Gender differences in the associations between health and neighbourhood environment

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Abstract

Multiple deprivation indicators are frequently used to capture the characteristics of an area. This is a useful approach for identifying the most deprived areas, and summary indices are good predictors of mortality and morbidity, but it remains unclear which aspects of the residential environment are most salient for health. A further question is whether the most important aspects vary for different types of residents. This paper focuses on whether associations with neighbourhood characteristics are different for men and women. The sociopolitical and physical environment, amenities, and indicators of economic deprivation and affluence were measured in neighbourhoods in the UK, and their relationship with self-rated health was investigated using multilevel regression models. Each of these contextual domains was associated with self-rated health over and above individual socioeconomic characteristics. The magnitude of the association was larger for women in each case. Statistically significant interactions between gender and residential environment were found for trust, integration into wider society, left-wing political climate, physical quality of the residential environment, and unemployment rate. These findings add to the literature indicating greater effects of non-work-based stressors for women and highlight the influence of the residential environment on women's health.
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Introduction

The growing literature on contextual influences on health shows that people living in deprived areas have higher rates of ill health and mortality (see reviews by Pickett & Pearl, 2001; Curtis & Rees-Jones, 1998). Multiple deprivation indicators are frequently used to capture the characteristics of an area. In the UK, such indicators are typically based on the proportion of

residents or households not owning their homes, not having access to a car, being unemployed, being employed in manual occupations, and living in over-crowded conditions (Townsend, Phillimore, & Beattie, 1988; Carstairs & Morris, 1991). A summary index of multiple deprivation allows us to identify the most deprived areas and is a good predictor of morbidity and mortality but it is not so useful for distinguishing the specific aspects of the residential environment which are most salient for health. This has parallels with socio-economic status based on occupation (at the individual level) which is a multidimensional construct encapsulating level of education, income, and the prestige of that

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occupation in society. Each of these dimensions is associated with health and a greater understanding of social inequalities in health can be obtained by unpicking their relative contributions. Such an approach also allows us to identify whether a particular aspect of socioeconomic status is more important for certain population subgroups. Progress has been made in separating out the different facets of an individual's socioeconomic status and examining how these relate to various health outcomes (Winkleby, Jatulis, Frank, & Fortmann, 1992; Bartley, Sacker, Firth, & Fitzpatrick, 1999; Sacker, Bartley, Firth, & Fitzpatrick, 2001; Macintyre, McKay, Der, & Hiscock, 2004). Research into contextual determinants of health has lagged behind and little is known about the specific aspects of area deprivation that influence health.

A further limitation with existing literature describing the possible health effects of the residential context is that these effects are often assumed to operate identically for different types of people. A more complex situation, whereby the specific aspects of the residential environment that are important for health vary according to a resident's sex, age, or socioeconomic position, can be envisaged. The focus of this paper is how different aspects of the residential environment are associated with health, and the extent to which the salient factors vary between men and women.

There has been relatively little investigation into gender differences in contextual effects. Stronger associations between multiple deprivation and life expectancy (Raleigh & Kiri, 1997) and mortality (Macintyre, 2001) have been found for men. Both of these studies used a summary deprivation index and were unable to determine whether associations between specific area characteristics and health were the same for men and women. Molinari, Ahern, and Hendryx (1998) found that perceptions of the social quality of the local environment were more important for the perceived health of women, whereas perceptions of the physical quality of the local environment were important for men. In that study, social problems included unemployment, crime, access to health care, and illegal drug use; physical problems included air quality and waste disposal. Conversely, Ellaway and Macintyre (2001) found a stronger association between perceptions of neighbourhood social cohesion and mental health in men than in women whereas local neighbourhood problems (ranging from lack of facilities to physical features such as fumes) were more strongly related to physical health amongst women than amongst men. In fact the classification of neighbourhood problems into those which are social and those which are physical in nature may not be that clear cut. The paper by Wilson and Kelling, (1982) entitled "Broken windows" suggests that physical and social disorder are correlated and reinforce each other. They describe a process whereby

minor physical disorder (such as a broken window left un-repaired) signals a lack of community social control which can subsequently attract more physical disorder and so the cycle continues.

There are three possible explanations for the differences between men and women. Firstly, men and women may perceive their environment differently. Using survey data from the Detroit area, Mohai (1997) found that women were more likely than men to report that pollution and the global environment were serious concerns for them although reporting of local problems in the neighbourhood showed little difference between the sexes. Perceptions of the local environment are associated with health (Sooman & Macintyre, 1995; Stafford, Bartley, Mitchell, & Marmot, 2001; Collins et al., 1998). Secondly, the exposure to various aspects of the local environment may differ between men and women. A greater effect in men or in women may indicate a dose–response relationship between the local environment and health. Finally, the vulnerability to aspects of the local environment may differ between men and women. Ellaway and Macintyre (2001) have examined these potential explanations. Using data from the West of Scotland Twenty-07 study, they showed that women perceived more local problems (such as lack of facilities, poor reputation of the neighbourhood, and fumes) although there was a tendency for men to report lower levels of social cohesion in the local area. They found no evidence that time spent in the local area (operationalised using employment status and assuming that employed people spend less time in the local area) explained the gender differences in perception of the local environment. However, the presence of children in the home did go some way towards explaining differences in men and women's perceptions. The social roles typically fulfilled by women, for example child-rearing or maintaining the home, may be more dependent on features of the local area.

Existing literature is contradictory: using a summary deprivation index, the health effect of the residential context appears to be larger for men; consideration of specific environmental factors suggests that the residential context is related to health for both men and women but that the salient factors are different for the two sexes. Furthermore, existing studies have not related individual health data to contextual area level measures in a multilevel framework, allowing for the hierarchical nature of the data with individuals clustered within neighbourhoods (Duncan, Jones, & Moon, 1998). Multilevel techniques allow the researcher to estimate the extent to which health varies across areas and to see how this variation is reduced as explanatory variables are added to the model. This is applied to our study of gender differences in contextual effects by modelling the variation which is within and between areas for men and women separately. In addition, the two studies which

have considered how specific aspects of the environment relate to men and women's health differently have used participants' perceptions of their local area as well as perceptions of their health. Gender differences in reporting style may explain some of the differences seen in those studies (Ellaway & Macintyre, 2001). It is therefore of interest to investigate how objective measures of the local environment are related to men and women's health.

This paper builds on previous work from two separate studies by the same authors which has established that some aspects of neighbourhood social cohesion are associated with self-rated health (Stafford et al., 2004) and some aspects of infrastructure (including the local amenities and the physical built environment) are associated with self-rated health (Cummins, Stafford, Macintyre, Marmot, & Ellaway, forthcoming). The current study extends this work by:

(i) looking at the inter-relationships between infrastructure and social cohesion, to explore the distinction or overlap between "physical" and "social" features of the local environment;
(ii) investigating gender differences in the extent to which self-rated health varies by area of residence using multilevel analysis; and
(iii) exploring whether the specific contextual influences that are salient for self-rated health are the same for men and women.

Methods

Data for this study were collected from three independent sources: individual level data from the Health Surveys, neighbourhood social cohesion data by postal questionnaire, and information on neighbourhood political environment, amenities, and economic characteristics from service providers and central government statistics. These data are described in turn.

Individual health and other demographic and socioeconomic data

Data from the Health Survey for England (HSE) (years 1994–1999) and the Scottish Health Survey (SHS) (years 1995 and 1998) were combined to provide a large dataset which was representative of the general population of England and Scotland. The data used here were collected by face-to-face interview in the participant's home. The Health Surveys have achieved an estimated response rate ranging from 69% to 81%. A random sample of postcode sectors is selected each year, stratified on health authority and percentage of households headed by someone in a non-manual occupation. Within each postcode sector, a random sample of approximately 19 households is drawn from the small

user Postcode Address File. Further details are given elsewhere (Erens & Primatesta, 1998; Shaw, McMunn, & Field, 2000).

Self-rated health was chosen as the primary health outcome for this paper because it captures the cumulative effect of overt and sub-clinical disease, encapsulates mental and physical well-being (Manderbacka, 1998), and predicts health service use and mortality (Idler & Benyamini, 1997). To the extent that a poor quality neighbourhood environment may reduce the opportunity for physical activity and a healthy diet, provide more limited health care, increase the problems associated with negotiating everyday activities such as banking and shopping, and increase stress because of crime or perceived crime and physical dereliction, the sum of these effects may most easily be detected in a global measure, such as self-rated health status (Segovia, Bartlett, & Edwards, 1989). Self-rated health was measured on a five-point scale and participants were grouped into those who reported very good, or good health versus fair, bad or very bad health (termed "less than good health" throughout this article). The Registrar General's coding of social class was based on the participant's current or most recent occupation (OPCS, 1991). Participants were also grouped into the following categories based on their current economic activity: in employment; unemployed; retired; other economically inactive (for example, people looking after the home, caring for family/friend, or long-term sick). The number of adults and children in the household was grouped into three categories of family type: single adult no children; multiple adults no children; one or more children in the household.

A total of 8440 Health Survey participants had complete data on age, sex, and socioeconomic position and were linked to contextual data. Self-rated health was missing for three participants, leaving 8437 participants (4611 women) resident in 238 neighbourhoods (170 in England, and 68 in Scotland). Over 40% of neighbourhoods had 40 or more Health Survey participants resident there.

Neighbourhood social cohesion

A review of the literature covering both theoretical development and empirical investigation of social cohesion and social capital was conducted. Based on this, eight separate aspects of social cohesion which appeared frequently in the literature and which were potentially related to health were identified and measured (Table 1): family ties, friendship ties, participation, integration into the wider community, trust, attachment to neighbourhood, tolerance, being able to rely on others for practical help. A postal questionnaire which included 29 items capturing these eight scales was sent to a random sample of residents aged 16 and over, selected

Table 1
Summary of scales capturing social cohesion and local infrastructure

Social cohesion scales (collected by postal survey)		Political environment, amenities and economic characteristics (collected through local/central government records, local agencies, commercial organisations)	
Label	Description	Label	Description
Family ties	Frequency of contact with local family	Political engagement	Voter turnout in UK election 1997 (%). Voter turnout in UK election 2001(%).
Friendship ties	Frequency of contact with local friends	Political climate	Left-wing political representation in 1997 and 2001
Participation	Regular participation in local organised groups (e.g. social, religious, neighbourhood interest, evening classes)	Crime	Reported crimes, per capita spending on police services
Integration into wider society	Contact with people in same area and outside local area	Access to multiple-owned foodshops	Number of Tesco, Sainsbury, Safeway stores
Trust	Six items (e.g. most people in area can be trusted, afraid to walk alone after dark, most people in area will take advantage)	Access to banks and building societies	Number of banks, building societies and ATMs
Attachment to neighbourhood	Four items (e.g. most people in area friendly, really feel part of this area)	Health services	Number of pharmacies, opticians, general practitioners
Tolerance	Six items (e.g. everybody in area should have equal rights, people in area tolerant of others not like them, people respect privacy)	Public recreation	Public swimming pools, attendance at leisure centres, number of libraries
Able to rely on others for practical help	3 items (e.g. comfortable asking neighbour to collect prescription if ill)	Quality of physical environment	Public sector housing vacancy rate, vacant and derelict land
		Transport wealth	Number of cars in insurance group 13–16 or 17–20 (high value cars)
		Access to private transport	Number of private cars per 1000 population, number of company cars per 1000 pop
		Unemployment	Claimant count per 1000 population, claimants unemployed more than 6 months

from the electoral register, living in the same neighbourhoods as Health Survey participants. Note that it was not sent to Health Survey participants themselves and so the social cohesion data are external to Health Survey data. For each of the eight scales, responses to the social cohesion survey were aggregated up to neighbourhood level by taking the mean score for all individuals within the neighbourhood. A higher score indicates higher levels of that construct, so a higher trust score indicates that people in the neighbourhood are more trusting. Women made up 57% of the sample of respondents to the social cohesion questionnaire. We chose to use the average neighbourhood score for all residents rather than sex-specific averages because the interest here is in externalities of social cohesion. Participation, local contact with family and friends, and so on may have benefits for those who participate but it may also have

benefits for the wider community. Only neighbourhoods in which at least 10 residents completed the social cohesion questionnaire were used in the analyses presented here. More detail on the design and validation of the social cohesion survey is given elsewhere (Stafford et al., 2003). (Previous work linking social cohesion to health used a different spatial scale and so multilevel regression estimates presented here differ slightly from earlier work in magnitude though not in direction (Stafford et al., 2004).

Neighbourhood political environment, amenities, and economic characteristics

More than 300 variables reflecting the political environment, local amenities, and economic deprivation or affluence were collected over various administrative

geographical scales. Data were obtained from a wide range of routine and non-routine sources including central government departments, local authorities, voluntary and public sector agencies, and commercial and industrial organisations. Most data were supplied free of charge or abstracted from information in the public domain using online sources and paper documents. Some data were only available for Scotland and some only available for England. The data were organised into pre-theorised domains which reflected our concept of human needs (Macintyre, Ellaway, & Cummins, 2002). Principal components analysis was used to explore and summarise the variables within each domain and to extract a single score for each neighbourhood. Eleven neighbourhood scores were created (Table 1): political engagement, political climate, crime, access to multiple owned foodshops, access to banks and building societies, health services, public recreation, quality of physical environment, transport wealth, access to private transport, unemployment. Detailed background on the theory, methodology, interpretation, and reliability of these scores can been found in Cummins, Macintyre, Davidson, and Ellaway (in press).

Selection of neighbourhoods

Data describing characteristics of the neighbourhood were collected in two stages. The study was initially conceived as an investigation of neighbourhood social cohesion, but subsequent extra funding allowed us to additionally collect data capturing the political, economic, and service infrastructure in the same areas. The areas included in the study of social cohesion were selected as follows: 109 census wards in London and the southeast (chosen in linked projects using other study cohorts but where HSE participants also happened to reside); 68 wards in the rest of England (chosen randomly from all wards with a minimum of 40 HSE respondents stratified by population density and Carstairs deprivation index); 81 postcode sectors in Scotland (chosen randomly from all postcode sectors with a minimum of 35 SHS respondents stratified as above). Infrastructure data were collected in the same areas, where available.

Defining neighbourhoods

Infrastructure data were more readily available using the postcode geography. Neighbourhood social cohesion data were obtained at census ward level in England but were converted to full and part postcode sectors using a look-up table available from Manchester Information and Associated Services. Postcode sectors were therefore used to define neighbourhood boundaries in England and Scotland for this study. Postcode sectors have an average population of around 5000 and are

administrative units created for the organisation of mail delivery. Administrative boundaries have the advantage that they are often used for routine data collection and the disadvantage that they do not necessarily match resident's perceptions and lived experience of their neighbourhood boundaries.

Data describing characteristics of the neighbourhood were available in a maximum of 238 neighbourhoods. The selected sample of neighbourhoods contained a greater proportion of economically deprived neighbourhoods and a greater proportion of urban neighbourhoods than all of England. The Scottish sample of neighbourhoods somewhat under-represented the most deprived neighbourhoods in Scotland. (This is because eligible neighbourhoods were not representative of the distribution of urban and deprived neighbourhoods in England and Scotland.)

Statistical methods

Correlation analysis was used to investigate the overlap between neighbourhood social cohesion and the political environment, amenities, and economic characteristics of those areas. Multilevel logistic regression models were used to investigate the association between reporting less than good health and neighbourhood characteristics. Such models allow for the clustering of Health Survey participants within neighbourhoods. Age, family type, social class, and economic activity were included in all models as these are established determinants of self-rated health that may influence where a person lives and may therefore confound the neighbourhood-health association. Individual psychological and behavioural characteristics were not added as they were a priori conceived as mediators of the neighbourhood-health association.

A random intercepts model was used, allowing the prevalence of less than good health to vary across neighbourhoods. The interpretation of the models is as follows:

$$y_{ij} = \beta_0 \text{ female}_{ij} + \beta_1 \text{ male}_{ij} + \beta_2 \text{ low trust}_j \times \text{female}_{ij}$$
$$+ \beta_3 \text{ medium trust}_j \times \text{female}_{ij} + \beta_4 \text{ low trust}_j$$
$$\times \text{ male}_{ij} + \beta_5 \text{ medium trust}_j \times \text{male}_{ij} + \text{age, family type,}$$
$$\text{social class, economic activity} + (u_{0j} + u_{1j} + e_{ij}),$$

where y_{ij} is the log odds ratio of ith person in the jth neighbourhood having less than good health, β_2 the log odds ratio of less than good health for female residents in low trust neighbourhoods (compared to residents in high trust neighbourhoods), β_4 the log odds ratio of less than good health for male residents in low trust neighbourhoods, adjusted for age, family type, social class and economic activity (main effects and gender interactions). Var $(u_{0j}) = \sigma_{u0}^2$ is the between-neighbourhood variation in less than good health for women and

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var(u_{1j}) is the corresponding between-neighbourhood variation for men. The proportion of total variation in self-rated health among women which can be attributed to differences between neighbourhoods can be calculated as $\sigma_{u0}^2/(\sigma_{u0}^2 + \pi^2/3)$ and similarly for men (Hedeker & Mermelstein, 1996). The statistical significance of each neighbourhood characteristic was assessed using the Wald test, which is appropriate for testing two or more estimates simultaneously (Goldstein, 1995).

Results

The correlations between social cohesion and other neighbourhood characteristics are shown in Table 2. Political engagement was positively correlated with most aspects of social cohesion. As expected, crime was negatively correlated with trust and with several other aspects of social cohesion. Correlations between social cohesion and both amenities (access to foodshops, access to banks and building societies, health services, and public recreation) and physical environment were generally small in magnitude. However, positive correlations between public recreation facilities and trust, attachment, and practical help are worth noting. Low access to private transport and high unemployment have been used as markers of economic deprivation (Townsend et al., 1988; Carstairs & Morris, 1991) and these were correlated with most social cohesion scales. Transport wealth (ownership of high value cars), on the other hand, showed no consistent relationship with social cohesion. In summary, social cohesion, local political environment and crime were correlated with each other but can be distinguished from amenities and more physical aspects of the residential environment.

Sex-specific analysis (not presented) showed that the correlations between women's perceptions of social cohesion and other neighbourhood characteristics were very similar to the correlations between men's perceptions of social cohesion and other neighbourhood characteristics, with a few exceptions. Women living in areas with greater political engagement, less left-wing political climate, greater affluence and less economic deprivation tended to participate in more local groups and associations. In areas of lower unemployment, women also reported seeing local friends more frequently. These correlations were not seen for men. Putnam (1996) has highlighted women's vital role in maintaining social connections. The current findings draw attention to features of the local environment which may promote or inhibit women's local social connections, although the temporality of these associations cannot be understood with cross-sectional data.

The age-adjusted prevalence of less than good self-rated health was 23.0% for women and 23.9% for men (estimated at the average age of participants). The odds

Table 2
Spearman's rank correlation coefficients between social cohesion and other neighbourhood characteristics in 238[a] postcode sectors in England and Scotland

	No. neighbour-hoods with infrastructure data	Family ties	Friendship ties	Participation	Integration	Trust	Attachment	Tolerance	Practical help
Political engagement	237	0.04	0.11	0.24*	0.24*	0.45*	0.31*	0.22*	0.14*
Left-wing political climate	237	0.17*	-0.05	-0.22*	-0.25*	-0.38*	-0.22*	-0.25*	-0.12
Crime	238	-0.48*	-0.26*	-0.08	-0.16*	-0.48*	-0.42*	-0.14*	-0.32*
Access to multiple owned foodshops	237	-0.13*	-0.06	-0.06	-0.16*	-0.18*	-0.31*	-0.11	-0.20*
Access to banks and building societies	205	-0.15*	0.02	0.17*	-0.14*	0.05	0.13*	0.01	0.02
Health services	195	-0.23*	-0.11	0.05	-0.07	-0.13*	-0.03	-0.04	0.14*
Public recreation	219	0.36*	0.31*	0.00	0.04	0.27*	0.26*	0.01	0.19*
Quality of physical environment	204	-0.18*	0.08	0.05	0.24*	0.07	-0.03	-0.01	-0.04
Transport wealth	237	-0.61*	-0.13*	0.18*	0.01	0.02	-0.08	0.14*	-0.20*
Access to private transport	238	0.02	0.12	0.29*	0.26*	0.59*	0.41*	0.38*	0.21*
Unemployment	238	-0.09	-0.24*	-0.26*	-0.27*	-0.57*	-0.40*	-0.39*	-0.28*

*$p < 0.05$.
[a]All 238 postcode sectors had complete data on social cohesion.

ratio of less than good health increased with increasing age, and was higher for participants occupying lower social classes and for those who were unemployed, retired or economically inactive for other reasons (Table 3). The difference in self-rated health between otherwise economically inactive and employed women was smaller than the difference between otherwise economically inactive and employed men and probably reflects the larger proportion of women who choose not to join the paid labour force. There was no evidence of non-linearity in the associations between age and self-rated health or social class and self-rated health.

Table 4 shows the association between neighbourhood characteristics and self-rated health separately for women and men. Statistically significant interactions between gender, health and the following neighbourhood characteristics were found: trust, integration into wider society, left-wing political climate, physical quality of the residential environment, and unemployment. Associations with health were of greater magnitude for women in each case. For the neighbourhood characteristics where interactions did not reach formal statistical significance, still the magnitude of the association was generally greater for women. There was no clear gender divide in the specific features of neighbourhood which were associated with self-rated health. Aspects of the socio-political environment, amenities and the physical environment, and economic indicators were associated with women's self-rated health over and above age and social position. For women, residence in a neighbourhood with low levels of integration into wider society, trust, tolerance, or political engagement was associated with an increased reporting of less than good self-rated health. High family ties and left-wing local government control were associated with greater odds of less than good health among women. Other studies also point to the possible negative effects of strong ties (Granovetter, 1973; Stead, MacAskill, MacKintosh, Reece, & Eadie, 2001). Living in a neighbourhood with the lowest access to banks and building societies or fewer health services was associated with an increased reporting of less than

good health, although note that less than good health was most frequently reported in neighbourhoods with average access to banks and building societies. The distribution of banks and building societies across rural, suburban, and metropolitan areas is not known, but we speculate that the number of banks and building societies may differentiate between different types of housing conurbations. It was not possible to explore this in more detail as data describing the level of urbanisation were not available at postcode sector level. A poor-quality physical environment was associated with a moderately increased odds ratio of less than good health. Women living in more deprived neighbourhoods (indicated by lower access to private transport and higher unemployment) were more likely to have less than good self-rated health. Less clearly, aspects of the socio-political environment, amenities and the physical environment, and economic deprivation or affluence were also related to men's self-rated health. (Some of the neighbourhood scales shown in Table 1 were not related to women's health or to men's health and are not included in Table 4.)

The prevalence of less than good self-rated health varied more across neighbourhoods for women than for men (Table 5). The meaning of the between-neighbourhood variance estimate is not intuitive as it is on a log scale. As a percentage of the total variation in self-rated health, 6% was between neighbourhoods for women (and 94% was within neighbourhoods). For men, 4% of the total variation in self-rated health was between neighbourhoods. For both sexes, variation across neighbourhoods was a relatively small proportion of the total variation in self-rated health, but it was larger for women than for men. (This could be interpreted as indicating that neighbourhoods are relatively unimportant for self-rated health, although it should be noted that well-established individual risk factors usually explain only a small proportion of the total variation in single level models.) Adding the participant's socio-economic position and family type explained all of the between-neighbourhood variation for men and 41% for

Table 3
Individual socioeconomic position and self-rated health by sex

	Odds ratio of less than good self-rated health (95% CI)		
	Reference group	Women	Men
Social class[a]	Per 1 unit increase	1.29 (1.22,1.36)	1.30 (1.22,1.38)
Economic activity[b]	Employed		
Unemployed		2.03 (1.28,3.22)	3.08 (2.30,4.14)
Retired		1.63 (1.28,2.08)	1.87 (1.42,2.48)
Otherwise economically inactive		2.73 (2.30,3.24)	9.29 (7.33,11.78)

[a]The effect of social class is adjusted for age, family type and economic activity.
[b]The effect of economic activity is adjusted for age, family type and social class.

Table 4
Self-rated health and neighbourhood characteristics for Health Survey participants in England and Scotland separately for women ($n = 4611$) and men ($n = 3826$)

	Tertile	Odds ratio of less than good self-rated health (95% CI) adjusted for age, family type, social class and economic activity	
		Women	Men
I. *Socio-political environment*			
Family ties	Low	0.81 (0.66,1.00)	0.71 (0.58,0.86)
	Middle	0.78 (0.63,0.96)	0.75 (0.62,0.91)
	High	1	1
Integration	Low	1.33 (1.08,1.62)	0.99 (0.81,1.21)
	Middle	0.94 (0.76,1.16)	0.99 (0.80,1.21)
	High	1	1
Trust	Low	1.62 (1.31,1.99)	1.12 (0.92,1.38)
	Middle	1.41 (1.14,1.74)	1.03 (0.85,1.27)
	High	1	1
Tolerance	Low	1.54 (1.25,1.89)	1.21 (0.99,1.48)
	Middle	1.19 (0.96,1.47)	1.04 (0.85,1.28)
	High	1	1
Political engagement	Low	1.31 (1.07,1.59)	1.05 (0.86,1.31)
	Middle	1.24 (1.01,1.52)	0.97 (0.80,1.18)
	High	1	1
Left-wing political climate	Low	1	1
	High	1.31 (1.07,1.59)	0.99 (0.83,1.19)
Crime	Low	1	1
	Middle	0.93 (0.74,1.13)	1.25 (1.00,1.58)
	High	1.06 (0.84,1.33)	1.41 (1.12,1.78)
II *Amenities & physical environment*			
Access to multiple owned foodshops	Low	1.13 (0.93,1.37)	1.29 (1.07,1.55)
	Middle	1.02 (0.80,1.31)	1.07 (0.85,1.36)
	High	1	1
Access to banks and building societies	Low	1.25 (1.00,1.56)	1.05 (0.85,1.30)
	Middle	1.56 (1.24,1.95)	1.16 (0.93,1.45)
	High	1	1
Health services	Low	1.29 (1.02,1.63)	0.97 (0.78,1.21)
	Middle	1.10 (0.86,1.40)	1.01 (0.80,1.26)
	High	1	1
Quality of physical environment	Low	1.35 (1.10,1.67)	0.91 (0.73,1.13)
	Middle	1.17 (0.93,1.46)	1.22 (0.98,1.52)
	High	1	1
III *Economic indicators*			
Transport wealth	Low	1.23 (0.98,1.54)	1.31 (1.04,1.64)
	Middle	1.11 (0.88,1.39)	1.20 (0.95,1.50)
	High	1	1
Access to private transport	Low	1.44 (1.16,1.79)	1.10 (0.89,1.36)
	Middle	1.17 (0.95,1.44)	1.10 (0.90,1.34)
	High	1	1
Unemployment	Low	1	1
	Middle	1.48 (1.20,1.83)	1.00 (0.81,1.23)
	High	1.48 (1.21,1.81)	0.95 (0.78,1.16)

women (shown by a drop in between-neighbourhood variation from 0.212 to 0.125). Aspects of the socio-political environment, amenities and the physical environment, and economic characteristics explained between 7% and 30% of this remaining variation amongst women when added singly. With neighbourhood characteristics included simultaneously, there were no remaining health differences between neighbourhoods for women (data not shown).

Table 5
Variation in self-rated health between neighbourhoods by sex: random intercepts model

	Women		Men	
	Variation (se) between neighbourhoods on a log scale	Change from previous model (%)	Variation (se) between neighbourhoods on a log scale	Change from previous model (%)
Model 1: age	0.212 (0.048)		0.141 (0.045)	
Model 2: age, family type, social class + economic activity	0.125 (0.039)	41	0.005 (0.033)	96
Model 3: M1 + each environmental factor one at a time[a]				
I *Socio-political environment*				
Family ties	0.107 (0.038)	14	0.000 (0.000)	Negligible between neighbourhood variation to explain
Integration	0.098 (0.036)	22	0.005 (0.033)	
Trust	0.087 (0.035)	30	0.007 (0.034)	
Tolerance	0.097 (0.036)	22	0.000 (0.000)	
Political engagement	0.111 (0.038)	11	0.007 (0.034)	
Left-wing political climate	0.105 (0.037)	16	0.006 (0.034)	
Crime	0.116 (0.039)	7	0.008 (0.034)	
II *Amenities & physical environment*				
Access to multiple owned foodshops	0.099 (0.041)	21	0.000 (0.000)	
Access to banks and building societies	0.093 (0.038)	26	0.000 (0.000)	
Health services	0.101 (0.044)	19	0.000 (0.000)	
Quality of physical environment	0.091 (0.040)	27	0.000 (0.000)	
III *Economic indicators*				
Transport wealth	0.114 (0.038)	9	0.002 (0.033)	
Access to private transport	0.107 (0.038)	14	0.005 (0.033)	
Unemployment	0.087 (0.035)	30	0.006 (0.034)	

[a]Only factors which were statistically significant are presented here.

Discussion

There was no difference in the overall age-adjusted prevalence of less than good self-rated health between men and women. This is consistent with findings from recent studies that have found either no gender difference or that the difference between men and women was not consistent across the life course (Lahelma, Martikainen, Rahkonen, & Silventoinen, 1999; McDonough & Walters, 2001; Macintyre, Hunt, & Sweeting (1996)).

Between-neighbourhood differences in self-rated health were larger for women than for men. Additionally, aspects of the socio-political environment, amenities and the physical environment, and economic characteristics were more consistently associated with women's self-rated health. Both these findings suggest

that the residential environment may be more important for women's health. On the other hand, individual economic activity was more strongly related to self-rated health for men. Other studies of gender differences in the effects of work and domestic conditions suggest that occupational factors are more important for men's health whereas the home environment is important for women's health. Factors such as control at home and effort–reward imbalance outside work predict depression in both men and women, with larger effects for women (Griffin, Fuhrer, Stansfeld, & Marmot, 2002; Knesebeck & Siegrist, pers. comm.). In a prospective study of civil servants, Chandola, Kuper, Singh-Manoux, Bartley, & Marmot (2004) found that low control at home predicted coronary heart disease in women but not in men. However, we note that the gender differences found in these studies may be cohort- or

context-specific. A study in a white-collar organisation found similar levels of work-home conflict for men and women, and similar relationships between work-home conflict and health for both sexes (Emslie, Hunt, & Macintyre, forthcoming). The relative effects of the work and home context are not the focus of this study, but our findings add to this literature by highlighting the influence of the residential environment on women's health especially. Further work is needed to determine how features of the neighbourhood might influence social roles; the Health Survey for England and Scottish Health Survey data available within this project did not allow us to investigate this.

A strength of this study is that neighbourhood characteristics have been measured externally to the health data. These findings add to the existing literature documenting an association between perceptions of problems in the neighbourhood and perceived health (Ellaway & Macintyre, 2001) because they avoid the problem of affect bias. A tendency for women to report negatively about all aspects of their life, including their neighbourhood and their health, cannot be the sole explanation for larger associations between neighbourhood environment and health in women. An alternative explanation for the gender differences seen is that the exposure to various aspects of the local environment differs between women and men. When the analyses were limited to participants in current employment, gender differences in the association between neighbourhood environment and health were less clear, with the exception of neighbourhood unemployment rate. This suggests that some of the stronger association between neighbourhood characteristics and health seen amongst women may be due to the fact that women spend more of their time in the neighbourhood (assuming that employed women and men spend the same amount of time in their neighbourhood). Data on time spent in the neighbourhood were not available, however a study of housing and health in the West of Scotland suggests that women do not spend a considerably greater amount of time in the home than men. In that study, the average time spent at home was 16.6 hours per day for women and 15.2 for men on weekdays, and 17.2 for women and 16.2 for men at weekends (McKay, pers. comm.). Although both sex differences were statistically significant, they were smaller than expected and do not suggest a substantial exposure difference. Considering employed participants only, residence in a neighbourhood with high unemployment was associated with poorer health for women but not for men. Greater vulnerability to features of the residential environment may play an additional part in explaining the larger associations seen amongst women.

Differences between neighbourhoods in the prevalence of less than good health were fully explained by the variables captured here for both sexes. For men, between-neighbourhood differences were explained by the spatial separation of people from higher and lower socioeconomic backgrounds. For women, some differences between neighbourhoods remained after accounting for individual socioeconomic factors and the socio-political, service, and economic characteristics of neighbourhoods measured here fully explained those remaining differences. This suggests that we have not omitted important features of the neighbourhood from this study.

On the whole, correlations between socio-political aspects of the neighbourhood and the physical environment and amenities were low indicating that "social" and "physical" domains can, to some extent, be considered separately. In contrast with previous work which suggested that social and physical domains are associated with men and women's health differently (Molinari et al., 1998; Ellaway & Macintyre, 2001), we found no clear gender division in the characteristics of neighbourhood which were most salient for health. The lack of association between social cohesion and poor quality physical environment was unexpected, given previous work in the US (Wilson & Kelling, 1982). It is possible that Wilson and Kelling's theory does not apply in the UK context. Alternatively, the lack of association may reflect the fact that the items used (number of missed waste collections, public sector housing vacancy rate, and vacant and derelict land) reflect institutional rather than informal lack of care over the physical environment.

Some limitations with this study should be acknowledged. As with the majority of quantitative studies of neighbourhoods and health, neighbourhoods are defined by administrative boundaries rather than by a theoretical approach. However, qualitative work suggests that many people do express some identification with the electoral ward they live in, suggesting a degree of overlap between geographically and psychologically defined communities (Campbell & McLean, 2002). Some of the data capturing amenities and the physical environment used here were obtained from routine data sources and it is possible that the quality varies across neighbourhoods. We cannot rule out the possibility that measurement error has masked some true effects of the neighbourhood characteristics investigated here. Regression modelling is limited in its suitability for investigating the complex relationships between the different aspects of neighbourhood and health. Future work should use an approach which tests a priori causal pathways and considers how aspects of neighbourhoods can feedback or reinforce each other over time.

This observational study is based on cross-sectional data and so selection of less healthy participants into neighbourhoods with a poorer quality residential environment cannot be ruled out as a possible explanation for the associations between neighbourhood

characteristics and health. However, we think it is unlikely that selection explains all of the associations presented here. Analysis of the 1991 Sample of Anonymous Records (Boyle, Norman, & Rees, 2002) showed that migration did not account for the association between economic deprivation and health. Also note that socioeconomic position is likely to be an important determinant of where a person lives. This aspect of selection has been accounted for in the modelling since social class and economic activity were included in all models. (Income data were missing for a substantial proportion of participants so it was not possible to additionally control for income.)

In the UK, where responsibility for looking after the home and family tends to fall on women and where social and economic resources and amenities are not equitably distributed across areas, we find that women's self-rated health is more strongly associated with features of the neighbourhood than is men's health. These findings need to be tested in other settings.

Previous studies of neighbourhoods and health have largely used a summary index based on routine data which describes concentrated deprivation. The current study has looked at different facets of the socio-political, physical and economic environment as well as local amenities as a step towards identifying points for intervention. There is evidence that each of these is associated with self-rated health over and above individual demographic and socioeconomic factors and that the associations are larger in magnitude for women. The health impact of area regeneration policies may be different for men and women. Our findings suggest that improving features of the local residential environment could be beneficial for women's health, but could have less impact on men's health.

Acknowledgements

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