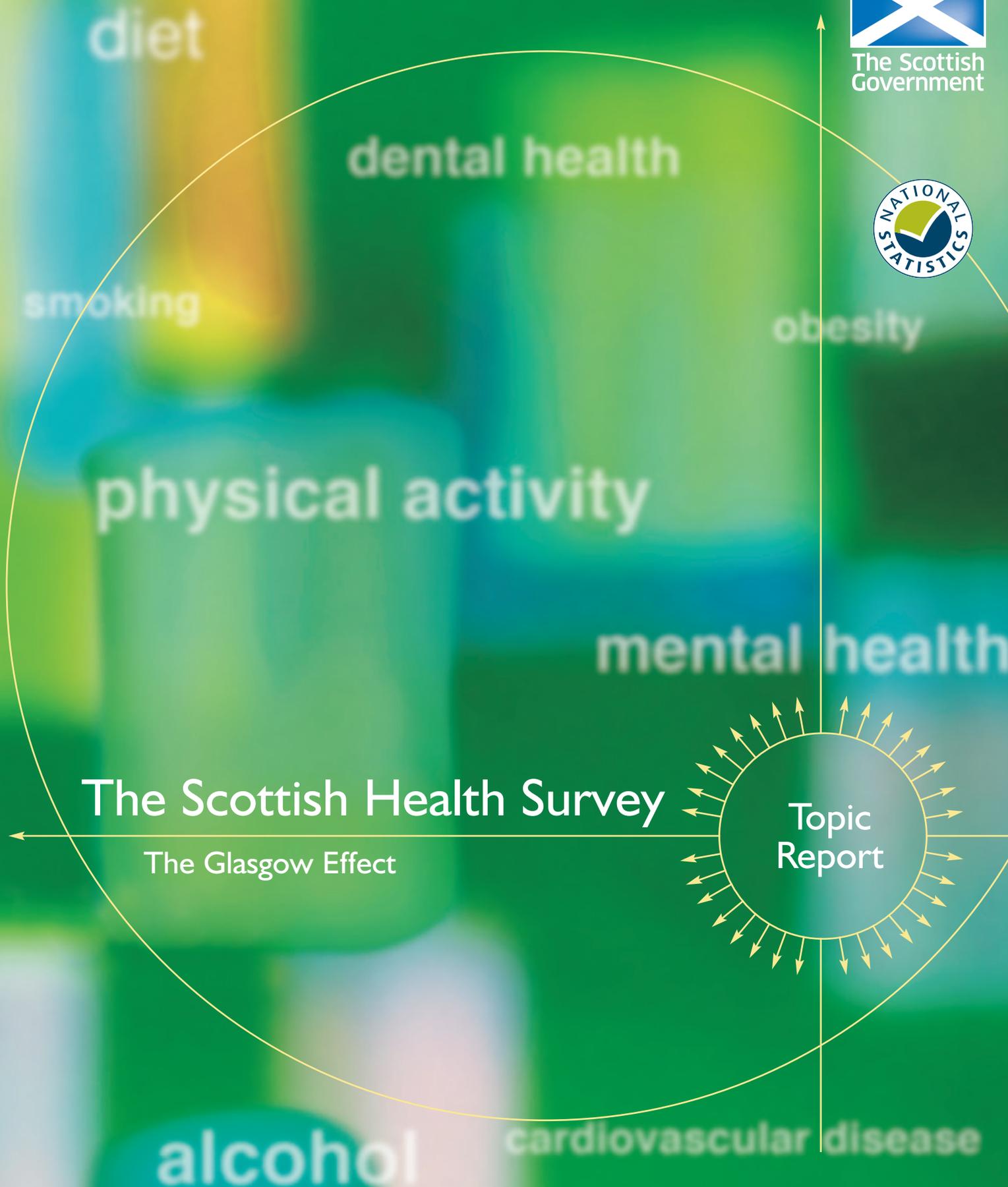




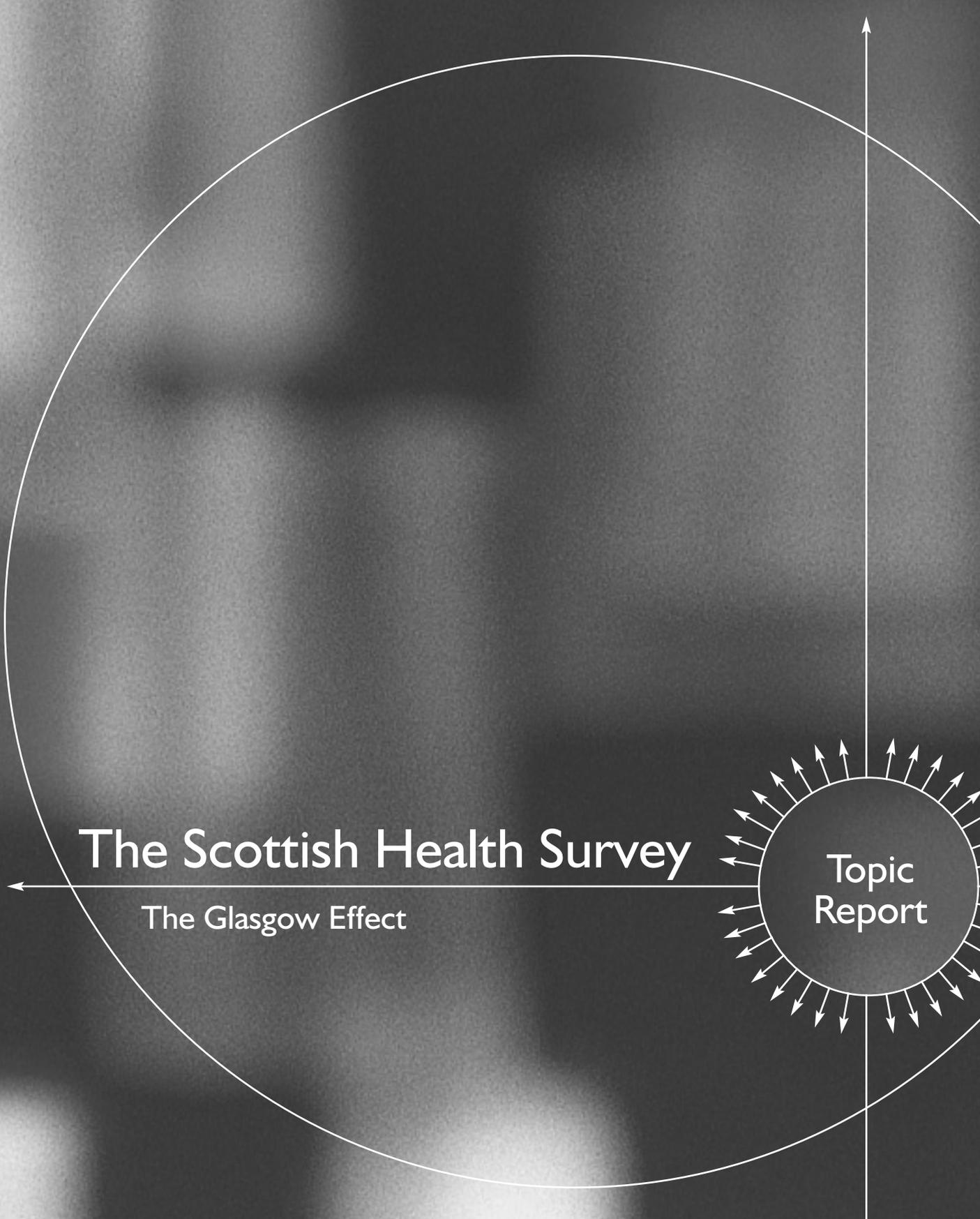
The Scottish
Government



The Scottish Health Survey

Topic
Report

The Glasgow Effect



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Authors:

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Responsibility for all analyses and conclusions lies with the authors.

Rebecca Landy, David Walsh and Julie Ramsay

Summary

The link between socio-economic circumstances and health is well known, and there is an increasing evidence base supporting the hypothesis of a 'Scottish Effect', and more specifically a 'Glasgow Effect', the terminology used to identify higher levels of mortality and poor health found in Scotland and Glasgow beyond that explained by socio-economic circumstances. The last study which investigated the existence of a 'Glasgow Effect' in a wide range of health behaviours and outcomes used data from the 1995, 1998 and 2003 Scottish Health Surveys, using the Carstairs measure of area-based deprivation, which is less spatially sensitive than the Scottish Index of Multiple Deprivation (SIMD) now available. Additionally, that study only investigated whether socio-economic factors explained any differences between Glasgow and the rest of Scotland, and did not investigate other potential explanations. This report therefore both updates and extends that work by using the 2008 and 2009 Scottish Health Survey data. The overall aim of this work was to investigate whether residence in Glasgow was independently associated with poorer health outcomes and worse health behaviours compared to the rest of Scotland, after controlling for socio-economic, behavioural, biological and other health-related risk factors.

To accomplish this aim a series of logistic regression models were carried out for a variety of adverse health behaviours and mental and physical health outcomes, and the extent to which any observed differences between Greater Glasgow and Clyde and the rest of Scotland were explained was examined by first adjusting for age and sex, then additionally adjusting for area level deprivation using the Scottish Index of Multiple Deprivation (SIMD), individual level socio-economic factors, behavioural, biological, relationship and social mobility variables.

This study showed that combined area and individual level socio-economic circumstances explained the differences found between Greater Glasgow and Clyde and the rest of Scotland for the majority of outcomes investigated. However four outcomes remained where differences were not explained by socio-economic factors: anxiety, doctor diagnosed heart attack, high GHQ scores, and being overweight. Of these, the latter two were explained by differences in biological factors. However there remained an unexplained 'Glasgow Effect' in relation to prevalence of anxiety and doctor diagnosed heart attack, with higher levels found in Greater Glasgow and Clyde. Therefore further research is needed into the reasons behind the increased levels of anxiety and heart attacks found in Greater Glasgow and Clyde.

1. INTRODUCTION AND METHODOLOGY

1.1 Introduction

The link between socio-economic circumstances and health is well known, and has been widely investigated, with deprivation found to be a key factor for a variety of health outcomes. One such health outcome is mortality. Scotland has the highest mortality rate in western Europe among the working age population, and has done since the late 1970s¹.

Carstairs and Morris² analysed data from 1980 – 1982 investigating whether social class and deprivation could explain the excess mortality experienced by Scotland compared to England and Wales. They found that standardising for social class had little effect, whereas standardising for relative affluence and deprivation greatly reduced the difference. However the impact of deprivation on the difference in mortality between Scotland and England and Wales has been found to have reduced since 1981; using census data from 1981, 1991 and 2001, Hanlon et al³ found that whilst in 1981 deprivation explained over 60% of the excess mortality found in Scotland, in 1991 and 2001 deprivation explained less than half of the excess mortality. The excess mortality increased from 4.7% in 1981 to 8.2% in 2001 after adjusting for age, sex and deprivation. The largest excesses have been found in the most deprived areas of Scotland.

Work published earlier this year compared the health outcomes in Glasgow with those of almost identically deprived cities Liverpool and Manchester⁴, and found that premature deaths in Glasgow were over 30% higher, with the excess mortality found across men and women, all ages except the very young, and both deprived and non-deprived neighbourhoods. Approximately half of the excess premature deaths were found to be directly related to alcohol and drugs.

Other recent work has investigated whether the mortality excess relates to country of residence or country of birth, as it is known that those born in Scotland who live in England and Wales have a higher mortality rate than those born in England and Wales⁵, and those born in England and Wales but living in Scotland have a lower mortality rate than those born in Scotland⁶. Popham et al⁷ therefore compared mortality by country of birth and country of residence, with the effect of country of residence attenuated by country of birth, but not the other way round.

This recent work has shown that there exist factors beyond deprivation which influence the excess mortality rate found in Glasgow. Many hypotheses have been suggested, including societal breakdown leading to self-destructive behaviours and adverse childhood experiences and the Glasgow population's response to them⁴.

Much of the work investigating the 'Glasgow Effect' has focused on mortality as an outcome; it is also of interest to know whether there is a 'Glasgow Effect' for other health outcomes and health behaviours, which themselves influence mortality. A report written for the Glasgow Centre for Population Health in 2006⁸ examined the levels of many health behaviours in Glasgow City and Greater Glasgow compared to the rest of Scotland, and found many examples of worse health behaviours, including alcohol consumption, diet and smoking, as well as worse health outcomes,

such as higher prevalence of limiting long-term illness. A piece of work carried out by the Glasgow Centre for Population Health in 2008⁹ compared health indicators in Greater Glasgow with those in areas across Europe. It found that Greater Glasgow had the worst levels for a number of health behaviours and health outcomes, including binge drinking, excess weekly alcohol consumption, self-assessed general health and psychological morbidity.

Using data from the 1995, 1998 and 2003 Scottish Health Surveys, Gray¹⁰ investigated the impact of living in Glasgow City, Greater Glasgow and West Central Scotland on a range of health-related factors, covering mental health, physical health and health behaviours, and the extent to which adjustment for socio-economic conditions explained any effects. The socio-economic conditions adjusted for contained both area-level and individual-level deprivation, using the Carstairs measure of area-level deprivation, social class, educational qualifications and economic activity. The study found that the levels of binge-drinking and alcohol consumption in men were higher than in the rest of Scotland, even after adjusting for Glasgow's socio-economic profile, as were the levels of psychological distress for both men and women. However adjusting for socio-economic conditions accounted for many of the worse health behaviours and outcomes in Glasgow, implying that improving Glasgow's health is strongly linked to addressing the socio-economic conditions in Glasgow. More detailed conclusions from Gray's report are discussed at the end of each section, alongside the results from the analyses carried out in this study.

1.2 Aims

The overall aim of this work was to investigate whether residence in Glasgow was independently associated with poorer health outcomes and worse health behaviours compared to the rest of Scotland, after controlling for socio-economic, behavioural, biological and other health-related risk factors. The supplementary research questions are:

1. To what extent do socio-economic factors explain differences in health-related outcomes?

Previous analyses have examined the role of area based deprivation in explaining poor health related outcomes in Glasgow¹⁰, however these were based on the Carstairs measure of area-based deprivation at postcode level, which is less spatially sensitive than the Scottish Index of Multiple Deprivation (SIMD), which is measured at datazone level, with an average population of only 750. These previous analyses only controlled for socio-economic factors, and therefore did not investigate other possible explanations for the remaining effect of residence after adjusting for socio-economic factors. The analyses in this report used data from the 2008 and 2009 Scottish Health Surveys, whereas the previous analyses used data from the 1995, 1998 and 2003 Scottish Health Surveys.

As part of this aim the socio-economic factor which best explained both the health outcomes and the differences between Glasgow and the rest of Scotland was investigated.

2. To what extent are differences in health-related outcomes influenced by 'relationship'-based factors?

An advantage of using the Scottish Health Survey data to investigate the 'Glasgow Effect' is the wealth of data available, including the relationships between members of each household. There were not sufficient foster parents or adoptive parents in the study to examine their effect on the various outcomes; therefore only single parenthood and being a stepparent were examined.

3. Are aspects of 'social mobility' significantly associated with health and health-related outcomes?

One of the current hypotheses relating to the 'Glasgow Effect' is the effect of social mobility¹¹. Therefore the effect of social mobility on both health behaviours and health-related outcomes were investigated, as well as their impact on explaining any effect of residence in Greater Glasgow and Clyde.

1.3 Methodology

The combined 2008 and 2009 Scottish Health Survey datasets were used to carry out this work. The combined dataset contains information on 18,353 individuals, with 13,996 (76%) aged 16 and over, of whom 7,866 (56%) were female. A subsample from both the 2008 and 2009 surveys were selected for a nurse visit to collect biological measurements, and some of these participants agreed to provide a blood sample. As these subsamples are not representative of those who agreed to take part in the original survey, new weights were developed to allow analysis of these complete subsamples to provide results which are representative of Scotland's population. More information on the sample design and data collection is available in the 2008 and 2009 Scottish Health Survey reports^{12,13}.

In order to investigate the 'Glasgow Effect' an area must be identified to be compared with the rest of Scotland. Greater Glasgow and Clyde was chosen as data on Greater Glasgow and Clyde health board is more representative, and more data is available, than if just Glasgow City had been used. This made the results more robust. 3,242 adults in Greater Glasgow and Clyde provided data in the main sample, with 504 in the nurse subsample and 392 in the blood subsample.

An initial logistic regression model was carried out for each outcome of interest with explanatory variables age, sex and residence in Greater Glasgow and Clyde, and a second model added SIMD quintiles. Explanatory variables were then added to this model in groups, so the new model contained the new explanatory variables as well as all the explanatory variables previously entered into the model. Backward selection was carried out after each group of variables had been added, until all the variables in the model were significant at the 5% level. More details on all variables can be found in the Scottish Health Survey 2009 main report¹².

The first group of explanatory variables contained socio-economic risk factors:

- Income-related benefits (receiving at least one of job seekers allowance, income support or housing benefit)

- National Statistics Socio-economic Classification (NS-SEC) (categorised as: managerial and professional occupations, intermediate occupations, small employers and own account workers, lower supervisory and technical occupations and semi-routine occupations, as well as a category for people for whom the NS-SEC is not applicable, such as full-time students)
- Economic activity (full time education, paid employment/self-employed/government training, looking for/intending to look for work, permanently unable to work, retired, looking after home/family, doing something else)
- Highest educational qualifications attained (HNC/D or degree level or higher, Standard Grade or Higher Grade, other school level, none)
- Housing tenure (owner occupied, private rental and social rental)
- Marital status (single (never married or in a civil partnership), married/civil partnership and living together, married/civil partnership but separated, divorced/civil partnership legally dissolved, widowed/surviving civil partner).

The next group covered behavioural risk factors:

- Smoking status (never/ex-occasional, ex-regular, light, moderate, heavy/don't know how many a day¹⁴)
- Binge drinking (more than 6 units per day for women, and 8 units for men)
- Drinking over the recommended weekly alcohol limit (more than 14 units per week for women, and 21 units for men)
- Abstaining from alcohol consumption
- Scoring 2 or more on the CAGE questionnaire to identify potential problem drinking¹⁵
- Level of physical activity (high (30 minutes or more at least 5 days a week), medium (30 minutes or more on 1 to 4 days a week) or low (fewer than 30 minutes of activity a week))
- Portions of fruit and vegetables consumed per day.

The third group contained biological risk factors:

- Collected from everyone:
 - BMI (<25 kg/m², ≥25 kg/m² and <30 kg/m², ≥30 kg/m²)
- Collected from those who had a nurse visit:
 - Waist-hip ratio (high if ≥0.95 for men, ≥0.85 for women)
 - Blood pressure (normotensive untreated, normotensive treated, hypertensive untreated, hypertensive treated)
 - Forced expiratory volume in one second
- Collected from those who had a blood sample taken:
 - Total cholesterol (above or below 5 mmol/l)
 - HDL-cholesterol (above or below 1 mmol/l)
 - Fibrinogen (sex-specific quintiles)
 - C-reactive protein (sex-specific quintiles).

The analyses were adjusted for the complex survey design, and different survey weights were used depending on the variables included in the model. Although BMI was collected from everyone in the main sample, the other biological variables were collected during the nurse visit. As the sample size is reduced for the nurse variables, and reduced again for the blood variables, if all the blood variables

dropped out of the model then the model was re-run excluding the blood variables, and based on the nurse weights, thereby enabling a larger sample to be used. If all the nurse variables then dropped out of the model, it was re-run with only BMI added to the model, using the full sample and therefore the full sample weights.

The fourth group were relationship variables and social mobility variables:

- Single parent
- Stepparent
- Parental NS-SEC (the higher of the mother's and father's NS-SEC)
- Social mobility (indicating whether the participant was upwardly mobile, downwardly mobile or stable by comparing parental NS-SEC and individual NS-SEC. Participants who did not have an NS-SEC category were not assigned a social mobility category.)

Not all predictor variables were added to each model if it was not appropriate; for example BMI and high waist-hip ratio were not added to the models analysing outcomes of being overweight or obese. Any variables which were not included in the modelling are mentioned in the relevant section. All analyses were restricted to participants aged 16 plus.

As not all variables have complete data, the sample size varies depending on which variables remain in the model. For direct comparisons to be made between models using odds ratios and pseudo R-squared values, for the purpose of determining the model which provides the best fit to the data (see Appendix 1), it is important to maintain a constant sample¹⁶. Therefore after the final model was selected using all available data at each stage, the resulting models from adding each group of variables were re-run on data restricted to include participants with full data on all variables included in any of the models, and these are the results reported. Other results are reported as required.

To investigate which socio-economic factor best explained the health outcome and the difference in health outcomes between Glasgow and the rest of Scotland, the final model was run using all available data, and then run containing each of SIMD, NS-SEC, economic activity, household tenure, educational qualifications, receiving income-related benefits and equivalised income in place of all the socio-economic variables (including SIMD, but excluding marital status) which were in the final model. McFadden's pseudo R²s were compared to find the socio-economic variable which best explained the health outcome, with the highest pseudo R² indicating the best model. For the models where a "Glasgow Effect" remained, the odds ratios for residence were compared, with the lowest odds ratio indicating the model which explained the largest proportion of the difference.

2. MENTAL AND GENERAL HEALTH

SUMMARY

Anxiety

- The factors which were found to be significantly associated with anxiety were: age, sex, residence, economic activity, potential problem drinking, abstaining from alcohol and physical activity level.
- Even after controlling for all of these factors, residents of Greater Glasgow and Clyde were almost twice as likely to have symptoms of moderate to high severity anxiety (92% increased risk when compared to the rest of Scotland).

GHQ

- The factors which were found to be significantly associated with a high GHQ score (indicating possible psychiatric disorder) were: age, sex, residence, receiving income-related benefits, economic activity, educational qualifications, marital status, smoking status, potential problem drinking, abstaining from alcohol and physical activity level.
- Residents of Greater Glasgow and Clyde had an increased risk of having a high GHQ score even after adjusting for all of these factors (19% increased risk compared to the rest of Scotland).

WEMWBS

- Although residence in Greater Glasgow and Clyde was associated with greater odds of having a low WEMWBS score (indicating lower levels of mental wellbeing) when age and sex were adjusted for, subsequent adjustment for SIMD accounted for all of the difference.

Depression

- Although residence in Greater Glasgow and Clyde was associated with increased risk of depression when only age and sex were adjusted for, when age, sex and socio-economic variables, specifically NS-SEC, economic activity, equivalised income and marital status, were included in the model, the excess risk associated with residence in Greater Glasgow and Clyde was removed.

Self-assessed health

- Despite residents of Greater Glasgow and Clyde having higher odds of poor self-assessed health when adjusting for age and sex, the so-called 'Glasgow Effect' was fully explained when socio-economic variables were adjusted for, specifically SIMD, receiving income-related benefits, economic activity, household tenure, equivalised income, educational qualifications and NS-SEC.

2.1 Introduction

The outcomes covered in this chapter are anxiety, psychological ill health, mental wellbeing, depression and self-assessed general health.

Anxiety

Participants were classified as suffering from anxiety if they had a score of 2 or more on the anxiety scale of the Revised Clinical Interview Schedule, indicative of symptoms of moderate to high severity. Anxiety was only measured in the nurse sample.

General Health Questionnaire (GHQ-12)

The General Health Questionnaire (GHQ-12) is a widely used standard measure of mental distress and psychological ill-health, consisting of 12 questions on concentration abilities, sleeping patterns, self-esteem, stress, despair, depression, and confidence in the previous few weeks. As the GHQ-12 measures deviations from people's usual functioning it cannot be used to detect chronic conditions. However it allows comparisons between groups to be investigated. Responses to the GHQ-12 items were scored, resulting in an overall score between zero and twelve. A score of four or more indicates the presence of a possible psychiatric disorder.

Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS)

WEMWBS is an indicator of mental wellbeing, which comprises 14 positively worded statements with a five item scale ranging from '1 - None of the time' to '5 - All of the time'. The scores therefore range from 14 to 70. A participant was classified as having a low WEMWBS score if it was more than one standard deviation below the mean.

Depression

Participants were classified as suffering from depression if they had a score of 2 or more on the depression scale of the Revised Clinical Interview Schedule, indicative of symptoms of moderate to high severity. Depression was only measured in the nurse sample.

Self-assessed health

Self-assessed health was investigated via a question asking participants to rate their health in general as 'very good', 'good', 'fair', 'bad' or 'very bad'. Those who answered 'bad' or 'very bad' were classified as having poor self-assessed health. It is important to note that the responses will be affected by individual perceptions, as with other self-assessed measures.

2.2 Mental Health

2.2.1 Anxiety

9% of adults had a score of 2 or more on the anxiety scale of the Revised Clinical Interview Schedule. There were significant differences by gender, with women more likely to be display symptoms of anxiety than men (10% vs. 7%). There was a significant difference by age, with increasing prevalence of anxiety from age 16 – 24 to a maximum at 45 – 54, with the pattern less clear for older ages. The prevalence

of anxiety significantly increased with increasing deprivation, with the prevalence more than twice as high in the most deprived SIMD quintile compared to the least deprived (13% vs. 6%). There was also a significant difference in prevalence of anxiety between residents of Greater Glasgow and Clyde and the rest of Scotland, with around twice the prevalence (14% vs. 7%).

The model development process can be found in Appendix 2, along with McFadden's pseudo R²s for the different models. In view of these, the best fitting model was chosen, and the results for that model using the full data available are described here.

The factors which were found to be significantly associated with anxiety were: age, sex, residence, economic activity, potential problem drinking, abstaining from alcohol and physical activity level. As anxiety was only measured in participants in the nurse sample, the sample size was 1,887.

Residents of Greater Glasgow and Clyde were almost twice as likely to have moderate to severe anxiety symptoms when compared to the rest of Scotland (odds ratio of 1.92) even after adjusting for the other variables in the model. Women had significantly higher odds of having anxiety than men (odds ratio of 1.70). Age was associated with anxiety but there was no clear trend; those aged 35 – 44 had the highest odds compared to 16 – 24 year olds (odds ratio of 2.61).

Economic activity was also associated with anxiety, with those who were looking for or intending to look for work having significantly higher odds of anxiety, compared to those in paid employment, self-employed or in government training (odds ratio of 4.06). Similarly, those who were permanently unable to work had higher odds of anxiety (odds ratio of 2.68). People who were identified as potential problem drinkers according to the CAGE questionnaire had significantly increased odds of anxiety (odds ratio of 2.88). Those who abstained from alcohol also had significantly higher odds of anxiety (odds ratio of 1.67) compared to people who drank alcohol. Whilst these findings may seem contradictory, it should be noted that a proportion of those who abstain from alcohol will do so following medical advice to stop drinking.

Physical activity levels were associated with anxiety. Those whose physical activity levels were high or medium had significantly lower odds of anxiety when compared to those with low levels of physical activity, with odds ratios of 0.63 and 0.55 respectively.

Table 1

2.2.2 General Health Questionnaire (GHQ-12)

15% of adults had a high GHQ-12 score (indicating possible psychiatric disorder), however there were significant differences within the population. Women had a significantly higher prevalence (17% compared to 12% of men). There was also significant variation by age, although the pattern was not linear, with the highest prevalence found among 45 – 54 year olds (17%), compared to 65 – 74 year olds, who had the lowest prevalence of 10%. Prevalence increased with deprivation, with prevalence in the least deprived quintile (10%) half of that found in the most deprived

quintile (21%). A significant difference also existed between residents of Greater Glasgow and Clyde (18%) and the rest of Scotland (14%).

The model development process can be found in Appendix 3, along with McFadden's pseudo R^2 s for the different models. In view of these, the best fitting model was chosen, and the results of that model using the full data available are presented here. It should be noted that the addition of biological variables to the model removed the effect of residence, however this model did not fit the data as well as the model described here. The results of the best fitting model were accepted over those found in other models.

The factors which were found to be significantly associated with a high GHQ score were: age, sex, residence, receiving income-related benefits, economic activity, educational qualifications, marital status, smoking status, potential problem drinking, abstaining from alcohol and physical activity level. The weighted sample size with complete data was 11,088.

Residents of Greater Glasgow and Clyde had an increased risk of having a high GHQ score when compared to the rest of Scotland after adjusting for all the other variables in the model (odds ratio of 1.19). Women had higher odds than men (odds ratio 1.59), and there was a significant association with age, with those aged 45 and above having lower odds than the youngest age group (16-24).

Moderate and heavy smokers had an increased risk of a high GHQ score when compared to those who had never smoked or who were ex-occasional smokers (odds ratios of 1.41 and 1.47 respectively). People in receipt of income-related benefits had significantly higher odds of a high GHQ score (odds ratio of 1.35). Potential problem drinkers and abstainers both had increased risks, with the odds for potential problem drinkers more than twice as high as those who were not (odds ratio of 2.09), and abstainers were two-thirds more likely to have a high GHQ score (odds ratio of 1.67) compared to those who drank alcohol.

People who were married/in a civil partnership and were living together were the least likely to have a high GHQ score. Those who were separated had the highest odds (odds ratio 1.81), followed by those who were widowed (odds ratio of 1.49). Level of educational qualifications was significantly associated with high GHQ scores but there was no clear pattern. Those who had high or medium levels of physical activity had lower odds of having a high GHQ score than those with low levels of physical activity (odds ratios of 0.67 for both categories).

Economic activity was significantly associated with high GHQ scores, with those who were looking for or intending to look for work and those who were permanently unable to work having the greatest risk of a high GHQ score when compared to those in paid employment, self-employed or government training (odds ratios of 3.36 and 2.91 respectively).

Table 2

2.2.3 WEMWBS

A similar pattern was found for having a low WEMWBS score as for having a high GHQ score. Overall 15% of adults in Scotland had a low WEMWBS score (defined as one standard deviation or more below the mean score), however there were significant differences within the population. Women had a significantly higher prevalence of low WEMWBS scores (16% compared to 14% of men). There was significant variation by age, although the pattern was not linear, with the highest prevalence found among those aged 75 and over (18%), whereas 65-74 year olds had the lowest prevalence (12%), followed by 25-34 year olds (13%). Prevalence increased with deprivation, with the prevalence in the least deprived quintile (8%) just over a third of that found in the most deprived quintile (23%). A significant difference in prevalence also existed between residents of Greater Glasgow and Clyde (17%) and the rest of Scotland (14%).

In the initial logistic regression model containing only age, sex and residence, residence in Greater Glasgow and Clyde had an odds ratio of 1.25, meaning that participants who resided in Greater Glasgow and Clyde had 25% increased odds of having a low WEMWBS score, compared to the rest of the Scotland. However once the model was also adjusted for SIMD the odds ratio dropped to 1.10, which was not significant at the 5% level. SIMD was highly significant, with increasing odds of poor mental wellbeing with increasing deprivation. This indicates that the different distribution of SIMD in Greater Glasgow and Clyde compared to the rest of Scotland explains the difference in prevalence of low WEMWBS scores.

2.2.4 Depression

8% of adults had two or more symptoms of depression on the Revised Clinical Interview Schedule, with significantly higher rates in women (10%) than men (7%). There was also significant difference by age, although there was no clear linear pattern. Prevalence of depression increased from age 16 – 24 (4%) to 45 – 54 (11%), but then decreased before increasing again for those age 75 and over. Residence was also significantly associated with depression, with a much higher prevalence among residents of Greater Glasgow and Clyde (13%) than the rest of Scotland (7%). The prevalence of depression increased with increasing deprivation, from 5% among those in the least deprived SIMD quintile to 13% in the most deprived SIMD quintile.

In the initial logistic regression model containing only age, sex and residence, residence in Greater Glasgow and Clyde had an odds ratio of 1.80 indicating that residents of Greater Glasgow and Clyde's odds of having moderate to severe depression were 80% higher than the rest of Scotland, after adjusting for age and sex. When SIMD was added to the model the odds ratio decreased to 1.66, showing that a small amount of the "Glasgow Effect" has been accounted for by deprivation. When the group of socio-economic variables were added to the model and backward selection performed, residence was no longer significant at the 5% level. The variables which remained in the model (with $p < 0.05$) were age, sex, NS-SEC, economic activity, equivalised income and marital status. When residence dropped from the model only these variables remained in the model, showing that these variables fully explained the effect previously observed from residing in Greater Glasgow and Clyde.

2.3 General Health

2.3.1 Self-assessed health

7% of adults rated their health as 'bad' or 'very bad', with no significant difference between men and women. The prevalence increased with increasing age, from 1% of 16-24 year olds to 14% of those aged 75 and over. There was a large significant difference in prevalence by SIMD, with prevalence decreasing from 14% in the most deprived quintile to 3% in the least deprived quintile. Prevalence of poor self-assessed health was significantly higher for those living in Greater Glasgow and Clyde than for the rest of Scotland (9% vs. 4%).

In the initial logistic regression model containing age, sex and residence, residents of Greater Glasgow and Clyde had an odds ratio of 1.56 of having poor self-assessed health, meaning they were 56% more likely than those in the rest of Scotland to report poor health. When SIMD was added to the model all four variables were significant predictors of having poor self-assessed health, with the odds ratio for Greater Glasgow and Clyde reduced to 1.20, indicating that more than half of the "Glasgow Effect" in relation to poor self-assessed health was explained by SIMD. However there was still a 20% increase in odds of having poor self-assessed health for residents of Greater Glasgow and Clyde compared to the rest of Scotland. When socio-economic variables were added to the model and backward selection performed, residence was no longer significant at the 5% level. The variables which remained in the model (with $p < 0.05$) were age, sex, SIMD, receiving income-related benefits, economic activity, household tenure, equivalised income, and educational qualifications. When residence dropped from the model NS-SEC was also in the model. This finding suggests that these socio-economic variables, alongside SIMD, explain the apparent difference in rates of poor self-assessed health between Greater Glasgow and Clyde and the rest of Scotland.

2.4 Assessing the impact of the socio-economic variables individually

When examined individually, the socio-economic variable which provided the best-fit model for the mental and general health outcomes was economic activity as it had the highest McFadden's pseudo R^2 , indicating that this measure was the best predictor of the general and mental health outcomes after adjusting for the rest of the variables in the final models. For anxiety and GHQ it was also possible to see which socio-economic variable best explained the difference between Greater Glasgow and Clyde and the rest of Scotland; equivalised income explained the most difference for anxiety, and economic activity for GHQ.

2.5 Conclusions and Discussion

Despite adjusting for age and sex, residents of Greater Glasgow and Clyde had increased odds of having bad or very bad self-assessed health compared to the rest of Scotland. Further adjusting for SIMD partly attenuated this increased risk and adjusting for a wider range of socio-economic variables fully attenuated the increased risk, removing the so called "Glasgow Effect". Previous analyses¹⁰ investigating Greater Glasgow using the 1995, 1998 and 2003 Scottish Health

Surveys, found that adjusting for socio-economic factors did not fully attenuate the risk. This difference in findings may represent a change over time; may be due to the different geographical areas investigated (due to the change in health board structure); may be due to the inclusion of a wider range of socio-economic variables in the current study, or the more spatially specific area-level deprivation variable used.

There was a degree of variability between mental health outcomes in relation to whether residence in Greater Glasgow and Clyde significantly affected risk. A higher prevalence of moderate to severe depression was found among residents of Greater Glasgow and Clyde, with increased odds after adjusting for age and sex, which were reduced slightly by additionally adjusting for SIMD. However the effect was completely removed by further adjusting for a variety of socio-economic variables.

A significant difference in prevalence was found for low WEMWBS scores, with a higher prevalence in Greater Glasgow and Clyde. There was an increased risk of having a low WEMWBS score after adjusting for age and sex, but once SIMD was adjusted for, the effect was removed. However, when looking at high GHQ scores, adjusting for SIMD did not remove the higher odds found among residents of Greater Glasgow and Clyde, nor did adjusting for socio-economic or behavioural variables. Adjusting for biological variables did remove the 'Glasgow Effect', but this model did not fit the data as well as a previous model, so the results were not accepted. These analyses include a much broader set of explanatory variables than Gray's analyses¹⁰. However, the results are comparable to the extent that Gray also found that residence in Greater Glasgow was associated with significantly higher levels of possible psychiatric disorder, with the increased risk attenuated but not removed by adjusting for socio-economic factors.

GHQ-12 and WEMWBS have been compared and been found to measure different things, with participants who have the same GHQ score having a variety of scores on the WEMWBS scale¹⁷. Confirmatory factor analysis of WEMWBS supports the hypothesis that the scale measures a single construct of wellbeing¹⁸. Conversely, GHQ-12 has often been found to contain two or three dimensions, with the best fitting model finding three dimensions; 'Anxiety', 'Social dysfunction' and 'Loss of confidence'¹⁹, which may explain the difference in results between the two outcomes.

The increased odds of moderate to severe anxiety in Greater Glasgow and Clyde remained significant after adjusting for socio-economic, behavioural, biological, relationship and social mobility variables. The odds ratio for residence in Greater Glasgow and Clyde when only age and sex were adjusted for was 2.92, meaning that residents were almost 3 times as likely to have anxiety than people in the rest of Scotland. The inclusion of additional variables in the model gradually attenuated this risk to the extent that once all variables were adjusted for, the odds ratio for Greater Glasgow and Clyde had reduced to 1.92. This indicates that even after taking account of all of the factors noted above, people living in Greater Glasgow and Clyde still had a 92% higher risk of anxiety than those living elsewhere.

It is important to note that the variables may not be causative, but merely predict individuals who are more likely to suffer from anxiety. People identified as potential problem drinkers by the CAGE questionnaire have 2.88 times the odds of anxiety of

those who were not identified as potential problem drinkers, and abstainers had odds 1.67 times those who do drink alcohol. It may be that the anxiety causes the potentially problem drinking rather than drinking causing the anxiety, and this study is not aiming to investigate the direction of the association. Using an outcome measuring depression and anxiety, a previous study found that abstaining from alcohol was associated with common mental disorder symptoms only among previous consumers, but not among lifelong abstainers²⁰. Unfortunately the two groups cannot be separated in this study. People who have medium levels of physical activity have close to half the odds of anxiety of those who have low levels of physical activity. Again, it is not within the scope of this report is to examine the direction of this relationship; however, many studies have found that exercise reduces levels of anxiety²¹.

Tables

Table 1: Estimated odds ratios for moderate to severe anxiety symptoms, by associated risk factors

<i>Aged 16 and over</i>	<i>2008/2009</i>		
Independent variables	Base (weighted) 1,898	Odds Ratio	95% Confidence Interval
Residence (p=0.002)			
Rest of Scotland	1,482	1	
Greater Glasgow and Clyde	416	1.92	1.28, 2.88
Sex (p=0.007)			
Male	941	1	
Female	957	1.70	1.16, 2.49
Age (p=0.024)			
16-24	269	1	
25-34	306	1.60	0.67, 3.85
35-44	357	2.61	1.06, 6.39
45-54	344	2.07	0.83, 5.21
55-64	296	1.65	0.65, 4.20
65-74	189	0.58	0.19, 1.81
75+	137	0.86	0.28, 2.63
Potential problem drinker (p<0.001)			
No	1,680	1	
Yes	217	2.88	1.66, 4.98
Abstainer (p=0.031)			
No	1,639	1	
Yes	259	1.67	1.05, 2.67
Economic activity (p<0.001)			
Paid employment, self-employed or government training	584	1	
Full time education	667	0.69	0.41, 1.18
Looking for/intending to look for work	86	4.06	1.97, 8.36
Permanently unable to work	224	2.68	1.30, 5.52
Retired	254	1.91	0.93, 3.89
Looking after home/family	56	1.73	0.75, 4.03
Doing something else	28	1.83	0.50, 6.70
Physical activity (p=0.025)			
Low	550	1	
Medium	596	0.55	0.34, 0.87
High	751	0.63	0.40, 1.00

Table 2: Estimated odds ratios for high GHQ score (4+), by associated risk factors

Aged 16 and over

2008/2009

Independent variables	Base (weighted) 11,088	Odds Ratio	95% Confidence Interval
Residence			
		(p=0.026)	
Rest of Scotland	8,578	1	
Greater Glasgow and Clyde	2,510	1.19	1.02, 1.39
Sex			
		(p<0.001)	
Male	5,502	1	
Female	5,586	1.59	1.38, 1.82
Age			
		(p<0.001)	
16-24	1,529	1	
25-34	1,742	1.01	0.76, 1.34
35-44	2,101	0.96	0.72, 1.27
45-54	2,095	1.16	0.86, 1.55
55-64	1,729	0.58	0.42, 0.80
65-74	1,146	0.29	0.20, 0.42
75+	747	0.31	0.20, 0.48
Smoking status			
		(p=0.002)	
Never/ex-occasional smoker	5,836	1	
Ex-regular smoker	2,484	1.11	0.93, 1.33
Light smoker	749	1.23	0.95, 1.61
Moderate smoker	1,099	1.41	1.13, 1.75
Heavy smoker/don't know how many smoke a day	921	1.47	1.18, 1.82
Receive income-related benefits			
		(p=0.004)	
No	9,949	1	
Yes	1,139	1.35	1.10, 1.67
Potential problem drinker			
		(p<0.001)	
No	9,954	1	
Yes	1,134	2.09	1.72, 2.54
Abstainer			
		(p<0.001)	
No	9,685	1	
Yes	1,403	1.67	1.41, 1.99
Marital status			
		(p<0.001)	
Married/civil partner and living together	5,743	1	
Single (never married/civil partnership)	3,453	1.27	1.05, 1.54
Married/civil partner and separated	375	1.81	1.36, 2.40
Divorced/civil partnership legally dissolved	810	1.32	1.06, 1.64
Widowed/surviving civil partner	708	1.49	1.15, 1.94
Highest Educational Qualifications			
		(p=0.033)	
No Qualifications	2,035	1	
Other School Level	747	0.98	0.75, 1.28
Standard Grade or Higher Grade	4,204	0.82	0.68, 0.99
HNC/D, Degree and higher	4,103	1.04	0.85, 1.26

Table 2 continued
Independent variables

	Base (weighted) 11,088	Odds Ratio	95% Confidence Interval
Physical activity		(p<0.001)	
Low	3,202	1	
Medium	3,514	0.67	0.57, 0.79
High	4,373	0.67	0.57, 0.80
Economic activity		(p<0.001)	
Paid employment, self-employed or government training	3,695	1	
Full time education	3,692	1.12	0.94, 1.33
Looking for/intending to look for work	440	3.36	2.49, 4.53
Permanently unable to work	1,250	2.91	2.26, 3.74
Retired	1,432	2.08	1.62, 2.67
Looking after home/family	391	1.43	1.04, 1.99
Doing something else	190	1.88	1.17, 3.03

3. PHYSICAL HEALTH

SUMMARY

Heart attack

- The factors which were found to be significantly associated with doctor-diagnosed heart attack were: age, sex, residence, household tenure, marital status, smoking status, abstaining from alcohol, drinking over the recommended weekly alcohol limit, physical activity level, BMI and being a stepparent.
- Even after controlling for all of these factors, residents of Greater Glasgow and Clyde were nearly one-and-a-half times as likely to have had a doctor-diagnosed heart attack (42% increased risk compared to the rest of Scotland).

Limiting longstanding illness

- Although residence in Greater Glasgow and Clyde was associated with increased risk of limiting longstanding illness when age, sex and SIMD were adjusted for, the difference was explained with further adjustment for socio-economic variables, specifically receiving income-related benefits, economic activity, household tenure, equivalised income, educational qualifications and marital status.

Stroke

- There was no significant difference in risk of stroke between residents of Greater Glasgow and Clyde and the rest of Scotland, either before or after adjusting for age and sex.

CVD

- There was a significantly higher risk of CVD for residents of Greater Glasgow and Clyde compared to the rest of Scotland after adjusting for age and sex, however this was explained by further adjusting for SIMD.

COPD

- Despite adjusting for age and sex, the risk of COPD was 44% higher among residents of Greater Glasgow and Clyde compared to those living in other parts of Scotland; however, this was fully explained by the addition of SIMD to the model.

3.1 Introduction

Participants were classified as having had a heart attack, stroke or chronic obstructive pulmonary disease (COPD) if they reported that it was doctor-diagnosed. Participants were asked about longstanding illness and whether it limited their activities. CVD was classified based on a series of questions on whether participants had suffered from any of the following conditions: angina, heart attack, stroke, heart murmur, irregular heart rhythm and 'other heart trouble'.

3.2 Heart attack

3.3% of participants had suffered a doctor-diagnosed heart attack, with a significantly higher prevalence for men (4.3% vs. 2.3%). Prevalence increased sharply with age, with less than 1% of those aged 16-54 having suffered a heart attack compared with 13% of those aged 75 and over. There was also a significant difference by SIMD quintile, with prevalence of 2.2% in the most deprived quintile compared to 4.1% in the least deprived quintile. The difference in prevalence between residents of Greater Glasgow and Clyde and the rest of Scotland was small but significant (3.9% vs. 3.1%).

The model development process can be found in Appendix 4, along with McFadden's pseudo R^2 s for the different models. In view of these, the best fitting model was chosen, and the results for that model using the full data available are described here. Nurse and blood variables could not be included in the analysis due to the low prevalence of heart attacks, and the reduced sample sizes resulting from the addition of variables collected in the nurse subsample.

The factors which were found to be significantly associated with doctor diagnosed heart attack were: age, sex, residence, household tenure, marital status, smoking status, abstaining from alcohol, drinking over the recommended weekly alcohol limit, physical activity level, BMI and being a stepparent. Using all available data the weighted sample size was 11,685. The odds ratio for residents of Greater Glasgow and Clyde was 1.42, showing that even after adjusting for socio-economic, behavioural, biological, relationship and social mobility variables, residents of Greater Glasgow and Clyde were nearly one and a half times as likely to have had a doctor diagnosed heart attack. Being overweight and obese were also significantly associated with doctor-diagnosed heart attack (odds ratios of 1.71 and 2.44 respectively).

Females were less likely than men to have suffered a doctor-diagnosed heart attack (odds ratio of 0.37), and risk increased with increasing age, as would be expected. Private renters had significantly lower odds than owner occupiers (odds ratio of 0.53), whereas social renters had significantly higher odds than owner occupiers (odds ratio of 1.37). People who had never been married or in a civil partnership had lower odds of having had a heart attack than those who were married/in a civil partnership and living together (odds ratio of 0.47), and those who were widowed or surviving civil partners were 1.55 times as likely to have had a heart attack. Compared to people who had never smoked or were ex-occasional smokers, ex-regular smokers, current moderate smokers and current heavy smokers all had significantly higher odds, with odds ratios of 2.63, 2.36 and 2.44 respectively.

Those who drank over the recommended weekly alcohol limit had lower odds of having had a heart attack (odds ratio of 0.68), whilst those who abstained from alcohol had higher odds compared to those who drank (odds ratio of 1.77). It should be noted that drinking behaviour measured in the survey relates to current and not previous behaviour. Those who have had a heart attack may have been advised to stop drinking by a doctor. Having a medium or high level of physical activity was associated with lower odds of having had a heart attack compared to having a low

level of physical activity (odds ratios of 0.57 and 0.50 respectively). The odds ratio for being a stepparent was 0.05.

Table 3

3.3 Longstanding limiting illness

25% of participants reported a limiting longstanding illness, with significantly higher prevalence among women than men (27% vs. 23%). Prevalence increased significantly with age, from 9% of those age 16-24 to 54% of those age 75 and over. The most deprived SIMD quintile had almost double the prevalence of the least deprived quintile (35% vs. 18%). Residents of Greater Glasgow and Clyde had a significantly higher prevalence of limiting longstanding illness than the rest of Scotland (28% vs. 25%).

In the initial logistic regression model containing age, sex and residence, residents of Greater Glasgow and Clyde had an odds ratio of 1.33, meaning their odds of having a limiting longstanding illness were 33% higher than the rest of Scotland. When SIMD was added to the model all four variables were significant predictors with the odds ratio for Greater Glasgow and Clyde reduced to 1.17, showing that half of the additional odds of having a limiting longstanding illness was explained by SIMD. However there was still a 17% increase in odds of having a limiting longstanding illness for residents of Greater Glasgow and Clyde compared to the rest of Scotland.

When the group of socio-economic variables were added to the model and backward selection performed, residence was no longer significant at a 5% level of significance. The variables which remained in the model (with $p < 0.05$) were age, sex, receiving income-related benefits, economic activity, household tenure, equivalised income quintiles, educational qualifications and marital status. When residence dropped from the model only these variables remained in the model, showing that these variables fully explain the effect previously seen of residence in Greater Glasgow and Clyde.

3.4 Stroke

2.5% of participants reported a doctor-diagnosed stroke, with no significant difference by sex. Prevalence increased with increasing age, from less than 1% of 16-54 year olds to 11% of those aged 75 and over. There was also a significant difference by SIMD quintile, with the prevalence in the most deprived quintile more than twice that of the least deprived quintile (3.7% vs. 1.7%). There was no significant difference in prevalence of stroke between residents of Greater Glasgow and Clyde and the rest of Scotland, nor any difference in odds of having had a doctor-diagnosed stroke after controlling for age and sex.

3.5 Cardiovascular disease (CVD)

15% of adults had a doctor-diagnosed CVD condition, with no significant difference by sex. There was a significant relationship with increasing age, with a prevalence of 5% among 16-24 year olds, which rose to 31% of those age 65-74 and 41% of those age 75 and over. A significant difference was also found by SIMD quintile, with those living in the most deprived quintile more likely to have a doctor-diagnosed CVD

condition than those in the least deprived quintile (17% vs. 12%). There was no significant difference for residents of Greater Glasgow and Clyde compared to the rest of Scotland.

Despite this, in the initial logistic regression model containing only age, sex and residence, residents in Greater Glasgow and Clyde had an odds ratio of 1.20, meaning that they had a 20% higher risk of having a CVD diagnosis compared to the rest of Scotland. Once the model also adjusted for SIMD the odds ratio dropped to 1.12, which was not significant at the 5% level of significance. SIMD was highly significant, with an increased risk of having a CVD diagnosis in more deprived areas. This shows that the difference in prevalence of doctor-diagnosed CVD between Greater Glasgow and Clyde and the rest of Scotland was explained by their different SIMD distributions.

3.6 Chronic obstructive pulmonary disease (COPD)

3.5% of participants reported doctor-diagnosed COPD, with a significantly higher prevalence in women than men (3.8% vs. 3.1%). The prevalence increased with increasing age, from 1.5% among 16-54 year olds to 8.7% for those aged 75 and over. The prevalence also increased with increasing deprivation, with over three times the prevalence in the most deprived SIMD quintile than the least deprived SIMD quintile (6.0% vs. 1.9%). The prevalence among residents of Greater Glasgow and Clyde was significantly higher than in the rest of Scotland (4.2% vs. 3.2%).

In the initial logistic regression model containing only age, sex and residence, residents in Greater Glasgow and Clyde had an odds ratio of 1.44, meaning that they had 44% increased odds of having a COPD diagnosis compared to the rest of Scotland. However once the model also adjusted for SIMD the odds ratio dropped to 1.17, which was not significant at the 5% level of significance. SIMD was highly significant, with increasing odds of having a COPD diagnosis for increasing levels of deprivation. This shows that the difference in prevalence of doctor-diagnosed COPD between Greater Glasgow and Clyde and the rest of Scotland was explained by their different SIMD distributions.

3.7 Assessing the impact of the socio-economic variables individually

For the physical health outcomes the model containing economic activity as the only socio-economic variable provided the model which best fit the data (as it had the highest McFadden's pseudo R^2), indicating that this measure was the best predictor of physical health after adjusting for the rest of the variables in the final models. For heart attack it was also possible to investigate which socio-economic variable explained the most difference between Greater Glasgow and Clyde and the rest of Scotland, with household tenure explaining the most difference.

3.8 Conclusions and Discussion

Despite adjusting for socio-economic, behavioural, biological, relationship and social mobility variables, residents of Greater Glasgow and Clyde had 42% increased odds of having a doctor-diagnosed heart attack. It is important to note that this outcome only relates to survivors of heart attacks, as data are obviously not collected from

people who have had fatal heart attacks. The odds ratio for residence in Greater Glasgow and Clyde decreased slightly between adjusting for age and sex, and adding SIMD to the model, but further adjusting for a range of socio-economic and behavioural variables did not further reduce the odds.

In the final model the odds ratio for residence in Greater Glasgow and Clyde was 1.42, showing a 42% higher risk of having had and survived a heart attack. As expected the lower odds were for people who had never smoked or were ex-occasional smokers, with increasing odds for current light smokers, current moderate smokers, current heavy smokers and ex-regular smokers. The increased risk for ex-smokers could be due to the effect of smoking on cardiovascular risk factors; although the levels decline after smoking cessation, it has been found to take five years for the levels to return to those of people who have never smoked²². Another possibility is that people stop smoking after they have had a heart attack, as they are advised to do so.

Those people with low levels of physical activity, have around double the odds of those who have a medium or high level of physical activity. The level of physical activity may also be linked to having had a heart attack in both directions; people may be more limited in the physical activity they can carry out or may be scared to do a lot of physical activity, alternatively their levels of physical activity may increase due to recommendations from a health professional.

There are similar issues with interpreting the alcohol variables – abstainers have an odds ratio of 1.77 compared to those who drink alcohol, but it may be that people who have had a heart attack are advised to reduce their alcohol consumption. Another factor to bear in mind is that people who become abstainers may have drunk heavily earlier in their lives. However both lifelong abstainers and former drinkers have been found to have an increased prevalence of coronary heart disease²³. For drinking over the weekly alcohol limit the odds were 0.68, which again is not what would instinctively be expected. It is also possible that people's BMI, drinking, smoking and physical activity levels affect their chance of surviving a heart attack.

The analyses described in this report using the 2008 and 2009 data found no difference in prevalence of doctor diagnosed CVD between residents of Greater Glasgow and Clyde and the rest of Scotland; however after adjusting for age and sex, residence in Greater Glasgow and Clyde was associated with higher odds of CVD. The effect was removed by adjusting for SIMD. In Gray's report¹⁰ using the 1995, 1998 and 2003 data the results differed for men and women, with no effect for women in Greater Glasgow and a lower risk for men after adjusting for socio-economic factors.

No difference in prevalence was found for stroke in the 2008 and 2009 data, whereas using the 1995, 1998 and 2003 data¹⁰ a significantly higher prevalence was found among women in Greater Glasgow, which was explained by the socio-economic factors. There was no difference in prevalence found between men in Greater Glasgow and the rest of Scotland.

Using the 2008 and 2009 data residents of Greater Glasgow and Clyde had significantly increased odds despite adjusting for age, sex and SIMD; however the effect was removed by further adjustment for socio-economic variables. Gray¹⁰ investigated longstanding illness, which is different to *limiting* longstanding illness which was investigated in this report; however, the results are still of interest. For both men and women in Greater Glasgow a significant difference was found in longstanding illness after adjusting for age and survey year, with the difference becoming non-significant after adjusting for socio-economic factors, as with limiting longstanding illness in this report.

3.9 Tables

Table 3: Estimated odds ratios for having had a doctor-diagnosed heart attack, by associated risk factors

<i>Aged 16 and over</i>		<i>2008/2009</i>	
Independent variables	Base (weighted) 11,685	Odds Ratio	95% Confidence Interval
Residence			
		(p=0.011)	
Rest of Scotland	9,011	1	
Greater Glasgow and Clyde	2,674	1.42	1.08, 1.86
Sex			
		(p<0.001)	
Male	5,711	1	
Female	5,974	0.37	0.29, 0.46
Age			
		(p<0.001)	
16-54	7,681	0.13	0.08, 0.21
55-64	1,813	0.51	0.36, 0.72
65-74	1,307	0.73	0.54, 1.00
75+	884	1	
Smoking status			
		(p<0.001)	
Never/ex-occasional smoker	6,095	1	
Ex-regular smoker	2,632	2.63	1.96, 3.52
Light smoker	799	1.96	1.12, 3.43
Moderate smoker	1,191	2.36	1.52, 3.65
Heavy smoker/don't know how many smoke a day	967	2.44	1.57, 3.80
Physical activity			
		(p<0.001)	
Low	3,403	1	
Medium	3,691	0.57	0.42, 0.77
High	4,591	0.50	0.36, 0.71
BMI			
		(p<0.001)	
< 25 kg/m ²	4,054	1	
≥25 kg/m ² and < 30 kg/m ²	4,441	1.71	1.24, 2.35
≥30 kg/m ²	3,190	2.44	1.77, 3.37
Weekly alcohol limit			
		(p=0.026)	
Below weekly limit	8,845	1	
Over weekly limits	2,840	0.68	0.48, 0.95
Abstainer			
		(p<0.001)	
No	10,377	1	
Yes	1,308	1.77	1.36, 2.31
Marital status			
		(p=0.002)	
Married/civil partner and living together	5,959	1	
Single (never married/civil partnership)	3,641	0.47	0.28, 0.80
Married/civil partner and separated	391	1.15	0.62, 2.13
Divorced/civil partnership legally dissolved	847	0.98	0.62, 1.54
Widowed/surviving civil partner	848	1.55	1.12, 2.16

Household tenure

		(p=0.003)	
Owner Occupied	8,378	1	
Private Rental	1,135	0.53	0.30, 0.92
Social Rental	2,172	1.37	1.03, 1.82

Stepparent

		(p=0.002)	
No	11,561	1	
Yes	124	0.05	0.01, 0.33

4. ADVERSE HEALTH BEHAVIOURS

SUMMARY

Overweight

- Women in Greater Glasgow and Clyde were no more likely to be overweight (including obese) than women in the rest of Scotland, before or after adjusting for age.
- After adjusting for age, SIMD, socio-economic and behavioural variables, men in Greater Glasgow and Clyde were significantly less likely to be overweight (including obese).
- However additional adjustment for biological variables removed the effect, specifically when the model adjusted for equivalised income, marital status, smoking status, cholesterol and C-reactive protein.

Obese

- Men in Greater Glasgow and Clyde were no more likely to be obese than men in the rest of Scotland, before or after adjusting for age.
- However after adjusting for age and SIMD, women in Greater Glasgow and Clyde were less likely to be obese than those in the rest of Scotland, although this difference was explained by further adjusting for equivalised income, a socio-economic variable.

Binge drinking

- Residents in Greater Glasgow and Clyde had a significantly higher prevalence of binge drinking than the rest of Scotland, but this was fully explained by adjusting for age and sex.

Drinking over the recommended weekly alcohol limit

- There was no significant difference in odds of drinking over the recommended weekly alcohol limit between Greater Glasgow and Clyde and the rest of Scotland, either before or after adjusting for age and sex.

Potential problem drinking

- Residents of Greater Glasgow and Clyde had significantly higher odds of potential problem drinking than the rest of Scotland, but this was fully explained by adjusting for age and sex.

Current smoking

- Residents of Greater Glasgow and Clyde had significantly higher odds of being a current smoker than the rest of Scotland, but this was fully explained by adjusting for age and sex.

Heavy smoking

- Residence in Greater Glasgow and Clyde was associated with higher odds of heavy smoking after adjusting for age and sex; however further adjustment for SIMD fully explained this effect.

Fruit and vegetable consumption

- Residents of Greater Glasgow and Clyde had significantly higher odds of consuming less than 2 portions of fruit and vegetables per day than the rest of Scotland, but this was fully explained by adjusting for age and sex.

4.1 Introduction

This section describes the outcome variables which were used to investigate the existence of a 'Glasgow Effect' for adverse health behaviours.

Overweight/obesity

Body Mass Index (BMI) was used to classify individuals as overweight and obese. BMI is defined as weight (kg) divided by height squared (m^2), and therefore uses the participants' heights and weights which were measured by the interviewer as part of the main interview.

Participants were classified as overweight if their BMI was greater than or equal to $25kg/m^2$, and obese if their BMI was greater than or equal to $30kg/m^2$.

Alcohol

In the Scottish Health Survey data on alcohol consumption was self-reported, and self-reported data often produces lower estimates of alcohol consumption than alcohol sales data would suggest. However these data can still be used to compare relative values between groups.

Weekly alcohol consumption was estimated by first asking participants aged 16 and over how often during the last 12 months they had consumed the following six types of drinks:

- normal beer, lager, cider and shandy
- strong beer, lager and cider
- sherry and martini
- spirits and liqueurs
- wine
- alcoholic soft drinks ("alcopops").

The average number of times per week each type of drink had been drunk was estimated from this question. They were then asked how much of each drink they had usually consumed on each occasion. This data was then converted into units; for more details see the Scottish Health Survey 2009 main report¹².

Women are advised not to consume more than 14 units per week, with 21 units the recommended limit for men: participants who drink above these levels, therefore, are considered to drink more than the recommended weekly alcohol limit.

Daily consumption was measured by asking participants aged 16 and over about their alcohol consumption on their heaviest drinking day from the week preceding the interview. They were asked how much they had consumed on that day of the six types of drinks mentioned above, and from this an estimate of units was calculated.

Binge drinking has been defined as the consumption of more than 6 units on one occasion for women, and more than 8 units for men; participants who drank above these cut-offs are considered to be binge drinkers.

Participants self-completed the CAGE questionnaire which highlights indicators of potential problem drinking. A positive answer to 2 or more of the questions was taken as an indicator of potential problem drinking.

Smoking

Smoking status was self-reported. Information about smoking status in adults aged 16 and 17 was collected via a self-completion questionnaire, whereas for adults aged 20 and over this information was collected as part of the main interview. For adults aged 18 and 19 the data were collected either by means of the self-completion questionnaire, or at the main interview (this was at the interviewer's discretion).

Participants were defined as current smokers if they reported being a current cigarette smoker, and participants were classified as heavy smokers if they smoked 20 or more cigarettes a day.

Fruit and vegetable consumption.

Participants were asked about the portions of fruit and vegetables they had consumed in the 24 hours preceding the interview. Portion sizes are defined in detail in the Scottish Health Survey 2009 main report. As fruit and vegetable consumption is being used here as a measure of poor diet, two cut-off points of no portions and less than two portions of fruit and vegetables were used.

4.2 Weight

The analyses for weight were carried out separately for each sex, due to the different patterns often observed in men and women.

4.2.1 Overweight

61% of adult women were overweight (including obese). The prevalence of overweight increased with age until age 55-64, then decreased. The lowest prevalence was among 16-24 year olds (39%), with the highest prevalence among 55-64 year olds (75%). There was also significant variation between SIMD quintiles although there wasn't a clear linear pattern, with the highest prevalence found in the middle quintile (66%) and the lowest prevalence in the least deprived quintile (54%). There was no significant difference in overweight prevalence between women in Greater Glasgow and Clyde and the rest of Scotland, nor a difference in odds of overweight when adjusting for age.

68% of adult men were overweight (including obese). The prevalence of overweight increased with age from 35% of 16 – 24 year olds to 83% of 55 – 64 year olds, then decreased. There was also significant variation between SIMD quintiles, with the highest prevalence found in the middle quintile (72%) and the lowest prevalence in the most deprived quintile (65%). Male residents of Greater Glasgow and Clyde had

a significantly lower prevalence of overweight than the rest of Scotland (63% vs. 70%).

The model development process for men can be found in Appendix 5, along with McFadden's pseudo R^2 s for the different models. In view of these, the best fitting model was chosen, and the results for that model using the full data available are described here.

The model which best fit the data for overweight men started with all the socio-economic, behavioural and biological variables, except HDL cholesterol as only 34 men had low HDL. After backward selection the model contained: equivalised income, marital status, smoking status, cholesterol level and C-reactive protein. As blood analytes are included in this model, the sample size was 654.

Men in the lowest equivalised income quintile had less than a third of the odds of being overweight than men in the top quintile (odds ratio of 0.32). Single men, men who were married/in a civil partnership and separated and men who were widowed were significantly less likely to be overweight compared to men who were married/in a civil partnership and living together (respective odds ratios of 0.37, 0.23 and 0.27). Moderate smokers had significantly lower odds of being overweight than men who had never smoked or who were ex-occasional smokers (odds ratio of 0.40). Men with high cholesterol ($\geq 5\text{mmol/l}$) were two-thirds more likely to be overweight (odds ratio of 1.68), and the odds of overweight increased with increasing C-reactive protein quintile up to the fourth quintile (odds ratio of 6.46), then decreased slightly (odds ratio of 3.88).

4.2.2 Obesity

26% of adult men were obese. The prevalence of obesity increased with age until age 55-64, then decreased. The lowest prevalence was among 16-24 year olds (9%), and the highest prevalence among 55-64 year olds (38%). Although the prevalence increased with increasing deprivation from 24% in the least deprived quintile to 29% in the most deprived quintile, this difference was not significant. There was no difference in obesity prevalence between men in Greater Glasgow and Clyde and the rest of Scotland, nor was there a difference in odds of obesity when adjusting for age.

28% of adult women were obese. The prevalence of obesity increased with age from 17% of 16 – 24 year olds to 35% of 65 – 74 year olds. There was also significant variation between SIMD quintiles, with prevalence increasing with increasing deprivation from 20% in the least deprived quintile to 32% in the most deprived quintile. Female residents of Greater Glasgow and Clyde had a significantly lower prevalence of obesity than the rest of Scotland (25% vs. 28%).

In the initial logistic regression model for women containing age and residence, residents in Greater Glasgow and Clyde did not have a significantly different odds of obesity from the rest of Scotland, however residence became significant with further adjustment for SIMD (odds ratio of 0.83, meaning female residents of Greater Glasgow and Clyde had 17% lower odds of obesity). SIMD was also significant, with increasing odds of obesity for increasing deprivation. Further adjustment for socio-

economic variables removed this effect, with the final model containing age, SIMD and equivalised income. This shows that any difference in the level of obesity between women in Greater Glasgow and Clyde and the rest of Scotland were explained by socio-economic effects.

4.3 Alcohol Consumption

4.3.1 Binge drinking

22% of Scottish adults binge drink, with a significantly higher prevalence in men than women (26% vs. 17%). There was a significant difference by age group, with the prevalence decreasing with increasing age, from 35% of 16-24 year olds to 1% of those aged 75 and over. There was no significant difference in prevalence between the SIMD quintiles, yet the prevalence in Greater Glasgow and Clyde was significantly higher than the rest of Scotland (23% vs. 21%).

In the initial logistic regression model containing only age, sex and residence, residence in Greater Glasgow and Clyde had an odds ratio of 1.07, which was not significant. This shows that the difference in prevalence of binge drinking between Greater Glasgow and Clyde and the rest of Scotland has been explained by the differing age and sex distributions.

4.3.2 Drinking over the recommended weekly alcohol limit

24% of adults consumed more than the recommended weekly alcohol limit, with a significantly higher prevalence for men than women (29% vs. 19%). There was a significant difference by age group, with the prevalence generally decreasing with increasing age, from 34% of 16-24 year olds to 7% of those age 75+, but with a prevalence of 27% for 45-54 year olds, which was the second highest prevalence. There was a significant difference in prevalence by SIMD quintile, with the highest prevalence for those in the least deprived quintile (27%). The level of drinking over the recommended weekly alcohol limit was very similar in the three most deprived quintiles, with a range in prevalence of 21% - 23%. There was no significant difference in prevalence between Greater Glasgow and Clyde and the rest of Scotland, nor any difference in odds of drinking over the weekly alcohol limit after controlling for age and sex.

4.3.3 Potential problem drinking

10% of adults had a score of 2 or more on the CAGE questionnaire, indicating potential problem drinking, with a significantly higher prevalence among men than women (13% vs. 8%). There was also a significant difference by age, with prevalence decreasing as age increases, from 18% of 16-24 year olds to 2% of those aged 75 and over. The prevalence was highest in the most deprived SIMD quintile (13%), and decreased with decreasing deprivation to 8% of the least deprived SIMD quintile. The prevalence in Greater Glasgow and Clyde was significantly higher than the rest of Scotland (12% vs. 10%).

In the initial logistic regression model containing only age, sex and residence, residence in Greater Glasgow and Clyde had an odds ratio of 1.16, which was not

significant. This shows that the difference in prevalence of potential problem drinking between Greater Glasgow and Clyde and the rest of Scotland was explained by the differing age and sex distributions.

4.4 Smoking

4.4.1 Current smoking status

25% of adults were current cigarette smokers, with no significant difference between men and women. There was a significant difference by age, with similar rates for those aged 16 to 54 (range: 28% - 31%), and decreasing rates with increasing age from age 55. Current smoking rates were almost three times higher in the most deprived SIMD quintile compared to the least deprived SIMD quintile (39% vs. 14%). Residents of Greater Glasgow and Clyde had a significantly higher current smoking prevalence than the rest of Scotland (27% vs. 25%).

In the initial logistic regression model containing only age, sex and residence, residence in Greater Glasgow and Clyde was not significant. Age was the only variable which was a significant predictor of smoking status in the model, implying the difference in prevalence of current cigarette smokers between Greater Glasgow and Clyde and the rest of Scotland was explained by the differing age distributions.

4.4.2 Heavy smokers

8% of adults were heavy smokers, with a significantly higher prevalence among men than women (9% vs. 7%). The relationship of heavy smoking with age was shaped like a negative quadratic, with the prevalence increasing from 16 – 24 (prevalence 3%) until age 45 – 54 (12%), then decreasing again, with a prevalence of 3% for those aged 75 and over. There was also a strong relationship with SIMD, with prevalence in the most deprived quintile more than 4 times higher than the least deprived quintile (14% vs. 3%). The prevalence was significantly higher in Greater Glasgow and Clyde than in the rest of Scotland (9% vs. 8%).

In the initial logistic regression model containing only age, sex and residence, residence in Greater Glasgow and Clyde had an odds ratio of 1.21, indicating residents of Greater Glasgow and Clyde had a 21% increased risk of being a heavy smoker compared to the rest of Scotland. However once the model adjusted for SIMD, the effect of residence was fully explained. SIMD was highly significant in the model, with increasing odds of being a heavy smoker associated with increasing levels of deprivation; the odds of being a heavy smoker for someone in the most deprived quintile were more than five times the odds for someone in the least deprived quintile, after adjusting for age and sex.

4.5 Fruit and vegetable consumption

31% of adults consumed less than 2 portions of fruit and vegetables per day, with a significantly higher rate for men than women (34% vs. 28%). There was also a significant difference by age, with decreasing rates corresponding to increasing age, from 42% of 16-24 year olds to 25% - 27% of those aged 55 and over. A significant difference was also found by SIMD quintile, with those living in the most deprived

quintile twice as likely to consume less than 2 portions of fruit and vegetables per day than those in the least deprived quintile (42% vs. 22%). There was a small but significant difference for residents of Greater Glasgow and Clyde (33%) compared to the rest of Scotland (30%).

9% of adults consumed no portions of fruit and vegetables per day, with similar patterns found for the relationship between consuming no portions of fruit and vegetables per day and age, sex and SIMD quintile as were found for consuming less than two portions of fruit and vegetables per day; however there was not a significant difference in the proportion who consumed no portions of fruit and vegetables per day in Greater Glasgow and Clyde and the rest of Scotland. When controlling for age and sex there was still no significant difference between residents of Greater Glasgow and Clyde and the rest of Scotland.

When considering the outcome 'consuming less than two portions of fruit and vegetables per day', the initial logistic regression model containing only age, sex and residence found that residence in Greater Glasgow and Clyde had an odds ratio of 1.13, of borderline significance ($p=0.058$). However once the model also adjusted for SIMD quintiles the odds ratio dropped to 1.01, completely removing the relationship. SIMD was highly significant, with increasing odds for increasing deprivation.

4.6 Assessing the impact of the socio-economic variables individually

For the adverse health behaviours there were a range of socio-economic variables which resulted in the model which provided the best fit to the data (as they had the highest McFadden's pseudo R^2) when only one socio-economic variable was included. For all the alcohol-related outcomes, the socio-economic variable which produced the model which best fit the data was equivalised income, but different variables provided the best fitting model for the other adverse health behaviours.

4.7 Conclusions and Discussion

The overall result of this chapter is that after adjusting for age and sex, almost all of the adverse health behaviours were found not to be significantly different in Greater Glasgow and Clyde from the rest of the country. The exceptions to this were heavy smoking, where the effect was explained by SIMD, obesity for women, where the effect was explained by socio-economic variables, and overweight for men, where the effect was explained by additional adjustment for socio-economic, behavioural and biological variables.

The analyses in this report found no significant difference in current smoking levels between Greater Glasgow and Clyde and the rest of Scotland after adjusting for age and sex. This is different to the results found in a study which investigated smoking status with respect to the Glasgow Effect²⁴ using data from the 1995, 1998 and 2003 Scottish Health Surveys. Using a multilevel analysis they found that before adjustment residents of Greater Glasgow were more likely to smoke; however after adjusting for socio-economic variables this association was no longer significant. The same data were used in a study by Gray¹⁰ which compared health related behaviours and health measures between Glasgow and the rest of Scotland, and found that adjusting for age and year of survey did not remove the effect, but

adjusting for socio-economic variables did, without using a multilevel approach. There are various possible explanations for the difference between the results in this report and those using the earlier Scottish Health Surveys. One is that the smoking levels have changed differently in Greater Glasgow and Clyde compared to the rest of Scotland over time; another allows for the different division of Scotland into health boards between the earlier and later Scottish Health Surveys, as the earlier study only uses Greater Glasgow, whereas this study investigates the health board of Greater Glasgow and Clyde.

This report found that there was a significantly higher level of binge drinking in Greater Glasgow and Clyde, but that adjusting for age and sex removed this effect, without the need to adjust for any socio-economic variables; however Gray¹⁰ found that residence in Greater Glasgow was associated with increased levels of binge drinking for men, which was not fully attenuated by adjusting for socio-economic variables. This report found no difference in prevalence in drinking over the weekly alcohol limit between Greater Glasgow and Clyde and the rest of Scotland. This differs to results reported by Gray, where residence in Greater Glasgow was associated with exceeding the recommended weekly alcohol limit for men, with the effect not attenuated at all by adjusting for socio-economic factors.

The prevalence of both binge drinking and drinking over the recommended weekly alcohol limit has decreased slowly since 2003 for men and women¹². Gray reported a prevalence of 35% for binge drinking among men in Greater Glasgow, the highest of all regions, whereas in Greater Glasgow and Clyde this value was 26% for 2008 and 2009 combined. From these analyses it is not possible to know whether this is due to the use of the larger health board area in the analysis, which would lower the binge drinking levels, or whether levels of binge drinking have declined faster in Greater Glasgow than in the rest of Scotland. It is also important to note that unit conversion factors for alcohol were revised in 2008, which may have contributed to the difference in results.

The analyses in this report using the 2008 and 2009 Scottish Health Surveys found no difference in prevalence of consuming no portions of fruit and vegetables per day between Greater Glasgow and Clyde and the rest of Scotland, but found that a difference did exist in prevalence for consuming less than two portions of fruit and vegetables per day. However, this difference was of borderline significance when adjusting for age and sex, and was removed completely by further adjusting for SIMD. One study by Gray and Leyland has previously investigated fruit and vegetable consumption with respect to the Glasgow Effect²⁵ using data from the 1995 and 1998 Scottish Health Surveys, but looked at consumption of 5 or more portions of fruit and vegetables per day, rather than using fruit and vegetable consumption as an indicator of poor diet as was done in this report. Gray and Leyland found there was no difference in the proportion consuming 5 or more portions of fruit or vegetables per day for either men or women between residents of the Greater Glasgow area and the rest of Scotland. In a separate report Gray¹⁰ used the 2003 Scottish Health Survey data and found no difference in consumption of five or more portions of fruit or vegetable per day for women when comparing Greater Glasgow with the rest of Scotland. For men there was no significant difference when adjusting for age, but when socio-economic factors were also adjusted for, residence

in Greater Glasgow became significant, with men in Greater Glasgow more likely to eat at least 5 portions of fruit and vegetables per day.

An interesting relationship exists for obesity among women in Greater Glasgow and Clyde; there was a significantly lower prevalence of obesity in women in Greater Glasgow and Clyde, which was removed by adjusting for age and sex, but then became significant again when adjusting for SIMD, with an odds ratio of 0.83, showing less risk of obesity than women the rest of Scotland. The same results were found by Gray using the 1995, 1998 and 2003 Scottish Health Survey data¹⁰; for women there was no significant difference before adjusting for socio-economic factors, but after adjustment residence in Greater Glasgow was associated with lower likelihoods of being obese compared to the rest of Scotland. No significant difference was found between obesity in men in Greater Glasgow and the rest of Scotland for men, either before or after adjusting for socio-economic factors.

5. RELATIONSHIPS AND SOCIAL MOBILITY

5.1 Relationships

The relationship variables available in the data were single parent, stepparent/living with partner's children, foster parents and adoptive parents; however the number of foster and adoptive parents were too small to be analysed.

Relationship variables only remained in the model for two of the outcomes, with stepparents having a significantly lower risk of heart attack after adjusting for all the socio-economic, behavioural, biological, relationship and social mobility variables. Step-parents had an odds ratio of 0.05, meaning that compared to the rest of the population, stepparents had less than one-twentieth of the odds of having had a heart attack after adjusting for the other variables in the final model, namely: age, sex, residence, household tenure, marital status, smoking status, abstaining from alcohol, drinking over the recommended weekly alcohol limit, physical activity level, BMI. However only 1.1% (124) of the 11,685 participants in this model were stepparents.

The other model containing a relationship variable after adjusting for all the socio-economic, behavioural, biological, relationship and social mobility variables was for the outcome WEMWBS. Single parents had significantly higher odds of having a low WEMWBS score, indicating worse mental wellbeing, with an odds ratio of 1.52 after adjusting for the other variables in the final model, namely: age, SIMD quintile, NS-SEC, economic activity, educational qualifications, marital status, abstaining from alcohol, binge drinking, potential problem drinking, physical activity level and portions of fruit and vegetables consumed per day.

5.2 Social mobility

The social mobility variables used in the model were parental NS-SEC and a variable indicating whether the participant was upwardly or downwardly socially mobile, or socially stable. More detail is given in Section 1.3. The participant's own NS-SEC was also included in each model as a measure of socio-economic circumstances.

The variable showing whether the participant was upwardly or downwardly mobile was not a significant predictor of any of the outcomes, but parental NS-SEC was a significant predictor for COPD. The individual's own NS-SEC did not remain in the model, implying that social mobility was not important, rather that childhood socio-economic circumstances had an effect on COPD, even after adjusting for socio-economic variables from later in life (supporting the life course hypothesis²⁶). Participants whose parent was in an 'intermediate' job had significantly higher odds of COPD than those whose parents were in managerial and professional positions, after adjusting for the other variables which remained in the model, namely: age, sex, receiving income-related benefits, economic activity, equivalised income, smoking status and physical activity level. Parental NS-SEC also remained in the model for the outcome consuming less than two portions of fruit and vegetables per day, however this was not the model which best fit the data.

6. OVERALL CONCLUSIONS

This study sought to examine the extent to which residence in Glasgow was significantly and independently associated with the risk of a range of health behaviours and both mental and physical health outcomes, and whether any associations were explained by area level deprivation, socio-economic, behavioural, biological, relationship and social mobility factors.

Table 4 shows the percentage of the difference between Greater Glasgow and Clyde and the rest of Scotland which was explained by adjusting for each group of explanatory variables. All the residence effect has been explained when 100% of the difference has been explained. For different outcomes the percentage of the difference explained by SIMD compared to SIMD and socio-economic variables varies; much more of the residence effect is explained by SIMD for self-assessed health than depression, but both are fully explained after further adjusting for the socio-economic variables.

The results have shown that even when area based deprivation and a range of other socio-economic factors are taken into account, there remains a significant excess risk associated with residence in Glasgow for anxiety, GHQ, self-reported doctor diagnosed heart attack and, for men, being overweight. Of these, all of the excess risk can be explained in terms of behavioural and biological characteristics for being overweight and having a high GHQ score. However, for two important outcomes relating to both physical and mental health, no explanation can be derived for the excess risk of doctor diagnosed heart attack or anxiety from the wealth of information collected in the Scottish Health Survey.

The socio-economic variable which had the largest impact on predicting health outcomes when each socio-economic variable was included as the only socio-economic variable in the final model for each outcome was economic status.

Although it is encouraging that differences in many of the adverse health behaviours were explained by the differing age and sex distributions, the differences for many health outcomes were explained by either area or individual level socio-economic factors. This underlines the importance of improving both the area and individual level socio-economic circumstances of those experiencing poverty and deprivation. However further research is needed into the reasons behind the increased levels of anxiety and heart attacks found in Greater Glasgow and Clyde as these are not fully explained by socio-economic circumstances.

There are some limitations to the study, such as the use of so many self-reported measures; however as this was the same for residents of Greater Glasgow and Clyde and the rest of Scotland the results are still comparable between the two regions. Complete case analyses were carried out; although weights were used to ensure the participating sample represented Scotland, this does not account for item non response within participants, which occasionally led to different results when the same model was run using the nurse/blood sample and the complete sample. The number of participants who had suffered strokes or heart attacks were small, and this meant certain biological relationships could not be investigated. Finally this is a cross-sectional dataset, so it is not possible to draw conclusions regarding the

direction of effects. However the many advantages of the study outweigh the disadvantages, such as the large sample size and breadth of information available in the Scottish Health Surveys, allowing these analyses to be carried out, extending previous work which only investigated the extent of socio-economic variables in explaining differences between Glasgow and the rest of Scotland. An additional advantage is the use of a more spatially-specific variable to examine the effect of area-level deprivation.

Table 4: Percentage of difference between Greater Glasgow and Clyde and the rest of Scotland explained by each group of explanatory variables

Outcome	Significant difference for residents of Greater Glasgow and Clyde after adjusting for age and sex?	Percentage of difference between Greater Glasgow and Clyde and the rest of Scotland explained by:				
		SIMD	SIMD and socio-economic variables	SIMD, socio-economic and behavioural variables	SIMD, socio-economic, behavioural and biological variables	SIMD, socio-economic, behavioural, biological, relationships and social mobility variables
<u>Mental and General Health</u>						
Anxiety	✓	5	19	36	30	100 ^a
GHQ	✓	9	28	100 ^b		
WEMWBS	✓	100				
Depression	✓	18	100			
Self-assessed health	✓	64	100			
<u>Physical Health</u>						
Heart attack ^c	✓	24	22	20	4	4
Limiting longstanding illness	✓	48	100			
Stroke	x					
CVD	✓	100				
COPD	✓	100				
<u>Adverse Health Behaviours</u>						
Overweight ^d – men	✓	100 ^b	100 ^b	100 ^b	100	
Overweight ^d - women	x					
Obesity – men	x					
Obesity – women	x ^e	e	e			
Binge drinking	x					
Drinking over the recommended weekly alcohol limit	x					
Potential problem drinking	x					
Current smokers	x					
Heavy smokers	✓	100				
Consuming less than 2 portions of fruit and vegetables per day	x					

^a This model is not as good a fit to the data as the previous model, so is not used as the final model

^b Residence is no longer in the model when the restricted sample necessary for comparisons is used, but remains in the model when behavioural variables have been added when the full available sample is used

^c For heart attack the only biological variable added was BMI

^d For overweight neither BMI nor waist-hip ratio were added as biological variables

^e For women there was no significant difference in likelihood of obesity after adjusting for age, but the difference became significant when further adjusting for SIMD, and was fully removed when adjusting for SIMD and socio-economic variables

Appendix 1: Pseudo R²s

A variety of approaches exist for developing a pseudo R², based on the different approaches for thinking about R²s in ordinary least squares regression, which enable comparisons to be made between models¹⁶. The two most appropriate approaches are considering R² as the proportion of the total variability that is explained by the model, and the improvement in prediction from the null model to the fitted model.

McFadden's pseudo R² mirrors both of these approaches, and is calculated as follows:

$$R^2 = 1 - \frac{\ln \hat{L}(M_{Full})}{\ln \hat{L}(M_{Intercept})}$$

where \hat{L} is the estimated likelihood, M_{Full} is the model with predictors and $M_{Intercept}$ is the model without predictors. The higher the R², the better the fit of the full model compared to the intercept model. If two models were being compared on the same data, McFadden's pseudo R² is higher for the model with the higher likelihood, indicating the model which fits the data better. This therefore enables models to be directly compared to find which of the discussed models best fits the data.

Appendix 2: Anxiety model development

Many models are discussed here; all odds ratios given are for the sample with complete data on all variables contained in any of the 'final' models, allowing them to be directly compared. This sample size was 1,134, as some final models contained variables only collected from participants who had a blood sample taken. The weights for the blood sample were therefore used in all the analyses, even if they did not contain any blood variables, as the sample was restricted to those who provided a blood sample. McFadden's pseudo R^2 s are compared for the models.

In the initial logistic regression model (Model 1) containing age, sex and residence, residents of Greater Glasgow and Clyde had an odds ratio of 2.92 for suffering from anxiety, meaning their odds were almost three times those of the rest of Scotland. McFadden's pseudo R^2 for this model was 0.057. When SIMD was added to the model (Model 2) the odds ratio for residence in Greater Glasgow and Clyde dropped slightly to 2.82, showing that only a small amount of the higher levels of anxiety found in Greater Glasgow and Clyde was explained by the SIMD. McFadden's pseudo R^2 for this model was 0.079, showing this model to be a better fit than the previous model.

The socio-economic variables were then added to the model and backward selection performed (Model 3). The variables which remained in the model were age, sex, residence, economic activity and marital status. The odds ratio for residence in Greater Glasgow and Clyde was reduced slightly further to 2.55, showing that socio-economic variables did not fully explain the increased levels of anxiety found in Greater Glasgow and Clyde. McFadden's pseudo R^2 for this model was 0.107, showing this model to be a better fit than either of the previous models.

The next model (Model 4) started with all the socio-economic and behavioural variables, and after backward selection contained age, sex, residence, economic activity, potential problem drinking, abstaining from alcohol and physical activity level. Residents of Greater Glasgow and Clyde had over twice the odds of anxiety compared to the rest of Scotland, with an odds ratio of 2.21. This odds ratio was lower than in any of the previous models, but the socio-economic and behavioural variables did not fully explain the increased odds of anxiety for residents of Greater Glasgow and Clyde. McFadden's pseudo R^2 for this model was 0.115, showing this model to be a slightly better fit than the previous model.

Model 5 started with all the socio-economic, behavioural and biological variables, and after backward selection only residence, fibrinogen quintile and lung function remained in the model. Residents of Greater Glasgow and Clyde again had over twice the odds of anxiety compared to the rest of Scotland, with an odds ratio of 2.34. McFadden's pseudo R^2 for this model was 0.066, meaning this model did not fit the data as well as the previous model. Model 4 would therefore be chosen in preference to this model.

The last model, Model 6, added relationships and social mobility to the variables entered into the previous model, and after backward selection it contained equalised income, fibrinogen quintiles and lung function. McFadden's pseudo R^2 for this model was 0.063, meaning this model did not fit the data as well as Model 4.

Appendix 3: GHQ model development

Many models are discussed in this section; all odds ratios given are for the sample with complete data on all variables contained in any of the 'final' models, allowing them to be directly compared, unless it is stated otherwise. This sample size was 1,795, as variables only collected in the nurse subsample are included.

In the initial logistic regression model containing only age, sex and residence (Model 1), residence in Greater Glasgow and Clyde had an odds ratio of 1.67, representing increased odds of having a high GHQ-12 score for those who reside in Greater Glasgow and Clyde compared to the rest of Scotland. When SIMD was added to the model (Model 2) the odds ratio decreased slightly to 1.61, showing that a small amount of the increased risk was explained by the different rates of deprivation in Greater Glasgow and Clyde. McFadden's pseudo R^2 was 0.027 for Model 1, and 0.040 for Model 2, showing that Model 2 was a better fit to the data.

When the socio-economic variables had been added to the model and backward selection performed, age, sex, SIMD, receiving income-related benefits, economic activity and marital status remained in the model (Model 3). Residence in Greater Glasgow and Clyde had an odds ratio of 1.48, which was just outside of significance at a 5% level, however when the whole sample available was included in the model the odds ratio was significant, so it was kept in the model. The same applied to SIMD and income-related benefits; they were not significant predictors using the restricted sample, but remained in the model as they were significant when the full available sample was included. McFadden's pseudo R^2 for the model with the restricted sample was 0.094, showing this model to be a better fit than Model 2.

When the behavioural variables had been added to the model and backward selection had been performed (Model 4), the variables which remained in the model were age, sex, residence, receiving income-related benefits, economic activity, educational qualifications, marital status, smoking status, potential problem drinking, abstaining from alcohol and physical activity level. Residing in Greater Glasgow and Clyde had an odds ratio of 1.45, which was again not quite significant at a 5% level of significance, but in the model containing the full available sample residence was significant. The same is true of receiving income-related benefits, educational qualifications and smoking status, so all remain in the model. McFadden's pseudo R^2 for the model with the restricted sample was 0.117, showing this model to be a better fit than Model 3.

The biological variables were then added to the model and backward selection performed. As all the blood analytes dropped from the model it was re-run without the blood analytes, allowing the nurse sample to be used rather than the blood sample, increasing the sample size. After backward selection was run the variables remaining in the model (Model 5) were age, economic activity, marital status, binge drinking, potential problem drinking, physical activity level and waist-hip ratio. As it is not possible to re-run this model using a larger sample due to the inclusion of waist-hip ratio, which was measured at the nurse visit, it is not possible to know whether, as in the earlier models described, residence in Greater Glasgow and Clyde would have been significant in a larger sample. McFadden's pseudo R^2 for the model with the restricted sample was 0.097, showing Model 4 to be the best fitting model.

Appendix 4: Heart attack model development

Many models are discussed in this section; all odds ratios given are for the sample with complete data on all variables contained in any of the 'final' models, allowing them to be directly compared. This sample size was 11,201. Participants aged 16 to 54 were combined into one category due to the very low prevalence of heart attacks in young people.

In the initial logistic regression model (Model 1) containing age, sex and residence, residents of Greater Glasgow and Clyde had an odds ratio of 1.46 of having had a heart attack, meaning their odds of having had a heart attack were 46% higher than the rest of Scotland. This model had a McFadden's pseudo R^2 of 0.159.

When SIMD was added to the model (Model 2) all four variables were significant predictors of having had a doctor-diagnosed heart attack, with the odds ratio for Greater Glasgow and Clyde reduced slightly to 1.35 by the addition of SIMD, showing that around a quarter of the additional odds of having had a heart attack was explained by SIMD. However there was still a 35% increased risk for residents of Greater Glasgow and Clyde compared to the rest of Scotland. McFadden's pseudo R^2 for this model was 0.165.

The third model included age, sex, residence, SIMD and the socio-economic variables. After backward selection had been performed the variables which remained in the model (Model 3) were age, sex, residence, economic activity, educational qualifications, household tenure and marital status. The odds ratio for residence in Greater Glasgow and Clyde remained very similar at 1.36, implying that after adjusting for age, sex and SIMD, adjusting for other socio-economic variables did not alter the excess risk found in residents of Greater Glasgow and Clyde. This model had a McFadden's pseudo R^2 of 0.193.

The next model included age, sex, residence, SIMD, socio-economic and behavioural variables. After backward selection had been performed the variables which remained in the model (Model 4) were age, sex, residence, NS-SEC, household tenure, marital status, smoking status, abstaining from alcohol, drinking over the recommended weekly alcohol limit and physical activity level. The odds ratio for residence in Greater Glasgow and Clyde remained similar at 1.37, implying that this effect was independent of the behavioural variables added to the model. This model had a McFadden's pseudo R^2 of 0.218, showing this model was a better fit than the previous model.

When all the biological variables were added the sample size was reduced to 974, with just one participant having suffered a heart attack. This was clearly not sufficient for analysis. There were also not a sufficient number of heart attacks for analysis when the nurse variables excluding the blood analytes were included in the model; therefore BMI was added to the socio-economic and behavioural variables, with the full sample and full sample weights used.

The variables which remained in the model after backward selection (Model 5) were age, sex, residence, household tenure, marital status, smoking status, abstaining from alcohol, drinking over the recommended weekly alcohol limit, physical activity

level and BMI. The odds ratio for residents of Greater Glasgow and Clyde increased slightly to 1.44, implying that the BMI distribution in Greater Glasgow and Clyde would predict a lower rate of heart attack than in the rest of Scotland. This makes sense, as Greater Glasgow and Clyde had a lower prevalence of overweight than the rest of Scotland, and the odds ratio of having had a heart attack for being overweight compared to being a healthy weight was 1.42. This model had a McFadden's pseudo R^2 of 0.224, showing a slight improvement over the previous model.

Parental NS-SEC, social mobility, single parenthood and being a stepparent were added for the final model (Model 6), and after backward selection had been carried out the model contained stepparent in addition to the variables in the previous model. The odds ratios for all variables remain virtually unchanged, with an odds ratio 1.44 for Greater Glasgow and Clyde. This model had a slightly higher McFadden's pseudo R^2 of 0.229, which indicated that Model 6 was the best-fitting model.

Appendix 5: Overweight model development for men

The McFadden pseudo R^2 s given below are the results when the same sample of 651 is used in each model.

In the original logistic regression model containing only age and residence (Model 1) residence was not significant with the reduced sample, however it was when the full available sample was used (odds ratio of 0.78). McFadden's pseudo R^2 for this model was 0.054. Similarly residence was not significant when SIMD was added to the model for the restricted sample (Model 2), but was when the full sample was used (odds ratio of 0.80). This model had a McFadden's pseudo R^2 of 0.066, showing it to be a better model than the Model 1.

When the socio-economic variables had been added (Model 3) the variables remaining in the model when all available data were used were: age, residence, equivalised income and marital status; however of these variables only equivalised income and marital status were significant with the reduced sample. The odds ratio for residence in Greater Glasgow and Clyde was significant when the full available sample was used, and the odds ratio was 0.80. McFadden's pseudo R^2 for this model was 0.118, showing that this model provides a better fit than the previous models.

When the behavioural variables had been added (Model 4) the variables remaining in the model when all available data were used were: age, residence, marital status, smoking status, binge drinking and physical activity level; however of these variables only marital status was significant with the reduced sample. The odds ratio for residence in Greater Glasgow and Clyde was 0.81 when the full available sample was used. McFadden's pseudo R^2 for this model was 0.117, showing that this model is a slightly worse fit than Model 3.

When the biological variables had been added (Model 5) the variables remaining in the model when all available data were used were: equivalised income, marital status, smoking status, cholesterol level and C-reactive protein. HDL cholesterol was not added to the model as only 34 men had low HDL, all of whom were overweight, causing a separation in the data. As it is not possible to re-run this model using a larger sample due to the inclusion of blood analytes, it is not possible to know whether, as in the earlier models described, residence in Greater Glasgow and Clyde would have been significant in a larger sample. McFadden's pseudo R^2 for this model was 0.196, showing this model to fit the data best out of the models described here.

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¹⁴ There are only 76 participants aged 16 plus and over who do not know how many cigarettes they smoke a day.

¹⁵ The CAGE questionnaire contains six statements:

- I have felt that I ought to cut down on my drinking
- I have felt ashamed or guilty about my drinking
- People have annoyed me by criticising my drinking
- I have found that my hands were shaking in the morning after drinking the previous night
- I have had a drink first thing in the morning to steady my nerves or get rid of a hangover
- There have been occasions when I felt that I was unable to stop drinking

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