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SOCIO-GEOGRAPHIC MOBILITY AND HEALTH STATUS: A LONGITUDINAL ANALYSIS USING THE NATIONAL POPULATION HEALTH SURVEY OF CANADA

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Abstract

This paper considers the relationships between health status and socio-geographic mobility over time for individuals sampled in the longitudinal *National Population Health Survey* of Canada. The study aims to elucidate the associations between individuals' health outcomes (assessed on various measures), and area deprivation in their place of residence. We also aimed to investigate the significance of selective residential migration as a possible contributor to area differences in health.

Background

A large international literature, comprehensively reviewed elsewhere (Duncan, Jones and Moon, 1993; MacIntyre, McIver and Soomans, 1993; Curtis and Jones, 1998; Diez-Roux, 1998, 2000; Curtis, 2004), makes the case that there are theoretical and empirical associations between the health of individuals and the area conditions in their place of residence. This leads us to anticipate statistical associations between individuals' health status and the levels of material and social deprivation in their area of residence. People in poor health are typically more concentrated in deprived areas while those in better health are more likely to live in more advantaged places. In many empirical studies this relationship of health with aspects of place is significantly, but not completely attenuated when the socioeconomic characteristics of individuals are taken into account, supporting the idea that conditions in one's residential neighbourhood interact with one's individual risk factors in ways that are important for health. (Pickett and Pearl, 2001; Oakes, 2004; Subramanian, Lochner & Kawachi 2003). These relationships between area 'deprivation' and individual 'health' are complex in several respects. In the present study we are particularly concerned with three aspects of this complexity.

First, causal pathways linking 'deprivation' to 'health' are multi-faceted and different aspects of area deprivation may show distinct associations with a given health outcome. For example, much of the literature on 'social capital' and health inequalities (e.g reviewed by (Kawachi, Kim, Coutts, Subramanian, 2004) is based on the argument that social conditions such as lack of trust, low levels of social support and restricted social networking, are important for health, as well as material poverty. Several studies suggest that contextual?

social and material disadvantage show a degree of independent association with health (Congdon, 1996; Weich, Twigg, Holt, Lewis & Jones, 2003; Pampalon, Hamel & Raymond, 2004).

Second, since the causal pathways affecting risks for different health conditions vary, the associations with area deprivation indicators may vary for different types of health problem (e.g Curtis, Copeland, Fagg, et al., 2006; Pampalon, Hamel & Raymond, 2004).

Third, the associations between area conditions and health are likely to be associated with dynamic processes operating over time. Much research on geographical health inequalities invokes causal pathways by which *area deprivation influences health* through various socio-economic health determinants accumulating over time. Some studies are also concerned with socio-geographical processes of 'health selection', through which people with illnesses (especially chronic conditions) are more likely either to move to, or to remain in relatively deprived areas, while people in better health are more likely to move to, or remain in more affluent areas. These selective migration patterns may over time contribute to greater concentrations of people in poor health living in deprived, rather than advantaged areas. There is some evidence of such socio-geographic 'sorting' of people according to their health status, so health selection may contribute to area inequalities in health (though health selection processes are unlikely to fully explain population health differences between more and less deprived areas) (e.g Boyle, Norman & Rees, 2002; Larson, Bell & Young, 2004; DeVerteuil, Hinds, Lix, et al,2007). Also socio-geographic 'health selection' may operate in quite complex ways; for example, there is some evidence that people in poor health who move home may not always migrate towards more deprived areas (Norman, Boyle and Rees, 2005).

Empirical research on the relative importance of socio-economic determinants of health vs. health selection effects is strengthened by a longitudinal design. This helps to establish whether differences in socio-geographical health determinants predict subsequent development of health inequalities, in ways that suggest causal relationships. Longitudinal studies may also help us to establish whether selection effects seem to be operating so that inequalities in health are predictive of later distributions of the population into more or less socially disadvantaged areas.

This paper reports an empirical analysis to explore the relevance of these ideas at the national level in Canada, using longitudinal data from the *National Population Health Survey* (NPHS*),* which has followed a national sample of Canadians over time, collecting data at 6 time points between 1994 and 2004. The first aim of the analysis was to discover whether, at the 5th cycle of the survey, in 2002, socio-economic conditions in the respondent's place of residence were associated with different aspects of individual health status. Second we aimed to establish whether health status in 2002 could be predicted by socio-economic conditions in the places where they were living in the 2nd survey cycle carried out in 1996. The third objective was to explore whether there was evidence for socio-geographical 'health selection' (i.e. whether, over time, people with or without health problems differed in their patterns of migration into more or less deprived areas).

Method

The NPHS has followed a nationally representative community sample over the period from 1994 to 2004, with 6 sweeps of data collection over this period. From an initial sample of households, one individual was randomly selected to be the NPHS respondent and was followed over time. We have selected for this analysis men and women aged over 15 and under 54 years at the start of the survey in 1994. Older people were excluded because we

wished to examine patterns of migration in relation to health that were not likely to be influenced by effects of 'retirement migration'.

The analysis focuses on data from the second survey cycle (in 1996) and the fifth cycle (in 2002). We were not able to use the first cycle data for this analysis since some of the postcode information recorded for the respondents at the beginning of the survey was for the initial contact address and may not have been accurate for their residential location. The fifth cycle data were used because the NPHS sample date is closest to the 2001 census date of the information used to classify area conditions.

Data on health of the individual respondents: we used four measures of health from the NPHS, which were recorded at both time points considered. These indicators were selected because they included both psychological and physical aspects of health that might theoretically be influenced by area as well as individual processes, and they all relate to conditions that have potential to be sufficiently long lasting to impact on respondents in ways that might give rise to health related migration.

Self reported mental distress was measured using a questionnaire based on the Composite International Diagnostic Interview (Kessler and Ustun, 2004). Individuals who score 4 or more on this scale have an 80% probability of clinical depression, though the score is not considered to be a completely reliable measure of clinically recognized mental illness. Here we have used a binary measure to indicate whether the individual has a score of 4 or more, indicative of relatively severe mental distress.

Self reported general health was measured here using a binary categorical variable distinguishing between those who assessed their health as 'poor or fair', as opposed to those whose self reported health is 'good', 'very good' or 'excellent'. This type of indicator is widely used in studies of general population health in Canada and elsewhere and it reflects a combination of both physical and psychological state at the time of questioning.

The ***Health Utility Index*** was developed at McMaster University (Furlong, Feeny, Torrance, et al. 1998; Feeney, Furlong, Boyle et al, 1995) and assesses health in terms of 6 physical and psychological aspects which are weighted according to an assessment of 'social preferences' that reflects the average importance attributed to each aspect of health by a representative general population sample from Hamilton, Ontario. This measure has the advantage of being scored using independent assessments and it relates to longer term impairments. Lower scores reflect worse 'health utility' and in this study, scores of less than 0.8 (in a range varying from 0.36 to 1.00) were taken as indicating relatively poor health. Lindeboom and van Doorslaer (2004) found that people reporting their health as 'poor' had HUI values less than 0.8.

A binary indicator of whether or not the individual has ***restricted activity*** due to any one of a checklist of health conditions was also included. This reflects significant impairment due to a range of health problems most of which are likely to be chronic in nature.

Individual variables associated with poor health

We also drew from the NPHS data on a number of individual demographic and socio-economic characteristics, which were expected to show an association with health inequalities. The variables retained in the models all show some significant associations with at least one of the health status indicators. The variables used were: *sex* and *age* (respondents were categorized into 4 age groups); *income* (classified in 4 ranked groups, based on total household income and numbers of people in the household); *household type* (distinguishing those living alone or as unattached adults in larger households, single parents

living with dependent children only and those living in households with in partnership with another adult, with or without children); highest *educational level* attained by the individual (classed as: less than secondary graduation; secondary school graduation; some post-secondary education; post-secondary graduation).

Area variables linked to the survey

For this analysis we have linked area information on deprivation to the NPHS survey. The area data relate to Dissemination Areas (DAs) (the smallest areas for which area census data is disseminated). There were 52,993 DAs in Canada nationally in the 2001 census, each with population size of 400–700 persons. There are two indicators for each area, relating respectively to material poverty and social disadvantage. These have been generated for all DAs in Canada by Pampalon, Hamel & Raymond (2004). The material deprivation indicator comprises information on the population aged over 15 years: proportions without a high school certificate or diploma; proportions unemployed and average income. It is meant to reflect average levels of financial and economic poverty in the local population. The social deprivation measure comprises data on the proportion of the population over 15 years old who live alone and the proportion separated, divorced or widowed, as well as the proportion of households that are single parent families. This is taken to stand for differences in social isolation or social cohesion. As discussed above, both measures have been found to be associated with health outcomes in other studies.

There is weak correlation at area level between social and material deprivation. These measures are proxies for different aspects of socio-economic conditions at the local level, and have been demonstrated to vary independently (Pampalon et al, 2004). In our sample, the association between social and material area deprivation across all the individuals analysed was weakly negative (Pearson's correlation coefficient −0.07). Other research, cited above, using similar measures of material and social deprivation also supports the argument that they are distinct dimensions of socio-economic disadvantage with independent associations with health outcomes.

We used the matching procedure developed by researchers at Statistics Canada (described by Gonthier, Hotton, Cook et al, 2006) based on the Post Code Correspondence File, to identify the Dissemination Area (DA) from the 2001 population census in which the respondent lived in 1996 and in 2001. In cases where a Postal Code area covers all or part of more than one adjacent DA, the matching procedure operates a random allocation procedure to return the DA of residence. This makes the allocation process to DA rather approximate and may result in some inaccuracy in the area classification attributed to individuals. Also, in some cases, this can mean that a person who has not moved will be recorded in two different DAs in 1996 and 2002. To eliminate this effect we used the survey information about postcode to specify whether there had been a change of address. If the person had not changed their postcode, the DA in 2002 was taken to be the same as the DA in 1996.

The DA identifier from the 2001 census was used to attribute to each survey respondent area indicators of deprivation describing their area of residence. The DAs in urban areas are quite small areas, but in rural areas the administrative areas defined by postal codes and by census geography are larger so these indicators summarise conditions over quite extensive areas within which there is likely to be local variation. Because of the approximations involved in area attribution and also to protect the anonymity of individuals, we have classified areas into centile or quintile groups ranked by material or by social deprivation. These area data do not identify geographical position in the country, but only relative level of area deprivation. Where respondents were known to have changed address between survey cycles 2 and 5, change in area category calculated as the difference in percentile position between their earlier and later location.

Modelling strategy

The analyses were conducted in STATA (version 9) (Long and Freese, 2006) using logistic regression for binary outcomes. The unit of analysis were the individual respondents for whom we had complete data. Separate analyses were conducted with each of the four health variables as outcomes, and also for certain other outcomes of interest for this study concerning patterns of residential migration. The predictor variables are expressed in 'indicator' mode as categories. For categories on a predictor variable, probability of the outcome is expressed as a relative risk ratio (rrr), as compared with one 'reference' category. Significant associations are indicated by rrr values for which the 95% confidence interval does not include 1.00. The standard errors are adjusted for geographical clustering of individuals within DAs, using the 'CLUSTER' option in STATA. (However, the data are not hierarchically structured in a manner that would call for multi-level modelling, since the average number of individuals in a DA in the sample data for 2002 was 1.3 (range 1–32) and for 88.7% of the DAs represented, only one sample member was resident in the area in 2002). To allow for the complex sample design of this longitudinal survey and for the effects of attrition on the representativeness of the sample, we employed 'bootstrap' methods. This technique conducted 500 replications of the analysis on different subsamples of the total and employs the combined results to adjust the standard errors.

The analysis started with an examination of 'cross sectional' data, for the fifth survey cycle (in 2002), of the bi-variate associations between the health outcomes and the individual variables applicable in cycle 5 (Table 1) as well as the material and social deprivation indicators for area of residence in cycle 5 (Table 2).

We then conducted a multivariate analysis using a series of regression models designed to test whether any cross-sectional associations between health and area deprivation in the fifth survey cycle were significant once we had controlled for individual attributes (Table 3, models 1–8).

The next stage of the analysis applied multivariate regression models to data from both cycle 2 and cycle 5 to examine whether health changes in outcomes between cycles 2 and 5 were associated with initial individual characteristics and area conditions in cycle 2 (Table 4 models 9–16). In order to assess change in health, we used health in cycle 5 as the outcome, and included initial health at cycle 2 in the model. We particularly wanted to know whether area deprivation at an earlier date predicted subsequent health change, as this might be consistent with the idea that area conditions influence risk of ill health.

To investigate processes of 'health selective' migration, we used information on change of address between cycles 2 and 5 to set up an outcome variable to show whether ranked material or social deprivation for area of residence had changed. We considered two outcome measures of 'mobility' in terms of change in area deprivation. First we investigated *change* in quintile ranks (models 9–12). For material deprivation (models 9 and 10), the reference group was those showing 'no change' in material deprivation quintile (including those who did not move). This reference group was compared with two other categories: (1) those who moved from cycle 2 to cycle 5 so that the quintile ranking of residential area increased (deteriorated) and (2) those for whom residential area quintile rank decreased (ameliorated). Similar categories were generated for change in social deprivation rank. The regression models predicted the rrr of area 'amelioration' or 'deterioration' according to individual socio-demographic characteristics of the individuals. For this model we excluded people who were already in quintiles 1 or 5 ranked by the relevant deprivation score, in order to eliminate 'floor' or 'ceiling' effects whereby/conditions for those who already live in the 'worst' areas cannot 'deteriorate' any further, and those in the 'best' areas cannot 'ameliorate'. Similar models (11 and 12) were tested for change in social deprivation.

The second set of models (labelled 13–16) report a similar analysis using data on centile rank on deprivation to calculate rrr of an 'amelioration' or a 'deterioration' of at least 10 percentile points in rank of area deprivation between cycle 2 and cycle 5 (as compared with 'no change' or a change of less than 10 percentiles). For this model, those who were initially in the top or the bottom decile on the relevant deprivation score were excluded, so that floor and ceiling effects would not interfere with the analysis. We report here differences in the rrr of 'deterioration' or 'amelioration' of area deprivation score (compared with 'no change') for socio-demographic groups of individuals.

Table 5 (models 17 – 20) expands models 9 – 12 to include the psychological health variable at cycle 2 as a predictor of deprivation change. This analysis shows whether there was selective migration into more or less deprived areas associated with initial health status, and whether any association is independent of individual socio-demographic variables. We do not report further modelling to include the other health variables as predictors of change in area deprivation, since these showed no significant prospective association with the outcome variables.

Results

Table 1 shows that at cycle 5 there were significant bivariate associations between the health outcomes of interest and the socio-demographic variables used for this analysis, justifying their inclusion in the regression models. The 'individual' variables (sex, age, household type, and income and education all show associations with one or more of the health outcomes). The risk of severe distress was significantly greater for women than men and there were insignificant differences by sex for the other health outcomes (slightly higher risks for women). The proportions with low health utility, restricted activity or poor/fair general health were greater in older, rather than younger age groups, but psychological distress was more common in the younger age groups. Compared with the reference category (lowest income group), risk of poor health on each of the four measures was reduced for those in higher income groups. Those with lower levels of education had greater risk of poor health as measured by health utility, restricted activity and poor/fair general health but psychological distress was not associated with education. Those who were unattached or were single parents had higher risk of poor health measured by health utility, restricted activity and psychological distress and a similar trend for poor/fair general health was also apparent, though less significant.

Table 2 shows the bivariate associations between each health indicator, as measured in 2002 (the fifth survey cycle), and quintile ranks for deprivation of the area of residence at that time. In 2002, area material deprivation quintile rank was associated with health utility, restricted activity and poor/fair general health. For each of these indicators, health was worse for those living in areas with higher levels of material deprivation. Psychological distress in 2002 was not associated with material deprivation of area of residence in the fifth cycle. On the other hand, social deprivation was only associated significantly with psychological distress, which was more prevalent for those living in the 4^{th} and 5^{th} quintile groups.

Table 3 shows regression models 1–8 that related characteristics recorded at cycle 2 to the health outcomes in cycle 5. The models are presented controlling for initial health status in cycle 2, in order to examine whether *change* in health status from 1996–2002 is more clearly related to the predictors than the final health outcome overall. The fact that all the sociodemographic variables show independent associations with risk of developing at least one of the health outcomes justified their retention in these and subsequent models.

Women were more likely, prospectively, to develop psychological distress but sex was not related to the risk of developing other health problems measured here when controlling for other factors in the models. Older people were more likely to develop low health utility, restriction of activity and to report worsening general health by cycle 5. However, older individuals were less likely to develop severe psychological distress. Risks of worsening health on all four indicators were greater for people in the lowest income group (the reference) than for those in the higher income groups, as indicated by the fact that the rrr is always significantly below the reference category. For health utility (models 1 and 2) and poor/fair general health (models 5 and 6), educational level at cycle 2 showed significant association with health outcomes in cycle 5, after controlling for the other factors in the model, such that more educated people had lower risks. Single parents and those living alone or unattached were more likely to develop poor health utility (models 1 and 2) and those who lived alone or unattached showed a greater risk of developing distress. Also, there is a weak tendency in the same direction for lone parents (models 7 and 8).

Controlling for these individual sociodemographic characteristics at cycle 2, risk of developing restricted activity (model 3) was greater for residents of areas in the middle quintiles for material deprivation (as compared with the highest and lowest quintiles) but change in the other health outcomes was not predicted by material deprivation at cycle 2 (models 1, 4, 7). Worse area social deprivation at cycle 2 was not, predictive of change in health (models 2,4,6,8).

Table 4 concerns selective migration, seeking to show whether people with different individual characteristics in cycle 2 varied in their tendency to move ‘up’ or ‘down’ the ranks of area deprivation. Women were slightly less likely than men to make a move resulting in amelioration of area social deprivation (models 12 and 16). Older people were much less likely to change rank of deprivation. This partly reflects their higher level of residential stability as they are relatively unlikely to change their place of residence between cycle 2 and cycle 5. Those in the lowest income group were significantly more likely to move to an area with greater material deprivation (models 9 and 13). Those with higher educational level were significantly more likely to make a move resulting in amelioration of social conditions (models 12 and 16). Single parents were relatively likely to move to an area in a different deprivation category, though this may result in amelioration or deterioration of area conditions (significant in all models 9–16). Those living alone were also highly mobile and they appear to be moving to areas which are wealthier but with more single person households; this group were likely to see material deprivation improve (models 10 and 14), but are also more likely to experience a deterioration in social deprivation (models 11 and 15).

Health status at cycle 2 did not predict residential moves causing a change in area conditions except in the case of psychological health. Version A of models 17 and 19 show that those who reported psychological distress in cycle 2 were more likely to move to areas which were more deprived materially or socially by cycle 5. This seems to be consistent with the idea of health selection in residential migration. When the sociodemographic variables are included in version B of these models, the association with prior health status is no longer statistically significant, though the trend remains the same.

Discussion and Conclusions

Before summarising our conclusions we note some limitations to our analysis. The information on health used here is restricted to self report data which, although it is derived from established and validated indicators may introduce a further level of complexity into the processes we are trying to assess. Furthermore, our measures of area conditions are

probably rather approximate, due to the problems of linkage of postcode and area data, and we have not been able to assess change in area conditions within areas over the time covered by this analysis. It is possible that for those who did not make any residential moves, experience of living in 'improving areas' would be different from that in areas in decline, for example. In addition our longitudinal analyses rest on data for two time points and for a fairly limited period, especially bearing in mind that we have no information on experiences early in the life course of the individuals studied (all of whom were at least 15 by the time they joined the sample analysed here).

Bearing in mind these limitations we suggest that some conclusions arise from our analysis, which have significance for international debates about area conditions and their association with health outcomes.

First we find different associations with material area deprivation than with social deprivation, which supports other research suggesting that these aspects of deprivation are independently and differently related to health. In a cross sectional analysis at cycle 5 of this survey, material deprivation, rather than social deprivation at area level seemed more strongly associated with the health outcomes measured by health utility, restriction of activity and poor/fair general health. For morbidity measured in terms of psychological distress, in contrast with the other health outcomes there was no association with material deprivation at cycle 5 but area social deprivation seemed important as a predictor of morbidity in cross sectional analysis. This underlines the idea that different sorts of area conditions may be associated with illness and disability, depending on the type of health condition considered.

Secondly our results suggest that area effects may be largely, but not completely mediated by the individual variables we considered. The relationship with material deprivation for health utility, restriction of activity and poor/fair general health was attenuated (but not completely insignificant) when we controlled for the individual variables. This would seem to fit the hypothesis that material socioeconomic deprivation is significant for health but that the relationship with area conditions is strongly mediated by individual variables.

Furthermore, there is no evidence that this association was influenced by 'direct' 'health selection' effects (whereby those who already had poor health on these indicators in cycle 2) were more likely to move into poorer areas. On the other hand, some people whose individual characteristics may have put them more at risk of later poor health (e.g. those on low incomes, unattached adults and single parents) were more likely to move 'down the ranks' over time in terms of area conditions, so weak, 'indirect' health selective migration may operate for these health outcomes, whereby growing concentrations of people who are most at risk of poor physical health tend to accumulate in deprived areas. We also note that one important reason for lack of geographical health selection effects for these outcomes is that they relate to health conditions mainly affecting older people who are less residentially mobile than younger people.

Health selective migration may be more important for health conditions that affect younger, more mobile population groups. Those in poor psychological health in cycle 2 were more likely to move than other groups and were especially likely to move towards materially, as well as socially deprived areas. This seems to provide some support for the 'health selection' process whereby people with mental health problems tend to 'drift' towards poor, socially disadvantaged areas. The full regression models suggest that this affect is largely explained by the tendency for 'downward mobility', in terms of area conditions, among younger people, those on low incomes and those who live alone, or are single parents (all risk factors for psychological distress in themselves).

We therefore should consider health selective migration effects as being differentiated according the health condition considered and mediated by probably quite complex socio-demographic processes.

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Table 1

Bivariate associations between the individual predictor variables and the health outcomes in cycle 5: weighted relative frequencies values *(and in italics p value with boostrapping)*

Individual Predictor Variable	Categories	Restricted Activity	Psychological Distress
Sex	Males	0.19	0.06
	Females	0.20	0.09
	*(p *)*	*0.28*	*<0.000*
Age Cohort **Described by Age in 1996	15–24	0.15	0.12
	25–34	0.15	0.07
	35–44	0.21	0.07
	45–54	0.27	0.05
	*(p *)*	*<0.000*	*<0.000*
Income Group Cycle 5	Lowest	0.34	0.16
	Low Middle	0.22	0.10
	Upper Middle	0.19	0.07
	Highest	0.16	0.05
	*(p *)*	*<0.000*	*<0.000*
Educational Level Cycle 5	Less than Secondary	0.23	0.07
	Secondary Graduation	0.22	0.07
	Some Post Secondary	0.21	0.07
	Post-Secondary Graduate	0.17	0.08
	*(p *)*	*0.006*	*0.88*
Household Composition Cycle 5	Living with Partner with/without children	0.18	0.06
	Single Parent with dependent children	0.22	0.11
	Living Alone/unattached	0.25	0.13
	*(p *)*	*0.005*	*<0.000*

* p = probability that differences in proportions between the categories are random; significant differences have $p < 0.05$) $p < 0.05$.

** Age cohorts are defined in the text.

Table 2

Bivariate associations between measures of area deprivation and the individual health outcomes: weighted relative frequencies *(and in italics p values with bootstrapping)*

Area Predictor variable	Categories	Restricted Activity	Psychological Distress
Material Deprivation Quintile Cycle 5	1st (least deprived)	0.16	0.07
	2nd	0.17	0.07
	3rd	0.22	0.08
	4th	0.22	0.09
	5th (most deprived)	0.20	0.07
	(p [*])	*0.01*	*0.60*
Social Deprivation Quintile Cycle 5	1st (least deprived)	0.19	0.07
	2nd	0.18	0.07
	3rd	0.20	0.05
	4th	0.21	0.10
	5th (most deprived)	0.20	0.09
	(p [*])	*0.84*	*0.05*

[*] p = probability that differences in proportions between the categories are random; significant differences have $p < 0.05$)

$p < 0.05$.

[**] Age cohorts are defined in the text.

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Table 3

Regression models predicting risk of illness in cycle 5 from individual and area characteristics in cycle 2: Odds ratios compared with reference group (and confidence intervals in parentheses).

		Restricted Activity		Psychological Distress	
		model 1	model 2	model 3	model 4
Individual Predictor Variables					
Variable and Reference Category	Categories				
Health status on the Outcome (reference group is no health problem)	Already has Health Problem	9.16 (7.31 – 11.48)	9.05 (7.21 – 11.34)	4.77 (3.12 – 7.29)	4.97 (3.23 – 7.62)
Sex (reference groups is males)	Females	1.06 (0.88 – 1.29)	1.06 (0.87 – 1.29)	1.53 (1.12 – 2.10)	1.53 (1.11 – 2.09)
Age Cohort (by age in 1996) Reference group is (15–24)	25–34	1.01 (0.70 – 1.47)	1.02 (0.70 – 1.48)	0.65 (0.42 – 0.99)	0.64 (0.42 – 0.99)
	35–44	1.49 (1.04 – 2.12)	1.49 (1.04 – 2.12)	0.65 (0.44 – 0.97)	0.66 (0.44 – 0.99)
	45–54	2.03 (1.45 – 2.85)	2.01 (1.43 – 2.82)	0.45 (0.28 – 0.71)	0.44 (0.28 – 0.71)
Individual Predictor Variables					
Income Group Cycle 2 (reference group is lowest income)	Middle	0.53 (0.36 – 0.79)	0.53 (0.36 – 0.78)	0.69 (0.43 – 1.11)	0.66 (0.40 – 1.07)
	Upper Middle	0.51 (0.35 – 0.73)	0.50 (0.34 – 0.73)	0.54 (0.32 – 0.90)	0.53 (0.32 – 0.89)
	Highest	0.42 (0.28 – 0.64)	0.41 (0.27 – 0.61)	0.42 (0.25 – 0.71)	0.42 (0.25 – 0.70)
Educational Level Cycle 2 (reference group is less than secondary)	Secondary Graduation	1.20 (0.84 – 1.72)	1.21 (0.84 – 1.72)	0.80 (0.42 – 1.54)	0.82 (0.43 – 1.57)
	Some Post Secondary	1.10 (0.81 – 1.49)	1.09 (0.81 – 1.49)	0.79 (0.45 – 1.38)	0.81 (0.46 – 1.40)
	Post- Secondary Graduate	0.94 (0.69 – 1.29)	0.92 (0.67 – 1.24)	0.92 (0.56 – 1.52)	0.92 (0.56 – 1.52)
Household Composition cycle 2 (reference group is living with partner with/without children)	Single Parent with Dependent Children	1.15 (0.88 – 1.51)	1.13 (0.86 – 1.50)	1.37 (0.95 – 1.99)	1.35 (0.92 – 1.97)
	Living Alone/Unatt ached	1.19 (0.85 – 1.66)	1.18 (0.84 – 1.66)	1.60 (1.05 – 2.44)	1.58 (1.02 – 2.44)
Area Predictor variables					
Material Deprivation quintile cycle 2 (Reference group is quintile 1)	2nd	1.10 (0.82 – 1.50)		0.95 (0.59 – 1.54)	
	3rd	1.50 (1.11 – 2.03)		1.02 (0.68 – 1.54)	
	4th	1.42 (1.05 – 1.93)		1.12 (0.71 – 1.76)	
	5th (most deprived)	1.09 (0.79 – 1.51)		0.82 (0.50 – 1.36)	

		Restricted Activity		Psychological Distress	
		model 1	model 2	model 3	model 4
Social Deprivation quintile cycle 2 (reference group is quintile 1)	2nd		0.92 (0.67 – 1.26)		1.03 (0.66 – 1.62)
	3rd		1.05 (0.76 – 1.43)		0.63 (0.38 – 1.03)
	4th		1.00 (0.74 – 1.36)		1.23 (0.77 – 1.98)
	5th (most deprived)		0.95 (0.68 – 1.31)		0.92 (0.58 – 1.43)

Table 4

Analysis of individual socio-demographic factors predicting residential migration and quintile change in deprivation from cycle 2 to cycle 5: relative risk ratios (and confidence intervals in parentheses).

Indicator Predictor Variables		Model 5 Quintile Change for Material Deprivation		Model 6 Quintile Change for Social Deprivation	
		rrr of deterioration vs. no change	rrr of amelioration vs. no change	rrr of deterioration vs. no change	rrr of amelioration vs. no change
Sex (reference groups is males)	Females	1.10 (0.85 – 1.42)	0.99 (0.79 – 1.23)	0.96 (0.76 – 1.22)	0.75 (0.60 – 0.95)
Age Cohort (by age in 1996) (reference group is 15–24)	25–34	0.62 (0.43 – 0.90)	0.69 (0.49 – 0.98)	0.41 (0.28 – 0.61)	0.96 (0.66 – 1.40)
	35–44	0.30 (0.20 – 0.44)	0.36 (0.26 – 0.50)	0.20 (0.14 – 0.29)	0.42 (0.30 – 0.60)
	45–54	0.20 (0.13 – 0.30)	0.24 (0.16 – 0.35)	0.18 (0.12 – 0.26)	0.27 (0.18 – 0.41)
Income group (reference group is lowest income)	Middle	0.55 (0.36 – 0.84)	0.78 (0.53 – 1.16)	0.93 (0.60 – 1.43)	0.96 (0.62 – 1.50)
	Upper Middle	0.48 (0.32 – 0.73)	0.83 (0.57 – 1.20)	1.02 (0.68 – 1.54)	0.93 (0.60 – 1.46)
	Highest	0.43 (0.25 – 0.74)	1.36 (0.85 – 2.18)	0.97 (0.57 – 1.66)	0.99 (0.58 – 1.68)
Educational Level (reference group is < secondary)	Secondary graduation	1.28 (0.81 – 2.01)	0.90 (0.60 – 1.36)	1.45 (0.96 – 2.18)	1.98 (1.23 – 3.18)
	Some Post Secondary	1.41 (0.97 – 2.07)	1.35 (0.95 – 1.91)	1.53 (1.07 – 2.19)	1.84 (1.22 – 2.77)
	Post- Secondary graduate	1.31 (0.85 – 2.02)	1.31 (0.92 – 1.86)	1.15 (0.78 – 1.69)	2.17 (1.45 – 3.25)
Household Composition (reference groups is living with partner)	Single Parent with Dependent Children	1.51 (1.01 – 2.25)	2.01 (1.48 – 2.71)	1.98 (1.34 – 2.93)	1.53 (1.01 – 2.34)
	Living Alone/Unattached	1.02 (0.68 – 1.54)	1.76 (1.23 – 2.51)	1.79 (1.24 – 2.58)	0.31 (0.18 – 0.54)

Table 5

Analysis of factors predicting residential migration and quintile change in deprivation from cycle 2 to cycle 5, including psychological health in cycle 2 as a predictor of migration: relative risk ratios (and confidence intervals shown in parentheses).

Individual Predictor Variables		**Model 7 Quintile Change for Material Deprivation**		**Model 8 Quintile Change for Social Deprivation**	
Version A Including Health Variable Only		**rrr of deterioration vs. no change**	**rrr of amelioration vs. no change**	**rrr of deterioration vs. no change**	**rrr of amelioration vs. no change**
Psychological status in cycle 2 (reference group is not distressed)	Existing Distress	1.82 (1.17 – 2.83)	1.36 (0.85 – 2.19)	1.79 (1.14– 2.82)	1.15 (0.66 – 1.99)
Version B Including Health Variable and Other Predictors					
Sex (reference group is males)	Females	1.09 (0.84 – 1.41)	0.98 (0.72 – 1.78)	0.96 (0.75 – 1.22)	0.76 (0.60 – 0.96)
Age Cohort (by age in 1996) (reference group is 15–24)	25–34	0.68 (0.47 – 0.98)	0.76 (0.54 – 1.07)	0.44 (030 – 0.64)	1.24 (0.85 – 1.79)
	35–44	0.32 (0.22 – 0.47)	0.40 (0.29 – 0.54)	0.21 (0.14 – 0.31)	0.54 (0.38 – 0.76)
	45–54	0.22 (0.14 – 0.33)	0.26 (0.18 – 0.39)	0.19 (0.13 – 0.28)	0.35 (0.23 – 0.53)
Income group (reference group is lowest income)	Middle	0.55 (0.36 – 0.85)	0.79 (0.53 – 1.17)	0.96 (0.62 – 1.49)	0.96 (0.61 – 1.50)
	Upper Middle	0.49 (0.32 – 0.74)	0.83 (0.57 – 1.21)	1.04 (0.68 – 1.58)	0.95 (0.61 – 1.49)
	Highest	0.43 (0.25 – 0.74)	1.35 (0.85 – 2.14)	0.95 (0.55 – 1.66)	1.00 (0.59 – 1.71)
Educational Level (reference group is < secondary)	Secondary graduation	1.30 (0.77 – 2.21)	0.90 (0.57 – 1.42)	1.26 (0.80 – 1.99)	1.71 (1.00 – 2.90)
	Some Post Secondary	1.23 (0.78 – 1.96)	1.09 (0.73 – 1.64)	1.13 (0.74 – 1.71)	1.50 (0.94 – 2.42)
	Post-Secondary graduate	1.33 (0.85 – 2.08)	1.35 (0.91 – 1.99)	1.28 (0.82 – 1.99)	1.82 (1.16 – 2.88)
Household Composition (reference groups is living with partner)	Single Parent with Dependent Children	1.49 (1.00 – 2.23)	2.01 (1.49 – 2.71)	1.98 (1.33 – 2.93)	1.31 (0.85 – 2.02)
	Living alone/unattached	0.98 (0.65 – 1.49)	1.73 (1.21 – 2.48)	1.70 (1.17 – 2.47)	1.48 (0.97 – 2.27)
Psychological Status in cycle 2 (reference group is not distressed)	Existing Distress	1.49 (0.95 – 2.32)	1.13 (0.72 – 1.78)	1.62 (0.98 – 2.68)	1.13 (0.64 – 1.98)