, UK immigration policy changed several times over the last decades, favouring different groups in terms of region of origin and skills (Boswell 2008). These selection processes are reflected in the socio-demographic characteristics of different arrival cohorts. We therefore group migrants into four cohorts by their length of residence in the UK: 0-3 years, 4-6 years, 7-10 years and more than 10 years.

As Wave 1 of Understanding Society does not offer many suitable measures of respondents' cultural orientation an "ethnic-religious background" variable was constructed, combining ethnicity and religious background. Religious background is the religion the respondent belongs to or, if the respondent does not belong to a religion, the one he or she was brought up in. Ethnic group is the UK 2011 Census ethnic group measure. The groups are as follows: white Christian (including mainly people from the Americas, Australia, South Africa and Europe), which will be used as reference category, black Caribbean, black African[11], Pakistani, Indian Muslim, Indian Hindu, Indian Sikh, Bangladeshi, Chinese/Buddhist (including the few Chinese that are Christian), Asian Christian (including Indian Christians), Arab and other Muslim, and a category 'other' that comprises all other ethno-religious combinations with insufficient cell sizes .

2.3.4 Modelling strategy

Even though survey participation is a multi-stage process, many analyses do not differentiate between non-contact and refusal, often because information on detailed response outcome is unavailable. However, as discussed, locating, making contact and gaining cooperation are distinct processes. Factors associated with nonresponse at the different stages differ, so do mechanisms of how these factors lead to nonresponse (Groves and Couper 1998). A model that allows relating factors associated with nonresponse to the stage(s) in which they operate is therefore useful.

One way to do this is to use a multinomial model, modelling non-contact and refusal compared to the baseline category of cooperation (e.g., O'Muircheartaigh and Campanelli 1999; Durrant and Steele 2009, both in a multilevel framework). An alternative is to model the process in the sequence it occurs as with sequential binary models: First modelling non-contact for the whole sample and then, conditional on contact, refusal (e.g., Lepkowski and Couper 2002; Hawkes and Plewis 2006)

In the following, the strengths and drawbacks of these models is discussed, following Steele and Durrant's (2011) review of approaches to (multilevel) modelling of nonresponse. An advantage of multinomial models over sequential binary models is that they allow testing effects for equivalence across different outcome categories. A drawback of a multinomial model is that interpretation is not as intuitive as in a logistic

[11] Separate categories for black African Muslims and black African Christians were tested but coefficients were not significantly different from each other, and black African Muslims are a relatively small group. Therefore this variable combines them into one category.

model because coefficients for non-contact have to be compared with the baseline category cooperation, i.e. the result of two steps, contact and cooperation.

Both multinomial and sequential models do not allow for correlation between factors influencing both the contact and the cooperation process, leading to potential bias (Steele and Durrant 2011). The propensity of non-contact and the propensity of refusal can be correlated in two ways. Firstly, the ease of contact of sample members and their willingness to cooperate might be correlated. This means estimated coefficients for refusal of the contacted sub-sample can be biased (i.e., if one had also observed the outcome for the cooperation stage for the non-contacted sample members, estimated coefficients might be different). This is normally irrelevant as non-contacted people do not make a decision about cooperating or refusing, but there is the possibility of misclassification, e.g. when unwilling respondents pretend not to be at home. In this case the two processes would be correlated and a model for refusal based only on the contacted subsample would produce biased estimates (Nicoletti and Peracchi 2005; Steele and Durrant 2011). Given that Understanding Society respondents know by wave 2 what the interview entails and may have found it burdensome at wave 1 this behaviour is a possibility even if for relatively small numbers in the sample. However, interviewers make multiple contact attempts so it is not likely that this strategy would be successful throughout all contact attempts.

Secondly, there can be cross-process correlation due to interviewer characteristics that affect both the contact and cooperation process. When the factors that influence both processes are unobserved there is risk of biased estimates (Steele and Durrant 2011). O'Muircheartaigh and Campanelli (1999) and Durrant and Steele (2009) find positive correlation between random effects for interviewers for contact and cooperation, suggesting that interviewers are either successful or unsuccessful at both making contact and gaining cooperation. More recently, studies addressed (aspects of) this problem by jointly estimating probit models of the two stages, thus allowing for sample selection, or with multilevel multinomial models that allow for correlation between different outcomes (Nicoletti and Peracchi 2005; Steele and Durrant 2011). In both cases there was no evidence of strong dependence of the two processes of making contact and gaining cooperation, once a set of suitable control variables are included in the model. Lepkowski and Couper (2002) suggest including estimated propensity of the previous process (e.g., contact propensity) as predictor for the following process (e.g., cooperation propensity). This analysis will assume the two processes are, conditional on control variables included in the model, uncorrelated.

We estimate two sequential logit models to identify factors associated with nonresponse amongst migrants. In the first set of models we estimate the likelihood of a wave 1 migrant respondent (assumed to be eligible for interview at wave 2) living in a non-contacted household at wave 2. In the second set of models we estimate the likelihood of a migrant refusing an interview in the second wave conditional on the individual having been contacted.

For both refusal and non-contact, we estimate a series of models where we sequentially add covariates relating to different aspects of nonresponse. As will become apparent in section 5.4.2 the propensity to move and to live in a non-contact household are confounded. Therefore, the final non-contact model is also run on only those who did not move house between the first and second waves. The models were built stepwise, adding variables of each step and removing those not significant at 5% level.

Most covariates used are lagged, i.e. from wave 1, some variables relate to information collected on the Address Record Form of wave 2. Wald tests were used to test joint significance of categorical variables. Some variables important to nonresponse theory are retained despite not being statistically significant at 5 percent level.

Stata's survey commands with design weights are used to account for the complex sample design of the UKHLS (clustered and stratified samples and differential selection probabilities of sample members).[12]

2.4 Descriptive statistics

We present descriptive statistics for migrant and UK-born respondents in the analysis samples of the non-contact model and the refusal models in several tables (Table 25 to Table 29) in appendix A.[13] Migrants of different arrival cohorts differ in their characteristics. Furthermore, immigrant sample members differ from UK-born sample members in some important characteristics. Main differences are pointed out in the following.

The migrant population in the sample is younger than the UK-born population (47percent of 20-39 year olds compared to 37 percent), and recently arrived migrants are younger than migrants who came to the UK a decade ago. Migrants more often hold degrees than UK-born and more recent cohorts more likely to hold a degree than those who came ten or more years ago (49 vs. 30 percent). Migrants from the oldest arrival cohort mainly name English as their first language (57 percent), while this is only the case for 18 to 20 percent of the more recent cohorts.

The housing situation differs also considerably between migrant cohorts, reflecting differing age compositions between cohorts and length of time they had to establish themselves in the UK (as well differences in intended length of stay): Almost twice as

[12] For the non-contact model we tested alternatively design weighted models with robust standard error that account for the clustering of individuals within households (and including ethnicity dummies to account for unequal selection probabilities). The estimated standard errors were generally smaller than for these models and so we report this more conservative option.
[13] The two tables give descriptive statistics for the covariates used in each of the models and are based on the respective analysis samples (i.e. England only for non-contact model (table 28); all UK, conditional on contact for refusal model (table 29). This results in some inconsistencies between the two tables (e.g. different proportions for time spent in the UK).

much (37 percent) of very recent migrants live in flats, compared to the most established migrants. Almost half (49 percent) of the most recent migrant cohort lives in private furnished accommodation, which is typically associated with short tenures, while 69 percent of the oldest arrival cohort is owner occupier.

Finally, 36 percent of the most recent migrants moved house between wave 1 and wave 2, while this is only the case for 6 percent of the oldest cohort. Overall, migrants are almost twice as mobile as UK-born sample members: 15 percent of migrants moved between waves, compared to 8 percent of UK-born. For 2 percent of migrant sample members it is unclear whether they moved, mostly because the interviewer could not visit the household.[14]

Distribution of outcome variables

There is a marked difference in contact rates between migrants and UK-born respondents. The proportion of non-contacted sample members is twice as high for migrants (12.2 percent) than for UK-born sample members (5.4 percent) (Table 28). The proportions of refusals do not differ as much, with 15.7 percent of contacted migrants refusing compared with 13.7 percent of UK-born (Table 29).

The non-contact rate varies by move status. Amongst non-movers, which represent 83 percent of migrants, only 2.7 percent of migrant sample members live in a non-contact household (not shown in Tables). For migrant split household movers the non-contact rate increases to 52 percent, and for whole household movers it is 58 percent. In the UK-born population (90 percent of whom are non-movers) the pattern is similar though the difference is not as extreme.

[14] There is a problem of endogeneity because the code 'could not visit household' (variable b_origaddstat) is also used when the interviewer did not attempt to visit because the household refused to participate by contacting ISER.

2.5 Results

Table 1 presents the marginal effects for being a migrant on different non-response outcomes. These are from separate models for each response outcome: overall non-response, non-contact and refusal condition on contact with no covariates other than migrant status. It shows that there is a large difference in non-contact propensity between migrant and non-migrants, but not that much of a difference in propensity to refuse, although the latter is also statistically significantly different from zero. In the rest of this section we present results from the analysis of multivariate analysis of non-contact and refusal conditional on contact models as described in Section 2.3.4.

Table 1 Marginal effects of being a migrant on wave 2 outcome

	dy/dx	Z	P>z	n
Non-interview	0.096	13.77	0.000	47,304
Non-contact (individual)	0.078	17.18	0.000	47,304
Refusal (conditional on contact)	0.019	3	0.003	41,999

Table 2 Logit models for living in non-contact household at wave 2

		All							Non-movers	
		Migrants						UK-born	Migrants	UK born
Variable		(1) Migrant	(2) address	(3) socio-dem.	(4) para data	(5) tenure	(6) full	(7) full	(5) tenure	(5) tenure
Time in UK	7-10 yrs	0.0877**	0.0721**	0.0471**	0.0480**	0.0343*	0.0132		0.0027	
(ref: > 10yrs)	4-6 yrs	0.109**	0.0734**	0.0395**	0.0381**	0.0108	-0.0036		-0.0024	
	0-3 yrs	0.205**	0.162**	0.0852**	0.0828**	0.0428*	0.0194		-0.0019	
IMD rank (LSOA,	2nd		0.0064	0.0039	0.0047	0.0033	-0.0020	0.0010	-0.0051	-0.0009
quintiles)	3rd		-0.0251+	-0.0237+	-0.0197	-0.0204	-0.0241*	-0.0030	-0.0211**	0.0001
(ref: 1st - most	4th		-0.0307+	-0.0256	-0.0186	-0.0186	-0.0149	-0.0062	-0.0190*	-0.0061+
deprived)	5th		-0.0373*	-0.0340*	-0.0248	-0.0244	-0.0269+	-0.0088+	-0.0205*	-0.0071*
London (dummy) [1]			-0.0080	-0.0096	-0.0232*	-0.0267*	-0.0044	0.0017	0.0011	0.0002
Dwelling (wave 2)	semi/terraced		0.0374**	0.0300+	0.0252	0.0169	0.0146	0.0101*	0.0001	0.0047+
(ref: detached)	flat (or: flat/other)		0.0946**	0.0679**	0.0621**	0.0411*	0.0279+	0.0148**	0.0004	0.0025
	Other		0.140*	0.0960+	0.0966	0.0672	0.0156	0.0073		
	missing		0.696**	0.645**	0.626**	0.604**	0.338**	0.224**		
Age group	16-19 yrs			-0.0160	-0.0233	-0.0267+	-0.0385**	0.0086+	-0.0248**	0.0030
(ref: 40-59 yrs)	20-29 yrs			0.0850**	0.0791**	0.0604**	0.0271*	0.0092*	0.0153	0.0119**
	30-39 yrs			0.0283*	0.0237+	0.0150	-0.0029	0.0030	-0.0118*	0.0032
	60-69 yrs			-0.0320+	-0.0337*	-0.0295	-0.0203	-0.0179**	-0.0106	-0.0078**
	70+ yrs			-0.0480**	-0.0423**	-0.0397*	-0.0367*	-0.0231**	-0.0124+	-0.0094**
Unemployed (dummy)				0.0351*	0.0313+	0.0321+	0.0115	0.0071+	0.0133	0.0014
One person hh (dummy)				0.0785**	0.0967**	0.0836**	0.0510**	0.0239**	0.0248*	0.0254**
Hh with 2+ adults but no couple (dummy)				0.0482**	0.0535**	0.0388*	0.0241*	-0.0014	0.0097	0.0016
1+ person receive benefits (dummy)				-0.0439**	-0.0311**	-0.0284*	-0.0178+	0.0001	-0.0100+	0.0019
Hh income in top quartile (dummy)				-0.0328**	-0.0342**	-0.0264*	-0.0060	-0.0063	0.0106	-0.0030

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		All							Non-movers	
		Migrants						UK-born	Migrants	UK born
Variable		(1) migrant	(2) address	(3) socio-dem.	(4) para data	(5) tenure	(6) full	(7) full	(5) tenure	(5) tenure
# calls until first contact (wave 1)					0.0054**	0.0052**	0.0039**	0.0013**	0.0004	0.0008**
At least 1 stable contact in household					-0.0331**	-0.0340**	-0.0297**	-0.0195**	-0.0096	-0.0031
Cooperation in w1 interview fair or worse					0.0492*	0.0465*	0.0495*	0.0157*	0.0307*	-0.0012
Partially responding household in w1					0.0549**	0.0536**	0.0338**	0.0186**	0.0144+	0.0167**
Change of interviewer between waves[2]					0.0524**	0.0539**	0.0216**	0.0309**	0.0295**	0.0233**
Tenure	LA rented					0.0266+	-0.0039	0.0069	-0.0065	-0.0010
(ref: owned)	private unfurnished					0.0652**	-0.0183	0.0101*	0.0027	0.0030
	private furnished					0.0935**	-0.0214+	0.0172**	-0.0081	0.0046
	other					0.0347	-0.0470*	-0.0022	-0.0181+	-0.0075
Move status[1,2]	whole hh mover						0.483**	0.337**		
(ref: no move)	split hh mover						0.139**	0.0977**		
	unclear						0.506**	0.314**		
Observations		7,832	7,832	7,783	7,012	6,982	6,982	29,769	5,812	26,924

Note: Average marginal effects. Design-weighted, linearized standard errors. ** p<0.01, * p<0.05, + p<0.1. Covariates measured at wave 1 unless otherwise stated. [1] Contains interaction term between London and move status. 2 Contains interaction term between change of interviewer and move status. England only.

2.5.2 Non-contact model

In the following we discuss the results of the model estimating the probability of a wave 1 respondent living in a non-contact household at wave 2 (Table 2). We will refer to this also simply as probability of non-contact but note this is not individual-level non-contact, but rather whether an individual lives in a household with non-contact as final interview outcome. We estimate a series of models where we sequentially add different covariates. In the first model we include time spent in UK in the model, in the second model we add characteristics of the address, such as dwelling type and location, in the third we add socio-demographic and socio-economic characteristics, the fourth model includes variables representing the interview situation at the previous year, and whether the interviewer changed between waves. In the final two models we add variables relating to residential mobility (housing tenure and whether the respondent's household or part of it has moved (move status)). The full model (model 6) (without migrant- specific covariates) is run on the UK born sample as a comparison. As will become apparent in section 5.4.2 the propensity to move and to live in a non-contact household are confounded. Effects are reported as average marginal effects (AME) and are statistically significant at the 5 percent level unless otherwise mentioned.

Before considering the non-contact models for immigrants, and how predictors of non-contact compare to predictors of non-contact for UK-born, one should note that there is generally a difference in effect sizes found for the two populations. Comparing the full model (model 6) for migrants with the non-contact model for UK-born (model 7) it is noticeable that the magnitude of effects is generally smaller for UK-born. This will partly reflect that the covariate selection was based on the immigrant sample. However, the model does include all important predictors of non-contact. This implies that non-contact patterns amongst immigrants are more systematic than those of UK-born panel members.

Migrant-specific characteristics

Immigrants' probability of not being contacted at wave 2 varies widely depending on the length of time spent in the UK. The more recently a migrant has arrived, the higher the probability of non-contact. In model 1, i.e. without other control variables, the most recently arrived migrants (0-3 years since migration) are 20.5 percent more likely to live in a non-contact household, compared to long-standing migrants (10+ years since migration), for the 7-10 years since migration cohort the equivalent effect is still 8.8 percent.

The substantial reduction of the average marginal effects for the migrant cohort variable in models 2 to 4 suggests that this variation among immigrants can be largely extent attributed to differences in address characteristics and socio-demographic characteristics of more recent immigrants compared to long-standing migrants. These models indicate that characteristics well-known to be associated with high non-contact also predict migrants' non-contact: such as living in a flat or 'other' accommodation, being a young adult, living in a one person household or in a household with 2 or more adults that are not a couple (e.g. a shared house) (models 2 and 3). Accounting for residential mobility, with housing tenure (model 5) and in particular with whether the household or part of it moved between wave 1 and 2 (model 6) reduce the remaining cohort differences in non-contact probability to non-significant levels.

Address characteristics

Area characteristics are associated with non-contact in the expected ways. Compared to respondents living in the most deprived areas, those living in less deprived areas are less likely to live in a non-contact household, though this is only significant at 5 percent level for those in the least deprived areas (model 2). In the full model this effect is only somewhat reduced so that migrants living in less deprived areas (with exception of those in the 4th quintile) are still around 2.5 percent less likely to be non-contact than those in the most deprived areas (model 6).[15]

Contrary to expectations, whether the panel member lives in a large city (London) does not necessarily affect the likelihood of non-contact of migrants. Only after accounting for characteristics of the past interview situation (model 4) this becomes statistically significant where, contrary to expectations, it reduces the probability of a migrant living in a non-contact household by 2.3 percent. In the full model this is not statistically significant anymore, neither is it for UK-born.

The type of dwelling is the address characteristic that is strongest associated with non-contact. Living in any dwelling type other than a detached house increases the probability of non-contact (model 2): Living in a flat is associated with an increase in probability of non-contact by 9.5 percent, for living in ‘other’ accommodation, such as bedsits, this is 14 percent. Dwelling type is associated with non-contact for two reasons: First, some types of housing often are difficult to access for the interviewer, such as blocks of flats with entry phones. Second, dwelling types are associated with socio-economic position and life course stage. The first explanation, physical barriers, does however not seem to play an important role: Direct indicators such as locked entrances, entry phones, and whether the address is in a high rise building were tested but not statistically significant (and are not included in the models presented). The fact that the effect sizes for dwelling type are much reduced by introduction of individual and household characteristics (model 3), and housing tenure (model 5) suggests that

[15] Other area characteristics such as population density and population turnover were also tested and are significantly associated with non-contact, but are not included as the Index of Multiple Deprivation is the strongest predictor.

dwelling type mainly reflects socio-economic position and life course stage.[16] The category “missing on Address Record Form” has very large marginal effects of 70 percent to 34 percent (model 2 to 6). Information on dwelling type is endogenous to non-contact because it is most often not recorded for households that the interviewer did not visit at wave 2, and such cases usually have non-contact as final outcome.

Household and individual characteristics

The effect of age on non-contact is curvilinear; both very old and very young respondents have a lower chance to live in non-contact households compared to 40-59 year olds. This could be explained due to the youngest respondents still living mainly in their parents’ households and older people being more likely retired and at home. Models 5 and 6 suggest that age effects are apparently related to the propensity of moving address, and in the non-movers model age is less important.

Migrants’ economic activity is only weakly associated with non-contact. Only being unemployed is statistically significantly related to living in a non-contact household and is therefore entered as a dummy variable. In model 3 unemployed migrants are 3.5 percent more likely to live in a non-contacted household but in the full model this effect is reduced to non-significant levels. For UK-born sample members the marginal effect of being unemployed in the full model is smaller than that in the migrant model but is marginally significant.

With respect to household structure migrants in single person households are considerably harder to contact than those in larger households; even in the full model the average marginal effect is 5.1 percent (model 6). Also, migrants in households with 2 or more adults in which there are no couples are harder to contact than other

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[16] Interactions between living in London, dwelling type and tenure were tested but were not significant and are not included in the model presented here.

households. This effect is halved in magnitude when accounting for residential mobility (model 6) and has no effect for the UK-born which might indicate that it reflects, at least partly, the effect of migrants living transient shared housing arrangements.[17],[18]

Low socio-economic status, as measured by household benefit receipt, is associated with lower non-contact probability. High socio-economic status, measured by household income in top quartile is also associated with lower non-contact probability. This could be interpreted as a u-shaped association between SEP and non-contact for migrants similar to findings for the general population in the BHPS (Uhrig 2008). However, low income was also tested in the model and it was not statistically significant. For UK-born neither benefit receipt nor high income are statistically significantly associated with living in a non-contact household.

Covariates tested for non-contact in model 3 but not included because they were not statistically significant at 5 percent level are gender, marital status, ethnicity and poor self-rated health. An indicator of young children in the household was not statistically significant in the presence of other socio-demographic characteristics.

Para data on interview situation and fieldwork characteristics

Model 4 introduces factors related to the wave 1 interview situation and to fieldwork of wave 2. Migrants who lived in difficult-to-contact households at wave 1 (proxied by number of calls necessary to establish first contact) also tend to do so in wave 2, though the effect is rather small. Having provided stable contact details at the first interview makes migrants 3 percent less likely to be in a non-contact household at wave 2, even

[17] Other multi-adult households with at least one couple did not differ in their probability of non-contact from other household types.
[18] A household in the UKHLS is defined by either sharing a meal per day together or sharing living accommodation. This means that house shares with a communal living room are classified as a household, while house shares with no communal living room will not count as one household unless they share a daily meal (Lynn 2009).

after accounting for move status in the full model.[19] In the non-movers model there is no statistically significant effect as stable contact details are only relevant in the case of a move. Lack of cooperativeness in the first wave, both at individual level and household level predicts non-contact: Migrants whose cooperativeness in the wave 1 interview was assessed by interviewers as 'fair' or worse are 5 percent more likely to be non-contact at the next wave than more cooperative respondents, the equivalent effect for UK-born is only 1.6 percent.[20] Amongst non-mover migrants this effect is only 3.1 percent. Similarly, migrant respondents who were in a partially responding household at wave 1 are 5.5 percent more likely to be non-contact at wave 2 (model 4), this reduces to 3.4 percent in the full model.

A change of interviewer can mean several things: It can be related to move of sample member outside the interviewer's area. Or, if the sample member did not move it can mean that the new interviewer has less knowledge of the household and is possibly less experienced. It could also indicate that the area is generally difficult for interviewers and therefore interviewer turnover is higher. A change of interviewer between waves is associated with an increase in the probability of a migrant sample member living in a non-contact household of 5.2 percent (model 4). In the full model this is reduced to 2.2 percent, however this is averaged across move status as these terms are interacted in the model. In the non-movers model the effect is slightly higher with 2.9 percent.

Residential mobility (housing tenure and move status)

Model 5 adds housing tenure which is related to how likely a household is to move, and hence affects chances of establishing contact. Migrants who lived in rented accommodation at wave 1 are subsequently harder to contact than those who are

[19] The effect of having stable contact details on non-contact should differ by move status and an interaction between these variables was tested but was not statistically significant.
[20] An indicator whether the respondent was suspicious towards the survey (interviewer assessed) has a similar effect on probability of non-contact than respondents' cooperativeness.

owner-occupiers. Migrants in private rented furnished accommodation and those in private rented unfurnished accommodation are hardest to contact. Once the move status is accounted for (model 6), the marginal effects for these tenure categories become negative, though are significant only for the 'other' category and the private furnished category at 10 percent level. Similarly, for non-movers housing tenure other than owner occupied has mostly non-significant negative effects. This might indicate that once residential mobility is accounted for (with move status as covariate, or by only considering non-movers), controlling for housing tenure represents mainly socio-economic position, which the models already control for with other measures.

Whether the respondent moved house between wave 1 and 2 has the biggest impact on the probability of living in a non-contact household at wave 2. For respondents who moved as a whole household, so that the interviewer cannot find anyone at the old address, the marginal effect on household non-contact is 48 percent, compared to respondents who did not move. For respondents who moved out of a household while parts of the wave 1 household still lives at the old address ('split household movers'), the effect is not as big, with 13.9 percent. For those where it could not be determined whether they moved or not the marginal effect is 50.6 percent, however undetermined mover status is endogenous to non-contact. Move status is interacted with living in London and the detrimental effect of being a split household mover on household contact is not as strong for Londoners than non-Londoners (-10 percent). This could be explained by different types of people living in shared houses in London compared to the rest of England.[21]

[21] Having British citizenship and having a British partner were also tested, as these variables could indicate an intention to stay in the UK, but were not significant. (Not all migrants who leave the UK will be correctly identified as having moved out of scope and therefore there will be misclassified cases amongst non-contacted migrants).

2.5.3 Refusal model

The probability of refusal is estimated for wave 1 respondents conditional on being contacted in wave 2. The refusal model is built in four steps presented in Table 3. First, the probability of refusal is estimated only using migrants' main characteristics (time spent in the UK, cultural background, and English difficulties). Models 2-4 add variables that are commonly associated with refusal in order to see how much of the 'migrant effect' can be explained by them. Model 2 adds individual socio-demographic and socio-economic characteristics. Model 3 adds factors relating to nonresponse theory (social isolation, social engagement and social exchange). The last model adds factors relating to the interview situation at waves 1 and 2.

Similar to the non-contact models, there is generally a difference in estimated effect sizes between the migrant and UK-born populations. With some exceptions discussed below, the magnitude of effects is generally smaller for UK-born.

Migrant-specific characteristics

The more recently migrants came to the UK the more cooperative they are: In the most recent cohort are 6.5 percent less likely to refuse than migrants in the country for more than 10 years (model 1), the 7 to 10 year migrant cohort this is 3.5 percent, albeit only significant at 10 percent level. Even after adjusting for a wide range of control variables the marginal effects for the two more recent migrant cohorts are only reduced by around one third and still statistically significant.

Table 3 Logit models for refusal at wave2 conditional on contact

Variable		(1) Migrant chars	(2) Sociodem. chars	(3a) social engagement/ exchange	(3b) social isolation	(4) Interview	(5) UK-born
Time spent in UK	7-10 yrs	-0.0346+	-0.0207	-0.0240	0.0046	-0.0078	
(ref: >10yrs)	4-6 yrs	-0.0569**	-0.0443*	-0.0517**	-0.0290	-0.0353*	
	0-3 yrs	-0.0645**	-0.0530**	-0.0649**	-0.0440*	-0.0506**	
Ethnic-religious	black Caribbean	0.0196	-0.0018	0.0016	0.0065	-0.0150	-0.0123
background [1]	Asian Christian	-0.0212	-0.0160	-0.0129	-0.0092	-0.0311	-0.0079
(ref: white Christian)	black African	0.0625**	0.0492*	0.0568**	0.0692**	0.0386+	0.0187
	Arab Muslim	0.0932+	0.0864+	0.0958+	0.0924+	0.0751+	-0.0339
	Indian Muslim	0.0380	0.0315	0.0305	0.0274	0.0138	0.0179
	Pakistani	0.0609*	0.0617*	0.0715**	0.0725*	0.0497+	-0.0172
	Bangladeshi	0.118**	0.0939*	0.107**	0.0682+	0.0665+	-0.0365
	Indian Hindu	0.0192	0.0142	0.0131	0.0197	-0.0020	0.0209
	Indian Sikh	0.102*	0.0992*	0.0978*	0.0418	0.0745+	0.0586
	Chinese/Buddhist	0.0146	0.0205	0.0049	0.0018	-0.0026	0.0419
	other	0.0398+	0.0478+	0.0477*	0.0232	0.0378+	-0.0099+
English	no difficulties	0.0224	0.0166	0.0134	0.0079	0.0025	
(ref: first language)	difficulties	0.0321	0.0196	0.0156	-0.0043	0.0047	
	no English	0.102+	0.102	0.1040	0.0784	0.0866	
Gender[1]	Female		-0.0106	-0.0135	-0.0034	-0.0122	-0.0086**
Age (ref: age 40-59)	age 16-19		-0.0327	-0.0538*	-0.0568*	-0.0573*	0.0373**
	age 20-29		0.0060	-0.0022	0.0006	-0.0010	0.0355**
	age 30-39		-0.0075	-0.0068	-0.0145	-0.0109	-0.0001
	age 60-69		0.0190	0.0061	0.0227	0.0017	-0.0024
	age 70+		-0.0073	-0.0268	-0.0342	-0.0100	0.0268**

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Variable		(1) Migrant chars	(2) Sociodem. chars	(3a) social engagement/ exchange	(3b) social isolation	(4) Interview	(5) UK-born
Educational level (ref: none)	GCSE		0.0141	0.0189	0.0141	0.0193	-0.0101+
	A-level		-0.0073	-0.0013	-0.0029	-0.0029	-0.0305**
	degree		-0.0222	-0.0145	-0.0070	-0.0137	-0.0448**
	Hh income <25th percentile		0.0429**	0.0432**	0.0360*	0.0324*	0.0167**
	London		0.0469**	0.0461**	0.0391**	0.0234+	0.0078
Political interest (ref: none)	not very			-0.0347*	-0.0249	-0.0295+	-0.0119*
	fairly			-0.0543**	-0.0406*	-0.0442**	-0.0205**
	very			-0.0788**	-0.0641**	-0.0632**	-0.0242**
Benefit receipt (ref: none)	1 type			-0.0352*	-0.0444**	-0.0377**	0.0039
	2+ types			-0.0598**	-0.0458**	-0.0583**	-0.0067
	Year moved to current address				-0.0015+		
	Child under 10 in hh				0.0355*		
	Neighbourhood integration (1 low – 10 high)				-0.0009		
	Partially responding hh at w1					0.0686**	0.0837**
	Respondent suspicious					0.0882**	0.0893**
	Change of interviewer					0.107**	0.118**
	N	6,034	6,033	5,917	4,088	5,907	34,163

Note: Average marginal effect. Design-weighted, linearized standard errors. ** p<0.01, * p<0.05, + p<0.1. Covariates measured at wave 1 unless otherwise stated. [1] Includes an interaction between female and ethno-religious group.

Migrants' cultural background as proxied by ethno-religious group also affects their probability of refusal.[22] Compared to the reference group of white Christian migrants, migrant sample members of other Christian groups (Caribbean, Asian Christians) but also some Asian groups, namely, Hindus and Chinese/Buddhist, do not differ significantly in their probability to refuse an interview at wave 2. In contrast, Muslim groups are more likely to refuse at wave 2, between 6.1 percent and 11.8 percent, although this is not statistically significant for Indian Muslims and for Arab Muslims it is only significant at 10 percent level) (model 1). Sikhs and black African are also more likely to refuse (AME 10.2 percent and 6.3 percent, respectively).

Differences in socio-demographic and socio-economic composition between these groups explain only little of this pattern, as effect sizes in model 2 are only slightly reduced. Neither do factors related to nonresponse theory, such as the idea of survey participation as a form of social exchange, reduce the differences in refusal probability across cultural groups by much (model 3a). In the model testing indicators of social isolation (model 3b) the differences across ethno-religious groups are mainly reduced to non-significant levels. However, this model is restricted to respondents who filled in the self-completion questionnaire, which represent a group of particularly compliant respondents, and item-nonresponse to this part of the survey was high among ethnic minority sample members. The effect of cultural group is most reduced (though still significant at 10 percent level for all groups that differed significantly from the white Christian reference in model 1) once characteristics of the interview situation are accounted for (model 4). This would suggest that respondents in ethnic groups that are significantly more likely to refuse an interview at wave 2 experience the interview

[22] Alternative measures of cultural orientation were tested but not significant and hence not included in the models presented here, such as importance of parents' ethnicity, British citizenship, whether sending remittances.

situation differently, and/or felt less comfortable with refusing an interview at the initial request in the first wave outright.

With respect to gender-specific response behaviours, we need to note that the effects of ethno-religious group in models 2 to 4 are averaged across gender, as these models include an interaction between gender and cultural background. In general, women seem more cooperative than men, and Indian Muslim and Pakistani women are significantly more cooperative than men from the same groups. In contrast, in some other groups, such as Bangladeshi and Sikh, refusal propensity is high for both genders.

For UK born ethnic minorities, cultural background does not affect propensity of refusal in the same way (comparison model), suggesting higher acculturation to British behaviours for second and third-generation migrants.[23]

English language problems can be a hurdle in survey participation. However, given the large effort that goes into providing the UKHLS questionnaire in different languages, and providing bilingual interviewers, and also that respondents already agreed to give an interview at wave 1, it is not surprising that English skills do not play a big part in refusal. Only the 1 percent of migrant sample members who did not speak any English at all at wave 1 are more likely to refuse a second interview compared to the reference category of migrants with English as first language (significant at 10 percent level, only in model 1). Non-English speaking migrant sample members were also most likely to

[23] In the model for UK-born simpler cultural background classifications were tested as cell sizes for many of the groups in the model presented here are very small, however this does not change overall results.

also have an interpreter at the interview present or a family member translating for them which would probably increase the perceived burden of the interview.[24]

Socio-demographic and socio-economic characteristics

Refusal propensity typically varies by gender, age and educational level (Groves and Couper 1998). Amongst immigrants, these characteristics seem less predictive of interview refusal. Women are typically more cooperative compared than men. In both the UK-born model and the migrant models, there is however only a very small gender effect, and in the case of the latter, this is not statistically significant. However, as discussed, for migrants of some ethno-religious groups there are gender differences in the expected direction with women significantly being more cooperative (Indian Muslim, Pakistani). With respect to age, both young and very old people typically more often refuse than middle-aged people, and this is the case in the model for UK-born. However, for migrants such an age pattern cannot be found: All marginal effects apart from those for 16-19 year olds are not statistically significant (model 5). For UK-born sample members, the effect of educational qualification is in the expected direction, i.e. with increasing level of education sample members become increasingly less likely to refuse. For migrants, a roughly similar trend can be seen, but effects are much smaller and not statistically significant. Educational level was still included in the model because it varies considerably between different migrant cohorts.

Low income is commonly associated with higher refusal rates. This is also the case here for migrants in all models: Migrants in households that are in the bottom quartile of the income distribution are around 3 percent more likely to refuse than respondents from more wealthy households (model 5). Living in an urban location (London) is associated

[24] Various variables regarding translation of interview, by the interviewer him-/herself, an interpreter, or a family member, were tested in the model but are not significant, probably due to small numbers

with a 4.7 percent higher likelihood to refuse in model 2, but this effect is reduced by half in the full model and is then only marginally significant.

Factors related to theories of social engagement, social exchange and social isolation

One of the few available measures that capture the concept of *social engagement* is respondents' level of political interest. Increasing level of political interest has a positive effect on cooperativeness: Even respondents who are 'not very' interested in politics are 3.5 percent (model 3) less likely to refuse than respondents who have no interest in politics at all. The probability of refusal decreases with increasing level of political interest and this effect is only slightly reduced in the full model.

Respondents who receive state benefits might feel, in the sense of a social exchange, that they can give something back to society by agreeing to an interview request for a social survey. Receiving benefits is in fact associated with a lower probability to refuse and this effect stays almost the same in the full model.[25] Interestingly, there is no significant association of benefit receipt on probability of refusal amongst the UK-born population.

Model 3b tests various measures of social isolation. As these are partly based on the self-completion questionnaire this reduces the number of observations considerably. Various measures of neighbourhood integration, all based on the self-completion questionnaire (whether can borrow things/get advice from neighbours, how important local friends and associations are, whether talk to people in neighbourhood regularly and whether feel they belong to the neighbourhood), were tested but none of them individually, or combined to an index, were significant. Other measures of social isolation are how recently the respondent moved into the neighbourhood (interpreted

[25] The benefits measure excludes child benefit and state pensions but does include other universal benefits.

as lack of integration) and whether there are young children in the household (facilitating social integration via the child's activities in schools and clubs). However, without neighbourhood integration, both these measures are not significant and therefore not included in models 4 and 5.[26] This also allows us to use the less selective sample for the final two models.[27]

Interview situation

The final step adds variables relating to the interview situation at wave 1 and whether the interviewer changed for wave 2 (model 4). Respondents living in households where another household member did not give an interview in the first wave are 6.9 percent more likely to refuse an interview themselves at wave 2 than respondents from households fully cooperating at wave 1. If the interviewer described the respondent as being suspicious during the first interview, the chance of refusal at wave 2 increases even more, by 8.8 percent. Lastly, if the interviewer is new to the respondent, this increases the probability of refusal by 10.7 percent.[28] All these effects are roughly similar to those in the comparison model of UK-born respondents.

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[26] With the (non-significant) neighbourhood integration index in the model both *year moved to current address* and *child under 10 in the household* are statistically significant, however the effect is not in the expected direction: Controlling for neighbourhood integration, the more recently people have moved to their current address, the more cooperative they are (marginal effect of -1.46%, p<.1, model 3a). This is a finding also found by Groves & Couper (1998) who explain it with the fact that people who moved recently are more likely to have small children and therefore more cooperative. The effect of a child under age 10 being in the household on the probability to refuse is also contrary to the expected direction: Respondents in such households are 3.6% more likely to refuse than households without a child.
The neighbourhood integration index is based on questions from the self-completion questionnaire. Restricting the sample to those who answered this self-completion questionnaire has noticeable effects on the estimated marginal effects for some cultural groups. Especially for Sikhs, the marginal effect is reduced by almost half when limiting the analysis to the subsample of respondents with self-completion questionnaires. This indicates that the people who filled in the self-completion questionnaire are – at least amongst some cultural groups – considerably more cooperative than the overall group of respondents. Therefore, the counterintuitive results for child under 10 in household and year moved to address should be interpreted with caution.

[27] Living in a one person household, or being single, could also be interpreted as being socially isolated, but neither household type nor marital status were statistically significant.

[28] An interaction between change of interviewer and whether the respondent expected to move was tested (not shown). The estimated marginal effect of having a change of interviewer was

2.6 Discussion and conclusion

The analysis shows that there is considerable variability amongst migrant respondents in their response behaviour at wave 2 of the UKHLS. Propensity of non-contact and refusal differ by individual characteristics amongst migrants at least as much as it does amongst UK-born respondents. Both non-contact and refusal models demonstrate large differences between migrant groups, largely associated with length of residence in the UK. The analysis also confirms what has been found in other countries (e.g., Feskens, Hox et al. 2007), namely that poor response rates of migrants are not mainly linked to low cooperation, but are rather to high levels of non-contact. Migrants' length of residence is associated with non-contact and refusal in opposite directions: Non-contact probability decreases with length of residence, while refusal propensity increases with length of residence. There is therefore no uniform 'migrant effect' on nonresponse as such. Rather, for both non-contact and refusal nonresponse probability of migrants depends on length of residence, factors related to length of residence, and other individual characteristics commonly associated with nonresponse generally. Lastly, there is some evidence of a cultural dimension to migrants' nonresponse behaviour.

Associations between factors and non-contact amongst migrants are mostly similar to those among the UK-born population. Residential mobility predicts non-contact at wave 2 amongst migrants more than any other factor and is particularly relevant for them due to their higher mobility. The substantial reduction of marginal effects of many variables with the introduction of move status illustrates that many individual and household characteristics essentially capture the likelihood to move, such as housing tenure, dwelling type but also time spent in the UK and whether the person was unemployed at wave 1.

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actually lower for those who did not expect to move (9.5%), while those who probably did move were 16% more likely to refuse when they (unavoidably) had a new interviewer. A possible explanation might be that recent movers still have a lot of work to do around the house and are therefore less likely to comply.

The remaining variables that have large marginal effects in the full model are related to the likelihood to be at home (age, single person household) or to the respondents' cooperativeness in wave 1.

As expected, lack of cooperativeness in the previous interview is also related to non-contact. This suggests that a proportion of non-contact cases amongst migrants are hidden refusals and might partly explain high non-contact rates amongst migrants (cf Feskens, Hox et al. 2007). This could be interpreted as a result of culturally differing behaviour; migrants from some cultures might want to avoid a direct confrontation and hence pretend not being at home, rather than refusing outright to the interviewer. Migrants might have also already been reluctant in wave 1 but did not feel comfortable to refuse. However, a negative effect of lack of cooperativeness in the past can also be seen for UK-born.

Most factors that predict refusal are similar for migrants and UK-born (though for the latter often with reduced magnitudes). The exceptions are the basic socio-demographic characteristics age, gender and education which are associated with refusal of UK-born in the expected way, but not, or less strongly, for migrants. This might partly reflect that migrants are a selected population, where associations between these characteristics and refusal behaviour could be different.

Length of residence is a significant predictor of migrants' survey behaviour: Compared to long-standing migrants more recent migrants are more cooperative, even after controlling for all other factors. Recent migrants might consider being asked to be part of a national household panel survey as an acknowledgment of their belonging to the UK. As such, continued participation can be considered as re-affirming this belonging, as reciprocation. Alternatively, one could interpret recent migrants' cooperativeness in the light of a social obligation towards UK society that they might feel more than more long-standing migrants.

The expectation that migrants' cultural background affects their response behaviour is confirmed. These marginal effects are reduced in the full model once other characteristics are controlled but persist and vary between 3.5 percent and 7.5 percent (though significant only at 10 percent level). A possible explanation why cultural background effects are particularly reduced when characteristics of the interview situation are added could be that the high refusal propensity of some cultural groups is linked to the communication situation, e.g. that high context requirements led to misunderstandings and therefore suspicion about the survey (Johnson et al., 2002) .

Characteristics of the previous interview situation (whether the household was only partially responding at wave 1 and whether respondent was suspicious of the survey) and change of interviewer between waves have the largest effects on refusal propensity at wave 2 among migrants.

There is some evidence for social engagement and social exchange to be relevant for survey cooperation amongst migrants. With increasing political interest, the probability of refusal decreases. Migrants who receive one or more state benefits are more cooperative than those receiving no benefits. Cooperating with the survey could be seen as a social exchange, and a way for migrants to show their gratefulness for the state support. Interestingly, survey cooperation of UK-born respondents does not depend on benefit receipt. This might be because they feel more entitled to state benefits and hence less obliged to give something back, compared to foreign-born recipients of state benefits.

For a link between social integration or isolation and survey cooperation of migrants, no evidence could be found. Time spent in the UK could also be considered as measure of social integration, as very recent migrants are less likely to have extensive social networks in the UK, or to be active in the local community. Despite this we find the opposite effect - the more recent migrant cohorts are, after adjusting for other variables, significantly less likely to refuse. However, this could be due to unobserved heterogeneity between migrants from different arrival cohorts that the model cannot fully account for.

There are some limitations to this analysis. With respect to the non-contact model, there are issues of endogeneity with respect to several variables, especially whether the interviewer has changed and other variables relating to wave 2, in particular dwelling type and move status. A limitation of the refusal model is that it does not account for urbanicity or area very well. Using small area variables could explain non-contact propensity with a better urban/rural measure and also be used to distinguish better between interviewer and area effects. Given the commonalities of the models with respect to past cooperativeness affecting both non-contact and refusal a path for future research would be to use sequential binary models (Steele and Durrant 2011).

3 Healthy immigrant effect among immigrants in the UK

3.1 Introduction

In many high-income countries recent immigrants are found to be in better health than comparable native-born people. This phenomenon is called the Healthy Immigrant Effect (HIE). It is complemented by a negative effect on health associated with increasing time spent in the host country (duration effect), whereby immigrants over time lose their initial health advantage up to or even beyond the point where there is no difference to the native born population (Newbold and Danforth 2003; McDonald and Kennedy 2004).

With continuing inflows of immigrants to the United Kingdom (UK) and a stock of 12.4% foreign-born population (United Nations 2013), immigrants' health is an important public health issue. However, the focus of UK research in the past has been on ethnic minority groups rather than all immigrants (Ingleby 2012), mostly ignoring that ethnicity and migrant status intersect and can have different implications for health. The concern has primarily been the poor health outcomes of some ethnic minority groups compared to the white British majority population. Therefore, there is only limited evidence regarding the HIE for the UK and, to our knowledge no studies have considered the variation of immigrant health relative to natives' over duration of residence in the UK. This is the specific contribution of this chapter to the literature.

Immigrant flows to the UK over the past decades have been diverse and individual characteristics of immigrants and regions of origin have changed over time. This heterogeneity amongst the foreign-born population means immigrant status and ethnic group membership intersect in complex ways. For example, the proportion of foreign-born varies considerably across ethnic groups, as does the average length of residence of the foreign-born population. Immigrants' health trajectories over time and in subsequent generations combine to generate ethnic health disparities (Jasso, Massey et al. 2004). Any analysis of health across ethnic groups is therefore potentially affected by immigrant status and length of residence, i.e. the HIE and duration of residence effect.

This chapter addresses this gap by taking both factors into account using the UK Household Longitudinal Study (UKHLS), a survey particularly well suited to studying immigrants among ethnic groups as it includes an Ethnic Minority Boost sample (discussed further in section 3.6) allowing sufficiently sample sizes of immigrants and some of the major ethnic minority groups.

The two main research questions are:

1. Is there a Healthy Immigrant Effect for immigrants (HIE) to the UK at arrival, and if so, how large?

2. If there is a HIE, does the health advantage of immigrants decrease with increasing length of residence of immigrants (duration effect)?

Given the analysis is cross-sectional and cannot fully disentangle the effects of length of residence and time of arrival in the UK it is beneficial to consider more homogeneous groups by comparing the health of immigrants and UK-born participants within ethnic groups. We therefore consider the HIE for the UK population as a whole and within five major ethnic groups, allowing a differentiated view of the effect of immigrant status on health overall as well as within ethnic groups.

A further issue addressed in this chapter is the suitability of different health measures for immigrant-native comparisons. Many HIE studies rely on self-rated health (SRH) and diagnosis of a chronic condition - health measures that may be problematic when comparing the health of immigrants and natives (McDonald and Kennedy 2004; Chiswick, Lee et al. 2008; Farré 2013). This analysis uses these standard measures but also uses a measure of physical functioning (namely, Short-form Health Survey 12 Physical Component Summary (SF-12 PCS)) that is arguably better suited to such a comparison. Therefore, this chapter also contributes to the literature by offering a comparison between these different health measures.

For our main measure of health, poor physical functioning (SF-12) the analysis finds an estimated health advantage of male immigrants in the year after arrival at 6.5 percentage points, compared to the UK-born population but only a small non-significant advantage for female immigrants. This initial health advantage decreases with length of residence and is largely not statistically significant for immigrants from between 8 and 15 years since migration, depending on gender and health measure. The analysis also illustrates that findings are sensitive to the health measures used with some commonly used measures likely overestimating the initial immigrant advantage.

3.2 Background

3.2.1 Health advantage of recent immigrants

Positive selection effects

Numerous studies in developed countries such as the U.S., Australia and Canada but also several in European countries find that the health of recent immigrants is better than that of 'comparable' native born people, a definition typically based on age, gender[29] and education. While there is agreement with respect to the empirical evidence for the existence of a HIE, there is no unified theory and different explanations as to why this is observed have been put forward.

Authors agree that positive selection of immigrants is a major part of the reason for this pattern (Jasso, Massey et al. 2004; Kennedy, McDonald et al. 2006 (who also provide evidence for extent of selection on education); Chiswick, Lee et al. 2008; Razum 2009; Farré 2013). Positive selection means people who emigrate are particularly healthy compared to the general population of the sending country. According to economic theory, the expected gain of migration (i.e. higher earnings compared to country of origin) needs to exceed the cost of migration for a person to decide to migrate (Borjas 1985; Borjas 1987). Migration costs include direct costs such as travel, as well as emotional costs, for example being separated from family or cultural differences. Earnings are determined by both observed characteristics such as education and qualifications and unobserved characteristics such as motivation and ambition. Labour immigrants are positively selected from the population of the country of origin on both skills (education and qualifications) and unobservable characteristics (Jasso, Massey et al. 2004).

The main characteristics associated with this positive selection – skills and unobserved characteristics such as character traits that ensure labour market success – are also associated with good health. For example, a high level of education affects health positively in many ways. Educated people have higher incomes and are therefore better able to afford a healthy lifestyle and better decision-making skills also help maintain

[29] Immigrant groups are more likely to be younger and more likely to be male and hence have better physical health. These factors are sometimes considered as positive selection (e.g., Kobayashi, Prus et al, 2008) but mostly the HIE is already considered net of age-sex differences.

good health (Jasso, Rosenzweig et al. 2001). Unobserved characteristics such as forward-looking behaviour that may improve labour market chances are in the same way important for good health (Kennedy, McDonald et al. 2006). People migrating for labour are therefore also positively selected on health (Jasso, Massey et al. 2004; Chiswick, Lee et al. 2008; Kennedy, Kidd et al. 2014).

This type of cost/benefit model also implies variation in the degree of selectivity depending on region of origin. Costs depend on the distance of the move and the potential gain depends on the difference between income in the home country and destination country, something which varies with the skills price across countries of origin. Greater costs for migration require greater benefits to make migration worthwhile (Jasso, Massey et al. 2004). Selective immigration policies that try to attract skilled workers such as the points-based system introduced in the UK from 2004 onwards can also be considered as positive selection on observable and unobservable characteristics associated with better health (Kennedy, Kidd et al 2014)

In addition to this indirect selection on health, there is also a direct selection on health. Firstly, this is because a certain minimum level of health is required to make migration worthwhile (Jasso, Massey et al. 2004). Secondly, some countries conduct health screenings at the time of entry. These have also been put forward as an explanation for the healthy immigrant effect by some (Dunn and Dyck 2000; Laroche 2000; Chiswick, Lee et al. 2008). However, in most cases this only rules out specific (infectious) diseases, so is not likely to have a strong influence (Domnich, Panatto et al. 2012) and there is little evidence of this having an effect. Furthermore the UK has no comprehensive health screening system.

Self-selection mechanisms only apply to voluntary migration. As far as they are related to labour outcomes, they are applicable especially to economic migrants and to a lesser extent to family migrants. Though most authors do not detail this explicitly, voluntary non-labour migrants, such as family migrants, can also be positively selected even though their gains from migration are not related to potential earnings. They will be positively selected on characteristics relevant in taking any migration decision, such as being forward-looking (Kennedy, McDonald et al. 2006). To some extent they will also be selected on education or family background because they need the financial means to migrate (Kennedy, McDonald et al. 2006).

When considering positive selection one needs to keep in mind that immigrants are selected from the overall population of the country of origin and average population health differs across sending countries. This means that if average health in the sending country is very low, even very positively selected immigrants might not be much healthier than comparable native-born in the receiving country (Jasso, Massey et al. 2004; Chiswick, Lee et al. 2008).

Health behaviour effects

The second explanation for the HIE is that it is due to healthier behaviours in the country of origin, especially in less developed countries (e.g., Chiswick, Lee et al. 2008; Malmusi, Borrell et al. 2010; Farré 2013; Kennedy, Kidd et al. 2014). These behaviours include healthier dietary habits, lower levels of smoking and alcohol consumption, and a less sedentary lifestyle. These health behaviours reduce the risk of chronic conditions that are leading causes of mortality such as cardiovascular disease (Chiu, Austin et al. 2010). However, as Smith, Kelly et al. (2012) point out with respect to ethnic minority groups (as distinct from immigrants), not all have consistently favourable profiles across all health behaviours.

Economists tend to define the HIE exclusively by positive selection, and argue that immigrants' health should ideally be compared to the population of the country of origin that has not emigrated to identify a HIE (e.g., Jasso, Massey et al. 2004; Farré 2013). From a public health perspective however, the comparison to the population in the host country is of interest (e.g., Fennelly 2007). Most studies understand the HIE relative to native born, due to their focus on the health advantage over a given native born population, or simply due to lack of suitable data for inter-country comparisons. This analysis considers the HIE in this sense, relative to the native-born population. The degree of the selection relative to sending country health is only indirectly of interest, in as far as it results in health differences relative to the native-born population.

Reflecting the different perspectives the healthy immigrant effect is understood in different ways. The health difference understood by most authors as HIE is the health difference between recent immigrants and "comparable" native-born people. Often studies do not give detail in what respect native-born should be comparable to immigrants, however mostly there is an adjustment for SEP, e.g. education.[30] This implies that they view the cause of the HIE as positive selection beyond selection on education, such as unobserved skills or character traits such as being forward-looking and healthier behaviours that can follow from this. This is broadly similar to what economists consider as "immigrant selectivity" which is conditional on observable skill (Jasso, Massey et al. 2004). *This health advantage compared to native born with similar observable characteristics is what we understand as the HIE.*

[30] Especially in public health research studies models frequently use post-migration characteristics, especially socio-economic variables, without considering the implications for interpreting a health difference at or shortly after arrival. (e.g. Dunn and Dyck 2000; Newbold 2006) While using post-migration SEP might be considered necessary when having longer-standing immigrants in the sample, one has to consider that this captures part of the a disadvantage (over qualification, discrimination) that migrants face in the host country and which causes the negative duration effect but which is not appropriate to consider for the initial HIE because initial health can only be related to pre-migration characteristics.

In addition to positive selection effects and healthy behaviour effects, we also need to consider methodological and measurement issues. Some have argued that an apparent HIE is due to measurement artefacts or spurious findings due to methodological limitations (McDonald and Kennedy 2004; Vissandjee, Desmeules et al. 2004; Nolan 2012). The impact of using different health measures is discussed further in section 3.4.

3.2.2 Health assimilation

The HIE is relatively short-lived. Once in the host country, immigrants' health starts to decline and converges over time with native levels (e.g., McDonald and Kennedy 2004; Biddle, Kennedy et al. 2007). *Immigrants' health seems to deteriorate more over time than would be expected due to normal ageing processes. This assimilation is referred to as the duration effect.* Various explanations have been put forward for the apparent decline in immigrants' health over time; many of them are complementary to each other rather than competing.

Possible explanations for the deterioration of immigrants' health after migration centre around immigrants' acculturation such as adopting unhealthy eating habits and other lifestyles such as smoking or alcohol consumption from the host country (e.g., Biddle, Kennedy et al. 2007; Finch, Lim et al. 2007). Dietary acculturation is complex. However, usually there is a shift from diets that are less calorie dense, low in saturated fat and low in processed foods to diets higher on these characteristics (for black Caribbean Sharma, Cade et al. 1999; Satia and Shatenstein 2010).

Discrimination that immigrants experience in the labour market with higher occupational risks (Szczepura, Gumber et al. 2004; Johnson 2006) and in the housing market where they often have poorer quality housing (Nazroo 2003), can also have a detrimental effect on physical health over time. Barriers to accessing health services due to language problems, insufficient knowledge of the health system and cost can lead to leaving health problems untreated, as can underuse of preventive health services (Newbold and Danforth 2003; Fennelly 2007).

Poor socio-economic conditions in early life that can affect risk of some chronic conditions later in life (Nazroo and Williams 2006) and poor health care in the sending country could contribute to deteriorating health of immigrants post-migration because of the long term implications of early life exposures. These factors possibly do not affect the risk of ill health at the time of migration and in the first years after migration when most immigrants are young adults but rather later in life. This is rarely explicitly considered as a possible explanation for the negative duration effect but implied for example by Dunn and Dyck (2000).

Jasso et al (2004) and Biddle, Kennedy et al. (2007) argue that the deterioration is simply the consequence of the initial positive self-selection and can be interpreted as simple regression of immigrants' health to the mean. This would imply that the deterioration does not go beyond native health levels. However other factors such as discrimination, could explain any excess deterioration.

For subjective health measures like self-reported health adjusting one's perception of what constitutes good health is another possible explanation. With increasing experience of the host country, immigrants' comparison group when rating their own health may change to the (higher) standards of the host country. As a result immigrants health seemingly deteriorates over time even if there is no change (Farré 2013).

3.3 Empirical evidence

In the following two sections empirical evidence for the HIE and duration effect, respectively, are reviewed. The review only considers studies on morbidity, not mortality as this study considers the HIE in terms of morbidity only[31]. This review focusses on studies that identify a HIE in the sense used in this paper, i.e. net of observable characteristics, and relative to the native-born population.

Many, especially Canadian, studies control for aspects that give rise to the HIE and by including post-migration measures (especially socio-economic position but also health behaviours or health service use) they answer different questions at the same time (e.g. Gee, Kobayashi et al. 2004; McDonald and Kennedy 2004; Newbold 2005; Newbold 2006; Kobayashi and Prus 2012; Nolan 2012). Hence, despite interpreting the results as HIE they do not actually quantify the initial health advantage of immigrants. This can result in an over- or underestimate of the HIE, depending on immigrants' post-migration socioeconomic status relative to their pre-migration socioeconomic status, in particular, education.

3.3.1 Initial Health Advantage

The majority of studies considering recent immigrants[32] find evidence that they are in better health than natives across a range of health measures including poor self-rated health (SRH), presence of chronic condition(s), and low birth weight (Newbold and Danforth 2003; McDonald and Kennedy 2004; Kennedy, McDonald et al. 2006; Newbold 2006; Biddle, Kennedy et al. 2007; Chiswick, Lee et al. 2008; Farré 2013).

Findings largely reflect the theories relating immigrants' health advantage back to selection, and reflect differing degrees of selectivity. Compared to immigrants with higher migration cost or less potential gain, there is often only a smaller (or even no)

[31] Studies on mortality are not included because for mortality there are separate additional issues with respect to native-immigrant comparisons such as registration; also, for the initial health advantage mortality is a very strict measure given the young age distribution of the population we consider.

[32] Most of the studies do not strictly estimate the health advantage of immigrants at arrival, but rather compare the health of "recent" immigrants to that of the native born population. The definition of recent varies and is often up to 10 years of residence in the host country.

health advantage for recent immigrants who have less migration cost, such as people emigrating from English speaking countries to other English speaking countries (McDonald and Kennedy 2004, for Canada; Biddle, Kennedy et al. 2007, for Australia), or not migrating over far distances (Chiswick, Lee et al. 2008; Farré 2013) and for immigrants who have potentially larger gains from migration such as those coming from less developed countries (Chiswick, Lee et al. 2008; Malmusi, Borrell et al. 2010; Domnich, Panatto et al. 2012).

Also in accordance with theory, advantages in (self-rated) health of immigrant women – who more often migrate for family-related reasons and should be less positively selected – are smaller than those of immigrant men (Vissandjee, Desmeules et al. 2004; Kobayashi and Prus 2012). Comparisons of chronic conditions yield equally large immigrant advantages for both sexes (McDonald and Kennedy 2004; Vissandjee, Desmeules et al. 2004). This might also reflect problems with the health measure rather than actual health status, as will be discussed below. Studies find evidence both for the role of positive selection on education (Kennedy, Kidd et al. 2014) and better health behaviours (Sander 2009, for body mass index among immigrants in Germany; Kennedy, Kidd et al. 2014 for smoking, but not for obesity, among immigrants in the UK) in explaining the health advantage of recent immigrants over native born populations.

Few studies compare immigrants to members of the same ethnic group born in the host country, probably owing to the young age structure of native-born ethnic minorities in most host countries and limited sample sizes. Cho, Frisbie et al. (2004) find for the U.S. that recent Latin American, white and black immigrants have a health advantage over U.S. born people of the same ethnic group. Whether this advantage is bigger or smaller than the advantage of the immigrant population as a whole depends on the ethnic group.

An important difference between the UK and the countries that are most commonly considered in HIE studies (the United States, Australia and Canada), is the free movement for EU citizens to the UK. Free movement within the EU means that people with very low migration costs are part of the immigrant population in the UK, implying lower selectivity for immigrants from these countries. The immigrant population of the United States also does not have the same educational advantage relative to the native-born population as is the case in the UK (Antecol and Bedard 2006; to a lesser extent also in Kennedy, Kidd et al. 2014). Results from these countries are therefore not entirely transferable to the UK.

Evidence for the UK

There is little evidence available for the HIE in the UK because very few UK immigrant health studies distinguish immigrants by length of residence. An early study on immigrant mortality in England and Wales (Marmot, Adelstein et al. 1984), based on 1971 Census data and register data, finds that immigrant mortality is lower than that of the general population in Britain. Mortality rates for immigrants from Poland, Italy, the Indian subcontinent and the Caribbean were also much lower than mortality rates in their respective home countries, though not those of immigrants from Ireland who had the lowest immigration cost and should therefore show less positive health selection.

Nazroo (1997) finds less consistent results for self-reported health. Using data from a cross-sectional survey in Britain in 1994, the Fourth National Ethnic Minorities Survey, he compares the health of immigrants and UK-born people of the same ethnic groups. He finds Caribbean and Indian immigrants are considerably less likely to report fair or poor health (rather than good or excellent health) than their UK-born counterparts, but for Pakistani and Bangladeshi groups the differences are negligible. However, due to small sample sizes the analysis can only adjust for age and gender and considers only 15-year age bands for each group (covering younger to middle-aged adults) because of little overlap in the age distribution. Given that both studies include longstanding immigrants it is remarkable that they still find a health advantage over the UK-born population. Other studies that look at specific ethnic groups amongst immigrants find the opposite. For example Harding, Rosato et al. (2004) find that children born to foreign-born Indian, Pakistani, Bangladeshi, Black Caribbean and Black African mothers have lower birthweight compared to UK-born white mothers.

Two studies compare specifically the health of fairly recent immigrants to the UK-born population (Swerdlow 1991; Kennedy, Kidd et al. 2014) and they both find an immigrant health advantage. Swerdlow (1991) finds in a follow-up study lower mortality as well as lower cancer rates for Vietnamese refugees who have been in England and Wales for up to 10 years, compared to the general population. Given that refugees are not normally positively selected from the sending country's population this likely reflects healthier behaviours of Vietnamese in general.

The second study is by Kennedy, Kidd, McDonald and Biddle (2014) which is to our knowledge currently the only study that quantifies the HIE of recent immigrants in the UK. Using data from the Health Survey for England (HSE) and the General Household Survey (GHS), they estimate the proportions in poor health for immigrants at 2.5 years since migration (YSM)[33] and for native-born, adjusted for gender, age, education and marital status. Immigrants are categorised into country of birth groupings broadly similar to ethnic groups, for example they consider South Asians i.e. Indian, Bangladeshi and Pakistani. These groupings are fairly wide as there are for example significant differences in health between Indians and other South Asians (Nazroo 1997). As the study uses data from between 1999 and 2005 it also misses most of the Eastern

[33] The sample includes immigrants up to 10 years since migration. Prevalence of ill health of immigrants is estimated at 2.5 years since migration (personal communication).

European immigration for whom the HIE might be smaller than for Western European immigrants.

Kennedy, Kidd et al. (2014) find the foreign-born population overall has less often a chronic condition than the UK-born (6 percentage points), with some variation across groups of origin. However, as the authors acknowledge the chronic condition measure in the HSE suffers from severe under-reporting because respondents were asked to name any diagnosed condition rather than having a list read out to them.[34] Even when accepting the underreporting, in order for this measure to be valid for an immigrant-native health comparison the underreporting would need to be homogeneous across groups. However, given the design of the question the underreporting is probably related to educational level. With respect to self-rated health the estimated HIE in this study are less consistent: Overall immigrants again have a 6 percentage point advantage over native-born but continental European and African immigrants are the only two groups for which the advantages are significant, while Middle Eastern immigrants are at a substantial disadvantage (Kennedy, Kidd et al. 2014).

3.3.2 Health assimilation

There is abundant evidence consistent with a negative duration effect based on cross-sectional data, e.g. for Canada (Dunn and Dyck 2000; Newbold and Danforth 2003; Vissandjee, Desmeules et al. 2004; Kobayashi and Prus 2012), the United States (Cho, Frisbie et al. 2004, also within ethnic groups; Uretsky and Mathiesen 2007; Williams, Mohammed et al. 2010, within ethnic groups), as well as European countries (Malmusi, Borrell et al. 2010, for Spain; Nolan 2012, for Ireland). The weakness of the cross-sectional designs is that they confound period of arrival and time since migration.

[34] Their HSE-based estimate of adjusted prevalence of chronic condition is 14.5% for UK-born. For a similar sample using wave 1 data of the UKHLS the estimate for the adjusted prevalence of chronic condition amongst UK-born is 29%.

Results could therefore reflect permanent differences between arrival cohorts rather than genuine effects of length of residence.

Studies using multiple cross-sections can overcome this and provide evidence for a genuine health assimilation of immigrants to native levels with increasing length of residence (McDonald and Kennedy 2004, in Canada; Antecol and Bedard 2006, in the U.S.; Biddle, Kennedy et al. 2007, in Australia). All three studies find significant YSM effects net of any effects of arrival cohort. These results support the idea of a duration effect rather than there being permanent health differences across immigrant cohorts. In McDonald and Kennedy (2004) and Biddle, Kennedy et al. (2007) some early cohorts (arriving pre-1970) retain their health advantage over time more than other cohorts. However, McDonald and Kennedy (2004) demonstrate that the degree of misspecification introduced by not accounting for arrival cohort is small and they argue the results are mainly explained by length of residence. Biddle, Kennedy et al. (2007) also interpret their results mainly as length of residence effect.

Two longitudinal studies, for Canada (Newbold 2005) and Germany (Ronellenfitsch and Razum 2004) also support the negative duration effect. Both find that over a period of six years immigrants are more likely than natives to transition into poor self-rated health. Newbold (2005) finds that the increase in risk is greater for more recent arrivals. This could indicate a more rapid decline in health at the beginning of the stay. However, the study does not control well for compositional differences between immigrant cohorts.

Cases where no duration effect is found are the exception, most often found with respect to specific chronic conditions e.g., Nolan (2012) and Biddle, Kennedy et al. (2007). A study comparing a number of different immigrant groups in Australia (Gray, Harding et al. 2007) demonstrates that some migrant groups can enjoy a protective effect of retaining behaviours from their regions of origin, such as healthy diet which might be the explanation for lower CVD mortality compared to Australian born. In exceptional cases, studies find that the health advantage of immigrants increases with length of residence (Newbold 2006, for asthma).

Whether and, if so, at what point full convergence of immigrants' health levels to that of the native-born population is observed varies and also depends on the modelling approach. When length of residence is used as a categorical variable**,** most studies find that immigrants in the top coded category still have significantly better health than the native born population (e.g. for SRH in the U.S. the studies of Cho, Frisbie et al. (2004) and Uretsky and Mathiesen (2007); in Canada Vissandjee, Desmeules et al. (2004) for immigrant of chronic condition, but not for SRH). This apparently persistent health advantage even for the most long-settled immigrants could be due to the relative low cut-off for the top category used in most studies (mainly 10+), meaning that mean length of residence in this group might still be relatively low.

Studies using length of residence as a continuous variable are informative because they give an indication at what length of residence immigrants' health is not anymore significantly better than that of natives. In line with the large initial advantages usually found for chronic condition full convergence is observed particularly late: For non-severe chronic condition McDonald and Kennedy (2004) estimate convergence at 30 YSM for men and 20 YSM for women, the latter beyond native levels . Biddle, Kennedy et al. (2007) even find at 45 YSM no full assimilation in the prevalence of chronic condition of male immigrants (especially Europeans) to native health levels, while female English speaking immigrants' prevalence convergences after a few years. Convergence of immigrants' and natives' levels of poor SRH tends to be estimated earlier: in McDonald and Kennedy (2004) at 15 YSM for women (while men had no advantage in the first place, and the trajectory over time is flat) and Nolan's (2012) results imply convergence at around 6 YSM.[35]

In summary, studies vary widely in age range of study population, sample size, composition of migrant population and their modelling approach with regard to length of residence but consistently find a duration effect. Those that can distinguish between YSM and cohort effect find that the YSM trajectory is more important than cohort effects. The longitudinal studies cited here have the drawback that the periods covered are short, so that change in health status is limited.

3.3.3 Ethnic health inequalities and differences in health behaviours in the UK, and intersection with immigrant status

Analyses of the HIE by ethnic group are rare, mostly are for the U.S. (e.g. Cho, Frisbie et al. 2004; Williams and Mohammed 2008). Studies in other countries usually compare immigrants to the native-born population as a whole. There are several reasons for this. Firstly, for a within-ethnic comparison there needs to be a large enough native-born (adult) population of the ethnic group, which is only with a reasonably long immigration history. Secondly, sample sizes will often be too small. Thirdly, region of origin is an important determinant of immigrant selectivity and therefore takes precedence over ethnicity, which overlaps with it.

Ethnic group membership, understood as ancestry or region of origin, has long been recognised as being associated with a broad range of outcomes relating to people's life chances for education, health or employment (Nazroo and Williams 2006). At the core of ethnicity is the common culture, sharing factors such as language, diet and religion (Bhopal 2004) which can affect health in many ways.

[35] These figures are based on own calculations of the marginal effects given in the tables, as Nolan does not discuss the health trajectory. As there are hardly any such long-settled immigrants in Ireland apart from British people it is maybe not appropriate to draw conclusion with respect to longer YSM.

Migration introduces major differences in a person's environment and lifestyle that may have health implications. At the same time, migrants often belong to a different ethnic group than the native-born majority population of the host country. The importance of this intersection of ethnicity and immigration status has been acknowledged by several authors (Nazroo 1997; Bhopal and Rafnsson 2012). Health differences between ethnic groups can be related to health-related immigrant selection as well as heterogeneous post-migration experiences (Nazroo 1997) but also differing pre-migration exposures. For example, Harding, Rosato et al. (2008) suggest that the changing composition of ethnic groups with respect to migrant status, combined with different pre-migration exposures, could explain why trends of risk factors for coronary heart disease and stroke mortality differ across South Asian groups in the UK. Both the proportion of foreign-born and in particular the role of length of residence in ethnic health comparisons is often not considered and could explain part of these patterns or mask important differences.

Ethnic health inequalities are an important public health issue in the UK. Just over half of the foreign-born UK population belongs to an ethnic minority group[36]. Conversely, between 40% and 80% of each of the five largest non-white ethnic groups in the UK are foreign-born (own calculations, UKHLS wave 1, ages 16+). Despite this large intersection, health inequalities across ethnic groups have been a focus of UK research while the effect of immigrant status on health receives far less attention compared to other countries (e.g. Canada). This can be partly explained by a lack of data sources containing information on immigrant status and in particular year of arrival.

There are considerable health differences between ethnic groups in the UK. For SRH black Caribbean, Pakistani and Bangladeshi have a higher risk of reporting fair or poor health (as opposed to good or excellent health) than white British, while Indian and

[36] In the following the term ethnic minority group will be used to describe non-white groups.

Chinese do not differ significantly from white British (Nazroo 1997; Nazroo 1998). Mindell, Knott et al. (2013) find that these inequalities in poor SRH are greater among women than men. The extent of inequality for chronic conditions varies depending on the condition but again black Caribbean, Bangladeshi and Pakistani have a significantly higher risk for two of four chronic conditions, while for Chinese the risk is similar to that of white British for all conditions (Nazroo 1997; 1997; 1998).[37] Indians only have a higher risk of diabetes and a significantly lower risk of hypertension. There are many possible explanations for these differences, such as educational level or health behaviours. It needs to be noted that these results were only age and gender standardised and so lower levels of education amongst the older foreign-born Bangladeshi/Pakistani cohorts, as well as the high levels of education amongst Indians might explain part of these differences.

For poor SRH Nazroo (1997) shows that adjustment for socio-economic position accounts for part of the disadvantage but not all. There are several possible explanations for the remaining difference. For example, belonging to an ethnic minority group, especially a 'visible' minority group, can be a source of discrimination and affect health directly and indirectly (Nazroo 2003). Experience of discrimination, both interpersonal and institutional, leads to accumulating disadvantage in many forms that contribute to the inequalities (Karlsen and Nazroo 2002). Albeit the role of genetic differences is often overstated by viewing SEP adjustment as complete when it usually is not, and attributing the remaining effect of ethnicity on health as genetic or cultural (Karlsen and Nazroo 2002), genetic differences can also help explain differences in health across ethnic groups. Finally, there is a cultural component. Culturally determined health behaviours could contribute both to health advantages and

[37] A caveat is that all the statistics on ethnic groups are based on samples with mixed immigrant status, comprising mainly of foreign-born people, but their mean length of residence will vary across groups. Hence these results can be affected by migrant status.

disadvantages of minority ethnic groups compared to white British, depending on the behaviour and health outcome in question. The HIE and its explanation as (partly) originating from healthier behaviours of non-Western immigrants reflects this and emphasises that these behavioural differences are 'imported' by the foreign-born population within any ethnic group and are not necessarily stable over time and across generations. With increasing acculturation, these culturally determined health behaviours are gradually replaced by the less healthy behaviours of the host society (e.g. with respect to diet, Gilbert and Khokhar 2008). This acculturation takes place both within the first generation as their length of residence increases, but also across generations.

There is a lack of studies that compare health behaviours of second generation immigrant groups to the majority population but Smith, Kelly et al. (2012) provide a comprehensive comparison of health behaviours (smoking, alcohol use, physical activity, diet) of 1st and 2nd generation black Caribbean, Indian, Pakistani, Bangladeshi, Chinese and Irish compared to the white majority population in the Health Survey for England. Adjusted for age and sex they find considerable variation in the health behaviours with Indians of both generations having the most favourable and Bangladeshi of both generations the least favourable health behaviour profile among the minority groups. Smoking and alcohol use are the behaviours with the largest advantages of ethnic minority groups of both generations over white British, especially South Asians who are Muslim.[38] Dietary behaviours (eating crisps and sweets, eating fried food, fruit and vegetable intake) are more mixed but overall UK-born ethnic minority groups tend to have slightly better behaviours than white British (Smith, Kelly

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[38] While Smith, Kelly at al. (2012) find that Bangladeshi women of both generations have exceptionally low prevalence of smoking (2%) this does not consider the custom of chewing pan which often includes tobacco and carries similar health risks (Khan, Robinson et al., 2000). Pan chewing is common in South Asian populations in the UK, but particularly amongst Bangladeshi of both genders (ibid.), with an estimated prevalence of 66% among Bangladeshi in England (Health Education Authority 1994).

et al. 2012). These results suggest that while there is considerable deterioration in health behaviours from 1st to 2nd generation immigrants, most health behaviours of non-white UK-born groups – in particular smoking and alcohol use – are still better than those of the white UK-born population.

3.4 Health measures in HIE studies

The choice of health outcomes to measure (physical) health status in datasets is often limited. Many studies therefore rely on SRH as a measure of health despite acknowledging problems of this measure (e.g., Nolan 2012). SRH is a subjective measure based on a single question asking how people assess their health with usually five answer categories ranging from poor to excellent (or similar). Poor SRH is a valid health status indicator and has proven a good predictor of mortality (Quesnel-Vallee 2007; Singh-Manoux, Gueguen et al. 2007), of functional limitation (Idler and Benyamini 1997) and health service use (Miilunpalo, Vuori et al. 1997).

SRH is known to have problems of reporting heterogeneity across socio-economic position (Lindeboom and van Doorslaer 2004; Johnston, Propper et al. 2009). The use of SRH in immigrant-native health comparisons is also criticised because it might introduce bias due to different response styles for immigrants and natives, and across ethnic groups where there may be a lack of cultural equivalence (Acevedo-Garcia, Bates et al. 2010; Kobayashi and Prus 2012).

Even more pertinent to HIE studies is that comparisons across subpopulations are not valid if no comparison group is stated in the survey question and respondents might use different comparison groups (King, Murray et al. 2004). For immigrants it is unclear what comparison group they use when assessing their health – the population in the host country or that in the country of origin that might be more familiar to them. It is also likely that their reference group will change with duration of residence (Cho, Frisbie et al. 2004; McDonald and Kennedy 2004; Chiswick, Lee et al. 2008; Farré 2013). For immigrants from countries with less good population health, this leads to an overestimate of the health advantage of (recent) immigrants due to lower expectations compared to the native born population. Hence the often rapid decline in SRH among immigrants with increasing YSM might reflect more their changing perception of health, rather than an actual deterioration in health (McDonald & Kennedy 2004, Newbold 2005).

The second commonly considered outcome in HIE studies is presence of a diagnosed chronic condition. Chronic conditions are non-communicable conditions of an enduring nature, usually with onset in adult life and progressing slowly (Salway, Platt et al. 2007; no author 2015). The main types are cardiovascular disease, cancer, chronic respiratory disease and diabetes and are frequently related to unhealthy lifestyles.

HIE studies implicitly use both SRH and chronic condition as a proxy for general physical health (e.g., Nolan 2012; Kennedy, Kidd et al. 2014). Some HIE studies consider diagnosed chronic condition as a more robust measure of (physical) health than poor self-rated health (Acevedo-Garcia, Bates et al. 2010; Jatrana, Pasupuleti et al. 2014). HIE research using chronic condition shows more consistent evidence for a HIE across studies than SRH which is interpreted as indicating the quality of the measure (Acevedo-Garcia, Bates et al. 2010). More consistent results are not necessarily more accurate, probably this is simply a result of overestimation making a significant HIE more likely regardless of immigrant group considered. Diagnosed condition is indeed a more objective measure of health than SRH in the sense that it asks for information originally given by a health professional and does not rely on respondents' subjective assessment.[39] However, there are several issues that are problematic when using it to compare health of new immigrants versus native born Western populations:

As McDonald and Kennedy (2004) point out, immigrants from countries with a poor health care system who have a chronic health condition will have less likely been diagnosed than people in highly developed countries, thus underestimating levels of chronic conditions. Health care systems in developing countries often focus on acute rather than chronic conditions (Steyn and Damasceno 2006), leading to underdiagnosis of chronic conditions.[40] Related to this is the fact that where recent immigrants do not use the health services of the host country to the same extent as natives, the immigrant would also be less likely to be diagnosed in the host country (Farré 2013). With increasing length of residence immigrants' use of health services should increase and formerly undiscovered conditions diagnosed (McDonald and Kennedy 2004; Nolan 2012).[41] In an empirical analysis this would appear to be a negative duration effect, with immigrants' health getting worse with increasing length of residence despite there being no real deterioration.

Furthermore, lack of diagnosis implies that the health condition remains untreated, leading to even poorer health than if the condition was diagnosed and treated (i.e. for people who were subject to different health care systems the underestimation of poor health by "diagnosed chronic condition" is larger than just the difference in health

[39] Although a study by Johnston and Propper (2009) suggests there is still potential for reporting heterogeneity across SEP (underestimating income/health gradient) and across ethnic groups (overestimating disadvantage of ethnic minority groups as they have more false positives).
[40] E.g. underdiagnosis of diabetes in developing countries: Guariguata, L., T. Nolan, et al. (2013). IDF Diabetes Atlas, 6th edition, International Diabetes Federation.
[41] For Canada, Kennedy and McDonald (2004) found that after 6 to 9 years immigrants use the health service as much as the native-born population. Their levels of diagnosed chronic conditions however take much longer to reach the high native-born levels. Another study (Jasso, Massey et al 2004) compares the rates of chronic conditions between new immigrants who have seen a doctor in the past year to the native-born population, and still finds that immigrants have much lower rates. However both studies acknowledge that there is still scope that there are differences in diagnosis, e.g. due to language barriers, and that would lead to immigrants being less likely diagnosed.

between a person without a condition and a person with a diagnosed and treated condition). Even conditional on correct diagnosis in the home country, quality of treatment will differ across regions thus the actual health status associated with having a given condition might vary across regions of origin.

The discussion also does not recognise that chronic condition can only be a valid measure or proxy of poor health status if the proportion of ill health due to chronic conditions relative to other causes – mainly infectious diseases and injuries – is similar across populations. This is not the case. Around 90% of the total disease burden in high income countries is attributable to non-communicable diseases[42]. In low/middle income countries, non-communicable diseases contribute just 45% of the disease burden (Mathers, Fat et al. 2008). Immigrants from developing countries might suffer from other health problems more often, e.g. problems related to insufficient nutrition or health care in early life, such as musculoskeletal conditions, or long-term consequences from infectious diseases (e.g. post-polio syndrome). Injuries are not only more common in less developed countries but will also more often have lasting effects due to insufficient treatment.

In summary, all these aspects – differing composition of causes of ill health, differing probabilities of diagnosis and treatment quality – have the same effect when comparing immigrants' and natives' health. Diagnosed chronic condition will underestimate ill health of immigrants relative to the UK-born population. For immigrants (from developing countries), the probability of diagnosed chronic condition will be smaller than the probability of poor health estimated with a functional health measure that captures effects noticeable to the respondent regardless of cause and diagnosis. For the UK-born, the relationship between the two health measures might even be reversed.

[42] The WHO uses the term non-communicable diseases rather than chronic condition, but they are interchangeable: no author. (2015). "Factsheet Noncommunicable diseases " Retrieved 18.9.2015, from http://www.who.int/mediacentre/factsheets/fs355/en/.

The probability of having a diagnosed chronic condition will be larger than that of poor SRH or functional health measures to the extent to which a diagnosis of a chronic condition goes hand in hand with its effective treatment. These effects would result in a substantial overestimate of HIE in the UK when using chronic condition as measure of poor health.

We conclude that both SRH and chronic condition have the potential to overestimate the initial health advantage of immigrants and of the rate of the following decline. Some studies therefore use more reliable measures such as birth outcomes (Farré 2013; Giuntella 2013)

3.5 Hypotheses regarding health differences between immigrant and native born populations in the UK by length of residence

This paper asks whether there is a HIE for recent immigrants to the UK, and if so, how large is the effect. With respect to the first research question, if there is a HIE, we formulate specific hypotheses in the following. While this paper considers the health advantage net of observable characteristics as the HIE, we start one step before and consider the age-sex adjusted health advantage as starting point. This reflects the overall advantage of immigrants due to all observable and unobservable differences over UK-born.

Hypothesis 1 (H1): The HIE is partly due to immigrants' higher education compared to native born. We therefore hypothesize that after accounting for differences in pre-migration socio-economic characteristics (educational level), the HIE will be smaller than the age-sex adjusted HIE. The reason for immigration of male immigrants to the UK is more often work or study, while female immigration is more often for family-related reasons (especially amongst non-EEA migrants) (Cooper, Campbell et al. 2014). This means that the HIE for female immigrants should be considerably smaller than that for male immigrants.

Hypothesis 2 (H2): We hypothesise that among low educated people, the HIE for immigrants will be larger than among highly educated people. Jasso, Massey et al. (2004) argue that a minimum level of health is required to make migration worthwhile and therefore immigrants from countries with very poor health will be more highly selected. Amongst potential immigrants with low education (and therefore on average poorer health than more educated groups) the same should apply and therefore the selection should be stronger than amongst immigrants with high education, other things being equal.

The review in the preceding section has emphasized the role of positive selection in determining the health advantage of recent immigrants: The degree of positive selection is in turn determined by the migration cost and the potential gain from migration, both of which depends on characteristics of the country of origin. The health advantage will therefore vary within the UK immigrant population.

Geographical and cultural distance and also immigration rules determine migration costs. The main distinction from a UK perspective is here whether immigrants are from the EU or from outside the EU[43]. The gain from migration mainly depends on the additional earnings compared to the earnings in the home country. These depend on average income and skill prize (Jasso, Massey et al. 2004). This analysis is not concerned with quantifying the degree of selectivity of immigrants, and deriving a skill price

[43] An alternative measure for cultural distance in particular would have been whether a country is English speaking. This has been used for example by Chiswick, Lee et al (2008) and McDonald and Kennedy (2004). However for UK immigrants this criterion groups immigrants from countries that differ very much in the economic development (North America, Australia versus Caribbean). The EU non-EU distinction captures two important cost factors the geographical distance and the immigration hurdles and as such seems the stronger factor. To use it in addition to the other criteria would have resulted into small groups.

measure for immigrants from all countries of origin is complex. Therefore, we take the route of other papers that distinguish between rich and poor (or developed/less developed) countries only (Malmusi, Borrell et al. 2010). The grouping criteria reflect the selection mechanisms that should apply most to labour migrants. However, at least migration cost should affect immigrants considering migration for other reasons as well.

Grouping the immigrant population in the UK according to these criteria the main groups are: EU-14 countries, EU accession countries, high income non-EU countries[44] and low income non-EU countries. When holding educational level constant these regions reflect the degree of selection on unobservable characteristics, because the regions are associated with different migration costs (low for EU countries, high for other countries) and potential gains (low for high income countries (which includes most of EU-14), high for low income countries).

Hypothesis 3 (H3): We hypothesise that amongst immigrants from countries that are comparable in the potential gain of migration, those from countries with higher migration cost will have a larger HIE than those from countries with lower migration cost to the UK. This means immigrants from high-income non-EU countries should have a larger HIE than immigrants from EU-14 countries. Immigrants from low-income non-EU countries should have a larger HIE than immigrants from new EU countries.

Hypothesis 4 (H4): Amongst immigrants from countries that are comparable in the migration cost but differ in terms of potential gain immigrants from countries with

[44] High income countries are (with migrants in the analysis sample used in this paper) (as defined by the World Bank with Gross National Income per capita of at least US$ 10,066 in 2004 (Mathers, Fat et al 2008):
Non-EU: Australia, Brunei Darussalam, Canada, Israel, Japan, Kuwait, New Zealand, Qatar, Republic of Korea, Saudi Arabia, Singapore, United Arab Emirates, United States of America
EU-14, Norway and Switzerland: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland (and United Kingdom)
EU accession 2004/2007: Cyprus, Malta, Slovenia

higher potential gains should be less selected and therefore have a smaller HIE. This means that immigrants from old EU countries should have a larger HIE than immigrants from new EU countries. Also, immigrants from high-income non-EU countries should have a larger HIE than immigrants from low-income non-EU countries.

Of course, countries within each group also differ in other aspects that are not reflected in this categorization.[45] For example, it does not reflect whether a country is English speaking or not, which affects the transferability of skills to the UK and reduces the migration cost, both leading to lower selectivity. Hence there is considerable heterogeneity within country groups, especially within the group of high income non-EU countries. The health distribution in the population in the country of origin is another factor that determines immigrants' health. This should be captured in the grouping by income level. This means the grouping by income level reflects both potential migration gain and the population health of the country of origin. Both should be associated with immigrants' health in the same way.

Hypothesis 5 (H5): The last hypothesis concerns the HIE within ethnic groups. We hypothesise that for non-white minority groups the HIE within ethnic group should be smaller than the overall HIE (i.e. the HIE of all immigrants compared to the general UK-born population). While health behaviours of second generation immigrants, i.e. UK born ethnic minorities, are not as good as those of the first generation, they are overall still better than for white UK-born (Smith, Kelly et al. 2012). In as far as healthier behaviours give rise to the HIE and UK-born people of a given ethnic group still follow their own (healthier) cultural traditions, the health advantage of foreign-born people over UK-born people of the same group should be smaller. Health behaviours are here

[45] E.g. the U.S., Canada and Australia are countries with high skill prizes and geographically far from the UK, implying high selectivity of immigrants, but at the same time they are English-speaking, thus increasing skill transferability and reducing the hurdles of integration, which lowers migration cost; this would imply lower selectivity.

conceptualised as cultural-level characteristics, which can be captured by ethnicity (which is mainly determined by culture (Bhopal 2007)). Within-group variation across individuals is accounted for by adjusting for education which is a major predictor of health behaviours (Bartley 2004; van Oort, van Lenthe et al. 2005). White immigrants are not expected to have an advantage in terms of health behaviours over UK-born white because their health behaviours do not differ markedly from the general population in the UK.

3.6 Data and measures

This study uses data from the first wave of *Understanding Society*, the UK Household Longitudinal Study (University of Essex. Institute for Social and Economic Research. 2015) conducted in 2009/10. The UKHLS is a household panel study that follows a nationally representative sample of circa 26,000 households and an additional 4,200 households from an Ethnic Minority Boost (EMB) sample (Knies 2015).

The UKHLS collects detailed information on immigrant status, including time of arrival, and a series of health measures. The inclusion of EMB sample makes UKHKLS particularly suited to this analysis. It allows subgroup analyses of the five largest ethnic minority groups in the UK which had the aim to interview at least 1,000 adult respondents from each of Caribbean, Indian, Pakistani, Bangladeshi and African origin (Berthoud, Fumagalli et al. 2009). The questionnaire was provided in 10 languages, including those most relevant to the biggest minority groups, which should minimise non-response related to lack of English skills of immigrants.

3.6.1 Operationalisation of immigrant status and ethnic group membership

Immigrants are operationalised as people born outside the UK and can be identified in the data by their country of birth. The UKHLS includes a set of migrant-specific questions including when they (last) arrived to live in the UK, allowing us to infer the duration of residence at time of interview.

Ethnic group membership is self-identified. The single response question "What is your ethnic group?" is based on the UK Census 2011 question and provides 17 specified categories plus one 'any other ethnic group' (McFall, Nandi et al. 2014) All white sub-categories (British/English/Welsh/Scottish/Northern Irish, Irish, Gypsy/Traveller, any other white background) were combined into white and Bangladeshi and Pakistani were combined into one group. Black African and Indian remain groups as in the original question. This grouping allowed having around 1,000 respondents (after applying the sample restrictions detailed below) in four groups for separate analysis: White, black African, Indian, Bangladeshi/Pakistani[46]. Chinese, other Asian, other black, Arab/Middle Eastern groups, mixed backgrounds and "any other ethnic group" (if not further specified in the follow-up question) are included in the models of the overall population but cannot be considered as separate ethnic groups because sample sizes are too small.

While this ethnicity classification is in line with much epidemiological and health inequality research it hides heterogeneity with regard to aspects important for health. Cultural characteristics such as language (fluency of English) or religious affiliation (and with it dietary habits and other lifestyles) can vary substantially within some of these broad groups (Holmboe-Ottesen and Wandel 2012). Moreover, especially in the case of the white and black African groups they also encompass people from many different countries of origin, with different levels of economic development.

[46] Bangladeshi's health is usually worse than Pakistani's (e.g. Mindell et al 2013). Indians usually enjoy better health than Pakistani or Bangladeshi and are also the least disadvantaged in socio-economic terms. For this reason the latter two are often grouped together when small sample sizes make this necessary (Bhopal 2007). Table 27 in appendix B also shows the health of the Pakistani and Bangladeshi population is comparable for all three measures. The Bangladeshi/Pakistani model includes a dummy variable for Bangladeshi.

The sample is restricted to immigrants who have lived in the UK between 0 and 15 years. While this is not ideal for estimating the health of very recent immigrants, it is a compromise in order to allow analysis by ethnic group. In several studies (Cho, Frisbie et al. 2004; Uretsky and Mathiesen 2007) immigrants of 10 to 15 years of residence still have a health advantage over the native born population.

The choice tries to balance several factors[47]: The more recent migrants are, the younger their age structure. This leads in turn to quite a narrow age range in the analysis sample if it is to be reasonably age-balanced between UK-born and immigrants. This results in small sample sizes for the ethnic models and means it is in most cases not feasible to restrict the analysis to very recent migrants. The narrower the range of length of residence, the more likely that any compositional characteristics that are unique to this immigrant cohort are reflected in the estimated HIE. As previous studies have shown there is still HIE left in many cases for 10-15 if not more years. It is therefore not unreasonable to include such immigrants.

Sensitivity tests restricting the sample to 15, 10, 5 and 2 YSM show that results are indeed sensitive to choice of cut-off point (see Table 36 in appendix). The 15 YSM cut-off tends to give the largest HIE. This is rather counter-intuitive as one would expect that including longer-standing migrants with poorer health would reduce any immigrant advantage. When comparing across different health outcomes, the relative magnitude of HIE is the same regardless cut-off, with SF-12 PCS yielding the smallest advantage and chronic condition the largest.

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[47] An alternative approach would have been matching immigrants and UK-born with propensity score matching to achieve a balanced sample with respect to age (and other characteristics). This is difficult because there are not enough pre-migration variables available that allow predicting immigrant status. Also, for a within-ethnic group analysis there would not be sufficient UK-born cases to match.

The length of residence criterion means that the earliest year of arrival for this immigrant sample is 1994, the latest is 2010. For some immigrant groups this time frame includes changes in entrance criteria (for non-EU immigrants: the introduction of the points based immigration system (PBS) from 2002 onwards; for immigrants from Eastern Europe the EU accession from 2004 onwards (though there were hardly any immigrants from Eastern Europe in the earlier part of the time period)). However, the PBS affects mainly the educational level of the immigrants and this should be captured with the proxy education (described below). Only immigrants who moved to the UK aged 18 or older are included in the sample.

Refugees represent only a small proportion of immigrants to the UK. Only among African immigrants do they play a larger role relative to the total stock of foreign-born people in the UK .[48] Refugees do not underlie the same selection process as other immigrants. Moreover, the migration experience itself will often have negative health consequences for them (Chiswick, Lee et al. 2008). Ideally, we would therefore be able to distinguish between immigrants who arrived as refugees and others. We should then be able to identify a HIE for non-refugees. However, it is not possible to identify refugees in the data because information on reason for immigration or visa status is not available. African immigrants are therefore grouped into three categories based on the estimated likelihood of immigrants from a given country of birth having come to the UK as an asylum seeker (see appendix B).

[48] The highest number of asylum seeker applications, at least in the 2000s, came from people from (mainly Sub-Saharan) Africa and Asia (no author 2013). However, Asian asylum seekers make up only a small proportion out of the total Asian foreign-born population in the UK, while amongst the total foreign-born African population they are relatively more important. In the UKHLS data the only country of birth outside Africa with a sizeable number of immigrant respondents from a country that is classed as medium or higher risk (see description in appendix)) is Pakistan, though with an estimated 7% the risk is also rather low.

3.6.2 Analysis sample

UK-born ethnic minority members are mainly young as they are the children of the first generation of immigrants coming to the UK, while their foreign-born counterparts are older on average. There is therefore a lack of overlap of the age distributions of the two groups. This means older immigrants lack an adequate comparison group which can lead to biased estimates, a common problem in within-ethnicity comparisons. We restrict the study population to ages 21 to 49 to ensure common support across the age range (in particular within ethnic groups).[49]

The initial sample has 22,446 respondents with a full interview, aged between 21 and 49, and in the case of immigrants only people who have moved to the UK aged 18 or over and up to 15 years since migration. Of these, 132 were excluded due to missing health information. Another 962 cases were excluded due to missing values in one or more explanatory variables. This leaves a sample of 21,350 observations of which 17,856 are UK-born and 3,494 are immigrants. Table 4 gives the number of observations for the analysis sample by immigrant status and ethnicity.

Table 4 Number of observations by immigration status and ethnicity in the analysis sample; wave 1 UKHLS, ages 21-49 with complete covariate information

	UK-born	immigrants	total
White	15,873	961	16,834
Black African	117	578	695
Indian	419	547	966
Bangladeshi	136	264	400
Pakistani	337	316	653
Other, mixed or missing	974	828	1802
total	17,856	3,494	21,350

[49] Alternative approaches for this issue are matching techniques, which have not been pursued here because of the lack of suitable pre-migration variables to match immigrant and UK-born respondents; or using an age-matched sample (e.g. Ronnellenfitsch and Razum, 2004).

3.6.3 Health outcomes

This study uses three health outcomes: A measure of general (subjective) health (poor self-rated health), a measure capturing more distinct health problems (whether the respondent reported a chronic condition), and a measure of health-related quality of life (Physical Component Summary from the Short Form-12 Health Survey (SF-12)). Each health measure not only reflects different aspects of health but, as discussed in section 3.4, has different implications in the context of immigrant-native health comparisons. Despite their shortcomings this study still uses poor SRH and chronic condition, to facilitate comparability with other studies. The use of SF-12 as additional, more objective measure will offer a useful comparison of the HIE across the different measures.

Poor self-rated health

In the UKHLS the SRH question is part of the SF-12 instrument. It asks "In general, would you say your health is ..." and response categories are poor, fair, good, very good and excellent. People who answer 'poor' or 'fair' are classified as being in poor health. One needs to keep in mind that both physical and mental health aspects enter people's assessment of their overall health (Ware and Kosinski 2001) so it is not a pure measure of physical health.

Chronic condition

The second measure of poor health is whether the respondent has any diagnosed physical chronic condition. For a list of chronic health conditions, respondents are asked whether they were ever diagnosed with it, and then whether they still have this condition. If a respondent was diagnosed with and still suffers from at least one condition they are classified as having a chronic condition. The conditions included in the measure of physical chronic conditions are: Asthma, arthritis, angina, coronary heart disease, heart attack, stroke, emphysema, hyperthyroidism, hypothyroidism, any kind of liver condition, cancer or malignancy, diabetes, epilepsy and high blood pressure.

Most studies that use chronic condition, e.g. Kennedy, Kidd et al. (2014), cannot distinguish time of diagnosis. Though we can determine whether a condition was diagnosed before or after migration[50], it is difficult to use this information in the modelling as there is no equivalent cut-point for the native-born population. Just under half of the chronic conditions amongst immigrants were diagnosed after migration. One could consider only chronic conditions that were diagnosed before a specific age, so that for immigrants this still relates to their country of birth, but this is a results in cut-points at very young ages to be able to use chronic conditions at age 18 as proxy for health at time of migration. The type of chronic conditions that are diagnosed at such a young age are likely to be even less reflective of general physical health than chronic conditions overall, given that a typical feature of chronic conditions is that they usually develop at older ages (no author 2015).

Biddle, Kennedy et al. (2007) point out that of the chronic conditions some are more likely to reflect genetic predisposition, others more influenced by environmental conditions (and hence more likely influenced by assimilation). Analysis of specific diseases would therefore help elucidate pathways however this is mostly not feasible because of low case numbers.

SF-12 Physical Component Summary (SF-12 PCS)

The 12-item Short-form Health Survey (SF-12) is a generic functional health measure that measures health related quality of life (Ware, Kosinski et al. 1996). It comprises eight subscales: physical functioning, role (physical), bodily pain, general health, vitality,

[50] Respondents are asked at what age they were first diagnosed with a given chronic condition (and whether they still have this condition). If this age is before the age the respondent first moved to the UK, the condition was diagnosed pre-migration.

social functioning, role (emotional) and mental health which are weighted and aggregated into two scales: a physical component summary (PCS) that is used here, and a mental component summary. Note that the PCS contains SRH, though it has very little weight. For immigrants it is particularly relevant that SF-12 includes items on pain and physical mobility thus capturing poor health from a wide range of causes including injuries or insufficient health care in the country of birth.

The construct validity of SF-12 across ethnic groups in England has been assessed by Jenkinson, Chandola et al. (2001) who find only little differences across groups, compared to self-rated health and limiting long-standing illness (which are arguably themselves not without potential issues across ethnic groups). Schulz (2012) confirmed in an analysis of the German Socio-Economic Panel the cultural equivalence of the SF-12 across German born and immigrant groups, finding only evidence for some reporting heterogeneity across several other characteristics that are related to immigrant status such as age, socio-economic position.

The PCS scores range between 0 and 100, with a higher score indicating better health. For this analysis the SF-12 summary scores are dichotomised into measures of poor physical health. PCS scores under 46.47 are classified as low PCS score and assigned the value 1, while those with higher scores are assigned a value of 0.[51]

A functional health measure such as SF-12 emphasises the perspective of society by assessing health "relating to ability to perform activities of daily living and fulfil role obligations" (Bowling 2001, p6). This makes it more objective and comparable across groups than SRH because the reference frame is clear: it is about a person's ability to fulfil their role in society. Of course there is the caveat that these roles can differ

[51] This is equivalent to the bottom quintile for the population aged 21-60.

systematically by immigrant status, e.g. in some ethnic groups immigrant women might be less likely to do paid work.

Compared to chronic condition the main advantage of a functional health measure for an immigrant-native health comparison is that it captures any health problem, regardless of whether a) it is among the listed chronic conditions and b) it has been diagnosed, as long as the respondent feels an impact on daily activities (that is what poor health persists after treatment). In the discussion which follows we refer to a low SF-12 PCS score as 'poor physical functioning'.

3.6.4 Operationalisation of educational level

The major confounder of the immigrant-health relationship is education. The second model therefore introduces control variables to account for the positive selection of immigrants on education. However, there are few pre-migration characteristics in the dataset. This makes capturing the pre-migration characteristics that determine immigrants' (and equally natives') health challenging.

Ideally, education would be measured by the highest educational qualification for both UK-born and immigrants at a specific age which is pre-migration for all immigrants. Unfortunately the data do not allow identifying the highest educational qualification at time of migration or at a specific age for all immigrants.[52] Therefore highest parental education when respondent was aged 14 and own school leaving age is used as a proxy for highest level of education (referred to in the following as proxy education). The main limitation of using these two measures to capture educational level is that it effectively right censors the educational distribution by not distinguishing well between people who only achieved A-levels and those who obtained higher education.

[52] In particular for immigrants whose highest qualification is a higher university degree and in the UK one cannot determine whether they arrived with A-levels only or with their first degree.

Also, the association between school leaving age and educational attainment will differ across countries.[53] The risk that differences in the strength of association between SEP measures and health outcomes can exist between immigrants and natives, and also between ethnic groups (regarding the latter, see Fischbacher, Cezard et al. (2014)). For immigrants incomplete educational adjustment results in an overestimate of any health advantage as they are on average better educated than UK-born. This potential for residual confounding needs to be kept in mind when interpreting the results.

Parents' educational qualification is a categorical variable describing the highest educational qualification achieved by either the father or the mother: The reference category is that neither of the parents has any school qualification. This is opposed to at least one parent having a school qualification, a post-school qualification or a university degree. In cases where no parental educational qualification is available, this is proxied with the usual educational requirement associated with the highest parental occupation linked to the data via Standard Occupational Classification (Altorjai 2013). Again there is some potential for residual confounding because intergenerational educational mobility will differ across countries (and was probably particularly high in the UK). This means parents' educational level does not predict the respondent's education equally well across groups.

Calculating the predicted probabilities of poor health is based on the mean values of highest parental education and school leaving age amongst the immigrant population. In addition, probabilities are calculated for low proxy education (assuming highest parental educational level of no qualification, and school leaving age of 16) and high proxy education (assuming the highest parental educational level to be university degree, and school leaving age to be 17).

[53] However, a sensitivity test with the Indian group showed no significant difference when centering school leaving age for UK-born and immigrants at the respective typical ages to take A-levels (or A-level equivalent), compared to using school leaving age as is (centred at 16).

3.7 Methodology

3.7.1 Analysis strategy

The aim of the analysis is to determine if there is a HIE of immigrants in the UK and if so, the subsequent decline of the HIE with increasing YSM (duration effect). For the first research question, we quantify immigrants' health advantage at arrival in the UK both before and after accounting for the main factors that give rise to it, such as positive selection on observed and unobserved characteristics, and healthier lifestyles. Accounting for each cause should reduce the observed HIE. Following the hypotheses set out in section 3.5, a series of models are estimated:

Model 1: Age-sex adjusted health advantage

The starting point is the age-sex adjusted health advantage of new immigrants.

Model 2: Positive selection from source population on observable pre-migration characteristics

The second set of models quantifies the HIE after accounting for positive selection on observable characteristics, in particular pre-migration education of immigrants. Any health advantage remaining after accounting for immigrants' higher educational qualifications should be due to positive selection on unobservable characteristics, or due to healthier lifestyles. This model also enables us to compare health of immigrants' and UK-born's health for different levels of education. This can illustrate whether immigrants with particular characteristics have larger or smaller advantages over 'comparable' UK-born.

Model 3: Immigrants by region of origin

This third set of models splits immigrants by their region of origin in order to illustrate the differing degree of positive selection on unobservable characteristics. For this purpose a set of dummy variables for immigrant regions are used, dividing immigrants into four groups, grouping together countries of origin with broadly similar immigration gains and costs to the UK. These groups are: The EU-14 countries, including Norway and Switzerland[54]; the new EU countries from the EU accessions in 2004 and 2007; high income non-EU countries and low income non-EU countries. The size of the HIE should vary depending on the region of origin, reflecting the differing degree of selectivity, but also differences in levels of health in the regions of origin. Ethnicity and region of origin largely overlap so the models therefore do not also adjust for ethnic group.

Model 4: Health by immigrant status within ethnic group: Health behaviours and ethnicity-specific HIE

The last set of models estimates the HIE within each ethnic group separately as a test of the role of health behaviours in the HIE. As discussed, health behaviours within the same ethnic group will be more similar (and in addition there should be no genetic differences in the probability of ill-health that exists for some health conditions). This would imply that the health advantage of immigrants of ethnic minority groups over UK-born co-ethnics should be smaller than the HIE in the overall population. An additional advantage of ethnicity-specific models is that they should reduce unobserved heterogeneity, as far as it arises due to differences across ethnic groups, e.g. due to reporting heterogeneity (most pertinent for self-rated health, see above, Nielsen/Krasnik (2009)). However it needs to be recognized that the potential for reporting heterogeneity between immigrants and UK-born is probably at least as large as that across UK-born ethnic groups.

[54] Citizens of Norway and Switzerland underlie the same immigration rules as EU citizens (www.ukba.homeoffice.gov.uk/eucitizens/)

Model 5: duration effect over length of residence

The final step of the analysis addresses the second research question and determines in how far this health advantage is reduced for immigrants with longer period of residence. The difference in health between immigrants of different length of residence compared to UK-born is calculated based on model 2 described above, which controls for age, sex and education. For immigrants most life circumstances after migration should not only be considered as confounders but - at least to some extent - as mediating variables. We interpret – conditional on education – the socio-economic position of migrants after migration as a consequence of migration and hence as part of the duration effect. While immigrants' socio-economic position should improve over time (Antecol and Bedard 2006) it will on average be less advantaged than that of comparably educated native-born, especially for recent immigrants. Some immigrants will reach a socio-economic position comparable with that of similarly educated natives, while others will not. How immigrants' socio-economic trajectory after migration develops will impact on their health trajectory over time and is as such part of the duration effect.

3.7.2 Estimation

The analysis uses multivariate regression analysis to address the hypotheses set out. Health at arrival, or within the first year of arrival, is not known in the data (apart for some very recent immigrants). We estimate the health advantage an immigrant would have in his or her first year based on their characteristics, and adjusting for years since migration for the longer-standing immigrants in the sample. Following Borjas (1994) and Nolan (2012) we estimate logit models with the probability of poor health as

$$y_i = \beta x_i + \gamma immig_i + \delta ysm_i + \varepsilon_i \, .$$

X is a vector of control variables; ε is a random error term. *Immig* is a dummy variable that takes the value 1 for immigrants and 0 otherwise. *YSM* is a continuous variable that measures the years since migration for immigrants, and is set to 0 for UK-born people. The parameter γ gives the effect of being an immigrant on health at arrival. The parameter δ estimates the duration effect. A squared term for YSM that allows for non-linear effects of length of residence on health was tested but did not improve model fit (as indicated by Akaike Information Criterion).[55]

Using this specification has several advantages over the common approach of employing a series of dummies for migrants of different lengths of residence. Firstly, the continuous YSM variable avoids a priori definitions of which time periods are considered as "recent" or "settled" and it avoids having a top category. It enables us to pin-point at what length of residence migrants' health converges with native health levels even though it is difficult to determine an appropriate point at which to set an upper threshold.[56]

Secondly, with regard to the initial health advantage, the use of an immigrant dummy and continuous YSM allows us to quantify the health advantage in the first year after arrival, i.e. 0 YSM. This reflects the reasoning that the HIE is an advantage that migrants bring from their home country and then gradually lose i.e. the decline starts with their arrival in the country.

[55] The appropriate form of the YSM trajectory was tested in a model adjusting for age (as this is correlated to YSM) for all three outcome variables, and all groups (overall, ethnic groups). We compared the joint significance of the ysm and ysm/ysm^2 terms and AIC. The specification with squared term was only better for poor SRH for the overall population and white, and for SF-12 PCS for Indian. For all others, the simpler specification was preferred. As we compare results across the different outcome measures, we chose to apply the simpler specification to all populations and outcomes.

[56] Studies with continuous specification tend to find convergence around 20-25 YSM, while studies using a set of dummies for YSM sometimes find no significant effects of migrant status on health for categories such as 10+YSM or 15+YSM but the exact time of convergence is unclear.

Thirdly, and perhaps most importantly, the specification makes flexible estimation of the YSM trajectory for different immigrant groups (region of origin, gender) with interaction terms possible. This is not only useful for the estimation of the trajectory itself, but also allows the coefficients of the migrant dummy variable to vary by group, i.e. the initial health advantage is not averaged across heterogeneous groups.[57]

As we rely on cross-sectional data, the coefficient for YSM also captures any potential cohort effects because length of residence and year of arrival correlate perfectly. UK immigration policies have varied over time in their degree of selectivity. As discussed this has a direct bearing on the health advantage. Unfortunately, this analysis cannot account for immigration policy as it would be collinear with YSM. The estimated immigrant health advantage is therefore an average and will hide some heterogeneity. We attempt to illustrate this in the region model. As discussed, previous studies (McDonald and Kennedy (2004); Antecol and Bedard (2006)) find little evidence for cohort effects in studies using multiple cross-sections, although it is possible that the immigration regimes over the timeframe of the studies was more stable than for this analysis of the UK.

The specification used here averages across any uncaptured compositional differences in immigrant cohorts when estimating the YSM trajectory, and initial health advantage. A categorical specification would capture any cohort differences directly, but be less informative about the generalised pattern of health across years since migration that is applicable to all immigrant groups, if only to varying degrees. The continuous specification averages across the wide range of migrants which is arguably preferable over choosing a very narrow range, given we cannot account for migrant characteristics in more detail.

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[57] As the example of Nolan (2012) shows this can lead to underestimation (or overestimation) of the initial health advantage, if the duration effect is averaged across groups with very different assimilation trajectories (in her case British and overseas immigrants to Ireland).

All models are estimated for the overall population. In addition, separate models are estimated for white, black African, Indian and Bangladeshi/Pakistani. Variables were selected based on the model for SF-12 PCS, for the overall population. Age is included as a continuous variable. A squared term for age to allow for non-linearity of the age-health relationship was tested but did not improve model fit. A female dummy accounts for gender differences.

Theoretically important interaction terms were used regardless of statistical significance if they affected the predicted probabilities substantially. These include interactions between region of origin and YSM and between gender and immigrant status. Other interaction terms are only retained if significant at 5% level or if they improve the model fit as measured by the Akaike Information Criterion. All models (except the African models, see below) include interaction terms of the proxy education variables (highest parental qualification, school leaving age) with immigrant status (also to capture differences in measurement of education across countries). An interaction of the proxy education variables with gender was tested but not statistically significant and hence not included.

The African model has a more parsimonious specification (no interactions between proxy education and immigrant status) due to the small sample size of that group. While few variables in this model are statistically significant, the model is overall significant (for low SF-12 PCS: $F_{15,2429} = 2.09$, $p < .05$). For chronic condition, the region model (model 3) is simplified due to perfect separation when including the interaction of parental education and region of origin. Only the main effects are used instead.

Calculating the HIE

The HIE is calculated as the difference in predicted probability of poor health for immigrants and UK-born people within the first year after arrival, assuming similar values for immigrants and natives for all other variables. The HIE is calculated separately for men and women. Age is set to 26, the median age of arrival in the sample.

Due to the binary models the effect of the key variables of interest (migrant status and YSM) on the outcome depends on the values of the other explanatory variables. Odds ratios can therefore not be compared across the models for the three health outcomes (Mood 2010). Full model results, presented as odds ratios to allow a comparison with other studies, are in appendix B. For comparing the HIE across different models (e.g. overall population to ethnicity-specific models, in order to test the effect of health behaviours) the mean values of the proxy education variables in the immigrant population are used.[58]

The analysis uses Stata's survey commands for survey-weighted statistics. All analyses use cross-sectional analysis weights for the main questionnaire provided in the dataset account for unequal selection probabilities, differential non-response and sampling error (McFall 2013).

3.8 Results

3.8.1 Descriptives

Socio-demographic characteristics of UK-born and immigrants

Not only does the immigrant population differ from the UK-born population in many respects, but there is also considerable heterogeneity across ethnic groups, and within ethnic groups, between immigrants and UK-born.

[58] For the ethnicity-specific HIE, we also tested using the mean values within ethnic group but results do not differ much from those assuming overall mean immigrant characteristics and are not presented here.

While overall the immigrant population is younger than the UK-born population, Table 5 illustrates that within ethnic groups this is only the case for white, in all other ethnic groups immigrants are on average older than UK-born. Genders are balanced in all groups except Indian and Bangladeshi/Pakistani immigrants, where only 35% and 37%, respectively, are female.

The higher education of immigrants is reflected both in their higher mean age of leaving school, and the high levels of parental education. Black African and white immigrants have higher school leaving age than Indian and Bangladeshi/Pakistani migrants which is not reflected in their actual highest educational qualification. This suggests that to some extent school leaving age is influenced by cross-country differences in the school systems. However, the combination of the two variables, school leaving age and highest parental educational qualification, should capture own education reasonably well in all groups. Only immigrants from Bangladesh and Pakistan have parents whose highest educational qualification is close to the low levels of parents' education of white UK-born's. For UK-born Indians and Bangladeshi/Pakistani however, highest parental education is very low. This probably reflects lower selectivity of Commonwealth immigrants coming to the UK before the introduction of the points-based system.

The mean length of UK residence for all foreign-born within the analysis sample is 5.8 years. There are no large differences across ethnic groups in their mean length of residence due to restricting the sample to those who arrived within 15 years of the first interview. The median age at arrival is 26 years.

Table 5 Descriptive statistics (mean and standard deviation) by immigrant status, for the overall population and by ethnicity, ages 21-49, weighted

			Population All		White		Black African		Indian		Bangladeshi/ Pakistani	
	Immigrant status		**mean**	***(SD)***	**mean**	***(SD)***	**mean**	***(SD)***	**mean**	***(SD)***	**mean**	***(SD)***
age	UK-born		35.6	*(8.5)*	35.8	*(8.5)*	33.6	*(8.3)*	31.0	*(7.2)*	29.8	*(6.7)*
	Migrant		32.6	*(6.8)*	31.9	*(6.4)*	34.6	*(6.6)*	31.9	*(7.1)*	32.6	*(6.6)*
female	UK-born		0.50		0.50		0.50		0.48		0.48	
	Migrant		0.48		0.51		0.50		0.35		0.37	
age left school	UK-born		16.5	*(1.0)*	16.5	*(1.0)*	16.8	*(1.2)*	16.7	*(1.1)*	16.5	*(1.0)*
	Migrant		17.2	*(1.5)*	17.5	*(1.4)*	17.2	*(1.9)*	16.4	*(1.4)*	16.4	*(1.3)*
highest parental educational qualification	UK-born	none	21.5		21.2		7.4		30.9		37.4	
		some	34.5		34.5		21.4		31.1		40.8	
		post-school	30.8		31.3		31.3		20.2		12.4	
		university	13.3		13.1		39.9		17.8		9.3	
	Migrant	none	17.9		14.1		19.9		17.7		25.7	
		some	28.8		28.3		27.3		26.9		32.0	
		post-school	25.7		29.6		26.1		20.3		20.7	
		university	27.7		27.9		26.7		35.1		21.7	
Highest educational qualification	UK-born		2.8	*(0.9)*	2.8	*(0.9)*	3.2	*(0.8)*	3.3	*(0.8)*	3.0	*(0.9)*
(1 no qualification - 4 degree)	Migrant		3.2	*(1.0)*	3.1	*(1.0)*	3.1	*(1.0)*	3.5	*(0.8)*	3.0	*(1.1)*

Table 6 Correlation between variables of proxy education (age left school, parental highest education), and highest educational qualification

		Population				
		All	**White**	**Black African**	**Indian**	**Bangladeshi /Pakistani**
age left school - highest educational qualification	UK-born	0.49	0.51	0.12	0.36	0.31
	migrant	0.22	0.28	0.21	0.08	0.14
parental highest educational qualification - highest education qualification	UK-born	0.34	0.36	0.34	0.34	0.19
	migrant	0.38	0.34	0.28	0.46	0.44

Table 7 Years since migration and age at moving, immigrants aged 21-49, aged 18 or older at immigration, weighted

	Years since migration		**Age at moving**
	Mean	(SD)	Median
All foreign-born	5.8	(3.9)	26
White	5.6	(3.8)	26
Black African	6.9	(3.8)	28
Indian	5.1	(4.0)	26
Pakistani/Bangladeshi	6.7	(4.4)	25

Health status of the UK-born and immigrant population

Table 8 demonstrates that the prevalence of poor health is higher in the UK-born population compared to the foreign-born population for all three health outcomes (although among women these differences are not statistically significant for poor physical functioning (SF-12)).

In the UK-born population the highest levels of poor health are found for chronic condition (Table 8). Amongst UK-born, the prevalence of poor health measured by poor SRH and by poor physical functioning (SF-12) is similar for men, and for UK-born women poor SRH is only a slightly more positive picture than for poor physical functioning (SF-12). In contrast, levels of poor health among foreign-born men and women are clearly lowest when measured by poor SRH, while the other two measures estimate a much higher prevalence of poor health. This might indicate reporting bias in

SRH where immigrants are more positive in describing their health than UK-born. As would be expected according to theory, the differences between immigrants and UK-born are much larger amongst males than amongst females, with the exception of chronic conditions.

These descriptive statistics suggest that the comparison of immigrants health at arrival to UK-born's health will differ substantially according to the measure of poor health employed.

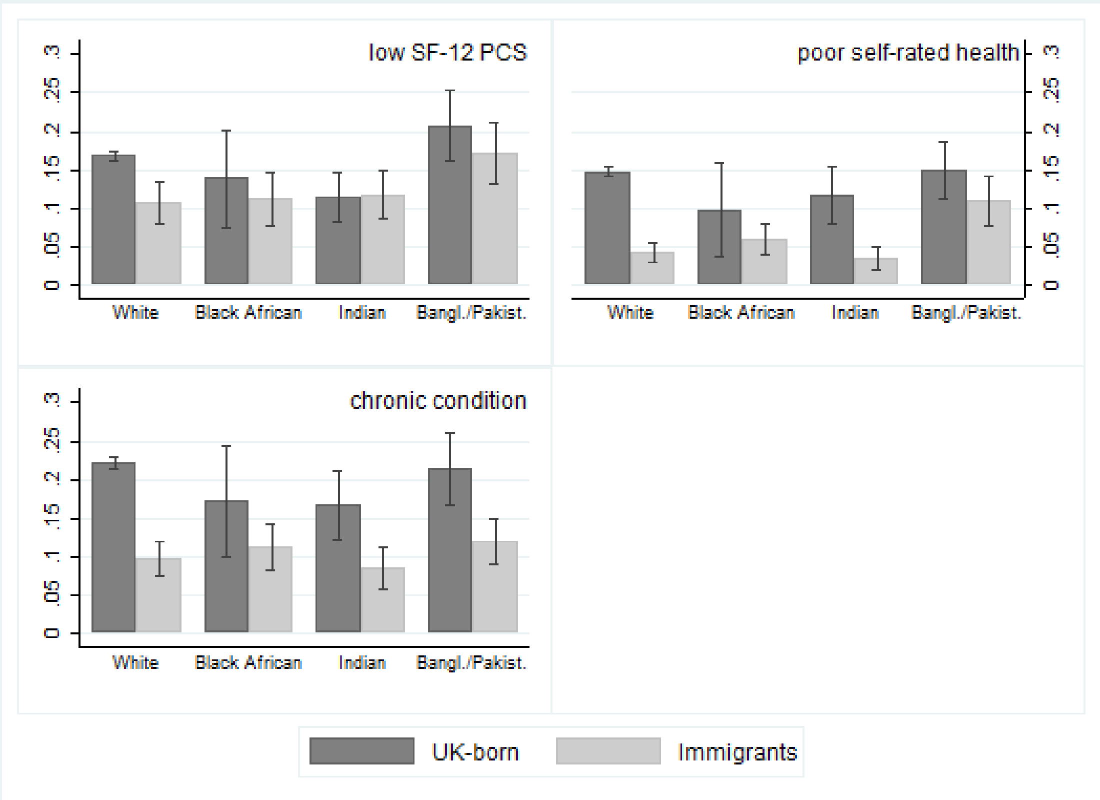
Table 8 Prevalence of poor health amongst UK-born and immigrant population by gender, aged 21-49

	UK-born		Immigrants	
Male	*%*	*(95% C.I.)*	*%*	*(95% C.I.)*
low SF-12 PCS	14.9	(14.0-15.8)	8.2	(6.5-10.0)
Poor SRH	14.1	(13.3-15.0)	4.0	(2.8-5.2)
Chronic condition	20.6	(19.6-21.6)	8.9	(7.0-10.8)
Female	*%*	*(95% C.I.)*	*%*	*(95% C.I.)*
low SF-12 PCS	18.5	(17.7-19.4)	15.7	(13.1-18.2)
Poor SRH	15.4	(14.6-16.1)	7.6	(6.3-8.9)
Chronic condition	23.8	(22.9-24.7)	10.9	(9.3-12.6)

Note: Low SF-12 PCS: score of 46.47 or lower; poor SRH: own health is rated fair or poor. Chronic condition: reporting at least one diagnosed physical chronic condition. Source: UKHLS, wave 1, own calculations.

Figure 1 presents the proportion of immigrants and UK-born in poor health within each ethnic group and for the three health outcomes. Across almost all measures and ethnic groups there are fewer immigrants than UK-born in poor health, though the differences are in most cases not statistically significant.

Figure 1 Proportion in poor health, by ethnic group and immigrant status



Note: Low SF-12 PCS: score of 46.47 or lower; poor SRH: own health is rated fair or poor; chronic condition: reporting at least one diagnosed chronic condition. Population aged 21-49, immigrants up to 15 years since migration. Survey weighted. Source: UKHLS, wave 1, own calculations.

3.8.2 Regression results

Research question 1: Initial health advantage (HIE)

The first research question asks whether immigrants have a health advantage at the time of arrival (in the first year since migration), over comparable UK-born. Table 9 to Table 11 present the predicted probabilities of poor health estimated by regression models for the three health outcomes, and the differences of these predicted probabilities between UK-born and immigrants. Columns three and eight in each table show the probability of poor health for UK born males and females, respectively. Columns four and nine show the probability of poor health for immigrants in the first year after arrival for males and females, respectively. Columns five and ten show the difference between the predicted probabilities of UK born and immigrants, the HIE. (The full outputs of the regression models are in appendix B, Table 38 to Table 43).

Out of the three health measures used in this study, the measure that is most suitable to compare immigrants' and UK-born health is the SF-12 PCS. Therefore, the following results section first discusses the results of the regression models mainly for poor physical functioning (SF-12) and in how far hypotheses are confirmed. The results of the models for poor self-rated health and diagnosed chronic condition are then discussed relative to the results for poor physical functioning (SF-12). This allows us to assess in how far these alternative measures of poor health yield similar results.

<u>Healthy immigrant effect estimated with poor physical functioning (SF-12)</u>

Turning our attention first at Table 9, model 1 finds a health advantage of male immigrants of 6.5 percentage points. UK-born males are twice as likely to be in poor health (11.3 percent) than male migrants of the same age (4.8 percent). The age-sex adjusted health advantage includes advantage due to higher education, unobserved characteristics and healthier behaviours of immigrants compared to native born. Female migrants only have a very small, statistically not significant health advantage of 1.8 percentage points. This gender difference, though not statistically significant, is in line with expectations because female migrants are less likely to have come to the UK for work and therefore are less likely to be positively selected on characteristics that lead to a HIE. However, for poor SRH and chronic condition the HIE estimated for male and female immigrants are very similar in size (and much larger, around 8 and 10.5 percentage points respectively), which runs counter to expectations. Most reasons for a health advantage of recent immigrants are more applicable to men than women, and should be more discernible in the male results. The discussion of the remaining hypotheses will focus on male immigrants only.

Table 9 Predicted probabilities and Healthy Immigrant Effect for poor physical functioning (SF-12), by immigrant status and gender

Model		case	MALE probability of poor health for UK-born		HIE	*95% confidence interval of HIE* *lower bound*		FEMALE probability of poor health for UK-born		HIE	*95% confidence interval of HIE* *lower bound*	
			UK-born	immigrants	HIE	*lower bound*	*upper bound*	UK-born	immigrants	HIE	*lower bound*	*upper bound*
1	**Age-sex adjusted**		0.113	0.048	**0.065**	*0.041*	*0.088*	0.140	0.123	**0.018**	*-0.021*	*0.056*
2	**Proxy education**	low proxy education	0.140	0.048	**0.093**	*0.066*	*0.120*	0.173	0.124	**0.049**	*0.003*	*0.096*
		high proxy education	0.089	0.041	**0.047**	*0.020*	*0.074*	0.111	0.109	**0.002**	*-0.039*	*0.043*
		mean proxy education	0.093	0.048	**0.046**	*0.022*	*0.070*	0.116	0.124	**-0.007**	*-0.045*	*0.030*
3	**Region**	high income non-EU	0.093	0.026	**0.067**	*0.032*	*0.102*	0.116	0.152	**-0.035**	*-0.162*	*0.091*
		EU14		0.022	**0.071**	*0.050*	*0.091*		0.097	**0.020**	*-0.062*	*0.102*
		new EU		0.057	**0.036**	*-0.010*	*0.082*		0.105	**0.011**	*-0.083*	*0.105*
		low income non-EU		0.048	**0.045**	*0.013*	*0.077*		0.132	**-0.016**	*-0.054*	*0.022*
Ethnic group models												
	White		0.093	0.026	**0.067**	*0.046*	*0.088*	0.115	0.129	**-0.014**	*-0.081*	*0.054*
	African[1]	low risk CoB	0.066	0.009	**0.056**	*-0.011*	*0.124*	0.154	0.015	**0.139**	*0.028*	*0.249*
		medium risk CoB		0.044	**0.021**	*-0.082*	*0.125*		0.136	**0.018**	*-0.169*	*0.206*
		high risk CoB		0.095	**-0.029**	*-0.181*	*0.123*		0.173	**-0.019**	*-0.209*	*0.170*
	Indian		0.060	0.057	**0.003**	*-0.059*	*0.066*	0.067	0.140	**-0.073**	*-0.159*	*0.013*
	Bangladeshi/Pakistani		0.106	0.044	**0.062**	*-0.030*	*0.154*	0.171	0.143	**0.028**	*-0.097*	*0.153*
	Actual highest qualification[2]		0.080	0.046	**0.034**	*0.010*	*0.057*	0.100	0.118	**-0.018**	*-0.055*	*0.019*

Note: HIE: Healthy immigrant effect, calculated as the difference between the predicted probability of poor health of a UK-born and that of an immigrant with the same characteristics. Values assumed for explanatory variables: age 26; low proxy education: highest parental education: none, age left school: 16; high proxy education: highest parental education: university, age left school: 17; mean proxy education takes the mean values of highest parental education and school leaving age in the immigrant population, these values are also assumed in model 3 and in the ethnic group models.

1 Risk grouping of countries of birth (CoB) refers to the probability of immigrants from a given country of birth to have arrived in the UK as an asylum seeker.

2 Using highest educational qualification as continuous variable (1 no qualification - 4 degree), and assuming mean highest qualification for migrants with "high proxy education" (who left school at age 17 and whose parents are university educated), which is 3.77.

Table 10 Predicted probabilities of poor self-rated health and Healthy Immigrant Effect, by immigrant status and gender

Model		case	MALE probability of poor health for UK-born	immigrants	HIE	95% confidence interval of HIE *lower bound*	*upper bound*	FEMALE probability of poor health for UK-born	immigrants	HIE	95% confidence interval of HIE *lower bound*	*upper bound*
1	**Age-sex adjusted**		0.112	0.027	**0.084**	*0.063*	*0.106*	0.121	0.039	**0.082**	*0.063*	*0.101*
2	**Proxy education**	low proxy education	0.171	0.038	**0.132**	*0.103*	*0.164*	0.182	0.054	**0.128**	*0.096*	*0.160*
		high proxy education	0.086	0.026	**0.060**	*0.033*	*0.087*	0.092	0.036	**0.056**	*0.032*	*0.079*
		mean proxy education	0.091	0.028	**0.063**	*0.042*	*0.085*	0.098	0.039	**0.059**	*0.039*	*0.078*
3	**Region**	high income non-EU	0.091	0.017	**0.074**	*0.045*	*0.103*	0.098	0.018	**0.080**	*0.043*	*0.117*
		EU14		0.014	**0.077**	*0.055*	*0.099*		0.038	**0.059**	*0.006*	*0.113*
		new EU		0.035	**0.056**	*0.011*	*0.100*		0.049	**0.048**	*-0.018*	*0.115*
		low income non-EU		0.032	**0.059**	*0.029*	*0.090*		0.038	**0.060**	*0.039*	*0.080*
Ethnic group models												
	White		0.091	0.017	**0.074**	*0.054*	*0.094*	0.096	0.045	**0.051**	*0.017*	*0.085*
	African[1]	low risk CoB	0.087	0.003	**0.084**	*-0.011*	*0.179*	0.091	0.008	**0.083**	*-0.012*	*0.179*
		medium risk CoB		0.029	**0.058**	*-0.040*	*0.156*		0.046	**0.045**	*-0.052*	*0.142*
		high risk CoB		0.017	**0.070**	*-0.028*	*0.168*		0.043	**0.048**	*-0.065*	*0.162*
	Indian		0.065	0.015	**0.050**	*0.008*	*0.092*	0.094	0.020	**0.073**	*0.018*	*0.129*
	Bangladeshi/Pakistani		0.096	0.047	**0.049**	*-0.018*	*0.116*	0.140	0.057	**0.082**	*-0.011*	*0.176*
	Actual highest qualification[2]		0.072	0.024	**0.048**	*0.028*	*0.069*	0.078	0.031	**0.047**	*0.030*	*0.063*

Notes see previous table

Table 11 Predicted probabilities and Healthy Immigrant Effect for diagnosed chronic condition, by immigrant status and gender

Model		Case	MALE probability of poor health for UK-born	MALE probability of poor health for immigrants	MALE HIE	MALE 95% confidence interval of HIE lower bound	MALE 95% confidence interval of HIE upper bound	FEMALE probability of poor health for UK-born	FEMALE probability of poor health for immigrants	FEMALE HIE	FEMALE 95% confidence interval of HIE lower bound	FEMALE 95% confidence interval of HIE upper bound
1	**Age-sex adjusted**		0.148	0.042	**0.105**	*0.082*	*0.129*	0.171	0.066	**0.106**	*0.083*	*0.121*
2	**proxy education**	low proxy education	0.166	0.033	**0.133**	*0.109*	*0.157*	0.191	0.050	**0.141**	*0.113*	*0.160*
		high proxy education	0.137	0.056	**0.081**	*0.051*	*0.111*	0.158	0.084	**0.074**	*0.041*	*0.108*
		mean proxy education	0.137	0.042	**0.095**	*0.072*	*0.118*	0.158	0.063	**0.095**	*0.073*	*0.118*
3	**Region**	high income non-EU	0.137	0.074	**0.081**	*0.002*	*0.159*	0.158	0.098	**0.062**	*-0.017*	*0.142*
		EU14		0.094	**0.043**	*-0.049*	*0.134*		0.061	**0.043**	*-0.071*	*0.157*
		new EU		0.022	**0.134**	*0.123*	*0.145*		0.039	**0.114**	*0.092*	*0.137*
		low income non-EU		0.033	**0.098**	*0.081*	*0.115*		0.066	**0.103**	*0.085*	*0.122*
Ethnic group models												
	White		0.138	0.047	**0.091**	*0.049*	*0.133*	0.158	0.075	**0.083**	*0.046*	*0.120*
	African[1]	low risk CoB	0.095	0.003	**0.094**	*0.026*	*0.161*	0.102	0.010	**0.093**	*0.011*	*0.175*
		medium risk CoB		0.027	**0.069**	*0.000*	*0.139*		0.060	**0.042**	*-0.045*	*0.129*
		high risk CoB		0.028	**0.068**	*-0.009*	*0.145*		0.100	**0.002**	*-0.147*	*0.150*
	Indian		0.083	0.012	**0.071**	*0.020*	*0.122*	0.145	0.054	**0.091**	*0.005*	*0.178*
	Bangladeshi/Pakistani		0.145	0.036	**0.110**	*0.033*	*0.186*	0.193	0.064	**0.129**	*0.026*	*0.232*
	Actual highest qualification[2]		0.132	0.045	**0.088**	*0.062*	*0.113*	0.153	0.066	**0.087**	*0.063*	*0.111*

Notes see Table 9

The next model (Model 2) shows the results for what is the actual HIE i.e. the health advantage of recent immigrants net of observable characteristics that can explain their advantage. Once accounting for the educational advantage of immigrants the HIE should decrease (H1). Indeed when comparing UK-born and migrants adjusted for educational background [59] the advantage reduces to 4.6 percentage points though this reduction is not statistically significant. This reduction should be seen as a lower estimate of the contribution of selection on education to the HIE. This is because the proxy education measures cannot fully account for the "excess" in educational attainment amongst highly educated people (which are overrepresented among immigrants). Even after adjusting for parental education and school leaving age immigrants will have an unobserved advantage in their actual educational qualification (and as a result, health) which results in too low estimates of immigrants' probability of poor health, relative to UK-born i.e. somewhat overstates the HIE.[60]

There is a considerable, albeit not statistically significant, difference in the HIE by educational level. As hypothesised (H2), for immigrants with low proxy education the HIE is 9.3 percentage points while for immigrants with high proxy education the advantage is only 4.7 percentage points. This difference is driven mainly by different propensities of ill health by educational level amongst the UK-born rather than different propensities amongst immigrants. UK-born males with low proxy education are 1.6

[59] Predicted probabilities for mean proxy education assume the mean values of parental education and school leaving age of the immigrant population.

[60] Most immigrants have finished their education before migration, or at least their educational trajectory is determined before migration. Assuming that, one can regard highest educational qualification as an indicator of pre-migration SEP with the advantage that it measures educational level more accurately.

When using actual highest educational qualification (see last row in Table 9 to Table 11) (disregarding the fact that some immigrants obtained these qualifications post-migration) the HIE indeed reduces to 3.4 percentage points (low SF-12 PCS). (Marginal effects are predicted assuming the mean values of immigrants with high proxy education). Compared to the HIE with high proxy education of 4.7 percentage points this is a reduction of 29%. Across all health outcomes, the reduction of the HIE when using actual highest educational qualification instead of proxy education is between 0.7 percentage points (chronic condition, male) and 2 percentage points (low SF-12 PCS, female).

times more likely to have poor physical functioning (SF-12) than highly educated fellow countrymen. In contrast, low educated migrants are only 1.2 times more likely to be in poor health than highly educated migrants. This result is in line with theoretical expectations on immigrant selectivity because migration requires a minimum level of health (Jasso, Massey et al. 2004), which leads to stronger selection on health among the less educated would-be migrants. Other reasons for the smaller educational gradient in health among migrants are also possible. For example, it is possible that in some countries of origin the gradient in health is generally less strong than in the UK. Also, the school leaving age measure might work less well in capturing variation in health across educational levels in migrants.

Model 3 demonstrates how the HIE varies by immigrants' region of origin, reflecting different degrees of selectivity for people from different countries but also different health distributions in their countries of origin. The group with the largest advantage for recent immigrants over UK-born males with 7.1 percentage points are immigrants from EU-14 countries. The group with the smallest, statistically not significant, health advantage over native born are immigrants from new EU countries with 3.6 percentage points. All confidence intervals between groups overlap, so again, differences are not statistically significant. However, the patterns mostly conform to expectations (H3): The potential gain from migration for people considering moving from EU-14 countries and non-EU high income countries to the UK is fairly small, but the migration cost is much lower for immigrants from EU-14 countries due to the cultural and geographical proximity as well as the absence of restrictive immigration policies. EU-14 migrants should therefore be less positively selected and have a smaller HIE. However, this is not the case although the difference between the two groups is only 0.4 percentage points. A possible explanation could be that most immigrants from the non-EU high-income countries are from English-speaking countries, which lowers migration cost e.g. due to better skills transferability. Whether the immigrant has English as first language was tested but not statistically significant.

Potential migrants from EU accession countries and non-EU low-income countries both have large potential gains from moving to the UK, but the latter face much higher costs. Consequently, immigrants from new EU countries should have a lower probability of ill-health than immigrants from low income non-EU countries. This is indeed the case, and the HIE is therefore larger for immigrants from low-income non-EU countries. Again these differences are not statistically significant.

When comparing immigrants across regions for which migration cost is roughly similar immigrants from countries where the potential gain is larger should be less positively selected than immigrants from countries with less potential gain and therefore have a smaller HIE (H4). Indeed, immigrants from low-income non-EU countries have a smaller HIE than those from high-income non-EU countries. (It is possible that the small HIE of low-income non-EU countries reflects lower population health in the countries of origin, rather than lower selectivity, because population health between these two groups differs a lot.) Likewise, immigrants from EU accession countries (with more potential gain) have a smaller HIE than immigrants from EU-14 countries. While this means that the patterns are consistent with our hypothesis, the differences between groups are too small to be statistically significant.

So far, we have accounted for positive selection on education, and – by looking at how the HIE varies across region of origin – considered the influence of positive selection on unobservable characteristics. Apart from positive selection, the other common explanation for immigrants' good health is that many immigrants have healthier behaviours than the UK-born population. To the extent that within a given ethnic group health behaviours are stable across generations the within-ethnicity HIE should be smaller than overall. UK-born ethnic minorities would need to have lower probabilities of poor health than the overall UK-born population for this to be the case (additionally, it is possible that the migrant population of a given ethnic group has also lower probabilities of poor health than the overall migrant population due to favourable health behaviours).

To test this hypothesis (H5), the HIE within the African group, the Indian group and they Bangladeshi/Pakistani group are compared to the HIE of the immigrant population overall (Table 9). A HIE within ethnicity that is smaller than 4.6 percentage points would confirm this. Indeed for (male) Africans and Indians this is true, in both cases the probability of poor health of the UK-born are lower than that of the overall population and as a result there is no significant health advantage of immigrants over UK-born males from the same ethnic group. Among Bangladeshi/Pakistani males however, the HIE is 6.2 percentage points (though statistically not significant), which is larger than for the overall population. This is driven by the high levels of poor health amongst UK-born Bangladeshi/Pakistani.

Because the health behaviour explanation does not depend on positive selection of labour migrants, this should apply equally to male and female immigrants. As there is no overall HIE for women, there can be no reduction of it. Rather, the disadvantage of migrant women that is not statistically significant overall might turn into a significant disadvantage in some groups. Contrary to expectations however, both African and especially Bangladeshi/Pakistani UK-born women have considerably poorer health than UK-born women overall. Only Indian UK-born women have a much lower probability of poor health than UK-born women overall, which could be interpreted as them having healthy behaviours. These larger gender differences (for UK-born) are in line with the findings of Mindell, Knott et al. (2014) who find that ethnic health inequalities are larger amongst women than men.

The mixed results suggest that the estimated probability of ill-health of ethnic groups relative to that of the overall UK born population does not capture healthier behaviours of ethnic minorities. While this could be due to in fact them not having healthier behaviours, it is likely that the weak controls – restricted to education – mean that the wider social disadvantage that ethnic minority groups face in the UK is not controlled. This might mask or cancel out any benefit from healthier behaviours of minority groups. The testing of the health behaviour hypothesis relies on the assumption that other confounders, especially socio-economic circumstances, are accounted for equally well across the different UK-born groups. This is challenging across ethnic groups (Kaufman, Cooper et al. 1997; Nazroo 2003). Across the different ethnic groups born in the UK a given level of education is probably not associated with the same level of socio-economic (childhood and current) circumstances.[61]

This suggests that our approach of comparing the within-ethnicity HIE to the HIE in the overall population is not a suitable way to find evidence for the role of health behaviours in contributing to the HIE. The ethnic health inequalities are driven by multiple factors which we cannot fully take account in this analysis because we are restricted to characteristics that pertain to the time before migration for immigrants. Given these restrictions, it seems it is not possible to isolate health differences between UK-born ethnic groups that might arise due to healthier behaviours in the current analysis.[62]

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[61] To test this we estimated the same models (model 2 and ethnicity models) with additional adjustment for a material deprivation index. We find that material deprivation explains all of the excess poor health of both males and females from ethnic minority groups amongst UK-born compared to the overall UK-born population. On the other hand it is questionable in how far it is appropriate to adjust for socio-economic position comprehensively and interpret remaining differences across ethnic groups as differences in health behaviour. While the differences in health behaviours across UK-born ethnic groups that we are aiming to capture here are culturally patterned, they are at the same time to a good part mediated by socio-economic position. A comprehensive adjustment for socio-economic position could remove most of the effect of differences in health behaviours on health.

[62] Ideally, to illustrate the role of health behaviours in the HIE one would want to account for health behaviours directly, but for immigrants this would need to be pertain to behaviours pre-

The ethnic group models used for testing H5 are also informative as estimates of ethnicity-specific HIE (Table 9). In the first year after arrival male immigrants in the white group have an initial health advantage in poor physical functioning (SF-12) of 6.7 percentage points over UK-born co-ethnics. Bangladeshi/Pakistani male immigrants have an initial health advantage that is only slightly smaller but not statistically significant, probably because of the smaller sample size. Amongst Indian men, the health of newly arrived immigrants is very similar to that of their UK-born counterparts.

Most black African migrants do not show an advantage in terms of poor physical functioning (SF-12) in the first year after arrival (Table 9). For both male and female black African migrants the risk of poor health increases with increased probability of the immigrant having arrived as a refugee, as estimated by the country of origin. Male black African migrants from the highest risk countries (comprising Angola, the Democratic Republic of Congo, Eritrea, Ethiopia and Somalia) have the highest risk of ill health of any male migrant group with 9.5 percent and are the only male migrant group where the probability of ill health is higher than that of the corresponding UK-born males. The lowest-risk black African migrant group have an unusually low probability of poor health (around 1 percent for both genders) which for women translates to a very large health advantage at arrival of 13.9 percentage points. This is probably due to the Zimbabwean immigrants in this group who seem to be unusually positively selected.[63]

migration for which we do not have information. One could possibly consider current health behaviours as a proxy for health behaviours at the point of migration if restricting the sample to more recent immigrants. However, wave 1 of UKHLS does not include measures of health behaviours beyond body mass index.

[63] The group of African immigrants from 'low-risk' countries is mainly made up of Zimbabweans, arriving from the year 2000 onwards. Zimbabweans leaving for the UK in these years are mainly part of the middle and upper classes (Pasura 2009), often health care workers, due to the breakdown of the Zimbabwean health care system (Stilwell, Diallo et al. 2004). Zimbabweans are by a margin the most important group of nationals amongst qualified clinical NHS staff from Africa (Chalabi and Health and Social Care Information Center 2014). There is evidence in the analysis sample that indeed health care workers are overrepresented amongst Zimbabwean immigrants.

While the patterns are consistent with the grouping of countries by probability of an immigrant from this country being a refugee there are of course other characteristics of the countries of birth that could explain the results. For example, countries with low risk of sending refugees are more often countries with higher income level and better population health. Also, each risk category is dominated by migrants from very few countries of birth: Zimbabweans in the low risk group, Nigerians in the medium risk group, Somali in the highest risk group. Hence the findings can also reflect country specific factors.

So far we focussed on the estimated HIE for men. For women, health differences measured by poor physical functioning (SF-12) between recent immigrants and natives are much smaller: foreign-born women have a probability of poor health measured by poor physical functioning (SF-12) that is close to that of UK-born women, resulting in a statistically non-significant health advantage of 1.8 percentage points in the first year after arrival (Table 9). Considering the HIE within ethnic groups black African is the only group where female immigrants – those from low and medium risk countries – have a statistically significant health advantage in the first year after arrival. In some cases the probability of poor physical functioning of foreign-born women is even bigger than that of UK-born women, though not significantly. This is particularly striking amongst Indian women and women from high income non-EU countries. While this might partly be explained by the women migrating for family reasons it seems unusually high and is not reflected in the estimates for self-rated health and only to some extent in the estimates for chronic condition. For the case of high income non-EU countries we find on closer inspection this effect is driven by the small number of Canadian women in the data many of whom have a low SF-12 PCS score while not being classified as in poor health with the other two measures. The modelled results therefore only reflect the data, as is the case of Indian women.

<u>Differences in the HIEs when estimated with poor self-rated health and diagnosed chronic condition</u>

As discussed in section 3.4 the two other health measures used in this study might for a variety of reasons overestimate the HIE of some immigrant groups. We find that both measures poor self-rated health and diagnosed chronic condition yield substantially larger HIEs than the functional health measure, in particular for women.

Table 44 (appendix B) shows the ratio of the predicted probabilities estimated for poor self-rated health to the predicted probabilities estimated for poor physical functioning (SF-12). For poor SRH the estimated HIE for men is in most cases roughly 1.3 times the size of the HIE estimated with poor physical functioning (SF-12), for women the differences are even larger, between two and eight times as large as with poor physical functioning (SF-12). The larger health advantages with poor self-rated health to result mainly from immigrants reporting lower levels of poor health with self-rated health compared to the physical functioning measure, especially among women[64]. Levels of health for UK-born men and women are more similar across outcomes. This pattern is consistent with the literature suggesting that self-rated health suffers from reporting bias because (recent) immigrants compare their health to the population left behind in their country of origin and have more generous standards than UK-born people (Cho, Frisbie et al. 2004; McDonald and Kennedy 2004; Chiswick, Lee et al. 2008; Farré 2013). The only exceptions are Bangladeshi/Pakistani male migrants for whom the level of poor health is roughly the same with the two measures.

[64] A possible explanation for particularly large difference between levels of ill health estimated by self-rated health and by SF-12 PCS for female immigrants is that these are young and have higher levels of fertility than most UK born groups. Pregnant women would interpret as applicable that "their health affects x" in the SF-12 items. Alternatively, there might be differences in how the SF-12 items regarding "your work" is interpreted by women of different ethnic groups as employment rates amongst some are very low.

Considering the relative differences between the HIE estimated by poor physical functioning (SF-12) and chronic condition (Table 45, appendix B), again, differences are particularly large for amongst women. In this case, the differences are due to both higher levels of poor health estimated amongst UK-born, as well as lower levels of poor health estimated for most immigrant groups when using chronic condition, compared to SF-12 PCS. Exceptions to this pattern (where levels of estimated chronic condition amongst immigrants are actually higher than for poor physical functioning (SF-12)) are found mainly for immigrants from highly developed countries that have a similar standard of health care as the UK.

Comparing in particular the results for African immigrants from high-risk countries across all three health outcomes (Table 9 - Table 11) illustrates that poor self-rated health and chronic condition (probability of poor health are 1.7 percent and 2.8 percent, respectively) seem to overstate the health of immigrants from developing countries with poor health care and health problems poorly captured by these measures. The corresponding estimated probability of poor physical functioning (SF-12) (9.5 percent) seems much more realistic and in line with theoretical expectations.

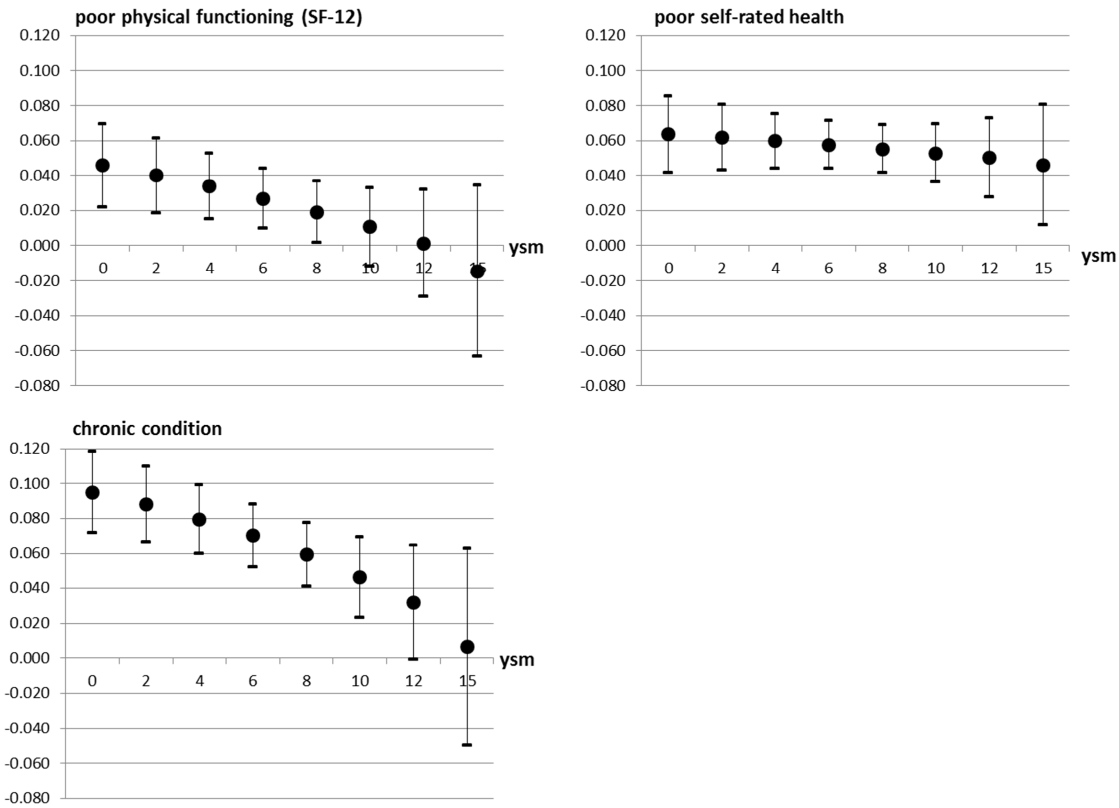
In summary, comparing the patterns of estimated HIE across health measures and immigrant groups support the view that a measure of physical functioning is a more appropriate health measure when comparing natives to immigrants from regions of origins that vary widely in health profiles and health care provision.

Research question 2: Trajectories across length of residence (Duration effect)

The second research question is in how far the HIE is reduced for immigrants of longer residence, implying a negative duration effect. Figure 2 shows how the estimated HIE reduces for male immigrants with longer duration of residence, based on model 2 (assuming mean proxy education of immigrant population), Figure 3 shows the equivalent for females. The first data point at YSM=0 is equivalent to the HIE discussed in the preceding section, the following data points represent the difference in predicted levels of ill health between UK-born and immigrants with different lengths of residence. These estimates are all based on cross-sectional data, we therefore cannot be sure that trajectories over years since migration change reflect immigrants' health deterioration over time. The alternative explanation would be that immigrant cohorts differ in their health permanently (with recent cohorts being healthier). We test this possibility with a robustness check at the end of the section.

The pattern of the health advantage across years since migration apparent in Figure 2and Figure 3 is in accordance with the health assimilation that one would expect. Both among males and females recent immigrants have the largest health advantage while longer-settled immigrants have smaller to non-significant advantages. The estimated duration effect differs markedly for the different outcome measures. Generally, the larger the advantage estimated for the first year after migration, the steeper the decline across years since migration. For males, the HIE for poor physical functioning (SF-12) stays statistically significant for immigrants of up to six years since migration. For diagnosed chronic condition the convergence with UK-born levels of ill health is observed at around 12 years since migration. The only health outcome with a very stable male immigrant health advantage across all years since migration is poor self-rated health, with around 6 percentage points, which is statistically significant for all years since migration. For women the patterns are slightly different. Recent immigrant women have no significant health advantage for physical functioning (SF-12) and the health difference to UK-born women stays similar across years since migration. For chronic condition the estimated duration effect is very similar to that for males, becoming only slightly non-significant later at 15 YSM. The particularly steep decline in chronic conditions possibly reflects that the trajectory for chronic condition not only capture real decline in health but also the catch-up in previously undiagnosed existing chronic conditions amongst immigrants. For poor self-rated health, both male and female immigrants have a similarly sized HIE in the first year after migration. In contrast to men, where this health advantage stays significant over all 15 YSM, the advantage for female immigrants is restricted to those up to 8 years since migration.

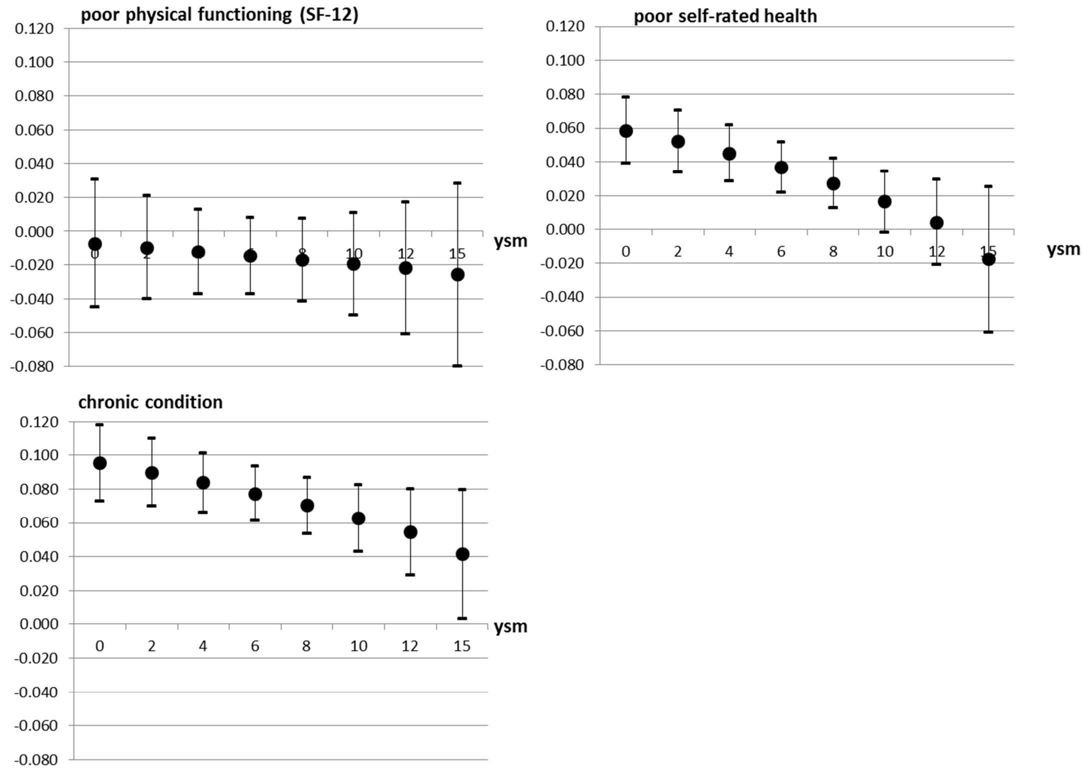
Figure 2 HIE across years since migration, for males



Note: Difference in predicted probability of poor health between UK-born and immigrants of different YSM (HIE), across years since migration (ysm), with 95% confidence intervals, based on model 2 using immigrants' mean proxy education.

These findings are comparable to others that have used both self-rated health and chronic condition in that convergence in terms of poor self-rated health seems to be quicker than in terms of chronic conditions (McDonald and Kennedy 2004; Vissandjee, Desmeules et al. 2004; Antecol and Bedard 2006). Also similar to our findings, because of the larger initial advantage with chronic condition compare to poor self-rated health McDonald and Kennedy (2004) also find steeper trajectories for chronic condition than for self-rated health.

Figure 3 HIE across years since migration for females



Note: Difference in predicted probability of poor health between UK-born and immigrants of different YSM (HIE), across years since migration (ysm), with 95% confidence intervals, based on model 2 using immigrants' mean proxy education.

There are interesting gender differences in the duration effect for poor self-rated health: Despite similar magnitudes of the initial HIE for poor self-rated health for men and women, the duration effect for poor self-rated health for women is equally steep as that for chronic conditions, while for men it is very flat and the health advantage is retained even for male immigrants of 15 YSM. A possible explanation for this could be that immigrants' perception in what constitutes good health changes more quickly for female immigrants than male immigrants. This could be because women generally have more contact with the health care system than men, and might therefore change their ideas more quickly. There is also evidence that self-rated health is not understood in the same way by women and men; for men it is more associated with mortality while for women it reflects more disability-related aspects (Deeg and Kriegsman 2003). Given the quick catch-up of immigrants of both genders in terms of chronic condition, it is possible that a diagnosis of a chronic condition affects female immigrants' assessment of self-rated health more than that of their male counterparts.

Robustness check regarding confounding of age and YSM

For reasons discussed, this analysis is limited to cross-sectional data. This means that migrants' age, their age at moving to the UK and length of residence in the UK are correlated and their respective effects on health cannot be fully disentangled. One way to test the potential for confounding in cross-sectional data is to stratify the sample by one of the confounding variables (Gray, Harding et al. 2007). For SF-12 PCS, which we found to be the most reliable health measure, we therefore repeat the analysis on stratified samples, once stratified by age and once stratified by age at moving.

For the first set of models we stratify the sample by age (21 to 25 years, 26 to 30 years, 31 to 35 years and 40 to 49 years). The results suggest that the HIE/duration effect found in the main models (Figure 2) is largely robust to age confounding. If the results had been mainly driven by age confounding, the migrant health advantage estimated by the age stratified models would be the same regardless YSM and mainly differ by age (with the largest health advantage for the youngest migrant cohort). Figure 13 (appendix B) shows for males that this is not the case. While the decline of the health advantage over native born differs across age cohorts, the overall pattern is similar to that found in the overall sample. Only for the oldest age cohort the trend is very slightly upwards with increasing length of residence.

Figure 14 (appendix B) shows the equivalent estimates for females. Here the pattern is not as clear, The trend in the youngest age cohort is opposite to what theory suggests – the most recent young immigrants do not show a health advantage over native-born, while surprisingly those who have been in the country for longer have a (non-significant) health advantage. The remaining age cohorts are more in line with expectations and with the trends estimated in the overall model.

Similar to age, age at moving to the UK is also correlated with length of residence. Given the restrictions of the sample (age range 21-49, 0-15 YSM and at least 18 years of age at the time of moving) it follows that the youngest migrants (aged 21) can have been in the UK for at most 3 years and must have been young when moving (between ages 18 and 21) while the oldest migrants (aged 49) were at least aged 34 when moving and they must have been in the UK for 15 years.

The second set of models uses samples stratified by age at moving. The groups are moved at ages 18-22, 23-27, 28-32, 33-40 and 41-49. The estimates for male migrants, presented in Figure 15 (Appendix B), do not support this. The estimated health advantage for the most recent migrants (YSM=0) differs only slightly by age at moving while the difference across length of residence is in most cases larger. An exception are those who moved over the age of 40. Within this group, the longer-settled migrants enjoy a much bigger health advantage over natives than recent arrivals. This is not surprising given that economic theory suggests that migrants that are older at time of migration are more positively selected (Jasso, Massey et al. 2004). For female migrants (Figure 16, appendix B), the picture is similar to that estimated by the overall sample. In sum, these results suggest that age at moving is not a major confounder in the YSM-health relationship.

Robustness check regarding effects of immigrant composition across YSM

There were two important changes to immigration policy in the UK that affect that quality of immigrant composition, and that might be inadvertently captured in the YSM trajectory. Firstly, the PBS, phased in from 2002 for immigrants from non-EU countries, which should favour highly skilled immigrants. Secondly, the accession of the new EU countries in 2004 and 2007, and the opening of the labour market in the UK to them, means that new EU immigrants are overrepresented amongst very recent white immigrants.

The top panel of Figure 12 (appendix B) shows the trajectory of the health advantage over UK-born for immigrants from low income non-EU countries of birth. If the higher immigrant quality due to the introduction of the PBS system is captured by the estimated trajectory across years since migration it should be particularly steep. This is not the case; the estimated trajectory is very similar to that for the overall immigrant population. The bottom panel shows the trajectory of the health advantage over white UK-born for white immigrants. New EU immigrants are overrepresented in the more recent arrival cohorts in this group and should be less favourably selected than earlier white immigrants. If these cohort differences were reflected in the estimated trajectory this would result in a very flat trajectory. Actually, the opposite is the case, the trajectory is particularly steep. While this suggests that indeed the immigrant composition affects the estimates, this is not in the expected direction.

We conclude from that that it seems unlikely that the trajectories across years since migration estimated with the cross-sectional data purely or mainly reflect compositional differences between arrival cohorts with permanent health differences. It seems more likely that they mainly reflect health assimilation that happens over time after immigration.

3.9 Discussion and conclusion

This study attempts to quantify the HIE for the immigrant population compared to the UK-born population overall and within major ethnic groups. The health advantage that recent immigrants have over the native-born population is considered controlling for different factors that are common explanations for immigrants' good health, such as differing degrees of selectivity from resulting e.g. in high levels of education, and - indirectly via ethnic groups - good health behaviours.

The analysis confirmed that recent immigrants have a significant health advantage over similar UK-born people which is estimated 4.6 and 9.5 percentage points for male immigrants in the first year after migration adjusted for age and education, depending on health measure. The magnitude of the HIE depends on the degree of migrant selectivity. Testing the formulated hypotheses with respect to selectivity for poor physical functioning (SF-12), our results are mostly in the correct direction though the differences are not statistically significant. Highly educated immigrants have a smaller HIE compared to similarly educated natives than immigrants with low education. Among immigrants from countries with similarly low migration costs those with lower potential gain from migration (EU-14 countries) have as expected a larger HIE than those from countries that have more to gain (EU accession countries). In the same vein among immigrants from countries with high migration costs those with lower potential gain (high-income non-EU countries) have a larger HIE than those from countries where migration should yield a higher gain (low-income non-EU countries). This latter result might however also reflect the low population health in the low-income non-EU countries, rather than lower selectivity. Among immigrants from countries with similarly high potential gain from migration those with higher migration cost have a larger HIE (low income countries, compared to new EU countries). Only among immigrants from countries with similarly low potential gain from migration expectations were not met because the EU-14 immigrants that faced lower migration cost (in terms of geographical distance and hurdles of immigration policies) compared to immigrants from high income non-EU countries have a marginally larger HIE.

Also in line with expectations regarding migrant selectivity the HIE for poor physical functioning (SF-12) for women is small and not statistically significant (1.8 percentage points). However, we do not find the same pattern for the female HIE for poor self-rated health and chronic condition, rather the female HIE estimated for chronic condition and poor self-rated health is similar or larger than that for men. This gender pattern is unexpected, given we know many women come to the UK as family migrants. It is also not in line with some studies, that do find smaller advantages for female immigrants (Vissandjee, Desmeules et al. 2004; Kobayashi and Prus 2012) though these do control for post-migration characteristics. However, McDonald and Kennedy (2004) also find larger health advantages for women than men for both poor self-rated health and (non-severe) chronic condition.

For ethnic groups whether we find an ethnicity-specific HIE depends on the health measure under consideration. For poor physical functioning (SF-12) only white male immigrants and black African female immigrants (except those from high-risk countries) have an initial advantage over their UK-born co-ethnics. When using poor self-rated health as health measure white and Indian immigrants of both genders have a significant HIE over co-ethnics. For diagnosed chronic condition the differences between recent immigrants of both genders and UK-born co-ethnics are statistically significant in all ethnic groups (with the exception of black African immigrants from medium or high risk countries). Especially for women this is driven more by high levels of poor health of the UK-born comparison groups, rather than very low levels of poor health of the foreign-born women of the same ethnic groups.

These results highlight the role that immigrant status plays in ethnic health inequalities in the UK. It demonstrates in more detail what Nazroo (1997) showed with more limited data, that there is considerable heterogeneity in health within ethnic groups in the UK depending on immigrant status and length of residence, reflecting the HIE. An analysis of health across ethnic groups will therefore to some extent be affected by the immigration patterns of the different ethnic groups. The proportion of foreign-born in a given ethnic group in the UK varies greatly as does their mean length of residence (see appendix B, Table 37). This variation in the composition of ethnic groups could therefore be masking differences, or introducing apparent differences between ethnic groups that are in fact largely driven by immigrant status and length of residence. This seems to be particularly relevant for poor self-rated health and chronic conditions. As the composition of ethnic groups in terms of migrant status and length of residence changes over time their health status compared to that of the white British population will potentially also change. The comparison across ethnic groups and in particular the patterns of the probabilities of ill-health across UK-born ethnic groups also highlight the challenge of adjustment for socio-economic circumstances across ethnic groups (Kaufman, Cooper et al. 1997; Nazroo 2003). Unfortunately, for the purpose of identifying a HIE we cannot adjust for it more comprehensively as this would be characteristics that are post-migration for immigrants.

With respect to the decrease of the HIE with length of residence, i.e. the duration effect we find that the HIE is statistically significant amongst immigrants between 6 to 15 years since migration, depending on gender and health measure used. For poor physical functioning (SF-12) the HIE is observable for the shortest time length of residence, for chronic condition the advantage is still observable for immigrants with 12 to 15 YSM.

A contribution of this analysis is that it provides a comparison of commonly used health measures in HIE studies, poor self-rated health and diagnosed chronic condition, to a measure of physical functioning (SF-12). We argue that SF-12 PCS is more suitable to compare health status across groups that are as heterogeneous as the immigrant population of the UK in terms of their health profiles and past experience of health care systems. It should also be less sensitive to differing reporting behaviours than self-rated health. The results seem to suggest that SF-12 PCS offers a more consistent estimate of the HIE across varying groups than the two alternative measures and yields HIE estimates that are more in line with theoretical expectations. The patterns overall suggest that self-rated health and chronic condition overstate the health advantage of recent immigrants, especially amongst women.

There are some limitations to this study. Most importantly the analysis is limited by its cross-sectional nature. However, using more than the first wave of *Understanding Society* and at the same time conducting the analysis by ethnic group would not have been realistic due to a combination of attrition and low completion rates of the self-completion questionnaire by ethnic minority boost sample members. The following chapter, which looks at the role of work conditions in the health assimilation of immigrants after migration, uses longitudinal data and also finds evidence of a negative duration effect. The results in this chapter are sensitive to the cut-off point for length of residence up to which immigrants are included in the sample. This is equally true for many other HIE studies, and that needs to be kept in mind when comparing results across studies. Lastly, the estimated net HIE is likely to contain some residual confounding in terms of unobserved differences in education, because the proxy measure of education that relies on pre-migration measures of educational status and cannot capture the full variation in educational level.

4 The role of physical and psychosocial work conditions in explaining working immigrants' health trajectories

4.1 Introduction

At arrival, immigrants are usually in better health than native born people of similar demographic and socio-economic characteristics. As discussed in the previous chapter, this is called the Healthy Immigrant Effect (HIE). Explanations for this effect focus on positive (self-)selection from the origin population and healthier behaviours (Agudelo-Suarez, Ronda-Perez et al. 2011).

Chapter 3 examined the HIE for immigrants in the UK based on cross-sectional data. As is well established and also observed in the analysis of the previous chapter, this health advantage is relatively short-lived as it is gradually lost with increasing length of residence. This gradual loss of immigrants' initial health advantage is from now on referred to as (negative) duration effect. The duration effect is again mainly explained by behaviours, more specifically by behavioural change as part of the acculturation process immigrants go through, but also by access barriers to health services (Newbold and Danforth 2003), and selective return migration.

This process is usually described as one where immigrants' health converges over time to native levels (Lassetter and Callister 2009). The possibility that immigrants' health can deteriorate beyond natives' health levels is not often explicitly considered albeit this is also observed (Biddle, Kennedy et al. 2007). For example, immigrants' health convergence can be towards that of people in similar (i.e. low) socio-economic position rather than to the population mean (Kunst, Stronks et al. 2011, for prevalence of chronic conditions).

Research on the negative duration effect of immigrants has focussed on two aspects: acculturation and selective return migration. With respect to the former, and behavioural change associated with acculturation especially diet and resulting BMI (Antecol and Bedard 2006; Sander 2009) or other health behaviours such as smoking or alcohol consumption (e.g., Biddle, Kennedy et al. 2007; Finch, Lim et al. 2007). With respect to selective return migration, some find that healthy men are more likely to return, resulting in a negative selection of immigrants with increasing length of residence (e.g., Sander 2007, for immigrant men in Germany), while others find that unhealthy immigrants are more likely to return (salmon bias) (Palloni and Arias 2004, for Mexican immigrants in the United States). Arguments depend at least to some extent on the host country under consideration.

To some extent the deterioration can be seen as a natural consequence of the initial positive self-selection (regression to the mean) (Jasso, Massey et al. 2004; Biddle, Kennedy et al. 2007). This would imply that the deterioration does not go beyond native levels. Only migrant-specific factors, e.g. discrimination, could explain any excess deterioration.

Antecol and Bedard (2006) point out aspects that would normally suggest an improving health trajectory of immigrants: Immigrants usually enter the host country's labour market at a low earnings level, and labour income then improves over time. As labour income and health are usually positively correlated immigrants should get healthier with longer residence (Jasso 2004, Antecol and Bedard 2006). However, this disregards that even if over time immigrants' socio-economic position (SEP) improves, this does not make past exposure to detrimental factors undone. Hence, at a given time, immigrants who have reached a relatively high SEP will likely have spent more time in the past in lower SEPs that their native born counterparts who will not have been as socially mobile. This limits the potential for health improvement over time.

There is a well-established literature on the impact of both physical and psychosocial work conditions on health, and social inequalities in health (Karasek and Theorell 1990; Siegrist and Marmot 2004). Poor work conditions have been identified as a possible contributor to the duration effect because, following from Grossman's Health Capital theory, immigrants are prepared for bigger health trade-offs for work than natives (Giuntella and Mazzonna 2014).[65] There is even a specific term –'exhausted migrant effect' – that implies work conditions could be an explanation for the negative duration effect (Rial González and Irastorza (no year)). Nonetheless, while there are studies on immigrants' work conditions in many European countries, few studies consider the relationship of these conditions and immigrants' health (Rial González and Irastorza (no year)). Most of the studies relate to physical work conditions, especially risky occupations. Even rarer are studies that relate the work conditions to immigrants health trajectories (as opposed to health status), so that one could draw conclusion with respect to the loss of the HIE.

One of the few studies investigating work conditions as explanation for immigrants' health decline is a study on immigrant workers in Germany (Giuntella and Mazzonna 2014) but – given the low-skilled immigrant population on consideration - it only considers physical work conditions. They find that the health of immigrants with

[65] Discrimination is another possible explanation for immigrants' health deterioration that is related to work conditions because it can result in work conditions that are poorer than should be expected given skill levels. This has not been given much attention in the literature despite evidence for Europe that discrimination in and outside of the workplace, has an influence on the health of immigrant workers (Agudelo-Suarez, Ronda-Perez et al. 2011).

physically demanding jobs deteriorates faster than the health of immigrants in less demanding jobs, and that the overrepresentation of immigrant workers in such manual jobs explains part of their negative trajectory. For the immigrant population in Spain as a whole –regardless of length of residence – Malmusi, Borrell et al. (2010) find that work conditions do not fully explain the health disadvantage immigrants have over Spanish-born workers.

This chapter addresses the question of how far poor physical and psychosocial work conditions contribute to the negative duration effect in immigrants' health trajectory. Using data from the first five waves of the UK Household Longitudinal Study (UKHLS) we examine to what extent the negative duration effect in immigrants' physical health can be attributed to task-related physical and psychosocial work conditions. The analysis uses a robust health measure of physical functioning that is arguably less subject to measurement error than commonly used subjective measures that tend to overestimate immigrant-native differences.

This analysis contributes to the literature by considering both physical and psychosocial work conditions, which means it is better at reflecting work stressors also relevant for immigrants in higher skilled occupations (while other studies consider physical conditions only, e.g. Giuntella and Mazzonna 2014). The analysis uses two main sets of explanatory variables. First we use work condition scores based on a validated external job-exposure matrices developed from the characteristics of occupations (Kroll, 2011). Second, the models include a measure of psychosocial work conditions - autonomy at work - that is reported by respondents. This is also, to the best of our knowledge, the first analysis of the duration effect in the UK that uses longitudinal data that can distinguish cohort effects from actual duration effects.

The next section reviews the literature on the effect of work conditions on physical health. Section 4.2 considers how work conditions may be linked to health and immigrants' work conditions are reviewed. Section 4.3 formulates the research questions, how work conditions could explain the negative duration effect in immigrant health. Sections 4.4 and 4.5 describe data and measures and the analysis strategy, respectively. The results of the analysis are described in section 4.6. The last section includes discussion and concluding remarks.

4.2 Work conditions and immigrant health

This analysis defines work conditions as task-related characteristics of work. Such characteristics have the potential to affect health directly by being at the workplace and doing the work. This is in contrast to other characteristics of work that can also affect health, but where the underlying mechanisms are not directly associated with the tasks done in the workplace (Sauter, Brightwell et al. 2002; Landsbergis, Grzywacz et al. 2014). Examples of such work characteristics would be pay or job insecurity. Such factors will only be considered as confounding factors.

4.2.1 Work conditions and health: Mechanisms and evidence

This section outlines the work conditions we consider in this analysis that may contribute to the negative duration effect and discusses the general mechanisms of how these work conditions could affect the health of workers in general, not just immigrant workers. Many factors can influence both physical and mental health, but only the former are discussed here.

Physical work conditions

Physical risk factors can be distinguished into risks related to exertion and risks related to safety hazards (such as dangerous work methods or exposure to toxic substances) which could affect health via different pathways (Karasek and Theorell 1990). Karasek and Theorell emphasise that "physical demands of work are still important to almost as many workers in the US and Sweden as the new psychological demands" (1990, p.65). This is still true for the EU (and presumably the UK) today: The prevalence of physical work stressors such as exposure to noise or vibrations (circa 25 percent) or moving heavy loads (37 percent) is about as high as the prevalence of low control over work (29-35 percent) or monotonous tasks (40 percent) (5th European Working Conditions Survey (EWCS), see Eurofound 2012). The most common physical risk is physical exertion, in particular repetitive hand or arm movements and working in tiring or painful positions (Eurofound 2012).

Current data collections on physical risk factors mostly do not consider physical inactivity (e.g. 5th ECWS). This is somewhat surprising given that physical inactivity is also a well-established risk factor, e.g. for cardio-vascular disease (CVD) and other chronic disease (Olsen and Kristensen 1991; Bull, Armstrong et al. 2004). More recently sedentary work specifically has been found to increase the risk of cardiometabolic diseases and premature mortality independently of activity levels outside work (Buckley, Hedge et al. 2015).

Evidence of the association between physical work conditions and health

The negative effect of physical work demands and the physical work environment on health has been shown in several studies, e.g. Ravesteijn (2013) show that manual work (and low job control) has a substantial negative effect on health that gets stronger with age. Fletcher, Sindelar et al. (2011) also confirm a cumulative negative effect of physical work demands and environmental conditions on health. Case and Deaton (2005) find that self-reported health of manual workers, which have higher physical work demands than non-manual workers, deteriorates faster than non-manuals workers'. However, they do not consider that at the same time psychosocial work conditions tend to be poorer in manual occupations and these could therefore also contribute to the faster decline in manual workers' health.

Psychosocial work conditions

Psychosocial work conditions are a fairly new focus of occupational health research which evolved with the changing industry structure towards the service industries (Karasek and Theorell 1990; Bamberg, Keller et al. 2006). Psychosocial conditions at work are considered as one of the major contributors to social inequalities in health in midlife (Siegrist & Marmot, 2004).

Psychosocial factors may not be connected with as high a risk of illness as some physical work hazards, but the potential impact also depends on the prevalence of a given psychosocial factor in the working population (Kristensen 1995). As the EWCS findings cited earlier demonstrate, many psychosocial work conditions that are considered to be risk factors are quite prevalent in the working population (Eurofound 2012).

While physical work conditions can be easily measured, and mechanisms on how they affect health are fairly straightforward, this is not the case for psychosocial conditions (Siegrist & Marmot, 2004). Various theoretical frameworks have been put forward most of which build on mechanisms from general stress theories. Examples are the Person-Environment-Fit theory (Caplan 1987), models based on equity theory (Siegrist et al 2004), the Effort-Reward-Imbalance theory (invoking ideas of reciprocity in the work contract) (Siegrist, Starke et al. 2004) and the Demand-Control(-Support) (DCS) model by Karasek and Theorell (1990). Some of the theories are difficult to test empirically, or are more commonly used in research on work-related outcomes such as job satisfaction. Only the last two –especially the DCS model – have been widely used in health research.

To explain the hypothesised mechanisms, the DCS model shall be outlined, because much of the research on psychosocial work conditions that is reviewed below makes use of it. There is considerable overlap with some of the other theories in terms of the postulated mechanisms.

The Demand-Control model, originally proposed by Karasek (1979), brings previously separate research traditions on the effects of work demands and work control together. The demands dimension comprises aspects of role ambiguity (conflicting demands), concentration, and mental work disruption. The control (or decision latitude) dimension comprises the aspects of skill discretion (variety of work and opportunity to learn), decision authority (autonomy over how work is done), skill utilisation and also macro level components (participatory influence in the organisation, union participation). Both low control and high demand are hypothesised to cause both physiological changes and behavioural changes that are detrimental to health. The combination of low control and high demands is called job strain, and Karasek's main hypothesis is that this is particularly bad for workers' health.

The Demand-Control model was extended by the dimension of social support by Johnson (Johnson and Hall 1988; Johnson 1989) and is as such referred to as Demand-Control-Support model. Social support is defined as "the overall levels of helpful social support on the job from both co-workers and supervisors" (Karasek & Theorell 1990, p69). High social support is thought to buffer the effects of psychological stressors on health, facilitate active coping patterns that indirectly benefit health, and also affect physiological processes important to maintain long-term health (Karasek & Theorell 1990).

The three dimensions of the DCS model act as stressors that can lead to psychological strain and ultimately affect physical (and mental) health negatively via two main pathways: Directly, work stress is thought to affect in particular coronary heart disease (CHD) risk via the neuroendocrine system. Indirectly, work stress can affect health through unhealthy behaviours, such as smoking or lack of exercise, as a reaction to stress (Karasek, Brisson et al. 1998; Chandola, Britton et al. 2008). The indirect pathway of work conditions affecting health via unhealthy behaviour is also emphasised by the idea that workers in jobs with high decision latitude, especially when combined with high demands (so-called 'active jobs') learn new behaviours from their positive work experience and transfer these into an active lifestyle outside work (Karasek and Theorell 1990).

A facet of the DCS model potentially relevant to immigrants is skill underutilisation. This refers to the situation where workers are not able to use the skills they have in their work, typically because they work in a job for which they are overqualified (Felstead 2002). While Karasek and Theorell discuss this in the DCS model, this is mainly in the context of work productivity. Only a few studies have used skill underutilisation or over qualification in a health context. Crollard, de Castro et al. (2012); and Konno and Munakata (2014) find a negative association with physical health but it is not clear if this implies a causal mechanism. Reid (2012) also finds an association of skill underutilisation with poorer mental health of migrant workers. Skill underutilization is also highly positively correlated with low control (Karasek and Theorell 1990). This paper will therefore not consider skill underutilization as a separate psychosocial work condition.

Poor physical work conditions and poor psychosocial conditions often go hand in hand. For example, Karasek and Theorell find that the "correlation matrix shows that decision latitude is (…) negatively correlated with physical demands" (1990, p 343). While physical risks are often associated with specific injuries, psychosocial factors affect the general illness risk. Karasek and Theorell (1990) therefore call for controlling for physical risks as confounders, although clearly physical and psychosocial risks are often associated with the same illnesses (e.g. CVD (Marmot and Wilkinson 2006)).

Evidence for association between psychosocial work conditions and health

A review of 19 high-quality longitudinal studies (de Lange, Taris et al. 2003) finds only limited empirical support for the specific hypotheses that the DCS model makes, which postulate an interactive relationship between demand, control and support. The significance of the three dimensions is better supported: High demands, low control and low support have been confirmed to predict independently and combined (i.e. additively) psychological strain and physical ill health (de Lange, Taris et al. 2003). In particular, there is strong evidence for a causal link between work stress and heart disease based on studies of the Whitehall II survey of civil servants (e.g., Chandola, Bartley et al. 2003; Chandola, Britton et al. 2008).

In summary, there is strong evidence for the relationship between physical and psychosocial work conditions and a wide range of physical health outcomes for the general population (e.g. Marmot, Siegrist, Theorell, 2006), including evidence that the extent of reverse causation (unhealthy workers selecting into jobs with poor work conditions) in this association is limited (Chandola, Bartley et al. 2003).

4.2.2 Immigrants and work conditions: the evidence

Having reviewed exposure mechanisms linking working conditions and health outcomes in the previous section, this section considers whether there is evidence in the literature of inequality of these associations based on immigrant status.

Poor work conditions could contribute to explaining immigrants' negative duration effect in two ways: Either through differential exposure, i.e. migrants are overrepresented in jobs with poor work conditions; or through differential vulnerability, i.e. migrants' health suffers more under the same work condition than natives' health (e.g. Landsbergis 2014). Arguments for these two pathways are reviewed in turn.

Do immigrants more often work in jobs with poor work conditions?

With respect to the first possibility, differential exposure, there are both theoretical arguments for it and empirical evidence indicating that immigrants' are overrepresented in jobs with poor work conditions.

Migrants are more likely to be found in so-called three D jobs ("dirty, dangerous, demeaning") (Orrenius and Zavodny 2012). Economic theory suggests that immigrants are for several reasons more likely to work in such risky (or unpopular) occupations than natives. The hypothesis of compensating differentials and Grossman's Health Capital theory posits that workers make a trade-off between their health (and other unfavourable work conditions) and the pay they receive (Case and Deaton 2005; Orrenius and Zavodny 2012). Given the constraints many immigrants face when looking for work (such as discrimination, poor transferability of skills from their home country) they are more likely to trade-off health for pay than natives. With respect to health, jobs can be undesirable due to the physical conditions, or psychosocial conditions. This includes conditions that are detrimental to worker's health, either due to higher injury risk, or conditions such as physical exertion or exposure to hazards that can lead to chronic conditions , or due to stressful psychological or social conditions (Bryson, Barth et al. 2012; Orrenius and Zavodny 2012; Giuntella and Mazzonna 2014), including unstable work conditions.

The theoretical argumentation why immigrants are prepared to take risky jobs also applies to non-risky (not hazardous) jobs with (mainly psychosocial) work conditions that can be detrimental to health for other reasons, e.g. due to chronic stress. This is not necessarily a conscious trade-off migrants make. Depending on occupational standards in the country of origin, many, especially non-manual, jobs might seem "healthy" to an immigrant and they might not be as aware of chronic (psychosocial) risk factors affecting health as natives are (Orrenius and Zavodny 2012). However, there has been less research into whether immigrants are overrepresented in jobs with less obvious health risks.

Evidence for higher prevalence of poor work conditions among immigrants

Empirically, it is well documented that immigrants in advanced economies (US, Canada, Australia, some European countries) are more likely to work in occupations that have high rates of injuries and fatalities (Orrenius and Zavodny 2009; Orrenius and Zavodny 2012; Landsbergis, Grzywacz et al. 2014; Rial González and Irastorza (no year)). Such risky occupations are mainly manual, often low-skilled occupations such as in agriculture and food manufacturing (Migration Advisory Committee 2014) . Nonetheless, Szczepura, Gumber et al. (2004) find that immigrants have lower rates of workplace injuries than UK-born workers. However as Reid, Lenguerrand et al. (2014) find in a mixed-method study on workplace injuries among migrant workers in Australia this could be explained with migrant workers being less likely to report workplace injuries, either because of concerns for job security, or due to lack of understanding of what constitutes a workplace injury and their rights as workers.

The evidence with regard to overrepresentation of immigrants in jobs with poor psycho-social work conditions is mixed. While Sundquist, Ostergren et al. (2003) find that psychosocial work conditions between immigrants and Swedish natives do not differ a lot, a British study finds that civil servants of South Asian origin (most of whom are foreign-born), have less job control and social support at work, and a higher perceived imbalance between efforts and rewards (Hemingway, Whitty et al. 2001). In Germany, Hoppe (2011) concludes that immigrants have more stressors from social interactions in the work environment, but similar levels of task-related psycho-social stressors (e.g. time pressure).

In the UK, immigrants are (slightly) overrepresented in low-skilled jobs which are usually associated with poor psychosocial conditions. Despite their on average higher education just under half (ca. 47 percent) of all foreign-born workers are in low-skilled jobs according to the ONS skills definition[66], compared to 44.5 percent of UK-born workers (Migration Advisory Committee 2014). Qualitative research on low-skilled jobs (Migration Advisory Migration Advisory Committee 2014) also supports that employers find UK immigrants more willing to take on (and retain) jobs that involve sustaining a high pace of work (but also long work hours or anti-social shifts). Immigrants also suffer from higher levels of discrimination at work than UK-born workers (Smith, Wadsworth et al. 2005).

There is some evidence of that occupational risk of immigrants decreases with increasing length of residence (for an overview, see Orrenius and Zavodny 2012) . This is consistent with the idea that immigrants' estimate of occupational risk becomes more accurate over time, also because of increased fluency in language, and this influences their occupational choices (Szczepura, Gumber et al. 2004; Orrenius and Zavodny 2009). This would suggest that poor (physical) work conditions are more prevalent among recently arrived immigrants compared to longer-settled immigrants, other things being equal.

[66] Office for National Statistics (ONS) Standard Occupational Classification (SOC) skill classification, which at its broadest level categorises the following as low-skilled occupations: Administrative and secretarial occupations; caring, leisure and service occupations; sales and customer service occupations; process, plant and machine operatives; and elementary occupations.

Do poor work conditions have a more detrimental effect on immigrants' health?

The second possibility of how poor work conditions could explain the negative duration effect, is that immigrants' health is more vulnerable to some work conditions than natives' health. This would mean that, faced with the same work conditions, immigrants' health outcomes are worse than natives' outcomes.

Landsbergis, Grzywacz et al. (2014) review the evidence of differential exposure and differential vulnerability of immigrants and ethnic minorities to work organisation, including psychosocial stressors. While they find evidence for the former, there is very little evidence for differential effects (though this is also due to lack of studies that test it in the first place). Sundquist, Ostergren et al. (2003) hypothesise that job strain (i.e. low control combined with high demands) and low social support at work have a more detrimental effect on immigrants' health than on native Swedes' health due to immigrants' being less likely to leave a poor quality job. However, they find only very limited support for this (only for lack of social support for refugees, not for labour migrants; and not for job strain).

In summary, there is not much empirical evidence to support differential effects on immigrant health and it is difficult to imagine why this should be the case.

4.3 Research questions

The review of the literature showed two things. First, that physical and psychosocial work conditions influence health and second, that immigrants are more likely to work under work conditions that are unfavourable for health.

We have two main research questions: First, do physical work conditions contribute to the health decline observed for immigrants with increasing length of residence? And second, do psychosocial work conditions, understood as high psychological demands, low control over work and/or low social support at work, contribute to the negative duration effect? Based on the existing research findings reviewed, we assume a that work conditions can explain immigrants' negative health trajectories due to distributional differences between immigrants and UK natives, not due to a more detrimental effect of the same work conditions on immigrants compared to natives.

4.4 Data and measures

The study makes use of the UK Household Longitudinal Study (University of Essex. Institute for Social and Economic Research. 2015) which started in 2009 and follows members of around 30,000 households in the UK (Knies 2015). All adult members (16+ years or older) of these households (including new members joining after the first interview) are interviewed annually. Each annual interview is referred to as a "wave" and currently data from the first five waves is available. Interviews are administered by an interviewer. Those who complete these interviews are requested to complete an additional self-completion questionnaire.

The data lend themselves well to the research question because UKHLS collects several measures of physical health, detailed information on occupation and migration history and includes an ethnic minority boost sample with a high proportion of immigrants. In addition, in wave 2 questions on health behaviours were asked, and waves 2 and 4 contain a module on work conditions. As data from five waves is available, we can only analyse duration effects over a span of four years.

4.4.1 Analysis sample

The negative duration effect is the gradual loss of the health advantage that new immigrants have when they arrive in the host country (healthy immigrant effect). Therefore, we would ideally like to restrict the analysis to immigrants who had a health advantage on arrival. However, neither health status at arrival nor reasons for migration are known. We can therefore only exclude immigrants for whom the theory and empirical evidence suggests that the healthy immigrant effect is less likely to apply, that is, they are less likely to be positively selected on health. Labour migrants, who are more often male than female and who typically migrate at young adult ages are more likely to be positively selected on health. Immigrants who do not take the migration decision themselves, such as children, and people who migrate at older ages (Jasso, Massey et al. 2004) or female migrants who are more likely to be family migrants are less positively selected on health. We thus restrict the analysis sample to male immigrants who moved to the UK between the ages of 18 and 40[67]. People who work are on average healthier than those who do not because unhealthy people tend to drop out of work (Healthy worker effect) (e.g. Mora, 2008). In order to minimise the selectivity of the sample, all men in paid employment at wave 1 are selected and only any subsequent non-employment (or self-employment)[68] spells excluded. We include males of core working age, aged between 21 and 60 years, and employed at first interview.

We also include men in this age group who refused a full interview in wave 1 and were employed at wave 2. This provides a sample of 8,773 men. After excluding observations with missing values for any of the control variables and the key dependent health variable, SF-12, the sample is reduced to 5,450 men and 20,608 person-period observations. This is not a balanced panel, the reasons for which are discussed below.

Respondents with poor health are more likely to drop out of a panel survey (Jones, Koolman et al. 2006) and so, estimates of health based on a balanced sample might be upwards biased. Furthermore, attrition is particularly high amongst immigrants

[67] In addition, women are more likely than men to drop out of the labour market if their health deteriorates. This means that working status and continued exposure to the work conditions of a given job are more endogenous to health for women than men.
[68] Self-employment spells are excluded because the meaning of some of the work condition measures differs between employed and self-employed workers, as discussed in section 4.4.3.

compared to UK-born sample members, in part due to their high mobility (see chapter 2), both within the UK but also as a result of return migration (Jasso, Massey et al. 2004). By wave 5, only 51 percent of immigrants but 66 percent of UK-born wave 1 respondents in the analysis sample are interviewed (Table 12).

Table 12 Number of person-periods by wave and immigrant status (or cohort) in analysis sample

wave	UK-born	8+ YSM	0-7 YSM	Total
1	4,499	279	278	5,056
2	4,438	235	238	4,911
3	3,474	169	189	3,832
4	3,255	158	161	3,574
5	2,950	141	144	3,235
Total	18,616	982	1,010	20,608

The longitudinal sample may become progressively selective and it is not clear how far the health trajectories of those who drop out might differ systematically from those who stay in the sample.[69] The analysis sample is therefore unbalanced, to minimise selectivity by including persons who drop out or have intermittent non-response patterns (Table 13).

[69] We compared initial health and other characteristics at first interview between respondents in the analysis sample that are observed for at least 3 interviews over a period of at least 4 waves (respondents with long follow-up, n=4,283), to respondents in the analysis sample who drop out after providing less than 3 interviews and before wave 4 (respondents with short follow-up, n=1,167) and respondents who are not in the analysis sample because they do not have complete information (mainly because they dropped out permanently after wave 1) (attriters, n=3,323). Respondents with long-follow-up are the oldest (mean age 41), most educated with the best work conditions (mean overall job index = 5.1) and least healthy (mean SF-12 PCS= 53.3). Attriters (who are not part of the analysis sample) are youngest (mean age 38) with the best health (mean SF-12 PCS= 53.7) and slightly less favourable characteristics in terms of education and work conditions than respondents with long follow-up. Respondents with short follow-up have the poorest education and work conditions of the three groups (mean overall job index = 5.6), their health is in between the two other groups. However, the association between work conditions and health at first interview is strongest for this group (and weakest for respondents with long follow-up). This suggests that the respondents with short follow-up that can be included in the analysis sample actually differ more from respondents with long-follow up than the attriters that are not part of the analysis sample. The fact that the association between work conditions and health is strongest for respondents for whom we only observe a short trajectory implies that we might underestimate the role of work conditions in health trajectories.

Table 13 Response patterns in analysis sample (male respondents with full wave 2 interview, aged 21-60, employed at first interview)

Response pattern	Frequency	Percent
11111	3384	62.09
11. . .	627	11.50
111. .	367	6.73
1111.	329	6.04
.1111	191	3.50
11.11	161	2.95
111.1	115	2.11
.1. . .	94	1.72
11.1.	46	0.84
.11. .	40	0.73
other pattern (11. .1, .111., .1.11, .1.1., .11.1, .1. .1)	96	1.76
Total	5450	100

The immigrant measure is constructed based on country of birth: people born outside of the UK are considered immigrants. The health decline of immigrants after arrival is often said to be stronger in the early years after migration, while later health trajectories gradually converge to those of native-born. The negative duration effect that can be observed over the 4-year period in this sample could therefore differ depending on the length of residence.[70] To allow for differing trajectories, immigrants are grouped into three arrival cohorts (0-4 years since migration (YSM), 5-11 YSM, 12+ YSM). YSM is measured as the difference between the year of arrival to the UK and the first interview. For the analysis stratified by education immigrants are grouped into two groups: 0-7 YSM and 8+ YSM, to maximise cell sizes of each immigrant group in both populations.

[70] In addition, the foreign-born working population in the UK is not a homogenous group with respect to their skill levels, language proficiency and other characteristics important for labour market integration. Splitting immigrants into arrival cohorts therefore allows to capture differences between cohorts.

This analysis excludes periods of non-employment. Overall, continuous employment (understood as having a job at all interviews, but possibly spells of non-employment between interviews) is high. In this sample of men employed at wave 1, 85% of immigrants and 86% of UK-born have a job at all interviews after the first interview. Restricting the sample to only people who are employed at all interviews would introduce bias towards healthier people and potentially underestimate the effect of work on health. It is therefore preferable to keep cases of people who are not employed continuously in the sample. While for people who are not employed because of health reasons this is endogenous this is a very small group, with only 27 respondents with one period of being long-term sick and 9 respondents with two or three periods.

4.4.2 Health measure

The previous chapter used three different health measures to estimate health differences between immigrants and the UK-born population: poor self-rated health, diagnosed chronic condition, and physical functioning derived from SF-12 (PCS). This analysis models mean health using SF-12, the reason for which is explained below.

Given that work conditions are associated with many chronic conditions, such as heart disease, diagnosed chronic condition would seem an obvious choice but there are two key reasons why we do not use chronic condition for this analysis. Firstly, as discussed in the previous chapter, diagnosed chronic condition overstates the health advantage of recent immigrants compared to natives because recent immigrants are often not aware of having a condition (Jasso, Massey et al. 2004; McDonald and Kennedy 2004). The increased diagnosis of pre-existing conditions can overstate the health decline after immigration. We are not able to distinguish between catching-up with undiagnosed pre-existing conditions or actual new conditions that could be a result of their work conditions in the UK. Secondly, one would need a longer observation period than the four years available in order to observe meaningful increases in prevalence of chronic conditions (Jasso, Massey et al., 2004, who acknowledge this problem in their own analysis that covers five years). We also reject self-assessed health as a good measure to compare immigrants' and natives' health because it is subjective (see detailed discussion in Chapter 3). Immigrants are bound to adjust their idea of what constitutes good health over time in the host country. With increasing length of residence, the comparison standards that immigrants apply when assessing their health can change (usually upwards). Therefore, immigrants health can seemingly deteriorate with time even when it is stable (Farré 2013). An additional problem with self-rated health is be that it is a rather coarse measure and observed change in self-rated health over a four-year period may be limited.

In the previous chapter we found that the SF-12 physical component summary (PCS) is best suited to compare immigrants' and natives' health, and is least likely to overstate immigrants' health advantage and subsequent decline. The SF-12 PCS is based on a 12-item instrument of physical functioning, with a continuous scale ranging from 0 (low functioning) to 100 (high functioning). This analysis models mean health using SF-12 PCS as continuous variable which is able to pick up the relatively small changes to be expected over the four-year period.

Because SF-12 PCS measures health by capturing how well a person can fulfil their role in society it does mean that the health score depends to some extent on the type of job a person has. For example, of two persons with similar health the one with a more physically demanding job is more likely to report not being able to fulfil their role and hence have a lower health score on account of that. This would mean that negative effects of work conditions on health are overestimated with SF-12 PCS. Three items of the SF-12 PCS instrument either explicitly or implicitly refer to a person's role at work: the bodily pain item (item 5) asks how much pain interfered "with your normal work (including both work outside the home and housework)". The physical role items (3a and 3b) ask whether the person has accomplished less than they would like as a result of physical health and whether they were limited in the kind of work or other activities as a result of physical health. These items indirectly depend on the usual role, i.e. work, that a respondent does. However there are also three items on physical functioning (item 1, general health, and items 2a and 2b, physical functioning) that do not implicitly or explicitly relate to one's role.

In the first survey wave, the SF-12 instrument was part of the main questionnaire which is interviewer administered. From the second wave onwards it was moved to the (computer-assisted) self-completion questionnaire. Self-completion questionnaires tend to elicit more honest responses on problematic subjects, as which poor health could be considered. However, there is no reason to expect this to differ by immigrant status. As not all respondents agree to fill in the self-completion questionnaire, this means that there are higher levels of item-missingness for this measure as compared to the other interview-administered health measures.

4.4.3 Operationalisation of work conditions

Measures of work condition can be distinguished into self-reported measures directly collected from the respondent and external measures that are assigned to respondents based on some matching variable such as occupational title (often referred to as job-exposure matrices). Self-reported measures have the advantage that they measure someone's actual work conditions more accurately but they are also subjective. This paper uses a combination of external measures and self-reported that are collected in the work conditions module of UKHLS. Job-exposure matrices are aggregate measures of work conditions based on occupational groupings. They have the advantage that they are more objective, and can reduce upward bias due to negative reporting of both work conditions and health (negative affinity) (Schwartz, Pieper et al. 1988; De Lange, Taris et al. 2004). Such aggregate scales however limit the variation within occupational groups which may underestimate the actual associations between work conditions and health outcome (Alfredsson and Theorell 1983; Kristensen 1995). With respect to immigrants one needs to keep in mind that job-exposure indices assign the same score to everyone based on occupational title. If actual work conditions for immigrants are worse than for other workers due to discrimination within occupational groups or within firms this is not reflected in the score assigned to the immigrant work are based on the job-exposure index. There is unfortunately no measure in UKHLS for discrimination (at the workplace or elsewhere) that is available for the whole sample.

As discussed earlier, this paper analyses two types of work conditions: physical and psycho-social. For each type of work condition, the best measure(s), self-report, an external measure, or a combination, is used and reasons for these choices are discussed below.

The external measures available are based on the job indices created by Kroll (2011) for use as explanatory or control variables, amongst other applications in studies on health risks at work (Kroll, Müters et al. 2015). They use data from a representative 2006 German survey on working conditions to derive job exposure matrices mapped to the International Classification of Occupations of 1988 (ISCO-88). He derived three job indices, based on 39 indicators of work demands: an overall job index, a physical job index and a psychosocial job index (Santi, Kroll et al. 2013). The values of the indices from 1 to 10 refer to deciles of occupations, ranked from low to high work demands. The three indices have been validated for European countries using the EWCS 2010, where it predicts various health outcomes including self-rated health and a health symptoms score. The indices are provided at 2-, 3- and 4-digit level of ISCO-88, though with some missing values at the 3- and 4-digit level when the survey did not contain sufficient cases to estimate job demands of some less common occupations. This analysis uses the 4-digit version as far as possible, and the 3-digit version for most of the remaining cases (17 percent of person-periods). For three occupations the 2-digit level had to be used (0.1 percent of person-periods).[71] The job index measures were tested in preliminary models as categorical variables. The association with health shows a linear trend, and in this analysis they are therefore used as continuous measures.

Measures of physical work conditions

The work conditions module of UKHLS includes a self-reported measure of physicality at work, collected in wave 2 only. However, it is unclear if 'being (very) physically active' can be regarded as an indicator of high physical demands as it can encompass both 'good' activity, such as walking, and potentially harmful activity, such as heavy lifting. It is likely that for workers in higher skilled occupations being active can be associated with health benefits (e.g. it suggests infrequent sitting) or is at least not harmful. For workers in low skilled occupations being physically active is more likely to entail monotonous or strenuous movements which can be detrimental to health. Preliminary analyses showed that being physically active in the job was not consistently associated with health. This measure is therefore not used in this analysis.

We hence only use the physical job index (Kroll, 2011) as measure of physical work conditions. This index includes environmental demands such as being frequently exposed to smoke, noise, dirty environments or working with dangerous substances; and ergonomic demands such as frequent standing, lifting and carrying of heavy loads and working in constrained positions. It does not consider physical inactivity as a risk factor. On the contrary, infrequent sitting counts as physical demand. This is common to other measures of physical work demands, but is a limitation because there is mounting

[71] These occupations are: Market-oriented crop/animal producers (n=2) ; Handicraft workers in wood, textile, leather (n=4); Stationary plant and related operators (n=13)

evidence that sedentary behaviour at work is an independent risk factor for health (i.e. regardless levels of physical activity outside work) (Biswas, Oh et al. 2015).

Measures of psychosocial work conditions

The dimensions aggregated into the psychosocial job index by Kroll (2011) are largely overlapping with the Demand-Control-Support model (see Section 4.2.1 for detailed discussion). However, as will be explained, the psychosocial job index does not directly nor exclusively measure the dimensions of the Demand-Control-Support model. We only aim to cover psychosocial work conditions that were identified by the literature as predicting independently associated with health by using this (additive) indicator.

The psychosocial job index covers three dimensions: mental stress, social stress and temporal loads, which are equally weighted (Kroll 2011; Santi, Kroll et al. 2013). The mental stress dimension comprises 10 items and covers mainly aspects that fall into the Demand dimension of the Demand-Control-Support model, such as having to work very fast or hard, being interrupted during tasks, or doing work where small errors have large consequences.

Three out of the 10 items of the mental stress dimension of the psychosocial job index are problematic, in that the way they are coded is opposite to how their association with health would be expected in the Demand-Control-Support model. In the German work conditions survey, these three items (‘facing new tasks’, ‘doing things not learned’ and ‘improving procedures’) were used to classify jobs by their level of demand on learning and creativity (Hall 2009), but not in view of implications for health. The job index classifies them as a demand/stressor, i.e. facing these learning or creativity demands frequently equates a (negative) work demand that contributes to a higher job index score (Kroll 2011)[72]. However, these demands are essentially the same as skill discretion in the Demand-Control-Support model ("the breadth of skills workers could use on the job" (Karasek and Theorell 1990, p. 31)) which are hypothesised to be beneficial for health because they help to meet psychological job demands such as high workloads or conflicting demands and thus limit job strain (Karasek and Theorell 1990).

In the construction of the job index by Kroll (2011) this should have led to an overestimation of psychosocial stress for workers in high-skilled jobs, i.e. their work conditions as measured by the psychosocial job index are worse than they actually are.[73] For workers in low skilled jobs, who presumably state less often that they frequently need to face new tasks, do things they have not learnt, or improve procedures, these problematic items should not lead to very different score compared to if these items had been included in the direction suitable for the Demand-Control-Support model. Overall, this suggests that the psychosocial job index could underestimate the difference between (poor) psychosocial work conditions in low skilled jobs and (good) psychosocial work conditions in high skilled jobs.

The social stress dimension of the psychosocial job index includes five items that fall into the control dimension if the Demand-Control-Support model (such as being able to organise own work, influence on workload and break times), but also includes aspects

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[72] Kroll (2011) does not give much detail on why specific items from the survey were chosen for the creation of the job index. The internal consistency of the psycho-social index is low (Cronbach's alpha 0.24, ibid.) which could be attributed to the fact that the three sub-dimensions of the psychosocial job index already combine quite different aspects that will not be highly correlated in all occupations. However, the job index seems to classify both occupations that have high learning demands (constituting high skill discretion, an aspect of decision latitude in terms of the DCS model i.e. favourable work conditions) and occupations that have low levels of autonomy over work (constituting low decision latitude in terms of the DCS model i.e. unfavourable work conditions) equally as having unfavourable work conditions. This would be an alternative explanation for the low internal consistency because high skill discretion and high levels of autonomy over work often go together.

[73] The construction of the job index only considers items when a respondent stated that a given negative condition occurs 'frequently' (or a positive condition occurs 'never') in their job. (Kroll, 2011)

such as being informed about developments in the organisation and receiving information necessary for own work in good time which can be considered a more indirect aspect of control. It also includes items about line manager and colleague support that are relevant to the support dimension of the Demand-Control-(Support) model.

The dimension of temporal loads that is the last part of the psychosocial job index includes items such as long weekly working hours, working shifts or weekends. These job characteristics are not directly task-related but we cannot exclude them given that they are part of the psychosocial job index.

An issue to consider is that the use of external job indices will result in some measurement error, as there can be variation across employers in the exact work demands associated with the same occupational title. Actual work demands for immigrants might be higher than for UK-born workers with the same job index score for three reasons:

First, actual demands could differ due to labour market discrimination: Within occupational title and associated job index score actual work conditions will vary to some extent. If immigrants have more difficulties securing a job with good work conditions than similarly skilled UK-born workers, this can be reflected not only in observed higher job index score. Therefore, immigrants with the same job index score might have jobs with slightly worse work conditions than native workers. Second, actual demands could differ due to workplace discrimination[74]: If there is discrimination within the workplace, work conditions might again be worse for immigrant workers than for UK-born colleagues with the same job index score for example they might be

[74] A study on migrant workers in Europe for example concludes there is discrimination of migrant workers even within occupation. (Rial González, E. and X. e. Irastorza ((no year)). Literature Study on Migrant Workers. Brussels, European Agency for Safety and Health at Work.)

given the most unpopular tasks or receive less support from colleagues. Last, actual demands could differ due to the ability of worker to perform tasks safely and efficiently. Immigrants for whom English is not their first language might complete tasks in a way that carries more risk, or causes them more stress, because they do not understand instructions and training as well as native speakers (Rial González and Irastorza (no year)). The same score of the physical or psychosocial job index could therefore be associated with a more detrimental effect on health for immigrants than for UK-born workers because the actual work conditions have higher demands for them.

With the psycho-social job index we are not able to distinguish between psychosocial demands that come from intellectual challenges as opposed to low forms of control. However, in addition to the psychosocial job index we also have self-reported work autonomy available which is a pure measure of job control/decision latitude though it does not cover all aspects of the concept. Work autonomy is used as a time invariant measure because information was only collected in waves 2 and 4. There are five items on work autonomy, asking how free workers are in deciding which tasks they do, and in the manner, pace and order of tasks, as well as in when they start/finish work. The five items are added up for each wave, and the total scores are then averaged across the two waves. Where only information for one wave is available, this value is used. Given there is little within-person variation due to few job changes where the respondent has a different occupation, this should not hide much within-person variation.[75],[76] Nevertheless, in models that combine the time-varying job index measures and the time-invariant work autonomy measure effect sizes of the latter are potentially reduced.

[75] 62% of respondents stay in the same job in the observed period. Among those that did change job around half changed to a job with the same ISCO88 occupational code, suggesting a similar level of work autonomy. Only 13% (734 respondents with a total of 901 person-periods) changed job and have a different occupational title than at the first interview.
[76] Averaging should also help reduce measurement error. The work autonomy items are measured with a four-point scale from “none” to “a lot”, and the time-varying measure would potentially introduce much spurious change if levels of work autonomy for respondent has not actually changed over time but he happens to choose a different response on this short scale.

Both the psychosocial job index and in particular the work autonomy items have potentially different meanings for employees and self-employed workers. This analysis therefore only includes employees in paid employment and excludes any subsequent spells of self-employment.

4.5 Analysis strategy

This analysis assumes, in line with the general assumption of most work stress models of a one-directional pathway implying social causation (De Lange, Taris et al. 2004), that the main causal direction runs from poor work conditions to ill health, not that unhealthier people select into jobs with poor work conditions (health selection).

In order to model how work conditions affect immigrants' (and natives') health over time a multilevel growth curve approach is used. Growth curve models describe change over time and how this change is affected by different (time-invariant and time-varying) factors (Luke, 2008). Growth models are mainly used in a multilevel modelling context (Curran, Lee et al. 2012). A multilevel growth curve model views the data as hierarchically structured, with the repeated measurements at the lower level being nested within individuals at a higher level (Singer and Willett, 2003). Differing lengths between measurements can be easily accommodated in growth curve models while this is more difficult in other approaches such as structural equation modelling. The following equations are for a general linear growth model:

Level 1 $Y_{ij} = \pi_{0i} + \pi_{1i}\, time_{ij} + \pi_{2i}\, X_{ij} + \varepsilon_{ij}$

Level 2 $\pi_{0i} = \gamma_{00} + \gamma_{01}\, X_i + \zeta_{0i}$

$\pi_{1i} = \gamma_{10} + \gamma_{11}\, X_i + \zeta_{1i}$

$\pi_{2i} = \gamma_{20}$

The level 1 equation represents intra-individual change over time, where Y_{ij}, the health of individual i at time j, is a function of time. The shape and structure of the health trajectories are described by the growth curve parameters: A parameter (π_{0i}) describing the initial health status at the first measurement (when time is zero), and a parameter (π_{1i}) describing the rate of change. The level 2 equations describe how the two growth parameters describing initial health and rate of change are affected by person-level characteristics. Parameters γ_{00} and γ_{10} represent the population average of initial health and its rate of change, respectively. Parameter γ_{20} is the population average difference in health over time depending on work conditions. X_i is a vector of time-invariant variables (including work conditions) for individual i. γ_{00} and γ_{10} represent the effect of these variables on the growth trajectories. ζ_{0i} and ζ_{1i} are residual terms (random intercept and slope at level of individual). Effects of various factors on the initial status or the rate of change are modelled by including stable and time-varying variables at the appropriate level.

The extent to which migrants' trajectory diverges from that of natives is modelled with a cross-level interaction of time (level 1) and migrant status (level 2). A negative duration effect in immigrants' health is present if there is a statistically significant negative slope for migrants on the time trend. This means that immigrant employees' health deteriorates faster than that of similar UK-born employees.

Variables entering the level 2 equation for the initial status account for differences in initial conditions.[77] We hypothesize that the negative duration effect can partly be

[77] Immigrants and UK-born differ in ways that affect initial health that will be partly unobserved. This is the case if immigrants are inherently healthier people. Multilevel growth curve models assume independence of the error term from the covariates in the model otherwise the estimates will be biased. One way to address this problem in multilevel models is the use of the Mundlak correction, which adds the unit-level means of the covariates to the model and as such removes correlation between the unit-specific effects and explanatory factors (Skondral and Rabe-Hesketh 2004). In the context of a growth curve where the higher level represents persons with multiple observations nested in the lower level, this is not possible. The analysis can only

explained by on average poorer work conditions for immigrants, compared to similar UK-born men. Measures of time-invariant work conditions will be added to the level 2 equation to test this, measures of time-varying work conditions will be added to level 1. They are expected to reduce significance and magnitude of the parameters estimating the immigrant trajectory. Subsequently, other possible explanations for the negative duration effect, such as health behaviours, will be added to the level 2 model for the rate of change, as well as general confounders, to test the robustness of the association between work conditions and health.

The model allows for heteroskedastic variance for the independent person-wave errors by immigrant status and cohort by using group-specific level-1 variance parameters (Rabe-Hesketh and Skrondal 2012). We account for the nesting of individuals within households (at wave 1) using a Huber-style variance estimator. The growth curve models are estimated using the `mixed` command in Stata 14 which estimates the models using maximum likelihood estimation.

There is considerable item- missingness for the health measure SF-12 from wave 2 onwards, which is concentrated amongst migrants from the new EU countries and from low income non-EU countries (Table 54). This item-missingness could potentially be addressed by applying multiple imputation techniques for longitudinal data (Biering, Hjollund et al. 2015). However, this is hampered by the considerable amount of attrition that occurs over the five waves: By wave 5 almost 27% of UK-born and 40% of migrants have been lost to follow-up (Table 55).

Time dimension

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attempt to control comprehensively for initial differences in health to reduce remaining differences between groups as far as possible. It is unavoidable that some endogeneity will remain.

The choice of time metric is an important decision in growth curve modelling. The theoretical process responsible for observed change should determine choice (Hoffman 2012). The negative duration effect in immigrants' is attributed to increasing length of residence of immigrants. Therefore, length of residence would be an obvious time measure but as the trajectories are compared to those of natives for whom length of residence is not a valid measure, this is not possible.

Age as a time dimension would have the advantage that it applies to immigrants and UK-born people equally. However, the negative duration effect is not thought of as caused by aging (though of course length of residence increases with age). The hypotheses about differences between immigrants' and natives' health trajectories are largely independent of age (though most applicable to labour immigrants who typically migrate as young adults). Therefore, the analysis merely adjusts for different initial health levels and rates of change depending on age at first interview.

An alternative for the time metric would be the time a worker has been in his current job. This would allow us to consider the persistence of work conditions. However, work conditions typically do not change much with job changes. The exposure to similar work conditions will likely stretch across different jobs. Using time in current job as time metric would therefore risk conflating exposure to current work conditions with factors influencing how likely someone is to change jobs.

The time scale should reflect the passing of time between interviews, as it is this passing of time which is associated with change in health in the data. Possible choices for the scale of the time dimension are: wave of interview, date of interview, time of interview relative to time of first interview. Table 14 illustrates these options with a hypothetical case (assuming complete measurements). Survey wave is an obvious measure of time in a panel survey, but is a poor representation of time between interviews. While UKHLS aims to provide annual measures, in practice, it is not always possible to interview respondents exactly 12 months after their last interview. In some cases, time between interviews is as short as 6 months, or as long as 18 months.

Table 14 Hypothetical case illustrating construction of time since first interview variable

Measurement occasion	**1**	**2**	**3**	**4**
UKHLS survey wave	1	2	3	4
Date	1.4.2009	6.6.2010	No interview	2.9.2012
Months (starting from first interview for each respondent)	1	14	./.	41
Months/12 = Year with decimal places	1/12 = 0.083	14/12 = 1.167	./.	41/12= 3.42
Year, centred so that intercept = first measurement occasion	0	1.084	./.	3.337

Naturally, for immigrants, time between interviews represents increasing time since migration, while for natives it does not represent anything over and above aging. Therefore, time since first interview seems the best choice for the time dimension, even though of course the negative duration effect is not assumed to start at the first interview but from the point an immigrant arrived in the UK. So, depending on the length of residence at wave 1, different parts of the residence period are represented in the time that passes between interviews. Time since first interview for the respondent emphasises that the passing of time as such is the most important feature. It assumes that regardless of when a respondent's first measurement took place, the effect of time passing between first and subsequent measurements on health should be the same across respondents.

This analysis uses time since first interview in years, with decimal places and centered so that the first measurement occasion is 0. The centering facilitates the interpretation of the intercept as initial status.

Shape of the growth curve

The shape of the unconditional growth curve (i.e. average growth curve regardless of immigrant status) could have different shapes, depending on the assumed average health trajectory of people over time. Physical health declines with age, though not necessarily linearly. Tests indeed show a statistically significant non-linear growth when adding quadratic term for time. However, given that we work with only five waves, we choose to model a monotonously decreasing linear shape. Any non-linearity observed within the 4-year period observed should be rather modest.

Stratification by education (degree status)

We model immigrants' health trajectories in comparison with the native-born population in two ways: Firstly, for the population as a whole, adjusting for education. Secondly, stratifying by education, specifically whether the worker has a university degree or not.

Stratifying the analysis by degree status has several advantages. In terms of the negative duration effect, it allows for immigrants with different levels of education to have different levels of negative duration effect, because we know that the initial health advantage amongst degree-holding immigrants is smaller than amongst non-degree immigrants (differences estimated in Chapter 3 were quite large albeit not statistically significant). It also allows us to examine the effect of work conditions in populations with different work condition profiles: For example, amongst workers with a degree physical demands are overall much lower than amongst workers without a degree and therefore the effect of increasing physical work demands is based on average lower demands.

Selection of control variables

In our analysis we estimate two sets of models. The first only includes basic controls in order to quantify the negative duration effect net of the effect of age and education (the base model). In this base model we then test the different work conditions. The second set of models builds on the base model but includes more comprehensive control variables. The models with control variables aim to adjust for health determinants that potentially confound the work conditions-health relationship. These include in particular wider work (not task-related) conditions and alternative explanations for the negative duration effect in immigrants but also general determinants of health.

We include socio-demographic and socio-economic characteristics (ethnic group, marital status (being single and not cohabiting), household income, material deprivation) (apart from age and educational qualification which are already included in the base modes) as well as indicators of chronic stress outside work (social support, financial strain) that are established social determinants of health (Marmot and Wilkinson 2006; Smith, Frank et al. 2008).

Wider work conditions included because they can confound the relationship between task-related work conditions and health are work characteristics that often go together with poor physical or psychosocial work conditions. Specifically, these are perceived job insecurity and unsocial work schedules which are indicators of wider poor “job quality” (Landsbergis, Grzywacz et al. 2014). Job insecurity, understood as perceived threat of job loss (de Witte, 2005) can affect mental but also physical health (Sverke et al. 2002, Cheng and Chan 2008). In terms of unsocial work schedules we consider rotating shift work which can is a type of psychological work load with evidence for increased illness (Karasek and Theorell 1990), and also working nights. We also control for an (average) effect of past work conditions on initial health status by adjusting for age and educational level, the combination of which proxies work experience.

Health behaviours are not only a main health determinant, but changing health behaviours are also the main explanation for the negative duration effect, as part of the acculturation process of immigrants (Satia and Shatenstein 2010). Unfortunately, we cannot account for changing health behaviours in immigrants (or UK-born people) because they have only been measured once. We include as health behaviours: having a poor diet (which is a dummy variable indicating whether someone's diet includes at least two of the three behaviours: low fruit and vegetable intake, drinking full fat milk, eating white bread); being a current smoker; having a brisk walking pace; doing moderate exercise at least once a week. Alcohol consumption was tested in preliminary models but did not significantly predict health in models including basic controls.

Some health behaviours are at least partly a mediator of the work conditions-health relationship, rather than a confounder (e.g. Smith, Frank et al. 2008, with respect to smoking). For example, smoking for workers in some occupations may be particularly difficult to stop because many of their colleagues are smokers and smoking is an important feature during break times. In jobs with high stress levels, i.e. psychosocial demands, workers may also find it more difficult to stop smoking, because smoking acts as a stress release. We therefore tested if effects of work conditions on health trajectories are reduced after controlling for smoking status, but this was not the case and we therefore use it as a control variable.

Control variables are all measured at wave 1 (wave 2 for health behaviours and social support) and are tested in a model without work condition variables, first by adding them to the equation for initial health status. Important confounders (such as diet) are retained regardless of significance level to control for inter-individual differences in initial health. In the second step the variables that were selected for the initial status are tested for the rate of change, retaining those significant at 5 percent level. The exact control variables differ between the overall population and the degree and non-degree sub-populations (see full model outputs in Table 60, Table 62, Table 64 in appendix C).

4.6 Results

4.6.1 Descriptives

As discussed in section 4.3, we hypothesize that the negative duration effect is partly explained by migrants' working disproportionately in jobs with poor work conditions. After comparing the health distribution and health trajectories of immigrants and UK-born we therefore establish whether indeed immigrants work on average in poorer work conditions.

Descriptive statistics referring to initial characteristics at first interview are weighted with longitudinal wave 2 self-completion weights. This means that for these statistics the five percent of respondents for whom the first full interview is wave 2 are excluded.

Health

Table 15 shows that at the time of the first interview mean physical health differs slightly between the immigrant population and natives. The kernel density plot (Figure 4), also shows slight differences in the distribution of physical health at the first interview: Immigrants have somewhat more often high scores and less often low scores between 40 and 50 than natives. The health distribution is slightly negatively skewed, indicating that some people have considerably lower than mean health scores, while few have very high scores.

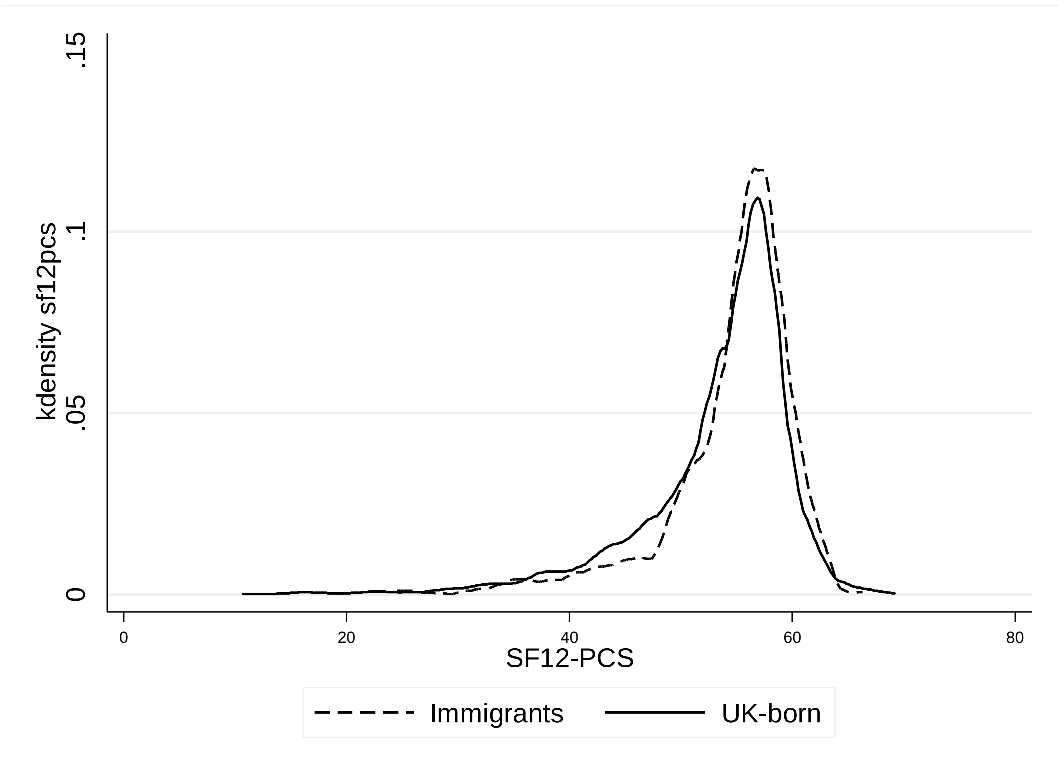
Table 15 Initial physical health (SF-12 PCS) by immigrant status

	Mean	(95% C.I.)	SD
UK-born	53.32	(53.09 – 53.54)	6.94
Immigrants	54.64	(54.02 – 55.25)	5.82

Note: Excludes respondents for whom first interview is at wave 2; weighted.

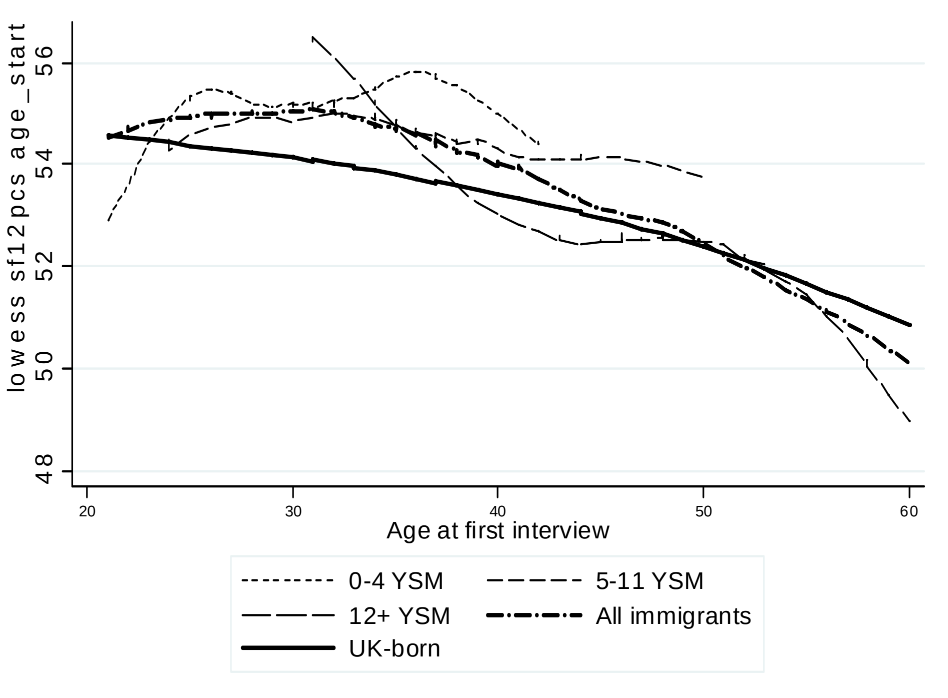
Respondents' initial (as measured at first interview) health status depends strongly on age (see Figure 5): the health trend across age is fairly flat for people in their twenties, and then falls with age, especially among immigrants. The figure suggests a quadratic shape for the age-health relationship.

Figure 4 Distribution of physical health at first interview, by immigrant status



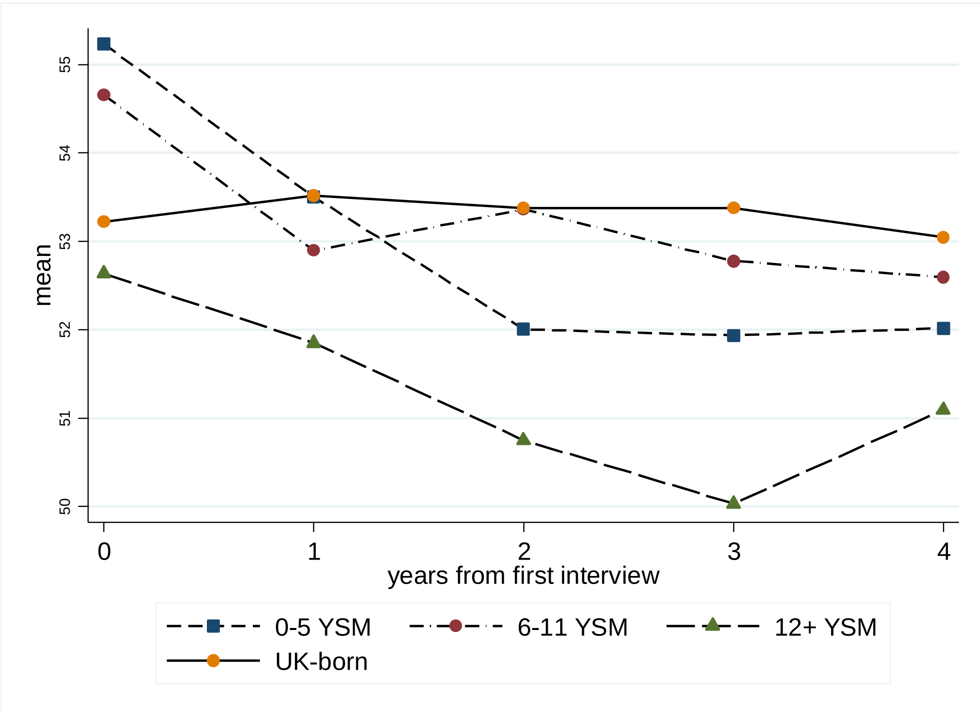
Source: UKHLS, wave 1. Note: UK-born and immigrants aged 21-60; immigrants who immigrated aged between 18 and 40. This graph excludes respondents for whom first interview is wave 2. Weighted.

Figure 5 Physical health across age at first interview, by immigrant status and cohort



Source: UKHLS, wave 1. Note: YSM= years since migration. Male UK-born and immigrants aged 21-60; immigrants who immigrated aged 18 to 40; unweighted

Figure 6 Mean physical health over time since first interview, by immigrant status and cohort



Source: UKHLS, waves 1-5. Note: YSM= years since migration. Male UK-born and immigrants aged 21-60; immigrants who immigrated aged between 18 and 40. Unweighted.

Figure 6 shows a general downward trend in health across the five annual measurements. Amongst the UK-born this decline is very small. For immigrants there is a much stronger downward trend. The observed health decline is particularly strong for the most recent arrivals, though it levels off after the first two years. This is consistent with a levelling-off of the negative duration effect after a longer period of residence in the UK.

Immigrant patterns for those with and without a degree are broadly similar (see Figure 14 and 15 in the Appendix); the downward trend levels off for all immigrant cohorts other than the degree holders among the 0-7 YSM cohort. Physical health of the 8+ YSM cohort in the non-degree population is much lower at the first measurement than for the 0-7 YSM cohort in the same population, but at the same time their trajectory is relatively flat so that in the later years their health is similar. This could be partly explained by the fact that the 8+ YSM cohort in the non-degree population has spent the longest time in the UK out of the four immigrant cohorts (median of 16 years, compared to median of 13 years for the 8+ YSM cohort in the degree population).

Employment and work conditions

We use descriptive statistics to establish to what extent immigrants indeed more often work in unfavourable work conditions, as suggested by the literature.[78] Depending on the measure under consideration poorer work conditions equate higher physical or psychosocial work demands (as measured by the respective job index), or less

[78] Underestimation of poor work conditions for migrants may occur because it is difficult to contact immigrants who work illegally or are in the country illegally (Agudelo-Suarez, Ronda-Perez et al 2011). We only consider the role of work conditions amongst the immigrant population that is reachable by household surveys. This is not to say that for particularly vulnerable immigrant groups the picture might be different.

autonomy over work (as measured by the self-reported work autonomy measure)[79]. In all three measures higher values indicate poorer work conditions.

Table 16 gives an overview of work conditions for immigrant and native workers. As expected from the literature, immigrants work, on average, under less favourable conditions than UK-born workers. Immigrants almost always have worse work conditions than the UK-born, both in the population as a whole, and in the degree and non-degree sub-populations. With the exception of physical job index in the overall population, the difference between immigrant and native born work conditions are highly statistically significant. In the non-degree population immigrants mean work conditions for all three measures are at least a third of a standard deviation worse than for native-born workers. In the degree population differences are not as marked.

The difference in physical work conditions is much smaller in the overall population than within degree holders or non-degree holders. This reflects that on the one hand UK-born workers are on average less educated than immigrant workers and therefore work more often in less skilled jobs that usually have relatively high physical demands. On the other hand it reflects that immigrant workers are more often overqualified for the occupations they work in, so that despite their high education they work in occupations with relatively worse physical work conditions.

Figure 7 shows the distribution of physical work conditions as measured by the physical job index, by immigrant status in the degree and non-degree subpopulations. Among degree holders, UK-born workers are concentrated in occupations with relatively low physical demands (left panel, Figure 7). Degree-holding immigrants are less

[79] When we refer to high psychosocial work demands (as measured by the psychosocial job index), we mean equally high psychosocial demands in the sense of the DCS model, low levels of control over work, and low levels of social support, all three of which are captured as a negative work condition in the additive job index.

Table 16 Mean work conditions at first interview by immigrant status

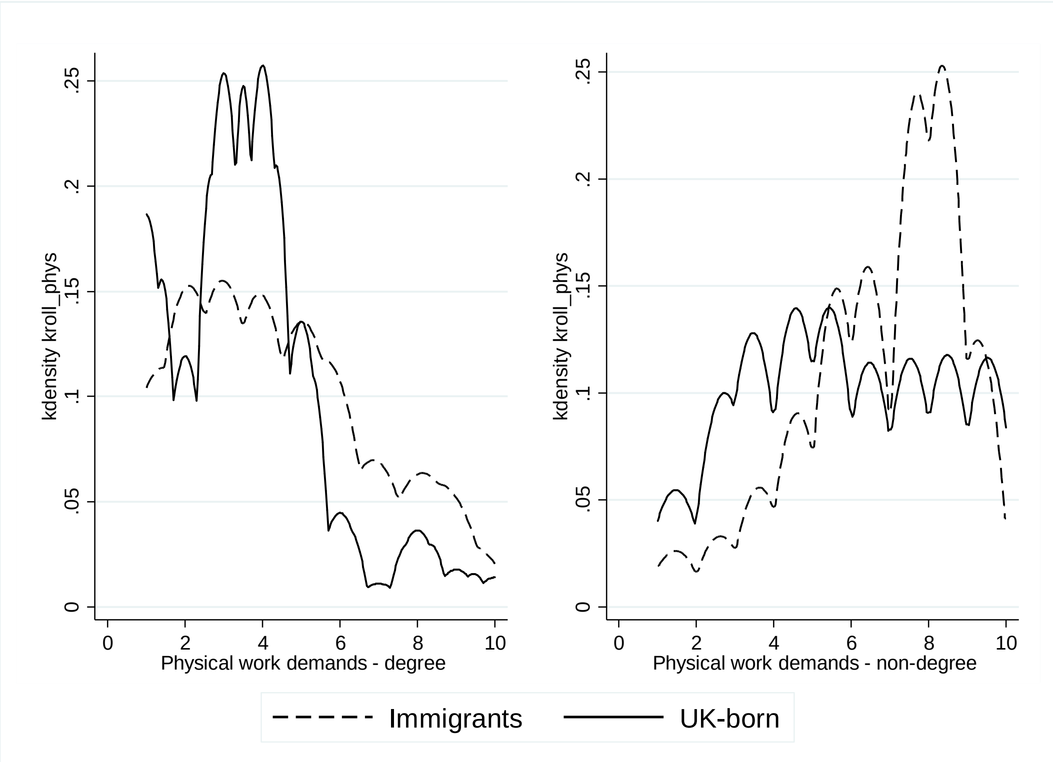
	immigrants		***UK-born***		
	mean	*(95% C.I.)*	*mean*	*(95% C.I.)*	*t*[1]
Physical job index					
All	5.40	(5.09-5.71)	5.25	(5.16-5.34)	-0.93
Degree	4.13	(3.75-4.51)	3.56	(3.44-3.68)	-2.79
Non-degree	6.80	(6.43-7.17)	5.93	(5.83-6.04)	-4.43
Psychosocial job index					
All	6.68	(6.38-6.97)	6.11	(6.03-6.20)	-3.54
Degree	5.99	(5.60-6.38)	5.28	(5.12-5.44)	-3.32
Non-degree	7.42	(7.02-7.83)	6.45	(6.35-6.56)	-4.50
Work autonomy (self-reported)					
All	2.07	(1.99-2.16)	1.89	(1.87-1.92)	-4.02
Degree	1.88	(1.78-1.99)	1.68	(1.65-1.72)	-3.69
Non-degree	2.28	(2.15-2.42)	1.98	(1.95-2.00)	-4.38

Source: UKHLS wave 1 and 2. Note: Physical and psycho-social job index: 4-/3-digit job index is measured at the first interview for those respondents for whom their first interview is wave1 (this is the case for most individuals in the sample). Work autonomy: averaged over wave 2 and wave 4 values. [1] T-statistic for the difference between group means. Weighted

concentrated in occupations with low physical demands, and comparably many have very high physical demands, suggesting they work in occupations for which they are overqualified. In the non-degree subpopulation, UK-born workers are relatively evenly spread across the whole spectrum of physical work conditions, with the exception of occupations with very low physical demands (right panel, Figure 7). Non-degree holding immigrants in comparison concentrate in occupations with very high physical demands.

With respect to psychosocial work conditions as measured by the psychosocial job index UK-born degree-holders mainly have occupations with favourably low demands, but there is also a substantial number working in occupations with unfavourable psychosocial work conditions (left panel, Figure 8). It is likely that this does not only reflect over-qualification[80], but rather that the psychosocial job index covers dimensions where highly skilled occupations can be classified as poor psychosocial work conditions as discussed in section 4.4.3. Similar to the pattern for physical work conditions degree-holding immigrants work less often in occupations with very good psychosocial conditions, and more often in occupations with very unfavourable psychosocial conditions. When considering the specific psychosocial condition of work autonomy, the distribution is overall skewed to a positive evaluation of their level of autonomy (Figure 9), but immigrants in both sub-populations less often described their level of autonomy as very high, and in the case of non-degree holding immigrants, more often as very low.

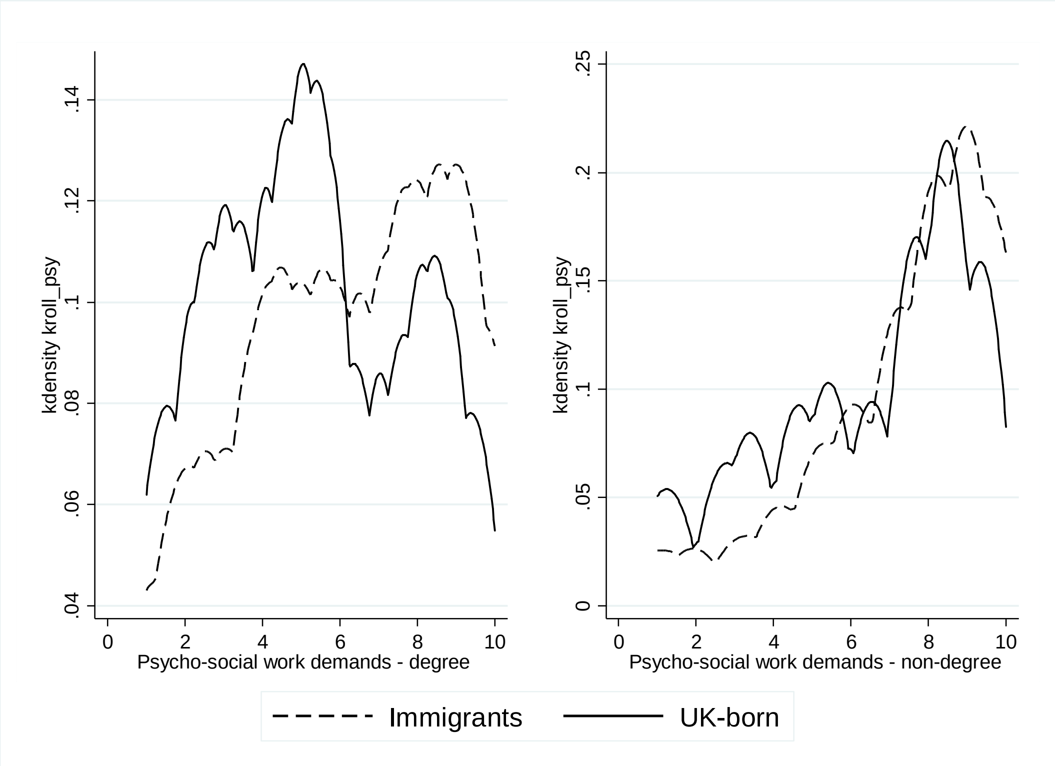
Figure 7 Distribution of physical job index, by immigrant status and degree, at first interview



Source: UKHLS, wave 1 and 2. Note: Male UK-born and immigrants aged 21-60; immigrants who immigrated aged 18 to 40; unweighted.

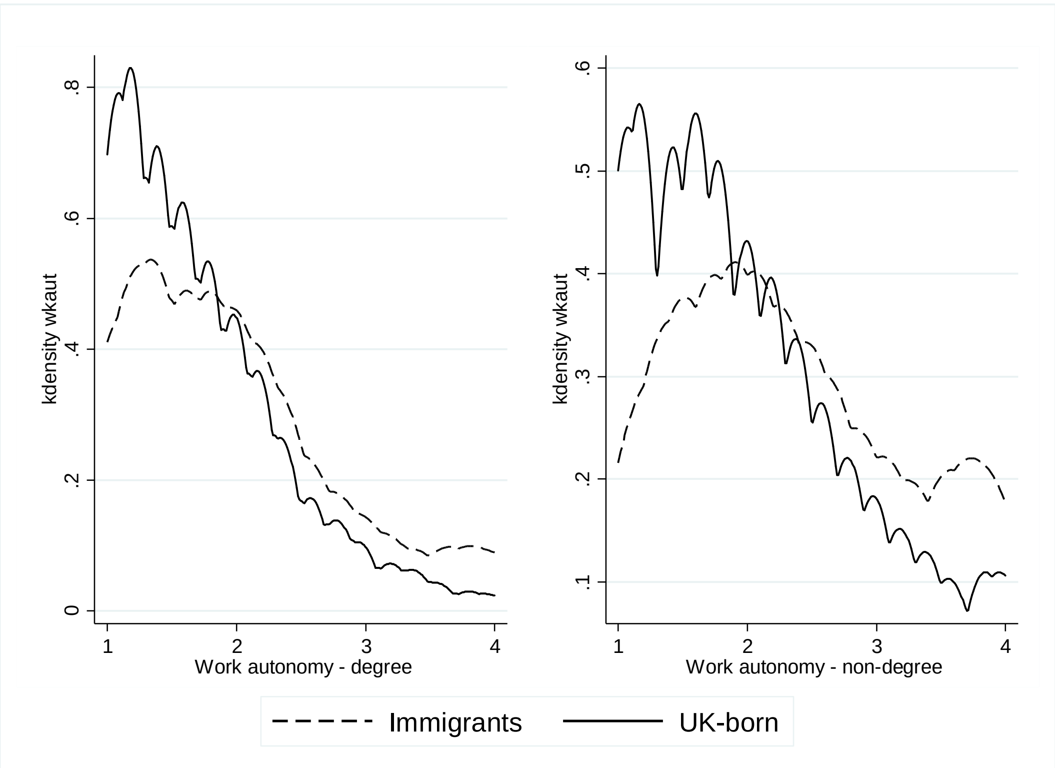
80 61 percent of UK-born degree-holders with a psychosocial job index of 7 or higher have occupations that fall into ISCO-88 major group 1 (legislators, senior officials and managers) or major group 2 (professionals) suggesting that they are not overqualified.

Figure 8 Distribution of psychosocial job index, by immigrant status and degree, at first interview



Source and Note: see figure 7.

Figure 9 Distribution of self-reported work autonomy, by immigrant status and degree



Source: UKHLS, wave 2 and 4. Note: Male UK-born and immigrants aged 21-60; immigrants who immigrated aged 18 to 40; unweighted. Higher values mean lower work autonomy. Work autonomy values average from wave 2 and wave 4 where available, else from the only wave available.

Table 17 Correlations between work conditions at first interview, overall and by degree status

	All	Degree	Non-degree
physical job index and psychosocial job index	0.33	0.46	0.22
physical job index and work autonomy	0.27	0.25	0.21
psychosocial job index and work autonomy	0.16	0.12	0.14

Source: UKHLS wave 1. Note: Male UK-born and immigrants aged 21-60 who migrated aged between 18 and 40. Excludes respondents for whom first interview is wave 2. Weighted.

Physical and psychosocial work conditions (in particular job control or work autonomy) are correlated and an analysis of one should therefore control for the other (Karasek and Theorell 1990). We find for our data also that this is the case (Table 17). The correlation is highest between the two external job index measures as they are both based on occupational title, while work autonomy is self-reported, hence varies within occupation. Surprisingly, correlation is lowest between self-reported psychosocial work conditions measure (work autonomy) and the external psychosocial work conditions measure, despite the latter incorporating measures of work autonomy.

As noted in section 4.1 immigrants' SEP generally increases with length of residence in the host country (Antecol and Bedard 2006). This should limit the potential of work conditions to explain immigrants' health decline, as a higher occupational class is usually associated with better work conditions. Over the course of the four years that we observe, there is however little evidence of improving work conditions (Table 18).

Table 18 Overall work conditions over time, by immigrant status and cohort

	first measurement	last measurement	n
UK-born	5.34	5.34	3,147
Immigrants 8+ YSM	5.71	5.81	159
Immigrants 0-7 YSM	5.93	5.86	163
Total	5.38	5.39	3,469

Source: UKHLS wave 1-5. Note: The overall job index classifies occupations combining the physical and psychosocial job index (Kroll, 2011). First measurement is at first interview (i.e. wave 1 or wave 2), last measurement is the fourth or fifth measurement, depending on how long a respondent is observed. Respondents with fewer than four measurements are excluded. Higher values denote higher work demands. Unweighted.

Control variables

Table 19 presents the mean values for other factors that could explain different health trajectories of immigrants and natives. For all socio-economic indicators apart from educational qualification immigrants are disadvantaged compared to natives, though differences are not always statistically significant. Immigrants mainly have poorer health behaviours than UK-born – this does not necessarily mean that they did not have healthy behaviours at arrival, as it averages across all immigrants (mean length of residence is 10 years). Immigrants are more often disadvantaged in wider work conditions, such as work schedules and perceived job insecurity.

Immigrants (and also within the immigrant population, specific communities) tend to concentrate in certain industries (Ahmad and Bradby 2008). Table 50 to Table 53 confirm this for our analysis sample. We do not control for industry because this would capture a large extent of the differences in work conditions.

Table 19 Mean and 95% C.I. of control variables, by immigrant status

	Immigrants		UK-born	
	Mean	**(95% CI)**	**Mean**	**(95% CI)**
Immigrant cohort				
UK-born (n=4,854)	0		100	
>12 yrs (n=182)	25.7	(21.6 - 30.4)	0	
5-11 yrs (n=247)	39.4	(34.3 – 44.7)	0	
0-4 yrs (n=167)	34.9	(29.7 – 40.5)	0	
Age at first interview	36.23	(35.25 - 37.20)	39.89	(39.53 - 40.25)
Log household income, equivalised	9.58	(9.57 - 9.60)	9.59	(9.59 - 9.60)
Single, not cohabiting	19.4	(14.8 - 25.1)	19.7	(18.2 – 21.2)
Ethnicity				
white	47.7	(42.1 - 53.5)	96.5	(95.9 - 97.1)
Caribbean	1.3	(0.6 - 2.9)	0.3	(0.2 - 0.5)
				Continued / …..
Continued..				
Black African	8	(6.0 - 10.5)	0.2	(0.1 - 0.3)
Asian (other)	8.7	(6.3 - 11.9)	0.4	(0.2 - 0.8)
Indian	20.9	(16.9 - 25.5)	1	(0.7 - 1.3)
Pakistani	5	(3.3 - 7.4)	0.5	(0.4 - 0.8)
Bangladeshi	2.5	(1.3 - 4.6)	0.3	(0.2 - 0.7)
mixed/other	6	(3.9 – 9.0)	0.8	(0.5 - 1.1)
Highest educational qualification				
none	4.9	(3.2 - 7.4)	4.8	(4.1 - 5.5)
GCSE/lower	20.9	(16.5 - 26.1)	30	(28.5 - 31.6)
A-level/below BA	21.9	(17.5 - 27.0)	36.3	(34.8 - 38.0)
degree	52.3	(46.7 - 57.9)	28.9	(27.3 - 30.4)
Material deprivation (above overall population mean)	31.4	(26.6 - 36.6)	25.4	(23.9 - 26.9)
Has poor diet	37.6	(32.5 - 43.0)	26.6	(25.2 - 28.1)
current smoker	22.9	(18.4 – 28.1)	23.3	(21.9 - 24.8)
Brisk average walking pace	45.4	(40.1 - 50.7)	52.1	(50.4 - 53.8)
Moderate sports 1+/week	40.1	(34.5 - 46.0)	42.6	(40.9 - 44.2)
Social support index (1 low – 10 high)	5.44	(5.05 - 5.83)	5.90	(5.79 - 6.0)
Financial strain (Behind with rent/mortgage or bills)	24	(19.6 - 29.0)	16.6	(15.3 - 18.0)
Works rotating shifts	12.2	(9.2 - 15.8)	10.4	(9.5 - 11.5)
Works nights	6.6	(4.4 – 9.8)	2.1	(1.7 – 2.6)
Perceived job insecurity				
not insecure	80.2	(74.8 - 84.6)	86.2	(85.0 - 87.3)
very insecure or insecure	15.5	(11.4 – 20.7)	11.2	(10.2 - 12.3)
not employed wave 2&4 or missing	4.3	(2.6 – 7.1)	2.6	(2.1 - 3.2)

4.6.2 Growth Curve models

This section presents the results of a set of multilevel growth models for physical health trajectories over the space of four years. Models 1 to 4 (Table 20 for overall population, Table 57 in appendix C for the degree population, Table 58 in appendix C for the non-degree population), are growth curve models estimated for the overall population that sequentially include more predictors, building up to the model that identifies the duration effect. Model 4 will serve as the base model. Model 5 is a growth curve model that includes work condition measure and Model 6 includes all controls included in Model 4 and work condition measures. The variants 5a to 5d (and 6a to 6d) include different work condition measures. Specifically, Model 5a and 6a includes the physical job index, Model 5b and 6b include the psycho-social job index, models 5c and 6c include work autonomy. Models 5d and 6d include both the physical job index and work autonomy. These models are estimated for the overall population as well as for the degree and non-degree sub-populations.

Model 1 in Table 22 is an unconditional means model that does not include any predictors. The mean estimated SF-12 score is 53.2 points, and there is significant variation both within persons and between persons. This confirms that there is sufficient variation within persons, which is the prerequisite to fit a growth curve model. The intraclass correlation coefficient is 0.5, indicating that around half of the variation in health is due to changes within persons and the remaining half is due to variation between persons. Model 2, is an unconditional linear growth model. It adds time (years since first interview) as a predictor to the level-1 sub-model. The effect of time essentially captures ageing over the period of observation: on average people lose 0.11 points in physical health per year.

In order to establish whether immigrants' health over time declines faster than natives', that is, Model 3 adds two dummies for immigrant cohorts to the level-2 sub-models for initial status and rate of change. The former allows immigrants' initial health to differ in level from UK-born, the latter allows the slopes of immigrants' growth trajectories to differ from the slope of UK-born.

The initial health status varies by immigrant status and also across immigrant cohorts. The two longer-standing immigrant cohorts have on average one point lower SF-12 PCS than UK-born at the beginning of the observation. The most recent immigrant cohort has a health advantage over UK-born of 1.4 points. Over time, the health of all groups deteriorates but it does so faster for all immigrant cohorts than the UK-born; all three migrant cohorts lose between 0.4 and 0.8 more points per year more than UK born. This indicates that there is indeed a negative duration effect which is largest amongst the most recent immigrants. However, this decline in health that immigrants experience over and above that of UK-born is only a gross effect which does not take into account compositional differences between groups. As discussed in the previous chapter, part of the health advantage immigrants have at arrival can be attributed to their young age profile and high level of education. The healthy immigrant effect is usually estimated after controlling for these factors. The duration effect which represents the gradual loss of this advantage should therefore also be estimated after controlling for these compositional differences. We do this in model 4.

Table 20 Results of multilevel growth curve models for health (SF-12 PCS) – overall population

Parameter			Model 1	Model 2	Model 3	Model 4
Fixed effects						
Initial status						
	Intercept		53.22***	53.40***	53.36***	52.12***
			(0.08)	*(0.09)*	*(0.09)*	*(0.42)*
	age at first interview					-0.09***
						(0.01)
	age squared					-0.003**
						(0.00)
	Educational Qualific.	GCSE-level				0.57
						(0.44)
		A-levels				1.40**
						(0.43)
		degree				2.91***
						(0.42)
	Immigrant	arrived >12yrs			-0.98*	-0.96+
					(0.50)	*(0.48)*
		arrived 5-11yrs			-0.85*	-0.25
					(0.35)	*(0.36)*
		arrived 0-4 yrs			1.37***	-0.05
					(0.38)	*(0.38)*
Rate of change						
	Intercept (time)			-0.11***	-0.06+	-0.07*
				(0.03)	*(0.03)*	*(0.03)*
	age					-0.01***
						(0.00)
	Immigrant	arrived >12yrs			-0.59**	-0.51*
					(0.20)	*(0.20)*
		arrived 5-11yrs			-0.44**	-0.52**
					(0.15)	*(0.15)*
		arrived 0-4 yrs			-0.75***	-0.86**
					(0.20)	*(0.20)*
Variance components						
Level 1	*var(within person)*		27.32***	25.47***		
			(0.31)	*(0.63)*		
	Var(UK-born)				25.19***	25.17***
					(0.66)	*(0.66)*

Continued/..

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	Var(12+YSM)			35.04***	34.94***
				(3.66)	*(3.65)*
	Var(5-11YSM)			21.66***	21.86***
				(2.48)	*(2.51)*
	Var(0-4YSM)			29.18***	29.16***
				(3.54)	*(3.52)*
Level 2	*var(initial status)*	27.12***	25.10***	25.04***	23.11***
		(0.68)	*(1.51)*	*(1.50)*	*(1.41)*
	var(rate of change)		0.78	0.77	0.76*
			(0.13)	*(0.13)*	*(0.13)*
	Covariance of L2 variances		0.08	0.08	-0.14
			(0.34)	*(0.33)*	*(0.33)*
Goodness-of-fit					
AIC		134898	134718	134651	134237
BIC		134921	134766	134770	134403
Observations		5,450 (20,608)	5,450 (20,608)	5,450 (20,608)	5,450 (20,608)

Note: Coefficients and robust standard errors (in brackets). + p<.10; * p<.05; ** p<.01; *** p<.001. Reference categories: Immigrant cohorts: UK-born; educational level: no qualification. Time is years since first interview. Age is mean centered.

Model 4 adds age, age squared and a categorical variable for highest educational qualification to the level 2 sub-model for the intercept, and age to the level 2 sub-model for the slope.[81] Age at first interview also affects initial health and the estimated slope negatively, that is, the health decline in older workers over the observed time period is larger than in their younger counterparts.

As one would expect a higher level of education is associated with higher initial health. An interaction between education and immigrant status was tested but not significant. After adjusting for age and education the initial health advantage of the recent immigrant cohort in model 3 disappears. After accounting for the different age and educational composition of the different groups, the estimated negative duration effect

[81] The same variables are added to the equivalent model 4 in the non-degree sub-population. In the degree population educational level (having a higher university degree) is not significant, neither is the age*time interaction. Model 4 for the degree sub-population therefore only adjusts for age.

for the two recent immigrant cohorts is even more marked while for the longest-standing immigrant cohort it is slightly reduced.

Immigrants of the arrival cohorts 5-11 and 12+ YSM both experience a health decline of around 0.5 points per year in addition to the decline in health of their UK-born counterparts. The rate of excess health decline for the most recent cohort compared to the UK born is bigger, 0.9 points. These estimates are largely in line with expectations: The negative duration effect should be stronger among more recent immigrants. The health trajectory of long-standing immigrants should be closer to that of UK-born as they have already converged more towards native-born health levels. This is indeed the case although a difference of an annual 0.5 point loss as compared to the UK born is still substantial.[82]

In summary, model 4 confirms that immigrant health declines faster than that of the UK-born population, even after accounting for compositional differences in age and education.[83] Chapter 3 found that the HIE tends to be smaller among more educated people than amongst less educated people. As a consequence, we expect the duration effect to be smaller amongst the degree population, compared to the non-degree population (see Table 57and Table 58 in appendix C). This is the case at least for recent immigrants, that is, those who have been in the UK for up to 7 years. The excess health decline for recent immigrants is 0.99 points amongst non-degree holders, but only 0.77

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[82] As discussed we cannot be certain that all immigrants in our sample had a health advantage over UK-born at arrival. To ensure that the observed negative duration effect is not driven by poor health trajectories of negatively selected groups we ran model 4 excluding those immigrant groups that were found to be least healthy in the analysis in Chapter 3 (immigrants from EU accession countries, Africans from countries where it is likely they arrived as asylum seekers, Indians, n= 195) the negative duration effect is reduced for the two more recent cohorts (to -0.38 points for the 5-11 YSM cohort, and to -0.60 for the 0-4 YSM cohort) but still statistically significant at 5 percent level.

[83] Initial health should in principle reflect any remaining healthy immigrant effect (HIE). The main reason we do not see a HIE in these models is that models average across immigrants of different length of residence. Also, the sample in this chapter includes older respondents (ages 21-60 as opposed to 21-49 in chapter 3) which increases mean age in the immigrant groups and therefore includes slightly more immigrants that came to the UK at less typical ages (implying a lower degree of positive selection).

points in the non-degree population. Long-standing immigrants in both the degree and non-degree population lose around 0.42 points per year more than their UK-born counterparts.

As mentioned at the beginning of this section, model 4 serves as the base model to which we compare subsequent models that include work condition measures to explain immigrants' health deterioration over time. We first describe the effects of the individual work conditions, and then discuss their impact on immigrants' health trajectories.

<u>Models with work conditions</u>

Models 5a-5c and 6a-6c (Table 21 - Table 23) each introduce a different work condition measure and its interaction with time to explain differences in initial status and slope between immigrants and UK-born. The final models, model 5d and 6d (Table 24), include both the physical job index and the self-reported work autonomy measure. The models are fitted for the whole sample, and separately for the degree and non-degree population. All work condition measures are centered on the overall population mean but for the degree sub-population estimation these are centred on the mean for degree-holding immigrants. We discuss the results for each work condition in turn, and assess how far they explain the immigrants' negative health trajectories (relative to UK-born).

Physical work conditions

Model 5a (see Table 21) includes a time-varying indicator of the physical job index, and its interaction with time. As discussed, externally measured work conditions could be associated with a more detrimental effect on health for immigrants than for UK-born workers because actual work conditions are worse than indicated by the external measure. We therefore test this with interaction terms of immigrant cohort with the physical job index in each of the populations (overall, degree and non-degree sub-populations). The interaction is statistically not significant in any of the populations, the models presented here therefore do not include such interactions.[84], [85]

While the effect on initial health is very small and not significant, the effect on the trajectory is highly significant: an increase in physical work demands by one standard deviation is associated with a loss of 0.13 points for the overall population (0.15 points for non-degree population) in health per year[86]. Amongst degree-holders, physical work conditions do not predict change in health over time. When controlling for other health determinants the effects of physical work conditions on the change in health of the overall population and the non-degree sub-population is only slightly reduced (Model 6a in Table 21).

We also tested whether physical work conditions (as well as the two measures of psychosocial work conditions) have a more detrimental effect with increasing age (as Ravesteijn (2013) found for manual work and low job control). There is no evidence for this in our data.

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[84] In the degree population the three-way interaction of physical work demands, long-standing immigrants and time is marginally significant (10% level), with a coefficient of 0.18, indicating that a higher score on the physical job index is associated with a larger health loss for long-standing immigrants than UK-born degree-holding workers. The equivalent term for recent immigrants is not, and the interaction is jointly not significant.

[85] Discrimination that results in measurement error in the external job index for certain groups could also apply to ethnic minorities, rather than immigrants. We tested equivalent interactions of non-white ethnicity with work conditions and time, but they were not statistically significant.

[86] Standard deviations of each work condition in the whole sample, and in the degree and non-degree sub-populations, are listed in Table 56 in appendix C.

Table 21 Growth curve models of physical health with physical job index (Models 5a and 6a)

	without controls Model 5a			with controls Model 6a		
	all	non-degree	degree	all	non-degree	degree
Constant	52.266***	52.33**	54.49***	52.28***	52.318***	53.271***
12+YSM	-0.905+			-0.196		
5-11YSM	-0.214			0.543		
0-4YSM	0.007			0.796+		
8+YSM		-1.113+	-0.002		0.109	0.252
0-7YSM		0.459	-0.414		1.046*	0.299
Physical job index	-0.025	-0.002	-0.107+	0.034	0.068	-0.024
Time	-0.071*	-0.064	0.012	-0.015	-0.019	0.111*
12+YSM* time	-0.494*			-0.296		
5-11YSM* time	-0.513***			-0.337+		
0-4YSM* time	-0.833***			-0.668**		
8+YSM * time		-0.357+	-0.420*		-0.361+	-0.082
0-7YSM* time		-0.913***	-0.755***		-0.916***	-0.333
Physical job index* time	-0.048***	-0.058***	-0.011	-0.041***	-0.054***	0.002

Note: Coefficients; p-values: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. The categories of the migrant cohort variable are the cohorts are 0-4 YSM, 5-11 YSM and 12+YSM in the overall population. In the degree and non-degree sub-populations they are, due to small sample sizes, 0-7 YSM and 8+ YSM. Time is years since first interview. Models 5a and 6 a include age, age squared, age*time and education (except degree sub-population models which include only age). Models 6a include further controls in addition, full models see appendix.

Psychosocial work conditions

Psychosocial job index

Models 5b and 6b (Table 22) tests how psychosocial work conditions influence health, and possibly explain immigrants' health trajectories using the psychosocial job index on initial health and rate of change. The psychosocial job index predicts the health trajectories significantly in the overall and non-degree population, though for the former not significantly in the model with controls.[87] The annual loss in health

[87] As for the physical job index, we tested a possible interaction effect between psychosocial job index and immigrant cohort, but this was not statistically significant for any of the populations.

associated with a one standard deviation increase in the psycho-social job index is 0.06 points for the overall population, and 0.08 for the non-degree population.

Interestingly, despite high psychosocial work demands being widespread in the degree population they do not explain change in health as they do in the non-degree population. A possible explanation for this is that it is likely that amongst degree holders (as opposed to non-degree holders) higher scores for psychosocial demands derive from intellectual challenges rather than from low autonomy. As discussed in section 4.4.3 these intellectual challenges capture aspects of skill discretion in the sense of the DCS model. As such they are not considered as work demand in a negative sense. This could explain the limited power of the psychosocial job index to predict physical health.

Generally, there are several reasons why the explanatory power of the psychosocial job index is rather low. First, there are two aspects of the DCS model (psychological demands and social support) that feed into the psychosocial job index do generally not discriminate very well between occupations (i.e. most variation is between person; this is in contrast to decision latitude (=control), and in contrast to physical demands) (Karasek and Theorell 1990). Second, this model models the effect of work conditions on health in the same year. Psychosocial work conditions are however mainly associated with chronic conditions such as heart disease, where a longer exposure and a lagged health outcome would be more appropriate. Given the limited observed time period and incomplete information on respondents' employment history make it difficult to give this justice.

Table 22 Growth curve models of physical health with psycho-social job index (Model 5b and 6b)

	without controls Model 5b			with controls Model 6b		
	all	non-degree	degree	all	non-degree	degree
constant	52.157***	52.278***	54.624***	52.270***	52.352***	53.330***
12+YSM	-0.916+			-0.152		
5-11YSM	-0.224			0.571		
0-4YSM	-0.012			0.832*		
8+YSM		-1.083+	-0.008		0.138	0.338
0-7YSM		0.494	-0.482		1.096*	0.317
Psycho-social job index	-0.030	-0.028	-0.037	-0.023	-0.004	-0.019
time	-0.067*	-0.090*	0.030	-0.006	-0.032	0.109*
12+YSM* time	-0.491*			-0.308		
5-11YSM* time	-0.508***			-0.347*		
0-4YSM* time	-0.853***			-0.691***		
8+YSM * time		-0.375+	-0.423*		-0.361+	-0.012
0-7YSM * time		-0.946***	-0.766***		-0.940***	-0.333
Psycho-social job index* time	-0.022*	-0.029*	-0.002	-0.015	-0.027+	-0.007
N	20608	13767	6841	20608	13767	6841

Note: Coefficients; p-values: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001.The categories of the migrant cohort variable are the cohorts are 0-4 YSM, 5-11 YSM and 12+YSM in the overall population. In the degree and non-degree sub-populations they are, due to small sample sizes, 0-7 YSM and 8+ YSM. Time is years since first interview. Models 5b and 6b include age, age squared, age*time and education (except degree sub-population models which include only age). Models 6b include further controls in addition, full models see appendix.

Work autonomy

The second measure of psychosocial work conditions that we test is work autonomy. Model 5c (Table 23) for the overall population shows that an increase in work autonomy score (equating lower levels of control) by one standard deviation is associated with 0.07 point loss in health per year. The effect of work autonomy on the slope is however only statistically significant for the overall population.

Table 23 Growth curve models of physical health with level of work autonomy (Models 5c and 6c)

	without controls Model 5c			with controls Model 6c		
	All	non-degree	degree	all	non-degree	degree
constant	52.27***	52.35***	54.47***	52.27***	52.35***	53.21***
12+YSM	-0.83+			-0.15		
5-11YSM	-0.12			0.59		
0-4YSM	0.12			0.857*		
8+YSM		-0.98+	0.10		0.15	0.344
0-7YSM		0.58	-0.30		1.11*	0.375
Work autonomy	-0.45***	-0.34*	-0.86***	-0.19	-0.04	-0.65**
time	-0.068*	-0.092*	0.018	-0.006	-0.036	0.11+
12+YSM* time	-0.487*			-0.317		
5-11YSM	-0.513***			-0.358*		
0-4YSM	-0.84***			-0.69***		
8+YSM * time		-0.383+	-0.416*		-0.377+	-0.02
0-7YSM * time		-0.94***	-0.75***		-0.94***	-0.34
Work autonomy* time	-0.10*	-0.08	-0.07	-0.05	-0.06	-0.03

Note: Coefficients; p-values: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. The categories of the migrant cohort variable are the cohorts are 0-4 YSM, 5-11 YSM and 12+YSM in the overall population. In the degree and non-degree sub-populations they are, due to small sample sizes, 0-7 YSM and 8+ YSM. Time is years since first interview. Models 5c and 6c include age, age squared, age*time and education (except degree sub-population models which include only age). Models 6a include further controls in addition, full models see appendix. Higher values of work autonomy mean lower degree of autonomy. Work autonomy values average from wave 2 and wave 4 where available, else from the only wave available.

Interestingly the coefficient for the work autonomy time interaction for the degree population is only slightly smaller than for the overall population. This suggests – albeit the effect being not statistically significant - that low control could be detrimental to health over time, while other aspects that contribute to high scores on the psychosocial job index among degree holders do not have the same effect on degree holders' health over time.

Combined work conditions and their effect on immigrants' health trajectories

The last set of models (Table 24) combine physical work conditions and work autonomy, in order to account for the fact that these two work conditions are correlated

(Karasek and Theorell 1990). In the models testing work conditions individually, physical work conditions and work autonomy decreased the negative duration effect in the overall population to a similar extent. In the degree population, work autonomy reduced the immigrant trajectory slightly more than physical conditions (albeit neither work condition significantly predicts the health trajectory in the first place). In the models using the work conditions combined, the effect of work autonomy on the rate of change is reduced to non-significant levels when also including physical demands in all populations. Therefore, it seems that physical work conditions rather than work autonomy are most strongly associated with health change. It is also possible that the time-invariant nature of the work autonomy measure limits its ability to predict health changes over time, especially in the presence of another time varying work condition measure.

In the overall population, the coefficients representing the negative duration effect of immigrants are reduced by around 4.8 percent for the most long-standing and the most recent immigrants, but only 1.3 percent for the middle cohort.

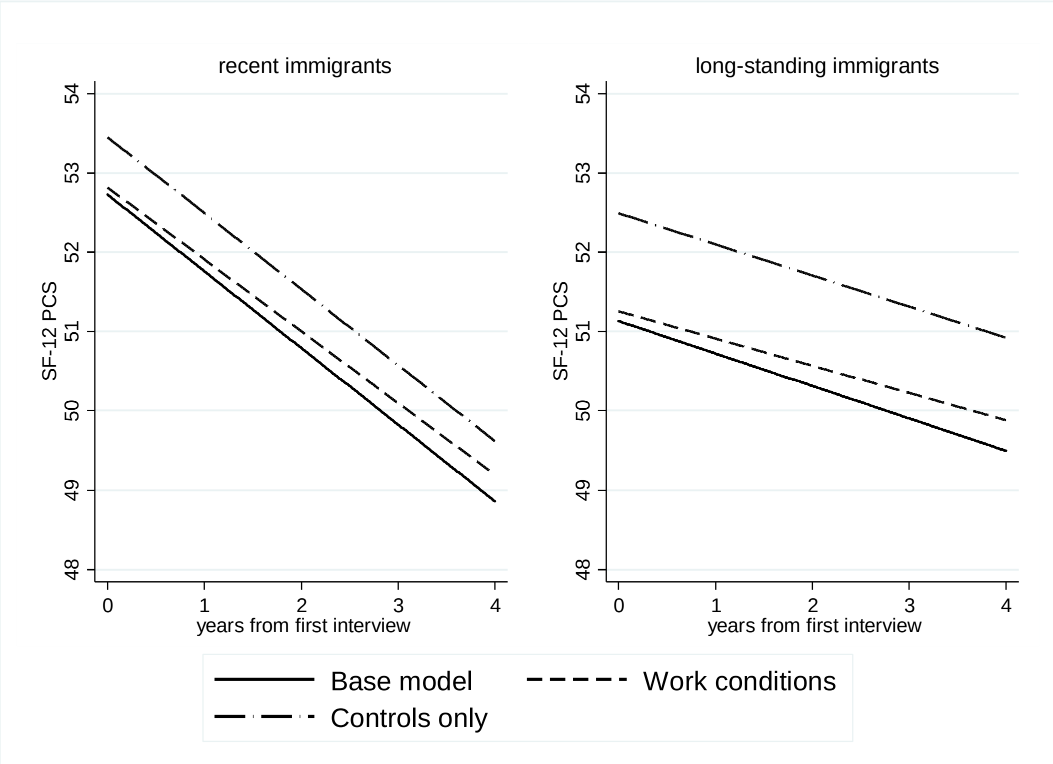
Figure 10 and Figure 11 show the predicted trajectories for immigrants relative to the UK-born by degree status. In the non-degree population, the slope for recent immigrant cohort compared to the base model, is reduced by 0.06 points or 6.5 percent, for long-standing immigrants the reduction is 0.07 points or 15 percent. While these are modest reductions they are still larger than the reductions observed in the model controlling only for other health determinants (household income, smoking status (and age)). The controls-only model reduces the slope for long-standing immigrants by 0.02 points and for recent immigrants by 0.01 points compared to the base model.

Table 24 Growth curve models of physical health with physical demands and work autonomy (models 5d and 6d)

	without controls			with controls		
	Model 5d			Model 6d		
	all	non-degree	Degree	all	non-degree	degree
Constant	52.36***	52.40***	54.36***	52.29***	52.32***	53.202***
12+ YSM	-0.80			-0.18		
5-11 YSM	-0.09			0.58		
0-4 YSM	0.15			0.84*		
8+ YSM		-0.99+	0.05		0.122	0.278
0-7 YSM		0.56	-0.25		1.058*	0.347
Physical job index	-0.00	0.01	-0.03	0.04	0.069+	-0.001
work autonomy	-0.47***	-0.36*	-0.79**	-0.22	-0.081	-0.630**
Time	-0.07*	-0.06	0.03	-0.02	-0.019	0.110+
12+YSM* time	-0.48*			-0.29		
5-11YSM/8+YSM* time	-0.51***	-0.35	-0.49*	-0.34*	-0.355	-0.079
0-4YSM / 0-7YSM* time	-0.82***	-0.90***	-0.74***	-0.67**	-0.909***	-0.333
work autonomy* time	-0.05	-0.04	-0.04	-0.02	-0.030	-0.000
Physical job index* time	-0.05***	-0.06***	0.01	-0.04**	-0.052***	0.002
N	20608	13767	6841	20608	13767	6841

Note: The categories of the migrant cohort variable differ between the degree/non-degree sub-populations, compared to the overall population, due to small sample sizes in the models stratified by education: In the overall population, the cohorts are 0-4 YSM, 5-11 YSM and 12+YSM. In the degree and non-degree sub-populations they are 0-7 YSM and 8+ YSM. Higher values of work autonomy mean lower degree of autonomy. Work autonomy values average from wave 2 and wave 4 where available, else from the only wave available. All models (with and without controls) include age, age squared, age*time and education (except degree sub-population models which include only age). Models with include further controls in addition, full models see appendix.

Figure 10 Non-degree population: Predicted trajectories for immigrants relative to UK-born

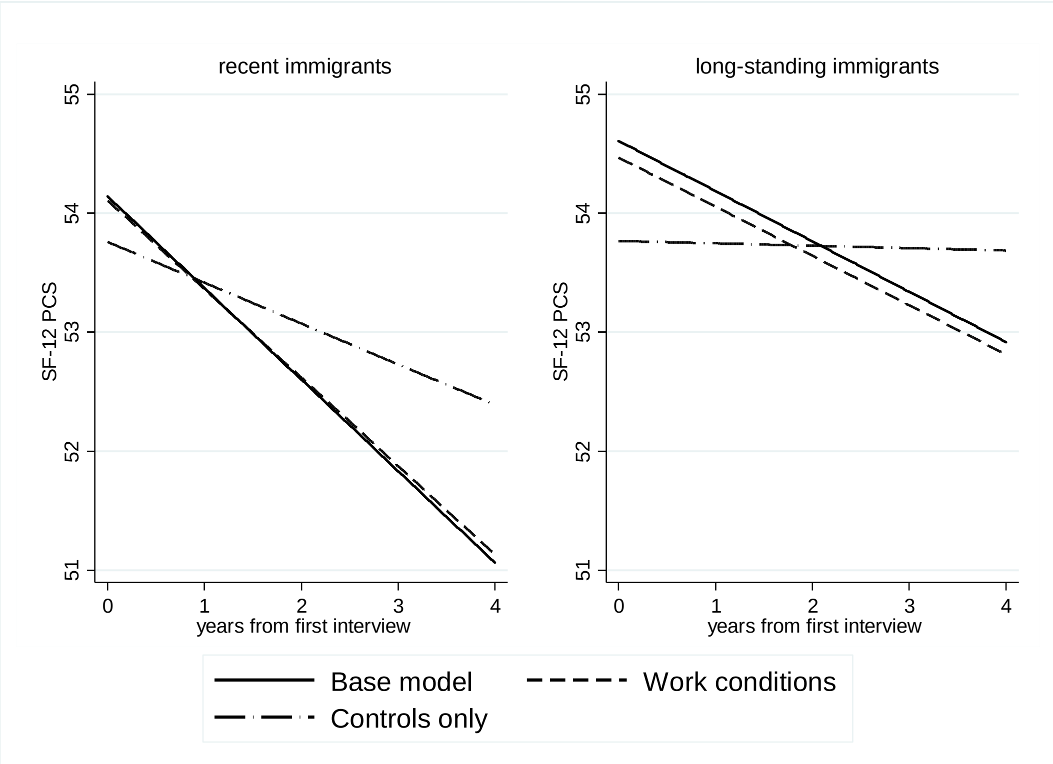


Note: All other variables at 0, which equals mean age and mean work conditions. A zero slope would mean no difference to UK-born slope. Models used are: Base: model 4A, work conditions: model 5d, controls only: model 7; all for non-degree sub-population.

In contrast we have seen that work demands do not significantly predict health change in the degree population. Hence combined physical work conditions and work autonomy combined reduce immigrants' negative health trajectory only marginally (2 percent for longstanding and 3 percent for recent immigrants). This means that in the degree population, despite immigrants having poorer work conditions than natives, with high physical or psychosocial demands, this does not explain their health decline. Regardless of immigrant status, degree holders' health trajectories seem less affected by work demands than non-degree workers'.

In the degree population, the negative duration effect is however explained by other factors, namely non-white ethnic group membership and financial strain. These two factors are both highly significant and are each associated with over 0.5 point annual loss in health. For long-standing immigrants, this reduces the immigrant slope to close to zero, and for recent immigrants the slope is approximately halved and not significant anymore (Figure 11).

Figure 11 Degree population: Predicted trajectories for immigrants relative to UK-born



Note: All other variables at 0, which equals mean age and mean work conditions. A zero slope would mean no difference to UK-born slope. Models used are: Base: model 4A, work conditions: model 5d, controls only: model 7; all for degree sub-population.

One possible explanation why work conditions do not have the same explanatory power among degree-holders than amongst non-degree holders could be a protective effect of education or occupational status (that will be positively correlated with education) for the detrimental effect of work conditions. That is, more educated people possibly suffer less from the same work conditions, for example because the initial health status is better, or because they have better coping mechanisms. With respect to high and low status workers, there is indeed evidence that associations between psychosocial work conditions and various physical health outcomes (heart disease; blood pressure during working hours) are stronger among low status workers (Landsbergis, Grzywacz et al. 2014).

4.7 Discussion and conclusion

This chapter seeks to explain the negative health trajectory of immigrants compared UK-born male employees through the poorer average task-related work conditions that immigrants experience. It considers not only physical work conditions, but also psychosocial work conditions, which are more relevant to workers in skilled occupations. These measures are therefore particularly relevant to the situation in the UK where many immigrants work in highly skilled jobs.

The analysis exploits waves 1 to 5 of the UKHLS, which contains annual measures of occupation, to which we link an external job index to measure physical and psychosocial work conditions. In addition, waves 2 and 4 of UKHLS contain a module on work conditions from which we use a measure of self-reported work autonomy, as another measure of (a specific part of) psychosocial work conditions (namely, control over work). We use a multilevel growth curve modelling approach to estimate health trajectories of male immigrants relative to male UK natives, and to observe how far the negative health trajectories of immigrants can be explained by work conditions.

The first step of the analysis was to establish the negative duration effect for immigrants that we seek to explain with work conditions. Therefore, as a by-product, we find evidence of a negative duration effect for physical health using a longitudinal perspective. Although there are few studies of the HIE and the duration effect using a longitudinal approach, to the best of my knowledge there are none for the UK. This longitudinal perspective is crucial in identifying a duration effect that does not conflate cohort effects with YSM effects. We cannot show a significant initial health advantage, mainly due to the age range of the sample that is more suitable to observe immigrants over longer lengths of residence, and the averaging across a number of arrival years. However, we find clear evidence that the health of immigrants indeed deteriorates with increasing time in the host country. As would be expected the observed deterioration is largest for the most recent arrivals, but is still statistically significant for even the 12+ YSM cohort in the overall population. This could suggest that over a longer time period immigrants' health advantage deteriorates beyond health levels of similar (in terms of age and education) UK-born men.

Regarding our first research question, whether physical work conditions contribute to the health decline that immigrants experience with increasing length of residence, we find some evidence that this is the case for immigrants in the population as a whole, and amongst non-degree holders. For these two populations, the effect of physical work conditions, as measured by the external physical job index, is robust to the inclusion of controls. The reduction in the duration effect resulting from accounting for physical work conditions depends on population and immigrant cohort. In the overall population, the decrease is largest amongst the most recently arrived immigrant cohort (0-4 YSM) with 3.6 percent and smallest for the cohort with 5-11 YSM (1.3 percent). In the non-degree population, the reductions are larger: 5.6 percent for recent immigrants (0-7 YSM), and 12.9 percent for immigrants of 8+ YSM. This large reduction for long-standing immigrants has to be interpreted with caution as the initial negative health trajectory for this cohort of -0.41 is statistically significant at only 10 percent level. In contrast, among degree holders, physical work conditions do not significantly predict health trajectories. Although some degree-educated immigrants have very physically demanding work conditions we cannot find that these conditions explain the negative duration effect in their health.

The second research question is whether psychosocial work conditions, understood as high psychological demands, low control over work and/or low social support at work, contribute to the negative duration effect? This question was answered using two measures, one measure incorporating all three aspects of psychosocial work conditions just mentioned (the external psychosocial job index), and one measure only capturing the aspect of psychosocial work conditions for which there is the strongest evidence in the literature that it affects health, namely low control over work. For this we use a self-reported measure of work autonomy.

Using the psychosocial job index, we find that for the overall population and the non-degree population increasing demands in the sense of a higher psychosocial job index score are associated with a significant decrease in health over time. However, this effect is not as robust to the inclusion of controls, and remains only marginally significant in the non-degree population, losing statistical significance altogether in the overall population. The decrease in immigrants' negative health trajectory associated with the psychosocial job index is smallest for the most recent arrivals and largest for the longest-standing immigrants in the population overall (between 1.3 and 3.3 percent). In the non-degree population the reduction of the negative duration effect is again quite large (8.5 percent) for the long-standing cohort, which might be an overstatement. For the recent immigrants among non-degree holders the reduction is in line with that for the overall population, with 2.2 percent.

Against expectations, the psychosocial job index does not predict health trajectories of workers with university degree. Possible reasons for this were discussed in the results section and are probably partly related to issues around the inclusion of intellectual demands as negative stressors in the psychosocial job index, which are particularly problematic for degree-holders where high intellectual demands are common. Negative trajectories of degree-holding immigrants cannot be explained by the combination of high job demands, low job control and low social support, in the way the psychosocial job index combines these.

The second measure of psychosocial work conditions, work autonomy, only predicts significantly health trajectories in the overall population, but not in the two sub-populations by degree status (despite the effect size in these populations being only slightly smaller than in the overall population). Also, the effect of work autonomy is not robust to the inclusion of controls. In the overall population the model with work autonomy (model 5c) reduces the negative duration effect of immigrants' health trajectories (model 4) by between 1.3 percent (for the middle cohort) and 4.9 percent (for the longest-standing immigrants).

We can therefore only partly confirm that psychosocial work conditions, whether measured by the external job index, or self-reported work autonomy, help explain immigrants' negative health trajectories. With respect to physical work conditions the analysis finds that these do indeed contribute to the negative duration effect observed in the physical health of male immigrants to the UK, except amongst degree-holders.

However, in any case we can only identify a small role of work conditions in explaining the negative duration effect, especially amongst degree holders. In the non-degree population, most of the observed negative duration effect cannot be explained by any of the predictors of the growth rate in health (neither by work conditions, nor by alternative health determinants). While immigrants undoubtedly have worse work conditions, and physical work conditions at least explain the health trajectory of the population overall, in a way that is robust to controls, this does not translate into a sizeable reduction of the immigrant trajectories, especially amongst degree educated workers.

This seemingly small role of work conditions in explaining immigrants' health trajectories can be due to several reasons. First, it might be possible that work conditions do actually not have a significant role in the negative duration effect but that seems a rather unlikely explanation for two reasons: i) The evidence reviewed from the literature regarding the association between work conditions and health, combined with the clear evidence that immigrants in our sample have significantly less favourable work conditions than UK natives on all measures make this unlikely. There is no good reason why poor work conditions should have differential effect for immigrants as opposed to natives. ii) This is supported by the lack of a statistically significant interaction term between the (external) work conditions measures and immigrant cohorts which would be the case if there was any kind of protective effect of immigrant status, e.g. due to their forward looking nature. Second, due to imperfect measurement of work conditions it is likely that we underestimate their role in explaining immigrant health trajectories. Related to this is probably the most important shortcoming of the analysis which is the lack of a long-term view. Exposure to work conditions accumulates over the life course, but this analysis only allows work conditions to affect health of the same period. Considering the impact of work conditions over time would be particularly important for psychosocial work conditions, because they are mainly associated with chronic conditions that take longer exposure to develop.

Potential alternative explanations of the negative duration effect could not be adequately tested with the available measures. With respect to migrant-specific determinants of change in health over time the analysis cannot control well for possible changes in health behaviours as opposed to time-invariant health behaviours. Also, differential health access and use especially of preventive health services could not be considered. Another possible health determinant that this analysis could not incorporate is the experience of harassment and discrimination, because measures of discrimination were asked of ethnic minority groups only and not all immigrants in

UKHLS[88]. However, at least part of these effects should be captured by adjusting for ethnic group membership.

In the overall population and the non-degree population the results also imply that important determinants that explain why immigrants' health deteriorates faster than natives' may be unobserved. A possible explanation for the remaining negative trajectory of immigrants' health could be that these represent long-term effects exposure to risk experienced pre-migration (Dunn and Dyck 2000). It is likely that less educated immigrants, such as those in the non-degree population, more often experience early life exposures that can lead to ill-health later in life than degree educated immigrants, who probably had a more affluent upbringing.

While SF-12 PCS as a health measure is superior to self-rated health and chronic conditions in the context of immigrant-native comparisons of health, it is not without its problems for this analysis. In an analysis of the role of work conditions on health SF-12 PCS , as discussed in section 4.4.2, can potentially overestimate the association between work conditions and health because workers with more demanding roles will be more likely to assess their health as restricting them in fulfilling this role, compared to workers in less demanding roles.

[88] There are measures of harassment and discrimination in the UKHLS, but these are only collected for the Ethnic Minority Boost sample and for immigrants up to 3 years since migration, and not for the whole sample.

5 Conclusion

This thesis contains three empirical analyses of immigrants in the UK, all using the nationally representative household panel survey, Understanding Society: the UK Household Longitudinal Study (UKHLS). Chapter 2 is an analysis of factors that are associated with nonresponse (specifically attrition between the first and the second wave of the UKHLS) among immigrant sample members. Chapters 3 and 4 focus on the physical health of immigrants and how it varies across length of their residence in the UK and compares this to the physical health of the UK born population.

Chapter 2: Non-response and attrition among immigrants in Understanding Society

Although attrition of immigrants may limit the usefulness of any longitudinal survey which is used for sub-group analyses of immigrants, this is not a well-researched area. The aim of the second chapter of this thesis is to fill this gap in the specific case of the UK using the UKHLS.

Non-contact among immigrants is considerably higher than amongst UK-born (wave 1) respondents (12 percent compared to 5 percent). Once contact is established, immigrants are only slightly more likely to refuse participation in the interview than UK-born (15 percent compared to 13 percent). We estimate two sets of logit models: one for the probability of living in a non-contact household, and the other for the probability of refusal conditional on contact and include control variables chosen based on established theoretical models of non-response.

The more recently immigrants arrived in the UK, the higher is their probability of being non- contact at wave 2. Compared to immigrants who have lived in the UK for more than 10 years, more recent arrival cohorts are between 9 percent and 21 percent more likely to live in a non-contact household in wave 2. Indicators of residential mobility (either housing tenure, or a direct indicator of whether the sample member moved) suggest that this is mainly due to their young age structure, household structure (single person households) and in their high propensity to move.

The full model suggests that non-contact of migrants is mainly determined by characteristics related to high residential mobility. This is particularly important as twice as many immigrants than UK-born live in a household that moved address between waves 1 and 2 (13 versus 7 percent). This will be an ongoing concern in following survey waves for recent immigrants because immigrants are very mobile in their first years of residence in the UK.

Other characteristics that seem to predict non-contact slightly more for immigrants than UK-born are related to the survey situation at each wave especially cooperativeness of the respondent at wave 1, as rated by the interviewer. The fact that poor cooperation at the first interview predicts non-contact at the second wave, more so for immigrants than the UK born, possibly indicates that it is a form of covert refusal, and that interview-avoidance strategies may be culturally different.

We then estimate the multivariate refusal (conditional on contact) model and find that refusal behaviour of immigrants is predicted by similar characteristics to that of UK-born. The more significant differences are within the immigrant group where there is substantial variation across immigrant cohorts in the propensity to refuse. The more recently the immigrant sample members arrived, the less likely they are to refuse the interview, even after accounting for a large array of control variables. As other measures of social integration are not statistically significant this could reflect unobserved heterogeneity between these different migrant cohorts or they may feel some social obligation as recently arrived immigrants to take part. Alternatively, it is possible to interpret this as recent immigrants perceiving participation in a UK household panel as a way of acknowledging belonging to UK society.

There are substantial differences in cooperativeness across ethno-religious groups within the immigrant group. Black African, Arab Muslims, Pakistani, Bangladeshi and Sikh immigrants are more likely to refuse than white Christian immigrants, other things equal. These differences are most reduced (though still significant at 10 percent level) after accounting for cooperation in the previous wave. As interviews are social situations where respondents interact with interviewers, the degree of misunderstanding and possible suspicion could vary across these groups depending on culturally specific behaviours in social situations.

Factors related to nonresponse theories of social engagement and social exchange have been tested, and the results suggest that these ideas apply to immigrants as with the UK born population. The probability to refuse decreases with political interest as well as with being a recipient of state benefits among immigrants. In contrast, factors relating to social isolation theory yield results inconsistent with theory, that is, we do not find that people who are less integrated in society are more prone to refuse. .

Overall, the observed characteristics in both the non-contact and refusal (conditional on contact) models are more predictive for immigrants than for UK-born.[89] This could be seen as a more systematic pattern of non-response among immigrants, which would imply more potential for bias among the immigrant sub-sample, if these characteristics are related to the outcome of interest.

[89] Notable exceptions are age and educational level that are strongly associated with refusal amongst UK-born, but not amongst immigrants.

The results demonstrate that within immigrants drop-out differs greatly by different socio-demographic characteristics such as ethnicity. This can compromise ethnic subgroup analysis, especially when compounded by low rates for the self-completion questionnaire for some ethnic groups. One therefore needs to consider the combined impact of attrition and item non-response.

Problems of decreasing sample size for migrants can be addressed in several ways. In the UKLHS this has been partly remedied with the implementation of a new Immigrant and Ethnic Minority Boost (IEMB) from 2015 onwards (no author 2015). Future surveys could allow for differential attrition of specific groups already at the design stage (Jacobs 2010). In addition, strategies for higher retention of immigrant sample members are needed because it is the repeated measurements on the same individuals that enable the study of migrant trajectories. The results of the analysis indicate that non-contact is the main hurdle in gaining a second interview of immigrant sample members. In order to minimise attrition of immigrant sample members fieldwork efforts need to be tailored to the specific characteristics of this group (such as their mobility and lack of stable network). For example, many immigrant respondents do not (and possibly cannot) provide an alternative person as stable contact in case they cannot be contacted at the next interview. To compensate for this, incentives for keeping address details up-to-date could be offered to groups identified as being at risk of attrition (e.g. recent immigrants). Fieldwork procedures that take account of irregular at-home patters, such as increased number of call attempts and calling at different times of day would also particularly benefit immigrant sample members.

The paucity of suitable, especially longitudinal, data sources has been a long-standing problem in migrant health research (Jacobs 2010; Acevedo-Garcia, Sanchez-Vaznaugh et al. 2012; Font and Méndez 2014). General population surveys, even if including an adequate number of immigrants in the sample, usually lack detail on pre-migration variables and other migrant-specific factors such as reason for migration. Understanding Society is no exception to this. While the study includes a series of questions for recent immigrants, more attention is given to ethnic minorities (in line with including the EMB sample). For this EMB sample (and a White British comparison sample) an additional module of 5 minutes' worth of questions collects information relevant to ethnicity research, e.g. on acculturation and experience of harassment or discrimination. Most of these issues would be equally relevant to white migrants. This focus on ethnicity in the study design might also reflect that past immigrant (health) research focussed on non-white immigrants, especially those from the New Commonwealth countries (Hatton and Wheatley Price 1999; Bhopal 2014). This is, as Bhopal points out, "(…) unfortunate for disadvantaged White migrant minorities, for their needs may be overlooked. Immigrant and minority health cannot be disentangled easily, if at all" (2014, p. 95). Especially in light of the large immigrant flows from Eastern Europe to the UK in the last decade this is a gap that limits the usefulness of the study.

Chapter 3: Healthy immigrant effect among immigrants in the UK

Chapter 3 investigates the Healthy Immigration Effect (HIE), understood as a health advantage of recent immigrants compared to the native-born population in the UK. Theory suggests that HIE results from positive selection and healthier behaviours and empirical evidence shows that the HIE exists and decreases with length of residence (e.g., Jasso, Massey et al. 2004; McDonald and Kennedy 2004). Using data from the first wave of the UKHLS, we estimate the HIE at the first year of arrival, and how it decreases for immigrants with longer length of stay in the UK. While existing UK studies conflate ethnic minorities and immigrants we specifically consider immigrants and so are able to successfully estimate the HIE for the UK.

A key contribution lies in the use of a better health measure, SF-12 Physical Component Summary (SF-12 PCS) compared to two commonly used health outcomes to estimate HIE (poor self-rated health and diagnosed chronic condition). The subjective nature of self-rated health means that the measure is problematic when comparing immigrants of different lengths of residence to natives, because the reference frame that immigrants use when assessing their health possibly changes with increasing stay in the host country (McDonald and Kennedy 2004; Chiswick, Lee et al. 2008; Farré 2013). Diagnosed chronic condition is a more objective health measure but has its own weaknesses in an immigrant-native health comparison. Firstly, chronic conditions might be underdiagnosed in some regions of origin, and therefore an apparent increase in chronic condition can be due to the post-migration diagnosis of pre-existing conditions (McDonald and Kennedy 2004). Secondly, chronic condition is not a valid measure of health status if the proportion of ill health due to chronic conditions relative to other causes (i.e. infectious diseases and injuries) is similar across populations, as is the case for immigrants from developing countries compared to populations of highly developed host countries. Thirdly, differing probabilities of diagnosis and treatment quality mean that the association between true health and chronic condition will vary across regions. These aspects combined make it likely that diagnosed chronic condition underestimates ill health of immigrants from some regions relative to the UK-born population. A functional health measure such as SF-12 PCS is more suited to capture poor health regardless of cause, diagnosis and treatment quality up to the time of migration. In terms of poor physical functioning (as measured by SF-12 PCS), male immigrants have an advantage of 4.6 percent (lower probability of poor physical health) in the first year after arrival, after adjusting for age and education. This advantage, which is similar to findings for other countries, decreases over time. This becomes non-significant for immigrants who are at least 7 years since migration (YSM). Although the cross-sectional nature of the analysis means we cannot distinguish between cohort and duration effects, there is evidence for Canada and Australia that cohort effects are negligible (McDonald and Kennedy 2004; Biddle, Kennedy et al. 2007). Female immigrants have only a non-significant HIE of 1.8 percentage points for poor physical functioning.

The dataset includes first, second and third (migrant) generation individuals and allows an analysis of HIE within four main ethnic groups, white, black African, Indian and Bangladeshi/Pakistani. This is another contribution of this analysis. We find no statistically significant HIE within the three ethnic minority groups for poor physical functioning (SF-12), a result of small advantages combined with the relatively small sample sizes of the ethnic group models. For poor self-rated health the results are inconsistent and depend on ethnic group and gender. We find the most consistent and largest HIE within ethnic groups for diagnosed chronic condition where both male and female recent immigrants of all ethnic groups have a statistically significant HIE over their UK-born co-ethnics (with the exception of African immigrants from countries of origin where it is likely that they arrived as asylum seekers). Especially for women this is driven more by high levels of poor health of the UK-born comparison groups, rather than low levels of poor health of the foreign-born women.

When comparing the estimated HIE across the three measures, poor self-rated health and chronic condition yield a consistently larger HIE than the measure of poor physical functioning, SF-12 PCS. The relative magnitude of HIE for different groups as measured by poor self-rated health and chronic condition are also less in line with theoretical expectations. As SF-12 PCS is the most objective health measure of the three, this suggests that the former probably overstate the health advantage of immigrants, especially amongst women.

Chapter 4: The role of physical and psychosocial work conditions in explaining working immigrants' health trajectories

As widely documented in the literature (e.g., McDonald and Kennedy 2004; Newbold 2005; Biddle, Kennedy et al. 2007) and also suggested by the results of chapter 3, immigrants lose their initial health advantage over the native-born population with increasing length of residence in their host country. Proposed explanations (and empirical investigations) of this negative duration effect are mainly concerned with changing health behaviours and selective return migration. Chapter 4 investigates a different, poorly researched explanation, namely the role of work conditions which are on average poorer for immigrants compared to native-born employees.

This analysis is restricted to men employed at the first measurement occasion and uses a multilevel growth curve modelling approach to consider the impact of task-related physical and psychosocial work conditions of immigrants' physical health (measured by SF-12 PCS) over four years and how this could explain the negative duration effect over this period.

This chapter also contributes to the HIE literature in providing evidence of a negative duration effect for physical health (for male immigrants) using longitudinal data. We find clear evidence that the health of immigrants deteriorates with increasing time in the host country: immigrants of 5 or more YSM lose 0.5 point on the SF-12 PCS per year, while for the most recent arrivals up to 4 YSM the annual loss is larger with 0.9 points, compared to similar UK-born men (i.e. adjusted for age and education). This negative duration effect can be observed among immigrants who are degree holders as well as non-degree holders.

The analysis considers the potentially detrimental effect of two types of task-related work conditions, physical and psychosocial. The latter are understood as high psychological demands, low control over work and or low social support at work (Karasek and Theorell 1990). We use an external job index to measure physical and psychosocial work conditions (Kroll 2011). In addition, we measure one aspect of psychosocial work conditions, namely the level of control over work, using a self-reported measure of work autonomy.

We find some evidence that physical work conditions explain some of the negative duration effect. In the whole sample accounting for physical work conditions decreases the negative duration effect in immigrants' health by between 1.3 percent (for the immigrant cohort of 5-11 YSM) and 3.6 percent (for the most recent immigrant cohort of 0-4 YSM). Among non-degree holders, where physically demanding jobs are more common, the reduction of the negative duration effect is somewhat larger, while among degree-holders physical work conditions do not significantly predict workers' health trajectories and hence also cannot explain the excess deterioration observed in immigrants' health in this population.

The two measures of psychosocial work conditions, the psychosocial job index and work autonomy, are not as clearly associated with a reduction in the negative duration effect. While psychosocial work conditions as measured by the external job index do predict health trajectories for the population overall and for the non-degree population, these effects are not robust to the inclusion of controls, and their explanatory power with respect to the excess deterioration of immigrants' health is very small (between 1.3 and 3.3 percent in the overall population). The second psychosocial measure, work autonomy, is also not robust to the inclusion of control variables.

The negative duration effect is reduced most when considering the combined effect of physical work conditions and work autonomy, 5 percent for the most recent and long-standing immigrants (0-4 YSM and 12+ YSM), only 1 percent for the middle cohort in the overall population. In this model, work conditions explain more of the duration effect among less educated immigrants, while among degree-educated immigrants other factors seem more important.

It is likely that the relatively small role of work conditions identified is an underestimate of their true importance in immigrants' health trajectories, especially over the long term. This is possibly due to the poor measurement of psychosocial work conditions and the short duration over which the health trajectories are observed thus restricting the analysis to short term effects. The increasing availability of longitudinal data with sufficient numbers of immigrants in the UK, particularly with more waves of the UKHLS and the addition of the new immigrant and ethnic minority boost sample in the sixth wave, will go a long way towards enabling a better estimation of the negative duration health effects among immigrants in the UK.

The analyses from chapters 3 and 4 demonstrate that health decline is a common feature across different immigrant groups. Policy makers should move away from focussing exclusively on non-White (immigrant) groups and consider the implications of health care policies on all ethnic groups and different groups of immigrants.

The recent large inflows of immigrants from Eastern Europe (which show smaller HIE than other groups) also suggest that continued attention to health differences within the immigrant population is necessary, as their health is intimately linked to the selection mechanisms including changing immigration policies, and changing conditions in the regions of origin, and therefore these health differentials cannot be considered stable over time.

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A Appendix: Chapter 2

A.1 Construction of variable mover status

Whether respondent moved between wave 1 and wave 2

I constructed the individual-level variable move_type, whether a respondent moved between wave 1 and wave 2, mainly based on the household-level variable b_origaddstat (information recorded by the interviewers on the Address Record Form (ARF): "What is the status of the household at the original issued address at the front of the ARF?").

B_origaddstat indicates whether all, none or some of the eligible sample members were found at the original issued address (which is the wave 1 address, unless respondents moved and notified ISER of their new address). It also has a category 'interviewer could not visit household'.

For households where either all eligible are found at the address (that is, no-one moved) or where no eligible residents were found (that is, all moved), the move status for all sample members in the household can be inferred from b_origaddstat.

Households with b_origaddstat 'some eligible were found, some moved' have split. One part of the wave 1 household still lives at the original address, the other part(s) moved to one (or more) addresses and will be considered as separate households at wave 2. For these split households the variable b_finloc (final sample location identification) indicates which household members still live at this address (they will have value 1 for this address) and which sample members moved away from their wave 1 household (they will have value 0 for the original issued address, and an additional entry for the new, traced address with b_finloc=1). Hence, sample members of split households with multiple entries (of which at least one will have b_finloc=0) are those household members that left the household at the original address and moved to a new address. These sample members are classified as 'split household moves' while those members staying behind are non-movers.

Finally, the interviewers could not visit the original issued address of 258 migrants and 563 UK-born sample members. For these people (and for 8 with b_origaddstat=don't know), the move status cannot be determined and is classified in move_type as 'unclear'. Reasons why an interviewer could not visit the household are

Amongst those who moved, the address that is issued to the interviewer will be up-to-date for those sample members who notified ISER of their move. This is the case for about a third of movers (personal communication with Colette Lo, ISER). For the remaining sample members a tracking process begins when the interviewer finds that the household, or part of it, has moved. In the published data we cannot distinguish between movers where tracking was necessary and such where the issued address was up-to-date.

A.2 Use of wave 1 covariates for split households

For split households lagged covariates from wave 1 reflect the household circumstances at wave 2 to differing degrees. For example, the household type and household benefit receipt are based on information for the wave 1 household members. For split households this information is possibly only true for one of the two or more new households, but it can also still be accurate for all new households (e.g. for household benefit receipt). Other variables such as household type will always be inaccurate for at least some of the new wave 2 households. However, only 2.4% of migrants and 2.5% of UK-born live in a split household. Interactions between household type and move status were tested but not significant.

A.3 Tables

Table 25 Descriptive statistics for analytical sample, by country of birth: Gender, age at migration, age, year of arrival

	Freq.	Percent	Female	Age at migration		Age		Year of arrival	
Country of birth				mean	(min-max)	Mean	(min - max)	mean	(min - max)
United Kingdom	34,949	83.21	0.52	22	(0-50)	48	(16-80+)	1973	(1950-1990)
Republic of Ireland	273	0.65	0.56	17	(0-45)	56	(16-80+)	1971	(1925-2010)
France	68	0.16	0.51	21	(0-40)	37	(16-80+)	1994	(1950-2010)
Germany	208	0.5	0.59	11	(0-65)	40	(16-80+)	1980	(1940-2010)
Italy	68	0.16	0.49	21	(0-50)	52	(16-80+)	1979	(1945-2010)
Spain	36	0.09	0.54	23	(0-40)	40	(16-75)	1992	(1955-2010)
Poland	239	0.57	0.5	26	(5-60)	34	(16-80+)	2002	(1945-2010)
Cyprus	47	0.11	0.48	9	(0-35)	52	(16-80+)	1967	(1950-2010)
Turkey	58	0.14	0.48	24	(5-65)	37	(20-65)	1997	(1960-2010)
Australia	59	0.14	0.49	20	(0-55)	45	(16-80+)	1984	(1930-2010)
New Zealand	44	0.1	0.55	25	(0-55)	46	(25-80+)	1988	(1950-2010)
Canada	47	0.11	0.56	16	(0-55)	53	(16-80+)	1973	(1915-2010)
United States of America	96	0.23	0.65	24	(0-55)	41	(16-80+)	1993	(1930-2010)
China/Hong Kong	153	0.36	0.42	21	(0-60)	39	(16-75)	1991	(1935-2010)
India	881	2.1	0.44	24	(0-85)	46	(16-80+)	1987	(1925-2010)
Pakistan	717	1.71	0.44	20	(0-65)	42	(16-80+)	1988	(1940-2010)
Bangladesh	679	1.62	0.38	18	(0-65)	38	(16-80+)	1990	(1955-2010)
Sri Lanka	213	0.51	0.47	25	(0-55)	42	(16-80+)	1993	(1930-2010)
Kenya	158	0.38	0.36	16	(0-60)	50	(16-80+)	1976	(1955-2010)

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Country of birth	Freq.	Prop.	Female	Age at migration Mean (min-max)	Age Mean (min-max)	Year of arrival Mean(min-max)
Ghana	174	0.41	0.56	24 (0-50)	41 (16-80+)	1993 (1955-2010)
Nigeria	234	0.56	0.46	25 (0-65)	40 (16-80+)	1994 (1955-2010)
South Africa	145	0.35	0.49	22 (0-75)	40 (16-80+)	1992 (1935-2010)
Jamaica	311	0.74	0.58	19 (0-60)	56 (16-80+)	1973 (1935-2010)
Afghanistan	38	0.09	0.38	21 (0-65)	34 (16-80+)	1996 (1985-2010)
Algeria	18	0.04	0.52	24 (10-45)	39 (16-70)	1994 (1955-2005)
Angola	21	0.05	0.5	25 (5-55)	35 (16-70)	1999 (1970-2010)
Austria	14	0.03	0.51	23 (0-50)	57 (25-80+)	1976 (1945-2010)
Barbados	45	0.11	0.57	16 (0-40)	57 (30-80+)	1968 (1955-2005)
Belgium	18	0.04	0.65	17 (0-50)	47 (20-80+)	1979 (1945-2010)
Bosnia and Herzegovina	11	0.03	0.59	27 (5-60)	41 (20-75)	1995 (1990-2005)
Brazil	19	0.05	0.5	26 (10-35)	33 (16-50)	2003 (1980-2010)
Bulgaria	11	0.03	0.66	27 (20-40)	36 (20-50)	2001 (1990-2010)
Cameroon	13	0.03	0.47	29 (15-60)	39 (25-65)	1999 (1990-2010)
Colombia	14	0.03	0.69	24 (5-50)	44 (20-65)	1989 (1970-2005)
Czech Republic/Czechoslovakia	15	0.04	0.62	22 (10-35)	36 (25-70)	1996 (1960-2010)
Democratic Republic of Congo	47	0.11	0.56	21 (0-45)	35 (16-60)	1996 (1960-2010)
Denmark	15	0.04	0.79	25 (15-45)	52 (30-80+)	1983 (1950-2005)
Dominica	12	0.03	0.55	15 (0-45)	50 (20-80+)	1974 (1955-2005)
Egypt	31	0.07	0.54	17 (0-35)	59 (25-80+)	1968 (1925-2005)
Eritrea	24	0.06	0.61	29 (5-55)	39 (20-60)	1999 (1975-2010)
Ethiopia	21	0.05	0.64	22 (10-45)	38 (20-55)	1994 (1975-2010)

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Country of birth	Freq.	Prop.	Female	Age at migration Mean (min-max)	Age Mean (min-max)	Year of arrival mean (min-max)
Gambia	16	0.04	0.5	23 (5-55)	43 (20-80+)	1990 (1940-2005)
Greece	16	0.04	0.47	25 (5-45)	43 (20-80+)	1991 (1955-2010)
Guyana	40	0.1	0.48	19 (0-50)	61 (35-80+)	1968 (1955-2005)
Hungary	22	0.05	0.52	27 (15-45)	35 (20-75)	2002 (1955-2010)
Indonesia	15	0.04	0.76	26 (15-35)	47 (25-80+)	1989 (1955-2010)
Iran	41	0.1	0.34	23 (0-55)	41 (20-70)	1991 (1950-2010)
Iraq	52	0.12	0.35	22 (0-65)	38 (16-75)	1994 (1955-2010)
Ivory Coast	18	0.04	0.65	24 (10-35)	39 (20-50)	1995 (1985-2005)
Japan	24	0.06	0.78	22 (0-45)	39 (16-80+)	1993 (1965-2010)
Kashmir	13	0.03	0.21	16 (5-30)	51 (25-75)	1974 (1945-2000)
Latvia	15	0.04	0.61	27 (15-55)	32 (20-60)	2005 (2000-2010)
Lebanon	12	0.03	0.35	17 (0-45)	45 (16-65)	1981 (1950-2010)
Lithuania	30	0.07	0.53	25 (10-50)	32 (16-55)	2002 (1995-2010)
Malawi	27	0.06	0.35	18 (0-30)	41 (16-65)	1987 (1965-2005)
Malaysia	58	0.14	0.46	14 (0-40)	44 (20-70)	1980 (1940-2010)
Malta	23	0.05	0.41	5 (0-25)	49 (25-75)	1966 (1935-2010)
Mauritius	46	0.11	0.55	23 (0-60)	48 (16-75)	1984 (1955-2005)
Montserrat	17	0.04	0.47	29 (5-70)	55 (30-80+)	1984 (1955-2000)
Morocco	17	0.04	0.35	17 (5-40)	45 (20-60)	1982 (1955-2010)
Myanmar	17	0.04	0.4	18 (0-35)	56 (16-80+)	1971 (1940-2005)
Nepal	20	0.05	0.2	25 (15-50)	33 (20-55)	2001 (1980-2010)
Norway	10	0.02	0.7	20 (15-35)	37 (16-75)	1992 (1960-2010)

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Country of birth	Fre.	Prop.	Female	Age at migration Mean (min-max)	Age Mean (min-max)	Year of arrival Mean (min-max)
Philippines	79	0.19	0.56	26 (0-50)	36 (16-75)	2000 (1970-2010)
Portugal	44	0.1	0.43	23 (0-50)	36 (16-60)	1997 (1980-2010)
Romania	22	0.05	0.71	29 (5-60)	36 (16-60)	2003 (1975-2010)
Russia	23	0.05	0.76	26 (0-50)	43 (16-70)	1993 (1940-2005)
Saudi Arabia	13	0.03	0.54	18 (0-35)	26 (16-60)	2002 (1990-2010)
Sierra Leone	30	0.07	0.49	26 (10-55)	43 (25-80+)	1992 (1960-2010)
Singapore	42	0.1	0.59	7 (0-55)	44 (20-75)	1973 (1955-2010)
Slovakia	14	0.03	0.83	21 (0-35)	27 (16-35)	2004 (1995-2010)
Somalia	152	0.36	0.66	23 (0-65)	34 (16-75)	1999 (1975-2010)
Nevis	15	0.04	0.7	23 (0-40)	64 (45-80+)	1969 (1955-1995)
St Lucia	19	0.05	0.62	17 (5-30)	48 (20-80+)	1979 (1955-2000)
Sudan	22	0.05	0.26	24 (5-40)	38 (20-55)	1995 (1975-2010)
Sweden	19	0.05	0.78	25 (5-55)	47 (16-80+)	1987 (1950-2010)
Switzerland	10	0.02	0.46	24 (10-45)	50 (25-80+)	1984 (1945-2010)
Tanzania	32	0.08	0.37	18 (0-45)	50 (25-80+)	1977 (1965-2005)
Thailand	37	0.09	0.81	25 (5-45)	32 (20-50)	2003 (1990-2010)
the Netherlands	21	0.05	0.63	21 (0-40)	42 (20-70)	1988 (1945-2010)
Trinidad and Tobago	39	0.09	0.67	19 (0-65)	48 (25-70)	1980 (1950-2005)
Ukraine	14	0.03	0.81	29 (5-50)	46 (25-80+)	1993 (1950-2010)
Vietnam	26	0.06	0.36	23 (5-55)	42 (20-65)	1990 (1980-2005)
Yemen	17	0.04	0.73	23 (0-50)	40 (16-60)	1993 (1950-2005)
Zambia	35	0.08	0.35	18 (0-60)	44 (25-80+)	1983 (1965-2005)

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Country of birth	Freq.	Prop.	Female	Age at migration Mean (min-max)	Age Mean (min-max)	Year of arrival Mean (min-max)
Zimbabwe	126	0.3	0.5	25 (0-60)	38 (16-70)	1997 (1960-2010)
the Caribbean	62	0.15	0.6	18 (0-45)	50 (16-80+)	1978 (1945-2005)
Middle East	39	0.09	0.41	17 (0-45)	39 (16-75)	1988 (1945-2005)
Far East	10	0.02	0.45	15 (0-35)	36 (20-70)	1988 (1960-2005)
West Africa	17	0.04	0.54	22 (5-40)	42 (20-60)	1990 (1965-2010)
East Africa	110	0.26	0.57	17 (0-50)	46 (20-80+)	1980 (1945-2010)
other Africa	15	0.04	0.45	12 (0-35)	34 (20-60)	1988 (1950-2010)
South & Latin America	29	0.07	0.62	19 (0-40)	47 (20-80+)	1981 (1925-2010)
Western Europe (other)	28	0.07	0.62	20 (0-45)	48 (20-80+)	1982 (1940-2010)
Eastern Europe	31	0.07	0.46	25 (5-50)	36 (20-60)	1999 (1965-2010)
not elsewhere codable	14	0.03	0.57	22 (0-60)	35 (20-60)	1994 (1960-2010)

Note: Absolute and relative frequencies unweighted, all other statistics weighted using analysis weights. Countries of birth have been grouped to cells of at least 3 observations to prevent disclosure. Minima and maxima rounded to nearest 5 or (for age at arrival and age to minimum/maximum age at arrival/age as defined by analysis sample) if underlying cell count below 3.

Table 26 Descriptive statistics for analytical sample, by country of birth: Religion, whether a full-time student

Country of birth		Christian	Muslim	Hindu	Sikh	Buddhist	Jewish	other/none	student
United Kingdom	34,949	0.79	0.01	0	0	0	0	0.18	0.06
Republic of Ireland	273	0.95	0	0	0	0	0	0.03	0.03
France	68	0.71	0.05	0	0	0	0	0.21	0.16
Germany	208	0.7	0.01	0	0	0	0.01	0.26	0.09
Italy	68	0.92	0	0	0	0	0	0.08	0.1
Spain	36	0.76	0.05	0	0	0	0	0.19	./.
Poland	239	0.92	0	0	0	0	0	0.07	0.05
Cyprus	47	0.61	0.2	0	0	0	0	0.19	./.
Turkey	58	0.06	0.83	0	0	0	0	0.11	0.04
Australia	59	0.81	0	0	0	0	0	0.18	./.
New Zealand	44	0.79	0	0	0	0	0	0.21	./.
Canada	47	0.75	0	0	0	0	0	0.23	./.
United States of America	96	0.76	0	0	0	0	0.05	0.16	0.02
China/Hong Kong	153	0.32	0	0	0.01	0.19	0	0.47	0.24
India	881	0.2	0.12	0.45	0.22	0	0	0.02	0.05
Pakistan	717	0.03	0.97	0	0	0	0	0	0.05
Bangladesh	679	0	0.97	0.02	0	0	0	0	0.07
Sri Lanka	213	0.28	0.04	0.45	0	0.22	0	0.02	0.07
Kenya	158	0.36	0.07	0.49	0.05	0	0	0.05	0.02
Ghana	174	0.94	0	0	0	0	0	0.06	0.18
Nigeria	234	0.86	0.1	0	0	0	0	0.04	0.14
South Africa	145	0.74	0.03	0	0	0	0.03	0.2	0.04
Jamaica	311	0.86	0	0	0	0	0	0.13	0.02

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Country of birth		Christian	Muslim	Hindu	Sikh	Buddhist	Jewish	other/none	student
Afghanistan	38	0	0.82	0	0.07	0	0	0	0.2
Algeria	18	0	0.69	0	0	0	0	0	0.26
Angola	21	0.86	0	0	0	0	0	0	0.39
Austria	14	0.97	0	0	0	0	0	0	0
Barbados	45	0.79	0	0	0	0	0	0.19	./.
Belgium	18	0.74	0	0	0	0	0	0.2	./.
Bosnia and Herzegovina	11	0	0.59	0	0	0	0	0.26	./.
Brazil	19	0.98	0	0	0	0	0	0	./.
Bulgaria	11	0.47	0	0	0	0	0	0.53	0
Cameroon	13	1	0	0	0	0	0	0	./.
Colombia	14	0.91	0	0	0	0	0	0	0.24
Czech Republic/Czechoslovakia	15	0.47	0	0	0	0	0	0.53	./.
Democratic Republic of Congo	47	0.9	0.04	0	0	0	0	0	0.27
Denmark	15	0.73	0.02	0	0	0	0	0.24	0
Dominica	12	0.94	0	0	0	0	0	0	0
Egypt	31	0.37	0.45	0	0	0	0	0	0
Eritrea	24	0.61	0.24	0	0	0	0	0	./.
Ethiopia	21	0.79	0	0	0	0	0	0	0.16
Gambia	16	0.36	0.64	0	0	0	0	0	./.
Greece	16	0.55	0	0	0	0	0	0.45	0.23
Guyana	40	0.85	0	0.1	0	0	0	0	0
Hungary	22	0.83	0	0	0	0	0	0	./.
Indonesia	15	0.36	0.48	0	0	0	0	0	./.
Iran	41	0.11	0.72	0	0	0	0	0.17	0.09

Continued/….

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Country of birth		Christian	Muslim	Hindu	Sikh	Buddhist	Jewish	Other/none	student
Iraq	52	0	0.85	0	0	0	0	0	0.15
Ivory Coast	18	0.95	0	0	0	0	0	0	./.
Japan	24	0.18	0	0	0	0.33	0	0.45	0.27
Kashmir	13	0	0.8	0	0	0	0	0	0
Latvia	15	0.36	0	0	0	0	0	0.64	./.
Lebanon	12	0.4	0.6	0	0	0	0	0	0.26
Lithuania	30	0.88	0	0	0	0	0	0.12	0.14
Malawi	27	0.4	0	0.08	0	0	0	0	./.
Malaysia	58	0.66	0	0	0.01	0.17	0	0.08	0.07
Malta	23	0.92	0	0	0	0	0	0	./.
Mauritius	46	0.31	0.12	0.51	0	0	0	0	0.11
Montserrat	17	0.74	0	0	0	0	0	0.26	0
Morocco	17	0	0.65	0	0	0	0	0	0
Myanmar	17	0.58	0	0.26	0	0	0	0	0.16
Nepal	20	0	0	0.79	0	0.15	0	0	./.
Norway	10	0.33	0	0	0	0	0	0.62	0.42
Philippines	79	0.9	0	0	0	0	0	0	0.15
Portugal	44	0.85	0	0.04	0	0	0	0.11	0.11
Romania	22	0.91	0	0	0	0	0	0	./.
Russia	23	0.59	0	0	0	0	0	0.34	./.
Saudi Arabia	13	0.2	0.7	0	0	0	0	0	0.75
Sierra Leone	30	0.67	0.33	0	0	0	0	0	0.07
Singapore	42	0.69	0	0.06	0	0	0	0.24	./.
Slovakia	14	0.81	0	0	0	0	0	0.19	./.

Continued/….

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Country of birth		Christian	Muslim	Hindu	Sikh	Buddhist	Jewish	Other/none	student
Somalia	152	0.03	0.97	0	0	0	0	0	0.21
Nevis	15	0.96	0	0	0	0	0	0	0
St Lucia	19	0.87	0	0	0	0	0	0.13	./.
Sudan	22	0.21	0.68	0	0	0	0	0	./.
Sweden	19	0.57	0	0	0	0	0	0.4	0.06
Switzerland	10	0.8	0	0	0	0	0	0	./.
Tanzania	32	0.12	0.2	0.52	0.14	0	0	0	0
Thailand	37	0	0	0	0	0.84	0	0	0.1
the Netherlands	21	0.68	0	0	0	0	0	0.31	./.
Trinidad and Tobago	39	0.84	0	0	0	0	0	0.1	0.05
Ukraine	14	0.78	0	0	0	0	0	0.22	./.
Vietnam	26	0.14	0	0	0	0.61	0	0.25	0.1
Yemen	17	0	0.69	0.17	0	0	0	0	0.21
Zambia	35	0.63	0.07	0.06	0	0	0	0.23	./.
Zimbabwe	126	0.86	0.04	0	0	0	0	0.09	0.11
the Caribbean	62	0.77	0	0	0	0	0	0.17	0.11
Middle East	39	0.29	0.56	0	0	0	0.12	0	0.12
Far East	10	0.46	0	0	0	0.15	0	0	./.
West Africa	17	0.63	0.37	0	0	0	0	0	./.
East Africa	110	0.39	0.1	0.45	0.04	0	0	0.02	0.03
other Africa	15	0.68	0.14	0	0	0	0	0	0.14
South & Latin America	29	0.93	0	0	0	0	0	0	./.
Western Europe (other)	28	0.73	0	0	0	0	0.07	0.2	./.
Eastern Europe	31	0.56	0.28	0	0	0	0	0.16	./.
not elsewhere codable	14	0.55	0	0	0	0	0	0.28	./.

Note: Frequencies unweighted, proportions weighted using analysis weights. Countries of birth have been grouped to groups of at least 8 observations and cells based on less than 3 unweighted observations have been set to 0 (for religion) or suppressed (for student status) to prevent disclosure. Also, for religion the category missing is suppressed.

Table 27 Descriptive statistics for analytical sample, by country of birth: Ethnicity

		1 - White British/Irish	2 - Other White	3 - White and black Caribbean	4 - White and black African	5 - White and Asian	6 -Indian	7 - Pakistani	8 Bangladeshi	9 - Chinese	10 - Any other Asian	11 - Caribbean	12 - African	13 - Any other black	14 - Arab	15 - Any other
United Kingdom	34,949	0.96	0	0	0	0	0.01	0.01	0	0	0	0	0	0	0	0
Republic of Ireland	273	0.98	0	0	0	0	0	0	0	0	0	0	0	0	0	0
France	68	0.18	0.71	0	0	0	0	0	0	0	0	0	0.01	0	0	0.01
Germany	208	0.68	0.28	0	0	0	0	0	0	0	0.01	0	0	0	0	0
Italy	68	0.22	0.74	0	0	0	0	0	0	0	0	0	0	0	0	0
Spain	36	0.21	0.72	0	0	0	0	0.05	0	0	0	0	0	0	0	0
Poland	239	0.02	0.98	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyprus	47	0.64	0.31	0	0	0	0	0	0	0	0	0	0	0	0	0.05
Turkey	58	0.14	0.57	0	0	0	0	0	0	0	0	0	0	0	0	0.22
Australia	59	0.52	0.46	0	0	0	0	0	0	0	0	0	0	0	0	0
New Zealand	44	0.47	0.51	0	0	0	0	0	0	0	0	0	0	0	0	0
Canada	47	0.72	0.26	0	0	0	0	0	0	0	0	0	0	0	0	0
United States of America	96	0.21	0.68	0	0	0	0.02	0	0	0	0	0	0	0.01	0	0.03
China/Hong Kong	153	0.17	0	0	0	0	0	0	0	0.79	0.02	0	0	0	0	0
India	881	0.07	0	0	0	0.01	0.88	0	0	0	0.01	0	0	0	0	0.01
Pakistan	717	0.02	0	0	0	0	0.01	0.96	0.01	0	0	0	0	0	0	0

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		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Bangladesh	679	0	0	0	0	0	0	0	0.97	0	0	0	0	0	0	0
Sri Lanka	213	0.05	0	0	0	0.02	0.05	0	0	0	0.85	0	0	0	0	0.02
Kenya	158	0.19	0	0	0.03	0	0.62	0.01	0	0	0.04	0	0.08	0	0	0
Ghana	174	0.04	0	0	0.06	0	0	0	0	0	0	0	0.87	0	0	0
Nigeria	234	0.05	0	0	0.05	0	0	0	0	0	0	0	0.88	0.01	0	0
South Africa	145	0.43	0.41	0	0.02	0	0.02	0	0	0	0.01	0	0.04	0	0	0.05
Jamaica	311	0	0	0.06	0	0	0	0	0	0	0	0.88	0.01	0	0	0
Afghanistan	38	0	0	0	0	0.06	0.06	0	0	0	0.59	0	0	0	0.18	0
Algeria	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0.52	0
Angola	21	0	0	0	0.21	0	0	0	0	0	0	0	0.65	0	0	0
Austria	14	0.21	0.77	0	0	0	0	0	0	0	0	0	0	0	0	0
Barbados	45	0	0	0	0	0	0	0	0	0	0	0.84	0	0	0	0
Belgium	18	0.59	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
Bosnia and Herzegovina	11	0	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazil	19	0	0.81	0	0	0	0	0	0	0	0	0	0	0	0	0.19
Bulgaria	11	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0
Cameroon	13	0	0	0	0	0	0	0	0	0	0	0	0.95	0	0	0
Colombia	14	0.39	0.38	0	0	0	0	0	0	0	0	0	0	0	0	0.21
Czech Republic/Czechoslovakia	15	0	0.72	0	0	0	0	0	0	0	0	0	0	0	0	0
Democratic Republic of Congo	47	0	0	0	0	0	0	0	0	0	0	0	0.86	0	0	0
Denmark	15	0.24	0.73	0	0	0	0	0	0	0	0	0	0	0	0	0
Dominica	12	0	0	0	0	0	0	0	0	0	0	0.94	0	0	0	0
Egypt	31	0.45	0	0	0	0	0	0	0	0	0	0	0.03	0	0.37	0.1

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		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Eritrea	24	0	0	0	0	0	0	0	0	0	0	0	0.97	0	0	0
Ethiopia	21	0	0	0	0	0	0	0	0	0	0	0	0.96	0	0	0
Gambia	16	0	0	0	0	0	0	0	0	0	0	0	0.82	0	0	0
Greece	16	0	0.54	0	0	0	0	0	0	0	0	0	0	0	0	0.26
Guyana	40	0	0	0.1	0	0	0	0	0	0	0.07	0.4	0	0	0	0.19
Hungary	22	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Indonesia	15	0	0	0	0	0	0	0	0	0	0.66	0	0	0	0	0
Iran	41	0	0	0	0	0.12	0	0	0	0	0.25	0	0	0	0.42	0.08
Iraq	52	0	0	0	0	0	0	0	0	0	0.08	0	0	0	0.63	0.16
Ivory Coast	18	0	0	0	0	0	0	0	0	0	0	0	0.81	0	0	0
Japan	24	0.19	0	0	0	0	0	0	0	0	0.64	0	0	0	0	0
Kashmir	13	0	0	0	0	0	0	0.32	0	0	0	0	0	0	0	0.23
Latvia	15	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Lebanon	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0.6	0
Lithuania	30	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Malawi	27	0	0	0	0	0	0.54	0	0	0	0	0	0.3	0	0	0
Malaysia	58	0.49	0	0	0	0	0.06	0	0	0.27	0.16	0	0	0	0	0
Malta	23	0.88	0.12	0	0	0	0	0	0	0	0	0	0	0	0	0
Mauritius	46	0	0	0	0	0	0.22	0	0	0	0.24	0	0	0	0	0.38
Montserrat	17	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Morocco	17	0	0	0	0	0	0	0	0	0	0	0	0.15	0	0.23	0.22
Myanmar	17	0.42	0	0	0	0	0.08	0	0	0	0.34	0	0	0	0	0
Nepal	20	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Norway	10	0	0.77	0	0	0	0	0	0	0	0	0	0	0	0	0

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…/Continued (for category labels see start of table)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Philippines	79	0	0	0	0	0	0	0	0	0	0.9	0	0	0	0	0
Portugal	44	0	0.78	0	0.05	0	0.04	0	0	0	0	0	0.02	0	0	0
Romania	22	0	0.71	0	0	0	0	0	0	0	0	0	0	0	0	0.21
Russia	23	0	0.89	0	0	0	0	0	0	0	0	0	0	0	0	0
Saudi Arabia	13	0	0	0	0	0	0.14	0	0	0	0	0	0	0	0.66	0
Sierra Leone	30	0	0	0	0	0	0	0	0	0	0	0	0.8	0	0	0
Singapore	42	0.73	0	0	0	0.06	0.11	0	0	0.05	0.03	0	0	0	0	0
Slovakia	14	0.05	0.89	0	0	0	0	0	0	0	0	0	0	0	0	0
Somalia	152	0	0	0	0	0	0	0	0	0	0	0	0.96	0.01	0	0
Nevis	15	0	0	0.18	0	0	0	0	0	0	0	0.62	0	0	0	0
St Lucia	19	0	0	0	0	0	0	0	0	0	0	0.88	0	0	0	0
Sudan	22	0	0	0	0	0	0	0	0	0	0	0	0.51	0	0.35	0
Sweden	19	0	0.86	0	0	0	0	0	0	0	0	0	0	0	0	0
Switzerland	10	0.35	0.59	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanzania	32	0	0	0	0	0	0.69	0	0	0	0.16	0	0.11	0	0	0
Thailand	37	0	0	0	0	0.18	0	0	0	0	0.78	0	0	0	0	0
the Netherlands	21	0.23	0.76	0	0	0	0	0	0	0	0	0	0	0	0	0
Trinidad and Tobago	39	0.27	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0.1
Ukraine	14	0	0.98	0	0	0	0	0	0	0	0	0	0	0	0	0
Vietnam	26	0	0	0	0	0	0	0	0	0.33	0.67	0	0	0	0	0
Yemen	17	0	0	0	0	0	0.17	0	0	0	0	0	0	0	0.5	0
Zambia	35	0.45	0	0	0.06	0	0.13	0	0	0	0	0	0.2	0	0	0
Zimbabwe	126	0.22	0.1	0	0.07	0	0.02	0	0	0	0	0	0.53	0	0	0.03
the Caribbean	62	0.29	0.09	0	0	0	0	0	0	0	0	0.58	0	0	0	0

Continued/….

…/Continued (for category labels see start of table)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Middle East	39	0.26	0	0	0	0	0.09	0	0	0	0	0	0	0	0.42	0
Far East	10	0	0	0	0	0.17	0	0	0	0.15	0.24	0	0	0	0	0
West Africa	17	0	0	0	0.13	0	0	0	0	0	0	0	0.69	0	0	0
East Africa	110	0.1	0	0	0	0	0.52	0	0	0	0.04	0	0.27	0.02	0	0.02
other Africa	15	0.47	0	0	0	0	0	0	0	0	0	0	0.21	0	0.11	0
South & Latin America	29	0.31	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0.32
Western Europe (other)	28	0.65	0.35	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Europe	31	0.11	0.85	0	0	0	0	0	0	0	0	0	0	0	0	0
not elsewhere codable	14	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0

Note: White British/Irish includes white British, white Irish, gypsy or Irish traveller. Frequencies unweighted. Proportions weighted using analysis weights. Rows do not always sum to 1 due to suppression of proportions based on counts below 3.

Table 28 Descriptive statistics for analysis sample for non-contact model, by time spent in the UK (proportions)

		>10 yrs	7-10 yrs	4-6 yrs	0-3 yrs	Migrants	UK born	Total	n
Wave 2 outcome	Lives in non-contacted hh	0.06	0.15	0.17	0.27	0.12	0.05	0.06	38,207
Time spent in UK	>10 years					0.58			7,832
	7-10 years					0.14			
	4-6 years					0.14			
	0-3 years					0.14			
Index of Multiple Deprivation (quintiles)	1st quintile (most deprived)	0.26	0.34	0.32	0.29	0.28	0.17	0.19	38,207
	2nd quintile	0.22	0.23	0.31	0.25	0.24	0.19	0.19	
	3rd quintile	0.19	0.15	0.17	0.18	0.18	0.21	0.20	
	4th quintile	0.15	0.14	0.12	0.16	0.15	0.22	0.21	
	5th quintile (least deprived)	0.17	0.13	0.07	0.11	0.14	0.21	0.20	
London	Lives in London	0.33	0.38	0.31	0.36	0.34	0.08	0.11	38,207
Dwelling type	detached house	0.20	0.11	0.07	0.07	0.15	0.26	0.25	38,207
	semi-detached/terraced	0.60	0.55	0.53	0.51	0.57	0.62	0.61	
	flat	0.19	0.32	0.37	0.37	0.26	0.10	0.12	
	other (e.g. bedsit)	0.01	0.01	0.01	0.02	0.01	0.01	0.01	
	missing on ARF	0.01	0.02	0.03	0.04	0.02	0.01	0.01	
Age	16-19 yrs	0.02	0.06	0.06	0.06	0.04	0.07	0.06	38,207
	20-29 yrs	0.08	0.22	0.37	0.50	0.20	0.14	0.15	
	30-39 yrs	0.17	0.48	0.40	0.29	0.26	0.16	0.17	
	40-59 yrs	0.44	0.23	0.16	0.14	0.33	0.35	0.35	
	60-69 yrs	0.15	0.15	0.01	0.01	0.09	0.15	0.15	
	70+ yrs	0.13	0.04	0.00	0.01	0.08	0.13	0.13	

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		>10 yrs	7-10 yrs	4-6 yrs	0-3 yrs	Migrants	UK born	Total	n
Household type (dummies)	One person household	0.16	0.11	0.08	0.10	0.13	0.15	0.15	38,207
	2 or more adults, no couple	0.09	0.12	0.12	0.22	0.12	0.07	0.08	
Economic activity	unemployed	0.05	0.08	0.06	0.10	0.06	0.06	0.06	38,204
At least 1 person in hh receives benefits		0.43	0.41	0.39	0.26	0.40	0.43	0.43	38,059
Household income	in top 25% of distribution	0.27	0.26	0.21	0.21	0.25	0.24	0.25	38,207
# calls until first contact (mean)		3.9	4.2	4.4	4.4	4.1	4.0	4.0	37,124
At least 1 person in hh has stable contact details		0.28	0.23	0.22	0.25	0.25	0.38	0.37	38,129
Interviewer	Changed between waves	0.51	0.50	0.53	0.54	0.51	0.41	0.42	38,207
Partially responding hh at wave 1		0.31	0.27	0.29	0.25	0.30	0.26	0.27	38,207
Cooperation	fair or worse	0.08	0.06	0.06	0.06	0.07	0.03	0.03	38,091
Tenure	owned	0.69	0.39	0.25	0.15	0.51	0.72	0.69	38,095
	LA rented	0.18	0.20	0.12	0.08	0.16	0.16	0.16	
	private rented, unfurnished	0.07	0.19	0.30	0.23	0.14	0.08	0.09	
	private rented, furnished	0.05	0.19	0.32	0.49	0.17	0.03	0.05	
	other	0.01	0.03	0.02	0.05	0.02	0.01	0.01	
Residential mobility between wave 1 and 2	Did not move	0.92	0.78	0.73	0.62	0.83	0.90	0.90	38,207
	Whole hh mover	0.05	0.17	0.20	0.30	0.13	0.06	0.07	
	Split household mover	0.01	0.02	0.04	0.06	0.02	0.02	0.02	
	Move status undetermined	0.02	0.02	0.03	0.03	0.02	0.01	0.01	

Note: All variables measured at wave 1, apart from dwelling type and survey outcome at wave 2; and interviewer change and residential mobility, which represent change between waves 1 and 2. Design-weighted estimates.

Table 29 Descriptive statistics for analysis sample for refusal model (proportions)

		>10 yrs	7-10 yrs	4-6 yrs	0-3 yrs	Migrants	UK born	Total
Wave 2 outcome	refusal	0.17	0.14	0.11	0.10	0.16	0.14	0.14
Time spent in UK	>10 years					0.53		
	7-10 years					0.16		
	4-6 years					0.16		
	0-3 years					0.15		
Ethnic-religious background	white Christian	0.46	0.33	0.40	0.41	0.33	0.79	0.75
	black Caribbean	0.05	0.02	0.02	0.00	0.05	0.01	0.01
	Asian Christian	0.03	0.08	0.08	0.04	0.06	0.00	0.01
	black African	0.06	0.19	0.13	0.09	0.11	0.00	0.01
	Arab Muslim	0.02	0.03	0.03	0.03	0.03	0.00	0.00
	Indian Muslim	0.03	0.03	0.02	0.02	0.03	0.00	0.00
	Pakistani	0.06	0.05	0.05	0.05	0.07	0.00	0.01
	Bangladeshi	0.02	0.02	0.02	0.02	0.03	0.00	0.00
	Indian Hindu	0.08	0.07	0.07	0.11	0.10	0.00	0.01
	Indian Sikh	0.03	0.01	0.01	0.01	0.03	0.00	0.00
	Chinese or Buddhist	0.03	0.05	0.04	0.06	0.04	0.00	0.01
	any other	0.13	0.13	0.13	0.15	0.11	0.19	0.18
English language	first language	0.57	0.29	0.18	0.20	0.32		
	no difficulties	0.38	0.65	0.68	0.57	0.58		
	difficulties	0.05	0.06	0.13	0.21	0.10		
	no English	0.01	0.00	0.00	0.01	0.01		
Location	London	0.30	0.35	0.28	0.31	0.35	0.06	0.08
Gender	Female	0.56	0.61	0.54	0.55	0.57	0.56	0.56

Continued/….

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		>10 yrs	7-10 yrs	4-6 yrs	0-3 yrs	Migrants	UK born	Total
Age	16-19 yrs	0.02	0.05	0.06	0.06	0.03	0.06	0.05
	20-29 yrs	0.07	0.18	0.34	0.43	0.18	0.12	0.12
	30-39 yrs	0.17	0.49	0.42	0.34	0.29	0.15	0.16
	40-59 yrs	0.44	0.26	0.18	0.16	0.34	0.36	0.36
	60-69 yrs	0.15	0.02	0.01	0.01	0.09	0.16	0.16
	70+ yrs	0.14	0.00	0.00	0.00	0.07	0.15	0.14
Highest educational qualification	none	0.26	0.17	0.18	0.16	0.24	0.29	0.28
	GCSE or lower	0.23	0.14	0.18	0.15	0.18	0.33	0.32
	A-level	0.21	0.26	0.24	0.21	0.21	0.19	0.19
	degree	0.30	0.42	0.40	0.49	0.37	0.19	0.20
Level of political interest	none	0.23	0.28	0.34	0.39	0.29	0.25	0.25
	not very	0.29	0.30	0.30	0.23	0.29	0.29	0.29
	fairly	0.35	0.31	0.26	0.26	0.31	0.35	0.35
	very	0.13	0.10	0.09	0.11	0.11	0.10	0.10
Benefit receipt (excl. child benefits and pensions)	none	0.55	0.51	0.58	0.79	0.57	0.60	0.59
	1 type	0.21	0.22	0.17	0.10	0.19	0.18	0.18
	2 or more types	0.24	0.27	0.24	0.11	0.24	0.23	0.23
Hh income	in bottom 25% of distribution	0.26	0.19	0.19	0.24	0.25	0.24	0.24
Interviewer	Change between waves	0.47	0.46	0.49	0.48	0.49	0.39	0.40
Partially responding hh at wave 1		0.28	0.23	0.25	0.21	0.27	0.24	0.24
Respondent suspicious of survey		0.21	0.20	0.16	0.14	0.21	0.13	0.14

Note: All variables measured at wave 1, apart from survey outcome at wave 2. Design-weighted.

B Appendix: Chapter 3

B.1 Classifying countries of birth by how likely UK residents of it arrived as asylum seekers

African immigrants are grouped into three categories based on the estimated likelihood of having come to the UK as a refugee/asylum seeker. This likelihood is based on statistics of asylum seeker applications by country of birth of the years 1985 to 2012 (Constable 2002; 2013), and the total stock of people by country of birth in the Census for England and Wales 2011 (or 2001 if not available for 2011). From this we calculated the estimated proportion of refugees amongst the total stock from a given country of birth. Countries with an estimated proportion of refugees of up to 5 percent are classified as low risk countries; countries with an estimated proportion over 5 and up to 20 percent as medium risk, and countries with an estimated proportion of refugees over 20 percent as high risk.

Some countries for which there was no denominator data available had to be classified by researching if there were any major conflicts in the time period or based only on the absolute number of asylum seeker applications (Benin, Burundi, Liberia, Senegal, Rwanda and Togo).

The classification is as follows:

Low risk (n=152): Benin, Cameroon, Gambia, Guinea, Guinea-Bissau, Ivory Coast, Kenya, Malawi, Morocco, Namibia, South Africa, Tanzania, Zambia, Zimbabwe.

Medium risk (n=270): Burundi, Ghana, Liberia, Nigeria, Rwanda, Senegal, Sierra Leone, Sudan, Togo and Uganda.

High risk (n=139): Angola, Democratic Republic of Congo, Ethiopia, Eritrea and Somalia.

B.2 SF-12 v2 questionnaire items with response options

General Health

1. In general, would you say your health is…?

Excellent – very good – good – fair – poor

Physical Functioning

Now I'm going to read a list of activities that you might do during a typical day. As I read each item, please tell me if your health now limits you a lot, limits you a little, or does not limit you at all in these activities.

2a. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf

Does your health now limit you a lot, limit you a little or not limit you at all?

2b. Climbing several flights of stairs

Does your health now limit you a lot, limit you a little or not limit you at all?

Role Physical

The following two questions ask you about your physical health and your daily activities. During the past 4 weeks, how much of the time

3a. Have you accomplished less than you would like as a result of your physical health?

3b. Were limited in the kind of work or other activities as a result of your physical health?

All of the time-None of the time (5)

Role Emotional

The following two questions ask about your emotions and your daily activities. During the past 4 weeks, how much of the time

4a. have you Accomplished less than you would like as a result of any emotional problems (such as feeling depressed or anxious)?

4b. did you work or other regular daily activities less carefully than usual as a result of any emotional problems, such as feeling depressed or anxious?

All of the time-None of the time (5)

Bodily Pain

5. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework) ? Did it interfere...

Not at all – extremely (5)

Mental Health

The next questions are about how you feel and how things have been with you during the past 4 weeks. As I read each statement, please give me the one answer that comes closest to the way you have been feeling, using the showcard. How much of the time during the past 4 weeks…

6a. Have you felt calm and peaceful?

6c. Have you felt downhearted and depressed?

All of the time-None of the time (5)

Vitality

6b. Did you have a lot of energy?

All of the time-None of the time (5)

Social Functioning

7. How much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)

All of the time-None of the time (5)

B.3 Figures and tables

Table 30 Descriptive statistics for analytical sample, by country of birth: Gender, age at migration, age and year of arrival

Country of birth	Freq.	Percent	Female	Age at migration		Age		Year of arrival	
				mean	(min-max)	Mean	(min - max)	mean	(min - max)
United Kingdom	17,856	83.63	0.5			36	(21-49)		
Republic of Ireland	54	0.25	0.61	26	(18-45)	32	(23-49)	2003	(1995-2010)
France	54	0.25	0.41	26	(18-40)	32	(21-49)	2004	(1995-2010)
Germany	34	0.16	0.76	28	(18-45)	32	(21-49)	2004	(1995-2009)
Italy	30	0.14	0.37	27	(18-35)	31	(25-45)	2005	(1995-2009)
Spain	27	0.13	0.37	27	(20-35)	32	(25-45)	2004	(1995-2010)
Poland	273	1.28	0.47	26	(18-45)	30	(22-49)	2005	(1995-2010)
Turkey	44	0.21	0.31	25	(18-40)	32	(25-49)	2002	(1994-2010)
Australia	30	0.14	0.53	28	(18-40)	33	(25-45)	2004	(1995-2009)
New Zealand	18	0.08	0.47	28	(20-35)	35	(30-45)	2002	(1995-2010)
Canada	16	0.07	0.85	29	(20-40)	34	(25-49)	2004	(1995-2010)
United States of America	56	0.26	0.55	29	(19-45)	34	(22-49)	2004	(1997-2010)
China/Hong Kong	112	0.52	0.55	27	(18-45)	31	(21-49)	2005	(1995-2010)
India	508	2.38	0.36	27	(18-49)	32	(21-49)	2005	(1994-2010)
Pakistan	310	1.45	0.37	27	(18-45)	33	(21-49)	2003	(1994-2010)
Bangladesh	264	1.24	0.31	26	(18-45)	32	(21-49)	2003	(1994-2010)
Sri Lanka	115	0.54	0.44	30	(18-45)	36	(21-49)	2003	(1994-2010)
Kenya	27	0.13	0.57	25	(18-40)	32	(21-49)	2002	(1995-2010)
Ghana	80	0.37	0.56	30	(18-45)	36	(21-49)	2002	(1995-2010)
Nigeria	150	0.7	0.41	29	(18-45)	35	(21-48)	2004	(1994-2010)

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Country of birth	Freq.	Percent	Female	Age at migration Mean	Age at migration (min-max)	Age Mean	Age (min-max)	Year of arrival Mean	Year of arrival (min-max)
South Africa	84	0.39	0.4	28	(18-40)	34	(25-49)	2003	(1996-2008)
Jamaica	52	0.24	0.47	27	(18-40)	36	(25-49)	2001	(1995-2010)
Afghanistan	21	0.1	0.38	27	(18-35)	35	(21-45)	2001	(1995-2010)
Algeria	17	0.08	0.5	32	(18-45)	38	(30-49)	2003	(1995-2010)
Angola	14	0.07	0.68	25	(18-40)	34	(25-49)	2000	(1995-2005)
Brazil	26	0.12	0.54	26	(18-35)	31	(21-45)	2005	(2000-2009)
Bulgaria	13	0.06	0.55	27	(20-40)	30	(21-49)	2005	(1995-2010)
Czech Republic/Czechoslovakia	17	0.08	0.65	25	(18-40)	30	(21-40)	2004	(1995-2010)
Democratic Republic of Congo	27	0.13	0.56	27	(18-40)	34	(25-49)	2002	(1995-2010)
Eritrea	17	0.08	0.42	25	(20-40)	30	(25-45)	2005	(1995-2010)
Ethiopia	12	0.06	0.37	28	(20-40)	36	(21-49)	2001	(1995-2010)
Gambia	10	0.05	0.39	28	(18-35)	33	(25-45)	2003	(1995-2005)
Greece	15	0.07	0.31	23	(18-40)	28	(21-45)	2004	(1995-2010)
Hungary	21	0.1	0.49	29	(18-45)	31	(21-49)	2006	(1995-2010)
Indonesia	10	0.05	0.73	28	(20-35)	32	(25-40)	2005	(1995-2010)
Iran	23	0.11	0.33	28	(18-40)	33	(21-45)	2004	(1995-2009)
Iraq	22	0.1	0.4	27	(18-35)	34	(21-49)	2003	(1995-2010)
Japan	13	0.06	0.86	34	(20-45)	39	(30-49)	2004	(1995-2010)
Latvia	11	0.05	0.59	25	(18-35)	29	(21-35)	2005	(2000-2010)
Lithuania	32	0.15	0.45	25	(18-40)	32	(21-49)	2003	(1995-2010)
Malawi	12	0.06	0.38	26	(20-30)	36	(25-45)	2000	(1995-2005)
Malaysia	40	0.19	0.5	25	(18-40)	31	(21-45)	2003	(1995-2010)

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	Freq.	**Percent**	**female**	**Age at migration**		**Age**		**Year of arrival**	
Country of birth				Mean	(min-max)	Mean	(min-max)	Mean	(min-max)
Mauritius	18	0.08	0.55	30	(20-45)	37	(25-49)	2002	(1995-2005)
Nepal	21	0.1	0.24	26	(18-40)	29	(21-45)	2006	(1995-2009)
Philippines	60	0.28	0.59	30	(18-42)	34	(25-49)	2005	(2000-2010)
Portugal	30	0.14	0.5	28	(18-40)	34	(21-45)	2003	(1995-2009)
Romania	21	0.1	0.73	30	(20-45)	35	(21-49)	2005	(1995-2010)
Russia	21	0.1	0.79	27	(18-35)	36	(25-45)	2001	(1995-2010)
Saudi Arabia	14	0.07	0.37	28	(20-40)	29	(21-40)	2007	(2000-2008)
Rwanda	14	0.07	0.41	29	(18-35)	36	(30-45)	2002	(1995-2010)
Slovakia	19	0.09	0.72	24	(18-30)	28	(21-35)	2004	(2000-2010)
Somalia	79	0.37	0.57	29	(18-45)	37	(21-49)	2001	(1995-2008)
Sudan	19	0.09	0.52	30	(20-40)	36	(25-45)	2002	(1995-2010)
Sweden	10	0.05	0.86	23	(18-30)	31	(25-40)	2001	(1995-2010)
Thailand	31	0.15	0.93	29	(18-45)	34	(25-49)	2005	(1995-2009)
the Netherlands	11	0.05	0.36	28	(18-40)	33	(25-45)	2003	(1995-2010)
Trinidad and Tobago	11	0.05	0.66	30	(20-40)	35	(21-45)	2004	(2000-2007)
Ukraine	11	0.05	0.9	28	(20-35)	35	(25-40)	2002	(1995-2008)
Zambia	10	0.05	0.73	28	(22-40)	34	(25-45)	2003	(1995-2005)
Zimbabwe	92	0.43	0.54	28	(18-45)	36	(21-49)	2001	(1995-2010)
the Caribbean	31	0.15	0.49	27	(18-45)	34	(25-49)	2002	(1995-2010)
Middle East	35	0.16	0.34	28	(18-45)	33	(21-45)	2004	(1995-2010)
Far East	32	0.15	0.38	29	(18-40)	35	(25-49)	2004	(1995-2010)
West Africa	28	0.13	0.53	27	(18-45)	35	(25-45)	2001	(1995-2010)
East Africa	35	0.16	0.48	27	(20-40)	34	(21-45)	2003	(2000-2010)

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Country of birth	Freq.	Percent	Female	Age at migration Mean	(min-max)	Age Mean	(min-max)	Year of arrival Mean	(min-max)
other Africa	23	0.11	0.5	29	(20-40)	35	(21-45)	2003	(1995-2009)
South & Latin America	20	0.09	0.54	29	(20-40)	34	(25-49)	2004	(1995-2010)
Western Europe (other)	46	0.22	0.55	28	(18-45)	32	(21-49)	2004	(1995-2010)
Eastern Europe	29	0.14	0.56	27	(18-35)	33	(21-49)	2003	(1995-2010)
not elsewhere codable	12	0.06	0.7	27	(20-35)	30	(21-40)	2006	(2000-2010)
total	21,350	100							

Note: Absolute and relative frequencies unweighted, all other statistics weighted using analysis weights. Countries of birth have been grouped to cells of at least 3 observations to prevent disclosure. Minima and maxima rounded to nearest 5 or (for age at arrival and age to minimum/maximum age at arrival/age as defined by analysis sample) if underlying cell count below 3.

Table 31 Descriptive statistics for analytical sample, by country of birth: Religion, whether a full-time student

		Christian	Muslim	Hindu	Sikh	Buddhist	Jewish	none/other	student
United Kingdom	17,856	0.7	0.02	0.01	0.01	0	0	0.27	0.03
Republic of Ireland	54	0.94	0	0	0	0	0	0	0.09
France	54	0.6	0.07	0	0	0	0	0.32	0.13
Germany	34	0.59	0	0	0	0	0	0.33	0.12
Italy	30	0.89	0	0	0	0	0	0.11	0.17
Spain	27	0.88	0	0	0	0	0	0.11	0
Poland	273	0.92	0	0	0	0	0	0.07	0.04
Turkey	44	0	0.93	0	0	0	0	0.06	0
Australia	30	0.65	0	0	0	0	0	0.35	./.
New Zealand	18	0.64	0	0	0	0	0	0.36	./.
Canada	16	0.65	0	0	0	0	0	0.25	0
United States of America	56	0.83	0	0	0	0	0	0.12	0.18
China/Hong Kong	112	0.15	0	0	0	0.17	0	0.65	0.46
India	508	0.17	0.09	0.6	0.12	0	0	0.02	0.12
Pakistan	310	0.02	0.98	0	0	0	0	0	0.05
Bangladesh	264	0	0.96	0.03	0	0	0	0	0.2
Sri Lanka	115	0.15	0.06	0.42	0	0.37	0	0	0.1
Kenya	27	0.64	0.08	0	0	0	0	0.11	0.09
Ghana	80	0.96	0	0	0	0	0	0.04	0.15
Nigeria	150	0.77	0.16	0	0	0	0	0.07	0.18
South Africa	84	0.82	0.02	0	0	0	0	0.14	./.
Jamaica	52	0.92	0	0	0	0	0	0.08	0.1
Afghanistan	21	0	0.61	0	0	0	0	0.2	./.

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		Christian	Muslim	Hindu	Sikh	Buddhist	Jewish	None/other	student
Algeria	17	0	1	0	0	0	0	0	0.24
Angola	14	0.74	0	0	0	0	0	0	./.
Brazil	26	0.93	0	0	0	0	0	0	0
Bulgaria	13	0.31	0.38	0	0	0	0	0.32	0
Czech Republic/Czechoslovakia	17	0.52	0	0	0	0	0	0.48	0.11
Democratic Republic of Congo	27	0.9	0	0	0	0	0	0	0.16
Eritrea	17	0.77	0.23	0	0	0	0	0	0.08
Ethiopia	12	0.82	0	0	0	0	0	0	0.11
Gambia	10	0	0.9	0	0	0	0	0	0
Greece	15	0.57	0	0	0	0	0	0.43	0.52
Hungary	21	0.8	0	0	0	0	0	0.2	0.06
Indonesia	10	0.48	0.35	0	0	0	0	0	0.14
Iran	23	0	0.84	0	0	0	0	0	0.17
Iraq	22	0	1	0	0	0	0	0	./.
Japan	13	0	0	0	0	0.37	0	0.63	./.
Latvia	11	0.33	0	0	0	0	0	0.67	0
Lithuania	32	0.81	0	0	0	0	0	0.19	0
Malawi	12	0.93	0	0	0	0	0	0	0
Malaysia	40	0.3	0.3	0.04	0	0.28	0	0.08	0.39
Mauritius	18	0	0	0.86	0	0	0	0	0.16
Nepal	21	0	0	0.86	0	0	0	0	0.56
Philippines	60	0.96	0	0	0	0	0	0	0.12
Portugal	30	0.8	0	0	0	0	0	0.2	0
Romania	21	0.86	0	0	0	0	0	0.14	0.18

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Country of birth		Christian	Muslim	Hindu	Sikh	Buddhist	Jewish	None/other	Student
Russia	21	0.61	0	0	0	0	0	0.39	./.
Saudi Arabia	14	0	1	0	0	0	0	0	0.82
Rwanda	14	0.45	0.55	0	0	0	0	0	./.
Slovakia	19	0.89	0	0	0	0	0	0	./.
Somalia	79	0	0.96	0	0	0	0	0	0.06
Sudan	19	0	0.97	0	0	0	0	0	0
Sweden	10	0.45	0	0	0	0	0	0.46	./.
Thailand	31	0	0	0	0	0.91	0	0	0.06
the Netherlands	11	0.61	0	0	0	0	0	0.36	0
Trinidad and Tobago	11	0.69	0	0	0	0	0	0	0.33
Ukraine	11	0.76	0	0	0	0	0	0.24	0
Zambia	10	0.88	0	0	0	0	0	0	./.
Zimbabwe	92	0.85	0.04	0	0	0	0	0.12	0.11
the Caribbean	31	0.88	0	0	0	0	0	0.12	./.
Middle East	35	0.13	0.77	0	0	0	0.08	0	0.1
Far East	32	0.2	0	0.13	0	0.36	0	0.23	0.29
West Africa	28	0.72	0.24	0	0	0	0	0	0.15
East Africa	35	0.65	0.11	0.02	0.12	0	0	0	0.11
other Africa	23	0.15	0.7	0	0	0	0	0	0.14
South & Latin America	20	0.95	0	0	0	0	0	0	0.42
Western Europe (other)	46	0.65	0.05	0	0	0	0	0.29	0.17
Eastern Europe	29	0.49	0.32	0	0	0	0	0.18	0.13
not elsewhere codable	12	0.64	0	0	0	0	0	0.19	./.

Note: Frequencies unweighted, proportions weighted using analysis weights. Countries of birth have been grouped to groups of at least 8 observations and cells based on less than 3 have been set to 0 (for religion) or suppressed (for student status) to prevent disclosure. Also, for religion the category missing is suppressed.

Table 32 Descriptive statistics of analytical sample: Ethnicity (proportion)

	n	1 - White British/Irish	2 - Other White	3 - White and black Caribbean	4 - White and black African	5 - White and Asian	6 Indian	7 - Pakistani	8 - Bangladeshi	9 - Chinese	10 - Any other Asian	11 - Caribbean	12 - African	13 - Any other black	14 - Arab	15 - Any other
United Kingdom	17,856	0.94	0.01	0	0	0	0.01	0.01	0	0	0	0.01	0	0	0	0
Republic of Ireland	54	0.97	0	0	0	0	0	0	0	0	0	0	0	0	0	0
France	54	0	0.94	0	0	0	0	0	0	0	0	0	0.01	0	0	0
Germany	34	0.02	0.9	0	0	0	0	0	0	0	0	0	0	0	0	0
Italy	30	0	0.93	0	0	0	0	0	0	0	0	0	0	0	0	0
Spain	27	0	0.95	0	0	0	0	0	0	0	0	0	0	0	0	0
Poland	273	0	0.99	0	0	0	0	0	0	0	0	0	0	0	0	0
Turkey	44	0.18	0.52	0	0	0	0	0	0	0	0	0	0	0	0	0.26
Australia	30	0.13	0.85	0	0	0	0	0	0	0	0	0	0	0	0	0
New Zealand	18	0.16	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0
Canada	16	0	0.85	0	0	0	0	0	0	0	0	0	0	0	0	0
United States of America	56	0	0.8	0	0	0	0	0	0	0	0	0	0	0.02	0	0.04
China/Hong Kong	112	0	0	0	0	0	0	0	0	0.95	0	0	0	0	0	0
India	508	0	0	0	0	0	0.99	0	0	0	0	0	0	0	0	0
Pakistan	310	0	0	0	0	0	0	0.98	0	0	0	0	0	0	0	0
Bangladesh	264	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Sri Lanka	115	0	0	0	0	0	0.07	0	0	0	0.88	0	0	0	0	0.02
Kenya	27	0	0	0	0	0	0.28	0	0	0	0	0	0.45	0	0	0

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Country of birth		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ghana	80	0	0	0	0.08	0	0	0	0	0	0	0	0.92	0	0	0
Nigeria	150	0	0	0	0.02	0	0.02	0	0	0	0	0	0.94	0	0	0
South Africa	84	0.24	0.58	0	0.02	0	0.03	0	0	0	0	0	0.07	0	0	0.04
Jamaica	52	0	0	0	0	0	0	0	0	0	0	0.96	0	0	0	0
Afghanistan	21	0	0	0	0	0	0.13	0	0	0	0.54	0	0	0	0	0
Algeria	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0.79	0
Angola	14	0	0	0	0.4	0	0	0	0	0	0	0	0.6	0	0	0
Brazil	26	0	0.91	0	0	0	0	0	0	0	0	0	0	0	0	0.08
Bulgaria	13	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Czech Republic/Czechoslovakia	17	0	0.82	0	0	0	0	0	0	0	0	0	0	0	0	0
Democratic Republic of Congo	27	0	0	0	0	0	0	0	0	0	0	0	0.98	0	0	0
Eritrea	17	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Ethiopia	12	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Gambia	10	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Greece	15	0	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0.15
Hungary	21	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Indonesia	10	0	0	0	0	0	0	0	0	0	0.64	0	0	0	0	0
Iran	23	0	0	0	0	0.15	0	0	0	0	0.27	0	0	0	0.52	0
Iraq	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0.54	0.19
Japan	13	0	0	0	0	0	0	0	0	0	0.97	0	0	0	0	0
Latvia	11	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Lithuania	32	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Malawi	12	0	0	0	0	0	0	0	0	0	0	0	0.63	0	0	0

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Country of birth		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Malaysia	40	0	0	0	0	0	0.06	0	0	0.45	0.44	0	0	0	0	0
Mauritius	18	0	0	0	0	0	0.31	0	0	0	0.15	0	0	0	0	0.54
Nepal	21	0	0	0	0	0	0	0	0	0	0.95	0	0	0	0	0
Philippines	60	0	0	0	0	0	0	0	0	0	0.96	0	0	0	0	0
Portugal	30	0	0.84	0	0	0	0	0	0	0	0	0	0	0	0	0
Romania	21	0	0.76	0	0	0	0	0	0	0	0	0	0	0	0	0.2
Russia	21	0	0.92	0	0	0	0	0	0	0	0	0	0	0	0	0
Saudi Arabia	14	0	0	0	0	0	0.04	0	0	0	0	0	0	0	0.96	0
Rwanda	14	0	0	0	0	0	0	0	0	0	0	0	0.95	0	0	0
Slovakia	19	0	0.93	0	0	0	0	0	0	0	0	0	0	0	0	0.07
Somalia	79	0	0	0	0	0	0	0	0	0	0	0	0.97	0	0	0
Sudan	19	0	0	0	0	0	0	0	0	0	0	0	0.58	0	0.34	0
Sweden	10	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Thailand	31	0	0	0	0	0.12	0	0	0	0	0.88	0	0	0	0	0
the Netherlands	11	0	0.83	0	0	0	0	0	0	0	0	0	0	0	0	0
Trinidad and Tobago	11	0	0	0	0	0	0	0	0	0	0	0.77	0	0	0	0
Ukraine	11	0	0.98	0	0	0	0	0	0	0	0	0	0	0	0	0
Zambia	10	0	0	0	0.33	0	0	0	0	0	0	0	0.59	0	0	0
Zimbabwe	92	0.11	0.06	0	0.06	0	0	0	0	0	0	0	0.71	0	0	0
the Caribbean	31	0	0	0	0	0	0	0	0	0	0	0.65	0	0	0	0.31
Middle East	35	0	0.08	0	0	0	0.28	0	0	0	0	0	0	0	0.53	0
Far East	32	0	0	0	0	0	0	0	0	0.22	0.68	0	0	0	0	0
West Africa	28	0	0	0	0	0	0	0	0	0	0	0	0.86	0	0	0
East Africa	35	0	0	0	0	0	0.2	0	0	0	0	0	0.72	0	0	0

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Country of birth		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
other Africa	23	0	0	0	0	0	0	0	0	0	0	0	0.18	0	0.61	0
South & Latin America	20	0	0.48	0	0	0	0	0	0	0	0	0	0	0	0	0.45
Western Europe (other)	46	0.08	0.87	0	0	0	0	0.02	0	0	0	0	0	0	0	0
Eastern Europe	29	0.01	0.81	0	0	0	0	0	0	0	0.09	0	0	0	0	0
not elsewhere codable	12	0	0	0	0	0	0	0	0	0	0	0	0.18	0	0	0

Note: White British/Irish includes white British, white Irish, gypsy or Irish traveller. Frequencies unweighted. Proportions weighted using analysis weights. Countries of birth have been grouped to groups of at least 8 observations and cells based on less than 3 have been set to 0 to prevent disclosure.

Table 33 Item missingness for SF-12, by region of origin, ethnicity and years in UK (unweighted)

	Frequency	Percent
UK-born	63	0.4%
High income countries, excl. EU	1	0.6%
EU 14 + Switzerland	1	0.3%
New EU countries	1	0.2%
Low income countries, excl. EU	31	1.2%
Total	97	0.5%

	Frequency	Percent
White	57	0.3%
Caribbean	2	0.4%
African	6	0.9%
Asian (other)	2	0.4%
Pakistani/Bangladeshi	12	1.1%
Indian	10	1.0%
Other	7	0.9%
Total	96	0.4

	Frequency	Percent
UK-born	63	0.4%
11-15 YSM	6	1.0%
5-10 YSM	14	0.9%
0-4 YSM	14	1.0%
Total	97	0.5%

Table 34 Proportion (and 95% confidence interval) in poor health, by ethnicity and immigrant status

	UK-born		**Immigrants**	
Low SF-12 PCS	Proportion	(95% confidence interval)	Proportion	(95% confidence interval)
Ethnic group				
All	0.167	(0.161-0.173)	0.118	(0.102-0.133)
White	0.168	(0.161-0.174)	0.107	(0.08-0.134)
Black African	0.139	(0.075-0.202)	0.112	(0.078-0.145)
Indian	0.115	(0.082-0.147)	0.118	(0.087-0.148)
Bangladeshi/Pakistani	0.207	(0.162-0.252)	0.172	(0.132-0.21)
Pakistani	0.214	(0.162-0.264)	0.175	(0.127-0.222)
Bangladeshi	0.181	(0.087-0.274)	0.163	(0.106-0.22)
poor self-rated health	Proportion	(95% confidence interval)	Proportion	(95% confidence interval)
Ethnic group				
All	0.147	(0.141-0.153)	0.057	(0.047-0.066)
White	0.147	(0.141-0.153)	0.043	(0.029-0.056)
Black African	0.098	(0.038-0.158)	0.060	(0.04-0.079)
Indian	0.117	(0.08-0.154)	0.036	(0.021-0.05)
Bangladeshi/Pakistani	0.149	(0.111-0.187)	0.110	(0.078-0.141)
Pakistani	0.153	(0.106-0.198)	0.116	(0.073-0.157)
Bangladeshi	0.134	(0.066-0.202)	0.095	(0.051-0.139)
chronic condition	Proportion	(95% confidence interval)	Proportion	(95% confidence interval)
Ethnic group				
All	0.222	(0.215-0.228)	0.099	(0.086-0.111)
White	0.222	(0.215-0.229)	0.098	(0.076-0.119)
Black African	0.172	(0.099-0.244)	0.111	(0.081-0.141)
Indian	0.167	(0.122-0.211)	0.085	(0.058-0.111)
Bangladeshi/Pakistani	0.214	(0.166-0.26)	0.119	(0.089-0.148)
Pakistani	0.220	(0.166-0.272)	0.119	(0.082-0.155)
Bangladeshi	0.189	(0.106-0.271)	0.119	(0.069-0.169)

Source: UKHLS, wave 1. Note: ages 21-49, immigrants up to 15 YSM. Weighted.

Table 35 Highest actual educational qualification, by ethnicity and immigrant status, column percentages.

	Overall population			**White**		
	UK-born	*Immi-grants*	*total*	*UK-born*	*Immi-grants*	*total*
no school qualification	5.8	8.8	6.1	6.0	8.3	6.1
up to GCSE qualification	31.5	15.9	29.7	31.9	16.8	31.0
A-levels/below degree level	35.2	24.9	34.0	35.3	26.9	34.7
university degree	27.6	50.4	30.1	26.9	48.0	28.2
	100	100	100	100	100	100
	Black African			**Indian**		
	UK-born	*Immi-grants*	*total*	*UK-born*	*Immi-grants*	*total*
no school qualification	0.6	8.9	7.5	1.2	4.2	2.8
up to GCSE qualification	18.8	16.4	16.8	17.4	10.8	13.8
A-levels/below degree level	28.4	31.9	31.3	31.9	17.4	24.0
university degree	52.3	42.9	44.4	49.6	67.7	59.4
	100	100	100	100	100	100
	Bangladeshi/Pakistani					
	UK-born	*Immi-grants*	*total*			
no school qualification	5.7	16.3	10.8			
up to GCSE qualification	27.9	18.7	23.4			
A-levels/below degree level	31.3	18.6	25.2			
university degree	35.1	46.4	40.6			
	100	100	100			

Note: Population aged 21-49, immigrants up to 15 years since migration, weighted

Table 36 Estimated HIE at 0 YSM (and 95% confidence intervals) using samples with up to 2, 5, 10 and 15 YSM.

	low SF-12 PCS			poor SRH			chronic condition		
	HIE	*lower bound*	*upper bound*	HIE	*lower bound*	*upper bound*	HIE	*lower bound*	*upper bound*
up to 2 YSM	0.038	*-0.04*	*0.12*	0.029	*-0.065*	*0.124*	0.082	*0.025*	*0.138*
up to 5 YSM	0.018	*-0.04*	*0.08*	0.041	*-0.015*	*0.098*	0.076	*0.028*	*0.124*
up to 10 YSM	0.037	*0.00*	*0.07*	0.049	*0.013*	*0.085*	0.098	*0.071*	*0.126*
up to 15 YSM	0.046	*0.02*	*0.07*	0.063	*0.042*	*0.085*	0.095	*0.072*	*0.118*

Note: HIE at 0 years since migration (YSM), for male immigrants, model 2, mean proxy education of immigrant population.

Table 37 Proportion of foreign-born and mean length of residence for selected ethnic group and the total population

Ethnic group	Proportion foreign-born	Unweighted n	mean length of residence among immigrants (years)
White	0.09	18,005	13
Black Caribbean	0.30	637	18
Black African	0.88	1,073	10
Indian	0.62	1,273	12
Pakistan	0.59	1,000	15
Bangladeshi	0.74	842	17
Total	0.16	24,584	13

Note: This table uses not the analysis sample, but the whole sample of UKHLS wave 1 in the age range of 21-49. Weighted.

Table 38 Regression models of low SF-12 PCS

		M1	M2	M3
Immigrant[1]		0.233**	0.134**	
		(0.089)	(0.061)	
Region of origin[1]	high income non-EU countries			0.097
				(0.139)
	EU14/EEA countries			0.075**
				(0.050)
	new EU countries			0.061**
				(0.053)
	low income non-EU countries			0.073*
				(0.079)
Years since migration (YSM, 0 for UK-born)		1.134**	1.142**	1.182+
		(0.052)	(0.052)	(0.116)
YSM* High income non-EU countries				1.135
				(0.144)
YSM * EU14/EEA countries				1.026
				(0.095)
YSM * new EU countries				0.956
				(0.101)
Age		1.033**	1.030**	1.030**
		(0.003)	(0.003)	(0.003)
Female[3]		1.278**	1.272**	1.272**
		(0.058)	(0.058)	(0.058)
Female*immigrant		4.182**	4.316**	
		(1.877)	(1.965)	
Female* High income non-EU countries				18.462**
				(18.078)
Female * EU14/EEA				10.893**
				(7.231)
Female * New EU countries				3.428*
				(1.735)
Female * low income non-EU countries				8.878*
				(7.936)
Female * YSM		0.858*	0.856*	0.799**
		(0.053)	(0.052)	(0.049)
Parents' highest qualification[3]	School qualification		0.872*	0.872*
			(0.050)	(0.050)
	Post-school qualification		0.853**	0.853**
			(0.051)	(0.051)
	University qualification		0.772**	0.772**
			(0.068)	(0.068)
Parental qualification: school * immigrant			2.415*	
			(0.975)	
Parental qualification: post-school * immigrant			1.263	
			(0.500)	
Parental qualification: university* immigrant			1.067	
			(0.436)	

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Parental qualification: school * high income non-EU countries			1.229
			(1.359)
Parental qualification: school * EU14/EEA countries			2.014
			(1.218)
Parental qualification: school * new EU countries			6.447*
			(5.113)
Parental qualification: school * low income non-EU countries			2.282
			(1.997)
Parental qualification: post-school * high income non-EU countries			0.454
			(0.448)
Parental qualification: post-school * EU14/EEA countries			0.469
			(0.336)
Parental qualification: post-school *new EU countries			7.135*
			(5.717)
Parental qualification: post-school * low income non-EU countries			0.555
			(0.547)
Parental qualification: university* high income non-EU countries			0.073*
			(0.080)
Parental qualification: university*EU14/EEA countries			0.848
			(0.598)
Parental qualification: university* new EU countries			5.860*
			(4.975)
Parental qualification: university*low income non-EU countries			1.184
			(1.070)
School leaving age (centered at 16)		0.768**	0.768**
		(0.019)	(0.019)
Immigrant * School leaving age		1.343**	
		(0.137)	
School leaving age * high income non-EU countries			1.358
			(0.607)
School leaving age * EU14/EEA countries			1.324*
			(0.185)
School leaving age * new EU countries			1.338*
			(0.192)
School leaving age * low income non-EU countries			1.349
			(0.475)
Constant	0.055**	0.076**	0.076**
	(0.006)	(0.010)	(0.010)
Observations	16,480	16,480	16,478

** p<0.01, * p<0.05, + p<0.1. Odds ratios. Linearized standard errors in parentheses. Weighted model estimates. Source: UKHLS, wave 1. Note: [1] The reference category is UK-born. [2] The reference is male. [3] The reference category is no qualification.

Table 39 Regression models of poor SRH

		M1	M2	M3
Immigrant[1]		0.134**	0.109**	
		(0.074)	(0.068)	
Region of origin[1]	high income non-EU countries			0.071*
				(0.086)
	EU14/EEA countries			0.136*
				(0.129)
	new EU countries			0.045**
				(0.052)
	low income non-EU countries			0.051*
				(0.073)
Years since migration (YSM, 0 for UK-born)		1.072	1.077	1.161
		(0.086)	(0.086)	(0.154)
YSM * High income non-EU countries				0.912
				(0.131)
YSM * EU14/EEA countries				0.906
				(0.109)
YSM * new EU countries				0.856
				(0.125)
Age		1.027**	1.022**	1.022**
		(0.003)	(0.003)	(0.003)
Female[3]		1.079+	1.065	1.065
		(0.049)	(0.049)	(0.049)
Female*immigrant		2.556	2.612	
		(1.634)	(1.684)	
Female* High income non-EU countries				1.229
				(2.239)
Female * EU14/EEA				5.178
				(5.549)
Female * New EU countries				2.021
				(1.469)
Female * low income non-EU countries				3.139
				(3.810)
Female * YSM		0.945	0.945	0.946
		(0.083)	(0.083)	(0.120)
Parents' highest qualification[3]	School qualification		0.681**	0.681**
			(0.042)	(0.042)
	Post-school qualification		0.599**	0.599**
			(0.039)	(0.039)
	University qualification		0.603**	0.603**
			(0.058)	(0.058)
Parental qualification: school * immigrant			1.324	
			(0.563)	
Parental qualification: post-school * immigrant			1.158	
			(0.527)	
Parental qualification: university* immigrant			1.126	
			(0.513)	

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Parental qualification: school * high income non-EU countries			0.567
			(0.814)
Parental qualification: school * EU14/EEA countries			0.235
			(0.241)
Parental qualification: school * new EU countries			4.932
			(5.228)
Parental qualification: school * low income non-EU countries			4.742
			(4.795)
Parental qualification: post-school * high income non-EU countries			Empty[4]
Parental qualification: post-school * EU14/EEA countries			0.864
			(0.599)
Parental qualification: post-school * new EU countries			4.697
			(5.166)
Parental qualification: post-school * low income non-EU countries			1.452
			(1.586)
Parental qualification: university* high income non-EU countries			Empty[4]
Parental qualification: university* EU14/EEA countries			0.401
			(0.349)
Parental qualification: university* new EU countries			4.687
			(5.456)
Parental qualification: university* low income non-EU countries			2.760
			(2.786)
School leaving age (centered at 16)		0.743**	0.743**
		(0.021)	(0.021)
School leaving age * Immigrant		1.286+	
		(0.179)	
School leaving age * high income non-EU countries			3.622
			(3.108)
School leaving age * EU14/EEA countries			1.205
			(0.279)
School leaving age * new EU countries			1.447*
			(0.248)
School leaving age * low income non-EU countries			1.162
			(0.329)
Constant	0.062**	0.119**	0.119**
	(0.008)	(0.017)	(0.017)
Observations	16,480	16,480	16,404

** p<0.01, * p<0.05, + p<0.1. Odds ratios. Linearized standard errors in parentheses. Weighted model estimates. Source: UKHLS, wave 1. Note: [1] The reference category is UK-born. [2] The reference is male. [3] The reference category is no qualification. [4] Not estimable as 0 predicts failure perfectly.

Table 40 Regression models of diagnosed chronic condition

		M1	M2	M3
Immigrant[1]		0.291*	0.132**	
		(0.140)	(0.074)	
Region of origin[1]	high income non-EU countries			0.196+
				(0.183)
	EU14/EEA countries			0.606
				(0.456)
	new EU countries			0.092**
				(0.057)
	low income non-EU countries			0.220+
				(0.193)
Years since migration (YSM, 0 for UK-born)		1.087	1.083	1.121
		(0.066)	(0.065)	(0.094)
YSM* High income non-EU countries				0.916
				(0.095)
YSM * EU14/EEA countries				0.921
				(0.094)
YSM * new EU countries				1.045
				(0.093)
Age		1.039**	1.038**	1.038**
		(0.003)	(0.003)	(0.003)
Female[2]		1.180**	1.176**	1.177**
		(0.046)	(0.046)	(0.046)
Female*immigrant		1.469	1.408	
		(0.767)	(0.736)	
Female* High income non-EU countries				1.238
				(0.918)
Female * EU14/EEA				0.668
				(0.435)
Female * New EU countries				1.985
				(1.045)
Female * low income non-EU countries				1.960
				(1.372)
Female * YSM		0.914	0.915	0.915
		(0.059)	(0.060)	(0.057)
Parents' highest qualification[3]	School qualification		0.917	0.924
			(0.050)	(0.051)
	Post-school qualification		0.907+	0.922
			(0.051)	(0.051)
	University qualification		0.890	0.935
			(0.070)	(0.071)

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Parental qualification: school * immigrant		1.477	
		(0.668)	
Parental qualification: post-school * immigrant		2.411+	
		(1.096)	
Parental qualification: university* immigrant		3.564**	
		(1.437)	
School leaving age (centered at 16)		0.875**	0.872**
		(0.019)	(0.019)
Immigrant * School leaving age		1.136	
		(0.106)	
School leaving age * high income non-EU countries			1.358
			(1.415)
School leaving age * EU14/EEA countries			1.015
			(0.166)
School leaving age * new EU countries			1.328+*
			(0.211)
School leaving age * low income non-EU countries			0.976
			(0.219)
Constant	0.064**	0.078**	0.077**
	(0.006)	(0.009)	(0.009)
Observations	16,480	16,480	16,478

** p<0.01, * p<0.05, + p<0.1. Odds ratios. Linearized standard errors in parentheses. Weighted model estimates. Source: UKHLS, wave 1. Note: [1] The reference category is UK-born. [2] The reference category is male. [3] The reference category is no qualification.

Table 41 Ethnicity-specific logit models of low SF-12 PCS

	White	Black African	Indian	Bangladeshi / Pakistani
Immigrant[1]	0.134**		0.569	0.219+
	(0.061)		(0.374)	(0.191)
Immigrant from low-risk country[1,2]		0.134		
		(0.199)		
Immigrant from medium-risk country		0.658		
		(0.740)		
Immigrant from high-risk country		1.490		
		(1.437)		
Years since migration (YSM, 0 for UK-born)	1.142**	1.018	0.950	1.109
	(0.052)	(0.074)	(0.072)	(0.078)
Age	1.030**	1.034+	1.047**	1.037*
	(0.003)	(0.021)	(0.018)	(0.018)
Female[3]	1.272**	2.589	1.111	1.740+
	(0.058)	(1.631)	(0.348)	(0.553)
Female * immigrant	4.316**		2.422	2.082
	(1.965)		(1.524)	(2.033)
Female * YSM	0.856*		1.065	0.981
	(0.052)		(0.090)	(0.081)
Parent's highest qualification: school qualification[4]	0.872*	1.125	1.458	0.870
	(0.050)	(0.431)	(0.507)	(0.282)
Parent's highest qualification: post-school qualification	0.853**	0.954	1.814	1.037
	(0.051)	(0.384)	(0.858)	(0.490)
Parent's highest qualification: University degree	0.772**	0.943	0.536	0.715
	(0.068)	(0.361)	(0.345)	(0.420)
Immigrant * Parent's highest qualification: school	2.415*		0.641	0.997
	(0.975)		(0.352)	(0.501)
Immigrant * Parent's highest qualification: post-school	1.263		1.353	0.777
	(0.500)		(0.856)	(0.595)
Immigrant * Parent's highest qualification: University degree	1.067		2.316	1.553
	(0.436)		(1.723)	(1.108)
School leaving age (centered at 16)	0.768**	0.991	0.662**	0.694*
	(0.019)	(0.066)	(0.081)	(0.124)
School leaving age * Immigrant	1.343**		1.312	1.553*
	(0.137)		(0.220)	(0.337)
Immigrant from low-risk country * YSM		1.139		
		(0.157)		
Immigrant from medium-risk country * YSM		0.951		
		(0.109)		
Female * Immigrant from low-risk country		0.629		
		(0.600)		
Female * Immigrant from medium-risk country		1.311		
		(1.057)		
Female * Immigrant from high-risk country		0.773		
		(0.620)		

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Bangladeshi[5]				0.915
				(0.227)
Constant	0.076**	0.030**	0.029**	0.082**
	(0.010)	(0.025)	(0.020)	(0.050)
Observations	22,994	6,952	7,521	7,456

** p<0.01, * p<0.05, + p<0.1 Odds ratios. Linearized standard errors in parentheses. Weighted model estimates. Source: UKHLS, wave 1

Notes: [1] The reference category is UK-born. [2] Risk refers to risk for an immigrant from a given country of birth to have arrived in the UK as an asylum seeker (for more detail see section B.1 in this Appendix). [3] The reference category is male. [4] The reference category is no qualification. [5] The reference category is Pakistani.

Table 42 Ethnicity-specific logit models of poor SRH

	White	Black African	Indian	Bangladeshi / Pakistani
Immigrant[1]	0.109**		0.167*	0.413
	(0.068)		(0.128)	(0.296)
Immigrant from low-risk country[1,2]		0.031**		
		(0.038)		
Immigrant from medium-risk country		0.314		
		(0.273)		
Immigrant from high-risk country		0.178+		
		(0.171)		
Years since migration (YSM, 0 for UK-born)	1.077	1.089	1.036	1.027
	(0.086)	(0.084)	(0.095)	(0.056)
Age	1.022**	1.018	1.023	1.033*
	(0.003)	(0.031)	(0.026)	(0.016)
Female[3]	1.065	1.054	1.485	1.531
	(0.049)	(0.743)	(0.483)	(0.558)
Female * immigrant	2.612		0.907	0.806
	(1.684)		(0.854)	(0.685)
Female * YSM	0.945		1.110	1.101
	(0.083)		(0.116)	(0.076)
Parent's highest qualification: School qualification[4]	0.681**	0.602	0.453+	0.748
	(0.042)	(0.252)	(0.194)	(0.270)
Parent's highest qualification: Post-school qualification	0.599**	0.565	0.848	0.831
	(0.039)	(0.256)	(0.396)	(0.394)
Parent's highest qualification: University degree	0.603**	0.431	0.795	1.168
	(0.058)	(0.235)	(0.463)	(0.653)
Immigrant * Parent's highest qualification: School	1.324		0.782	1.243
	(0.563)		(0.598)	(0.707)
Immigrant * Parent's highest qualification: post-school	1.158		0.793	0.734
	(0.527)		(0.604)	(0.516)
Immigrant * Parent's highest qualification: University degree	1.126		0.649	0.495
	(0.513)		(0.504)	(0.374)
School leaving age (centered at 16)	0.743**	0.908	0.673**	0.806
	(0.021)	(0.071)	(0.103)	(0.115)
School leaving age * Immigrant	1.286+		1.558*	1.322
	(0.179)		(0.335)	(0.238)
Immigrant from low-risk country * YSM		1.250+		
		(0.145)		
Immigrant from medium-risk country * YSM		0.882		
		(0.085)		
Female * Immigrant from low-risk country		2.523		
		(2.521)		
Female * Immigrant from medium-risk country		1.538		
		(1.496)		
Female * Immigrant from high-risk country		2.491		
		(2.525)		

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Bangladeshi[5]				0.882 (0.221)
Constant	0.119** (0.017)	0.112+ (0.138)	0.086* (0.085)	0.067** (0.041)
Observations	22,994	6,952	7,521	7,456

** p<0.01, * p<0.05, + p<0.1 Odds ratios. Linearized standard errors in parentheses. Weighted model estimates. Source: UKHLS, wave 1. Notes see previous table.

Table 43 Ethnicity-specific logit models of diagnosed chronic condition

	White	Black African	Indian	Bangladeshi / Pakistani
Immigrant[1]	0.132**		0.162*	0.243*
	(0.074)		(0.116)	(0.161)
Immigrant from low-risk country[1,2]		0.026*		
		(0.045)		
Immigrant from medium-risk country		0.261*		
		(0.175)		
Immigrant from high-risk country		0.277		
		(0.243)		
Years since migration (YSM, 0 for UK-born)	1.083	1.037	1.213**	1.056
	(0.065)	(0.081)	(0.070)	(0.054)
Age	1.038**	1.071**	1.064**	1.069**
	(0.003)	(0.023)	(0.025)	(0.018)
Female[3]	1.176**	1.075	1.884+	1.412
	(0.046)	(0.574)	(0.632)	(0.468)
Female * immigrant	1.408		2.582	1.320
	(0.736)		(1.888)	(1.030)
Female * YSM	0.915		0.860*	1.051
	(0.060)		(0.061)	(0.078)
Parent's highest qualification: School qualification[4]	0.917	1.730	0.881	1.784
	(0.050)	(0.655)	(0.342)	(0.661)
Parent's highest qualification: Post-school qualification	0.907+	0.841	1.097	1.070
	(0.051)	(0.356)	(0.496)	(0.552)
Parent's highest qualification: University degree	0.890	1.583	0.705	1.696
	(0.070)	(0.625)	(0.386)	(0.793)
Immigrant * Parent's highest qualification: School	1.477		0.491	0.414+
	(0.668)		(0.297)	(0.220)
Immigrant * Parent's highest qualification: post-school	2.411+		0.488	0.449
	(1.096)		(0.347)	(0.340)
Immigrant * Parent's highest qualification: University degree	3.564**		1.192	1.321
	(1.437)		(0.860)	(0.812)
School leaving age (centered at 16)	0.875**	1.053	0.939	0.970
	(0.019)	(0.070)	(0.129)	(0.156)
School leaving age * Immigrant	1.136		1.108	1.258
	(0.106)		(0.197)	(0.255)
Immigrant from low-risk country * YSM		1.243		
		(0.182)		
Immigrant from medium-risk country * YSM		0.993		
		(0.093)		

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Female * Immigrant from low-risk country		3.354		
		(3.269)		
Female * Immigrant from medium-risk country		2.165		
		(1.475)		
Female * Immigrant from high-risk country		3.547		
		(2.820)		
Bangladeshi[5]				1.028
				(0.252)
Constant	0.078**	0.013**	0.022**	0.022**
	(0.009)	(0.011)	(0.022)	(0.014)
Observations	22,994	6,952	7,521	7,456

** p<0.01, * p<0.05, + p<0.1 Odds ratios. Linearized standard errors in parentheses. Weighted model estimates. Source: UKHLS, wave 1. Notes see previous table.

Table 44 Relative effect sizes for poor SRH compared to poor physical functioning

	Ratio poor SRH estimate/SF-12 PCS estimate					
	MALE			FEMALE		
Model	UK-born	immigrants	**HIE**	UK-born	immigrants	**HIE**
1: Age-sex adjusted	1.0	0.6	1.3	0.9	0.3	4.7
2: proxy education						
low proxy education	1.2	0.8	1.4	1.1	0.4	2.6
high proxy education	1.0	0.6	1.3	0.8	0.3	27.6
mean proxy education	1.0	0.6	1.4	0.8	0.3	7.9
3: region						
high income non-EU	1.0	0.6	1.1	0.8	0.1	2.3
EU14		0.6	1.1		0.4	3.0
new EU		0.6	1.6		0.5	4.4
low income non-EU		0.7	1.3		0.3	3.8
Ethnic group models						
White	1.0	0.6	1.1	0.8	0.4	3.7
low risk CoB						
African	1.3	0.3	1.5	0.6	0.5	0.6
medium risk CoB		0.7	2.7		0.3	2.4
high risk CoB		0.2	2.4		0.2	2.5
Indian	1.1	0.3	14.4	1.4	0.1	1.0
Bangladeshi/Pakistani	0.9	1.1	0.8	0.8	0.4	2.9

Note: The table presents the ratio of the predicted probabilities for poor SRH and physical functioning. For example, for the age-sex adjusted HIE for males the ratio is 0.084/0.065 = 1.3.

Table 45 Relative effect sizes for chronic condition compared to poor physical functioning

	Ratio Chronic condition estimate/SF-12 PCS estimate					
	MALE			FEMALE		
Model	UK-born	immigrants	**HIE**	UK-born	immigrants	**HIE**
1: Age-sex adjusted	1.3	0.9	1.6	1.2	0.5	6.0
2: proxy education						
Low	1.2	0.7	1.4	1.1	0.4	2.9
high	1.5	1.4	1.7	1.4	0.8	36.9
mean	1.5	0.9	2.1	1.4	0.5	12.9
3: region						
high income non-EU	1.5	2.8	1.2	1.4	0.6	1.8
EU14		4.2	0.6		0.6	2.2
new EU		0.4	3.7		0.4	10.3
low income non-EU		0.7	2.2		0.5	6.5
Ethnic group models						
White	1.5	1.8	1.4	1.4	0.6	6.1
African low risk CoB	1.5	0.3	1.7	0.7	0.6	0.7
medium risk CoB		0.6	3.2		0.4	2.3
high risk CoB		0.3	2.3		0.6	0.1
Indian	1.4	0.2	20.5	2.2	0.4	1.2
Bangladeshi/Pakistani	1.4	0.8	1.8	1.1	0.4	4.6

Note: The table presents the ratio of the predicted probabilities for poor SRH and physical functioning. For example, for the age-sex adjusted HIE for males the ratio is 0.105/0.065 = 1.6.

<u>Evidence of a catch-up of diagnosis of pre-existing chronic conditions after migration</u>

Table 46 shows the results of a logistic regression model estimating the probability of low SF-12 PCS amongst immigrants, splitting immigrants by whether they have a chronic condition and the time of diagnosis of this condition relative to the time of migration. Compared to immigrants without a chronic condition, immigrants with a chronic condition (diagnosed at any time) have worse health functioning, as would be expected. However, the group with the poorest health functioning is the group of immigrants whose age at diagnosis either coincides with their age of migration or diagnosis was one year after migration. This pattern is in line with undiagnosed pre-existing conditions that have been left untreated and hence have even worse health than having a chronic condition with timely diagnosis and treatment.

Table 46 Logistic regression model of low SF-12 PCS of immigrants only

	Odds ratio
Chronic condition, time of diagnosis and migration coincide (incl. + 1 year) (n=31) [1]	5.34**
	(2.57)
Chronic condition diagnosed > 1 year post-migration (n=145)	3.93***
	(0.97)
Chronic condition diagnosed >1 year pre-migration (n=133)	2.83***
	(0.66)
Chronic condition diagnosed <=1 year pre-migration (n=14)	1.18
	(0.84)
Chronic condition, time of diagnosis or migration not determinable (n=37)	3.60**
	(1.36)
Years since migration	1.02
	(0.21)
Age	1.02+
	(0.01)
Female[2]	2.08***
	(0.33)
Parent's highest qualification: school[3]	1.30
	(0.26)
Parent's highest qualification: post-school	0.99
	(0.19)
Parent's highest qualification: university	0.82
	(0.16)
School leaving age	0.96
	(0.04)
Constant	0.04***
	(0.01)
Observations	3,484

** p<0.01, * p<0.05, + p<0.1 Odds ratios. Linearized standard errors in parentheses. Survey weighted estimates. Source: UKHLS, wave 1. [1] Reference: no diagnosed chronic condition; [2] Reference: male; [3] Reference: Parents have no educational qualification.

Figure 12 HIE for low SF-12 PCS, males, for immigrants from low income countries (Model 3), and whites, assuming mean proxy education of the overall immigrant population

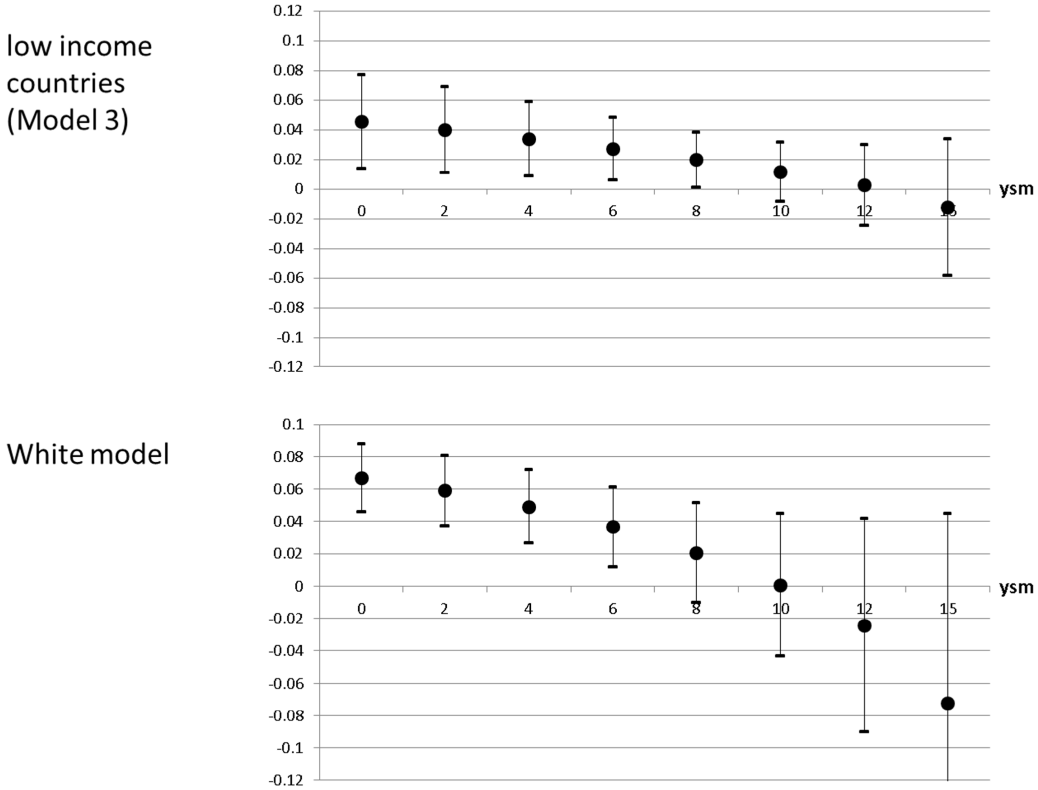
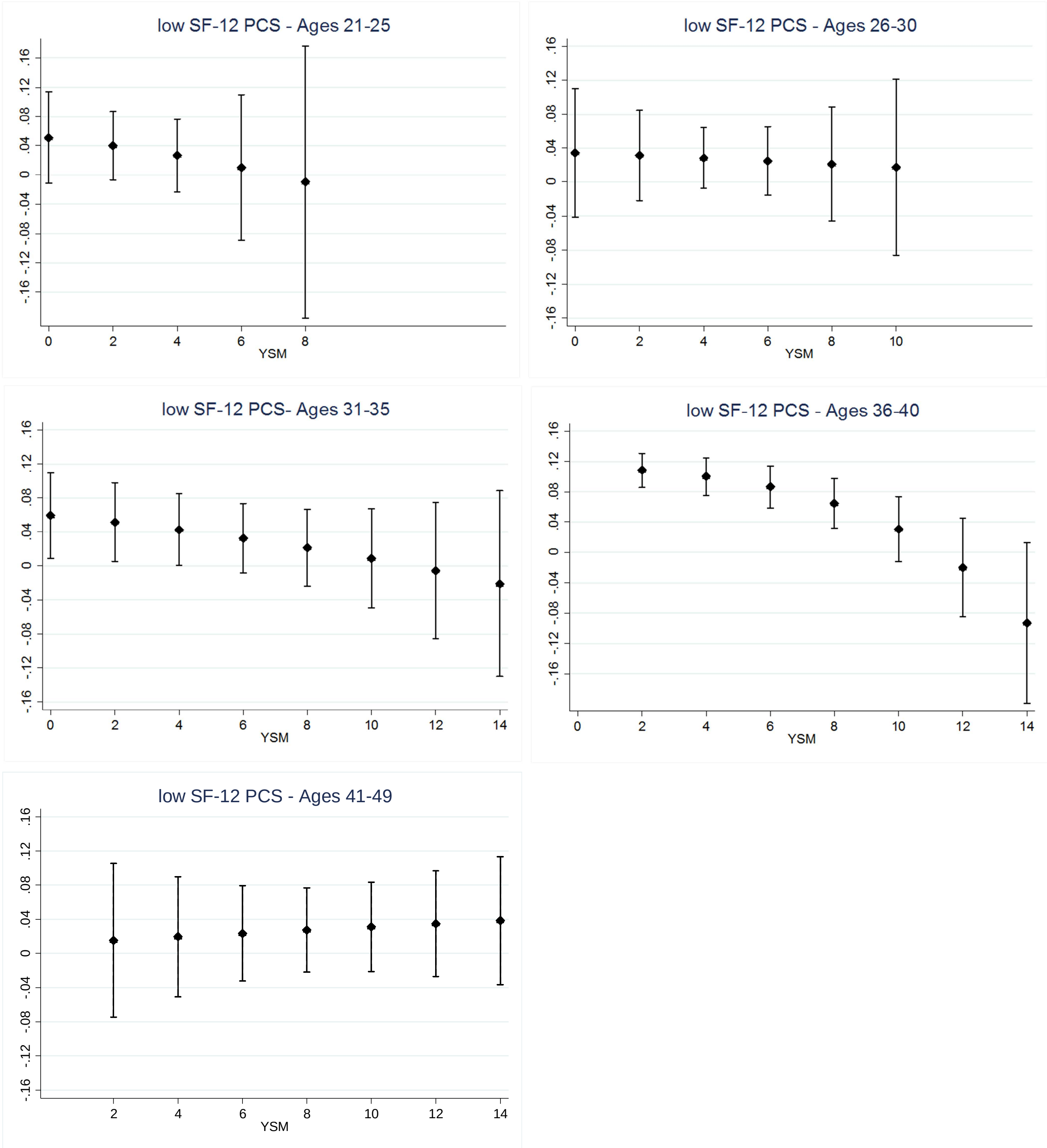
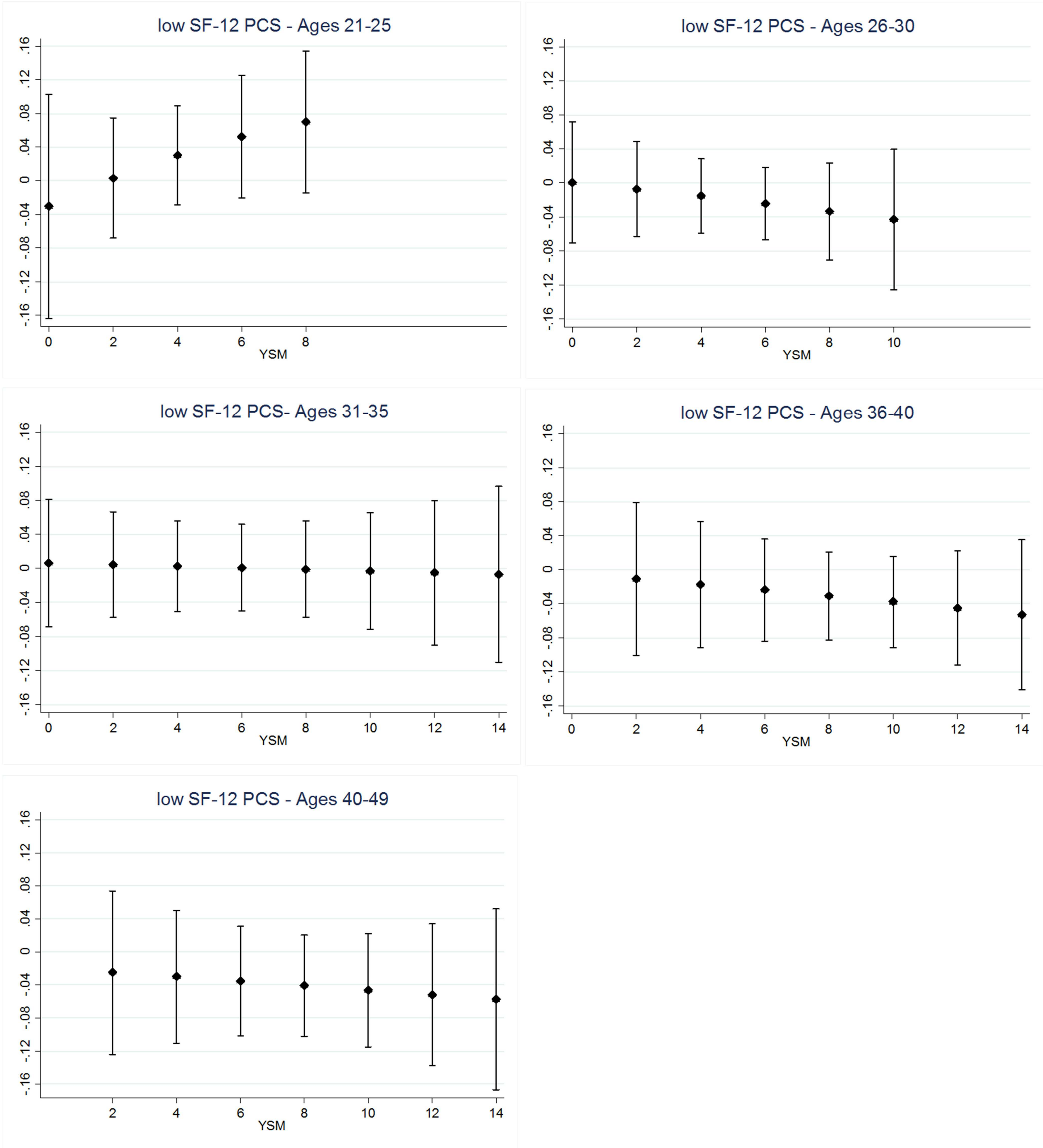


Figure 13 HIE by length of residence, for males, sample stratified by age



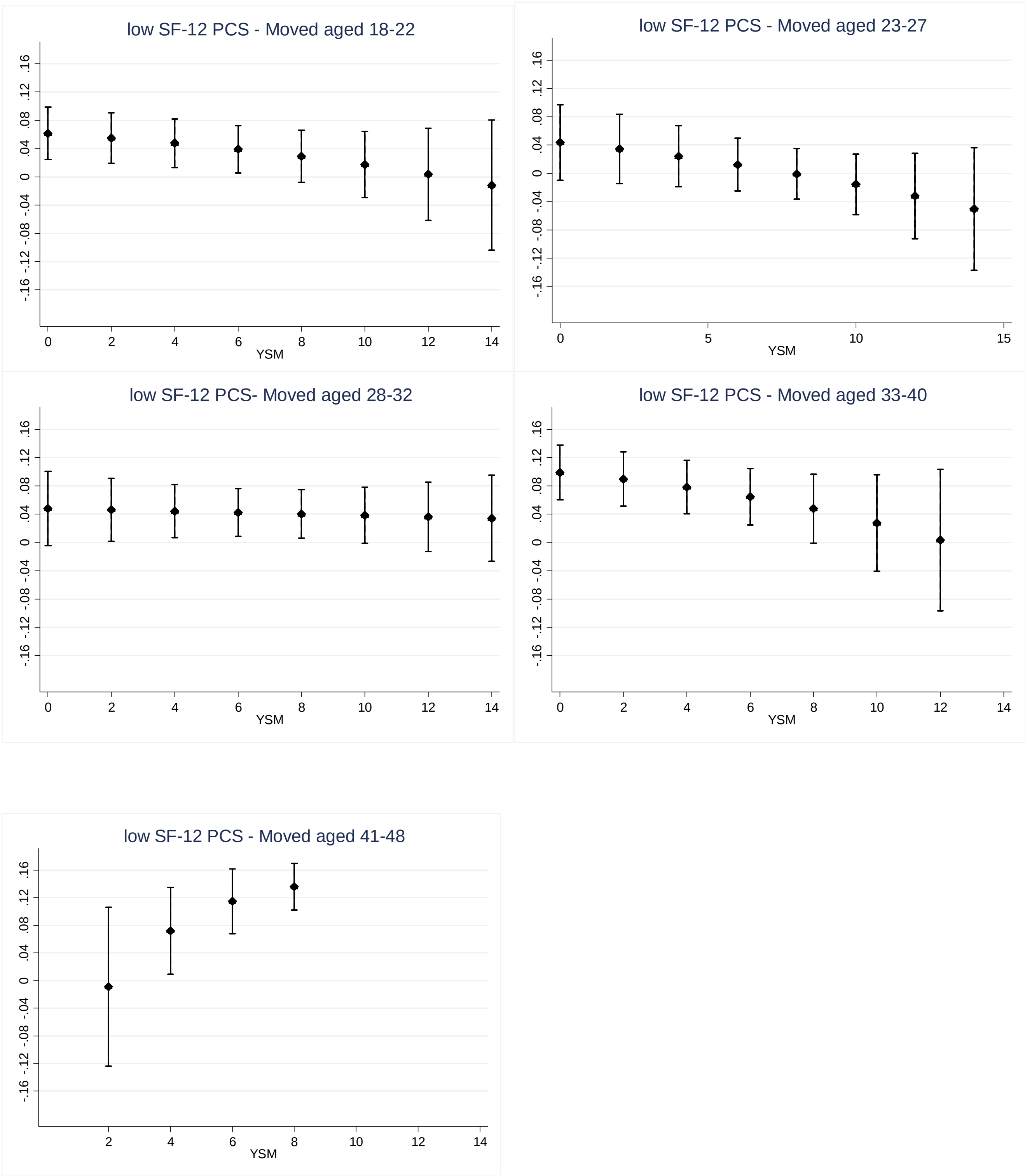
Note: Difference in predicted probability of poor health between UK-born and immigrants of different length of residence (HIE), with 95% confidence intervals. These estimates replicate model 2 (used in figure2), using age-stratified samples.

Figure 14 HIE by length of residence, for females, sample stratified by age



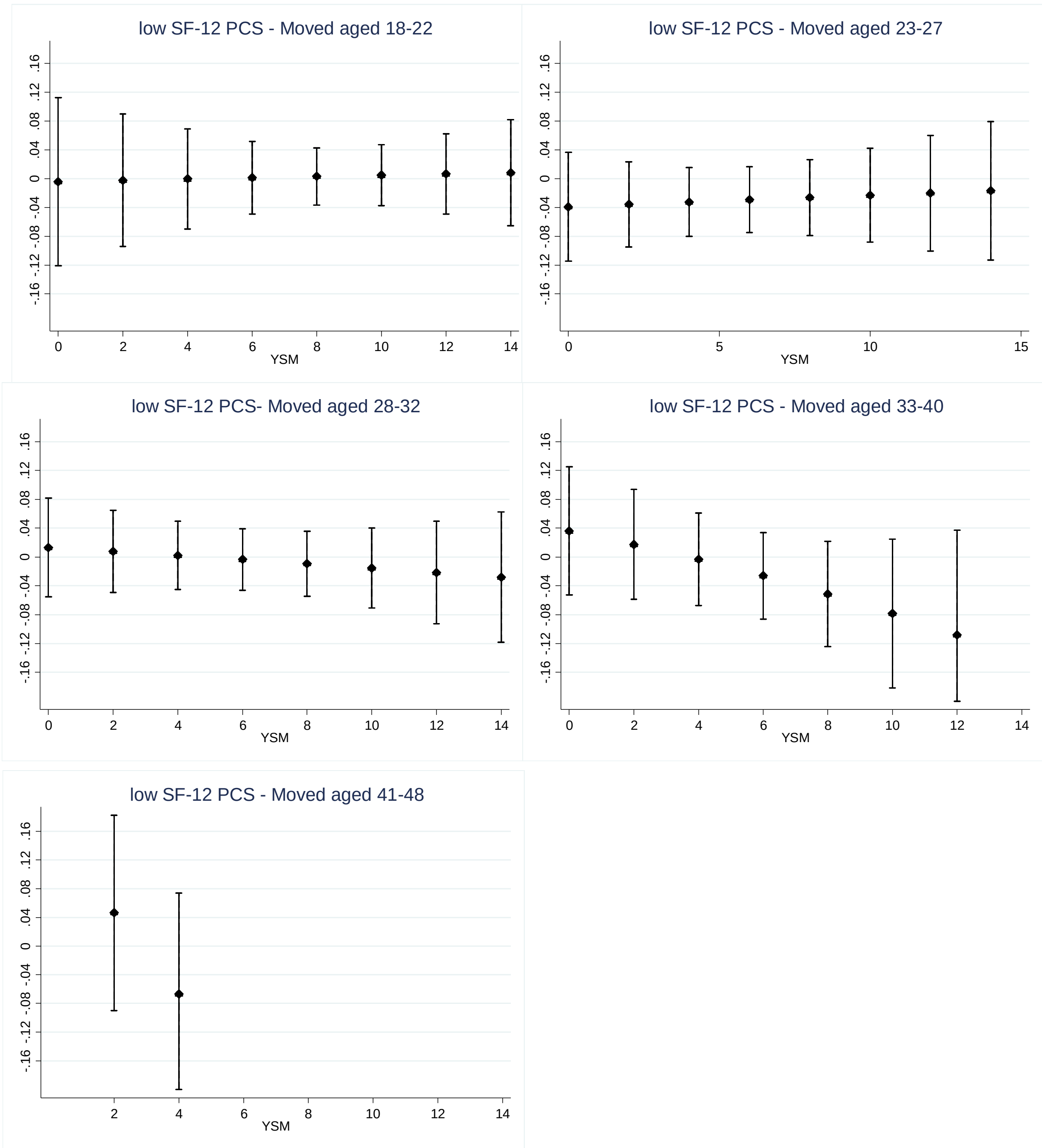
Note: Difference in predicted probability of poor health between UK-born and immigrants of different length of residence (HIE), with 95% confidence intervals. These estimates replicate model 2 (used in figure2), using age-stratified samples.

Figure 15 HIE by length of residence, samples stratified by age at moving, males



Note: Difference in predicted probability of poor health between UK-born and immigrants of different length of residence (HIE), with 95% confidence intervals. These estimates replicate model 2 (used in figure2), using samples stratified by age at moving.

Figure 16 HIE by length of residence, samples stratified by age at moving, females



Note: Difference in predicted probability of poor health between UK-born and immigrants of different length of residence (HIE), with 95% confidence intervals. These estimates replicate model 2 (used in figure2), using samples stratified by age at moving.

C Appendix: Chapter 4

C.1 Job Index scale

The Job Index scales by Kroll (2011) are based on survey items about the following work conditions listed below (translated from Kroll (2011), page 74). They were considered in the regression model estimating the work demands if the respondent classified an item as "frequent", "infrequent" or "never", as indicated.

Physical job index

Ergonomic stress (4 items)

Frequently: standing, lifting and carrying of heavy loads, working in constrained positions (kneeling, crouching etc.); infrequently: sitting.

Environmental pollution (9 items)

Frequently: working in smoke, dust or fumes; working in cold, heat, wet or draughts; in noisy environments; being exposed to grease, dirt; working in glaring or poor light; working with dangerous substances or radiation; having to wear protective clothing.

Psychosocial job index

Mental stress (10 items)

Frequently: time pressure, having to face new tasks, having to improve procedures, being interrupted during tasks, having to reach minimum targets, doing things one has not learnt, carrying out different tasks simultaneously, working on things where small errors have large consequences, having to go to one's limits, having to work very fast.

Social stress (10 items)

Never: able to organise own work, able to influence workload, able to decide work breaks, feeling that work is important.

Frequently: not being informed in time about developments in the organisation, not receiving information; that is necessary for own work in good time.

Never: feeling of community, good teamwork with colleagues, support from colleagues, support from line manager.

Temporal loads (6 items)

More than 48hrs actual working hours per week; frequently: on-call duty; working on Saturdays; working on Sundays and bank holidays; working between 11pm and 5am; working shifts.

C.2 Figures and tables

Table 47 Descriptive statistics for analytical sample, by country of birth: age at migration, age, year of arrival

Country of birth	Freq.	Percent	Age at migration		Age		Year of arrival	
			mean	(min-max)	Mean	(min - max)	mean	(min - max)
United Kingdom	4855	89.09			39	(21-60)		
Republic of Ireland	11	0.2	23	(18-30)	51	(25-60)	1981	(1970-2010)
France	11	0.2	28	(20-40)	33	(25-40)	2003	(1995-2010)
Poland	55	1.01	26	(18-35)	30	(20-40)	2005	(2000-2010)
Australia & New Zealand	12	0.22	29	(25-35)	42	(35-50)	1997	(1980-2005)
USA & Canada	13	0.24	30	(20-40)	37	(25-60)	2002	(1970-2010)
China/Hong Kong	11	0.2	30	(20-40)	40	(25-50)	2000	(1975-2006)
India	116	2.13	28	(18-40)	35	(21-60)	2002	(1975-2010)
Pakistan	50	0.92	26	(18-40)	33	(21-50)	2002	(1990-2010)
Bangladesh	38	0.7	28	(19-40)	34	(25-45)	2003	(1990-2010)
Sri Lanka	27	0.5	28	(18-40)	40	(30-55)	1997	(1975-2010)
Ghana	12	0.22	27	(20-40)	38	(25-55)	1997	(1985-2005)
Nigeria	28	0.51	29	(18-40)	39	(30-55)	1999	(1975-2010)
South Africa	27	0.5	26	(20-40)	34	(25-55)	2002	(1985-2005)
Zimbabwe	11	0.2	28	(20-40)	40	(30-55)	1997	(1975-2004)
S. America incl. Caribbean	17	0.31	28	(22-40)	37	(30-55)	2000	(1985-2010)
Middle East	21	0.39	27	(18-35)	39	(25-55)	1997	(1975-2010)
Far East	29	0.53	26	(18-40)	38	(21-60)	1997	(1970-2008)
West Africa	10	0.18	26	(18-35)	36	(25-40)	1999	(1990-2005)
East Africa	24	0.44	27	(18-40)	44	(30-60)	1991	(1968-2005)
other Africa	16	0.29	27	(20-35)	40	(25-50)	1996	(1985-2005)
Western Europe	31	0.57	28	(18-40)	37	(21-55)	1999	(1970-2010)
Eastern Europe	25	0.46	31	(20-40)	36	(30-50)	2004	(1990-2010)

Note: Absolute and relative frequencies unweighted, all other variables weighted using analysis weights. Countries of birth have been grouped to cells of at least 8 observations to prevent disclosure. Minima and maxima rounded to nearest 5 or (for age at arrival and age to minimum/maximum age at arrival/age as defined by analysis sample) if underlying cell count less than 3. Analysis sample: Males aged 21-60, employed, n=5,450.

Table 48 Descriptive statistics for analytical sample, by country of birth: Religion

	unweighted n	Christian	Muslim	Hindu	Sikh	Buddhist	Jewish	none/other/missing
United Kingdom	4,855	0.74	0.01	0	0	0	0	0.24
Republic of Ireland	11	1	0	0	0	0	0	0
France	11	0.68	0	0	0	0	0	0.32
Poland	55	0.94	0	0	0	0	0	0.06
Australia & New Zealand	12	0.84	0	0	0	0	0	0.16
USA & Canada	13	0.95	0	0	0	0	0	0.05
China/Hong Kong	11	0.38	0	0	0	0	0	0.63
India	116	0.15	0.12	0.58	0.14	0	0	0
Pakistan	50	0	0.97	0	0	0	0	0.03
Bangladesh	38	0	0.96	0	0	0	0	0.04
Sri Lanka	27	0.21	0	0.5	0	0.22	0	0.06
Ghana	12	1	0	0	0	0	0	0
Nigeria	28	0.74	0.18	0	0	0	0	0.08
South Africa	27	0.78	0	0	0	0	0	0.22
Zimbabwe	11	1	0	0	0	0	0	0
S. America incl. Caribbean	17	1	0	0	0	0	0	0
Middle East	21	0	0.75	0	0	0	0	0.25
Far East	29	0.47	0	0.3	0	0	0	0.23
West Africa	10	0.65	0.35	0	0	0	0	0
East Africa	24	0.47	0.28	0.24	0	0	0	0
other Africa	16	0	0.76	0	0	0	0	0.24
Western Europe	31	0.74	0	0	0	0	0	0.26
Eastern Europe	25	0.83	0	0	0	0	0	0.17

Note: Absolute and relative frequencies unweighted, all other variables weighted using analysis weights. Countries of birth have been grouped so that cells contain at least 8 observations to prevent disclosure. Proportions that are based on less than 3 observations have been set to 0 and the respective proportion has been added to the none/missing category to prevent disclosure. Rows do not always sum to 1 due to rounding. Analysis sample: Males aged 21-60, full-time employed, n=5,450.

Table 49 Descriptive statistics for analytical sample, by country of birth: Ethnicity (weighted proportions)

	n	White British/Irish	other white	white and black Caribbean	white and black African	white and Asian	any other mixed	Indian	Pakistani	Bangladeshi	Chinese	any other Asian	Caribbean	African	any other black	Arab
United Kingdom	4,855	0.96	0.01	0	0	0	0	0.01	0.01	0	0	0	0	0	0	0
Republic of Ireland	11	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
France	11	0	0.96	0	0	0	0	0	0	0	0	0	0	0	0	0
Poland	55	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Australia & New Zealand	12	0.37	0.53	0	0	0	0	0	0	0	0	0	0	0	0	0
USA & Canada	13	0	0.79	0	0	0	0	0	0	0	0	0	0	0	0	0
China/Hongkong	11	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
India	116	0.02	0	0	0	0	0	0.98	0	0	0	0	0	0	0	0
Pakistan	50	0	0	0	0	0	0	0	0.88	0	0	0	0	0	0	0
Bangladesh	38	0	0	0	0	0	0	0	0	0.99	0	0	0	0	0	0
Sri Lanka	27	0	0	0	0	0	0	0	0	0	0	0.94	0	0	0	0
Ghana	12	0	0	0	0	0	0	0	0	0	0	0	0	0.85	0	0
Nigeria	28	0	0	0	0	0	0	0	0	0	0	0	0	0.84	0	0
South Africa	27	0.28	0.65	0	0.04	0	0	0	0	0	0	0	0	0	0	0
Zimbabwe	11	0	0	0	0	0	0	0	0	0	0	0	0	0.63	0	0
S. America incl. Caribbean	17	0	0	0	0	0	0	0	0	0	0	0	0.37	0	0	0
Middle East	21	0	0.3	0	0	0	0	0	0	0	0	0.05	0	0	0	0.14
Far East	29	0	0	0	0	0	0	0.13	0	0	0	0.74	0	0	0	0
West Africa	10	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0

…./Continued

Continued/….

	n	White British/Irish	other white	white and black Caribbean	white and black African	white and Asian	any other mixed	Indian	Pakistani	Bangladeshi	Chinese	any other Asian	Caribbean	African	any other black	Arab
East Africa	24	0	0	0	0	0	0	0.24	0	0	0	0	0	0.28	0	0
other Africa	16	0	0	0	0.29	0	0	0	0	0	0	0	0	0	0	0.47
Western Europe	31	0.17	0.81	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Europe	25	0.12	0.84	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: White British/Irish includes white British, white Irish, gypsy or Irish traveller. Frequencies unweighted. Proportions weighted using analysis weights. Rows do not always sum to 1 due to suppression of proportions based on counts below 3. For disclosure control reasons the category "any other ethnic group" is not shown. Analysis sample: Males aged 21-60, employed.

Table 50 Industry classification of occupation (SIC07), by region of origin, unweighted frequencies

Industry (SIC07)	UK-born	high income	EU14	new EU	low income	missing	total
Agriculture & Mining	64	0	0	0	2	0	66
Manufacturing	848	3	6	26	57	1	941
Utilities	133	1	1	0	3	0	138
Construction	411	2	3	4	14	0	434
Retail	550	2	3	7	68	0	630
Transportation & hospitality	454	3	10	21	70	0	558
Information & Communications	295	4	5	0	33	0	337
Financial, Insurance,	260	3	6	2	24	0	295
Professional, scientific & technical	260	3	2	0	15	0	280
Admin & support	206	1	2	4	29	0	242
Public administration & defence	476	3	1	2	17	0	499
Education	365	0	7	2	26	0	400
Health & Social work	301	2	4	4	61	0	372
other services	153	2	1	1	14	0	171
missing	78	0	2	1	6	0	87
Total	4,854	29	53	74	439	1	5,450

Table 51 Industry classification of occupation (SIC07), by region of origin, weighted percentages

Industry	UK-born	high income	EU14	new EU	low income	missing
Agriculture & Mining	1.4	0.0	0.0	0.0	0.4	1.3
Manufacturing	17.0	9.6	9.9	28.2	11.2	16.8
Utilities	2.7	2.1	1.9	0.0	0.2	2.5
Construction	8.9	7.8	1.6	7.0	2.6	8.4
Retail	11.7	5.2	4.3	8.2	16.3	11.8
Transportation & hospitality	9.5	10.8	23.3	35.1	14.3	10.4
Information & Communications	6.1	16.4	12.4	0.0	7.8	6.2
Financial, Insurance,	5.3	14.0	8.0	3.3	5.4	5.4
Professional, scientific & technical	5.7	8.7	0.0	0.0	3.9	5.5
Admin & support	4.5	0.0	6.5	5.6	7.0	4.7
Public administration & defence	9.7	11.9	1.6	1.8	4.0	9.2
Education	7.2	0.0	18.1	5.3	6.1	7.1
Health & Social work	5.7	5.0	4.5	4.3	16.0	6.2
other services	3.0	8.5	2.4	1.4	2.5	3.0
Missing	1.6	0.0	5.5	0.0	2.3	1.6
Total	100	100	100	100	100	100

Table 52 Industry classification of occupation (SIC07), by migrant status and length of residence, unweighted frequencies

	UK-born	>20 YSM	11-20YSM	5-10YSM	0-4YSM	total
Agriculture & Mining	64	0	1	1	0	66
Manufacturing	848	6	29	24	34	941
Utilities	133	2	1	2	0	138
Construction	411	2	6	12	3	434
Retail	550	6	20	27	27	630
Transportation & hospitality	454	11	30	34	29	558
Information & Communications	295	3	5	16	18	337
Financial, Insurance,	260	5	5	15	10	295
Professional, scientific & technical	260	4	6	5	5	280
Admin & support	206	2	9	13	12	242
Public administration & defence	476	8	7	6	2	499
Education	365	3	4	19	9	400
Health & Social work	301	11	18	28	14	372
other services	153	2	2	12	2	171
Missing	78	1	0	6	2	87
Total	4,854	66	143	220	167	5,450

Table 53 Industry classification of occupation (SIC07), by migrant status and length of residence, weighted percentages

Industry	UK-born	>20 YSM	11-20YSM	5-10YSM	0-4YSM	total
Agriculture & Mining	1.41	0	0	0.7	0	1.3
Manufacturing	17.02	6.18	18.28	10.99	17.53	16.75
Utilities	2.68	3.83	0	0.36	0	2.47
Construction	8.91	1.96	4.37	5.68	1.79	8.4
Retail	11.73	6.76	10.72	10.69	16.94	11.8
Transportation & hospitality	9.47	20.16	23.16	12.48	23.55	10.41
Information & Communications	6.1	2.84	6.07	5.83	11.3	6.23
Financial, Insurance,	5.33	9.2	4.05	8.97	3.01	5.4
Professional, scientific & technical	5.73	5.03	2.85	3.42	2.2	5.47
Admin & support	4.48	2.41	7.03	5.99	6.89	4.65
Public administration & defence	9.73	13.31	6.3	2.08	1.79	9.16
Education	7.17	5.03	2.92	9.92	6.38	7.14
Health & Social work	5.65	17.99	14.18	15.04	4.72	6.23
other services	3.01	3.53	0.08	5.09	1.4	2.98
Missing	1.57	1.8	0	2.78	2.51	1.62
Total	100	100	100	100	100	100

Table 54 Item missingness of SF-12 in analytical sample, by region of origin and for migrant sample by years since migration, waves 2-5

frequency	UK-born	High income, non-EU	EU14 + CH	new EU	low income, non-EU	total		0-4 years	5-10 years	11-20 years	>20 years	total
wave 2	166	1	0	11	64	242	wave 2	20	29	25	2	76
wave 3	183	1	1	4	38	227	wave 3	11	17	15	1	44
wave 4	129	0	1	2	37	169	wave 4	8	15	13	4	40
wave 5	140	0	0	0	31	171	wave 5	6	9	13	3	31

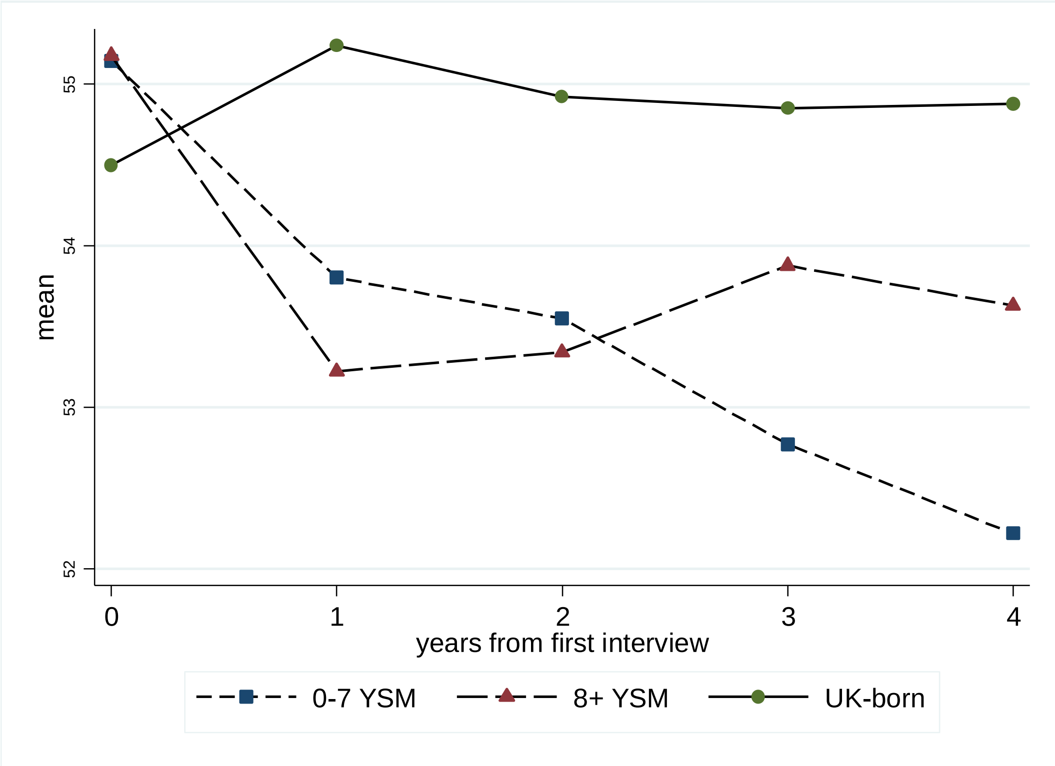
percentage	UK-born	High income, non-EU	EU14 + CH	new EU	low income, non-EU	total		0-4 years	5-10 years	11-20 years	>20 years	total
wave 2	3.6	3.6	0	15.9	15.9	4.7	wave 2	12.9	14.7	18.8	3.3	13.8
wave 3	5.0	5.0	2.4	7.6	13.3	5.6	wave 3	9.7	10.8	17.7	2.1	11.0
wave 4	3.8	0	2.7	4.6	14.1	4.52	wave 4	8.5	10.6	16.3	9.1	11.1
wave 5	4.5	0	0	0	13.6	5.02	wave 5	7.8	6.9	19.7	7.0	9.8

Note: There is no item missingness in wave 1 because the analysis sample is defined as having a health measure at first interview. Unweighted.

Table 55 Loss to follow-up by wave 5, by migrant status and for migrant sample by region of origin, unweighted

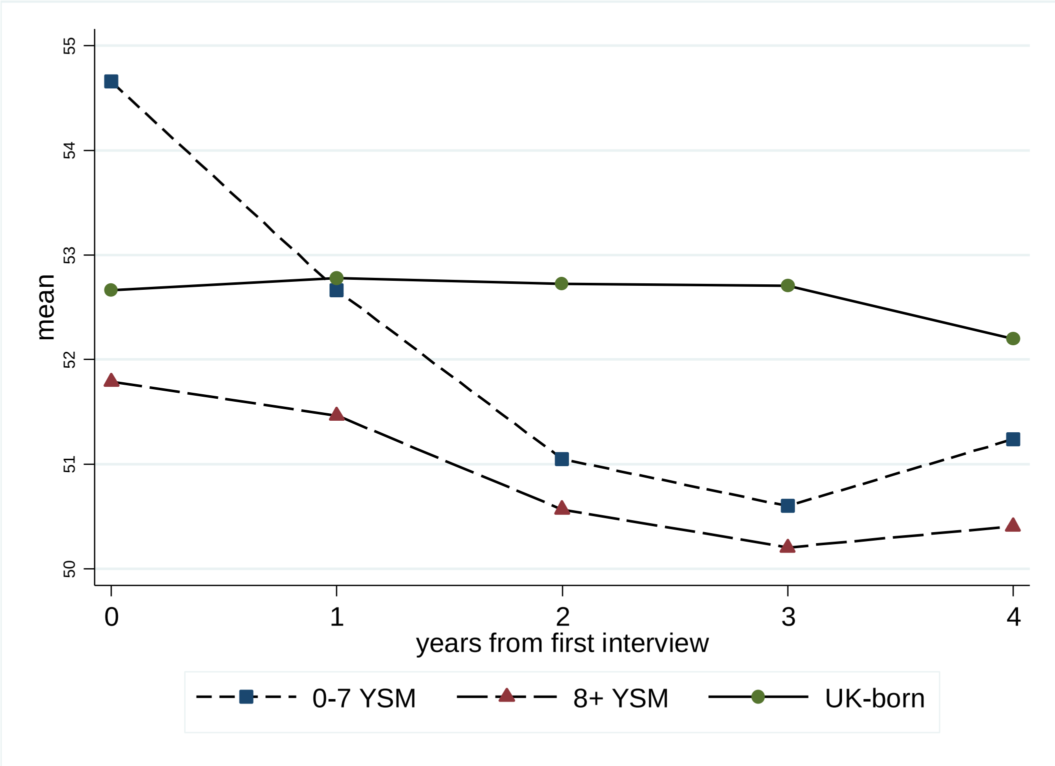
	UK-born	Migrant	total	High income non-EU	EU14, CH, Norway	new EU	low income non EU
Total at first interview	4,853	597	5,450	29	53	74	439
Lost by wave 5	1,295	240	1,535	12	17	30	181
	26.7%	40.2%	28.2%	41.4%	32.1%	40.5%	41.2%

Figure 17 Mean physical health over time from first interview in degree population, by immigrant status and cohort



Source: UKHLS, waves 1-5. Note: YSM= years since migration. Male UK-born and immigrants aged 21-60; immigrants who immigrated aged between 18 and 40. Unweighted.

Figure 18 Mean physical health over time from first interview in non-degree population, by immigrant status and cohort



Source: UKHLS, waves 1-5. Note: YSM= years since migration. Male UK-born and immigrants aged 21-60; immigrants who immigrated aged between 18 and 40; unweighted.

Table 56 Mean and standard deviation of work conditions (at first interview) by degree status, weighted

	All		**Degree**		**Non-degree**	
	Mean	(SD)	Mean	(SD)	Mean	(SD)
physical job index	5.26	(2.70)	3.65	(2.09)	5.99	(2.63)
psychosocial job index	6.17	(2.70)	5.40	(2.64)	6.52	(2.65)
work autonomy	1.91	(0.73)	1.71	(0.61)	2.00	(0.76)

Table 57 Results of growth curve models of physical health: degree population

Parameter			Model 1	Model 2	Model 3	Model 4
Fixed effects						
Initial status	Intercept		54.67***	54.76***	54.77***	54.65***
			(0.12)	*(0.13)*	*(0.14)*	*(0.15)*
	age					-0.10***
						(0.01)
	Immigrant	8+ YSM			-0.24	-0.04
					(0.38)	*(0.38)*
		0-7 YSM			0.12	-0.51
					(0.40)	*(0.40)*
Rate of change	intercept			-0.06	0.03	0.03
				(0.05)	*(0.05)*	*(0.05)*
	Immigrant	8+ YSM			-0.43*	-0.42*
					(0.18)	*(0.18)*
		0-7 YSM			-0.78***	-0.77***
					(0.20)	*(0.20)*
Variance components						
Level 1	*var(within person)*		22.63***	21.41***		
			(0.45)	*(1.01)*		
	Var(UK-born)				20.88***	
					(1.11)	
	var(8+YSM)				22.30***	
					(3.37)	
	var(0-7YSM)				25.68***	
					(2.91)	
Level 2	*var(initial status)*		18.63***	14.07***	14.18***	13.37***
			(0.85)	*(1.88)*	*(1.90)*	*(1.83)*
	var(rate of change)			0.53	0.46+	0.46+
				(0.21)	*(0.21)*	*(0.21)*
	covariance			0.97	0.97	0.96
				(0.41)	*(0.41)*	*(0.40)*
Goodness-of-fit						
AIC			43213	43118	43089	43027
BIC			43233	43159	43171	43116
Observations			1,759 (6,841)	1,759 (6,841)	1,759 (6,841)	1,759 (6,841)

Coefficients and robust standard errors (in brackets). + p<.10; * p<.05; ** p<.01; *** p<.001
Note: Reference category for immigrant is UK-born; age at first interview, mean centered

Table 58 Results of growth curve models of physical health: non-degree population

Parameter			**Model 1**	**Model 2**	**Model 3**	**Model 4**
Fixed effects						
Initial status	Intercept		52.53***	52.75***	52.76***	52.24***
			(0.10)	*(0.11)*	*(0.12)*	*(0.43)*
	age					-0.09***
						(0.01)
	Age squared					-0.003**
						(0.00)
	GCSE/lower					0.53
						(0.44)
	A-level					1.37**
						(0.44)
	Immigrant	8+ YSM			-1.03+	-1.11+
					(0.60)	*(0.59)*
		0-7 YSM			1.23**	0.48
					(0.47)	*(0.48)*
Rate of change	intercept			-0.14***	-0.11**	0.10*
				(0.04)	*(0.04)*	*(0.04)*
	age					-0.02***
						(0.00)
	Immigrant	8+ YSM			-0.44*	-0.41+
					(0.22)	*(0.22)*
		0-7 YSM			-0.80**	-0.97***
					(0.26)	*(0.26)*
Variance components						
Level 1	*var(within person)*		29.67***	26.49***		
			(0.42)	*(0.80)*		
	Var(UK-born)				27.11***	27.09***
					(0.82)	*(0.82)*
	var(8+YSM)				36.00***	35.93***
					(3.76)	*(3.76)*
	var(0-7YSM)				29.23***	29.43***
					(4.85)	*(4.86)*
Level 2	*var(initial status)*		29.74***	29.08***	29.02***	27.73***
			(0.91)	*(1.98)*	*(1.98)*	*(1.91)*
	var(rate of change)			0.92	0.91	0.88
				(0.17)	*(0.17)*	*(0.17)*
	covariance			-0.41	-0.44	-0.66
				(0.45)	*(0.45)*	*(0.45)*

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Goodness-of-fit				
AIC	91315	91206	91179	90974
BIC	91337	91251	91269	91102
Observations	3,691 (13,767)	3,691 (13,767)	3,691 (13,767)	3,691 (13,767)

Coefficients and robust standard errors (in brackets). + p<.10; * p<.05; ** p<.01; *** p<.001

Note: Reference category for immigrant is UK-born; reference category for educational qualification is no qualification; age at first interview, mean centered.

Table 59 Results of multilevel growth models for health (SF-12 PCS) for overall population, models without controls

Parameter	model 4 **base**	model 5a **physical**	model 5b **psycho-social**	model 5c **work autonomy**	model 5d **physical & work autonomy**
time	-0.067*	-0.071*	-0.067*	-0.068*	-0.071*
	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
Immigrant 12+YSM	-0.954*	-0.905+	-0.916+	-0.826+	-0.796
	(0.481)	(0.482)	(0.481)	(0.484)	(0.485)
Immigrant 5-11YSM	-0.251	-0.214	-0.224	-0.116	-0.093
	(0.358)	(0.357)	(0.358)	(0.355)	(0.354)
Immigrant 0-4YSM	-0.046	0.007	-0.012	0.119	0.152
	(0.378)	(0.379)	(0.377)	(0.378)	(0.378)
age	-0.094***	-0.095***	-0.093***	-0.095***	-0.096***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
age squared	-0.003***	-0.003***	-0.003***	-0.002**	-0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
GCSE/lower	0.574	0.524	0.565	0.486	0.456
	(0.438)	(0.439)	(0.437)	(0.442)	(0.442)
A-level/below BA	1.399**	1.256**	1.373**	1.203**	1.116*
	(0.432)	(0.436)	(0.431)	(0.439)	(0.441)
degree	2.907***	2.612***	2.823***	2.590***	2.405***
	(0.424)	(0.439)	(0.424)	(0.437)	(0.446)
age*time	-0.013***	-0.013***	-0.013***	-0.013***	-0.013***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Immigrant 12+YSM*time	-0.508*	-0.494*	-0.491*	-0.487*	-0.483*
	(0.204)	(0.203)	(0.204)	(0.204)	(0.203)
Immigrant 5-11YSM*time	-0.520***	-0.513***	-0.508***	-0.513***	-0.513***
	(0.152)	(0.151)	(0.153)	(0.152)	(0.151)
Immigrant 0-4YSM*time	-0.864***	-0.833***	-0.853***	-0.837***	-0.823***
	(0.201)	(0.202)	(0.201)	(0.203)	(0.202)
Physical demands		-0.025			-0.004
		(0.033)			(0.034)
Physical demands*time		-0.048***			-0.045***
		(0.011)			(0.012)
Psycho-social demands			-0.030		
			(0.031)		
Psycho-social demands*time			-0.022*		
			(0.011)		

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Work autonomy				-0.454***	-0.472***
				(0.133)	(0.136)
Work autonomy*time				-0.097*	-0.047
				(0.046)	(0.048)
Constant	52.119***	52.266***	52.157***	52.271***	52.363***
	(0.421)	(0.425)	(0.420)	(0.426)	(0.429)
var(time)	0.7558	0.732+	0.750+	0.747+	0.730+
	(0.131)	(0.131)	(0.131)	(0.131)	(0.131)
var(cons)	23.11***	23.077***	23.078***	22.983***	22.967***
	(1.415)	(1.417)	(1.417)	(1.405)	(1.406)
covar(cons, time)	-0.137	-0.137	-0.144	-0.141	-0.140
	(0.328)	(0.327)	(0.328)	(0.326)	(0.326)
var(within-person, UKborn)	25.171***	25.190***	25.183***	25.177***	25.190***
	(0.664)	(0.664)	(0.663)	(0.664)	(0.664)
var(within-person, 12+ YSM)	34.939**	34.977**	34.936**	34.926**	34.990**
	(3.646)	(3.650)	(3.632)	(3.654)	(3.659)
var(within-person, 5-11 YSM)	21.857**	21.833**	21.866**	21.825**	21.798**
	(2.506)	(2.50)	(2.502)	(2.49)	(2.492)
var(within-person, 0-4 YSM)	29.161**	29.242**	29.173**	29.184**	29.237**
	(3.517)	(3.522)	(3.515)	(3.525)	(3.525)
aic	134236.7	134212.0	134230.9	134207.3	134191.6
bic	134403.3	134394.5	134413.3	134389.8	134389.9
Observations	5,450 (20,608)	5,450 (20,608)	5,450 (20,608)	5,450 (20,608)	5,450 (20,608)

Note: Coefficients and cluster-robust standard errors (in brackets). + p<.10; * p<.05; ** p<.01; *** p<.001. Reference categories: Immigrant cohorts: UK-born; educational level: no qualification. Time is years since first interview. Continuous predictors are centered at their means.

Table 60 Results of multilevel growth models for health (SF-12 PCS) for overall population, models with controls

Parameter	model 7 **base**	model 6a **physical**	model 6b **psycho-social**	model 6c **work autonomy**	model 6d **physical & work autonomy**
time	-0.00	-0.02	-0.01	-0.01	-0.02
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Immigrant 12+YSM	-0.17	-0.20	-0.15	-0.15	-0.18
	(0.52)	(0.52)	(0.52)	(0.52)	(0.52)
Immigrant 5-11YSM	0.56	0.54	0.57	0.59	0.58
	(0.42)	(0.42)	(0.42)	(0.42)	(0.42)
Immigrant 0-4YSM	0.82+	0.80+	0.83*	0.86*	0.84*
	(0.42)	(0.42)	(0.42)	(0.42)	(0.42)
age	-0.10***	-0.10***	-0.10***	-0.10***	-0.10***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
age squared	-0.00**	-0.00**	-0.00**	-0.00**	-0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
GCSE/lower	0.27	0.27	0.27	0.25	0.25
	(0.44)	(0.44)	(0.44)	(0.44)	(0.44)
A-level/below BA	0.69	0.67	0.67	0.63	0.62
	(0.43)	(0.44)	(0.43)	(0.44)	(0.44)
degree	1.52***	1.48***	1.47***	1.43**	1.42**
	(0.44)	(0.44)	(0.43)	(0.44)	(0.45)
Caribbean	0.50	0.54	0.50	0.52	0.56
	(0.81)	(0.81)	(0.81)	(0.80)	(0.80)
Black African	1.57**	1.60**	1.58**	1.59**	1.63**
	(0.53)	(0.53)	(0.53)	(0.53)	(0.53)
Asian (other)	-0.70	-0.68	-0.70	-0.69	-0.66
	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)
Indian	-0.63	-0.60	-0.62	-0.61	-0.57
	(0.46)	(0.46)	(0.46)	(0.46)	(0.46)
Pakistani	0.31	0.34	0.32	0.34	0.38
	(0.53)	(0.53)	(0.53)	(0.53)	(0.53)
Bangladeshi	-0.95	-0.92	-0.93	-0.96	-0.92
	(0.79)	(0.79)	(0.78)	(0.78)	(0.78)
mixed/other	-0.95	-0.92	-0.95	-0.94	-0.90
	(0.67)	(0.67)	(0.67)	(0.67)	(0.67)
Single, not cohabiting	-0.29	-0.29	-0.30	-0.26	-0.26
	(0.24)	(0.24)	(0.24)	(0.24)	(0.24)
Household income	3.15***	3.46***	3.16***	2.99***	3.27***
	(0.80)	(0.81)	(0.80)	(0.81)	(0.82)

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Material deprivation score 15+	-0.85***	-0.85***	-0.85***	-0.82***	-0.82***
	(0.20)	(0.20)	(0.20)	(0.20)	(0.20)
Poor diet	-0.26	-0.26	-0.26	-0.26	-0.25
	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)
Smoker	-0.41+	-0.45*	-0.41+	-0.42+	-0.45*
	(0.22)	(0.22)	(0.22)	(0.22)	(0.22)
Brisk walking pace	1.67***	1.67***	1.67***	1.66***	1.66***
	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
Exercise 1+/week	0.65***	0.65***	0.65***	0.63***	0.63***
	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
Social support	0.09***	0.09***	0.09***	0.09***	0.09***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Job (very) insecure	-0.58*	-0.58*	-0.59*	-0.53*	-0.52+
	(0.27)	(0.27)	(0.27)	(0.27)	(0.27)
not employed w2&4 or missing	-0.92+	-0.93+	-0.93+	-0.95+	-0.98+
	(0.54)	(0.54)	(0.54)	(0.54)	(0.54)
Working shifts	-0.44	-0.49+	-0.41	-0.36	-0.40
	(0.29)	(0.30)	(0.30)	(0.30)	(0.30)
Non-white*time	-0.28*	-0.31*	-0.29*	-0.28*	-0.31*
	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)
Household income*time	0.74**	0.45	0.71*	0.67*	0.43
	(0.29)	(0.29)	(0.29)	(0.29)	(0.30)
Smoker*time	-0.18*	-0.15+	-0.18*	-0.18*	-0.15+
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Working shifts*time	-0.17+	-0.12	-0.14	-0.15	-0.11
	(0.10)	(0.11)	(0.11)	(0.11)	(0.11)
Age*time	-0.02***	-0.01***	-0.01***	-0.02***	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Immigrant 12+YSM*time	-0.32	-0.30	-0.31	-0.32	-0.29
	(0.21)	(0.21)	(0.21)	(0.21)	(0.21)
Immigrant 5-11YSM*time	-0.36*	-0.34+	-0.35*	-0.36*	-0.34*
	(0.17)	(0.17)	(0.17)	(0.17)	(0.17)
Immigrant 0-4YSM*time	-0.70***	-0.67**	-0.69***	-0.69***	-0.67**
	(0.20)	(0.20)	(0.20)	(0.21)	(0.21)
Physical demands		0.03			0.04
		(0.03)			(0.03)
Physical demands*time		-0.04***			-0.04**
		(0.01)			(0.01)
Psycho-social demands			-0.02		
			(0.03)		
Psycho-social demands*time			-0.01		
			(0.01)		

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Work autonomy				-0.19	-0.22
				(0.14)	(0.14)
Work autonomy*time				-0.05	-0.02
				(0.05)	(0.05)
Constant	52.25***	52.28***	52.27***	52.27***	52.29***
	(0.45)	(0.45)	(0.45)	(0.45)	(0.45)
var(time)	0.73+	0.72+	0.73+	0.73+	0.72+
	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)
var(cons)	21.37***	21.36***	21.36***	21.36***	21.35***
	(1.35)	(1.35)	(1.35)	(1.35)	(1.35)
covar(cons, time)	-0.16	-0.16	-0.17	-0.16	-0.16
	(0.32)	(0.32)	(0.32)	(0.32)	(0.32)
var(within-person, UKborn)	25.19***	25.19***	25.20***	25.19***	25.20***
	(0.66)	(0.66)	(0.66)	(0.66)	(0.66)
Var(within-person, 12+ YSM)	34.62***	34.68***	34.63***	34.63***	34.69***
	(3.55)	(3.56)	(3.54)	(3.56)	(3.57)
Var(within-person, 5-11 YSM)	21.59***	21.57***	21.60***	21.59***	21.58***
	(2.47)	(2.46)	(2.47)	(2.47)	(2.46)
Var(within-person, 0-4 YSM)	29.09***	29.15***	29.11***	29.11***	29.15***
	(3.52)	(3.52)	(3.52)	(3.53)	(3.53)
aic	133931.8	133923.4	133930.9	133929.8	133922.8
bic	134273.0	134280.4	134287.9	134286.8	134295.6
Observations	5,450 (20,608)	5,450 (20,608)	5,450 (20,608)	5,450 (20,608)	5,450 (20,608)

Note: Coefficients and cluster-robust standard errors (in brackets). + p<.10; * p<.05; ** p<.01; *** p<.001. Reference categories: Immigrant cohorts: UK-born; educational level: no qualification. Time is years since first interview. Continuous predictors are centered at their means.

Table 61 Results of multilevel growth models for health (SF-12 PCS) for degree population, models without controls

Parameter	model 4 base	model 5 a physical	model 5b psycho-social	model 5c work autonomy	model 5d physical & work autonomy
time	0.031	0.012	0.030	0.015	0.003
	(0.048)	(0.061)	(0.052)	(0.056)	(0.064)
Immigrant 8+YSM	-0.042	-0.002	-0.008	0.099	0.114
	(0.378)	(0.375)	(0.380)	(0.372)	(0.370)
Immigrant 0-7YSM	-0.511	-0.414	-0.482	-0.295	-0.250
	(0.404)	(0.403)	(0.404)	(0.401)	(0.401)
age	-0.097***	-0.097***	-0.097***	-0.103***	-0.102***
	(0.012)	(0.012)	(0.012)	(0.013)	(0.013)
Immigrant 8+YSM*time	-0.423*	-0.420*	-0.423*	-0.416*	-0.414*
	(0.180)	(0.179)	(0.180)	(0.181)	(0.180)
Immigrant 0-7YSM*time	-0.770***	-0.755***	-0.766***	-0.753***	-0.744***
	(0.198)	(0.196)	(0.197)	(0.198)	(0.197)
Physical demands		-0.107+			-0.062
		(0.057)			(0.059)
Physical demands*time		-0.011			-0.009
		(0.023)			(0.023)
Psycho-social demands			-0.037		
			(0.046)		
Psycho-social demands*time			-0.002		
			(0.018)		
Work autonomy				-0.858***	-0.811***
				(0.236)	(0.243)
Work autonomy*time				-0.066	-0.057
				(0.092)	(0.093)
Constant	54.652***	54.486***	54.620***	54.441***	54.356***
	(0.146)	(0.175)	(0.153)	(0.169)	(0.186)
var(time)	0.461+	0.453+	0.459+	0.461+	0.455+
	(0.207)	(0.207)	(0.206)	(0.206)	(0.206)
var(cons)	13.367***	13.317***	13.358***	13.090***	13.079***
	(1.827)	(1.829)	(1.825)	(1.784)	(1.788)
covar(cons, time)	0.959	0.953	0.9958	0.948	0.946
	(0.402)	(0.401)	(0.402)	(0.397)	(0.397)

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var(within-person, UKborn)	20.867***	20.891***	20.873***	20.876***	20.889***
	(1.106)	(1.108)	(1.105)	(1.106)	(1.108)
Var(within-person, 8+ YSM)	22.288***	22.216***	22.286***	22.154***	22.118***
	(3.371)	(3.344)	(3.363)	(3.343)	(3.329)
Var(within-person, 0-7 YSM)	25.730***	25.705***	25.720***	25.649***	25.640***
	(2.933)	(2.929)	(2.932)	(2.920)	(2.919)
aic	43027.2	43025.0	43030.0	43006.1	43007.9
bic	43116.0	43127.5	43132.5	43108.6	43124.0
Observations	1,759 (6,841)	1,759 (6,841)	1,759 (6,841)	1,759 (6,841)	1,759 (6,841)

Note: Coefficients and cluster-robust standard errors (in brackets). + p<.10; * p<.05; ** p<.01; *** p<.001. Reference categories: Immigrant cohorts: UK-born; educational level: no qualification. Time is years since first interview. Continuous predictors are centered at their means.

Table 62 Results of multilevel growth models for health (SF-12 PCS) for degree population, models with controls

Parameter	model 7 controls only	model 6a physical	model 6b psycho-social	model 6c work autonomy	model 6d physical & work autonomy
time	0.113*	0.092	0.108*	0.106+	0.089
	(0.050)	(0.061)	(0.052)	(0.056)	(0.064)
Immigrant 8+YSM	0.322	0.333	0.338	0.344	0.346
	(0.441)	(0.441)	(0.446)	(0.435)	(0.436)
Immigrant 0-7YSM	0.309	0.337	0.317	0.375	0.383
	(0.491)	(0.492)	(0.493)	(0.485)	(0.487)
age	-0.097***	-0.096***	-0.096***	-0.100***	-0.099***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Caribbean	-1.680	-1.703	-1.702	-1.774	-1.781
	(1.327)	(1.322)	(1.330)	(1.291)	(1.290)
Black African	1.771**	1.759**	1.759**	1.927**	1.918**
	(0.661)	(0.658)	(0.664)	(0.671)	(0.670)
Asian (other)	-0.048	-0.052	-0.059	0.011	0.010
	(0.890)	(0.890)	(0.891)	(0.896)	(0.896)
Indian	0.153	0.143	0.161	0.206	0.202
	(0.484)	(0.484)	(0.484)	(0.478)	(0.479)
Pakistani	0.226	0.221	0.218	0.324	0.321
	(0.700)	(0.704)	(0.703)	(0.688)	(0.691)
Bangladeshi	-0.350	-0.390	-0.355	-0.234	-0.257
	(1.017)	(1.015)	(1.016)	(0.990)	(0.991)
mixed/other	-0.619	-0.638	-0.623	-0.555	-0.563
	(0.766)	(0.765)	(0.766)	(0.763)	(0.762)
Household income	3.457***	3.340***	3.438***	2.938***	2.895***
	(0.734)	(0.740)	(0.735)	(0.748)	(0.751)
Financial strain	-0.188	-0.178	-0.183	-0.131	-0.129
	(0.464)	(0.466)	(0.464)	(0.460)	(0.462)
poor diet	-0.320	-0.304	-0.316	-0.343	-0.334
	(0.309)	(0.307)	(0.308)	(0.305)	(0.304)
Smoker	-0.660*	-0.642+	-0.657*	-0.625+	-0.617+
	(0.335)	(0.335)	(0.335)	(0.331)	(0.332)
Brisk walking pace	1.646***	1.643***	1.646***	1.644***	1.643***
	(0.241)	(0.242)	(0.241)	(0.241)	(0.241)
Exercise 1+/week	0.876***	0.882***	0.880***	0.865***	0.868***
	(0.220)	(0.220)	(0.220)	(0.219)	(0.219)
Job (very) insecure	-0.899*	-0.888*	-0.900*	-0.779+	-0.777+
	(0.441)	(0.441)	(0.442)	(0.430)	(0.430)
not employed w2&4 or missing	-1.479	-1.461	-1.481	-1.552	-1.542
	(1.095)	(1.093)	(1.095)	(1.081)	(1.080)

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Working nights	-2.315+	-2.201+	-2.249+	-2.227+	-2.173+
	(1.308)	(1.317)	(1.313)	(1.286)	(1.294)
Working shifts	-0.931+	-0.827	-0.866	-0.646	-0.602
	(0.526)	(0.546)	(0.545)	(0.524)	(0.540)
Financial strain*time	-0.513**	-0.507**	-0.513**	-0.513**	-0.509**
	(0.177)	(0.176)	(0.177)	(0.176)	(0.176)
Nonwhite*time	-0.597***	-0.598***	-0.603***	-0.593***	-0.596***
	(0.162)	(0.162)	(0.163)	(0.162)	(0.163)
Immigrant 8+YSM*time	-0.019	-0.015	-0.012	-0.018	-0.014
	(0.189)	(0.188)	(0.189)	(0.190)	(0.188)
Immigrant 0-7YSM*time	-0.344	-0.329	-0.333	-0.341	-0.328
	(0.215)	(0.214)	(0.214)	(0.215)	(0.214)
Physical demands		-0.047			-0.018
		(0.059)			(0.060)
Physical demands*time		-0.013			-0.012
		(0.023)			(0.023)
Psycho-social demands			-0.019		
			(0.046)		
Psycho-social demands*time			-0.007		
			(0.018)		
Work autonomy				-0.649**	-0.640**
				(0.230)	(0.235)
Work autonomy*time				-0.026	-0.015
				(0.091)	(0.092)
Constant	53.349***	53.271***	53.328***	53.189***	53.161***
	(0.280)	(0.295)	(0.285)	(0.293)	(0.302)
var(time)	0.412+	0.408+	0.409+	0.412+	0.409+
	(0.200)	(0.200)	(0.200)	(0.200)	(0.200)
var(cons)	11.962***	11.955***	11.960***	11.809***	11.809***
	(1.677)	(1.700)	(1.677)	(1.653)	(1.654)
covar(cons, time)	0.856	0.854	0.855	0.860	0.859
	(0.387)	(0.386)	(0.387)	(0.384)	(0.384)
var(within-person, UKborn)	20.848***	20.860***	20.854***	20.855***	20.863***
	(1.101)	(1.102)	(1.101)	(1.102)	(1.102)
Var(within-person, 8+ YSM)	22.282***	22.241***	22.284***	22.182***	22.154***
	(3.309)	(3.295)	(3.301)	(3.293)	(3.284)
Var(within-person, 0-7 YSM)	25.357***	25.357***	25.356***	25.308***	25.303***
	(2.854)	(2.853)	(2.853)	(2.848)	(2.846)
aic	42896.2	42898.3	42899.5	42887.1	42890.4
bic	43114.8	43130.5	43131.7	43119.3	43136.3
Observations	1,759 (6,841)	1,759 (6,841)	1,759 (6,841)	1,759 (6,841)	1,759 (6,841)

Note: Coefficients and cluster-robust standard errors (in brackets). + p<.10; * p<.05; ** p<.01; *** p<.001. Reference categories: Immigrant cohorts: UK-born; educational level: no qualification. Time is years since first interview. Continuous predictors are centered at their means.

Table 63 Results of multilevel growth models for health (SF-12 PCS) for non-degree population, models without controls

	model 4	model 5 a	model 5b	model 5c	model 5d
Parameter	**base**	**physical**	**psycho-social**	**work autonomy**	**physical & work autonomy**
time	-0.10*	-0.06	-0.09*	-0.09*	-0.06
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Immigrant 8+YSM	-1.11+	-1.11+	-1.08+	-0.98+	-0.99+
	(0.59)	(0.59)	(0.59)	(0.59)	(0.59)
Immigrant 0-7YSM	0.48	0.46	0.49	0.58	0.55
	(0.48)	(0.48)	(0.47)	(0.48)	(0.48)
age	-0.09***	-0.09***	-0.09***	-0.09***	-0.09***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
age squared	-0.00***	-0.00**	-0.00***	-0.00**	-0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
GCSE/lower	0.53	0.48	0.52	0.46	0.43
	(0.44)	(0.44)	(0.44)	(0.45)	(0.45)
A-level/below BA	1.37**	1.22**	1.33**	1.22**	1.12*
	(0.44)	(0.44)	(0.44)	(0.44)	(0.45)
age*time	-0.02***	-0.02***	-0.02***	-0.02***	-0.02***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Immigrant 8+YSM*time	-0.41+	-0.36+	-0.37+	-0.38+	-0.35
	(0.22)	(0.22)	(0.22)	(0.22)	(0.22)
Immigrant 0-7YSM*time	-0.97***	-0.91***	-0.95***	-0.94***	-0.90***
	(0.26)	(0.26)	(0.26)	(0.26)	(0.26)
Physical demands		-0.00			0.01
		(0.04)			(0.04)
Physical demands*time		-0.06***			-0.06***
		(0.01)			(0.01)
Psycho-social demands			-0.03		
			(0.04)		
Psycho-social demands*time			-0.03*		
			(0.01)		
Work autonomy				-0.34*	-0.36*
				(0.16)	(0.16)
Work autonomy*time				-0.08	-0.04
				(0.06)	(0.06)
Constant	52.24***	52.33***	52.28***	52.35***	52.40***
	(0.43)	(0.44)	(0.43)	(0.44)	(0.44)

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var(time)	0.88	0.85	0.88	0.87	0.85
	(0.17)	(0.17)	(0.17)	(0.17)	(0.17)
var(cons)	27.74***	27.71***	27.69***	27.66***	27.64***
	(1.91)	(1.91)	(1.91)	(1.90)	(1.90)
covar(cons, time)	-0.66+	-0.66+	-0.67+	-0.67+	-0.66+
	(0.45)	(0.44)	(0.45)	(0.44)	(0.44)
var(within-person, UKborn)	27.09***	27.10***	27.10***	27.09***	27.10***
	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)
Var(within-person, 8+ YSM)	35.93***	36.09***	35.93***	35.91***	36.07***
	(3.76)	(3.78)	(3.75)	(3.76)	(3.78)
Var(within-person, 0-7 YSM)	29.43***	29.50***	29.50***	29.46***	29.51***
	(4.86)	(4.86)	(4.86)	(4.88)	(4.87)
aic	90974.2	90956.4	90969.6	90963.8	90950.4
bic	91102.2	91099.4	91112.6	91106.8	91108.6
Observations	3,691 (13,767)	3,691 (13,767)	3,691 (13,767)	3,691 (13,767)	3,691 (13,767)

Note: Coefficients and cluster-robust standard errors (in brackets). + p<.10; * p<.05; ** p<.01; *** p<.001. Reference categories: Immigrant cohorts: UK-born; educational level: no qualification. Time is years since first interview. Continuous predictors are centered at their means.

Table 64 Results of multilevel growth models for health (SF-12 PCS) for non-degree population, models with controls

Parameter	model 7 **controls - only**	model 6a **physical**	model 6b **psycho-social**	model 6c **work autonomy**	model 6d **physical & work autonomy**
time	-0.038	-0.019	-0.032	-0.036	-0.019
	(0.043)	(0.044)	(0.043)	(0.043)	(0.044)
Immigrant 8+YSM	0.145	0.109	0.138	0.149	0.122
	(0.638)	(0.638)	(0.638)	(0.640)	(0.641)
Immigrant 0-7YSM	1.105*	1.046*	1.096*	1.106*	1.058*
	(0.512)	(0.511)	(0.512)	(0.514)	(0.513)
age	-0.103***	-0.103***	-0.103***	-0.103***	-0.103***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
age squared	-0.003**	-0.003**	-0.003**	-0.003**	-0.003**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
GCSE/lower	0.249	0.254	0.244	0.240	0.245
	(0.444)	(0.444)	(0.443)	(0.446)	(0.446)
A-level/below BA	0.657	0.657	0.639	0.630	0.634
	(0.444)	(0.448)	(0.443)	(0.449)	(0.452)
Caribbean	0.874	0.870	0.866	0.890	0.889
	(0.951)	(0.952)	(0.947)	(0.944)	(0.946)
Black African	1.078	1.078	1.098	1.081	1.081
	(0.799)	(0.798)	(0.797)	(0.802)	(0.801)
Asian (other)	-1.625	-1.646	-1.612	-1.617	-1.632
	(1.081)	(1.081)	(1.080)	(1.080)	(1.081)
Indian	-1.615*	-1.612*	-1.608*	-1.591*	-1.587*
	(0.746)	(0.745)	(0.746)	(0.748)	(0.746)
Pakistani	0.447	0.443	0.464	0.459	0.460
	(0.785)	(0.785)	(0.784)	(0.785)	(0.785)
Bangladeshi	-1.397	-1.402	-1.381	-1.413	-1.413
	(1.139)	(1.140)	(1.128)	(1.136)	(1.137)
mixed/other	-0.923	-0.934	-0.934	-0.925	-0.933
	(1.090)	(1.092)	(1.087)	(1.084)	(1.085)
Household income	4.173**	4.714**	4.198**	4.154**	4.621**
	(1.483)	(1.535)	(1.483)	(1.500)	(1.543)
Material deprivation score 15+	-0.929***	-0.932***	-0.926***	-0.918***	-0.920***
	(0.236)	(0.236)	(0.236)	(0.237)	(0.237)
Poor diet	-0.248	-0.246	-0.243	-0.244	-0.242
	(0.220)	(0.220)	(0.220)	(0.221)	(0.221)
Smoker	-0.438+	-0.478+	-0.442+	-0.443+	-0.481+
	(0.260)	(0.262)	(0.260)	(0.260)	(0.262)
Brisk walking pace	1.668***	1.668***	1.667***	1.664***	1.666***
	(0.193)	(0.194)	(0.193)	(0.193)	(0.194)

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Exercise 1+/week	0.513*	0.511*	0.511*	0.504*	0.504*
	(0.205)	(0.205)	(0.205)	(0.205)	(0.205)
Social support	0.135***	0.135***	0.135***	0.133***	0.133***
	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
Working shifts	-0.565*	-0.554+	-0.499+	-0.505+	-0.501+
	(0.288)	(0.291)	(0.292)	(0.295)	(0.296)
Household income*time	0.876+	0.420	0.837+	0.744	0.372
	(0.500)	(0.525)	(0.499)	(0.511)	(0.530)
Smoker*time	-0.183*	-0.153+	-0.175+	-0.180*	-0.152+
	(0.091)	(0.092)	(0.091)	(0.091)	(0.092)
Age*time	-0.020***	-0.019***	-0.019***	-0.019***	-0.019***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Immigrant 8+YSM*time	-0.392+	-0.361+	-0.361+	-0.377+	-0.355
	(0.215)	(0.216)	(0.216)	(0.215)	(0.216)
Immigrant 0-7YSM*time	-0.959***	-0.916***	-0.940***	-0.941***	-0.909***
	(0.260)	(0.260)	(0.262)	(0.260)	(0.260)
Physical demands		0.068			0.069+
		(0.042)			(0.042)
Physical demands*time		-0.054***			-0.052***
		(0.015)			(0.015)
Psycho-social demands			-0.004		
			(0.041)		
Psycho-social demands*time			-0.027+		
			(0.014)		
Work autonomy				-0.038	-0.081
				(0.163)	(0.165)
Work autonomy*time				-0.064	-0.030
				(0.056)	(0.057)
Constant	52.347***	52.318***	52.352***	52.354***	52.323***
	(0.483)	(0.487)	(0.483)	(0.485)	(0.488)
var(time)	0.864	0.844	0.858	0.859	0.842
	(0.166)	(0.166)	(0.166)	(0.166)	(0.166)
var(cons)	25.857***	25.824***	25.838***	25.849***	25.819***
	(1.834)	(1.830)	(1.836)	(1.833)	(1.829)
covar(cons, time)	-0.67+	-0.650+	-0.677+	-0.669+	-0.649+
	(0.434)	(0.432)	(0.434)	(0.434)	(0.432)
var(within-person, UKborn)	27.102***	27.105***	27.108***	27.107***	27.107***
	(0.820)	(0.820)	(0.820)	(0.820)	(0.820)
Var(within-person, 8+ YSM)	35.628***	35.727***	35.637***	35.605***	35.717***
	(3.688)	(3.705)	(3.681)	(3.682)	(3.703)
Var(within-person, 0-7 YSM)	29.453***	29.483***	29.525***	29.460***	29.486***
	(4.897)	(4.896)	(4.902)	(4.904)	(4.900)

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aic	90795.7	90786.9	90794.3	90797.4	90789.9
bic	91051.7	91058.0	91065.4	91068.5	91076.0
Observations	3,691 (13,767)	3,691 (13,767)	3,691 (13,767)	3,691 (13,767)	3,691 (13,767)

Note: Coefficients and cluster-robust standard errors (in brackets). + p<.10; * p<.05; ** p<.01; *** p<.001. Reference categories: Immigrant cohorts: UK-born; educational level: no qualification. Time is years since first interview. Continuous predictors are centered at their means.