

## ORIGINAL PAPER

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**Social disadvantage and schizophrenia****A combined neighbourhood and individual-level analysis**

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■ **Abstract** *Objective* To study, in a geographically defined area, associations between the neighbourhood social environment and individual socioeconomic status on the one hand, and treated incidence of schizophrenia and level of subsequent service use on the other. *Method* A combined data set of (i) patients with a case register diagnosis of schizophrenia and (ii) population controls was subjected to multilevel analyses, including neighbourhood exposures (neighbourhood socioeconomic disadvantage and social capital) and individual level confounders. Separate analyses were conducted for inpatient and outpatient psychiatric service consumption as indexed by the case register. *Results* Neighbourhood socioeconomic disadvantage and neighbourhood social capital did not impact on the treated incidence of schizophrenia, but quantity of inpatient service consumption was higher in neighbourhoods with higher level of social control (i.e. where it is more likely that neighbours intervene in neighbourhood-threatening situations). In addition, most indicators of lower individual socioeconomic status were associated with higher

treated incidence, while treated incidence was lower when individual educational status was low. *Conclusion* Residents of high social control neighbourhoods may seek greater levels of resolution of psychiatric disorder in patient-residents, and by consequence may induce greater levels of inpatient service consumption in patients diagnosed with schizophrenia. Individual-level indicators of social disadvantage are associated with higher risk of treated psychotic disorder, with the exception of lower educational status, which may confer a lower probability of treatment given the presence of psychotic disorder.

■ **Key words** mental health services – schizophrenia – neighbourhood socioeconomic disadvantage – individual socioeconomic status – social capital

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**Introduction**

Previously, both individual-level socioeconomic status and neighbourhood-level social environment have been linked with schizophrenia incidence rates. However, findings were inconsistent [1–3] which may be related to the fact that even though individual and neighbourhood characteristics are highly interrelated, the two concepts are rarely included in the same set of analyses.

For example, individual-level socioeconomic status has been associated with schizophrenia rates [1–5]. The direction of this association was inconsistent with associations in the direction of either low socioeconomic status [2, 3, 5–8] or high socioeconomic status (before the onset) [4, 9]. These early studies, however, did not differentiate between individual and neighbourhood socioeconomic status. Instead, socioeconomic status at the area level was considered a proxy for individual-level socioeconomic status and studies referred to each other

without distinguishing between individual-level and area-level measures.

More recently, the importance of area characteristics for schizophrenia risk was demonstrated in the study of, for example, urbanicity in relation to schizophrenia [10–15]. However, the mechanisms whereby urbanicity impacts on schizophrenia risk remain unknown. Seven decades ago, social isolation was hypothesised to have a causal influence on the development of psychotic symptoms [5], and this is supported by recent research [15]. A related mechanism has been proposed involving social capital, hypothesising that reduced trust, cohesion and social control between neighbours may be associated with higher risk of schizophrenia [16]. Social capital can be seen as the “glue that holds society together” [17]. It has been defined as “those features of social organisations—such as networks of secondary associations, high levels of interpersonal trust and norms of mutual aid and reciprocity—which act as resources for individuals and facilitate collective action” [18–20]. The measurement of neighbourhood social capital relies largely on the subjective assessments of the residents of the neighbourhood social environment, but the objective measure of residential instability can be seen as a proxy, because social capital is lower when neighbours move more frequently [21–23].

There is a growing interest in disentangling effects of individual and neighbourhood characteristics, using new statistical methods such as multilevel regression analyses. Previously, analyses including both individual and neighbourhood factors have been performed using both subjective (quality-of-life) and objective (mental health service use, crime) mental health outcomes [21, 24–27]. For example, one multilevel study including individual socioeconomic status showed that socioeconomic deprivation as well as lower levels of social capital were associated with higher rates of treated psychiatric disorders, but only before adjustment for individual-level confounders [25]. In addition, this study reported that social capital, given the presence of a psychiatric disorder, was associated with more contacts with mental health services. However, because differentiating between psychiatric disorders is essential [28], results may be different when studying schizophrenia. To our knowledge, only one recent study on neighbourhood factors and schizophrenia included a measure of individual-level socioeconomic status [29], while many others did not [30–35].

For the present study, data on patients with a diagnosis of schizophrenia were selected from a Psychiatric Case Register [36]. These data and data pertaining to population controls (unmatched case-control design) were matched with one measure of individual socioeconomic status and four neighbourhood measures: one measure of socioeconomic deprivation and three measures of social capital (informal social control, social cohesion & trust, res-

idential instability). The present paper addressed four research questions:

1. Is individual-level socioeconomic status associated with treated incidence of schizophrenia?
2. Are neighbourhood variables associated with treated incidence of schizophrenia?
3. Is individual-level socioeconomic status associated with the level of outpatient service consumption and number of inpatient days in patients diagnosed with schizophrenia? (Quantity of service consumption).
4. Are neighbourhood variables associated with the level of outpatient service consumption and number of inpatient days in patients diagnosed with schizophrenia? (Quantity of service consumption).

## Methods

Maastricht is a relatively small Dutch city with a population of 122,000 inhabitants (60 km<sup>2</sup>) living in 36 residential neighbourhoods (administrative units) of approximately 3000 inhabitants each (range 300–8500; all ages). The boundaries of these neighbourhoods follow main roads and are ecologically meaningful.

### ■ Cumulative incidence of schizophrenia

Since 1981, the Psychiatric Case Register South Limburg (PCR; formerly known as MHCR) has cumulatively collected data on all mental health contacts in Maastricht and surrounding areas (i.e. contacts with psychiatric hospital, community mental health centre, psychiatric department of university hospital, community psychiatric emergency outreach team, psychogeriatric nursing homes, sheltered housing, child psychiatric services, services for the mentally impaired or alcohol and drug misuse services). These collected data were chronologically ordered per patient using a probability linkage procedure involving five variables: gender, date of birth, first letters of the (maiden) name, place of birth and place of residence. Individual demographic (gender, age, marital status, education, employment and living conditions) and diagnostic data (e.g. schizophrenia, alcohol addiction and affective disorders) were also registered. For the present analyses, all patients diagnosed with schizophrenia (DSM IV 295, 297) living in the city of Maastricht were selected. All patients who were diagnosed with schizophrenia were included, both as first-ever diagnosis and after a diagnostic change (e.g. from early diagnosis of depression to later diagnosis of schizophrenia; see [30]). Within the city of Maastricht, all distances can easily be covered by bicycle and, therefore, effects of the distance to psychiatric services were negligible. Mental health services are covered by a national insurance and a general practitioner referral is not necessary for attending a community mental health centre. Individuals with no known or erroneous address were excluded from the analyses. In order to provide descriptive statistics per neighbourhood, neighbourhood-level 10-year cumulative incidence (1993–2002) of all cases aged 15 years and over was determined. Incident cases were individuals who did not have registered contacts with mental health services for at least 5 years. The mean size of the population, the denominator of the incidence fraction, was estimated by averaging the population sizes at 1-1-1995 and at 1-1-2001 (≥15 years) [37].

### ■ Relative risks of neighbourhood factors on schizophrenia

In order to analyse treated schizophrenia incidence rates, all incident cases (between 1-1-1998 and 31-12-2002) with the diagnosis of schizophrenia, aged between 20 and 65 years, were compared with

a population control group (case-control design, see below for details of analysis).

In order to obtain measures of social capital from each neighbourhood, approximately 200 inhabitants aged between 20 and 65 years were randomly selected using the municipal database [38]. These residents received a questionnaire on social capital (described in detail below), but the questionnaire also included demographic data so that the respondents (48%,  $n = 3469$ ) could serve as a control group for the current analyses according to an unmatched case-control design.

### ■ Quantity of service consumption

All incident cases, aged between 20 and 65 years at first contact between 1-1-1988 and 31-12-1997, were followed for 5 years to determine service consumption: number of days in hospital and number of outpatient contacts. Since the service consumption variables were highly skewed to the left, the scores were transformed using the natural logarithmic function.

### ■ Neighbourhood variables

The address at the first contact was used to define patients' neighbourhood of residence. The measures of neighbourhood socioeconomic deprivation and residential instability were based on various neighbourhood socioeconomic characteristics obtained from the Maastricht Statistics Department and Statistics Netherlands (CBS). In addition, the above-mentioned population control group originally served to collect neighbourhood-level measures of social capital in all neighbourhoods. Social capital was measured using two dimensions: informal social control (ISC) and social cohesion and trust (SC & T). These two collective efficacy scales were developed by Sampson and colleagues [22] and adapted to the Dutch situation (see appendix). The two sum scores were obtained from individual answers and aggregated to the neighbourhood level. The ISC scale measures the willingness to intervene in hypothetical neighbourhood-threatening situations, for example in the case of children misbehaving. The SC & T scale measures bonds and trust among neighbourhood residents. All four neighbourhood variables were standardised to unity standard deviation. Higher scores indicated more socioeconomic deprivation, more residential instability and lower levels of social capital.

### ■ Individual-level socioeconomic status variables

Individual demographic variables included in the PCR data, such as marital status, education, employment and living conditions, are proxies for individual socioeconomic status. In addition, an extra variable on socioeconomic status was added to the PCR data, using postal code house-price registrations [25]. Postal code areas (as used by the postal services) are defined by 6 characters, and the Maastricht residential neighbourhoods each contain between 27 and 186 postal codes (mean 82), and thus a postal code area includes only a few addresses. Therefore, measures at postal-code-level can be used as a proxy for individual-level variables. To estimate postal code socioeconomic status, house prices per postal code between 1998 and 2002 were collected from the website of the Dutch land registry organisation. The prices per year were divided by the mean price per year (to control for increase of the house prices over the years) and these were used as an index of postal code socioeconomic status. This index was not available from postal codes with rented houses only (43% of all residential postal codes). In order to obtain one proxy for both owner occupied and rented houses, house price index was estimated in postal codes with rented houses only using a regression model with all available data on rented houses, such as rent of the houses, mean number of floors and percentages of houses with a garden.

### ■ Statistical analysis

Data were grouped according to neighbourhood and were, in statistical terms, part of a multilevel structure with level-one units

(individuals) structured into level-two units (neighbourhoods). These hierarchically structured data were subjected to multilevel regression analysis [39] in order to investigate neighbourhood effects while controlling for individual effects. Multilevel or hierarchical linear and logistic modelling techniques are a variant of the more often used unilevel linear and logistic regression analyses and are ideally suited for the analysis of clustered data, in this case consisting of multiple persons clustered within a single neighbourhood. The  $\beta$ s (linear) and the odds ratios (logistic) are the regression outcomes of the predictors in the multilevel model and can be interpreted identically to the estimates in unilevel analyses.

First, the case-control data were subjected to multilevel logistic regression analyses using MLwiN (second order Penalised Quasi Likelihood method; PQL) [40-42]. Since we sampled the same number of controls in every neighbourhood, data of controls were weighted to reflect the distribution of the general population per neighbourhood. The individual variables gender, age group (20-30, 30-40, 40-50, 50-65), marital status, educational status (high, low), employment status (employed, unemployed), living conditions (not single, single, other) and individual socioeconomic status index (in quintile groups) were included in the analyses. Socioeconomic status index as well as the other individual-level variables had between 8 and 30% missing values. Therefore, the missing values of all individual-level variables were imputed, based on regression scores of the other individual-level variables, using the Stata statistical programme [43].

All categorical variables were recoded into dummies with the following reference categories: aged 20-30 years, married, high education, employed, not single and high socioeconomic status. This resulted in the following fixed effects multilevel logistic regression model:

$$\begin{aligned} \ln(\text{odds}) &= \beta_0 + \beta_1 \text{ neighbourhood variable}_j \\ &+ \beta_2 \text{ gender}_{ij} + \beta_{3-5} \text{ age dummy}(1-3)_{ij} \\ &+ \beta_{6-8} \text{ marital status dummy}(1-3)_{ij} \\ &+ \beta_9 \text{ low education}_{ij} + \beta_{10} \text{ unemployed}_{ij} \\ &+ \beta_{11-12} \text{ living conditions dummy}(1-2)_{ij} \\ &+ \beta_{13-16} \text{ socioeconomic status dummy}(1-4)_{ij} \\ &+ \mu_j \end{aligned}$$

The  $\ln(\text{odds})$  was the odds of being registered with the diagnosis of schizophrenia in the PCR (treated incidence). Due to collinearity (e.g. Pearson correlation between socioeconomic deprivation and SC & T: 0.89,  $n = 35$ ), neighbourhood variables (socioeconomic deprivation, residential instability, ISC and SC & T) were entered separately except for socioeconomic deprivation and informal social control (Pearson correlation 0.65,  $n = 35$ ).

Second, analyses on level of inpatient and outpatient service consumption of patients diagnosed with schizophrenia were performed using Stata (version 8) [43]. All the above-described confounders were again added to the models and again the missing values were imputed. This resulted in the following fixed effects multilevel linear regression model (maximum likelihood method):

Outcome

$$\begin{aligned} &= \beta_0 + \beta_1 \text{ neighbourhood variable}_j \\ &+ \beta_2 \text{ gender}_{ij} + \beta_{3-5} \text{ age dummy}(1-3)_{ij} \\ &+ \beta_{6-8} \text{ marital status dummy}(1-3)_{ij} \\ &+ \beta_9 \text{ low education}_{ij} + \beta_{10} \text{ unemployed}_{ij} \\ &+ \beta_{11-12} \text{ living situation dummy}(1-2)_{ij} \\ &+ \beta_{13-16} \text{ socioeconomic status dummy}(1-4)_{ij} \\ &+ \varepsilon_{ij} + \mu_j \end{aligned}$$

The outcome was the logarithmic function of inpatient days, or outpatient contacts, and the multiple error terms reflect residual variation at each level: individual ( $\varepsilon_{ij}$ ) and neighbourhood ( $\mu_j$ ). Again, the four neighbourhood variables were added to the model separately, socioeconomic and ISC were entered jointly.

## Results

### Cumulative incidence and neighbourhood variables

Per 1000 Maastricht residents aged 15 years and over, 2.9 were diagnosed with schizophrenia in the last 10 years (1993–2002) and had contact with a mental health institution (thus 10-year total schizophrenia incidence was approximately 29 per 100,000 person years). The cumulative incidence per neighbourhood ranged between 0.7 and 6.0 per 1000 residents. Figures 1–3 show variation in neighbourhood socioeconomic deprivation, ISC, and neighbourhood 10-year cumulative incidence of schizophrenia, respectively. Table 1 presents descriptives of all neighbourhood variables.

### Relative risk of neighbourhood factors on schizophrenia rate

Table 2 presents descriptives of cases and controls. Crude analyses showed that one standard deviation increase in one of the neighbourhood variables was associated with a 13–35% increase in treated incidence rates of schizophrenia (Table 3). The associations between social cohesion & trust and residential instability on the one hand and treated incidence on the other (OR = 1.29 and 1.35, respectively) were statistically significant, and the association between socioeconomic deprivation and treated incidence (OR = 1.19) was also apparent but statistically

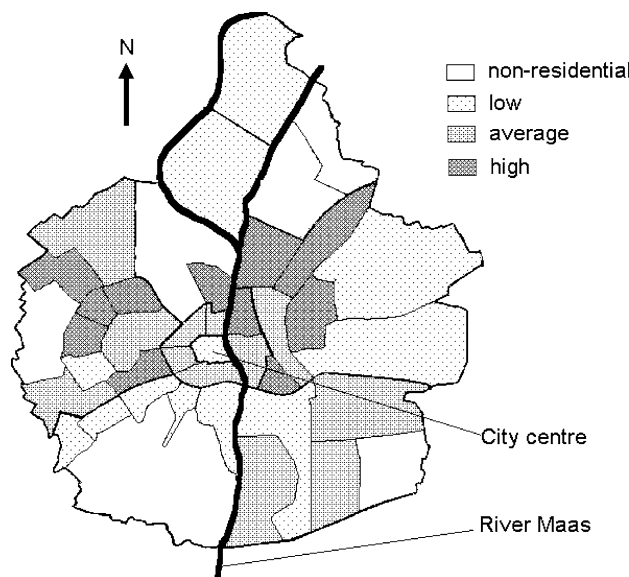


Fig. 1 Neighbourhood variation in socioeconomic deprivation

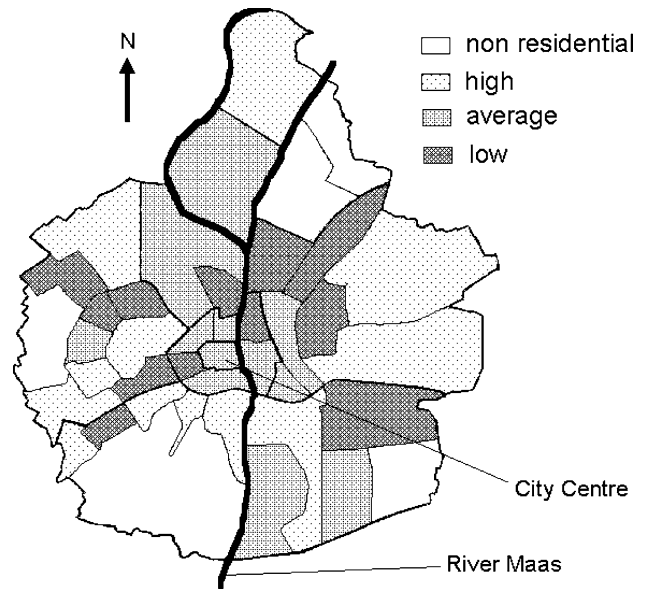


Fig. 2 Neighbourhood variation in informal social control (ISC)

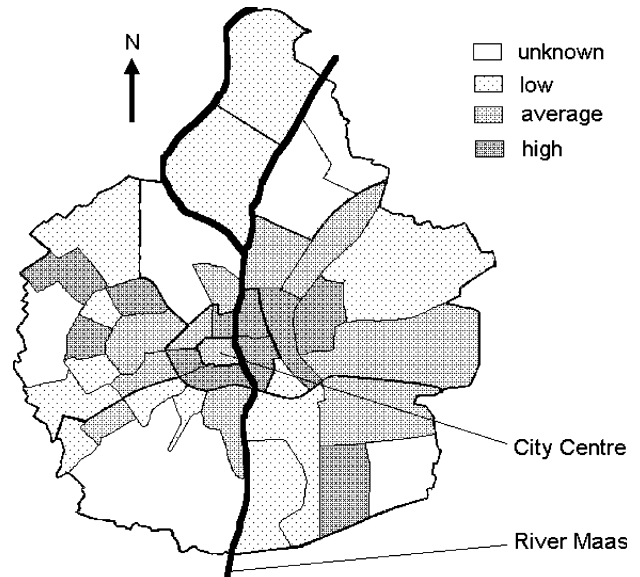


Fig. 3 Neighbourhood variation in incidence rates of schizophrenia (DSM IV diagnoses: 295 and 297)

imprecise by conventional alpha. However, when controlling for individual-level variables, the associations between socioeconomic deprivation, ISC and SC & T on the one hand and treated incidence rates on the other were reduced and non-significant. The association with residential instability was statistically imprecise by conventional alpha ( $p < 0.1$ ).

### Measures of individual socioeconomic status and schizophrenia rate

Persons who were not married (divorced, single or widowed) and persons who were unemployed had a



**Table 1** Means, standard deviations and Pearson correlation coefficients of neighbourhood variables

	Descriptives				Pearson correlations		
	<i>n</i>	Mean	SD	range	ISC	SC & T	Residential instability
Socioeconomic deprivation	35	0.00	1.00	−1.69–1.68	0.65 <sup>†</sup>	0.89 <sup>†</sup>	−0.00
ISC	36	29.10	1.86	24.54–32.79	1.00	0.68 <sup>†</sup>	0.04
SC & T	36	22.25	3.42	16.71–28.00		1.00	0.36*
Residential instability	35	0.00	1.00	−1.12–4.17			1.00

†*p* < 0.001, \*\**p* < 0.01, \**p* < 0.05

**Table 2** Description of individual-level variables in cases and controls (controls weighted to reflect distribution of the populations per neighbourhood)

	Cases (%)	Weighted controls (%)
<i>Gender</i>		
Female	34 (34.7%)	1883 (55.9%)
Male	64 (65.3%)	1483 (44.1%)
<i>Age group</i>		
20–30 years	32 (32.7%)	747 (22.2%)
30–40 years	25 (25.5%)	764 (22.7%)
40–50 years	24 (24.5%)	817 (24.3%)
50–65 years	17 (17.3%)	1041 (30.9%)
<i>Marital status</i>		
Married	11 (12.0%)	2362 (71.3%)
Single (never married)	61 (66.3%)	175 (5.3%)
Divorced	16 (17.4%)	713 (21.5%)
Widow/widower	4 (4.3%)	61 (1.8%)
<i>Education</i>		
Low	35 (48.6%)	827 (27.3%)
High	37 (51.4%)	2197 (72.7%)
<i>Employment</i>		
Employed	33 (36.7%)	2755 (88.9%)
Unemployed	57 (63.3%)	345 (11.1%)
<i>Living conditions</i>		
Family	26 (29.2%)	2309 (76.5%)
Single	48 (53.9%)	576 (19.1%)
Other	15 (16.9%)	132 (4.4%)
<i>Postal code socioeconomic status</i>		
Low	20 (30.8%)	522 (19.5%)
Low medium	18 (27.7%)	581 (21.7%)
Medium	10 (15.4%)	501 (18.7%)
High medium	9 (13.8%)	584 (21.8%)
High	8 (12.3%)	491 (18.3%)
Total	98 (100%)	3369 (100%)

higher risk of schizophrenia treated incidence than married persons and employed persons, respectively. On the other hand, low education was negatively associated with treated incidence of schizophrenia (also when not including other individual-level variables in the model). The results presented in the table including all socioeconomic status variables showed that lower socioeconomic status based on postal code was associated with a lower schizophrenia risk in a non-linear way, but this could be the result of collinearity. When only age, gender and socioeconomic status based on postal code were included, the association was linear, and the risk of schizophrenia was highest in the lowest three categories (OR = 2.5, 2.2 and 2.0, respectively, *p* < 0.05, cf. the highest category, data not shown).

**Table 3** Odds ratio's (OR) and 95% confidence Intervals (CI) of treated incidence of schizophrenia; multilevel logistic regression

98 cases/3369 controls	OR	CI
<i>Crude<sup>a</sup></i>		
Socioeconomic deprivation	1.19	0.97; 1.47
Informal social control <sup>b</sup>	1.13	0.90; 1.41
Social cohesion and trust <sup>b</sup>	1.29*	1.06; 1.57
Residential instability	1.35 <sup>†</sup>	1.03; 1.78
<i>Individual variables only<sup>c</sup></i>		
<i>Marital status</i>		
Married (reference)	1	
Single	71.95 <sup>†</sup>	22.42; 230.95
Divorced	46.39 <sup>†</sup>	9.63; 223.39
Widow/widower	41.22 <sup>†</sup>	7.87; 215.98
Low education	0.30 <sup>†</sup>	0.18; 0.52
Unemployed	11.13 <sup>†</sup>	6.62; 18.72
<i>Living conditions</i>		
Family or partner (reference)	1	
Single	0.14 <sup>†</sup>	0.05; 0.40
Other	0.42	0.11; 1.60
<i>Postal code socioeconomic status</i>		
High (reference)	1	
Low	0.45	0.18; 1.11
Low medium	0.45*	0.21; 0.96
Medium	0.73	0.34; 1.57
Higher medium	0.49	0.24; 1.01
<i>Neighbourhood variables controlled for individual-level confounders<sup>c</sup></i>		
Socioeconomic deprivation	0.88	0.66; 1.18
Informal social control <sup>b</sup>	0.90	0.70; 1.16
Social cohesion and trust <sup>b</sup>	0.93	0.71; 1.23
Residential instability	1.25	0.96; 1.63
<i>Two neighbourhood variables included jointly<sup>c</sup></i>		
Socioeconomic deprivation	0.91	0.67; 1.24
Informal social control	0.96	0.74; 1.23

†*p* < 0.001, \*\**p* < 0.01, \**p* < 0.0505

<sup>a</sup>Neighbourhood variation ( $\sigma^2_{\mu}$ ) in empty model: 0.100 (standard deviation = 0.124)

<sup>b</sup>Standardised before analyses (standard deviation = 1)

<sup>c</sup>The following individual-level variables were included the analyses: gender, age (in 10-year groups), marital status, education, employment, living conditions (family or partner, single, other), postal code socioeconomic status (quintiles)

## ■ Quantity of service consumption

Between 1988 and 1997, 343 incident cases were diagnosed with schizophrenia. On average, these cases were 150 days in an inpatient setting for psychiatric care (range 0–91% of the 5-year period) and accumulated 46 outpatient contacts (range 0–277 contacts) in the 5-year follow-up period (i.e. 260 weeks).

Crude analyses and analyses controlling for individual-level confounders showed that none of the

**Table 4** Associations between social variables (at neighbourhood and individual-level) and service consumption (natural logarithm) of cases; multilevel linear regression, bs and 95% Confidence Intervals (CI)

	Inpatient days (n = 159)	Outpatient contacts (n = 265)
<i>Crude analyses</i>		
Socioeconomic deprivation	0.16 (-0.16; 0.47)	-0.02 (-0.21; 0.17)
Informal social control <sup>a</sup>	-0.13 (-0.48; 0.23)	-0.01 (-0.22; 0.20)
Social cohesion and trust <sup>a</sup>	0.26 (-0.06; 0.58)	-0.00 (-0.19; 0.20)
Residential instability	0.24 (-0.13; 0.61)	0.09 (-0.11; 0.29)
<i>Individual variables only<sup>b</sup></i>		
Marital status		
Married (reference)	0	0
Divorced	0.16 (-0.51; 0.84)	-0.20 (-0.61; 0.22)
Single	-0.48 (-1.40; 0.44)	0.51 (-0.04; 1.06)*
Widow(er)	0.63 (-1.55; 2.80)	-0.00 (-0.91; 0.92)
Low education	0.00 (-0.54; 0.55)	-0.07 (-0.42; 0.28)
Unemployed	0.36 (-0.18; 0.90)	0.24 (-0.11; 0.59)
Living conditions		
Family or partner (reference)	0	0
Single	0.22 (-0.35; 0.79)	0.05 (-0.31; 0.41)
Other	0.51 (-0.24; 1.27)	-0.00 (-0.50; 0.49)
Postal code socioeconomic status		
High (reference)	0	0
Low	-0.51 (-1.51; 0.49)	-0.27 (-0.83; 0.29)
Low medium	-0.11 (-1.15; 0.92)	0.05 (-0.57; 0.66)
Medium	0.04 (-0.83; 0.91)	-0.33 (-0.86; 0.19)
High medium	0.18 (-0.64; 1.01)	-0.06 (-0.55; 0.43)
<i>Neighbourhood variables controlled for individual-level variables<sup>b</sup></i>		
Socioeconomic deprivation	0.14 (-0.18; 0.47)	-0.01 (-0.21; 0.18)
Informal social control	-0.19 (-0.56; 0.17)	-0.02 (-0.23; 0.20)
Social cohesion and trust	0.21 (-0.13; 0.55)	0.01 (-0.19; 0.20)
Residential instability	0.25 (-0.13; 0.64)	0.07 (-0.13; 0.28)
<i>Two neighbourhood variables included jointly<sup>b</sup></i>		
Socioeconomic deprivation	0.38 (-0.02; 0.78)	-0.01 (-0.25; 0.24)
Informal social control	-0.45 (-0.91; 0.002)	-0.01 (-0.29; 0.26)

†*p* < 0.001, \*\**p* < 0.01, \**p* < 0.05

<sup>a</sup>Standardised before analyses (standard deviation = 1)

<sup>b</sup>Controlled for individual-level confounders: Individual-level variables: gender, age (in 10-year groups), marital status, low education, unemployment, living conditions (family or partner, single, other) and, postal code socioeconomic status (quintiles)

neighbourhood variables were associated with quantity of inpatient or outpatient service consumption in patients diagnosed with schizophrenia (Table 4). However, ISC was associated with quantity of inpatient service consumption when controlling for neighbourhood socioeconomic deprivation albeit statistically imprecise by conventional alpha ( $\beta = -0.45, p = 0.05$ ): patients living in low ISC neighbourhoods (i.e. higher scores on the variable) had fewer inpatient days.

Patients aged above 40 years had fewer outpatient contacts than patients aged between 20 and 30 years. None of the individual socioeconomic status variables were associated with quantity of care consumption (Table 4).

## Discussion

### ■ Treated incidence rates

Although crude analyses showed statistically significant associations between neighbourhood factors and

treated incidence, all these associations were apparently explained by individual-level confounders. The results of socioeconomic disadvantage are in agreement with previous studies including a schizophrenia outcome [29, 32]. Studies on social capital and schizophrenia are scarce. An aggregate level study [33] reported a strong concentration of persons with schizophrenia in areas characterised by both socioeconomic disadvantage and weak social integration (social disorganisation). This is in agreement with results of our crude analyses, but aggregate level studies cannot take individual characteristics into account. A US multilevel study including individual socioeconomic status reported an association between neighbourhood residential instability and schizophrenia incidence rates [29], while the present results did not show such an association. This may be due to the fact that differences between Maastricht neighbourhoods are smaller [44, 45]. Unfortunately, studies on schizophrenia rates did not assess subjective measures of neighbourhood social capital. A previous Dutch multilevel study including all psychiatric service use (of which schizophrenia only represents a very small proportion) also did not show any effect of these social capital variables on treated incidence after controlling for confounders [25]. Thus, the present results do not provide evidence that neighbourhood social climate impacts on treated incidence of schizophrenia.

Individual-level variables were associated with treated incidence of schizophrenia: most factors related to the concept of socioeconomic status were risk factors, except for education that displayed an association in the opposite direction. Once patients are in contact with mental health services, there is no association between individual-level variables and the quantity of service consumption.

Thus, the present results suggest that it is the individual socioeconomic status that impacts on schizophrenia, while the neighbourhood social environment is only associated with treated incidence because it is a proxy of individual socioeconomic status. This suggests that the use of neighbourhood and individual-level socioeconomic status as interchangeable entities as was done in the early studies may be warranted [2–5]. In addition, associations with individual-level variables of socioeconomic status are inconsistent, even within the present study. Not only, low socioeconomic status, but also higher educational levels were associated with higher treated incidence. This may indicate a premorbid drift down the social ladder as a consequence of the developmental manifestations of the disease, as has been suggested previously [46]. However, schizophrenia is also associated with premorbid cognitive deficits that prevent individuals from reaching their potential [47, 48] making a primary association between schizophrenia and higher educational level improbable. One explanation may be that educational level may be particularly important in accessing services, such that

lower educated patients may experience more barriers in accessing mental health care services [49].

### ■ Quantity of service consumption of patients diagnosed with schizophrenia

The results showed that the number of inpatient contacts was higher in neighbourhoods high in ISC (after controlling for socioeconomic deprivation). Previously, ISC has been associated with quantity of outpatient service consumption of psychiatric patients (all diagnoses) [25]. When the analyses of this previous paper were post hoc repeated excluding the patients diagnosed with schizophrenia, this yielded very similar results. Thus, while informal social control may favour more outpatient service consumption in patients not diagnosed with schizophrenia (who have little inpatient service consumption), it appears to contribute to more inpatient service consumption when the patient is diagnosed with schizophrenia (associated with more inpatient service consumption). These associations may be the result of interventions by neighbours, residents of neighbourhoods with higher levels of social control possibly seeking greater levels of resolution of psychiatric disorder in patient-residents, and by consequence inducing greater levels of service consumption before community reintegration may be attempted [25]. The present results support this hypothesis, with the type of care being dependent on whether the disorder is less severe (more outpatient service consumption) or more severe (more inpatient service consumption).

### ■ Methodological issues

The two domains for analysis included in the present paper, treated schizophrenia incidence rates as well as quantity of in- and out-patient service consumption of patients diagnosed with schizophrenia were measures of service consumption and as such cannot be taken to represent the full spectrum of clinical outcome measures. Therefore, the presented associations can be the result of an increase in psychopathology or of an increase in service consumption due to other reasons, such as changes in social circumstances. The present paper cannot disentangle these two possibilities; nevertheless, service consumption by itself is an important dimension of outcome.

Although the MQoL neighbourhoods are widely used and ecologically meaningful geographical units, neighbourhood residents may perceive different boundaries to their neighbourhood. Therefore, methods of a previous study [50] were adapted and respondents of a relatively small convenience sample of individuals living in Maastricht ( $n = 23$ ), were asked to draw what they believed were the boundaries of their neighbourhood. Results showed that bound-

aries differ per person, and therefore perceived neighbourhoods cannot be used when studying the neighbourhood [51]. However, the not directly measurable, perceived neighbourhoods could be aggregated to the larger defined neighbourhoods, because boundaries of perceived neighbourhoods generally do not cross the boundaries of defined neighbourhoods. Associations in smaller areas will be even larger than the reported associations [51].

Based on previous research [38, 52], an interaction effect between neighbourhood socioeconomic deprivation and residential instability was hypothesised, and a recent study in which patients with all classes of psychiatric diagnoses were studied did show an association between socioeconomic disadvantage and quantity of service consumption in residential stable neighbourhoods only [25]. In the present analyses, analysing the subgroup of patients diagnosed with psychosis, there was no evidence for such an interaction.

The present paper has some limitations. First, because controls were interviewed in the year 2000, only cases that were incident between 1998 and 2002 (a 5-year period) were included in the analyses on treated incidence (i.e. 98 patients). Therefore, not finding any effect may be the result of low power. However, a previous case-control study in children including 56 cases and 206 controls did show effects of neighbourhood socioeconomic deprivation [53]. When calculating sample sizes in multilevel analyses, sample sizes of unilevel analyses need to be multiplied by a factor which depends on the intra class correlation and the number of observations per macro unit [39]. Using this multiplication factor, the unilevel equivalent of the sample size of the present study (3467) was calculated as 980. Unilevel analyses with a sample size of 980 and a prevalence in the data of 0.028 (98/3467) have a power of 90, 85, 80 and 70% to show an association when the odds ratio is 2.15, 2.0, 1.9 and 1.75, respectively [54, 55].

Second, incident cases were defined as the persons who did not have (known) contacts with mental health services for at least 5 years. Therefore, patients who had been in care somewhere outside the region who recently moved to the city of Maastricht were wrongfully classified as incident cases. This could have resulted in a slight overestimation of the incidence rates in all neighbourhoods. In addition, new Maastricht residents are more likely to settle in a neighbourhood with a higher residential turnover. However, it is unlikely that results are substantially biased, because migration rates are relatively low. In 2000, 5% of the population were new residents of the city of Maastricht. Since approximately one-fifth [56] of Maastricht new residents originate from the surrounding areas of Maastricht, the population that could have been misclassified as incident cases was approximately 4%.

For the first research question MLwiN was used because Stata has no routines to handle different

weights within one macro level unit (controls were weighted to reflect the distribution of neighbourhoods, and cases all had a weight of 1). The MLwiN multilevel logistic regression procedure can model four different estimation methods. We chose second order PQL (Penalised Quasi Likelihood), because this method has been reported to produce unbiased estimates [41, 42].

Variance at the neighbourhood-level was low in all analyses. However, neighbourhood researchers tend to analyse neighbourhood effects, even when the neighbourhood variation is low, and it is generally held that this is warranted [57].

Finally, socioeconomic and demographic variables had missing values. The percentage of missing values was highest in the cases, because the care-givers who should supply this information were not always accurate, with the result that missing data status depended on the case-control status. However, we assumed that the data were missing at random (MAR). Therefore, we could impute the missing data using information on case-control status and all other individual-level variables available. Analyses where missing values were imputed and analyses where missing values were deleted list-wise, yielded similar results. Additionally, sensitivity analyses were conducted using the Stata HOTDECK procedure. This procedure is used several times within a multiple imputation sequence since missing data are imputed stochastically rather than deterministically. For both research questions, five imputation sequences were run, yielding five data sets in which the analyses presented in the current paper were repeated. For the first analyses, the HOTDECK imputation was stratified by case-control status and age category; for the second research question the HOTDECK imputation was stratified by gender and marital status. Results were similar to the results presented in the current paper.

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## Appendix: translation of the Dutch ISC and SC & T items

### 1) ISC

What is the likelihood that your neighbours can be counted on to intervene in the following situations: (very likely, likely, neither likely nor unlikely, unlikely, very unlikely)?

- a. If neighbours throw out garbage on the street (added item)
- b. If one of the houses constantly produces noise pollution (added item)
- c. If children were skipping school and hanging out on the street corner (original item)
- d. If children get into mischief, are being naughty (added item)
- e. If children were spray-painting graffiti on a local building? (original item)
- f. If children were showing disrespect to an adult? (original item)
- g. If children were showing disrespect to an elderly person (added item)
- h. If a fight broke out in front of their house? (original item)
- i. If the fire station closest to their home was threatened with budget cuts (in Dutch not the fire station but the ambulance)
- j. If someone is planning to open a sex club (added item)

ISC all items

### 2) SC & T

How strongly do you agree or disagree with the following statements? (a 5-point Likert scale from strongly agree to strongly disagree)

- a. People are willing to help their neighbours (original item)
- b. This is a close-knit neighbourhood (original item)
- c. People in this neighbourhood can be trusted (original item)
- d. People in this neighbourhood generally do not get along with each other (original item)
- e. People in this neighbourhood do not share the same values (original item)
- f. Children in this neighbourhood are close-knit
- g. Children in this neighbourhood are heading for trouble
- h. Children in this neighbourhood play together a lot
- i. This neighbourhood is unsafe for children (traffic)
- j. I do not send my children to the neighbourhood school
- k. There are many children in this neighbourhood which I do not want my child to play with

SC & T: items a-h, j and k

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