Health & Place 67 (2021) 102470

Contents lists available at ScienceDirect

Health and Place

journal homepage: http://www.elsevier.com/locate/healthplace

Area deprivation, perceived neighbourhood cohesion and mental health at older ages: A cross lagged analysis of UK longitudinal data

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A B S T R A C T

Previous research on neighbourhood influences on older adults' mental health shows inconsistent evidence for effects of neighbourhood deprivation but stronger evidence for effects of perceived neighbourhood social cohesion, often proposed as a mediator of the link between neighbourhood deprivation and mental well-being. However, it is possible that mental health influences perceptions of neighbourhoods; this has rarely been considered. We use data from a large UK longitudinal study to investigate these associations. Results from cross-lagged models indicate that greater neighbourhood deprivation is associated with worse perceived social cohesion and worse mental health. Associations between change in perceived social cohesion and in mental health were reciprocal-lower perceived cohesion predicted poorer mental health and vice versa. Further research including three waves of data is needed to further unravel underlying directions of association.

1. Introduction

Local environments shape exposure to many stresses, supports and aspects of daily activities and numerous scholars have suggested an association between neighbourhood deprivation and mental health (Carpiano, 2006). Neighbourhood influences may be particularly salient for older people, especially those who are retired or frail, as on average they spend more time in their locality than younger adults and are more reliant on local resources (Kubzansky et al., 2005). Aspects of social organisation, such as neighbourhood social cohesion and social disorder, have been proposed as important mediators of associations between neighbourhood deprivation and mental health (Fone et al., 2007; Joongbaeck, 2010). Empirical studies of neighbourhood deprivation and the mental health of older adults have produced mixed results (Yen et al., 2009) but previous research more consistently indicates that subjective perceptions of neighbourhood social cohesion are important (Cramm et al., 2013; Elliott et al., 2014; Gale et al., 2011; Ruiz et al., 2018; Toma et al., 2015). These studies generally assume that it is perception of neighbourhood social resources that influences mental health. However, it also possible that mental health influences peoples' perceptions of their neighbourhood. In this study we examine effects of neighbourhood deprivation, measured using a multidimensional indicator, on both perceived neighbourhood social cohesion and mental health. We additionally use autoregressive cross-lagged models to assess reciprocal influences of mental health on subjective assessment of neighbourhood, and vice versa, using data from two rounds of a large nationally representative longitudinal study.

2. Previous research and research questions

The investigation of spatial variations in health has a long history and before the widespread availability of micro-data, many studies of associations between social disadvantage and health, including mental health, rested on analyses of area level differences (Faris and Dunham, 1939). This approach has been challenged on the grounds that drawing inferences about individuals from the characteristics of local populations represents an ecological fallacy. However, Diez-Roux (1998), among others, has cautioned that ignoring group level influences may lead to other interpretative fallacies and recent decades have seen renewed interest in contextual influences of local environments on health and well-being (Blair et al., 2014; Diez-Roux and Mair, 2010; Kawachi and Berkman, 2003). Identifying neighbourhood effects presents methodological and conceptual challenges. These include problems defining 'neighbourhood' and measuring neighbourhood deprivation, difficulties in distinguishing individual from neighbourhood effects when the latter are derived from aggregates of the former, and omitted variable bias which may mean associations are attributed to neighbourhood rather than individual characteristics (Diez-Roux and Mair, 2010). This is a particular issue given that sorting – via migration-into particular types of neighbourhoods is associated with individual characteristics related to health (Norman et al., 2005). Possibly for these reasons, results from studies of neighbourhood

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https://doi.org/10.1016/j.healthplace.2020.102470
Received 1 April 2020; Received in revised form 30 September 2020; Accepted 19 October 2020
Available online 16 November 2020

influences on the mental health of older adults have produced mixed results.

Yen et al. (2009) undertook a systematic review of studies of neighbourhood influences on the health of older adults and identified 33 papers which met their inclusion criteria, 8 of which considered mental health outcomes. They concluded that results for mental health were inconsistent. Some studies reviewed found associations between area deprivation and mental health, after control for individual characteristics, (e.g. Galea et al., 2007; Kubzansky et al., 2005); others did not (e.g. Walters et al., 2004). Results from more recent studies including some reviewed by Julien et al. (2012) are also mixed and predominantly cross-sectional. Beard et al. (2009) found that neighbourhood affluence in New York City was inversely associated with worsening depression among older adults and, in another North American study, Bassett and Moore (2013) found an association between census tract deprivation level and depression among older women in Montreal, and some indication that this was mediated by perceptions of neighbourhood cohesion. However, no such effect was found in men and the study was based on a cross-sectional survey with a response rate below 40%. Gale et al. (2011) analysed cross-sectional associations between neighbourhood deprivation (measured using the Index of Multiple Deprivation) and mental well-being among people aged 69–78 resident in the English county of Hertfordshire, taking account of individual socio-economic, health and personality characteristics. Respondents who reported a stronger sense of social cohesion and fewer neighbourhood problems had higher well-being. The study found no effect of area level deprivation although, as the authors note, Hertfordshire has low levels of deprivation compared to the rest of the UK and data were collected via a postal survey with a response rate of less than 50%. Behanova et al., 2017, who analysed cross-sectional data from surveys with response rates below 50%, similarly found no association between neighbourhood deprivation (indicated by local unemployment rate) and the mental health of older residents of four Slovak and Dutch cities.

There is more consistent evidence of a link between subjective perceptions of neighbourhood social characteristics and older adults' mental health. Elliott et al. (2014) in cross-sectional analyses of three British birth cohort studies, found an association between reported neighbourhood cohesion and mental well-being which was somewhat stronger for older than midlife adults. Several studies based on longitudinal analyses of the nationally representative English Longitudinal Study of Ageing (ELSA) have also reported associations between perceptions of neighbourhood social cohesion and mental health. Stafford et al. (2011) found that reported neighbourhood social cohesion was associated with fewer depressive symptoms at a two-year follow-up, independent of socio-demographic characteristics and depressive symptoms at baseline. Toma et al. (2015) used ELSA data to analyse associations between perceived neighbourhood disorder and mental health over a four-year follow-up. Results showed that higher levels of perceived neighbourhood disorder were associated with lower levels of well-being at follow-up, independent of baseline well-being. Ruiz et al. (2018) found an association between perceived neighbourhood social cohesion and both depressive symptoms at baseline and change in depressive symptoms over a twelve-year follow-up. A comparative analysis of longitudinal data from ELSA and three Eastern European locations also showed an association between PNSC and depressive symptoms (Ruiz et al., 2019). With very few exceptions (Ruiz et al., 2018), these previous studies have focussed on the influence of perceptions of the neighbourhood on mental health and not considered whether mental health also influences peoples' perceptions of their neighbourhood, although such an effect might underlie or contribute to reported associations.

3. Research questions

Our first aim in this study was to investigate whether neighbourhood deprivation, measured using an extensive multidimensional indicator, is associated with mental health and with perceived neighbourhood social cohesion (PNSC), and change in these, in a nationally representative sample of older people in the UK. Our second aim was to evaluate the effect of prior mental health on PNSC and vice versa using autoregressive cross-lagged models. These allowed us to analyse reciprocal influences, an aspect not considered, to our knowledge, in previous studies.

4. Data and methods

4.1. Study population

We used data from *Understanding Society: The UK Household Longitudinal Survey* (UKHLS) (University of Essex, Institute for Social and Economic Research, 2018) a nationally representative panel survey (Knies, 2015). The first wave, including approximately 40,000 households, was conducted in 2009 and respondents have been re-interviewed annually. This study is based on analyses of data from waves 3 (fielded in 2011) and 6 (2014) which included questions on perceived neighbourhood social cohesion (PNSC). We included respondents aged 65 or more at wave 3 who also participated at wave 6 and lived in the same area of residence at both waves, yielding an analytical sample of 6643 individuals (65.9% of people aged 65 or more at Wave 3) of whom 3048 were male and 3595 female.

4.2. Measures

4.2.1. Contextual measures

Information on local-area deprivation was obtained by linking UKHLS to indices of multiple deprivation (IMD) at the level of 2001 Lower-Layer Super Output Areas (LSOAs). These areas are standardized UK Census units used to report small-area statistics. There are 32,482 LSOAs in England and 1896 in Wales, with an average population of 1500 and 1600 inhabitants respectively. In Scotland these areas are known as Data Zones (6,505, with a population between 500 and 1000) and in Northern Ireland as Super Output Areas (890, with an average population of 2000). The reference years of the indices are 2009 for Scotland, 2010 for England and Northern Ireland, and 2011 for Wales.

The IMD is a multidimensional local-area indicator of relative deprivation combining information on 38 indicators from domains including income, employment, education, health, crime, access to services, housing, and the physical environment (DCLG 2011). The IMD is used to rank small areas in each constituent country of the UK, but, because of differences in the components of domains and their weighting, it is not possible to directly compare scores across the four countries. In this analysis the small areas in each country were grouped into deciles, with the 10th decile representing the most, and the 1st decile the least, deprived 10% of small areas in each constituent country. Levels of deprivation vary by constituent country of the UK which means that, for example, an area in a particular deprivation decile in Scotland might not be in the same decile if a UK wide classification were available. We included an indicator of country in our analyses in order to adjust for this, and country differences are themselves of interest. Previous studies have indicated rural-urban differences in mental health in Britain (Paykel et al., 2000) and, in the older population, differences by population density (Walters et al., 2004). We therefore additionally included a dichotomised rural-urban indicator which distinguished between those living in settlements which in 2001 had a population of 10,000 or more from those living in more sparsely populated areas.

4.2.2. Mental health

The indicator of mental health used was the SF-12 Mental Component Summary score (MCS-12), a multidimensional measure of mental health-related quality of life calculated from the 12-item Short-Form Health Survey (SF-12). The SF-12 is a short version of the original SF-36, one of the most widely used measures of self-reported health-

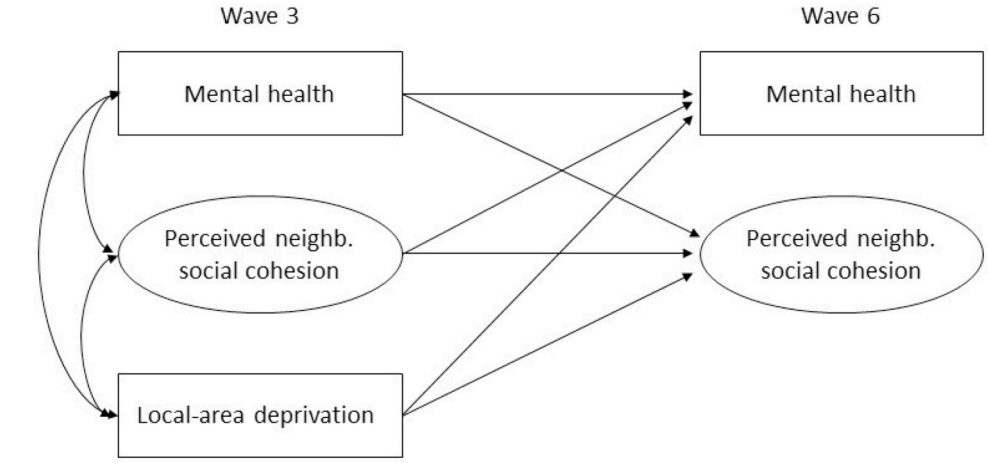
related quality of life which has been validated for use in older populations (Haywood et al. , 2005) and in the UK (Gandek et al., 1998). The SF-12 produces the same eight sub-scales as the extended SF-36: physical functioning; role limitations due to physical health problems; bodily pain; general health; vitality (energy/fatigue); social functioning; role limitations due to emotional problems; and mental health (psychological distress and psychological well-being). These are summarized - through a scoring algorithm-into two scales: a physical component score (PCS-12) and a mental component score (MCS-12) constructed to be independent of each other; validation studies have shown that both MCS-12 and PCS-12 scores closely mirror those from application of the SF-36, although with less precision, (Ware et al., 1996; Gandek et al., 1998). Both scores range from 0 to 100, with higher values indicating better health. As already indicated, the measure of main interest in this study was the MCS-12 score, this represents a valid indicator of depressive symptoms in the general population which has been used in similar studies (Loureiro et al., 2019).

4.2.3. Perceived neighbourhood social cohesion

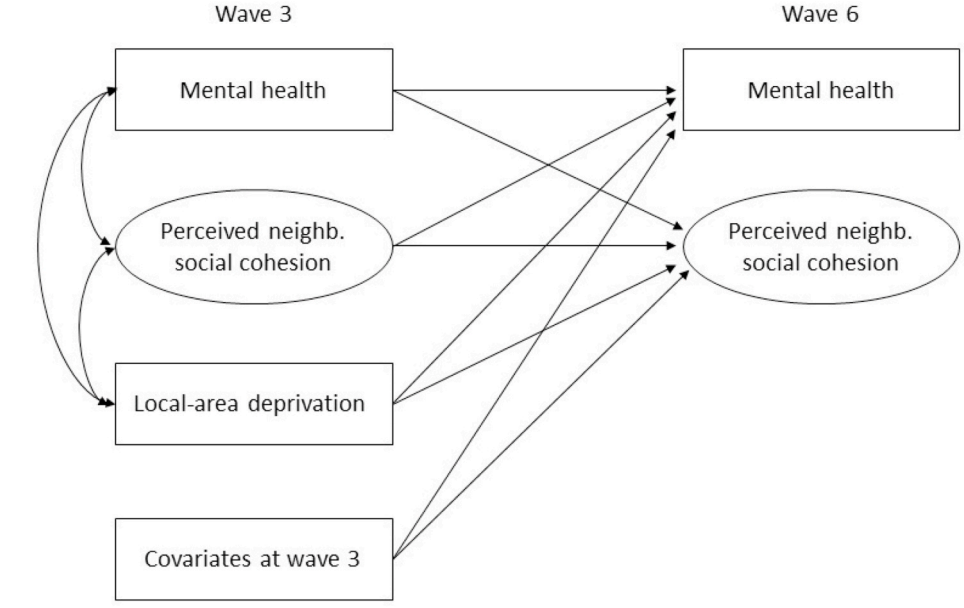
The indicator of perceived neighbourhood social cohesion (PNSC) was derived from responses to four questions developed by scholars from the Chicago neighbourhoods project (Sampson et al., 1997). These asked the extent to which respondents agreed with the following statements: "This is a close-knit neighbourhood", "People around here are willing to help their neighbours", "People in this neighbourhood can be trusted", and "People in this neighbourhood don't get along with each other". Each item was assessed on a 5 point-Likert scale (from 1 = Strongly agree to 5 = Strongly disagree). Their internal consistency was acceptable, with Cronbach's alpha equal to 0.74 in wave 3 and 0.76 in wave 6. For the analysis, scales were recoded so that higher values indicated higher levels of PNSC.

4.2.4. Covariates

Co-variates included physical health and sociodemographic indicators which previous studies have shown to be associated with local



Model 1 – Unadjusted for covariates



Model 2 – Adjusted for covariates

Fig. 1. Graphical representation of the cross-lagged models for local-area deprivation, perceived neighbourhood social cohesion and mental health.

area characteristics and with mental health. Age in single years was treated as a continuous measure. Partnership status was dichotomised into living with a partner (either spouse or cohabitee) or not. Level of education was dichotomised into 'high'- those with A′ levels (exams taken in school at around age 17–19), diplomas, university degrees or equivalent qualifications- and 'low': those with GCSE or equivalent (exams taken in school at around age 15–16), other lower level or no educational qualifications. Income, equivalised to take account of household size and composition, was measured in quintiles and treated as a continuous variable. Physical health was measured using the PCS score of the SF-12.

Mental health, neighbourhood perceptions and local area deprivation may all be associated with social support from family and friends. We therefore additionally included two indicators of potential support from these sources. These were ease of visiting family and relatives when needed, measured on a 5-point scale from 1 = Very difficult to 5 = Very easy and a dichotomous indicator of whether or not the respondent reported having any close friends.

These covariates were measured at baseline (wave 3) and treated as time-invariant in order to limit the number of parameters estimated in the already complex models. Additionally, information on some was not collected at follow-up (wave 6).

4.3. Statistical analysis

Autoregressive cross-lagged models based on structural equation modelling (SEM) (Mayer, 1986; Selig and Little, 2012) were fitted to assess temporal relationships between neighbourhood deprivation, PNSC, and mental health across the two waves.

A framework for the cross-lagged models is illustrated in Fig. 1. Model 1 estimated the association between local-area deprivation and both PNSC and MCS over time as well as the reciprocal temporal association between PNSC and MCS, allowing for autoregressive and cross-lagged pathways. The models estimate the effect of one variable on another at a later occasion controlling for the prior level of the outcome variable ("stability" effect). The relative strengths of longitudinal relationships can be compared through the calculation of standardized coefficients. In Model 2 associations between the variables of interest were analysed adjusting for the covariates discussed above.

The SEM approach adopted here allows analysis of relationships between observed variables and latent factors. In this case, PNSC - formed from the four items "Close-knit neighbourhood", "People willing to help their neighbours", "People in the neighbourhood can be trusted", and "People in this neighbourhood don't get along with each other" - was fitted as a latent variable in order to reduce measurement error. Local-area deprivation and mental health, measured through the composite variables of the IMD and MCS-12 respectively, were treated as manifest variables.

Establishing measurement invariance, an assurance that the measurement properties of a latent variable are stable over time, and that changes are not a consequence of a change in the meaning of the measure (Newsom, 2015), is a prerequisite for the implementation of cross-lagged models. To assess measurement reliability of the latent variable, we used confirmatory factor analysis (CFA) to examine metric and scalar invariance over time.

The analyses were performed using the Lavaan package Version 0.6–3 developed in the R Statistical software suite (Rosseel, 2018). Maximum likelihood estimation with robust standard errors was used to take account of any non-normality in the sample. To reduce potential bias introduced by missing data we used full-information maximum likelihood (FIML), which is a more efficient way of dealing with missing data than listwise or pairwise deletion or similar response pattern imputation (Enders and Bandalos, 2001).

Model fit was assessed by the Comparative Fit Index (CFI) and the Root-mean-square Error of Approximation (RMSEA). Fit is considered acceptable if CFI $\geq$ 0.90 and RMSEA $\leq$ 0.08, and good if CFI $\geq$ 0.95 and RMSEA $\leq$ 0.06 (Brown, 2015).

The analysis was carried out separately for males and females because of previously reported gender differences in associations between perceptions of neighbourhood and mental health (Bassett and Moore 2013).

5. Results

5.1. Descriptive results

Table 1 shows means and standard deviations or frequencies for the main study variables and covariates at baseline (wave 3) for all respondents included at wave 3 and also present in wave 6 (the balanced panel). The mean age of respondents was 74 and 54% were women. Seventy percent of respondents lived in an urban area and 83% lived in England. Most respondents reported positive perceptions of their neighbourhood, for example 80% agreed or strongly agreed that 'people in this neighbourhood can be trusted' and 'people are willing to help their neighbours' although only 56% agreed or strongly agreed that the neighbourhood was 'close-knit'. Most respondents (71%) found it easy or very easy to visit family or relatives when they needed to and only a few (6%) reported having no close friends. Fewer women than men lived with a partner and a lower proportion reported that it was easy to visit family if needed. Women on average had a lower level of education, lower income and lower (worse) PCS and MCS scores, However, women reported higher levels of perceived neighbourhood social support and compared with men, fewer lacked close friends.

Compared to the whole sample present at wave 3, balanced panel members were younger, included a higher proportion who were partnered, a higher proportion living in an urban area, and had higher educational levels and PCS scores, although these differences were very slight (Table A1). They also tended to find visiting family or relatives easier and fewer reported having no close friends. They reported slightly higher MCS scores and included higher proportions agreeing or strongly agreeing that people in their neighbourhoods could be trusted and were willing to help each other. These slight differences are consistent with the results of many studies which have shown that attrition from longitudinal studies – due to both drop out and death – is associated with disadvantage (Chatfield et al., 2005).

5.2. Measurement invariance of perceived neighbourhood social cohesion

As we wished to analyse changes in PNSC across time, a first step was to test the measurement invariance of the latent factor estimated from the four underlying variables. To do this we used confirmatory factor analysis involving examining covariances separately for males and females. The two models fitted the data well (CFI = 0.982 and RMSEA = 0.045 for males; CFI = 0.984 and RMSEA = 0.042 for females), indicating that the items measured our construct over time (configural invariance). Among men factor loadings for the four items were respectively equal to 0.62, 0.82, 0.67, and 0.48 in wave 3, and 0.66, 0.84, 0.71, and 0.53 in wave 6. Among women they were respectively equal to 0.65, 0.83, 0.67 and 0.49 in wave 3, and 0.68, 0.84, 0.70 and 0.49 in wave 6.

Longitudinal invariance was tested requiring that the factor loadings of the items in the models should be equivalent across time, and then requiring that both factor loadings and intercepts were constrained to be equal. All stability coefficients (measuring the effects of variables at wave 3 on the same variables at wave 6) were significant and equal to 0.67 for PNSC and 0.45 for MCS among men, and 0.66 and 0.45 among women, confirming the stability of the two constructs over time. We obtained, for each of the two genders, two models assessing respectively metric invariance - whether respondents attribute the same meaning to the construct over time -, and scalar invariance - including also whether the meaning of the levels of the items (intercepts) are equal across time -. Comparing the fit of both models (Men: metric model: CFI = 0.982,

Table 1
Percentage frequencies or mean and standard deviation of variables at baseline (wave 3) ($N = 6643$).

Variables	Men and Women			Men			Women		
	N	Percentage/Mean (SD)		*N*	Percentage/Mean (SD)		*N*	Percentage/Mean (SD)	
Age	6643	73.6	(6.65)	3048	73.2	(6.39)	3595	73.9	(6.84)
Female	6643	54.2			–			–	
High educational level	6614	35.6		3037	44.9		3577	27.8	
Partnered	6642	63.2		3047	76.5		3595	52.0	
Income quintile	6640	3.0	(1.41)	3047	3.1	(1.40)	3593	2.9	(1.41)
PCS-12 score	5364	43.8	(12.03)	2455	44.8	(11.43)	2909	43.0	(12.46)
Residence in urban area	6643	69.9		3048	69.2		3595	70.6	
Country of residence	6643			3048			3595		
England		83.0			83.1			82.9	
Wales		5.7			5.8			5.7	
Scotland		8.6			8.6			8.6	
Northern Ireland		2.7			2.5			2.8	
Visit family if needed	6337			2874			3463		
Very difficult		5.9			4.5			7.0	
Difficult		9.0			7.0			10.6	
Neither difficult nor easy		14.0			14.1			13.9	
Easy		41.7			42.4			41.2	
Very easy		29.5			32.1			27.3	
Any close friends	6345	93.7		2884	91.9		3461	95.1	
IMD decile	6643	5.5	(2.85)	3048	5.4	(2.84)	3595	5.5	(2.85)
Close-Knit neighbourhood	6443			2942			3501		
Strongly agree		9.5			8.6			10.3	
Agree		46.5			46.4			46.7	
Neither agree nor disagree		25.8			26.6			25.2	
Disagree		17.3			17.6			17.0	
Strongly disagree		0.8			0.8			0.8	
People willing to help their neighbours	6435			2934			3501		
Strongly agree		14.2			12.3			15.8	
Agree		65.4			66.2			64.7	
Neither agree nor disagree		13.3			14.9			12.0	
Disagree		6.4			6.1			6.7	
Strongly disagree		0.7			0.5			0.9	
People in this neighbourhood can be trusted	6393			2921			3472		
Strongly agree		13.3			13.1			13.4	
Agree		67.8			67.6			67.9	
Neither agree nor disagree		14.9			14.7			15.1	
Disagree		3.5			4.0			3.1	
Strongly disagree		0.6			0.6			0.5	
People in this neighbourhood don't get along with each other	6403			2922			3481		
Strongly agree		0.4			0.5			0.3	
Agree		6.0			6.6			5.5	
Neither agree nor disagree		14.4			14.0			14.8	
Disagree		68.3			68.2			68.4	
Strongly disagree		10.9			10.7			11.1	
MCS-12 score	5364	52.9	(8.63)	2455	53.5	(8.53)	2909	52.4	(9.20)

RMSEA = 0.041; scalar model: CFI = 0.976, RMSEA = 0.045. Women: metric model: CFI = 0.985, RMSEA = 0.038; scalar model: CFI = 0.980, RMSEA = 0.040) with the fit of the initial model, we found that releasing the equality constraints across waves produced only a small change in CFI (lower than 0.01), suggesting that they were not significantly different (Cheung and Rensvold, 2002) for either men and women. Configural, metric, and scalar invariance are considered sufficient for establishing measurement invariance (Milfont and Fischer, 2015).

5.3. Results from cross lagged models

Results from the application of the cross-lagged models are shown in Table 2. In models unadjusted for covariates (Model 1), local-area deprivation at wave 3 was negatively associated with both PNSC (standardized βs equal to −0.06 and −0.08 for men and women respectively) and MCS (standardized βs equal to −0.06 and −0.05) measured at wave 6, that is PNSC and MCS were both higher (better) in less deprived areas. Higher PNSC at wave 3 predicted higher MCS score at wave 6 (standardized βs equal to 0.05 and 0.08 respectively for men and women), controlling for MCS score at wave 3. At the same time, there was also a positive effect of MCS on PNSC, so higher MCS at wave 3 predicted higher PNSC at wave 6 (standardized βs equal to 0.07 and 0.06).

Controlling for covariates, we found substantively similar results (Model 2). Local-area deprivation at wave 3 was still significantly associated with PNSC (standardized βs equal to −0.05 for both men and women) and MCS (standardized βs equal to −0.04 and −0.03 respectively for men and women) measured at wave 6. The association between PNSC and MCS remained reciprocal (standardized βs equal to 0.04 and 0.06 among men; standardized βs equal to 0.07 and 0.05 among women). Of the covariates, older age, living in a rural area, and living in Northern Ireland or Scotland rather than England were associated with higher PNSC for both women and men; for men living in Wales rather than England and having any close friend were also associated with higher PNSC; for women having a partner and greater ease of visiting family if needed were both positively associated with PNSC. Higher PCS-12 score was associated with higher MSC-12 score for both men and women; for women having any close friends and greater ease of visiting family and friends were also associated with better mental health, and for men there was a small negative effect of living in an urban area.

Model fit was good for unconditional models (males: CFI = 0.95, RMSEA = 0.054; females: CFI = 0.96, RMSEA = 0.054), and adequate for adjusted models (males: CFI = 0.93, RMSEA = 0.041; females: CFI =

Table 2
Cross-lagged models for local-area deprivation, perceived neighbourhood social cohesion and mental health. Standardized coefficients.

Variables	Men				Women			
	Model 1		Model 2		Model 1		Model 2	
	Wave 6 PNSC	Wave 6 MCS-12	Wave 6 PNSC	Wave 6 MCS-12	Wave 6 PNSC	Wave 6 MCS-12	Wave 6 PNSC	Wave 6 MCS-12
Wave 3 IMD decile	−0.06 ***	−0.06 **	−0.05 **	−0.04 *	−0.08 ***	−0.05 **	−0.05 **	−0.03 *
Wave 3 PNSC	0.67 ***	0.05 *	0.65***	0.04 *	0.66 ***	0.08 ***	0.64 ***	0.07 **
Wave 3 MCS-12	0.07 ***	0.45 ***	0.06 **	0.44 ***	0.06 **	0.45 ***	0.05 **	0.43 ***
Covariances								
Wave 3 IMD decile - Wave 3 PNSC	−0.21 ***		−0.21 ***		−0.18 ***		−0.18 ***	
Wave 3 IMD decile - Wave 3 MCS-12	−0.11 ***		−0.11 ***		−0.12 ***		−0.12 ***	
Wave 3 PNSC - Wave 3 MCS-12	0.15 ***		0.15 ***		0.14 ***		0.14 ***	
Age			0.04 *	−0.02			0.04 *	−0.01
High Education (ref = Low)			−0.02	−0.01			0.03	0.03
Partnered (ref = No partner)			0.01	−0.02			0.05 **	−0.03
Income quintile			0.02	0.01			−0.01	−0.01
PCS-12			0.04	0.12 ***			0.03	0.07 ***
Urban (ref = Rural)			−0.05 **	−0.03 *			−0.07 ***	−0.02
Country (ref = England)								
Wales			0.03 *	−0.01			0.03	0.01
Scotland			0.04 *	−0.01			0.04 *	−0.02
Northern Ireland			0.08 ***	0.01			0.10 ***	0.01
Visit family if needed			0.03	0.02			0.04 *	0.06 **
Any close friends (ref = None)			0.04 *	0.03			−0.01	0.06 **
Model fit								
RMSEA (90% CI)	0.054 (0.049–0.060)		0.041 (0.038–0.044)		0.054 (0.050–0.059)		0.039 (0.037–0.042)	
CFI	0.95		0.93		0.96		0.93	

$p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$; IMD= Index of Multiple Deprivation; PNSC= Perceived Neighbourhood Social Cohesion; MCS = Mental Component Score of SF-12; PCS=Physical Health Component of SF-12. .

0.93, RMSEA = 0.039).

6. Discussion

Previous studies of neighbourhood influences on the mental health of older adults have shown mixed results for effects of neighbourhood deprivation but more consistent evidence of an association between subjective perceptions of neighbourhoods and mental health. Many of these previous studies have relied on cross-sectional analyses (Bassett and Moore, 2013; Behanova et al., 2017; Cramm et al., 2013; Elliott et al., 2014; Gale et al., 2011) and/or been able to use only one or two indicators, such as local unemployment rate, to derive classifications of neighbourhood deprivation (Behanova et al., 2017). Studies of associations between perceptions of neighbourhood and mental health have often not included objective indicators of neighbourhood quality (Cramm et al., 2013; Elliott et al., 2014; Ruiz et al., 2018; Stafford et al., 2011; Toma et al., 2015). Moreover, with very few exceptions (Ruiz et al., 2018) possible effects of mental health on perceptions of neighbourhoods have not been considered. Longitudinal analyses which have considered both area deprivation and indicators of neighbourhood social organisation have generally treated these as time invariant, although changes in neighbourhoods, as a result of gentrification or the reverse, may themselves have implications for the mental health of residents (Mair et al., 2015).

Using data from a UK longitudinal study, we addressed some of these issues by including in our analyses an indicator of neighbourhood deprivation based on measures from a wide range of domains and analysing reciprocal associations between perceived neighbourhood cohesion and mental health, something not previously considered. We found an association between local-area deprivation and mental health three years later-controlling for mental health at baseline-indicating that neighbourhood deprivation is linked to worse mental health conditions over time. This association persisted when individual level demographic, socio-economic and health characteristics were controlled. We also found that a higher level of neighbourhood deprivation was associated with lower perceived social cohesion over time. Again, this result persisted after controlling for confounding variables, including indicators of potential social support from family and friends. Our results also suggested that ease of visiting family and having friends were especially important for women's mental health. This is consistent with previous research indicating that whereas older men tend to rely on their spouse for social support, ties with and support from other relatives and friends may be more important for women's mental health (Kawachi and Berkman, 2001). Results from our cross-lagged analyses showed that PNSC and MCS had reciprocal influences which need to be considered in future work.

Strengths of this study include use of high quality data from a nationally representative longitudinal study, availability of a detailed multi-dimensional indicator of area deprivation, the application of auto regressive cross-lagged models to examine reciprocal influences of mental health and PNSC and use of advanced methods to adjust for possible bias arising from missing data. However, our study has some limitations. We treated co-variates as time invariant, as information for some was not available in both rounds of our data and because of difficulties in including time-varying co-variates in already complex models. This meant we did not consider some changes in individual circumstances, such as widowhood or deteriorating physical health, known to be relevant for mental health, although the relatively short-term follow-up suggests that meaningful change for most co-variates would be limited. The information on personal social networks and support available, known to be associated with PNSC and mental health, was restricted to a question related to access and another to availability of friends. Analyses including more detailed information on social ties is needed, this is rarely collected together with information on both PNSC and objective indicators of area deprivation and future data collections could usefully address this gap. Importantly too we found that the association between PNSC and mental health over time was reciprocal and of a similar strength in both directions. On the basis of our results it is therefore not possible to determine which is most likely to be the predictor. This means that it is important to control for time sequence in future studies of the potential role of PNSC as a mediator in the relationship between deprivation and mental health. We cannot rule out the

possible role of mental health as a mediator of the association between neighbourhood deprivation and PNSC although when a future wave of data including the relevant variables becomes available it will be possible to clarify these associations. Furthering our understanding of these interlinkages is particularly important in the context of the current coronavirus crisis which means that older people are even more reliant on very local resources. Perceived levels of neighbourhood cohesion may be important mediators of the effect of the pandemic on the mental health of older people with those in neighbourhoods perceived as unsupportive particularly disadvantaged. It is important that this is investigated in future studies of the effect of the pandemic, and restrictions on inter-household contacts, on the mental health of older people.

Funding

This research was funded by a European Commission grant, 667,661, as part of the Promoting Mental Wellbeing in the Ageing Population: Determinants, Policies and Interventions in European Cities (MINDMAP) research project. Additional funding for EG was provided by the Economic and Social Research Council (UK) Research Centre on Micro-Social Change at the University of Essex (grant number ES/L009153/1).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.healthplace.2020.102470.

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