ORIGINAL ARTICLE

Prevalence of Psychotic Disorder and Community Level of Psychotic Symptoms

An Urban-Rural Comparison

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Background: Urban and rural populations have different rates of psychotic illness. If psychosis exists as a continuous phenotype in nature, urban-rural population differences in the rate of psychotic disorder should be accompanied by similar differences in the rate of abnormal mental states characterized by psychotic or psychosislike symptoms.

Methods: A random sample of 7076 individuals aged 18 to 64 years were interviewed by trained lay interviewers with the Composite International Diagnostic Interview. Approximately half of those with evidence of psychosis according to the Composite International Diagnostic Interview were additionally interviewed by clinicians. We investigated associations between a 5-level urbanicity rating and (1) any *DSM-III-R* diagnosis of psychotic disorder (sample prevalence, 1.5%), (2) any rating of hallucinations and/or delusions (sample prevalence, 4.2%), and (3) any rating of psychotic or psychosislike symptoms (sample prevalence, 17.5%).

Results: Level of urbanicity was associated not only with *DSM-III-R* psychotic disorder (adjusted odds ratio [OR] over 5 levels, 1.47; 95% confidence interval [CI], 1.25-1.72), but also, independently, with any rating of delusion and/or hallucination (adjusted OR, 1.28; 95% CI, 1.17-1.40; clinician-assessed psychotic symptoms only: OR, 1.30; 95% CI, 1.03-1.64) and any rating of psychosislike symptom (adjusted OR, 1.18; 95% CI, 1.13-1.24). Psychotic symptoms were strongly and independently associated with psychotic disorder, regardless of the level of urbanization.

Conclusions: Community level of psychotic and psychosislike symptoms may be inextricably linked to the prevalence of psychotic disorder. The prevalence of abnormal mental states that facilitate development to overt psychotic illness increases progressively with level of urbanization.

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SOME RISK FACTORS for psychotic illness can be used to define populations with different levels of risk. For example, exposure to urban birth, upbringing, or residence increases the risk for later psychotic illness, suggesting that urban and rural populations have different lifetime risks.[1-4] A plausible explanation for the urban-rural differences is that environmental factors associated with urban life make individuals more vulnerable to the development of psychotic states.

The factors that increase the risk for psychotic disorder in urban areas may contribute to a much larger pool of preclinical psychotic experiences, of which only a small proportion may continue to result in overt disorder. This hypothesis would be compatible with the suspected multifactorial origin of psychotic disorders, according to which it is unlikely that any multifactorial disease exists as a purely dichotomous entity in nature without less severe, nonpathologic manifestations of the phenotype.[5] It is also compatible with accumulating evidence that schizotypal signs and psychosislike symptoms such as delusional ideation and isolated hallucinations are prevalent in the general population[6-9] and show longitudinal,[10-12] neuropsychological,[13] psychopathologic,[14] familial,[15] neuroradiologic,[16,17] epidemiologic,[6,18] and risk factor[19] continuities with clinical psychotic syndromes such as schizophrenia. All of these data suggest that, at the level of the general population, lesser psychotic states exist that are associated with the more severe clinical disorders that necessitate hospital admission.

Given these continuities, it is attractive to hypothesize that the higher level of psychotic disorders in urban areas is accompanied by a similar increase in the level of psychosislike symptoms. Population studies of minor psychiatric disorders

SUBJECTS AND METHODS

SUBJECTS

The Netherlands Mental Health Survey and Incidence Study is a prospective study with 3 measurement points during a period of 3 years.[22-24] The current report is based on the baseline data. A multistage, stratified, random sampling procedure was used to select first 90 municipalities, then a sample of private households, and finally a Dutch-speaking individual aged 18 to 64 years within each household. Selected households were sent an introductory letter by the Minister of Health, inviting them to participate. A total of 7076 individuals provided informed consent and were interviewed at baseline, representing a response rate of 69.7%. Nearly 44% of nonresponders agreed to complete a mailed questionnaire, including a General Health Questionnaire,[25] and were found to have the same mean score on the questionnaire (responders, 1.19; nonresponders, 1.16). Nonresponse was not associated with level of urbanicity.[22,23] The sample was representative of the Dutch population in terms of sex, marital status, and level of urbanization,[23] with the exception of a slight underrepresentation of individuals in the age group 18 to 24 years. As this was a study of relative rather than absolute risk, no poststratification weightings were applied to the data.

INSTRUMENTS

Subjects were interviewed at home. The Composite International Diagnostic Interview (CIDI) version 1.1[26-28] was used, yielding *DSM-III-R* diagnoses. The CIDI was designed for trained interviewers who are not clinicians and has high interrater reliability[29,30] and high test-retest reliability.[31-33] Ninety interviewers experienced in systematic data collection gathered the data, having received a 3-day training course in recruiting and interviewing, followed by a 4-day course at the World Health Organization–CIDI training center in Amsterdam, the Netherlands. Extensive monitoring and quality checks took place throughout the entire data collection period.[23]

PSYCHOSIS RATINGS

Lifetime ratings from the 17 CIDI core psychosis sections on delusions (13 items) and hallucinations (4 items) were used (items G1-G13, G15, G16, G20, and G21). These concern classic psychotic symptoms involving, for example, persecution, thought interference, auditory hallucinations, and passivity phenomena. All of these items can be rated in 6 ways: 1, no symptom; 2, symptom present but not clinically relevant (not bothered by it and not seeking help for it); 3, symptom the result of ingestion of drugs; 4, symptom the result of somatic disease; 5, true psychiatric symptom; and 6, may not really be a symptom because there appears to be some plausible explanation for it. Because psychotic symptoms are difficult to diagnose in a structured interview,[34-36] clinical reinterviews were conducted over the telephone by an experienced trainee psychiatrist for all individuals who had at least 1 rating of 5 or 6, using questions from the Structured Clinical Interview for *DSM-III-R*, an instrument with proved reliability and validity in diagnosing schizophrenia.[37] The CIDI ratings were corrected on the basis of these clinical interviews, and the Netherlands Mental Health Survey and Incidence Study *DSM-III-R* diagnoses of psychotic disorder are based on the data from these clinical reinterviews.

To examine the validity of the contrasts implied in the different CIDI ratings, associations were compared between the ratings and lifetime mental health service use (see below) and quality of life measured with the 36-item Short Form Health Survey quality-of-life schedule.[38,39]

Psychotic disorder was defined as any *DSM-III-R* affective or nonaffective psychotic diagnosis. *Psychotic symptom*

have shown that the prevalence of disorder is linearly related to the mean number of psychiatric symptoms.[20,21] A similar relationship between symptoms and disorder may exist in psychosis.

In the current study, we investigated to what degree the increase in risk for psychotic disorder associated with urban life is reflected in similar increases in the mean number of psychotic and psychosislike symptoms. We hypothesized that the mean level of symptoms would increase with the rate of disorder across increasingly urbanized areas. In addition, we hypothesized that the association between symptoms and disorder would be constant across the populations in the different strata, suggesting variation of susceptibility between populations rather than within populations.[20] For example, if the rate of some rare psychotic disorder is higher in population A than in population B, whereas their levels of more prevalent psychotic symptoms are the same, a likely explanation is that (1) some rare cause of a rare disorder is more prevalent in population A and (2) psychosislike experiences in the population are qualitatively distinct from the disorder. Thus, populations A and B are essentially similar, except for the distribution of some rare cause affecting a few individuals. There is variation within populations. If, however, not only the rate of disorder, but also the rate of symptoms, is higher in population A than in population B, a likely explanation would be that (1) the population level of vulnerability differs between population A and population B and (2) the psychosislike experiences are, at least in part, on a quantitative continuum with disorder. A graphic representation of this argument, using hypothetical data, is depicted in the **Figure**.

RESULTS

The sample consisted of 7076 individuals (46.6% male) with a mean age of 41.2 years (SD, 12.2). There were 936 individuals (13.2%) who were foreign-born or whose father or mother was foreign-born. The prevalences of the different CIDI ratings on the 17 psychosis items were as follows: any CIDI rating of 2, n=915 (12.9%); any CIDI rating of 3 or 4, n=39 (0.6%); any CIDI rating of 5, n=295 (4.2%); and any CIDI rating of 6, n=285 (4.0%). After

was defined as any CIDI rating of 2, 3, 4, 5, or 6 on any of the 17 CIDI core psychosis items. A previous study showed that all 5 of these ratings on the CIDI psychosis items were strongly associated with each other, including the clinical reinterview ratings of psychotic symptom (ie, a rating of 5 on any of the CIDI psychosis items). In addition, the 5 ratings independently showed a similar pattern of associations with known risk factors for psychosis.[19] As they therefore appear to reflect the same underlying latent dimension of "psychosis," they were joined into a single broad rating of *psychotic symptom* for the purpose of the current study. To check on the validity of this procedure, associations were also examined with "psychotic symptom" narrowly defined as a clinical reinterview rating of psychosis (ie, a rating of 5 on any of the CIDI psychosis items).

LEVEL OF URBANICITY

Five levels of urbanization were defined, following the standard classification of urbanization of place of residence according to the Dutch Central Bureau of Statistics. These are based on the density of addresses per square kilometer in an area and are classified as less than 500, 500 to 999, 1000 to 1499, 1500 to 2499, and 2500 or more. This density is calculated by assessing the density of addresses in a circle of 1 km around each address. The density of addresses in an area is then calculated as the mean address density of all the addresses in that area.[40]

DATA ANALYSES

The lifetime prevalences of at least 1 psychotic symptom, broadly and narrowly defined, and of any psychotic disorder were examined in relation to level of urbanicity of place of residence, adjusted for the a priori selected possible confounding effects of age in years, sex, level of education (4 levels), and country of birth of subject, subject's mother, and subject's father (coded Dutch-born, foreign-born, and information missing).

To assess the independence of any associations with urbanicity in the different symptom groups, associations were also examined after exclusion of individuals with psychotic disorder from the group with narrowly defined psychotic symptoms, and after exclusion of individuals with psychotic disorder and individuals with narrowly defined psychotic symptoms from the group with broadly defined psychotic symptoms.

To examine the possible effects of selective "drift" of mental health patients toward urban areas, we also looked for interactions with lifetime history of mental health care (any contact with community mental health center, psychiatric outpatient clinic, private psychiatrist, psychologist, or psychotherapist, or any psychiatric admission or day treatment; n=1352). Logistic regression yielding odds ratios (ORs) and 95% confidence intervals (CIs)[41] was used to examine associations between psychotic disorder on the one hand, and psychotic symptoms broadly and narrowly defined (coded 0, 1, 2, 3, 4, and 5 or more symptoms) on the other, at different levels of urbanicity. Interactions were assessed by likelihood ratio (LR) tests.[42]

SENSITIVITY ANALYSES

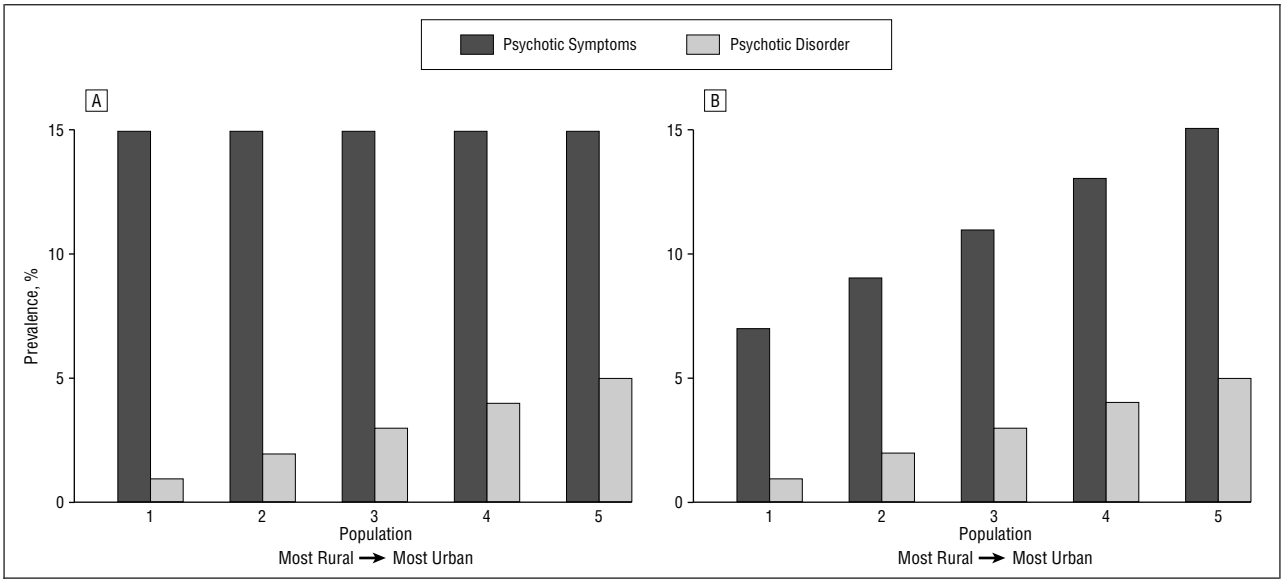
Of the 479 individuals who were eligible for a clinical reinterview over the telephone, 226 (47.2%) were actually interviewed. Successful reinterview was not associated with level of urbanicity (OR, 0.91; 95% CI, 0.79-1.04). Of a possible $226 \times 17 = 3842$ CIDI ratings of psychotic symptoms in the 226 individuals who were reinterviewed, changes after clinical reinterview were introduced in 266 ratings (6.9%). Change of CIDI rating was not associated with level of urbanicity (OR, 0.95; 95% CI, 0.86-1.04). Sensitivity analyses representing the possible extremes of clinical reinterview were performed to examine whether differential clinical reinterview rates could have biased the results.

adjustment for age, sex, ethnic group, educational level, level of urbanicity, and presence of any psychotic or nonpsychotic *DSM-III-R* diagnosis, all but one of the different CIDI ratings were independently (assessed by entering them together in the model) associated with a lifetime history of mental health service (rating 2: OR, 0.99; 95% CI, 0.82-1.19; rating 3 or 4: OR, 2.65; 95% CI, 1.30-5.44; rating 5: OR, 4.19; 95% CI, 3.23-5.44; rating 6: OR, 3.12; 95% CI, 2.39-4.06), and all were associated with a lower quality-of-life total score measured with the quality-of-life schedule of the 36-item Short Form Health Survey (rating 2: multiple regression coefficient B=–1.99; 95% CI, –3.24 to –0.75; rating 3 or 4: B=–6.78; 95% CI, –12.25 to –1.13; rating 5: B=–6.79; 95% CI, –8.94 to –4.63; rating 6: B=–3.09; 95% CI, –5.25 to –0.94).

The lifetime prevalence of *DSM-III-R* schizophrenia, schizoaffective psychosis, and schizophreniform disorder was 0.37% (26 cases), and the lifetime prevalence of affective psychosis (major depression or bipolar disorder with psychotic features) was 1.14% (81 cases), making a total of 107 cases (1.51%). The prevalence of psychotic symptoms broadly defined was 17.5% (n=1237), and the prevalence of psychotic symptoms narrowly defined was 4.2% (n=295).

PSYCHOSIS IN RELATION TO URBANICITY

The lifetime prevalences of *DSM-III-R* psychotic disorder, psychotic symptoms narrowly defined, and psychotic symptoms broadly defined increased in a monotonic fashion with level of urbanicity. Adjustment for age, sex, level of education, and country of birth of subject and parents changed the parameters only by a small amount (**Table 1**). Associations also remained after exclusion of individuals with psychotic disorder from the group with narrowly defined psychotic symptoms, and after exclusion of individuals with psychotic disorder and individuals with narrowly defined psychotic symptoms from the group with broadly defined psychotic symptoms (Table 1). There was no interaction with lifetime mental health treatment for any of the 3 groups (LR test psychotic disorder: $\chi^2_1=0.05$, $P=.83$; LR test narrowly defined: $\chi^2_1=0.21$, $P=.64$; LR test broadly defined: $\chi^2_1=0.00$, $P=.98$).



A, In this scenario, the prevalence of psychotic disorder increases in populations living in progressively more urbanized areas, but the prevalence of symptoms remains constant. This suggests that there is no continuity between symptoms and disorder. B, In this scenario, the prevalence of symptoms increases simultaneously with the prevalence of symptoms. If it can be shown additionally that symptoms are associated with disorder in each population, the situation in this graph suggests that symptoms are continuous with the disorder.

Table 1. Sample Prevalences of Psychotic Disorder and Narrowly and Broadly Defined Psychotic Symptoms in Relation to Urbanicity*

				Psychotic Symptoms			
		Any Psychotic Disorder		Narrow Definition†		Broad Definition†	
Area Address Density/km²	No. Interviewed	No. (%)	OR (95% CI)	No. (%)	OR (95% CI)	No. (%)	OR (95% CI)
<500	1185	7 (0.59)	1‡	28 (2.36)	1‡	163 (13.76)	1‡
500-999	1610	15 (0.93)	1.58 (0.64-3.89)	45 (2.80)	1.19 (0.74-1.92)	223 (13.85)	1.01 (0.81-1.25)
1000-1499	1541	23 (1.49)	2.55 (1.09-5.96)	69 (4.48)	1.94 (1.24-3.03)	262 (17.00)	1.28 (1.04-1.59)
1500-2499	1497	28 (1.87)	3.21 (1.40-7.37)	82 (5.48)	2.40 (1.55-3.70)	303 (20.24)	1.59 (1.29-1.96)
≥2500	1242	34 (2.74)	4.74 (2.09-10.73)	71 (5.72)	2.51 (1.61-3.91)	286 (23.03)	1.88 (1.52-2.32)
OR linear trend§		1.44 (1.24-1.68), $P<.001$		1.28 (1.17-1.40), $P<.001$		1.19 (1.14-1.25), $P<.001$	
Adjusted OR linear trend‖		1.47 (1.25-1.72), $P<.001$		1.28 (1.17-1.40), $P<.001$		1.18 (1.13-1.24), $P<.001$	
Adjusted OR with nonoverlapping outcomes¶		NA		1.19 (1.06-1.32), $P=.002$		1.16 (1.10-1.22), $P<.001$	

*OR indicates odds ratio; CI, confidence interval; and NA, not applicable.
†For explanation see the "Psychosis Ratings" subsection of the "Subjects and Methods" section.
‡Reference category.
§The summary increase in risk with 1-unit change in address density.
‖For explanation see the "Data Analyses" subsection of the "Subjects and Methods" section.
¶Adjusted as above, and excluding individuals with any psychotic disorder from the analysis with narrow psychotic symptoms, and excluding individuals with any psychotic disorder and narrow psychotic symptoms from the analysis with broad psychotic symptoms.

SENSITIVITY ANALYSES

The following analyses were conducted. First, we repeated the analyses of association between urbanicity and the 3 groups of symptom ratings, adjusted for age, sex, level of education, and country of birth of subject and parents, excluding the 253 individuals who were eligible for clinical reinterview but who were not interviewed. Second, we repeated the same analyses restricted to the group who were interviewed by the psychiatric trainees (n=226). Third, we repeated the analyses assuming that all individuals who were eligible for reinterview, but were not reinterviewed, would have received a rating of 5 (true symptom) on all CIDI psychosis items if they had been reinterviewed. Finally, we repeated the same analyses assuming that these individuals would have received a rating of 1 (no symptom) on all ratings. The pattern of results for all these analyses was the same and was similar to the results in Table 1 (**Table 2**).

ASSOCIATIONS BETWEEN SYMPTOMS AND DISORDER AT DIFFERENT LEVELS OF URBANICITY

Psychotic symptoms, broadly and narrowly defined, were strongly associated with psychotic disorder (broadly defined: summary OR over 6 levels, 3.59; 95% CI, 3.17-4.06; narrowly defined: OR, 6.96; 95% CI, 5.57-8.68). The association between psychotic disorder and broadly de-

Table 2. Sensitivity Analysis

Sensitivity Analysis*	Adjusted* Odds Ratio Linear Trend (95% Confidence Interval)†		
	Psychotic Disorder	Psychotic Symptom, Narrow Definition	Psychotic Symptom, Broad Definition
Exclusion of individuals missed for reinterview	1.54 (1.26-1.89)	1.32 (1.16-1.51)	1.19 (1.13-1.26)
Restriction to individuals who were interviewed by psychiatrist	1.34 (1.04-1.74)	1.30 (1.03-1.64)	1.15 (0.88-1.52)
Assuming all CIDI psychosis items of individuals missed at reinterview would have been rated "5"	1.35 (1.19-1.53)	1.21 (1.12-1.31)	1.19 (1.14-1.25)
Assuming all CIDI psychosis items of individuals missed at reinterview would have been rated "1"	1.54 (1.26-1.88)	1.32 (1.15-1.50)	1.18 (1.12-1.25)

*See the "Sensitivity Analyses" subsection of the "Subjects and Methods" section for explanation. CIDI indicates Composite International Diagnostic Interview.
†The summary increase in risk with 1-unit change in address density.

fined psychotic symptoms remained after adjustment for presence of narrowly defined psychotic symptoms (adjusted OR, 2.29; 95% CI, 1.93-2.73), indicating that broadly defined symptoms were associated with psychotic disorder independent of their association with narrow symptoms. There was no evidence that this association differed as a function of urbanicity (LR test broadly defined: $\chi^2_4=4.20$, $P=.38$; LR test narrowly defined: $\chi^2_4=4.51$, $P=.34$), or if the sample was restricted to those who had had clinical reinterviews (n=226; $P=.54$ and $P=.95$, respectively).

COMMENT

In a representative sample of 7076 subjects sampled from the general population, lifetime level of psychotic and psychosislike symptoms independently increased with level of urbanicity in the same manner as did *DSM-III-R* psychotic disorder. Initial response rate, clinical reinterview response rate, and change rate of CIDI psychosis items after clinical reinterview were not associated with level of urbanicity. At all levels of urbanicity, psychosislike symptoms were strongly associated with psychotic disorder. These findings therefore suggest that the increased prevalence of psychotic disorder in urban environments should be interpreted in light of increased levels of "psychosis proneness" in urban populations.

More generally, the results suggest that there is a link between community level of psychotic symptoms and rates of clinical disorder. As the association between symptoms and disorder did not differ as a function of urbanicity, the implication is that susceptibility to psychotic disorder varies between populations and can be demonstrated by comparing rates of psychosislike phenomena. Given that the rates of these phenomena are much higher than those for rare psychotic disorders, etiologic research may be served by focusing on these related phenotypes. Similarly, preventive action may be served by population interventions rather than, or in addition to, the high-risk strategies that are currently being explored.

The high rates of psychotic illness in urban environments may be the result of the influence of environmental factors. As the urban effect appears to have its impact during urban upbringing rather than during adult residence per se,[1,3] developmental mechanisms ought to be considered. A possible developmental mechanism whereby social factors may create enduring liabilities for adult psychosis are the effects of the wider social environment, such as the neighborhood environment, on child and adolescent development.[43] Mental states are reactive to experience, and differences in the level of deprivation and social isolation of the neighborhood environment in urban areas have been shown to be associated with variation in a range of mental health outcomes from problem behavior in children[44] to incidence of neurosis and schizophrenia.[45,46] High levels of deprivation and low levels of social capital[47] in the wider social environment may enhance the development of "at-risk" mental states that in turn may facilitate the onset of clinical psychosis in adult life.

These results should be viewed in light of several possible limitations. First, we examined lifetime rates of disorder and symptoms in relation to current urban residence. Thus, one explanation for the findings is that symptomatic individuals could have "drifted" to urban areas. Although we cannot exclude this mechanism, a previous report by our group found that there was a high degree of lifetime stability of urban exposure status (around 75% of individuals living in urbanized areas had also been born there), indicating that current exposure is likely to reflect stable lifetime exposure in most cases.[3] In addition, the association between psychosis and urbanicity did not differ as a function of lifetime mental health patient status. This suggests that it is unlikely that the findings can be explained solely by a process of urban drift of the most symptomatic individuals, in which case one would have expected associations to be stronger in the patient group. Second, the validity of the CIDI ratings of psychosis, such as a rating of 2 (symptom present but not clinically relevant) is not well researched. However, the associations with lifetime mental health service contact (no association with rating of 2 and significant associations with other ratings, especially rating of 5 for true psychotic symptom) and lower quality of life (weakest for rating of 2 and strongest for rating of 5), independent of each other and of any lifetime *DSM-III-R* diagnosis, provided some degree of validity for the conceptual contrast of the ratings as well as for their existence independent of psychiatric disorder. Third, psychotic symptom ratings were assessed by lay interviewers (CIDI ratings of 1, no symptom; 2, symptom present but not clinically relevant; 3, symptom the result of ingestion of drugs; and 4, symptom the result of somatic disease), whereas the other CIDI ratings (5, true psychiatric symptom; and 6, may not really be a symptom because there appears to be some plausible explanation for it) were as-

sessed by clinicians through telephone interviews in approximately 50% of eligible cases. Although the sensitivity analyses showed that incomplete rates of reinterview by clinicians are unlikely to have biased the results, it is likely that, especially with lay interviewer ratings,[1-4] a degree of misclassification did occur. However, for misclassification to explain the results, one would have to hypothesize that with greater degrees of urbanization, interviewers became progressively more likely to misclassify in one specific direction, and, furthermore, this influence of misclassification would have had to be the same for lay interviewers and clinicians. Although this cannot be excluded, it is unlikely, also because the rate of change in CIDI ratings after clinician reinterview was not associated with urbanicity and because the findings were similar when the sample was restricted to those who had been interviewed by a clinician.

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