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Descriptive Finding

Characteristics of urban regions and all-cause mortality in working-age population: Effects of social environment and interactions with individual unemployment

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Abstract

Using Finnish register data on individuals linked to information on urban regions, this study aimed to estimate the effects of some regional characteristics on all-cause mortality among working-age population in 1995-2001, and to find out whether these effects are different among those long-term unemployed than among others. Multilevel Poisson regression models were used. The characteristics of regions included unemployment rate, level of urbanisation, voting turnout, a summary measure of family cohesion, and the geographic location of the region. Our study showed that effects of most area characteristics on mortality were clear among those who suffered from long-term unemployment in the baseline but not among others, adjusting for basic socio-demographic characteristics of the individuals. The results thus suggest that the weaker in the society are more vulnerable to the effects of social environment than those better off.

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1. Introduction

Many multilevel studies have found effects of characteristics of areas on health and mortality after controlling for socioeconomic and other characteristics of individuals (e.g., Anderson et al. 1997, Blomgren et al. 2004, Davey Smith et al. 1998, Haan, Kaplan, and Camacho 1987, Martikainen, Mäki, and Blomgren 2004, Sloggett and Joshi 1998, Yen and Kaplan, 1999). Studies have been conducted on different area levels, with different area characteristics and adjusting for different individual variables, which complicates the comparability of the results. However, a consensus seems to prevail about the importance of community and area characteristics affecting health and mortality, but the effects are generally admitted to be modest compared to the effects of individual-level socioeconomic effects (see review of Pickett and Pearl 2001).

Most above-mentioned multilevel studies have focused on the effects of socioeconomic structure, unemployment rate or deprivation of areas and have generally reached the conclusion that poor socioeconomic circumstances induce adverse effects on mortality. Areas have also been characterised by their level of social capital or social cohesion. Social capital has been measured in a variety of ways, often based on Putnam's definition of the density of memberships in associations, levels of interpersonal trust and strengths of mutual aid and reciprocity (Kawachi and Berkman 2000, Putnam 1993). Defined in the Putnam way, social capital has been found to be associated with health and mortality in many studies both at the state level in the US (Kawachi, Kennedy, and Glass 1999, Kawachi et al. 1997) as well as at the neighbourhood level (Lochner et al. 2003). Other studies have used voting turnout and strength of traditional family norms as measures of social capital or social cohesion and have found that low levels of social cohesion are associated with increased alcohol-related and suicide mortality (Blomgren et al. 2004, Martikainen et al. 2004).

Most multilevel studies have adjusted for individual-level variables since part of the observed area differences in mortality may arise from the more favourable composition of population as regards to mortality in some areas than in others (Duncan, Jones, and Moon 1998). The relationships between mortality and socio-demographic characteristics of individuals, such as age, sex, education and social class, are well established. Among the individual-level socio-demographic characteristics, our study focuses on the effects of long-term unemployment and the joint effects of long-term unemployment and regional social characteristics on mortality. The relationship between unemployment and mortality has been shown in many studies. However, it has often been difficult to conclude whether there are true causal effects of unemployment on mortality or whether the unemployed are selected in terms of their characteristics leading both to poor health and higher risk of unemployment (Bartley 1994, Bartley and Ferrie 2001, Valkonen and Martikainen 1995). In this respect, the Finnish context of an

exceptionally deep economic recession in the beginning of the 1990's offers a special circumstance for investigating the effects of individual unemployment on mortality. During the deepest recession in 1993 and 1994, unemployment rates reached nearly 20%. In this context with high unemployment risks irrespective of health status, the selection effect to unemployment can be assumed to be smaller than in more favourable economic circumstances (Martikainen and Valkonen 1996).

Even though effects of individual characteristics and increasingly also area characteristics on mortality are well researched, less is known about their interaction effects. The question is whether the effects of area characteristics vary according to individual characteristics or, correspondingly, whether the effects of the individual characteristics depend on the value of the area variables, for example whether the level of deprivation of an area modifies the effects of individual socioeconomic status on health (Blakely and Woodward 2000). One hypothesis on cross-level interactions postulates that disadvantage of the area may be more fatal to disadvantaged individuals and that advantaged individuals may be less vulnerable since their personal resources protect them from the stressors in deprived areas. Similarly, advantaged areas may have a protective effect on disadvantaged individuals because of the better collective and social resources of these areas (Martikainen et al. 2004, Stafford and Marmot 2003). According to a contrary hypothesis, living in socially advantaged areas may increase the mortality risk of disadvantaged individuals because of the observed discrepancy between individual status and the general social environment (Stafford and Marmot 2003). For example, high general unemployment rates may be associated with less psychosocial stress and thus imply smaller repercussions compared to low unemployment rates for those suffering from unemployment (Cohn 1978, Platt and Kreitman 1985).

Supporting the second hypothesis, some studies on health and mortality have found larger socioeconomic differences in mortality in the most advantaged areas compared to the most disadvantaged areas (Ecob and Jones 1998, Yen and Kaplan 1999), suggesting differential access to resources in the advantaged areas or alternatively giving evidence to the relative deprivation hypothesis. On the other hand, some studies have found evidence for the first hypothesis and observed larger differences according to individuals' socioeconomic status in more deprived areas (Jones, Gould, and Duncan 2000) and stronger effects of individual unemployment in high unemployment areas (Turner 1995). Some studies have found no consistent interactions between area and individual socioeconomic status (Martikainen, Kauppinen, and Valkonen 2003, Martikainen et al. 2004) or between area and individual unemployment (Béland, Birch, and Stoddart 2002).

The variation of the results is naturally influenced by the different designs of the studies. Furthermore, interaction analyses have been conducted mostly focusing on

socioeconomic variables at individual and area levels. More research is needed on whether the effects of social cohesion, for example, are different for the advantaged and disadvantaged in the society.

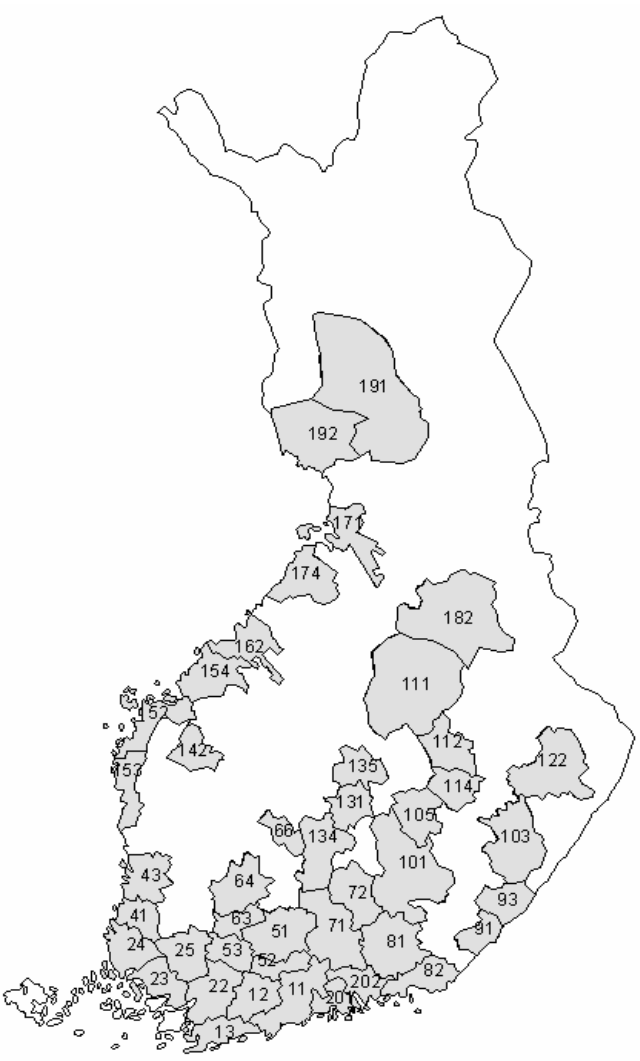
The main aims of this study are to estimate the effects of different aspects of regional social environment on all-cause mortality adjusting for individual-level covariates and to find out whether the effects of these regional characteristics on mortality vary according to individual's unemployment status. We are not aware of previous studies on mortality aiming to assess interactions between the unemployment of individuals and a set of regional variables characterising the social environment.

2. Data and methods

2.1 Structure of the data

The data are register-based individual-level data linked to information on urban regions, with baseline in years 1993-1994 and a mortality follow-up in 1995-2001. Thus, the data are organised in two hierarchical levels: that of individuals (level 1) and that of the functional urban regions of residence (level 2). Functional regions are neighbouring municipalities grouped according to travel-to-work areas and according to the patterns of cooperation among the municipalities. Each region normally contains one larger city or municipality with several commuting municipalities. Regions that include at least one urban municipality according to the classification of Statistics Finland and those regions that have been defined as urban regions in Finnish urban network studies (Antikainen 2001) were defined as urban regions. Map 1 shows these 43 regions, which covered 81% of the Finnish population in 1993. Rural regions were excluded because of their small average number of deaths even during a seven-year follow-up. Rural regions are shown as the residual white area in Map 1. Because of the generally mixed nature and relatively large size of the urban regions, there are no important differences in regional age structures. On average, 75% of the population belonged to the most active age group of 15-74-year-olds, with an average deviation of 1.0 percentage points between the regions in year 1995. The proportion of those aged 75 and over was on average 6.3% with an average deviation of 1.0 percentage point (StatFin (http://statfin.stat.fi) and Sotkanet (http://www.sotkanet.fi) databases).

Map 1: Urban regions of Finland



11 Helsinki region
12 Lohja region
13 Tammisaari region
22 Salo region
23 Turku region
24 Uusikaupunki region
25 Loimaa region
41 Rauma region
43 Pori region
51 Hämeenlinna region
52 Riihimäki region
53 Forssa region
63 Valkeakoski region
64 Tampere region
66 Mänttä region
71 Lahti region
72 Heinola region
81 Kouvola region
82 Kotka-Hamina region
91 Lappeenranta region
93 Imatra region
101 Mikkeli region
103 Savonlinna region
105 Pieksämäki region
111 Iisalmi region
112 Kuopio region
114 Varkaus region
122 Joensuu region
131 Jyväskylä region
134 Jämsä region
135 Äänekoski region
142 Seinäjoki region
152 Vaasa region
153 Kaskinen region
154 Jakobstad region
162 Kokkola region
171 Oulu region
174 Raahe region
182 Kajaani region
191 Rovaniemi region
192 Kemi-Tornio region
201 Porvoo region
202 Loviisa region

The individual-level data are register data from Statistics Finland (permission TK53-736-04). The data set was based on the longitudinal individual-level data file of employment statistics for the years 1989-2001. The file is updated annually and contains detailed information on the labour market position and several socio-demographic characteristics on all persons living in Finland. The records of this file were linked to longitudinal census records and to the death register. Based on information from 1993, those who were 30-54 years old, lived in urban regions, were Finnish- or Swedish-speaking and wage earners or unemployed were included in the data set. Those with missing information for 1994 were excluded because data on unemployment was measured on a two-year period 1993-1994. For those who were unemployed or whose occupation was unknown, occupational class was retrieved retrospectively from a previous year for which it was available. Students, entrepreneurs, farmers, pensioners and those whose socioeconomic status remained unknown were excluded.

The study cohort includes 638 294 women (who lived about 4.4 million person years during the follow-up 1995-2001) and 610 157 men (about 4.2 million person years). Altogether women in this cohort experienced 7219 deaths and men 17062 deaths in years 1995-2001.

2.2 Individual-level variables

The individual-level socio-demographic variables are sex (women and men are studied separately), age in 5-year age groups, mother tongue, education, occupational class and family type, which were all measured from 1993, labour market position in the period 1989-1990 and long-term unemployment in the period 1993-1994. All the variables were used as categorical. The classification of the variables and the distribution of the study cohort according to the variables as well as the number of deaths and age-adjusted death rates are shown in Table 1. Results on the effects on mortality of other individual level variables than long-term unemployment in 1993-1994 will not be discussed in this article. These effects have been widely researched in previous studies and were included in this study only in order to account for the compositional part of area differences in mortality (Duncan et al. 1998). The effects of long-term unemployment on mortality and especially the interactions between area characteristics and unemployment are, however, important with respect to the aims of the study.

Table 1: Distribution of the individual- and region-level independent variables and age-adjusted mortality per 100 000 person years in 1995-2001 according to each variable. Women and men aged 30-54 in Finnish urban regions in 1993 (entrepreneurs, farmers, students and pensioners not included).

	WOMEN			MEN		
	N (person years): 4 435 682			N (person years): 4 206 394		
	N (persons): 638 294			N (persons): 610 157		
	% of person years	Deaths	Age-adj. mortality/ 100 000 person yrs	% of person years	Deaths	Age-adj. mortality/ 100 000 person yrs
All	100	7219	163	100	17062	406
Individual level variables						
Age						
30-34	20.4	579	64	21.8	1597	174
35-39	21.1	1029	110	21.6	2535	280
40-44	22.3	1621	164	22.2	3851	412
45-49	21.8	2160	224	21.2	4900	548
50-54	14.4	1830	286	13.2	4179	751
Mother tongue						
Finnish	94.8	6865	164	94.7	16449	414
Swedish	5.2	354	144	5.3	613	254
Education						
Basic or less	29.7	3139	215	29.5	7524	551
Secondary	52.4	3206	151	52.2	8076	398
Higher	17.9	874	115	18.3	1462	189
Occupational class						
Unspecialised worker or unknown	15.1	1624	231	18.3	4948	650
Specialised worker	11.3	963	193	34.6	6840	473
Lower white-collar employee, not independent	28.8	1854	148	5.1	731	361
Lower white-collar employee, independent work	26.1	1772	151	17.9	2380	309
Upper white-collar employee	18.6	1006	126	24	2163	210
Family type						
Couple with child(ren)	57.1	2882	122	57.7	5836	244
Couple, no child(ren)	17.5	1817	216	17.1	3116	401
Single parent with child(ren)	10.8	817	174	1.8	355	420
No family or unknown	14.5	1703	259	23.4	7755	865

Table 1: (continued)

		WOMEN			MEN		
		N (person years): 4 435 682			N (person years): 4 206 394		
		N (persons): 638 294			N (persons): 610 157		
		% of person years	Deaths	Age-adj. mortality/ 100 000 person yrs	% of person years	Deaths	Age-adj. mortality/ 100 000 person yrs
Labour market position 1989-1990							
Mostly employed		78.1	5078	142	83.5	10872	306
Some unemployment		7.1	778	264	8.6	2935	876
Long-term unemployed		1.3	357	594	2.2	1587	1681
Mostly outside labour force or no data in 1989/90		13.5	1006	193	5.8	1668	727
Long-term unemployment 1993-1994							
Long-term unemployed		13.6	1923	323	19.2	7454	930
Other than long-term unemployed		86.4	5296	138	80.8	9608	282
Region level variables	N of regions						
Unemployment rate (average of 1993 and 1997) (%)							
14.2 – 17.9	9	39.3	3011	173	37.6	6016	380
18.0 – 21.9	20	38.1	2610	155	38.9	6777	414
22.0 – 25.7	14	22.6	1598	159	23.5	4269	432
Level of urbanisation							
Highest	13	67.6	4978	166	67	11232	403
Intermediate	18	22.3	1560	158	22.6	3985	408
Lowest	12	10.1	681	153	10.3	1845	416
Voting turnout in municipal elections (1992/1996 average) (%)							
68.0 – 75.4	16	18.6	1279	154	19.2	3067	375
64.0 – 67.9	16	30.3	2095	156	31.3	5631	426
60.0 – 63.9	11	51.1	3845	170	49.5	8364	405
Level of family cohesion							
Highest	13	13.3	866	147	13.9	2145	364
Intermediate	13	19	1332	159	19.7	3510	424
Lowest	17	67.7	5021	167	66.4	11407	409
Geographic location							
South / West	23	69.8	5107	164	68.5	11254	389
North / East	20	30.2	2112	159	31.5	5808	443

The contents of the categories of individual-level variables are largely self-explanatory with the exception of the two variables of labour market position. These are formed based on information on yearly months of employment and unemployment derived from the registers of the employment administration. Labour market status in 1989-1990 was included in order to adjust for a possible longer-term exclusion from the labour market that was not initiated by the recession of the early 1990's. Those who were employed at least 12 months during the two-year period and did not experience unemployment (but could be outside the labour force for some time) were classified as mostly employed. Those who suffered from 1 to 11 months of unemployment were classified as having some unemployment experiences. Those suffering from 12 to 24 months of unemployment were classified as long-term unemployed. Those being mostly outside the labour force and those for whom this two-year variable could not be formed due to missing data in either year formed the last category. Labour market position in 1993-1994 was included as a dichotomous variable, only separating the long-term unemployed from others to ease the treatment of interactions. Long-term unemployment in 1993-1994 was defined as described above.

Due to limitations of register-based data, we had no information on previous health status of the individuals and therefore cannot totally control for the possible selection effects of those in poorer health having both higher risks of unemployment, higher risks of mortality and possibly different propensity to move into certain types of areas compared to others. However, by adjusting for pre-recession labour market status and for other individual socio-demographic covariates related to health status we aim to account for at least part of the possible selection effect. For example, we assume that those who were unemployed and especially long-term unemployed already during the pre-recession economic boom were generally in poorer health compared to those employed. Over and above these controls, we may assume that the possible effects of selective migration in this relatively large area scale are of lesser importance than in studies comparing smaller units such as neighbourhoods or municipalities, for example (Blalock 1984).

2.3 Region-level variables

Data on the characteristics of regions were collected from the StatFin database of Statistics Finland (http://statfin.stat.fi) and from the statistical publication "Kuntakirja 1995", and by calculating aggregate area-level measures from a sample of the individual-level data set of this study and from another individual-level data set.

Region-level variables are the following:

- *Unemployment rate*, average of years 1993 and 1997 (%). (StatFin database.)
- *Level of urbanisation*, a sum variable of two standardized variables:
  - The proportion of persons working in other industries than agriculture, forestry and fishing industry in 1993 of all employed persons aged 15-64 (%). (Aggregated from individual-level data.)
  - The proportion of persons living in a densely populated area in 1990 of men aged 25-64 (%) (a densely populated area is defined as a group of buildings of at least 200 inhabitants where the distance between buildings is normally not more than 200 metres). (Aggregated from individual-level data.)
- *Voting turnout in municipal elections*, average of years 1992 and 1996 (%). (StatFin database.)
- *Family cohesion*, a sum variable of three standardized variables:
  - The proportion of one-person households of all households in 1995 (%). (Published statistics in Kuntakirja 1995.)
  - The proportion of single parent families of all families with children in 1995 (%). (Published statistics in Kuntakirja 1995.)
  - The proportion of divorced (by 1997) of those aged 30-54 who were married in 1993 (%). (Aggregated from individual-level data.)
- *Geographic location* (classified according to old province frontiers).

The first four variables describe the social environment of the region. Unemployment rate measures the general level of deprivation which may transfer to mortality by psychosocial effects on living prospects. Although all regions in this study are urban in the sense that they include at least one urban municipality, their level of urbanisation varies partly depending on the extent of rural areas in their labour market area. Two different types of variables related to social capital or social cohesion were distinguished: that related to associational life and connections with the broader society and that related to family and kinship, as suggested by Baum (1999). Voting turnout in municipal elections, measuring civic cohesion, is assumed to indicate general interest in taking care of common local issues, general affiliation to the regional community and interest in participation in reaching decisions in common goals. Family cohesion, on the other hand, represents adherence to traditional forms of family and living arrangements and characterises the local social norm environment. The population weighted correlations between these regional social variables were weak or moderate, $0.08 <= |r| <= 0.64$, (Table 2). Highest correlation, -0.64, was observed between family cohesion and level of urbanisation, meaning that the most urbanised areas tend to be

characterised by low levels of family cohesion. Also the two dimensions of social cohesion showed a moderate correlation, r=0.57.

In addition to the social characteristics of the regions, geographic location was included to adjust for the known mortality difference between Western/Southern and Eastern/Northern Finland which has still partly remained unexplained and may be due to, e.g., genetic differences of the populations which cannot be taken directly into account in this study (Koskinen 1995, Valkonen 2001).

The variables were each categorised into three classes except for geographic location. Unemployment rate and voting turnout were classified into approximately even intervals according to the rate. The classes of the level of urbanisation and family cohesion were formed by dividing the values of the sum variables into three using -1 and +1 as the cutting points. The classes and distributions of the variables with deaths and age-adjusted death rates in each class are shown in Table 1. Confirmatory analyses were conducted also with continuous region-level variables.

Table 2: Pearson correlation coefficients between the variables describing the regional social environment, weighted by the population. [a, b]

	Unemployment rate	Level of urbanisation	Voting turnout	Level of family cohesion	Geographic location
Unemployment rate	1.00				
Level of urbanisation	-0.41	1.00			
Voting turnout	-0.08	-0.49	1.00		
Level of family cohesion	0.49	-0.64	0.57	1.00	
Geographic location	0.62	-0.32	-0.28	0.39	1.00

[a] All correlations are statistically significant (p<0.01).
[b] All variables as continuous expect for geographic location (South / West vs. North / East).

2.4 Methods

Due to the rules of privacy protection, the individual level data set was cross-tabulated at Statistics Finland according to the individual-level variables and the regional identification code. Each cell (i.e. a combination of levels of individual covariates and region code) in this multivariate table gives the number of persons in the cell in 1993,

the number of deaths and the number of person years lived during the seven-year follow-up period 1995-2001. The total number of non-empty cells was 129 543. The values of the region-level variables were linked to the cells of the tabulated data by means of the regional identification code.

First, we calculated age-adjusted death rates according to classes of the individual- and region-level variables. To assess the extent of regional variation, we calculated these death rates also for each urban region, women and men separately. Second, regional variation and effects of individual- and region-level variables on mortality were assessed with multilevel Poisson regression models (Langford and Day 2001, Snijders and Bosker 1999). The models were fitted with SAS 8 Glimmix macro (Littell et al. 1996). In the models we used the number of deaths in the cells as the dependent variable, a Poisson distribution assumption, a log link, and the logarithm of person years as an offset. The results are presented as mortality rate ratios with the mortality in the reference group of each variable set at 1.00. The models are random intercepts models in which the regression coefficients of the independent variables are assumed to be the same for all areas (so called fixed effects), but the intercepts are allowed to vary across areas (random effects) (Snijders and Bosker 1999).

The method allows estimating posterior values for regional mortality rate ratios in each model, which indicate how much the mortality rate in each region deviates relatively from the average when a set of variables has been adjusted for. These estimated deviations are somewhat smoothed towards the average since multilevel analysis, using Bayesian estimation methods, diminishes variation in the data by using information on all higher level units when calculating the estimates (Snijders and Bosker 1999). Based on these regional deviations, regional average relative deviation was calculated from each model in order to assess the contribution of individual- and region-level variables in explaining regional differences in mortality. The formula is presented in Table 3.

The effects of long-term unemployment experienced during the recession years 1993-1994 on mortality are of special interest in this study. After looking at the general effects of the area characteristics on mortality, we investigated the cross-level interactions of long-term unemployment and regional characteristics, i.e. whether the effects of regional variables were different among the long-term unemployed group than among the others, or, correspondingly, whether the strength of the effect of long-term unemployment depends upon the area characteristics.

3. Results

3.1 Effects of individual-level variables

The age-adjusted mortality rate was 163 per 100 000 person years among women and 406 among men (Table 1). The proportion of deceased in 1995-2001 of the 1993 baseline study cohort was 1.1% of women and 2.8% of men. Age-adjusted death rates according to the individual-level variables are listed in Table 1. The effects of individual-level socio-demographic characteristics in multilevel models will not be reported in detail since they are not of primary interest in this study (results available from the first author). The effects of these characteristics followed expected patterns, and after mutual adjustment they were all statistically significantly associated with mortality except for mother tongue among women.

When all other individual-level characteristics and previous labour market position had been adjusted for, the long-term unemployed of the period 1993-1994 had a 1.7-fold mortality among women and 1.8-fold among men compared to those who were mainly working at the time.

3.2 Effects of the population composition and characteristics of regions

The age-adjusted regional mortality rates for the period 1995-2001 ranged from 97 to 206 deaths per 100 000 person years among women and from 226 to 582 among men. Calculated from regional deviations of the mortality rate ratios derived from multilevel models adjusting only for age, the average relative deviation (ARD) was 4.8% among women and 8.0% among men (Table 3). Adding all individual-level variables to the model produced clearly different results among women and men. Among women, the average relative deviation increased by 90% whereas among men it decreased by 23% (Table 3). This indicates that there were regional differences in mortality among women that were hidden when individual-level variables were not taken into account. Thus, in some regions the mortality rates would be even higher above the average if the individual characteristics of the inhabitants were not as favourable as they were with relation to mortality. Among men, population composition thus explained a part of the regional variation but among women, the regional differences were larger than originally when the population composition had been taken into account.

Table 3: Average relative deviations of the regional mortality rate ratios in different multilevel Poisson regression models

	Only age (Model 1)	All individual level variables (Model 2)	All individual and region level variables (Model 3)
		WOMEN	
Average relative deviation (ARD) (%) [a]	4.8	9.0	2.4
Change in ARD:			
Model 1 to Model 2 (%)	.	+89.9	.
Model 2 to Model 3 (%)	.	.	-73.1
Model 1 to Model 3 (%)	.	.	-48.8
		MEN	
Average relative (ARD) (%) [a]	8.0	6.2	4.6
Change in ARD:			
Model 1 to Model 2 (%)	.	-22.6	.
Model 2 to Model 3 (%)	.	.	-25.6
Model 1 to Model 3 (%)	.	.	-42.4

a Average relative deviation was calculated as

$$ARD = 100 * \sum_{i=1}^{n} \left(\left| \frac{RR_i - RR}{RR} \right| * pop_i \right)$$

where RR_i=estimated mortality rate ratio of the region compared to the average, RR=average mortality among women or men, pop_i=person years share of the region, and n=number of regions (=43).

Because regional variation in mortality was not explained by differences in the regional population compositions, we continued the analysis by adding regional characteristics to the model. Results from three types of models are shown in Table 4: 1) each regional variable and age in the model, 2) each regional variable and all individual-level variables in the model and 3) all individual and regional variables in the model. Results from the first type of models show whether each regional variable was associated with mortality when only age was adjusted for. These associations can, however, be explained by differences in individuals' characteristics. Thus, results from the second type of models indicate whether there are 'true' area effects. In the third type of models all regional variables are taken into account. These show the net effects of each variable when adjusting for each other and for the individual-level variables.

Table 4: Mortality rate ratios (RR) according to the region-level variables from multilevel Poisson regression models. Women and men aged 30-54 in Finnish urban regions in 1993, mortality follow-up 1995-2001 (women). [a]

	Each variable + age		Each variable +all individual level variables		All individual and region level variables	
	RR	(95% CI)	RR	(95% CI)	RR	(95% CI)
Unemployment rate (%)	(p=0.558)		(p=0.040)		(p=0.005)	
14.2 – 17.9	1.00		1.00		1.00	
18.0 – 21.9	0.96	(0.88-1.04)	0.89	(0.81-0.98)	0.86	(0.78-0.95)
22.0 – 25.7	0.99	(0.91-1.08)	0.90	(0.81-0.99)	0.85	(0.76-0.94)
Level of urbanisation	(p=0.709)		(p=0.690)		(p=0.415)	
Highest	1.00		1.00		1.00	
Intermediate	0.99	(0.92-1.07)	0.99	(0.91-1.08)	1.04	(0.96-1.13)
Lowest	0.96	(0.87-1.06)	0.95	(0.86-1.06)	0.97	(0.88-1.08)
Voting turnout (%)	(p=0.329)		(p=0.261)		(p=0.424)	
68.0 – 75.4	1.00		1.00		1.00	
64.0 – 67.9	1.02	(0.94-1.11)	1.00	(0.91-1.10)	0.98	(0.89-1.08)
60.0 – 63.9	1.06	(0.98-1.15)	1.07	(0.97-1.18)	1.04	(0.92-1.16)
Level of family cohesion	(p=0.080)		(p=0.188)		(p=0.120)	
Highest	1.00		1.00		1.00	
Intermediate	1.08	(0.98-1.19)	1.06	(0.95-1.18)	1.07	(0.97-1.18)
Lowest	1.10	(1.01-1.20)	1.10	(0.99-1.21)	1.11	(1.01-1.23)
Geographic location	(p=0.685)		(p=0.824)		(p=0.414)	
South / West	1.00		1.00		1.00	
North / East	1.01	(0.95-1.08)	0.99	(0.92-1.07)	1.04	(0.95-1.14)

[a] P-values in parentheses show the significance of each single variable in the respective model.

Table 4: continued (men) [a]

	Each variable + age		Each variable +all individual level variables		All individual and region level variables	
	RR	(95% CI)	RR	(95% CI)	RR	(95% CI)
Unemployment rate (%)	(p<0.001)		(p=0.335)		(p=0.166)	
14.2 – 17.9	1.00		1.00		1.00	
18.0 – 21.9	1.22	(1.08-1.37)	1.04	(0.95-1.14)	0.99	(0.90-1.09)
22.0 – 25.7	1.29	(1.13-1.46)	0.98	(0.89-1.08)	0.92	(0.83-1.03)
Level of urbanisation	(p=0.836)		(p=0.303)		(p=0.780)	
Highest	1.00		1.00		1.00	
Intermediate	0.97	(0.86-1.09)	0.96	(0.89-1.04)	0.99	(0.92-1.07)
Lowest	0.97	(0.84-1.11)	0.94	(0.86-1.02)	0.97	(0.89-1.06)
Voting turnout (%)	(p=0.006)		(p=0.127)		(p=0.504)	
68.0 – 75.4	1.00		1.00		1.00	
64.0 – 67.9	1.19	(1.06-1.32)	1.08	(1.00-1.17)	1.05	(0.96-1.15)
60.0 – 63.9	1.15	(1.02-1.30)	1.06	(0.98-1.15)	1.02	(0.92-1.14)
Level of family cohesion	(p=0.003)		(p=0.007)		(p=0.021)	
Highest	1.00		1.00		1.00	
Intermediate	1.21	(1.07-1.37)	1.11	(1.02-1.21)	1.12	(1.03-1.22)
Lowest	1.18	(1.05-1.33)	1.13	(1.04-1.22)	1.12	(1.02-1.22)
Geographic location	(p<0.001)		(p=0.459)		(p=0.410)	
South / West	1.00		1.00		1.00	
North / East	1.17	(1.07-1.29)	1.03	(0.96-1.10)	1.04	(0.95-1.14)

[a] P-values in parentheses show the significance of each single variable in the respective model.

Regional unemployment rate was not associated with mortality among women in the first type of model, but when the individual-level variables were entered, an effect of unemployment rate was revealed: living in the regions with higher unemployment rate meant an about 10% *lower* mortality risk than living in the regions with the lowest unemployment rate. Among men, on the other hand, living in high unemployment regions was associated with higher mortality, but the effect disappeared when individual variables were adjusted for. Since the correlations between area variables were low or moderate, these associations were not much affected by adding other area variables in the model.

Level of urbanisation did not have any effect on mortality in any of the models, for women or men. Voting activity was not significantly associated with mortality among women, but among men an association was observed when adjusted only for age: lowest or intermediate voting turnout in the region produced, respectively, a 15% and

19% higher mortality risk compared to the most active regions. However, when individual-level variables were added, most of this effect disappeared.

The level of family cohesion had the most consistent effects on mortality of the regional variables included in the analyses. Among women, living in regions with the lowest family cohesion meant an about 10% elevated mortality risk compared to regions with highest family cohesion. This result was not altered with inclusion of other variables. The middle category showed an estimate in between the others but did not differ statistically significantly from the reference category. Among men, the results were broadly similar: the regions characterised by lowest or intermediate level of family cohesion had an about 11-13% higher mortality risk than regions with highest cohesion when adjusted for the population structure. The intermediate and low cohesion regions thus formed one group compared to the high cohesion regions.

Geographic location had no effect on mortality among women. Among men, northern and eastern regions had higher mortality than southern or western regions. However, this difference was explained by differences in the population composition of these geographical areas.

The results concerning area effects remained broadly the same when the same analyses were performed by replacing the categorical region-level variables by continuous variables.

In Table 3, the last columns for women and men show the average relative deviations from the models that adjust for all variables. Among women, ARD from the individual effects model was decreased by 73% and among men by 26%. In total, the individual and regional variables in the model explained about 49% of the total regional age-adjusted mortality variation among women and 42% among men, respectively. There was thus remaining regional variation related to other variables than those taken into account in these analyses.

3.3 Cross-level interactions between long-term unemployment and regional social characteristics

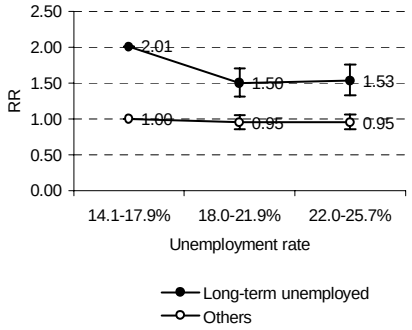
A further aim of the study was to see whether there were cross-level interaction effects on mortality between long-term unemployment experienced during the recession and regional social characteristics. Each interaction term was added separately to the model where the main effects of all individual-level variables and each region-level variable were adjusted for at the same time. We tested also interaction models including all other region-level variables, but the significance levels and forms of interactions remained the same. The results are presented in Figures 1-4. The mortality risk ratios (RR) were calculated relative to those who were not long-term unemployed in the reference

category of the area-level variable. 95% confidence intervals were calculated relative to the reference category of the area variable separately among the long-term unemployed and among the others.

All interactions were statistically significant except for the level of urbanisation among men. In most cases, effects of regional social environment were observed among the long-term unemployed but not among others. The effect of the regional unemployment rate on mortality among women (Figure 1a) observed in Table 4 was produced by this effect among the long-term unemployed only, and there was no effect among the others. Figure 1a shows that living in lowest unemployment regions compared to highest unemployment regions produced a clearly increased mortality risk among the unemployed but there was no effect among the others. Among men (Figure 1b) the results were roughly similar but not as clear.

Figure 1: Effect of the regional unemployment rate on mortality 1995-2001 by individual long-term unemployment in 1993-1994, adjusted for all individual-level variables. Mortality rate ratios + 95% CI.

a. Women (p<0.001).



b. Men (p<0.001).

Figure 2: Effect of the regional level of urbanisation on mortality 1995-2001 by individual long-term unemployment in 1993-1994, adjusted for all individual-level variables. Mortality rate ratios + 95% CI.

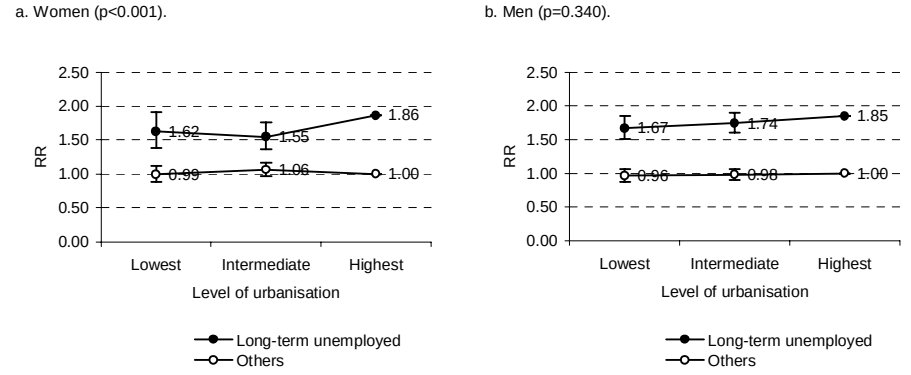


Figure 3: Effect of the regional voting turnout on mortality 1995-2001 by individual long-term unemployment in 1993-1994, adjusted for all individual-level variables. Mortality rate ratios + 95% CI

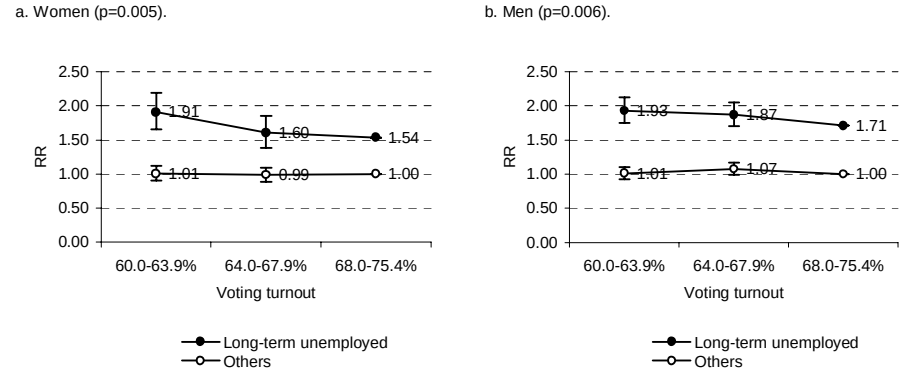


Figure 4: Effect of the regional level of family cohesion on mortality 1995-2001 by individual long-term unemployment in 1993-1994, adjusted for all individual-level variables. Mortality rate ratios + 95% CI.

The interactions of long-term unemployment and the regional level of urbanisation (Figure 2a and 2b) were less consistent. Among women, there was some indication that living in the most urbanised regions was associated with higher mortality among the long-term unemployed but not among others. Among men no interaction effect was observed.

Results regarding voting turnout (Figures 3a and 3b) were clear: among both long-term unemployed women and men, living in regions characterised by lowest voting turnout was associated with higher mortality compared to regions with highest voting turnout but there was no effect among others. The interaction between the level of family cohesion and long-term unemployment was even clearer (Figures 4a and 4b): the lower the level of family cohesion, the higher the mortality rate among the long-term unemployed. Among women, there was no difference between categories of area variables among others than those long-term unemployed. However, among men, being in the intermediate category meant an increased mortality risk also for others than those long-term unemployed.

4. Conclusion

Area effects on mortality indicate unequal chances of health and well-being between different areas. The area effect approach has gained growing importance in research into mortality during the past decade since it has been suggested that characteristics of areas may have an effect on the health of individuals over and above their personal characteristics, and that interventions to promote health should be targeted on socially disadvantaged areas rather than focused on certain population groups (Diez-Roux 2001, Robert 1999).

This study aimed to assess the effects of regional social environment on all-cause mortality among working-aged women and men in Finland with a special focus on cross-level interactions between individual unemployment status and regional characteristics. Our main results indicate area effects related to two dimensions of regional differentiation: that of depression or economic well-being, measured with regional unemployment rates, and that of the strength of social relationships, measured with family cohesion and voting activity. The regional differentiation in Finland according to these two dimensions may be roughly characterized as follows. Unemployment rates are lowest in the traditionally most industrialized regions in the South and West and rise towards the more distant regions of East and North. Social cohesion, on the other hand, is strongest in the regions on the West Coast and in some regions in Central Finland and lowest in the South and East. The patterns of cohesion observed today still seem to reflect the historical patrimony of village-based habitation in the West as opposed to more scattered settlement in the East (Riihinen 1965), and they also reflect differences in levels of urbanisation, as observed in the moderate correlation between family cohesion and level of urbanisation. Combined, these dimensions reveal a pattern of low unemployment rates and low strength of social ties in the urbanised South, low unemployment rates but high levels of cohesion in the West Coast, and higher unemployment rates with various levels of cohesion in the more rural Eastern, Central and Northern regions of the country.

Our analyses have shown that these regional differences along the two dimensions are reflected in regional mortality rates net of individual level covariates and net of other regional social covariates. In the first phase of this study, we found a strong causal effect of individual long-term unemployment on mortality, as found in many previous studies (e.g. Bartley 1994, Martikainen and Valkonen 1996). Second, by examining cross-level interactions, we found that effects of area characteristics on mortality were clear among those long-term unemployed but not that clear or non-existent among others. Theories on interactions between individual and area characteristics on health and mortality have focused on area deprivation, assuming either that those less well-off fare worse in better-off areas or, vice versa, that those less well-off fare worse in worse-

off areas (Stafford & Marmot 2003). Supporting the first interaction hypothesis, we found that living in regions characterised by lowest unemployment rates meant a clearly higher mortality risk for the long-term unemployed individuals compared to those living in areas of highest unemployment rates when individual level covariates were adjusted for. The finding may reflect relative deprivation and a labelling effect: the unemployed in low-unemployment areas may perceive a disparity between their own position and the position of those living in the same region and they may thus experience higher levels of psychosocial stress. They may also be treated as a deviant group in the society, which can lead to a twist of social exclusion (Cohn 1978, Gallie and Russell 1998, Platt and Kreitman 1985, Stafford and Marmot 2003). Mechanisms of social comparison may thus increase mortality in the unemployed group in regions where unemployment is rare.

However, since we could not control for previous health status, we cannot rule out the possibility that selection may at least partly explain the finding of the long-term unemployed being in highest mortality risks in areas with lowest unemployment rates. To minimize the possibility of selection, we adjusted for several individual level socio-demographic characteristics as well as pre-recession labour market status as a proxy for health status. Net of these adjustments, the long-term unemployed living in low-unemployment regions may still have been in generally poorer health status and have other more unfavourable characteristics compared to the perhaps more heterogeneous group of those unemployed living in high-unemployment areas.

Furthermore, our results showed that living in regions of low family cohesion and low voting turnout meant an increased mortality risk for the long-term unemployed but not for others. Correspondingly, own unemployment was more fatal to those living in low cohesion regions compared to those living in high cohesion regions. Strong social cohesion had a protective effect on disadvantaged individuals, helping to overcome the problems that may arise from individual's unemployment experiences. These effects may be related to the strength of social support, to psychosocial mechanisms and to lack of participation in low cohesion areas. This finding seems to support the second type of interaction hypothesis of those less well-off coping better in better-off areas. However, the above mentioned interaction theories have been formed in relation to area deprivation only (Stafford & Marmot 2003) and may thus not be generalized to other types of area measures. More research and theory formulation is needed on interactions according to various dimensions of area differentiation.

In conclusion, we have shown that several area characteristics may have effects on individual well-being be net of each other: for example, those long-term unemployed living in areas with low unemployment rates and low levels of cohesion are at the highest mortality risks, but high levels of social cohesion may help to overcome negative effects of other area characteristics. Overall, the results suggest that the weaker

in the society are more vulnerable to the characteristics of the social environment than those better off, and, correspondingly, that the mortality differences between groups of individuals may vary according to area characteristics. The earlier results of relatively small area effects on mortality may have been a consequence of analysing the general population and not taking into account that area effects may concern only sub-populations such as the unemployed or other vulnerable groups. Studies on area effects on health and mortality would gain more depth by considering interactions between individual and area levels. Future studies should also focus on finding out through which mechanisms the area effects are demonstrated especially among those less well-off in the society.

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