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Chapter 26

The Spatial-temporal Exploration of Health and Housing Tenure Transitions Using the Northern Ireland Longitudinal Study

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Abstract

The nature and value of the Northern Ireland Longitudinal Study (NILS) is demonstrated through a statistical analysis of changes in individuals' health status, housing tenure and residential movement between the 2001 and 2011 Censuses. Multilevel analysis of individuals located within Super Output Areas, and also aggregate mapping of Local Indicators of Spatial Association (LISA) using 2011 Census Area Statistics are undertaken. Over the ten year period in which some people report worsening of their health whilst others experience an improvement, we show how probabilities in health transition are related to starting tenure as well changes in tenure and address between 2001 and 2011. We also provide evidence of distinctive 2011 geographies of self-reported illness and housing tenure, and suggest that spatial context does matter to a degree for individual health transitions. The chapter concludes with a reflection on the analyses presented, consideration of potential future research applications using the NILS, and also some general observations on the changing data landscape.

26.1 Introduction

This chapter seeks to demonstrate the nature and value of using the Northern Ireland Longitudinal Study (NILS) as source of census microdata for longitudinal analysis of health. We do this through our involvement in a 'beta testing' project which aimed to assess the linkage of the 2011 Census to the NILS data spine. It also makes use of the Northern Ireland (NI) Census Area Statistics (CAS). The substantive example considers how individuals make transitions between 2001 and 2011 with respect to their health status, housing tenure (position in housing market) and residential movement (characterised in two different ways as explained in due course). In other words, this is an application that simultaneously considers individual wellbeing (and its geographical clustering), spatial mobilities, and also the relative importance of variations between people and places using longitudinal microdata as well as standard CAS statistics. We begin by considering the literature that informs the research application and, at the end of Section 26.2, we describe the organisation of the remainder of the chapter.

26.2 Health, place and movement

The substantive application is informed by three different strands of literature. The first is a more general literature on nature of health inequalities and specifically that on socio-demographic and geographical variations in self-reported illness (the focus of this chapter), observed morbidity and recorded mortality (Curtis, 2004; Gatrell and Elliott, 2009). Moreover, there have been in the UK numerous official inquiries that have reviewed persistent evidence of socioeconomic and geographical health inequalities (Marmot, 2010; GB Parliament, 2009; Gordon et al., 1999; Townsend et al., 1992). There is documented evidence, using aggregated and disaggregated census data, that has shown differences in health status by sex, age, social class/occupational group and ethnicity, as well as geographical variations at fine spatial scales within cities and urban districts, at coarser regional sub-regional scales, and also between rural and urban communities (Congdon, 1995; Gould and Jones, 1996; Norman and Boyle, 2014; Senior et al., 2000, Shouls et al., 1996; Sloggett and Joshi, 1994).

The second strand of literature reflects the much wider and enduring debate both in social science and public health about compositional (e.g. individual) versus contextual (e.g. neighbourhood) explanations for geographical variations in health outcomes (Macintyre et al., 1993; Duncan et al., 1998; Curtis and Jones, 1998). Sloggett and Joshi (1994), for example, have argued for compositional explanations for mortality using the England and Wales LS; whereas Smith and Easterlow (2005) argue that contextual explanations are overstated and present some compositional qualitative research findings of health discrimination and entrapment in the housing system. Others have provided evidence of contextual variations, the classic example being the 'Alameda County Study' in the USA (Hann et al., 1987), whilst Gould and Jones (1996) have demonstrated residual variation in self-reported illness after taking account of the social and demographic composition of somewhat coarse SAR areas (combinations of contiguous local authorities) using multilevel analysis of the 1991 Census microdata. Jones and Duncan (1995) demonstrate the importance of cross-level interactions between individual (i.e. compositional) and ecological (i.e. contextual) variables and we deploy this multilevel methodology in the analysis presented later in the chapter.

Arising from this wider debate has been a plea for place-sensitive research that identifies the 'actual' area characteristics associated with remaining contextual

variations after accounting for the demographic and socio-economic composition of these places. Macintyre et al. (1993; 2002) provide a useful classification of five different types of area characteristics/effects implicated in health inequalities, with the later paper making an explicit distinction between effects associated with 'infrastructure and opportunity structures' (i.e. physical features of the environment shared by all residents, availability of (un)healthy environments, and services provided to support people) and 'collective social functioning' (i.e. socio-cultural features of a neighbourhood and its reputation). Jones and Duncan (1995) provide a similar typology of place effects but additionally note the potential importance of processes of selective spatial mobility which provides the third strand of literature informing this chapter.

A growing number of studies have considered the inter-connections between migration, social mobility, selection effects and gradients in health outcomes but without consensus, although many studies note that younger migrants tender to be healthier and more mobile than older counterparts (Bartley and Plewis, 2007; Bentham, 1988; Boyle, 2004; Boyle et al., 2009; Connolly et al., 2007; Norman et al., 2005; Norman and Boyle, 2014). Chapter 24 in this volume by Darlington-Pollock and Norman considers selective sorting and the nexus of ethnicity, health, socioeconomic factors and internal migration. A fuller consideration of the geography health and migration can be found in Boyle and Norman, (2009) and Darlington et al. (2015). Smith and Easterlow (2005) also provide a valuable consideration of selective health entrapment, placement and displacement in risky/healthy spaces mediated through the housing system, demonstrating that different peoples' trajectories are bound up with their health histories.

Address changes (e.g. internal migration) can lead to changes in housing tenure type (e.g. moves from private renting to owner occupation) but can also be the result of moves within housing sectors (e.g. between owner-occupied houses). This, coupled with moves between more and less socially-deprived places, means that there are many possible housing and social transitions that an individual can experience through time, all or any of which could have implications for their health as they are exposed to, or removed from, potential hazards such as poverty, pollution, lack of recreational space, social exclusion, loneliness, et cetera (Kawachi and Berkman, 2003). This is the inspiration for the empirical case study of the transitions seen in Northern Ireland (NI) which we present later, but the theoretical implications are not

considered here more fully due to reasons of limited space. It should also be noted that this NI case study is related to a particular devolved, socio-historical and political context during a very interesting period of accelerated change and transition from sectarianism to peaceful coexistence (Shuttleworth et al., 2014).

Section 26.3 contains a brief brushstroke consideration of both the wider NI data landscape and more specifically the characteristics of the NILS relevant to the substantive application under consideration (the NILS has already been described in Chapter 9). In Section 26.4, we report an aggregate level analysis of spatial clustering of limiting-long illness and housing tenure using Anselin's (1995) Local Indicators of Spatial Association (LISA) as useful background to describing the geographical structure of Northern Ireland, and the contexts which influence the chances for individuals to make health transitions. In Section 26.5, we present a longitudinal analysis of changing health and housing tenure using both descriptive statistics and some multilevel statistical modelling of the NILS microdata. The chapter concludes with some general observations about both the research potential of the NILS to tackle other research issues and also its future position in the emerging new data landscape in NI and the UK as a whole.

26.3 Longitudinal NILS microdata and Census Area Statistics

The NILS is one of the family of UK LSs. Its individual-level microdata have similar characteristics to the Census Samples of Anonymised Records (SARs) and Small Area Microdata (SAM) (Dale et al., 2000), but are generally superior for a number of reasons. As has been highlighted in Chapter 9, the NILS data spine is an approximately 28% sample of the NI population, containing members with 104 of 365 birthdates drawn from the NI health card registration system which is analogous to the National Health Service Central Register (NHSCR) in England and Wales. These birth dates are unknown so as to preserve confidentiality and data security; NILS members are therefore anonymous.

These health service data provide basic demographic information on age and gender but a further strength is that they also give address information which is updated when someone reports a move to their GP or another health professional, thus allowing analysis of residential movement. The health card registration records are also linked to other data: the 1981, 1991, 2001 and 2011 Censuses of Population

and also vital statistics (although the latter is not considered in this chapter). Other researchers have used linked data on property characteristics provided by the NI Land and Property Services (LPS); and other opportunities exist to link to other administrative data using health card registration numbers (as consequence different devolved legislation in NI).

With such large amounts of information available, research access to the NILS is carefully controlled in much the same way as the other LSs. Only approved projects by recognised 'safe' researchers are allowed. There is an extra hurdle of medical relevance because of legal considerations as access to the core NILS data – based on health card data – is open via a legal pathway that allows it to be shared for health-research purposes. The data can only be accessed in a secure environment and research outputs are only released after careful vetting and confirmation that they are non-disclosive. Other aspects of the NILS 'user journey', including initial training, supervised data preparation and analysis in a controlled environment, are discussed elsewhere (Chapter 9).

The NILS' sampling fraction exceeds that of the other UK LSs and is the starting point of the NILS' extra analytical possibilities. It means that the sample is of sufficient size to consider people and place, investigating individuals and their spatial contexts, using the geography of super output areas (SOAs), of which there are 890 in NI. These are aggregated from output areas (OAs, see Chapter 6) and are designed to be both spatially compact and socially homogenous and meet a population size threshold. In NI, this is approximately 2,000 people on average which means typically around 500 NILS members per SOA. This is sufficient for descriptive mapping approaches besides statistical analyses that categorise SOAs into larger aggregated classes. Moreover, and uniquely, this fine grained geographical detail can be explicitly analysed and handled (e.g. in the English and Welsh LS, SOAs are indicated by type but are not locationally identifiable during analysis). There is considerable flexibility in choice of variables categories/tabulations – because the data are analysed in a secure data environment, not forgetting it is now possible to compare individuals' responses for up to four censuses in NI. For the purposes of the current chapter it also enables multilevel analysis to be carried out, where the number of higher-level SOA units is an important consideration (Duncan et al., 1998).

Multilevel modelling has many analytical advantages; it is a way to partition variance between people and places, and to examine how, for example, the

relationships between health outcomes and personal characteristics, such as living in owner-occupied housing, vary between different places. This chapter therefore explores what analytical and conceptual benefits can be gained from linking individual-level microdata such as that in the NILS to standard Census Area Statistics (CAS) at SOA level; and how combining individual and contextual levels of analysis and exploring cross-level interactions (simultaneously between individual and area-level covariates) can give extra insights. The other great strength of the NILS arises from the way data from different censuses has been linked to a common spine. This permits more detailed understanding and analysis than standard microdata products such as the SARs/SAM. The great strength of the NILS – and indeed the other LSs in the UK – is that they are longitudinal and can be used to examine transitions over time in ways which are impossible using cross-sectional microdata like the SAR. In the example we develop in this chapter, it is possible to investigate individual transitions in health and housing tenure status (here between 2001 and 2011), as well as relating these to whether individuals have changed address or not, together with opportunity for setting this all in the social context of which SOA they started out in at the time of the 2001 Census and where they ended up in 2011.

26.4 Aggregate analysis

Aggregated 2011 CAS mapped at SOA level in NI illustrate the spatial pattern of responses to the question about limiting long-term illness (LLTI), thus providing an indication of the spatial context for the analysis of NILS members (Figure 26.1). Not all these individuals will have the same opportunities available and existing geographies of inequality are not only a measure of context but also shape the opportunities open to individuals regarding spatial mobility (or immobility). For example, someone resident in an area with high social disadvantage, surrounded by other SOAs of high social disadvantage, will have far fewer chances to become upwardly socially mobile if moving locally (as most people do) than a similar person living in a disadvantaged SOA which is surrounded by less disadvantaged places. Understanding the geographical structure of the population is, therefore, key to understanding how life chances are structured, and what spatial mobility and immobility mean in making transitions up and down the health and housing ladders.

To paraphrase Marx, people make their own histories but they do not make them in geographies of their own choosing.

Spatial autocorrelation indicators are one way to explore how populations are structured and how they vary geographically. Those shown in Figure 26.1 and 26.2 make use of Anselin's Local Indicators of Spatial Association (LISA) and are implemented using the GeoDa™ software (Anselin, 1995; 2003). These are a local formulation of Moran's I, involving a decomposition of a global indicator based on each area's contribution and indicating whether a location differs from the mean value and when transformed using Z-scores, can be used to assess whether an area is statistically different from its neighbours (Anselin, 1995). LISA scores are signed such that positive values indicate similarly co-located areas, whilst negative values represent dissimilarity. In Figure 26.1, SOAs shaded white show a random patterning of health status, whilst areas shaded bright red are areas of high rates of illness surrounded by SOAs with similar high illness rates (high-high), whilst deep blue distinguishes area of low rates of illness bordered by similarly low rates of illness (low-low). In contrast, the pink areas represent places with high rates of illness surrounded by areas with low rates (high-low), whilst the pale blue areas represent SOAs with low rates of illness surrounded by high rates (low-high). In the case of high rates of limiting long-term illness (Figure 26.1) there is generally little spatial clustering of SOAs particularly in western and central parts and around the coast; but there are some pockets of SOAs with high rates surrounded by other high rate areas in Strabane, and Derry/Londonderry. There is, however, extensive clustering in in east and south Belfast. With respect to areas of low rates of LLTI, there is clustering in some parts of the districts of Antrim, Down, Lisburn, Bainbridge, Craigavon, Limavady and Coleraine. There are virtually no SOAs classified as low surrounded by high, nor high surrounded by low.

Source: NISRA, 2011 NI Census Area Statistics and Digitised Boundary Data

Figure 26.1 LISA mapping of percentage people with very limited long-term illness in 2011

Table 26.1 provides a summary of the global and LISA cluster typology means for the different census variables mapped to give indications of how the classifications

are scaled. So, for example, SOAs classified as high surrounded by high on average have nearly a fifth (19.2%) of people reporting LLTI which is considerably higher than that for the global average, and also for SOAs which are randomly distributed (both of which are close to 12%); and much higher than areas classified low/low.

Table 26.1 Mean SOA area rates for different census variables classified by different area cluster typologies and overall global averages

Cluster type (2001)	Mean		
	Very limited and limited long-term illness (%)	Owner occupied LISA (%)	Social renting LISA (%)
Random	11.8	69.6	13.0
High, high	19.2	83.8	40.8
Low, low	7.8	37.4	4.5
Low, high	10.7	57.8	8.9
High, low	14.4	74.0	20.9
Global	11.9	68.2	14.7

Source: NISRA, 2011 NI Census Area Statistics

The maps in Figure 26.2 show the spatial structure and clustering in housing tenure for owner occupiers and social renters. Areas of high levels of owner occupation are often similarly surrounded by other areas with high rates; and also areas of low rates of social renting are often surrounded by other SOAs with low rates. Spatial clustering of low rates of owner occupation and high rates of social renting are found in Derry/Londonderry and also in east and south Belfast (Figures 26.2a and 26.2b). However, the patterns for Belfast are more complicated than for LLTI shown in Figure 26.1 with some juxtaposition of SOAs with high rates of owner occupation being surrounded by low rates (Figures 26.2a), and also some areas with low rates of social renting being surrounded by high rates (Figure 26.2b). This reflects more spatial differentiation of housing tenure, a finding which accords with work reported elsewhere on the segregation of community background and socioeconomic deprivation – where clustering of the latter was less marked than the former (Shuttleworth et al., 2013; 2014).

Source: NISRA, 2011 NI Census Area Statistics and Digitised Boundary Data

Figure 26.2 LISA mapping of **a.** percentage owner occupiers in 2011, and **b.** percentage social renters in 2011

Figure 26.2 also shows that there are lots of SOAs located away from urban centres which display no spatial clustering of areas with low or high rates of owner occupation or social renting. We now turn our attention to consideration of individual-level health and tenure transitions.

26.5 Analysis of NILS data

Table 26.2 shows the health transitions between 2001 and 2011 for individual NILS members included in our analysis with both absolute cell counts and row percentages displayed. The vast majority of individuals (166,101) reported no LLTI at either time points, with approximately 81% of individuals who reported no illness in 2001 also doing so in 2011, whilst approximately one in five people who started with no illness in 2011 transitioned to illness in 2011. Approximately 77% of the 55,929 people who were ill at the 2001 starting point remained so in 2011, whilst around 23% transitioned to no LLTI in 2011. There is evidence of 36% of people (95,332) reporting illness at either one or the other of the two time points, with some 16% of NILS members (42,878) reporting illness at both time points. These figures and proportions for LLTI are higher than the responses for the other census question on self-reported general health (not presented here). There is, however, a caveat with the analysis presented as responses to the 2011 LLTI question have been pragmatically recoded/combined (into two categories to facilitate comparison with the 2001 question which was binary in nature). Moreover, there are some subtle differences in the wording of the question between 2001 and 2011, although they remain 'broadly comparable' (NISRA, 2012). These rates, based on the NILS sample, correspond closely with those recorded in aggregate key statistics and particularly when comparing the 'closed' starting point sample with full 2001 Census cross-section.

Table 26.2 Limiting long-term illness transitions, 2001-2011

		Limiting illness 2011		
		No	Yes	Total
Limiting illness 2001	No	166,101 80.8%	39,403 19.2%	205,504 100%
	Yes	13,051 23.3%	42,878 76.7%	55,929 100%

	Total	179,152 68.5%	82,281 31.5%	261,433 100%

Source: NILS

Table 26.3 classifies NILS members who remain in LLTI between 2001 and 2011 using the LLTI question and the LISA area-classification described in the previous section. The area-level typology was brought into the secure data analysis environment (with NISRA approval) and then attached to study members using SOA codes. Comparisons are made for four different area variable classifications for the 2011 end point: LLTI affecting daily activities and three housing tenures. Whilst NILS members who remain in LLTI live in all five categories of the LLTI area-typology, not unsurprisingly the largest proportion people (26.4%) live in area of high levels of self-reported LLTI surrounded by others areas with high rates, whilst the lowest proportion of individuals remaining in LLTI live in areas of low LLTI surrounded by other SOAs with low rates of LLTI. For owner occupation, the largest proportion of NILS members remaining ill is found for those living in areas of low owner occupation surrounded by other areas of low owner occupation. For the social renting category, the largest proportion of remaining ill individuals is found for high areas surrounded by other high areas. The pattern is slightly different for private renting with the biggest proportion (26.9%) of NILS members remaining ill being found in areas of low rates of private renting surrounded by high rates. Overall, these results are reassuring in confirming that individuals who remain in LLTI between 2001 and 2011 are more likely to live in spatially clusters areas of social disadvantage, high levels of rented accommodation and self-reported illness. We now consider this further for NILS using the different approach of multilevel modelling to simultaneously analyse individual and area characteristics, and the interaction of the two (Jones and Duncan, 1995).

Table 26.3 Percentage of NILS members remaining in LLTI 2001-2011, classified by different area cluster typologies

Cluster type (2001)	**% Remaining in LTTI, 2001-11, by SOA area classification**			
	Very limited and long-term long-term illness LISA (%)	Owner occupied LISA (%)	Private renting LISA (%)	Social renting LISA (%)
Random	15.8	15.9	16.5	15.7
High, high	26.4	12.3	17.6	26.9
Low, low	10.9	25.2	14.3	12.7

Low, high	16.2	17.9	26.9	16.6
High, low	16.6	17.8	15.3	16.2

Source: NILS & NISRA, 2011 NI Census Area Statistics

Multilevel analysis

Attention now turns to the simultaneous multilevel modelling of changes in health status and individual and area characteristics. Due to limitations of space, we give a flavour of what is possible by focusing on two illustrative models: (i) transitioning from no LLTI in 2001 to LLTI in 2011 – that is modelling individuals related to the first row of Table 26.2; (ii) staying in LLTI but including LISA indicators (discussed in the previous section) – but this time related to all individuals included in Table 26.2. In the former case 201,314, and in the latter case 252,784, individuals are actually statistically modelled, which are slightly smaller than the numbers than those shown in Table 26.2 and reflect non-response (missing/edited) observations for variables included as individual-level covariates.

Model 1 includes a number of individual characteristics: age, sex, 2001 housing tenure, occupational status, education and community background (Catholic, Protestant and other religion); as well as a typology summarizing whether an individual has changed housing tenure and/or moved address during the period 2001-2011. It should be noted that it is possible for individuals to move address but not change SOA; and also it is theoretically possible, albeit unlikely, for someone to change tenure but not change address by either re-mortgaging or buying from a landlord. The model also includes first-order interactions between 2001 (starting) tenure and the changed tenure/moved address (between 2001 and 2011) typology.

Big overall effects are found for housing tenure (not presented here due to the limitations of space), with those in social and private rented accommodation in 2001 generally having the largest probability of transitioning to ill-health between 2001 and 2011 when compared to those in owner occupation who have not changed tenure since 2001. These probabilities are slightly increased for both social and private renters who have moved but not changed tenure (there is no difference for owner occupiers). Indeed, considering the interaction between 2001 starting tenure and the changed tenure-changed/not changed address terms reveals more nuanced findings. The effects of changing tenure and moving/not moving address also increase the probability of transitioning to ill-health for individuals who started in owner occupation in 2001 and have subsequently 'moved down' the housing market rather than staying

put both spatially and as owner occupiers. For individuals who started as social and private renters in 2001, there are reductions in the probabilities of transitioning to ill-health if they changed tenure; similarly for those who have changed address. The biggest effect is for social renters who change tenure and not address, and moreover, the probability is the same for those in private renting.

In all these cases, these individuals are likely to have moved up the housing market over the ten year period and may have experienced improvements in their well-being. Increasing age and being retired also increase the probability of transitioning to LLTI; whilst having an educational qualification of any level reduces the probability of transitioning, with the biggest reduction for those with degrees relative to those with no qualifications. The fixed-effect parameters are statistically significant with the exception of the contrast categories for students, the economically inactive, and no community background (religion) – in each case these all represent small numbers of NILS members. The main effect for not changed tenure, but moved address is not statistically significant (but the higher level interactions terms with social and private rented tenure are) and is interpreted as there being no difference in health transitions for owner occupiers who do not change tenure (the base comparison) but who do or do not move.

The statistical model does not include LISA indicators but does include a SOA continuous scale index of multiple deprivation instead and its linear cross-level interaction with a four-way typology of individuals who have changed address and/or housing tenure (by multiplying the variables together and also including them as parameters in the model). The model parameters associated with these interaction terms are statistically significant; and the meaning of these results is most readily appreciated when presented graphically, as in Figure 26.3. The slopes shown in the figure are the product of multilevel regression of the 201,314 cases (not shown), using the particular model parameters (mentioned above) with the model prediction and graphing tools contained in the MLwiN software package (Rasbash et al., 2013). The horizontal axis shows the range of deprivation scores and the value of 17.8 represents the median stereotypical SOA deprivation level in 2001. The vertical axis shows the predicted probability of transitioning into ill-health based on the multilevel regression. The first thing to note is that all four lines (representing different combinations of individuals changing tenure and address and are based on model predictions for

people who are of average age and have all other base category characterises[1]) rise as SOA-level deprivation increases – with steepest lines found for individuals 'not changed tenure, not moved address'; and 'not changed tenure, moved address'. In more affluent areas, the probability of transitioning to illness is relatively low and similar to those who have 'not changed tenure, not moved address'; 'not changed tenure, moved address'; and 'changed tenure, not moved address'. For those who have 'changed tenure, moved address', there is a considerable increased probability of transitioning to ill-health. At the other end of the distribution for places with very high levels of multiple social deprivation, the differences between types of people are more marked for those not 'changed tenure, moved address' and having higher probabilities of transitioning to ill-health; now followed by 'changed tenure, moved address'; and' not changed tenure, not moved address'. The 'changed tenure, not moved address' category has the lowest probability of transitioning to ill-health at high levels of deprivation.

Source: Based on authors analysis of NILS

Figure 26.3 Cross-level interaction of individual changed tenure/address and multiple deprivation area effects on transitioning from no limiting illness to illness (Model 1)

Inspection of maps of SOA-level random terms (not presented here) indicates that there is some statistically significant remaining residual geographical variation in the probability of transition from no illness to illness. We suggest that this is a consequence of complex historical/political geographies of community background and local-level housing market structure (Shuttleworth et al., 2013). That said, we argue that geographical variations in health transitions are not purely compositional, but that context does matter to a degree – here measured in terms of multiple deprivation (but we have explored other variables too) and their interactions with individual tenure/address changes at two census points. Moreover, individuals starting tenure in 2001 and their interaction with 2001-2011 tenure and address change do matter for transitions to ill-health.

[1] That is 42 year old female Protestant who is employed, lives in owner occupation and has no qualifications.

Finally, we turn to two models of probabilities of staying in LLTI but this time including LISA area-level (summarised in Table 26.4) and individual-level predictors. The mains effects for individual characteristics are broadly as they were previously. This time we include the LISA cluster scores for: (i) LLTI affecting daily activities and (ii) owner occupation as main area effects. Because it is a nominal classification, the LISA indicators are not readily modelled and portrayed as a cross-level interaction; but this specification is parsimonious and has reasonable model fit. The summarised results in Table 26.4 (second column) indicate that SOAs with the high rates of LLTI surrounded by similar high rates in 2011 predicted the largest probability of individuals staying in LLTI; whilst SOAs with low rates of LTTI surrounded by low areas have decreased probabilities of individuals remaining in LLTI. Similar results are found for owner occupation (Table 26.4, third column) and provide further evidence of structural clustering of health transitions (c.f. Table 26.3) – here, staying in LLTI.

Table 26.4 Multilevel models of staying in LLTI, 2001-2011, that include LISA area-level cluster typologies

Cluster type (2001)	Nature of are-level fixed effects	
	(i) Limiting illness LISA	(ii) Owner occupied LISA
Random	Base category	Base category
High, high	Large positive, significant	Large positive, significant
Low, low	Large negative significant	Large negative, significant
Low, high	Not significant	Not significant
High, low	Not significant	Not significant

Source: Summary of authors' analysis of NILS and NISRA, 2011 NI Census Area Statistics

26.6 Conclusions and the future

The analytical and conceptual benefits that can be gained from linking and combining individual-level NILS microdata CAS have been shown to give extra/nuanced insights. We have demonstrated using the NILS data that there were transitions in self-reported long-term illness between 2001 and 2011 – and that there changes in both directions. Big overall individual-level effects for housing tenure were found, with those in social and private rented accommodation in 2001 generally having the largest probability of transitioning to ill-health between 2001 and 2011 when compared to those in owner occupation who have not changed tenure since 2001. The mapping of LISA scores for CAS data showed that there are distinctive and complex geographies in Northern Ireland for self-reported illness and housing tenure. Whilst many areas did not

significantly vary from overall average rates, other areas did. Multilevel analysis provided evidence of some remaining residual geographical variation in the probability of health transitions. We argue that context does matter to a degree – here measured in terms of multiple deprivation and their interactions with individual tenure/address changes at two census points.

One criticism that can be levelled at the analysis presented here is that it does not fully capture the richness of multiple inter-censal residential moves that are particularly important for people in living the private-rented sector, nor does it include specific data about the quality and value of housing stock in which these people live. Regarding the first point, we note that whilst some use of data from health card registrations was made to derive indicators of change address between 2001 and 2011, more use could have been made of information on the multiple number/frequency of moves made between censuses. This might facilitate getting purchase on the transitionary nature of private renters and whether this group are at higher risk of falling or remaining in poor health compared to those in other tenures, as well better understanding their '(re)placement' (i.e. geographies). However, a caveat must be added that certain demographic groups (e.g. young males) can delay registering change of doctors and/or addresses resulting in some under-reporting of residential moves in the NILS (Barr and Shuttleworth, 2012).

We noted earlier in the chapter that NILS projects can be linked to the NI LPS but this was not possible in our case as the work was undertaken as a beta-testing project. This is something that could be done in the future. Additional data on housing stock (e.g. year built, habitable square meterage) and capital value could be gathered to derive better defined proxies of household wealth and answer more specified research questions about the role of individual and contextual characteristics on changing health status. Moreover, data contained in the census/NILS on the number of rooms and central heating could also be utilised (and was not included in our analyses for issues of parsimony).

The analytical power of the NILS, and indeed the other LSs, is set to increase when data from other censuses, for example that planned for 2021, are added. This will give the ONS English and Welsh LS a run of 50 years of data from 1971 with six censuses and the NILS 40 years of data (from 1981) with five censuses. This means that the NILS and the other LSs are very powerful data resources to examine long-term social change across populations and neighbourhoods and their value will

increase over time as more data are added. Moreover, the close links between the NILS and the Administrative Data Research Centre for Northern Ireland (ADRC-NI) offers exciting new prospects for the ethical and appropriate linkage of other official data. These ADS-NI projects involve limited-life, one-off data linkage, extraction and analysis. They have benefits of using 100% sampling and the potential, in theory, to link a number of secondary data sources, albeit with complex logistical and legal constraints.

The NILS is perhaps logistically easier to use and access (albeit with access controls), making use existing ongoing collection of linked census with other data (vital statistics, health card registrations and property valuation data). Putting it another way, the NILS provides a now well tested data resource (at the time of writing over a hundred NILS projects have been initiated), a large set of sampled records, and a relatively confined (although extensive) set of data variables many of which are repeatedly measured at different census (albeit with subtle changes in question wording and coding – as in the case of self-reported illness). Indeed, the analysis we have described in this chapter, should be seen as the start of a much longer project, illustrating what can already be done, and setting out a route for what might be done in the future with emerging data.

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