The changing ethnic profiles of Glasgow and Scotland, and the implications for population health

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Summary

The overall aim of this work was to gain a better understanding of the potential population health implications of the changing ethnic profiles of Scotland and, in particular, Glasgow. This is important, given both the increasing ethnic diversity of Scotland's population, and the known variation in the risks of particular diseases across different population groups.

The evidence regarding the links between ethnicity and health, particularly in a Scottish context, was reviewed, alongside analyses of past and future trends in the size of the non-White ethnic minority population in Scotland as a whole, West Central Scotland and, especially, Glasgow.

From the evidence, it is clear that the relationship between ethnicity and health is an extraordinarily complex one. This complexity is arguably enhanced within a Scottish context given the quite different socioeconomic profile of many ethnic minority groups compared with those in other countries such as England and the USA. Proportionately, much higher numbers of some of the key ethnic minority groups (e.g. Chinese, Indian, Pakistani) live in much less socioeconomically disadvantaged circumstances in Scotland compared with the rest of Britain.

Overall levels of population health, as measured by indicators such as life expectancy, have been shown to be better among many non-White ethnic minority groups in Scotland compared with the White Scottish population. However, such analyses mask a highly complicated set of varying risks of particular diseases among different groups. There is, for example, a lower risk of cancer among many groups (compared with White Scots), but a similar (and in some cases, greater) risk of stroke. Those of Pakistani origin have a much greater risk of heart disease and diabetes, and the latter is also true of the Indian population. Chinese men and women tend to have a lower risk of many diseases (although some exceptions – e.g. liver disease – do apply). For many conditions (e.g. respiratory, mental health related, gastrointestinal), the relationships are complex, with no clear patterns across ethnic minority groups emerging.

The complex nature of the evidence extends to understanding the underlying causes of these differences in health status. These include the impact of the 'healthy migrant' effect (i.e. the better health characteristics associated with those who have the resources to migrate), how that effect may or may not change over time, and, not least, the association between ethnicity and different types and measures of socioeconomic circumstance.

The size of the ethnic minority population in Scotland, and particularly in Glasgow, has increased considerably in the last two decades. There was a four-fold increase between 1991 and 2011 in the proportion of the total population resident in both the city and the country belonging to a non-White ethnic group. By 2011, the latter accounted for 12% of the population of Glasgow, a total of just under 70,000 people. Although the national 2011 figure was, at 4%, small in percentage terms, it still equated to approximately 211,000 people. Looking forward, despite a number of uncertainties in relation to precise estimates, the size of Scotland's non-White minority population looks set to increase considerably. For example, forecasts suggest that by 2031, one fifth of Glasgow's total population (and one quarter of children under 16 years) will belong to a non-White minority group. There is a clear need, therefore, for policy-makers and service-planners to seek to understand the possible implications of these changes to the population.

Background and aims

Links between ethnicity and health status, including evidence of variation in the risks of particular diseases for certain population groups, have been the focus for a considerable amount of research. This is important because the composition of Scotland's, and especially Glasgow's, population has changed considerably in recent years with notable increases in the number of people classed as belonging to an ethnic minority. The overall aim of this work, therefore, was to gain a better understanding of what the population health implications of these changing ethnic profiles might be.

The specific research questions were:

1. What is known about the links between ethnicity and health (including their interactions with socioeconomic position) (a) in developed countries; (b) in Scotland in particular?
2. How have Scotland's, and Glasgow's, populations changed recently in relation to ethnic composition, and what are the likely future changes?
3. What are the potential implications of these changes for future health status?

Methods

Important note

It should be noted that the concept of ethnicity is one that is contested, and which encompasses a broad range of factors including race (itself contested), culture (which is often itself associated with religious differences) and context-specific factors such as discrimination and stigma against minority populations. As such, ethnicity can mean different things to different audiences and has different implications[1]. In this paper, we use a fairly specific definition, based on how individuals identify themselves in response to census questions.

The paper also employs a narrow definition of 'ethnic minority'. Partly on account of the nature of some of the (Scottish-based) evidence found in the research literature, and also because of the available population projection data discussed later in the paper, this project has focused on the *non-White* ethnic minority population. In discussing ethnic 'minorities' in a specifically Scottish context, therefore, it does not consider (for example) the White Irish or White Polish population (both of which accounted for significant proportions of the Scottish population in 2011[i]), nor the White Gypsy/Traveller population, the numbers of which are small (0.1% of Scottish population in 2011), but who are characterised by having a high prevalence of a number of particular health issues[2,3].

1) The changing ethnic profile of Glasgow and Scotland

Data from the census were examined for Scotland, Glasgow and Glasgow neighbourhoods[ii] to examine change over time in the size of the population classed as belonging to a non-White ethnic minority group[iii] between 1991 and 2011.

Future projections of the size of ethnic minority population groups were obtained from data made available by the University of Leeds and partners[4]. Projections have been produced for different ethnic groups, by UK local authority, age and sex for the period 2011-2061. They were calculated by means of a complex set of modelling analyses using existing census data on population, internal migration and immigration, and linked estimates of mortality, fertility, and emigration. Two sets of projections were produced, one based on an additional assumption regarding the impact of 'Brexit' on international migration – and it is this set of projections that have been used here. Although the data cover a 50 year period, we have – for reasons outlined later in the paper – limited our analyses of them to 2011-2031. Data were analysed for Scotland, Glasgow and West Central Scotland (WCS)[iv].

[i] In the 2011 Census, just over 54,000 people in Scotland identified themselves as 'White: Irish' (1% of the total), and over 61,000 identified themselves as 'White: Polish' (1.2% of the total).

[ii] There are 56 such 'neighbourhoods' across the city of Glasgow. Previously known as housing forum areas, and created by Glasgow City Council in consultation with housing associations, these have been used extensively in analyses of health and wellbeing in the city, including within the Understanding Glasgow indicators project (www.understandingglasgow.com).

[iii] For the 2011 Census, this includes the following ethnic groups: Mixed or multiple ethnic groups; Asian, Asian Scottish or Asian British; African; Caribbean or Black; other ethnic groups.

[iv] We use a definition of WCS that has been employed in previous studies. It is defined by 11 local authority areas: East Ayrshire; East Dunbartonshire; East Renfrewshire; Glasgow City; Inverclyde; North Ayrshire; North Lanarkshire; Renfrewshire; South Ayrshire; South Lanarkshire; and West Dunbartonshire.

2) Ethnicity and health: reviewing the evidence

There is a considerable amount of research evidence of the links between ethnicity and health status. However, the geographical context for that evidence is highly important. Notably, a lot of evidence for poorer health among particular ethnic minorities in developed countries has come from the USA, where such groups are also more likely to live in poverty compared with the majority White population[5,6]. The same is also true of minority ethnic groups in England[7-9]. However, as will be discussed, a different socioeconomic context applies in Scotland[2,8]. For that reason, the brief review of the literature focused primarily (although not exclusively) on the Scottish context. This was arguably a short-sighted approach; however, it can equally be argued that it would be potentially more problematic to apply evidence from other settings, especially when important differences in socioeconomic context have not been taken into account.

It should be noted that research was also limited primarily to studies which examined *health-specific* outcomes. There is a wealth of valuable Scottish research into ethnicity and other important topics such as housing[10], homelessness[11], service provision[12] and more, but these were not the principal focus of the study. Similarly, smaller, more qualitative, local studies were also largely excluded.

For these and other reasons, the main source of the literature, therefore, was from the Scottish Health and Ethnicity Linkage Study (SHELS) [13,14]. Based on the linkage of 2001 Census data to routinely collected morbidity and mortality data, this study has been able to provide unique insights into the health profiles of ethnic groups living in Scotland. It should be noted, however, that as most SHELS studies focused on outcomes of first hospitalisation or death, they do not measure the true *prevalence* of diseases among different ethnic groups. All published journal papers were examined. This was augmented by consulting various articles on ethnicity and health (including other work cited within those papers) from personal collections, supplemented by a (relatively limited) search of literature databases for reviews of the subject[v]. The limitations of this approach are discussed briefly later in this paper.

[v] Titles only (not abstracts) of papers in the EMBASE and MEDINFO databases (only for the period 1996 to the present) were searched using the following search terms: ethnic* and (health or mortality or morbidity or disease*) and (review or summary).

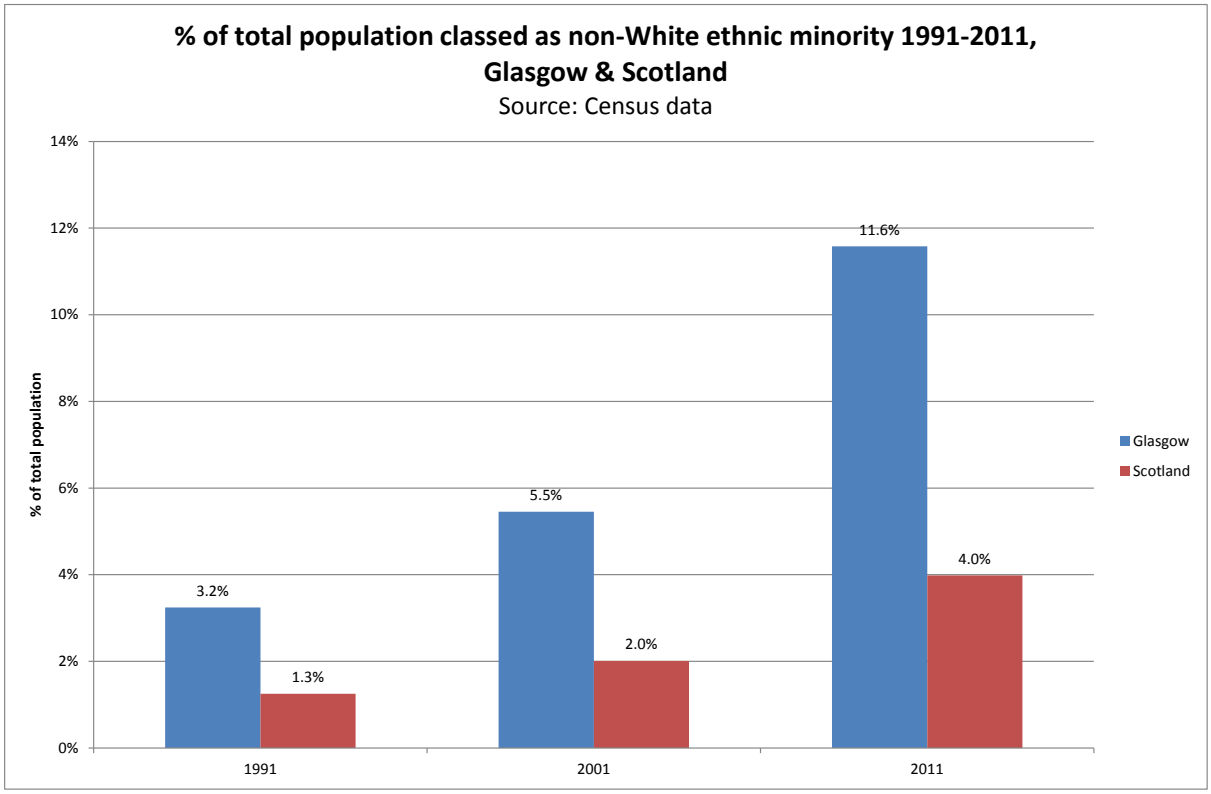
Results

1) The changing ethnic profile of Glasgow and Scotland

Past trends

The size of the ethnic minority population in Scotland, and particularly in Glasgow, has increased considerably in the last two decades. Figure 1 shows a near four-fold increase between 1991 and 2011 in the proportion of the total population resident in both the city and the country belonging to non-White ethnic group. By 2011, the latter accounted for 12% of the population of Glasgow, a total of just under 70,000 people. Although the national 2011 figure is small in proportionate terms, it still equates to approximately 211,000 people.

Figure 1.



It is worth noting that part of the increase in the size of the non-White ethnic minority population in Glasgow between 2001 and 2011 is likely to relate to the arrangement between Glasgow City Council and the UK government Home Office which saw thousands of asylum seekers housed in the city from 2000[15]. However, for a number of reasons, it is very difficult to quantify the precise contribution of this group to the increase.

Across Glasgow's neighbourhoods, the relative size of the ethnic minority population varies considerably. Figure 2 shows trends between 1991 and 2011 for four selected neighbourhoods in the city[vi]. As can be seen, in part of Pollokshields East, for example, by 2011 over half the

[vi] These areas were selected for illustrative purposes, and on the basis of having among the highest percentage figures for the minority non-White population in 2011.

approximately 7,000 population were from a non-White ethnic group. In a number of other areas (including those shown as examples in Figure 2), ethnic minority groups account for over one third of the total population. Across all Glasgow's neighbourhoods (areas with an average population size of approximately 10,000 people), the size of the non-White population in 2011 ranged from 2% (Springboig and Barlanark) to 56% (Pollokshields East). Previous analyses have shown that each of these neighbourhoods saw an increase in the size of the minority non-White population between 2001 and 2011[16].

Figure 2.

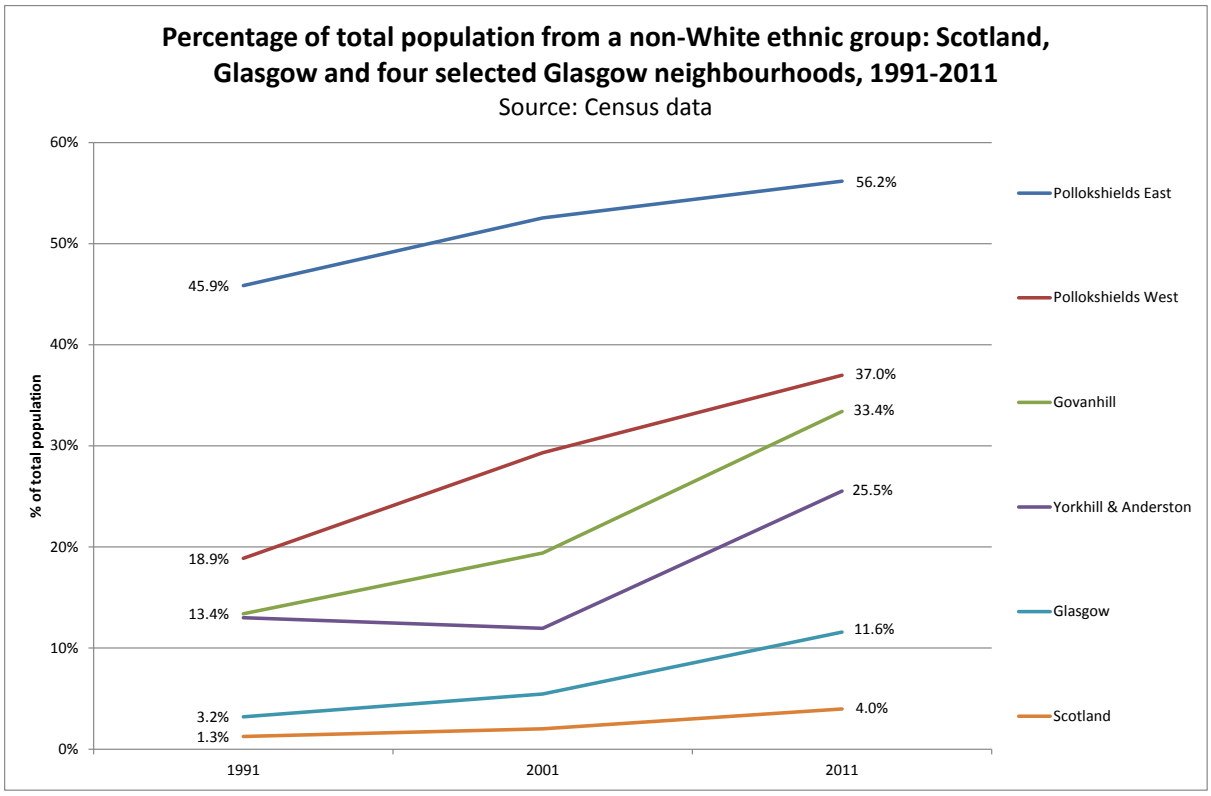
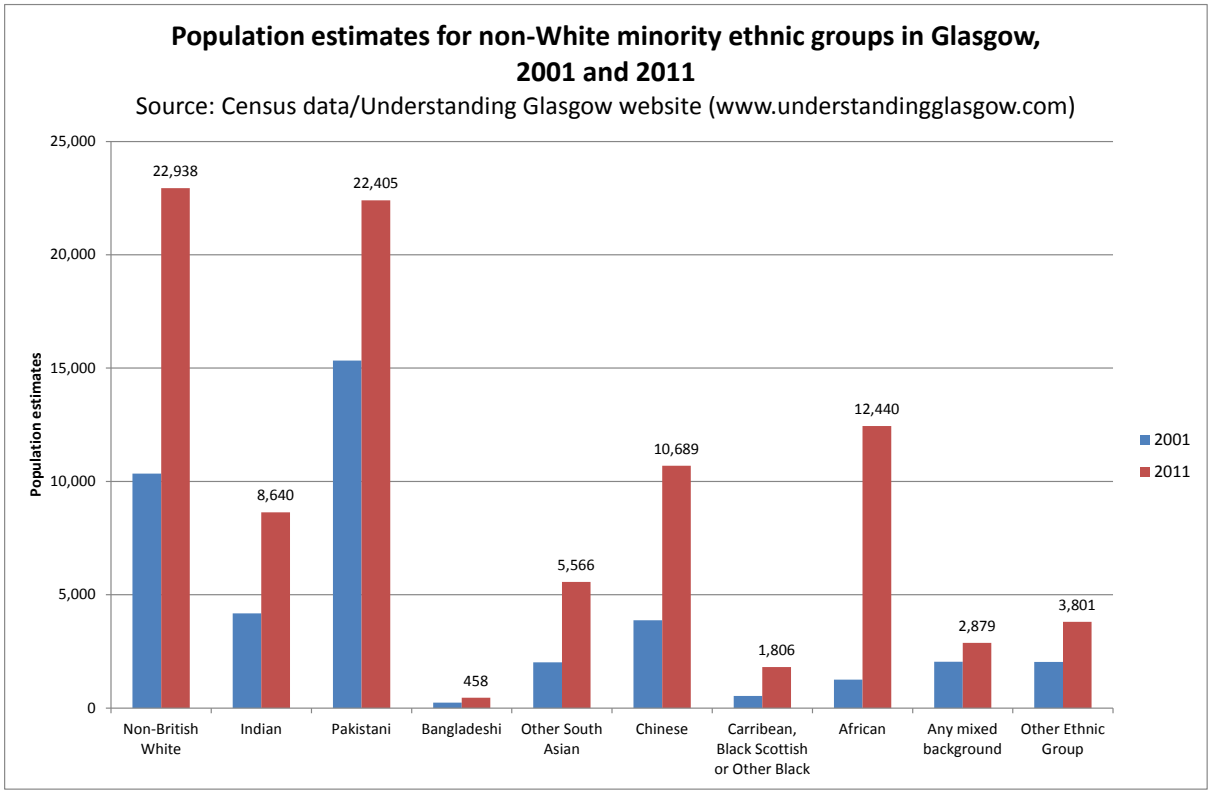


Figure 3 (taken from the Understanding Glasgow website[17]) shows that in the city as a whole, the biggest increases in the size of different ethnic minority groups between 2001 and 2011 were – in proportionate terms – among those of African origin. However, in absolute terms, the biggest individual non-White group was that of Pakistani origin, with more than 22,000 resident in the city at the time of the last census (approximately one third of the total non-White population in the city).

Figure 3.

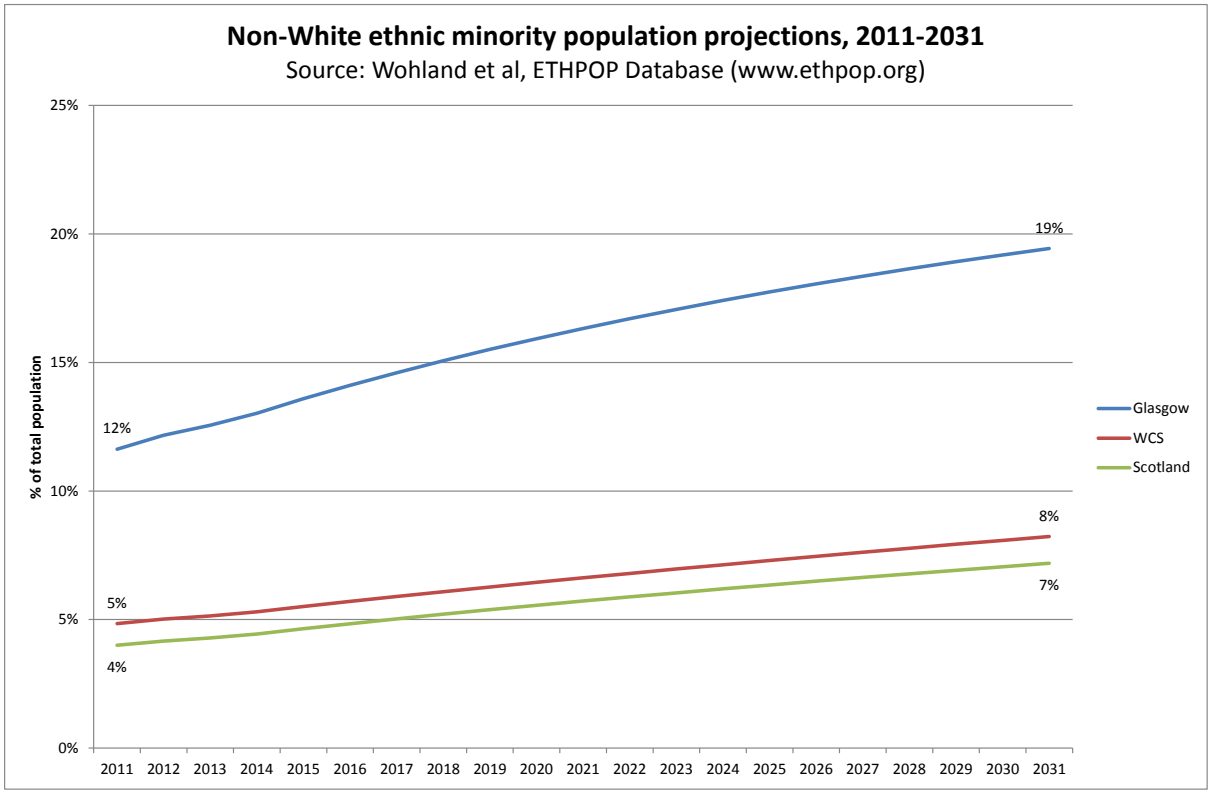


Future trends

How might these figures change in the years to come? Some insight into this can be obtained from the recently published population projections by ethnic group produced by the University of Leeds and partners. Clearly any projections of population size are subject to a whole range of uncertainties, limitations and assumptions, and in the case of *ethnicity*-based projections, yet more uncertainties (e.g. in relation to future immigration policy in Scotland and the UK) apply. Thus we must be extremely cautious in our use and interpretation of these data. That said, the projections take a complex set of factors into account, and comparisons with previous 2001-based projections suggested a reassuring level of accuracy, at least over a shorter period[18]. Thus they are a potentially valuable resource for our purposes, especially if we limit our own analyses to a reasonably short (and therefore, potentially less uncertain) time period.

Limiting our analyses to a 20-year period, Figure 4 shows the projected increases in the percentages of the total populations of Scotland, West Central Scotland (WCS) and Glasgow classed as non-White ethnic minority groups between 2011 and 2031. As can be seen, nationally the figure is expected to increase from 4% to 7% (similar to the projected increase for WCS of 5% to 8%). In absolute terms this equates to an increase from approximately 212,000 to 411,000 individuals. The equivalent figures for Glasgow suggest an increase from 12% to 19% of the total population (approximately 69,000 to 123,000 individuals).

Figure 4.



Figures 5 and 6 suggest that broadly similar increases will be seen among males and females (Figure 5) and different age groups (Figure 6) in all three areas. In Glasgow and WCS in particular, there will continue to be greater numbers of males than females. It is also notable that Figure 6 suggests that by 2031 around a quarter of children in Glasgow will be from an ethnic minority group.

Figure 5.

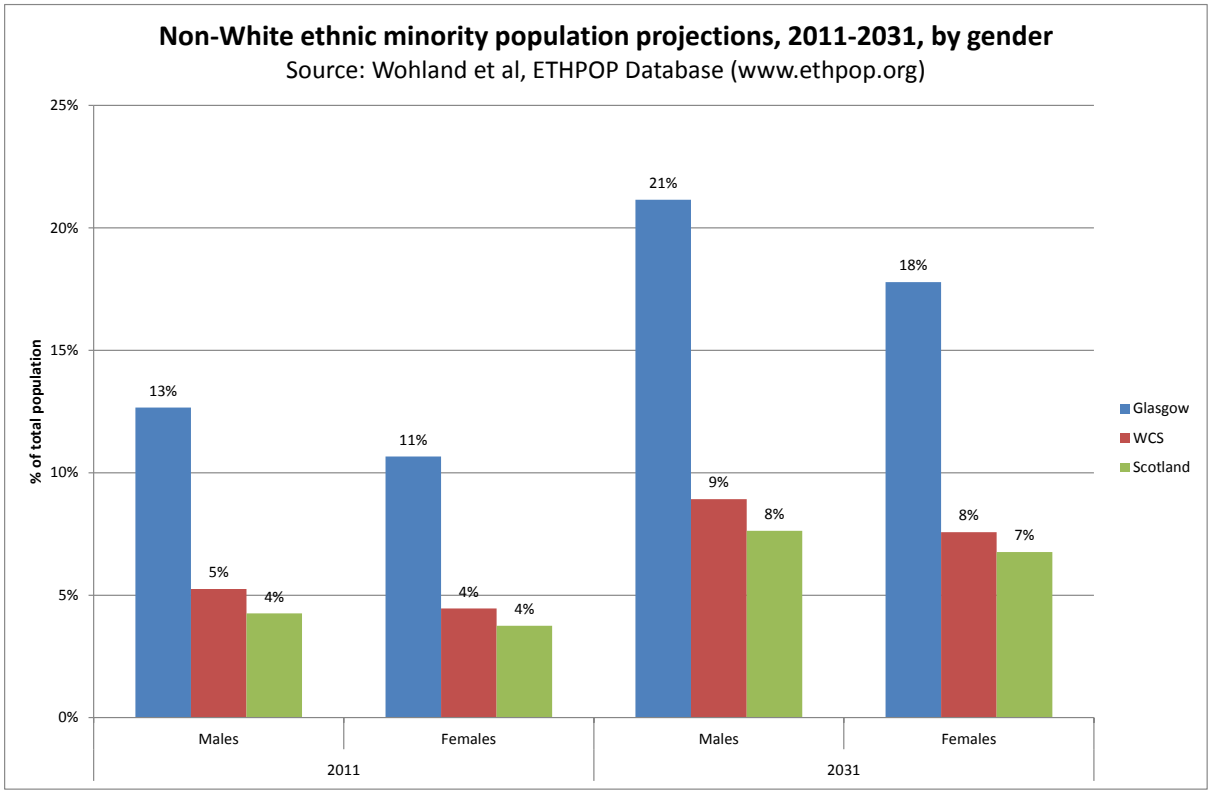
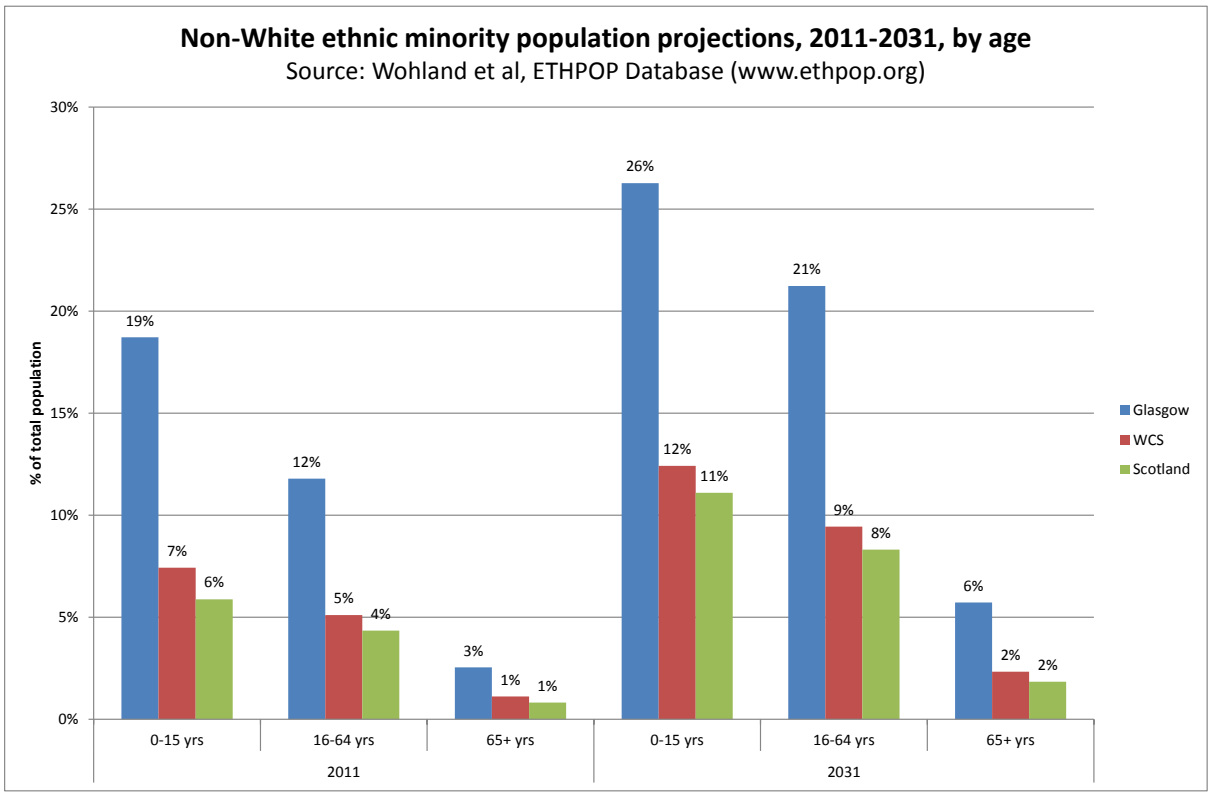


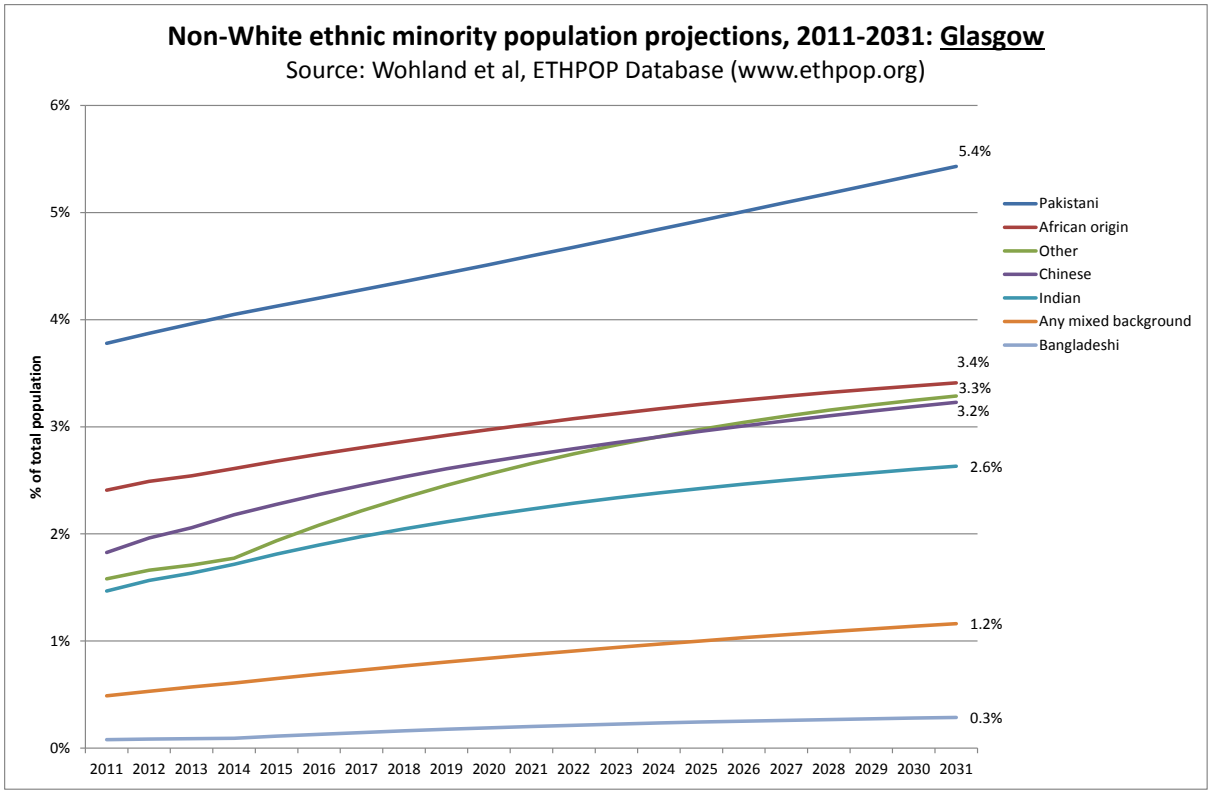
Figure 6.



Finally, Figure 7 suggests that in Glasgow, the biggest single non-White ethnic minority group will continue to be those of Pakistani origin. By 2031, it is predicted that this group will account for over

5% of the total population of the city (just under 35,000 individuals, approximately 28% of the non-White population).

Figure 7.



As stated earlier in the paper, the projections are derived from complex modelling of population, fertility, internal migration and immigration, mortality and emigration data. Across the UK, the projected increase in the numbers of some ethnic minority groups (e.g. Pakistanis) is in large part explained by higher fertility rates and younger age structures, while the growth of other groups (e.g. Chinese) relates more to increases in international migration[19].

2) Ethnicity and health: reviewing the evidence

Overview

The general perception of ethnicity and health in Scotland is one of ethnic minority groups experiencing better health than the White Scottish population. This has certainly been shown to be the case for most non-White groups in relation to better self-assessed health[2,3], longer life expectancy[20,vii] and lower all-cause mortality[21,viii]. This has arguably led to – from some quarters – an over-simplistic view of underlying causes which ignores both important disease-specific variation in health status between different ethnic groups, as well as its important socioeconomic context:

[vii] The cited SHELS research did not calculate life expectancy for all ethnic groups, only those with sufficient numbers including males and females of Indian, Pakistani and Chinese origin. The analyses did not adjust for SEP.

[viii] The cited research by Millard *et al*.[21] (based on analyses of the Scottish Longitudinal Study) only compared mortality between the White population and those of Asian origin (but excluding Chinese). Mortality rates were generally higher among Whites.

> "High levels of smoking and alcohol consumption have most probably contributed to the lower life expectancy of White Scots, along with poor diet... I hope we can learn lessons from ethnic minority communities that can be used to improve the health of the whole population."[22,23]

From the wealth of research evidence now available, it is clear that the reality is much more complex than such statements suggest is the case. Different ethnic groups in Scotland are known to have lesser or greater risks of a great many different morbidities: for example, compared with White Scots, South Asian groups are known to have higher rates of important diseases such as heart disease[24], diabetes[25] and some respiratory conditions[26], while Chinese men and women have lower rates of cancer[27] (and other conditions[28]). Interpretation of the underlying reasons for this is made more difficult because of the complexities of understanding the influence of socioeconomic position (SEP)[2,5,29-31], linked to other important characteristics such as the 'healthy migrant' effect[,32]. With regard to the latter, it is notable that lower all-cause mortality among non-White groups compared with White Scottish[33] and White English[34] has been observed among those born outside the UK, but *not* among those born in the UK – suggesting that descendants of immigrants do not benefit from the healthy 'selection' effects of migration. To paraphrase the title of a review, when it comes to understanding the links between ethnicity and health, there is a need 'to learn to live with complexity'.

As stated above, this complexity – particularly in terms of the relationship between ethnicity, health and SEP – also extends to the geographical context of the research evidence. Different results emerge from Scottish and English research (i.e. in terms of whether ethnic minority groups have better or worse health than the native White population) in part because of differences in socioeconomic context, but also (related to this) because of the reference points (White English or White Scottish) used in the analyses. Ethnic minority groups are compared with the White English or the White Scottish population, but of course mortality and morbidity rates tend to be higher among White Scots to start with, which influences the results and interpretation of those comparisons.

In focusing primarily on the Scottish context (in part with an aim of reducing some of this complexity), we are fortunate in having available a wealth of evidence from the SHELS study described above. The study has published results of analyses of a large number of disease categories. This includes: various types of cancer; various diseases of the circulatory system (e.g. stroke, heart disease); alcohol-related conditions; respiratory diseases; mental health disorders; and many more. A number of these are discussed later in this section of the paper.

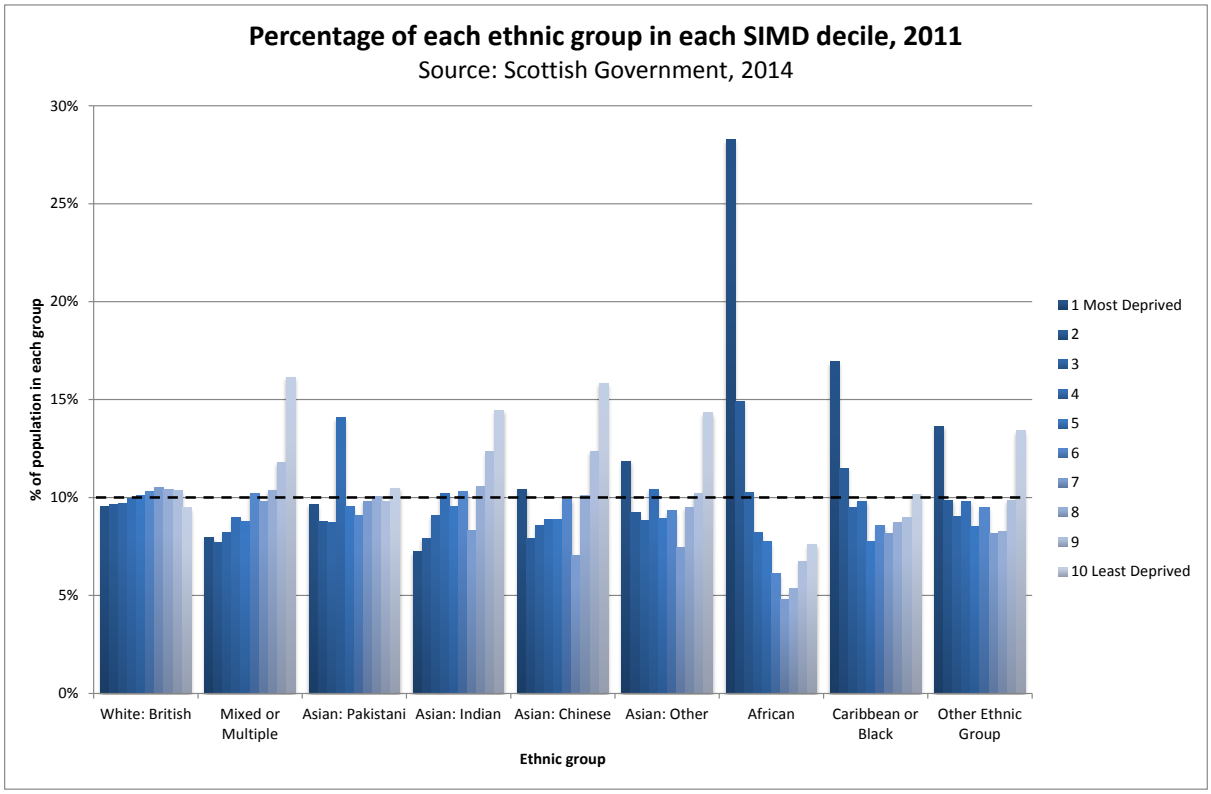
Socioeconomic profile of ethnic minority groups

It is generally assumed that in most developed countries, ethnic minority groups tend to have a more disadvantaged socioeconomic profile, and thus among some populations (in particular, the USA) ethnic inequalities in health are to a large degree a reflection of socioeconomic inequalities in health.

As stated, this is different in Scotland, where a more complex picture is apparent. Analysis of the 2011 Census by the Scottish Government (reproduced in Figure 8 below) shows that among minority

groups, those describing themselves as Indian, Chinese and mixed/multiple ethnic group are more likely to live in the *least* deprived areas of Scotland. High proportions of those of 'other' (non-White) and 'other Asian' ethnic groups live in *both* the least and most deprived areas. This is also the case with the Pakistani population, but with high numbers also living in 'middle' areas[ix]. However, people describing themselves as African, Caribbean or Black are much more likely to be living in the most deprived areas. Further analysis comparing Scottish and English census data highlights the differences between the countries in terms of percentages of the population living in the most deprived neighbourhoods[x]. As Figure 9 (again reproduced from Scottish Government analyses) shows, this is most true of those of Indian, Pakistani, Bangladeshi and mixed/multiple origin.

Figure 8[xi].

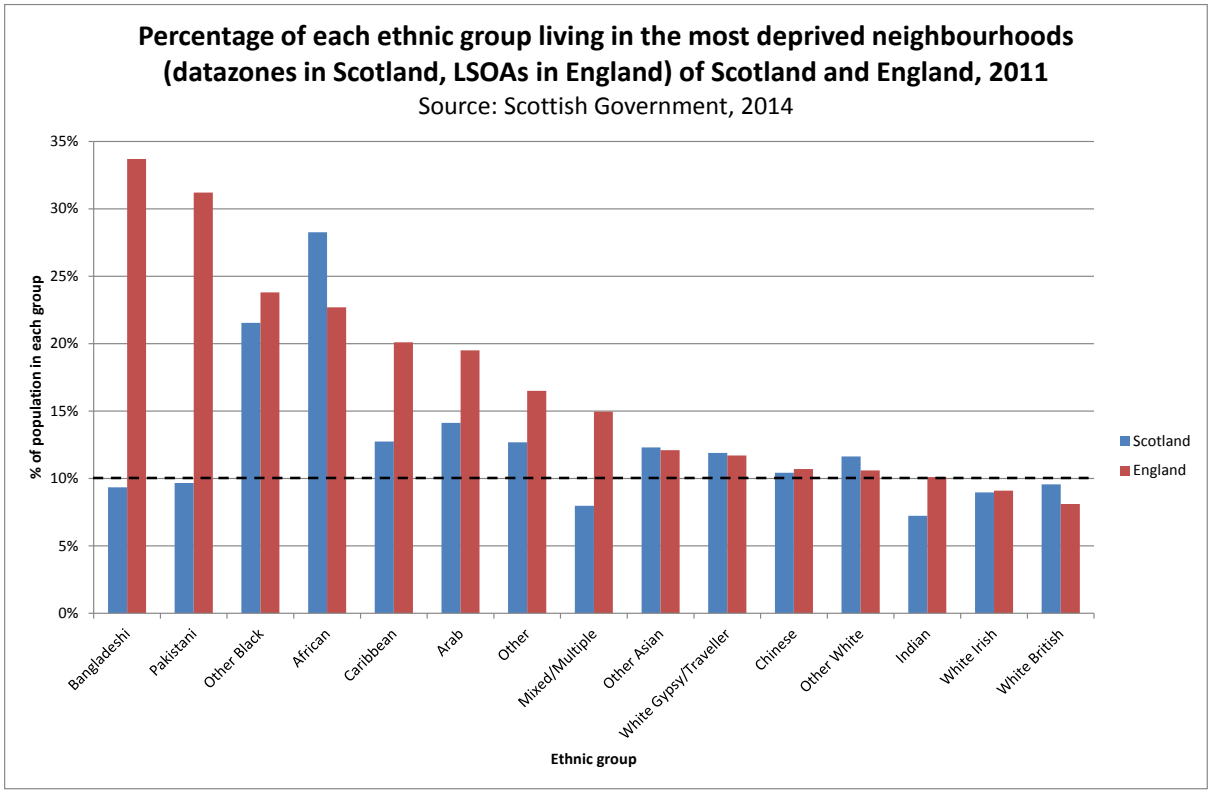


[ix] 'Middle' areas refers to the fact that, as Figure 8 shows, in 2011 the highest percentage of Pakistanis were resident in Decile 4 (where Decile 1 represents the *most* deprived 10% of the population, and Decile 10 represents the *least* deprived).

[x] These areas are datazones in Scotland and Lower Super Output Areas (LSOAs) in England. These are small geographical units used for a number of administrative purposes in each country, including the measurement of neighbourhood deprivation.

[xi] 'SIMD' in Figure 8 refers to the Scottish Index of Multiple Deprivation.

Figure9.



These differences are potentially significant, given that in Scotland as a whole in 2011, 23% of the minority non-White population identified themselves as Pakistani, 18% as Indian or Bangladeshi, and 9% as being of mixed/multiple race[35]. The equivalent figures for Glasgow were 33%, 14% and 4% respectively. However, it is also notable that 17% of the Scottish ethnic minority population (21% in Glasgow) described themselves as African, Caribbean or Black – and much higher numbers of people from those groups live in the most deprived areas (and other census analyses have shown that they also have much higher unemployment rates than the White population)[36]. Other individual (as opposed to area-based) analyses have also shown that there are much higher percentages of Asians (compared with the White population) in social classes I and II (60% of male Asians compared with 30% of the White population; 47% compared with 28% for females), and that there are higher percentages of the Indian and Black populations with high levels of educational attainment, and being in managerial/professional qualifications, compared with the White Scottish population[37].

Understanding the associations between socioeconomic position, ethnicity and health

As stated, much of the international evidence has emphasised the contribution of socioeconomic circumstances in explaining differences in health outcomes between particular ethnic groups. As one recent example from England, Mindell and colleagues showed that the higher levels of poor self-reported health among the vast majority of minority ethnic groups compared with the White population were entirely explained by differences in SEP[38]. However, other English studies were less conclusive[39,40], and in Scottish analyses the role of SEP appears much more complex. Although a

number of the early SHELS[xii] papers either did not appear to explicitly control for SEP (or did not report those analyses: these included analyses in relation to all cancer and site-specific cancers[xiii,27], acute myocardial infarction[xiv,24] and life expectancy), later analyses *did* control for different measures, but results were varied and often only slightly altered the higher or lower risks of particular disease categories for particular ethnic groups. For example, this was the case with: lower risk (compared with White Scots) of stroke among male and female Chinese[41]; greater risk of chest pain[42] and heart failure[43] among Pakistani men; and differences between certain ethnic groups for particular psychiatric outcomes[44]. However, in some cases controlling for SEP *did* have important effects. For example, adjustment increased, and made significant, the higher risk of: stroke among African men; heart failure among Indian men; and alcoholic liver disease among Indian men[45].

From the wider literature – as well as specific Scottish evidence – it is clear that the choice, and indeed the meaning and interpretation, of specific indicators of SEP are important. In one of the SHELS analyses (which focused on cardiovascular disease), Fischbacher *et al*. confirmed that there were different relations between different indicators of SEP and particular ethnic groups. The authors recommended preliminary exploratory analyses to determine what type of indicator was most appropriate for different analyses (advice that subsequent SHELS papers appear to have followed). Other authors (e.g. Kelaher, Stronks & Kunst) have made similar points regarding the multidimensional, complex nature of SEP, and the importance of selecting indicators that are the most appropriate for the analysis in question. This echoes comment by Davey-Smith[29,31], who suggested that although routinely available measures of SEP can be used (to an extent) for comparisons *within* the same ethnic groups, they cannot be used across different groups ("they are of little use for 'controlling out' the impact of socioeconomic differences when attempting to reveal a pure 'ethnicity' effect"). The author discusses a number of reasons why the relationship between SEP, ethnicity and health is so complex (these are summarised later in this paper), but suggests that the complexity is such that there is no simple solution: "the only productive way forward is through studies that recognize the contingency of the relations between socioeconomic position, ethnicity, and particular health outcomes".

'General' health outcomes

As stated earlier, life expectancy and all-cause mortality have been shown to be higher and lower respectively among minority ethnic groups compared with White Scots. This is also true for most (but not all[xv]) minority groups in relation to self-assessed health (as recorded, for example, in the census[2,3]), albeit that there are known difficulties in comparing self-reported health between different cultures which make interpretation even more difficult than other comparative analyses of

[xii] It is worth noting that because the SHELS study is based on the linkage of individual census records, it is possible to take account of a number of individual socioeconomic measures e.g. educational attainment, employment status, occupational social class.

[xiii] In this paper (by Bhopal *et al*.[27]) no SEP indicators were included in the modelling because the eight variables which were looked at "did not meet the requirement of a confounding variable for our purposes". This was reported as being on account of the inconsistent relationships between the different indicators, different ethnic groups and different outcomes (i.e. types of cancer) of interest.

[xiv] In this paper (by Fischbacher *et al*.[24]) incidence rates are presented without adjustment for area deprivation, although some other survival-based analyses are reported as having adjusted for this. Note also that a later (2013) SHELS paper on myocardial infarction by Bansal *et al*. [56] did adjust for a measure of education.

[xv] For example, those of Pakistani origin reported worse general health in the 2001 and 2011 Censuses[2], and by far the worst levels of self-reported poor health were by Gypsy travellers[3].

ethnic health[46- 52]. More complex findings emerged from recent analyses of acute hospital admission rates in Scotland[53]. Based on records which now have ethnicity recorded in almost 80% of cases, they showed (for all hospital admissions in 2013) a varied picture: compared with White Scots, higher admission rates for males and females of Pakistani origin, males classed as 'other Asian' and female Bangladeshis, but lower rates among males of Indian, Chinese and Caribbean/Black origin, and among females classed as Chinese or African. Rates were standardised by age, but not by any measure of SEP.

Cancer

Lower cancer rates (i.e. for all types of cancer combined[xvi]) were observed for the majority of ethnic minority groups (Indian and Pakistani males and females, Other South Asian, African, and Chinese males) compared with the White Scottish population. There were also differences among groups in relation to specific cancers: for example, lower rates of lung cancer and colorectal cancer among male and female Pakistanis respectively; and also of breast cancer among the latter. Rates of prostate cancer were lower among Indian and Pakistani men. As stated earlier, the reported results of analyses were not adjusted for SEP.

It is worth highlighting that other research has also highlighted relatively lower rates of breast cancer among UK South Asian women – but also showed that rates were increasing towards the level of the UK White population[54,55].

Diseases of the circulatory system

A number of circulatory system conditions have been the focus of recent analyses. For example, the SHELS study showed that a number of ethnic minority groups (e.g. Pakistani, Indian males and females, African origin females[xvii]) exhibit a similar risk of stroke (cerebrovascular disease) to the White Scots: this is unlike what has been observed elsewhere (e.g. England), partly reflecting the high prevalence rates among the White Scottish population. However, the risk was lower among male and female Chinese. These analyses adjusted for levels of educational attainment as one measure of SEP.

In terms of heart disease, the evidence shows a consistently greater risk for males and females of Pakistani origin, and a lower risk for male and female Chinese. This has been shown in SHELS studies of chest pain, angina, heart failure and acute myocardial infarction (AMI)[,56,xviii]. Controlling for SEP did not impact greatly on these results. Similar results were shown in separate (non-SHELS) analyses of admissions to hospital with a diagnosis of coronary heart disease (CHD). Higher risks of some forms of heart disease have also been shown for Indian males e.g. the above CHD hospital admissions analyses as well as – once SEP was taken into account – heart failure. Higher rates of CHD hospital admission were also noted for males and females of Bangladeshi origin[xix]. The findings in

[xvi] The analyses included all types of cancer with the exception of non-melanoma skin cancer.
[xvii] It is notable that although African origin females were observed to have a similar risk of stroke, African origin males had a notably higher risk (almost 40%) compared to the White Scottish group.
[xviii] Note that the lower risk of hospitalisation or death from heart failure was shown for Chinese men (age and education adjusted risk ratio: 42.3 (29.5 to 60.6)) but not women (77.3 (50.2 to 119.0)). For the other heart disease-related measures reported, a lower risk was observed for Chinese males and females.
[xix] Most of the SHELS studies cited here adjusted for a measure of SEP. However, the analyses of routine hospital admissions data did not.

relation to the greater risks associated with males and females of Pakistani origin are consistent with other studies[57-59].

Diabetes

The SHELS study has not published incidence rates for diabetes for the whole Scottish population. However, a previous study based on the population of the NHS Tayside area suggested that the prevalence of diabetes was 3-4 times higher among South Asians than non-South Asians in the area, which is consistent with the evidence from other populations. Similarly, SHELS pilot analyses of primary care data for selected GP practices within NHS Board areas of Lothian and Greater Glasgow & Clyde showed prevalence rates (unadjusted for SEP) to be 2-3 times higher among males and females of Indian and Pakistani populations compared with White Scots.

Liver disease, alcoholic liver disease, and all alcohol-related diseases

In contrast to most disease-specific analyses reported by SHELS, Chinese men and women were shown to be at much greater risk of all liver disease than the White Scottish population. A higher risk was also observed for females of Pakistani origin and 'other' South Asian men.

For alcoholic liver disease (ALD) and the broader category of alcohol-related diseases (ARD), Indian men were observed to be at considerably greater risk than White Scots (for example, 60% greater risk of hospitalisation or death from ALD). Men and, in particular, women of mixed origin were also at much greater risk of ARD than White Scots. However, many other ethnic groups had lower risks of these conditions than White Scots, for example Pakistani men (ALD, ARD) and women (ARD), and Chinese men and women (ARD). All analyses adjusted for a measure of SEP.

Respiratory conditions

A fairly complex set of results emerged from SHELS analyses of various respiratory conditions. However, there were some consistent findings in terms of observed lower risks (compared with White Scots) for Chinese males and females, and higher risks for males and females of Pakistani origin, for respiratory disorders generally[60] and, more specifically, for asthma and lower respiratory tract infections (which include pneumonia and influenza)[61]. In addition, a higher risk of chronic obstructive pulmonary disease (COPD) was shown for those of mixed background (males and females), while Indian men were shown to be at higher risk of asthma but lower risk of COPD. All analyses controlled for measures of SEP.

Mental health disorders

One SHELS study analysed psychological disorders based on admissions to psychiatric hospitals. No clear patterns by ethnic group emerged with the exception of notably lower risks of hospitalisation for Indian females and Chinese males and females, and a higher risk among females of African origin. These differences (compared with White Scots) persisted after adjustment for SEP.

Other research, however, has highlighted the fact that levels of unreported psychological distress are high among certain Asian communities, particularly so among women. Within the UK, levels of self-harm are known to be higher among South Asian women (compared with White UK women), while it is also well known that racial discrimination can impact severely on mental wellbeing among

minority groups. Such discrimination is one of the facets of stigma faced by minority groups, and as such can be seen as a 'fundamental cause' of poor health and, therefore, health inequalities[62].

Gastrointestinal diseases

Analyses examined a range of both lower (e.g. Crohn's Disease, appendicitis) and upper (e.g. pancreatitis, oesophagitis) gastrointestinal diseases. No particularly clear patterns emerged across the different ethnic groups, and for many conditions risk of hospitalisation or death was similar to that of White Scots[63, 64].

Maternal, child health and behavioural factors

Although the focus of this section has been on morbidity- and mortality-related health outcomes, ethnicity research has also been undertaken into maternity-related and other general health behavioural factors. Clearly, such research must be examined within the context of public health understanding the extent to which such behavioural factors are influenced by broader social, economic and environmental aspects[65- 72].

A number of maternity-related characteristics were analysed in one set of SHELS analyses. These showed that compared with a number of ethnic minority groups, White Scottish first-time mothers tended to be younger, less likely to breastfeed and more likely to have smoked during pregnancy. However, mean birthweight of non-White minority ethnic mothers tended to be lower even after adjustment for a range of potential confounders. Most analyses controlled for measures of SEP (education and housing tenure), although smoking in pregnancy was an exception[73].

The birthweight findings echo the results of other UK research which showed there was a greater likelihood of low birthweight among Indian, Bangladeshi and Pakistani babies compared with the White population[74].

In terms of more general behavioural factors, Scottish national survey data have shown that those of Pakistani, Chinese and 'other' Asian origin are significantly less likely to smoke than the White population[75 xx]. However, many minority groups are also less likely to take part in physical activity[2,76]. Most non-White minority groups are characterised by lower levels of alcohol consumption (including higher rates of abstinence); however, there is also evidence that generational differences have emerged over time e.g. with increases in levels of frequent and heaving drinking among Indian women and Chinese men. It is also known that some groups (e.g. Sikh men) are at greater risk of alcohol harm than the White population[77] – findings confirmed by the SHELS research reported earlier.

Finally, of potential relevance to the cancer analyses discussed at the start of this section is the fact that SHELS research has highlighted lower rates of breast cancer screening among minority groups (e.g. Pakistani, Indian, African origin) – a finding that was not explained by differences in socioeconomic circumstances[78].

All these results from the review of the literature are discussed further below.

[xx] There are also notable differences in smoking rates between Pakistani men and women, with much higher rates among men.

Discussion

Summary of main findings

The ethnic composition of the population of Glasgow and Scotland is changing, and it is almost certain that in future years the population will be much more ethnically diverse. This is particularly true in Glasgow, and it has potentially important consequences for population health.

Research evidence from across the globe consistently highlights the fact that the relationships between ethnicity, socioeconomic circumstances, and health are extremely complex. This complexity is arguably enhanced within a Scottish context given the quite different SEP profile of many ethnic minority groups compared with those in other countries such as England and the USA. Proportionately, much higher numbers of some of the key ethnic minority groups (e.g. Chinese, Indian, Pakistani) live in much less socioeconomically disadvantaged circumstances in Scotland compared with the rest of Britain. General health (as measured, for example, by life expectancy) tends to be better in those groups compared with White Scots, although that picture is less clear when different indicators such as hospital admissions are used, and when country of birth is taken into account. An extremely complex picture emerges from analyses of individual diseases and ethnic groups in Scotland. There is a lower risk of cancer among many groups (compared with White Scots) but a similar risk of stroke. Those of Pakistani origin have a much greater risk of heart disease and diabetes, and the latter is also true of the Indian population. Chinese men and women tend to have a lower risk of many diseases (although some exceptions – e.g. liver disease – do apply). For many conditions (e.g. respiratory, mental health-related, gastrointestinal), the relationships are complex, with no clear patterns across ethnic minority groups emerging.

Explaining differences in health across ethnic groups

How do we make sense of some of these differences between groups? Davey-Smith and colleagues have previously provided a useful summary of the most frequently proposed 'models of explanation' for differences in health status between different ethnic groups in Britain. These include a number of issues already discussed above, for example the complex relationship between SEP and ethnic health. An additional aspect of this, however, is social class (an important component of SEP) artefact. This includes evidence of limitations and inaccuracies associated with traditional social class categories, as well as the results of downward social mobility related to migration i.e. migrants of original 'high' social class engaged in 'low' social class occupations which can impact on SEP-related analyses. Also included are cultural factors, both in terms of different health-related behaviours already discussed, but also other issues relating to strong family support networks and religious activities, both of which have been shown to be associated with protective effects for health[79-88]. The impact of racism has also already been alluded to. Migration is also important: there is a considerable amount of evidence to support the 'healthy migrant effect' i.e. the better health characteristics associated with those who have the resources to migrate (this relates primarily to international migration, rather than sub-national migration). However, it is also known that these tend to diminish over time and over generations. There is less evidence for what has been referred to as 'salmon bias' i.e. the notion of older migrants returning to their country of birth before death (and which would, therefore, impact on ethnic mortality rates both in their country of birth and their previous country of residence). Other potential explanations discussed by Davey-Smith *et al*. for

which there is either very little supporting evidence, or which are deemed to have only a minor impact are: genetic factors (these are deemed to play a minor role, in part because there tends to be greater genetic differences within ethnic groups, rather than between them); worse access to health and social services (for which little evidence was identified at the time of publication); and artefact (a theory that Davey-Smith *et al*. discounted).

In conclusion, the relationship between ethnicity and health in Scotland is extremely complex, certainly more so than some commentators have suggested recently.

Implications for health of the changing ethnic profile of Scotland and Glasgow

What can we say about the projected trends in the size of the ethnic minority population in the light of the evidence from SHELS and other research discussed above? In truth, it is extremely difficult to arrive at meaningful conclusions with any degree of certainty. This is for a number of important reasons. First, the population projections presented earlier are, as already stated, subject to considerable uncertainties. Second, the issue of 'acculturation' among particular ethnic groups – whereby health-related behaviours and, therefore, outcomes among immigrants change over time to be more like the 'native' population – is well evidenced[89-92]. One potential example of this – rates of breast cancer among UK South Asian women increasing to the level of the UK White population – was discussed earlier; other evidence relating to, for example, obesity and maternity related factors (breastfeeding, smoking during pregnancy) has been published in recent times. Third, as the summary of the SHELS evidence showed, the whole picture of ethnic minority health in Scotland is extraordinarily complex, with greater and lesser risks of particular diseases evident across different groups, and with the relationship between health social and economic circumstances difficult to fathom: this renders future predictions even more problematic. Fourth, any analysis of the potential impact of changes in the size of the ethnic minority population on the health profile of the whole population clearly has to be undertaken alongside a deep understanding of changes to the health profile of the *non-minority* (majority) population. As is well understood, this is determined by a complex set of factors operating and interacting across the lifecourse. Key among these determinants are socioeconomic and political factors, and in an era of political and economic uncertainty, where the long-term effects of – for example – the recent global recession, the politics of so-called 'austerity' including important changes to the UK social security system, and 'Brexit' are still under discussion, it would be foolish to predict any future changes to the health status of the whole population, and to particular sections of it.

All that said, we can be reasonably confident of certain facts. The size of the non-White population is likely to continue increasing in future years. This will include increases in the number of ageing and elderly members of that population. We know that different ethnic groups have different risks of particular diseases (e.g. considerably higher risk of heart disease and diabetes among South Asians) compared with the White Scottish population. These basic facts are, therefore, of relevance to policy-makers and those involved in health and social service provision. At the very least, there is a need to be aware of any *possible* implications for these services of the changing size and nature of the population. With that in mind, Table 1 below summarises the projected increases in the size of some of the larger non-White groups, alongside details of some of the health characteristics of the groups taken from the SHELS evidence discussed earlier. However, while it is useful to be aware of

these factors, we do not attempt to draw any further conclusions from the research evidence presented.

Table 1.

Note:

With the exception of cancer, the quoted % risks (higher or lower) relate to the risk of either admission to hospital or death with the specified diagnosis/es. For cancer, it relates to a cancer registration or death. 'All cancer' excludes non-melanoma skin cancer.

Reported risks of cancer and psychiatric disorders are unadjusted for SEP. Reported risks for all other conditions are adjusted for different measures of SEP.

Group		Projected increase in population size 2011-2031, Glasgow (Scotland)[xxi]	Disease risk in comparison with White Scots
Indian	Men	87% (81%)	• c. 55% lower risk of all cancer • Not significantly different risk of cerebrovascular disease (stroke) • Not significantly different risk of acute myocardial infarction (AMI) (heart attack) (but c.30% greater risk of heart failure) • c. 30% greater risk of alcohol-related diseases • c. 10% greater risk of respiratory disease • Not significantly different risk of psychiatric disorders
	Women	94% (88%)	• c.55% lower risk of all cancer • Not significantly different risk of cerebrovascular disease (stroke) • Not significantly different risk of acute myocardial infarction (AMI) (heart attack) (& heart failure) • Not significantly different risk of alcohol-related diseases • Not significantly different risk of respiratory disease • c.55% lower risk of psychiatric disorders[xxii]
Pakistani	Men	51% (61%)	• c. 45% lower risk of all cancer

[xxi] It is worth noting that the projected increase in the population size for the 'all white' group over the same period is, in contrast, -3% for Glasgow, and +4% for Scotland.
[xxii] Unadjusted for SEP, but little effect of adjustment.

Group		Projected increase in population size 2011-2031, Glasgow (Scotland)[xxi]	Disease risk in comparison with White Scots
			• Not significantly different risk of cerebrovascular disease (stroke) • c.60% greater risk of acute myocardial infarction (AMI) (heart attack) & c. 40% greater risk of heart failure • c. 35% lower risk of alcohol-related diseases • c. 35% greater risk of respiratory disease • c. 20% lower risk of psychiatric disorders
	Women	54% (62%)	• c. 40% lower risk of all cancer • Not significantly different risk of cerebrovascular disease (stroke) • c. 40% higher risk of acute myocardial infarction (AMI) (heart attack) and c. 60% greater risk of heart failure • c. 55% lower risk of alcohol-related diseases • c. 30% greater risk of respiratory disease • Not significantly different risk of psychiatric disorders
Chinese	Men	90% (90%)	• c. 35% lower risk of all cancer • c. 35% lower risk of cerebrovascular disease (stroke) • Significantly lower risk of acute myocardial infarction (AMI) (heart attack (c. 65%)) (& heart failure (c. 60%)) • c. 50% lower risk of alcohol-related diseases • c. 30% lower risk of respiratory disease • c. 65% lower risk of psychiatric disorders[xxiii]
	Women	85% (93%)	• Not significantly different risk of all cancer • c. 30% lower risk of cerebrovascular disease (stroke) • c. 50% lower risk of acute myocardial

[xxiii] Unadjusted for SEP, but little effect of adjustment.

Group		Projected increase in population size 2011-2031, Glasgow (Scotland)[xxi]	Disease risk in comparison with White Scots
			infarction (AMI) (heart attack); no significantly different risk of heart failure • c. 50% lower risk of alcohol-related diseases • c. 35% lower risk of respiratory disease • c. 55% lower risk of psychiatric disorders[xxiv]
African origin	Men	56% (64%)	• c. 25% lower risk of all cancer • c. 40% greater risk of cerebrovascular disease (stroke) • Not significantly different risk of acute myocardial infarction (AMI) (heart attack) (& heart failure) • Not significantly different risk of alcohol-related diseases • Not significantly different risk of respiratory disease • Not significantly different risk of psychiatric disorders
	Women	44% (56%)	• Not significantly different risk of all cancer • Not significantly different risk of cerebrovascular disease (stroke) • Not significantly different risk of acute myocardial infarction (AMI) (heart attack) (& heart failure) • Not significantly different risk of alcohol-related diseases • Not significantly different risk of respiratory disease • c. 40% greater risk of psychiatric disorders[xxv]
Any mixed background	Men	165% (170%)	• Not significantly different risk of all cancer • Not significantly different risk of cerebrovascular disease (stroke) • Not significantly different risk of acute myocardial infarction (AMI) (heart attack) (& heart failure)

[xxiv] Unadjusted for SEP, but little effect of adjustment.
[xxv] Unadjusted for SEP, but little effect of adjustment.

Group		Projected increase in population size 2011-2031, Glasgow (Scotland)[xxi]	Disease risk in comparison with White Scots
			• c. 50% greater risk of alcohol-related diseases • Not significantly different risk of respiratory disease • Not significantly different risk of psychiatric disorders
	Women	142% (155%)	• Not significantly different risk of all cancer • Not significantly different risk of cerebrovascular disease (stroke) • Not significantly different risk of acute myocardial infarction (AMI) (heart attack) (& heart failure) • c. 100% greater risk of alcohol-related diseases • Not significantly different risk of respiratory disease • c. 40% greater risk of psychiatric disorders

Strengths and weaknesses of this research

There are some important weaknesses of the research reported in this paper. Most notably, the literature review was limited in its scope, and as already stated, there are a number of uncertainties associated with the use of population projections. As stated, the majority of SHELS studies have measured the risk of hospitalisation or death among ethnic minority groups compared with the White Scottish population: they have not, therefore, measured the *prevalence* of disease among the different groups; furthermore, for some conditions, limiting measurement to hospitalisation or death clearly captures only the extreme end of the spectrum of disease.

However, there is also a strength in (partly) limiting the review to Scottish evidence, given both the different socioeconomic profile of the country's ethnic minority population compared with England and other developed countries, and the complex relationships between ethnicity, health and SEP, as have been discussed. Furthermore, despite the stated limitations, the use of the SHELS study itself is a considerable strength, given the rich insights it has provided into ethnicity and health in a Scottish context that were previously not available.

Conclusions

The relationship between ethnicity and health is an extraordinarily complex one. Overall levels of population health, as measured by indicators such as life expectancy, have been shown to be better among many non-White ethnic minority groups in Scotland compared with the White Scottish population. However, such analyses mask a highly complicated set of varying risks of particular diseases among different groups. The complexity extends to understanding the underlying causes of these differences in health status, including the impact of the 'healthy migrant' effect, how that may or may not change over time, and, not least, the association between ethnicity and socioeconomic circumstances. This is arguably even more complex in Scotland, compared with, for example, England or the USA, given the quite different SEP profile of many of Scotland's ethnic minority groups. Looking forward, despite a number of uncertainties in relation to precise estimates, the size of Scotland's non-White minority population looks set to increase. This poses a challenge to researchers in seeking to understand the changing health profile of this important, and growing, section of the population – a challenge made greater by the lack of any planned follow-up to the unique SHELS study. More importantly, however, it presents an increasingly urgent challenge to policy-makers and service-planners, given their need to understand, and address, the possible implications of these changes to the population.

References

[1] Aspinall PJ. The utility and validity for public health of ethnicity categorization in the 1991, 2001 and 2011 British Censuses. *Public Health* 2011;125(10):680-687.

[2] Gordon DS, Graham L, Robinson M, Taulbut M. *Dimensions of Diversity: Population Differences and Health Improvement Opportunities*. Glasgow: NHS Health Scotland; 2010

[3] Scottish Government. *Which ethnic groups have the poorest health? An analysis of health inequality and ethnicity in Scotland*. Edinburgh: Scottish Government; http://www.gov.scot/Publications/2015/08/7995 (accessed July 2017)

[4] Wohland P, Burkitt M, Norman P, Rees P, Boden P and Durham H. ETHPOP Database, ESRC Follow on Fund "Ethnic group population trends". See www.ethpop.org (accessed February 2017).

[5] Stronks K, Kunst AE. The complex interrelationship between ethnic and socio-economic inequalities in health. *Journal of Public Health* 2009;31(3):324-325.

[6] Krieger N. *Epidemiology and the People's Health. Theory and context*. Oxford: Oxford University Press; 2011.

[7] Fitzpatrick J, Jacobson B, Aspinall P. *Indications of public health in the English regions 4: Ethnicity and health*. Association of Public Health Observatories; 2005. Available from: http://webarchive.nationalarchives.gov.uk/20170106093837/http://www.apho.org.uk/resource/item.aspx?RID=39367 (accessed July 2017)

[8] Scottish Government. *Overview of Equality Results from the 2011 Census Release 2*. Edinburgh: Scottish Government; 2014. Available from: http://www.gov.scot/Publications/2014/03/7340 (accessed July 2017).

[9] Darlington F, Norman P, Ballas D, Exeter D. Exploring ethnic inequalities in health: Evidence from the Health Survey for England, 1998-2011. *Diversity & Equality in Health & Care* 2015;12(2):54-65.

[10] Netto G. Minority ethnic communities and housing: access, experiences and participation. *In*: Craig G, Atkin K, Chattoo S, Flynn R (eds.). *Understanding Race and Ethnicity: Theory, history, policy and practice* (Understanding Welfare: Social Issues, Policy and Practice series). Bristol: Policy Press; 2012.

[11] Netto G, Fancy C, Pawson H, Lomax D, Singh S, Power S. *Black and minority ethnic communities and homelessness in Scotland*. Edinburgh: Scottish Executive Social Research; 2004. Available from: http://www.gov.scot/Publications/2004/07/19610/39940 (accessed August 2017)

[12] Simpson L, Parsons E. National research report identifying existing services and gaps in provision for ethnic minority communities in Scotland. Perth & Kinross Association of Voluntary Service (PKAVS); 2016. Available from: http://www.cpag.org.uk/sites/default/files/Mind%20the%20Gap%20Report%20Jan%202016.pdf (accessed August 2017)

[13] Bhopal R, Fischbacher C, Povey C, Chalmers J, Mueller G, Steiner M, Brown H, Brewster DH, Bansal N. Cohort profile: Scottish health and ethnicity linkage study of 4.65 million people exploring ethnic variations in disease in Scotland. *International Journal of Epidemiology* 2011;40(5):1168-1175.

[14] Scottish Health and Ethnicity Linkage Study (SHELS). http://www.ed.ac.uk/usher/scottish-health-ethnicity-linkage (accessed July 2017)

[15] Crawford F, Beck S, McLean J, Walsh D, Tannahill C. *Migration and health in Glasgow and its relevance to GoWell*. Glasgow: GoWell; 2012. Available from: http://www.gowellonline.com/publications/97_migration_and_health_in_glasgow_and_its_relevance_to_gowell (accessed August 2017)

[16] Nixon R. *Comparisons of aspects of Glasgow's 56 neighbourhoods*. Glasgow: Glasgow Centre for Population Health; 2016. Available from: http://www.gcph.co.uk/assets/0000/5492/Comparisons_of_aspects_of_Glasgows_56_neighbourhoods.pdf (accessed August 2017)

[17] Understanding Glasgow, the Glasgow indicators project. www.understandingglasgow.com (accessed July 2017)

[18] Prof. Phil Rees, University of Leeds. Personal communication, February 2017.

[19] Rees P, Wohland P, Norman P. The United Kingdom's Multi-ethnic Future: How fast is it arriving? *In*: Lombard J, Stern E, Clarke GP. (eds). *Applied Spatial Modelling and Planning*. London: Routledge; 2016. pp157-171.

[20] Gruer L, Cézard G, Clark E, Douglas A, Steiner M, Millard A, Buchanan D, Katikireddi SV, Sheikh A, Bhopal R. Life expectancy of different ethnic groups using death records linked to population census data for 4.62 million people in Scotland. *Journal of Epidemiology & Community Health* 2016;70(12):1251-1254.

[21] Millard AD, Raab G, Lewsey J, Eaglesham P, Craig P, Ralston K, McCartney G. Mortality differences and inequalities within and between 'protected characteristics' groups, in a Scottish Cohort 1991-2009. *International Journal for Equity in Health* 2015;14:142.

[22] University of Edinburgh media release. *Ethnic minorities in Scotland live longer than White Scots*. http://www.ed.ac.uk/news/2016/ethnic-minorities-in-scotland-live-longer-than-whi (accessed July 2017)

[23] Philip B. Ethnic minorities live longer than their white Scots neighbours. *The Scotsman*. Sunday 21 August 2016. (Quoting Laurence Gruer, University of Edinburgh) http://www.scotsman.com/news/ethnic-minorities-live-longer-than-their-White-scots-neighbours-1-4208934 (accessed July 2017)

[24] Fischbacher CM, Bhopal R, Povey C, Steiner M, Chalmers J, Mueller G, Jamieson J, Knowles D. Record linked retrospective cohort study of 4.6 million people exploring ethnic variations in disease: myocardial infarction in South Asians. *BMC Public Health* 2007;7:142.

[25] Fischbacher CM, Bhopal R, Steiner M, Morris AD, Chalmers J. Is there equity of service delivery and intermediate outcomes in South Asians with type 2 diabetes? Analysis of DARTS database and summary of UK publications. *Journal of Public Health* 2009;31(2):239-249.

[26] Sheikh A, Steiner MFC, Cezard G, Bansal N, Fischbacher C, Simpson CR, Douglas A, Bhopal R. Ethnic variations in asthma hospital admission, readmission and death: a retrospective, national cohort study of 4.62 million people in Scotland. *BMC Medicine* 2016;14:3.

[27] Bhopal RS, Bansal N, Steiner M, Brewster DH, on behalf of the Scottish Health and Ethnicity Linkage Study. Does the 'Scottish effect' apply to all ethnic groups? All cancer, lung, colorectal, breast and prostate cancer in the Scottish Health and Ethnicity Linkage Cohort Study. *BMJ Open* 2012;2(5):e001957.

[28] Scottish Health and Ethnicity Linkage Study (SHELS). *Key publications*. http://www.ed.ac.uk/usher/scottish-health-ethnicity-linkage/key-publications (accessed July 2017)

[29] Smith GD, Chaturvedi N, Harding S, Nazroo J, Williams R. Ethnic inequalities in health: A review of UK epidemiological evidence. *Critical Public Health* 2000;10(4):404-408.

[30] Kelaher M, Paul S, Lambert H, Ahmad W, Smith GD. The impact of different measures of socioeconomic position on the relationship between ethnicity and health. *Annals of Epidemiology* 2008;18(5):351-356.

[31] Smith GD. Learning to Live With Complexity: Ethnicity, Socioeconomic Position, and Health in Britain and the United States. *American Journal of Public Health* 2000;90(11):1694-1698.

[32] Razum O. Migrant mortality, healthy migrant effect. In: Kirch W (ed). *Encyclopedia of public health Volume 2*. New York: Springer; 2008.

[33] Buchanan D. ISD Scotland. Personal communication, September 2017.

[34] Wallace M. Adult mortality among the descendants of immigrants in England and Wales: does a migrant mortality advantage persist beyond the first generation? *Journal of Ethnic and Migration Studies* 2016;42(9):1558-1577.

[35] Scotland's census 2011. http://www.scotlandscensus.gov.uk/ (accessed July 2017).

[36] Kelly B, Ashe S. *Geographies of deprivation and diversity in Glasgow*. Manchester: ESRC Centre on Dynamics of Ethnicity (CoDE); 2014. Available from: http://www.ethnicity.ac.uk/medialibrary/briefings/localdynamicsofdiversity/geographies-of-deprivation-and-diversity-in-glasgow.pdf (accessed July 2017)

[37] Fischbacher CM, Cezard G, Bhopal RS, Pearce J, Bansal N, on behalf of Scottish Health and Ethnicity Linkage Study. Measures of socioeconomic position are not consistently associated with ethnic differences in cardiovascular disease in Scotland: methods from the Scottish Health and Ethnicity Linkage Study (SHELS). *International Journal of Epidemiology* 2014;43(1):129-139.

[38] Mindell JS, Knott CS, Ng Fat LS,Roth MA, Manor O, Soskolne V, Daoud N. Explanatory factors for health inequalities across different ethnic and gender groups: data from a national survey in England. *Journal of Epidemiology & Community Health* 2014;68(12):1133-1144.

[39] Harding S, Maxwell R. Differences in mortality of migrants. In: Drever F, Whitehead M (eds). *Health Inequalities*. London: The Stationary Office; 1997.

[40] Nazroo JY. The health of Britain's ethnic minorities: findings from a national survey. London: PSI; 1997.

[41] Bhopal RS, Bansal N, Fischbacher CM, Brown H, Capewell S, on behalf of the Scottish Health and Ethnic Linkage Study. Ethnic variations in the incidence and mortality of stroke in the Scottish Health and Ethnicity Linkage Study of 4.65 million people. *European Journal of Preventive Cardiology* 2012;19(6):1503-1508.

[42] Bhopal RS, Bansal N, Fischbacher CM, Brown H, Capewell S, on behalf of the Scottish Health and Ethnic Linkage Study. Ethnic variations in chest pain and angina in men and women: Scottish Ethnicity and Health Linkage Study of 4.65 million people. *European Journal of Preventive Cardiology* 2012;19(6):1250-1257

[43] Bhopal RS, Bansal N, Fischbacher CM, Brown H, Capewell S, on behalf of the Scottish Health and Ethnic Linkage Study. Ethnic variations in heart failure: Scottish Health and Ethnicity Linkage Study (SHELS). *Heart* 2012;98(6):468-473

[44] Bansal N, Bhopal R, Netto G, Lyons D, Steiner MFC, Sashidharan SP. Disparate patterns of hospitalisation reflect unmet needs and persistent ethnic inequalities in mental health care: the Scottish health and ethnicity linkage study. *Ethnicity & Health* 2014;19(2):217-239

[45] Bhala N, Cézard G, Ward HJT, Bansal N, Bhopal R, on behalf of the Scottish Health and Ethnicity Linkage Study (SHELS) Collaboration. Ethnic Variations in Liver- and Alcohol-Related Disease Hospitalisations and Mortality: The Scottish Health and Ethnicity Linkage Study. *Alcohol and Alcoholism* 2016;51(5):593-601.

[46] Sen A. Health: perception versus observation: self-reported morbidity has severe limitations and can be extremely misleading. *BMJ* 2002;324:860.

[47] Jürges H. True health vs response styles: exploring cross-country differences in self-reported health. *Health Economics* 2007;16:163-178.

[48] O'Reilly D, Rosato M. Dissonances in self-reported health and mortality across denominational groups in Northern Ireland. *Social Science & Medicine* 2010;71:1011-1017.

[49] Salomon JA, Nordhagen S, Oza S, Murray CJ. Are Americans feeling less healthy? The puzzle of trends in self-rated health. *American Journal of Epidemiology* 2009;170:343-351.

[50] Bostan C, Oberhauser C, Stucki G, Bickenbach J, Cieza A. Biological health or lived health: which predicts self-reported general health better? *BMC Public Health* 2014;14:189.

[51] Au N, Johnston DW. Self-assessed health: What does it mean and what does it hide? *Social Science & Medicine* 2014;121:21-28.

[52] Layes A, Asada Y, Kepart G. Whiners and deniers - What does self-rated health measure? *Social Science & Medicine* 2012;75:1-9.

[53] Knox S, Bhopal R, Buchanan D, Thomson CS, Millard A, Fraser A, Gruer L. Using routinely collected data to compare hospital admission rates by ethnic group in Scotland. Glasgow: ScotPHO; 2016. Available from: http://www.scotpho.org.uk/publications/reports-and-papers/1916-using-routinely-collected-data-to-compare-hospital-admission-rates-by-ethnic-group-in-scotland (accessed July 2017)

[54] Winter H, Cheng KK, Cummins C, Maric R, Silcocks P, Varghese C. Cancer incidence in the south Asian population of England (1990–92). *British Journal of Cancer* 1999;79(3-4):645-654.

[55] Ali R, Barnes I, Kan SW, Beral V. Cancer incidence in British Indians and British Whites in Leicester, 2001–2006. *British Journal of Cancer* 2010;103(1):143-148.

[56] Bansal N, Fischbacher CM, Bhopal RS, Brown H, Steiner MFC, Capewell S on behalf of the Scottish Health and Ethnicity Linkage Study. Myocardial infarction incidence and survival by ethnic group: Scottish Health and Ethnicity Linkage retrospective cohort study. *BMJ Open* 2013;3:e003415.

[57] Douglas A, Cézard G, Simpson CR, Steiner MF, Bhopal R, Bansal N, Sheikh A, Ward HJ, Fischbacher CM on behalf of the SHELS researchers. Pilot study linking primary care records to Census, cardiovascular hospitalization and mortality data in Scotland: feasibility, utility and potential. *Journal of Public Health* 2016;38(4):815-823.

[58] Fischbacher CM, Steiner M, Bhopal R, Chalmers J, Jamieson J, Knowles D, Povey C. Variations in all cause and cardiovascular mortality by country of birth in Scotland, 1997-2003. *Scottish Medical Journal* 2007;52(4):5-10.

[59] Wild SH, Fischbacher C, Brock A, Griffiths C, Bhopal R. Mortality from all causes and circulatory disease by country of birth in England and Wales 2001–2003. *Journal of Public Health* 2007;29(2):191-198.

[60] Bhopal R, Steiner MF, Cezard G, Bansal N, Fischbacher C, Simpson CR, Douglas A, Sheikh A, on behalf of the SHELS Researchers. Risk of respiratory hospitalization and death, readmission and subsequent mortality: Scottish health and ethnicity linkage study. *European Journal of Public Health* 2015;25(5):769-774.

[61] Simpson CR, Steiner MF, Cezard G, Bansal N, Fischbacher C, Douglas A, Bhopal R, Sheikh A, on behalf of the SHELS researchers. Ethnic variations in morbidity and mortality from lower respiratory tract infections: a retrospective cohort study. *Journal of the Royal Society of Medicine* 2015;108(10):406-417.

[62] Hatzenbuehler ML, Phelan JC, Link BG. Stigma as a Fundamental Cause of Population Health Inequalities. *American Journal of Public Health* 2013;103(5):813-821.

[63] Bhopal RS, Cezard G, Bansal N, Ward HJT, Bhala N, on behalf of the SHELS Researchers. Ethnic variations in five lower gastrointestinal diseases: Scottish Health and Ethnicity Linkage Study. *BMJ Open* 2014;4(10):e006120.

[64] Cezard GI, Bhopal RS, Ward HJ, Bansal N, Bhala N, on behalf of the SHELS researchers. Ethnic variations in upper gastrointestinal hospitalizations and deaths: the Scottish Health and Ethnicity Linkage Study. *European Journal of Public Health* 2016;26(2):254-260.

[65] Dahlgren G, Whitehead M. *Tackling inequalities in health: what can we learn from what has been tried?* Working paper prepared for the King's Fund International Seminar on Tackling Inequalities in Health, September 1993. Ditchley Park, Oxfordshire: King's Fund; 1993.

[66] Evans RG, Stoddart GL. Producing health, consuming health care. In: Evans RG, Barer ML, Marmor TR (eds.) *Why are some people healthy and others not? The determinants of health of populations*. Berlin, New York: Walter de Gruyter; 1994.

[67] WHO Commission on Social Determinants of Health. *Closing the gap in a generation: health equity through action on the social determinants of health*. Geneva: World Health Organization; 2008.

[68] Marmot M, Wilkinson RG. *Social determinants of health: the solid facts (Second edition)*. Denmark: World Health Organization; 2003.

[69] Black D, Morris J, Smith C, Townsend P. *Inequalities in health: report of a Research Working Group*. London: Department of Health and Social Security; 1980.

[70] McCartney G, Collins C, Mackenzie M. What (or who) causes health inequalities: theories, evidence and implications? *Health Policy* 2013;113(3):221-227

[71] Link BG, Phelan JC. McKeown and the idea that social conditions are fundamental causes of disease. *American Journal of Public Health* 2002;92(5):730-732.

[72] Scott S, Curnock E, Mitchell R, Robinson M, Taulbut M, Tod E, McCartney G. *What would it take to eradicate health inequalities? Testing the fundamental causes theory of health inequalities in Scotland*. Glasgow: NHS Health Scotland; 2013.

[73] Bansal N, Chalmers J, Fischbacher C, Steiner M, Bhopal R, on behalf of the SHELS researchers. Ethnicity & First Birth: Age, Smoking, Delivery, Gestation, Weight & Feeding: Scottish Health & Ethnicity Linkage Study. *European Journal of Public Health* 2014;24(6):910-915.

[74] Kelly Y, Panico L, Bartley M, Marmot M, Nazroo J, Sacker A. Why does birthweight vary among ethnic groups in the UK? Findings from the Millennium Cohort Study. *Journal of Public Health* 2009;31(1):131-137.

[75] Whybrow P, Ramsay J, MacNee K. Scottish Health Survey Topic Report: Equality Groups. Edinburgh: Scottish Government; 2012. Available from: http://www.gov.scot/Publications/2012/10/8988/0 (accessed July 2017)

[76] Fischbacher CM, Hunt S, Alexander L. How physically active are South Asians in the United Kingdom? A literature review. *Journal of Public Health* 2004;26(3):250-258.

[77] Hurcombe R, Bayley M, Goodman A. Ethnicity and alcohol: a review of the UK literature. York: Joseph Rowntree Foundation; 2010. Available from https://www.jrf.org.uk/report/ethnicity-and-alcohol-review-uk-literature (accessed July 2017)

[78] Bansal N, Bhopal RS, Steiner MF, Brewster DH, on behalf of the Scottish Health and Ethnicity Linkage Study. Major ethnic group differences in breast cancer screening uptake in Scotland are not extinguished by adjustment for indices of geographical residence, area deprivation, long-term illness and education. *British Journal of Cancer* 2012;106(8):1361-1366.

[79] Kawachi I. Social Capital and Community Effects on Population and Individual Health. *Annals of the New York Academy of Sciences* 1999;896(1):120-130.

[80] Kawachi I, Kennedy B, Lochner K, Prothrow-Stith D. Social Capital, Income Inequality, and Mortality. *American Journal of Public Health* 1997;87(9):1491-1498.

[81] Skrabski A, Kopp M, Kawachi I. Social capital in a changing society: cross sectional associations with middle aged female and male mortality rates. *Journal of Epidemiology & Community Health* 2003;57(2):114-119.

[82] Kripper CE, Sapag JC. Social capital and health in Latin America and the Caribbean: a systematic review. *Pan American Journal of Public Health* 2009;25(2):162-170.

[83] Murayama H, Fujiwara Y, Kawachi I. Social capital and health: a review of prospective multilevel studies. *Journal of Epidemiology* 2012;22(3):179-187.

[84] Maselko J, Hughes C, Cheney R. Religious social capital: Its measurement and utility in the study of the social determinants of health. *Social Science & Medicine* 2011;73(5):759-767.

[85] Koenig H, McCullough M, Larson D. *Handbook of Religion and Health*. New York: Oxford University Press; 2001

[86] McCullough ME, Hoyt WT, Larson DB, Koenig HG, Thorensen CE. Religious involvement and mortality: a meta-analytic review. *Health Psychology* 2000;19(3):211-222.

[87] Coruh B, Ayele H, Pugh M, Mulligan T. Does Religious Activity Improve Health Outcomes? A Critical Review of the Recent Literature. *Journal of Science and Healing* 2005;1(3):186-191.

[88] Hummer RA, Ellison CG, Rogers RG, Moulton BE, Romero RR. Religious involvement and adult mortality in the United States: Review and perspective. *Southern Medical Journal* 2004;97(12):1223-1230.

[89] Hawkins SS, Lamb K, Cole TJ, Law C. Influence of moving to the UK on maternal health behaviours: prospective cohort study. *BMJ* 2008;336(7652):1052-1055.

[90] Ajetunmobi O, Whyte B, Chalmers J, Fleming M, Stockton D, Wood R. Informing the "early years" agenda in Scotland: understanding infant feeding patterns using linked datasets. *Journal of Epidemiology & Community Health* 2014;68(1):83-92.

[91] Delavari M, Sønderlund AL, Swinburn B, Mellor D, Renzaho A. Acculturation and obesity among migrant populations in high income countries – a systematic review. *BMC Public Health* 2013;13:458.

[92] Thomson MD, Hoffman-Goetz L. Defining and measuring acculturation: a systematic review of public health studies with Hispanic populations in the United States. *Social Science & Medicine* 2009;69(7):983-991.