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URBANICITY AND MENTAL HEALTH IN EUROPE

A Systematic Review

Urbanicity has been described as a risk factor for mental disorders. Findings differ across countries and psychiatric outcomes. Our aim was to systematically review quantitative studies of the relationship between urbanicity and prevalent mental disorders in Europe. EBSCOhost and PubMed databases were searched for epidemiological studies of European populations, published in English between January 2002 and October 2012, using the combination of keywords (urban* OR environment*) AND (mental health OR mental disorder OR psych*). The eleven studies included in the review used different measures of urbanicity. The types of mental disorders most often examined, on which we focus in the review, were mood and anxiety disorders, psychosis, and substance use disorders. Seven out of nine studies reported more mood and anxiety disorders in some of the urban areas compared to rural areas. Two out of three studies indicated higher rates of psychosis in some more urbanised areas. Four out of six studies found more substance abuse with increased urbanicity. The same studies neither found any evidence for a relationship between urbanicity and mental disorders in several instances, and a lower prevalence of anxiety disorders in Belgian medium-sized cities compared to rural areas. Living in European cities can be a risk factor for mood and anxiety disorders, psychotic disorders, and substance abuse. More research is needed to understand which urban environment characteristics cause mental disorders.

Keywords: anxiety disorder, Europe, mental disorder, mental health, mood disorder, psychosis, substance abuse, systematic review, urbanicity, urbanisation

Urbanisierung und psychische Gesundheit in Europa: Eine systematische Übersichtsarbeit: Urbanisierung ist als Risikofaktor für psychische Störungen beschrieben worden. Die Forschungsergebnisse sind je nach Land und psychiatrischen Folgen unterschiedlich. Unsere Zielsetzung war, einen systematischen Überblick über quantitative Studien zum Zusammenhang zwischen Verstädterung und häufigen psychischen Störungen in Europa zu geben. Die Datenbanken EBSCOhost und PubMed wurden nach epidemiologischen Studien in der europäischen Bevölkerung durchsucht,

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welche zwischen Januar 2002 und Oktober 2012 in englischer Sprache veröffentlicht worden sind. Es wurde die Verknüpfung der Schlüsselwörter (urban* OR environment*) AND (mental health OR mental disorder OR psych*) benutzt. Die elf in die Übersichtsarbeit einbezogenen Studien wandten unterschiedliche Messgrößen für Urbanisierung an. Die am häufigsten untersuchten Arten von psychischen Störungen, auf die wir uns in der Übersichtsarbeit konzentrieren, waren affektive Störungen und Angststörungen, Psychosen und Suchterkrankungen. Sieben von neun Studien berichteten ein höheres Ausmaß an affektiven Störungen und Angststörungen in einigen stärker verstädterten Gebieten, welche mit ländlichen Gebieten verglichen wurden. Zwei von drei Studien zeigten höhere Raten von Psychosen in manchen städtischen Gebieten. Vier von sechs Studien fanden mit zunehmender Verstädterung mehr Substanzmissbrauch. Dieselben Studien fanden auch mehrfach keine Anhaltspunkte für eine Beziehung zwischen Urbanisierung und psychischen Störungen, sowie eine geringere Prävalenz von Angststörungen in mittelgroßen belgischen Städten im Vergleich zu ländlichen Gebieten. In europäischen Städten zu leben kann ein Risikofaktor für affektive Störungen und Angststörungen, psychotische Störungen und Substanzmissbrauch sein. Weitere Forschung ist notwendig, um zu verstehen, welche Eigenschaften eines städtischen Umfeldes psychische Störungen verursachen.

Schlüsselwörter: Angststörung, Europa, psychische Störung, psychische Gesundheit, affektive Störung, Psychose, Substanzmissbrauch, systematische Übersichtsarbeit, Urbanisierung, Verstädterung

1. Introduction

The United Nations predict that the vast majority of the human population will live in urban rather than rural areas by 2030, which is already the case in Europe and North and Latin America (UN-HABITAT 2010). The consequences of urbanisation go beyond the demographic shift from villages and small towns to cities. They affect the society, the economy, politics, human individuals, and their health (GALEA & VLAHOV 2005).

Living in a city is associated with both health advantages and disadvantages (ECKERT & KOHLER 2013; MATUSCHKE & KOHLER 2014). It has been considered a risk factor in regard to mental health (MARCH et al. 2008; WEEKE et al. 1975; VASSOS et al. 2012; HEINZ et al. 2013). Air pollution, traffic noise, deprived neighbourhoods, criminality, and poor social ties can negatively influence mental well-being (VLAHOV & GALEA 2002). Experiments with magnetic resonance revealed that city dwellers show an increased activity of the amygdala when processing social stress connected to an urban environment. People raised in the city presented an altered activity of the perigenual anterior cingulate cortex which regulates the amygdala region, negative emotions and stress (LEDERBOGEN et al. 2011). However, it is difficult to identify which urban environmental characteristics are more likely to cause mental disorders (MAIR et al. 2008).

Few studies have systematically reviewed research on urbanicity and mental health. A meta-analysis of ten studies on schizophrenia and urbanicity found elevated schizophrenia rates in urban environments (KRABBENDAM & OS 2005). An-

other meta-analysis of urban-rural differences in psychiatric disorders included 20 studies (PEEN et al. 2010). It reported an increased risk of mood disorders and anxiety in urban populations based on pooled odds ratios. No significant difference between urban and rural areas was found for substance use.

This article systematically reviews studies of urbanicity and mental disorders in European populations. Urbanisation refers to increases in the size, density and heterogeneity of cities. Urbanicity is a complementary term to urbanisation that describes the impact of living in an urban area at a given time. It refers to the presence of conditions that are particular to urban areas or present to a much greater extent than in non-urban areas (VLAHOV & GALEA 2002). The terms urbanisation and urbanicity are both used in the studies reviewed. We adopt the original terminology when possible and use the term urbanicity in our synthesis.

2. Methods

We searched EBSCOhost and PubMed for studies of urbanicity and mental disorders that were published in English between 1 January 2002 and 11 October 2012, using the combination of keywords (urban* OR environment*) AND (mental health OR mental disorder OR psych*). The time frame includes disease classifications according to the DSM-IV and ICD 10 classifications (American Psychiatric Association 1994; World Health Organization 1992).

We included those studies in our review which, firstly, report the incidence, prevalence or severity of mental disorders; secondly, contain urbanicity as an environmental risk factor or examined mental morbidity in an urban-rural catchment area; and, thirdly, were epidemiological, prospective or retrospective studies of a European population. We also searched the references of included studies. We excluded studies in which subjects represented a special population, such as members of one class in high school, prisoners or patients sharing a physical condition (*Figure 1*).

We discuss the three main and most often studied types of mental disorders in the review, namely, mood and anxiety disorders, psychosis and substance abuse. When more than two categories of urbanicity were studied, we describe merely the difference between the most rural and the most urban category or a summary measure in the text. The tables include additional information. Psychiatric morbidity or healthcare utilisation, studied in some articles, are not reviewed.
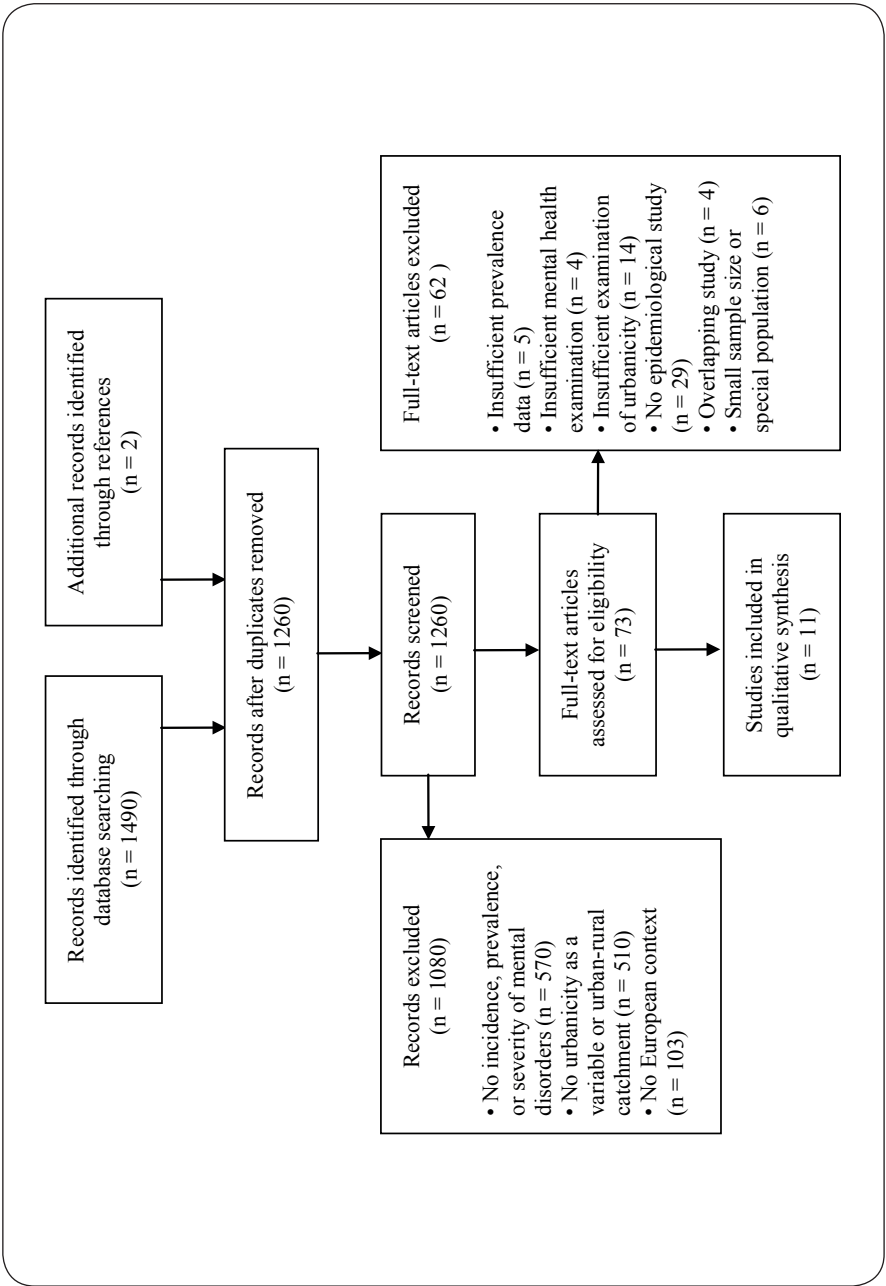
Figure 1
Flow diagram of study selection

3. Results

The search identified 1,490 studies, 11 of which met the inclusion criteria. All studies but one were conducted within one European country. The European Study of the Epidemiology of Mental Disorders (ESEMeD) studied six European countries. *Table 1* provides an overview of the studies reviewed and their characteristics, including the definition of urbanicity and control variables used. *Table 2* summarises the associations between urbanicity and mental disorders reported.

3.1. Mood and anxiety disorder

Nine studies examined the association between urbanicity and unipolar mood disorders, six additionally included anxiety disorders and one focused on bipolar mood disorders.

In the Ukraine, neither the prevalence of mood nor the prevalence of anxiety disorders varied with the degree of urbanicity assessed. The comorbidity among lifetime mood disorders and anxiety disorders was significant in men and in women (OR = 4.77, 95% CI: 2.76–8.23 and OR = 3.56, 95% CI: 2.69–4.70, respectively). The study also described significant regional differences in the prevalence of mood and anxiety disorders. The regional differences for mood disorders in comparison to the Western region were significant in the Kyiv metropolitan area (OR = 2.07, 95% CI: 1.57–2.74) and in the Eastern region (OR = 1.50, 95% CI: 1.11–2.01). The corresponding regional differences for anxiety disorders were significant in the central region without Kyiv (OR = 2.06, 95% CI: 1.28–3.33), in the Kyiv metropolitan area (OR = 2.90, 95% CI: 1.86–4.54) and in the Eastern region (OR = 2.46, 95% CI: 1.69–3.59) (BROMET et al. 2005).

In Sweden, neither the depression nor the anxiety prevalence differed between the urban and the rural population. However, women from the Skaraborg area had the highest depression rates in the youngest group, aged 20–34, whereas the distribution of depression in the female population of Stockholm was more even (DAHLBERG et al. 2007). In another Swedish study, inhabitants of the most densely populated area were 1.43 (95% CI: 1.32–1.55) times more likely to suffer from depression. A slightly lower hazard ratio remained significant after adjusting for marital status, attained level of education and immigrant status (HR = 1.2, 95% CI: 1.11–1.30), and a man living in the most urbanised quantile had a 12% higher chance of developing depression than one living in the least urbanised area (SUNDQUIST et al. 2004).

In Germany, the prevalence of mood disorders (OR = 1.36, 95% CI: 1.14–1.64) and the prevalence of anxiety disorders (OR = 1.41, 95% CI: 1.15–1.73) were significantly higher in urbanised areas (DEKKER et al. 2008).

A study of bipolar disorders in the Netherlands found that urbanicity influenced the cognitive but not the affective component of the illness. The rate of bipolar dis-

Table 1
Study characteristics

Study	Data source, study year	Diagnostic instrument	Classification	Measure of urbanicity	Control variables	Age of study population
Bromet et al. 2005	Epidemiologic study, 2002	WMH-CIDI	DSM-IV	Rural, mid-sized urban areas with towns up to 200,000 population, large urban	Age, education completed, employment status, financial status, language, marital status, region, sex	≥ 18
Dahlberg et al. 2007	Sample from the counties of Stockholm and Skaraborg, 1998–2003	MDI, SP-RAS, AUDIT		Stockholm versus County of Skaraborg	None	20–64
Dekker et al. 2008	German Health Interview and Examination Survey subsample, 1998	M-CIDI	DSM-IV	Very rural municipalities (< 5,000 inhabitants), rural (5,000–20,000 inhabitants), urban-I (municipalities with 20,000–100,000 inhabitants and the suburbs of the municipalities with 100,000–500,000 inhabitants), urban-II (centres of the municipalities with 100,000–500,000 inhabitants and the suburbs of the municipalities > 500,000), urban-III (centres of the municipalities > 500,000 inhabitants).	Age, gender, marriage, social class, and their interactions	18–65
Kaymaz et al. 2006	Netherlands Mental Health Survey and Incidence Study baseline data, 1996	CIDI	DSM-III-R	Addresses per km² in an area classified as < 500, 500–999, 1,000–1,499, 1,500–2,499 and ≥ 2,500	Age, cannabis use, education, sex	18–64
Kovess-M. et al. 2005a	European Study of the Epidemiology of Mental Disorders, 2001–2003	CIDI, SF-12	DSM-IV, ICD 10	Metropolis (> 100,000 inhabitants), medium-sized city (10,000–100,000 inhabitants), rural (< 10,000 inhabitants)	Age, marital status	≥ 18
Kovess-M. et al. 2005b	Sample from two very different French regions, NA	Simplified CIDI	DSM-IV	Official urbanicity index based on population density; type of dwelling	Age, event before the age of 12 years, marital status, provoking agent for the episode, sex	18–102
Leue et al. 2012	IMS Health's longitudinal prescription database, 2008–2009	Prescription data, analgesics potency and escalation	Modified WHO analgesic ladder	Addresses per km² in an area classified as < 500, 500–999, 1,000–1,499, 1,500–2,499 and ≥ 2,500; NIVEL's neighbourhood deprivation index with a cut-off of 5.5%, i.e, 885,000 people	Age, analgesics, deprived neighbourhood, gender, urbanisation, and antidepressants, antipsychotics, mood stabilisers, sedatives, migraine medication, cardiovascular drugs, or other somatic drugs intake	15–85
Pedersen et al. 2006	Danish Civil Registration System, Danish Psychiatric Central Register, Danish address and road database, 1956–2001	Register, central psychiatric register	ICD 8–10	Capital, capital suburb, provincial city (> 100,000 inhabitants), provincial town (> 10,000 inhabitants), rural areas; distance to the nearest major road	Age and its interaction with gender, calendar year of diagnosis, mental illness in a parent or sibling; geographical distance to nearest major road at the 15th birthday, degree of urbanisation at the 15th birthday	≥ 15
Peen et al. 2007	Netherlands Mental Health Survey and Incidence Study, 1996	CIDI	DSM-III-R	Addresses per km² in an area classified as < 500, 500–999, 1,000–1,499, 1,500–2,499 and ≥ 2,500	Age, education, gender, household composition, household income, social and occupational status	18–64
Sundquist et al. 2004	Entire Swedish population, 1996	Register, admission for psychosis or depression	ICD 9–10, DSM-IV	Population density divided into quintiles	Age, education, immigrant status, marital status	25–64
Weich et al. 2006	First two waves of the British Household Panel Survey, 1991–1992	GHQ		Population density of electoral wards divided into quartiles	Age, car access, education, employment status, ethnicity, financial strain, gender, household income, housing tenure, household type, marital status, number of current physical health problems, overcrowding, social class, structural housing problems	16–74

Note: AUDIT: Alcohol Use Disorders Identification Test; CIDI: Composite International Diagnostic Interview; DSM: Diagnostic and Statistical Manual of Mental Disorders; GHQ: General Health Questionnaire; ICD: International Classification of Diseases; NA: Not available; NIVEL: Netherlands Institute of Research in Healthcare; M-CIDI: Munich CIDI; MDI: Major Depression Inventory; SF-12: 12-Item Short Form Survey from the RAND Medical Outcomes Study; SP-RAS: Sheehan Patient Rated Anxiety Scale; WMH: World Mental Health; WHO ladder: The linear trend measures the summary increase in risk, expressed as odds ratio, associated with one unit change in the five-level exposure.

orders with narrowly and broadly defined symptoms was progressively higher in more urbanised areas (OR = 1.18, 95% CI: 1.09–1.42). Furthermore, mania was comorbid with psychotic symptoms and strongly positively influenced by the degree of urbanicity. The higher the degree of psychotic comorbidity, the larger the effect of urbanicity for three-symptom mania (OR = 1.22, 95% CI: 1.11–1.34), as well as for five-symptom mania (OR = 1.34, 95% CI: 1.18–1.53). No association with urbanicity was found for mania without psychotic symptoms. Hence, the environment might affect affective and psychotic symptoms differently (KAYMAZ et al. 2006). In another Dutch study which adjusted for differences in sex, age, education, household income, occupational status, and household composition, the high urbanicity categories had significantly higher odds of mood disorders (OR = 1.75, 95% CI: 1.25–2.45) and anxiety disorders (OR = 1.47, 95% CI: 1.13–1.91). The psychiatric comorbidity rates also showed a positive relation with urbanicity as the fraction of cases detected with two or more diagnoses was highest in the most urbanised categories (PEEN et al. 2007).

In the ESEMeD study, the overall OR for mood disorders in urban population, after adjustment for socio-demographic variables, was 1.08 (95% CI: 0.73–1.59), and was not significantly different from one. In Germany and France, where urban-rural differences were significantly larger, an additional category of urbanicity was introduced (medium-sized town). Contrary to the expectations of the researchers, the highest prevalence of mood disorders in France and Germany was found in medium-sized towns with 7.39% and 4.04%, respectively. Slightly higher urban-rural differences in the prevalence of anxiety disorders were more related to age and marital status than to urbanicity. In Belgium, the urban environment appeared to be a protective factor for psychiatric morbidity in medium-size cities (OR = 0.57, 95% CI: 0.32–0.99) (KOVESS-MASFÉTY et al. 2005a).

In France, the prevalence of experiencing a severe major depressive episode in the next 6 to 12 months increased significantly with the degree of urbanicity, as measured by the official urbanicity index or by the type of dwelling inhabited (p > 0.01). This association was less pronounced and less significant for a major depressive episode not considered severe (p > 0.05). The associations between the lifetime prevalence of not severe and of severe major depressive episodes and urbanicity were insignificant, except for the association between the lifetime frequency of severe major depressive episodes and the type of housing (p > 0.01) (KOVESS-MASFÉTY et al. 2005b).

In the United Kingdom, common mental disorders, understood in the study as a dimension including comorbid symptoms of mood disorders and anxiety, showed insignificantly higher rates in the non-rural group (episode onset OR = 1.24, 95% CI: 0.99–1.57; episode maintenance OR = 1.17, 95% CI: 0.90–1.53) (WEICH et al. 2006).

3.2. Psychosis

Three studies investigated the relationship between urbanicity and psychosis. Another study focused on schizophrenia.

In Germany, the one-year prevalence of psychosis in the urban setting was not significantly higher in urbanised areas after adjusting for socio-economic variables (DEKKER et al. 2008).

Traffic exposure as a candidate risk factor related to an urban environment was examined in Denmark. The distance to a major road showed an effect in the population sample of children. The highest relative risk RR = 1.30 (95% CI: 1.17–1.44) of schizophrenia was found in children who lived 500–1000 metres from the nearest major road at the time of their 15th birthday. When adjusting for the degree of urbanisation, the geographical distance to the nearest major road had no significant effect. A higher degree of urbanisation was consistently associated with a higher risk of schizophrenia. Living in the capital, for instance, was associated with a risk of schizophrenia twice as great as with living in a rural area (RR = 2.09, 95% CI: 1.96–2.22). Urban-rural differences in schizophrenia may therefore be more closely related to the degree of urbanisation than to the geographical distance to the nearest major road (PEDERSEN & MORTENSEN 2006).

In Sweden, the hazard ratio for psychosis in the fifth highest quantile of urbanisation was 2.66 (95% CI: 2.36–2.99) compared to the lowest quantile when adjusting for age, and 1.77 (95% CI: 1.56–1.99) when adjusting also for marital status, attained level of education and immigrant status. A man (woman) living in the most urbanised quantile had a 68% (77%) higher chance of developing depression than one living in the least urbanised area (SUNDQUIST et al. 2004).

3.3. Substance abuse

Six studies examined alcohol abuse, two of which additionally examined drug abuse.

In the Ukraine, there were no significant urban-rural differences in alcohol abuse and dependency. There were no regional differences between the Western Region, Central Region, Kyiv metropolitan area, and the Eastern Region. The other control variables: sex, age, language, marital status, education, employment, and financial status, correlated significantly with alcohol abuse and dependence (BROMET et al. 2005).

In Sweden, the rate of substance abuse was higher in the urban area for both sexes. Harmful alcohol use (AUDIT ≥ 11) was more prevalent in Stockholm County compared to the former County of Skaraborg for women (3.6% vs. 1.5%, p ≤ 0.00) and men (11.8% vs. 8.6%, p ≤ 0.00). A similar urban-rural difference was described for illicit drug use. Higher proportions of women (1.8% vs. 0.5%, p ≤ 0.00) and men (3.6% vs. 1.1%, p ≤ 0.00) consumed illicit drugs in Stockholm County during the last 12 months compared to the former County of Skaraborg. The use of prescribed

Table 2
Associations between urbanicity and mental disorders

Bromet et al. 2005 — Ukraine (N = 4725)

Town size in the area	Mood disorders %	OR	95% CI	Anxiety disorders %	OR	95% CI	Alcohol disorders %	OR	95% CI	Intermittent explosive disorders %	OR	95% CI
Rural	16.6	1.05	(0.60–1.85)	6.20	0.85	(0.37–1.94)	13.2	1	(0.65–1.52)	3.77	0.82	(0.51–1.31)
Mid-sized urban	15.0	0.93	(0.53–1.63)	4.94	0.66	(0.37–1.21)	14.0	1.07	(0.83–1.37)	4.27	0.93	(0.59–1.47)
Large urban	15.9	1 F		7.25	1 F		13.2	1 F		4.58	1 F	
Trend test	0.03	$p \geq 0.05$		0.17	$p \geq 0.05$		0.01	$p \geq 0.05$		0.78	$p \geq 0.05$	

Dahlberg et al. 2007 — Sweden (N = 13,979)

	Symptoms of panic %	p	Agoraphobic symptoms %	p	Social phobic symptoms %	p	Obsess.-compulsive disorder symptoms %	p	Depressive symptoms %	p
Women Stockholm	4.7	0.89	1.6	0.19	2	0.48	**6.5**	**0.00**	6.6	0.66
Women Skaraborg	4.7		1.2		1.8		**4.4**		6.9	
Men Stockholm	2.8	0.27	1.1	0.84	1.5	0.52	5.5	0.07	4.1	0.50
Men Skaraborg	2.3		1		1.3		4.3		4.4	

	Harmful alcohol use %	p	Illicit drugs last 12 months %	p	Any symptoms %	p	Any symptoms (excl. substance abuse) %	p
Women Stockholm	**3.6**	**0.00**	**1.8**	**0.00**	**17.2**	**0.00**	**13.7**	**0.05**
Women Skaraborg	**1.5**		**0.5**		**13.2**		**11.9**	
Men Stockholm	**11.8**	**0.00**	**3.6**	**0.00**	**20.2**	**0.00**	9.7	0.22
Men Skaraborg	**8.6**		**1.1**		**15.4**		8.6	

Dekker et al. 2008 — Germany (N = 4181)

Population density; centre and suburban area	Mood disorders $\%_w$	OR	95% CI	Anxiety disorders $\%_w$	OR	95% CI	Abuse disorders $\%_w$	OR	95% CI	Psychosis $\%_w$	OR	95% CI
Extremely	15.2			16.9			5.1					
Very urban	12.4			12.6			3.7			NA		
Urban	10.6			14.8			3.6					
Rural	9.8			14.3			4.9					
Very rural	9.3			12			5.1					
Urbanisation	**1.36**	(1.14–1.64)		**1.41**	(1.15–1.73)		1 NA			1 NA	NS	

Kaymaz et al. 2006 — Netherlands (N ≤ 7076)

Population density	At least 3 manic symptoms $\%_w$	OR	95% CI	At least 5 manic symptoms $\%_w$	OR	95% CI	Bipolar disorder $\%_w$	OR	95% CI
L1 (low)	2.8			1.4			1.3		
L2	2.7			0.9			1.2		
L3	3.8			2.1			2.2		
L4	5.0			2.9			2.1		
L5 (high)	6.1			4.0			2.8		
Linear trend — Unadjusted model		**1.27**	**(1.16–1.39)**		**1.43**	**(1.26–1.62)**		**1.24**	**(1.09–1.42)**
Adjusted model		**1.22**	**(1.11–1.34)**		**1.34**	**(1.18–1.53)**		**1.18**	**(1.03–1.35)**

Table 2
(continued)

Kovess-M. et al. 2005a — 6 EU countries (N ≤ 21,425)

		Mood disorders			Anxiety disorders			Alcohol disorders			Any disorder		
		%	OR	95% CI	%	OR	95% CI	%	OR	95% CI	%	OR	95% CI
Population density													
Belgium	Rural	6.38	1		9.06	1		2.85	1		15.93	1	
	Urban	4.96	0.76	(0.43–1.35)	5.80	0.62	(0.36–1.06)	1.60	0.56	(0.22–1.38)	10.22	0.6	(0.39–0.91)
	Medium cities	4.84	NA		5.38	0.57	(0.32–0.99)	1.61	NA		9.82	0.57	(0.38–0.87)
	Metropolis	5.88	NA		9.07	1.00	(0.51–1.97)	2.53	NA		13.38	0.81	(0.47–1.40)
France	Rural	5.45	1		7.41	1		1.05	1		11.13	1	
	Urban	7.23	1.22	(0.84–1.76)	10.14	1.33	(0.95–1.84)	1.47	1.09	(0.49–2.43)	16.18	1.42	(1.09–1.85)
	Medium cities	7.39	NA		10.02	NA		1.43	NA		16.35	1.49	(1.10–2.02)
	Metropolis	6.92	NA		10.37	NA		1.56	NA		15.85	1.35	(0.91–2.00)
Germany	Rural	2.08	1		5.79	1		0.65	1		7.58	1	
	Urban	3.87	1.72	(0.99–2.97)	6.79	1.14	(0.81–1.60)	1.39	2.06	(0.93–4.60)	9.73	1.27	(0.95–1.70)
	Medium cities	4.04	1.93	(1.08–1.46)	6.47	NA		0.93	1.45	(0.59–3.60)	9.00	NA	
	Metropolis	3.68	1.52	(0.82–2.79)	7.13	NA		1.80	2.69	(1.16–6.23)	10.51	1.72	(1.27–2.34)
Italy	Rural	2.68	1		5.01	1		0.13	1		6.54	1	
	Urban	3.64	1.37	(0.94–2.00)	4.53	0.90	(0.67–1.21)	0.19	1.5	(0.29–7.79)	7.01	1.07	(0.83–1.39)
Netherlands	Rural	3.27	1		5.75	1		1.43	1		9.95	1	
	Urban	5.15	1.61	(0.59–5.07)	7.81	1.39	(0.65–2.97)	1.97	1.38	(0.30–6.38)	12.27	1.27	(0.66–2.42)
Spain	Rural	3.86	1		5.22	1		0.70	1		7.75	1	
	Urban	4.55	1.19	(0.82–1.73)	5.16	0.95	(0.68–1.34)	0.66	0.77	(0.28–2.17)	8.73	0.74	(0.56–0.98)

Kovess-M. et al. 2005b — France (N=2638)

		Lifetime MDE			Lifetime severe MDE			6-12 months MDE			6-12 months severe MDE		
		%w	p	95% CI	%w	p	95% CI	%w	p	95% CI	%w	p	95% CI
Population density	Rural	11.3	NS	(7.9–16.0)	6.6	NS	(3.7–11.5)	3.4	>0.05	(2.4–5.0)	1.9	>0.01	(1.2–2.9)
	Urban	11.4		(9.5–13.7)	6.9		(5.3–8.8)	5.8		(4.4–7.7)	4.1		(3.0–5.8)
Type of dwelling	Detached house	9.5		(6.7–13.4)	3.9		(2.4–6.4)	3.6		(1.9–6.7)	1.7		(0.8–3.5)
	House in allotment	10.6	NS	(7.4–15.1)	6.6	>0.01	(4.0–10.9)	3.3	>0.05	(1.8–6.0)	2.2	>0.01	(1.0–4.7)
	Flat	10.8		(7.7–15.0)	6.0		(3.7–9.7)	5.5		(3.4–8.9)	3.9		(2.1–7.3)
	Flat in large building area	14.0		(10.3–18.9)	10.6		(7.2–15.2)	8.7		(5.8–13.0)	7.0		(4.3–11.2)

Leue et al. 2012 — Netherlands (N = 449,410)

		Group starting analgesics			Group continuing analgesics		
		%p	OR	95% CI	%p	OR	95% CI
Address density (for patient's pharmacy)	L1 (high)	27.3	1.24	(1.18–1.30)	27.7	1.18	(1.14–1.23)
	L2	30.3	1.16	(1.11–1.22)	29.9	1.14	(1.10–1.17)
	L3	18.7	1.11	(1.06–1.17)	18.0	1.08	(1.04–1.12)
	L4	17.0	1.07	(1.02–1.13)	17.1	1.05	(1.01–1.09)
	L5 (low)	6.7	1		7.3	1	
Deprived neighbourhood	Yes	7.5	1.07	(1.02–1.11)	7.7	1.04	(1.01–1.08)
	No	92.5	1		92.3	1	

Table 2
(continued)

Pedersen et al. 2006 — Denmark (N = 1.89 million)
Incidence of schizophrenia per 10,000 person-years at risk

	I	Adjusted model RR	95% CI	Fully adjusted model RR	95% CI
Geographical distance to nearest major road at 15th birthday					
0–50 m	3.08	**1.16**	**(1.04–1.30)**	1.05	(0.94–1.18)
50–100 m	3.37	**1.25**	**(1.11–1.40)**	1.08	(0.96–1.21)
100–250 m	3.38	**1.25**	**(1.13–1.38)**	1.07	(0.96–1.18)
250–500 m	3.47	**1.27**	**(1.15–1.40)**	1.05	(0.94–1.16)
500–1000 m	3.52	**1.30**	**(1.17–1.44)**	1.06	(0.96–1.18)
1000–2000 m	2.95	**1.13**	**(1.01–1.27)**	1.02	(0.91–1.14)
> 2000 m	2.57	1		1	
Degree of urbanisation at 15th birthday					
Capital	6.53	**2.10**	**(1.98–2.24)**	**2.09**	**(1.96–2.22)**
Capital suburb	4.07	**1.48**	**(1.40–1.56)**	**1.47**	**(1.38–1.56)**
Provincial city	3.49	**1.34**	**(1.25–1.43)**	**1.32**	**(1.23–1.42)**
Provincial town	2.96	**1.13**	**(1.07–1.19)**	**1.12**	**(1.06–1.18)**
Rural area	2.56	1		1	

Peen et al. 2007 — Netherlands (N = 7076)
Address density

	Mood disorder %	OR	95% CI	Anxiety disorder %	OR	95% CI	Substance abuse disorders %	OR	95% CI	One or more DSM-III-R diagnoses %	OR	95% CI
Very highly urbanised	10.4	**1.75**	**(1.25–2.45)**	14.4	**1.47**	**(1.13–1.91)**	5.8	**1.74**	**(1.23–2.47)**	28.0	**1.56**	**(1.27–1.93)**
Highly urbanised	8.9	**1.66**	**(1.20–2.31)**	13.7	**1.41**	**(1.10–1.81)**	6.0	**1.49**	**(1.05–2.11)**	24.5	**1.40**	**(1.15–1.73)**
Moderately urbanised	7.3	1.32	(0.94–1.85)	11.5	1.13	(0.87–1.46)	6.1	**1.78**	**(1.26–2.50)**	24.2	**1.31**	**(1.07–1.60)**
Not very urbanised	6.2	1.30	(0.93–1.82)	11.4	1.22	(0.95–1.57)	2.8	1.10	(0.77–1.58)	20.5	**1.25**	**(1.02–1.53)**
Not urbanised	5.3	1		10.8	1		3.5	1		18.6	1	

Sundquist et al. 2004 — Sweden (N = 4.4 million)

Psychosis

	Age-adjusted model %	HR	95% CI	Fully adjusted model HR	95% CI
Population density					
Women					
Q1 (low)	3.0	1		1	
Q2	3.4	1.12	(0.98–1.29)	1.10	(0.96–1.26)
Q3	4.0	**1.29**	**(1.14–1.48)**	**1.22**	**(1.07–1.39)**
Q4	5.6	**1.83**	**(1.62–2.07)**	**1.48**	**(1.31–1.68)**
Q5 (high)	8.4	**2.66**	**(2.36–2.99)**	**1.77**	**(1.56–1.99)**
Men					
Q1 (low)	3.2	1		1	
Q2	3.1	0.96	(0.84–1.09)	1.07	(0.93–1.22)
Q3	3.8	**1.17**	**(1.03–1.33)**	**1.31**	**(1.15–1.49)**
Q4	5.3	**1.63**	**(1.45–1.84)**	**1.53**	**(1.36–1.73)**
Q5 (high)	7.5	**2.25**	**(2.01–2.52)**	**1.68**	**(1.50–1.89)**

Depression

	Age-adjusted model %	HR	95% CI	Fully adjusted model HR	95% CI
Women					
Q1 (low)	8.4	1		1	
Q2	8.7	1.03	(0.95–1.12)	1.03	(0.95–1.12)
Q3	9.0	1.07	(0.99–1.17)	1.06	(0.97–1.15)
Q4	10.7	**1.27**	**(1.17–1.37)**	**1.17**	**(1.08–1.26)**
Q5 (high)	12.2	**1.43**	**(1.32–1.55)**	**1.20**	**(1.11–1.30)**
Men					
Q1 (low)	6.7	1		1	
Q2	6.6	0.97	(0.89–1.07)	1.02	(0.93–1.12)
Q3	6.6	0.98	(0.89–1.07)	1.03	(0.94–1.13)
Q4	7.1	1.06	(0.97–1.16)	1.04	(0.95–1.14)
Q5 (high)	8.7	**1.27**	**(1.17–1.39)**	**1.12**	**(1.03–1.23)**

Weich et al. 2006 — United Kingdom (N = 7659)

	Episode onset Unadjusted model %	OR	95% CI	Adjusted model OR	95% CI	Episode maintenance Unadjusted model %	OR	95% CI	Adjusted model OR	95% CI
Population density										
Q1 (low)	NA	1		1		NA	1		1	
Q2		1.07	(0.84–1.36)	1.05	(0.83–1.34)		**1.39**	**(1.07–1.79)**	**1.38**	**(1.06–1.80)**
Q3		1.02	(0.80–1.29)	1.02	(0.80–1.30)		**1.39**	**(1.07–1.81)**	**1.32**	**(1.01–1.73)**
Q4 (high)		1.10	(0.87–1.39)	1.08	(0.85–1.38)		**1.35**	**(1.05–1.73)**	1.30	(0.99–1.70)
Rurality										
Rural group		1		1			1		1	
Non-rural group		**1.25**	**(1.00–1.57)**	1.24	(0.99–1.57)		1.22	(0.95–1.57)	1.17	(0.90–1.53)

Note: CI: Confidence interval; I: incidence rate per 10,000 person-years; L: level of urbanicity; MDE: major depressive episode; NA: not available; NS: not significant; HR: hazard ratio; OR: odds ratio; p: p value of Chi square test; RR: relative risk; Q: degree of urbanicity quartile or quintile; %: prevalence; %w: weighted prevalence; %p: percentage of patients. Leue et al. 2012 predicted associations with escalation in pharmacological pain treatment. Results significant at the 5% level are emphasised.

medication by men was higher in rural than in urban areas (30% vs. 25%). This difference disappeared when stratifying for age groups (DAHLBERG et al. 2007).

In the ESMeD study, an increased prevalence of alcohol-related disorders was measured in metropolitan areas in Germany (OR = 2.69, 95% CI: 1.16–6.23) (KOVESS-MASFÉTY et al. 2005a). In another study in Germany, the prevalence of substance abuse was similar in urban areas when adjusting for socio-economic rural-urban differences (DEKKER et al. 2008).

In the Netherlands, analgesic escalation was associated with aspects of urbanisation (OR = 1.24, 95% CI: 1.18–1.30), neighbourhood deprivation (OR = 1.07, 95% CI: 1.02–1.11), and use of somatic and stronger psychotropic comedication (LEUE et al. 2012). In another study in the Netherlands, alcohol and drug abuse as well as alcohol and drug dependence (including sedatives, hypnotics and anxiolytics) were more prevalent in more urban settings (p < 0.001 for trend). After adjusting for socio-demographic variables, the OR for the one-year prevalence for a very highly urbanised area was 1.74 (95% CI: 1.23–2.47) (PEEN et al. 2007).

4. Discussion

Of the eleven studies reviewed, nine examined mood and anxiety disorders, three examined psychotic disorders, and six examined substance abuse. Two studies assessed the relationship of mental disorders with the distribution of the population, as well as with other environmental conditions that change through urbanisation, such as living close to a major road or in a deprived neighbourhood.

All studies but one reported one or more mental health disadvantages of an urban environment. Seven out of nine studies reported a significantly higher burden of mood and anxiety disorders in some more urban areas. Two out of three studies indicated that psychosis can be more frequent in more urbanised areas. The authors of the German study, which did not find a rural-urban difference in the one-year prevalence of psychosis, reconciled the discrepancy of their result with other findings by noting that the absolute number of psychotic patients in their population survey may have been too small to find an association between psychosis and urbanicity. Findings of other studies published after our systematic literature search also suggest that increasing population density does not reduce psychotic disorders. Transition from health to psychotic disorder was not significantly associated with urban birth in the Netherlands and in Dutch-speaking Belgium (OR = 3.7, 95% CI: 0.9–15.4) (NIEROP et al. 2013). Within rural areas in Germany, the admission rates of people with schizophrenia (p > 0.062) and affective disorders (p > 0.000) increased with population density (LOSERT et al. 2012). With respect to substance abuse, including alcohol, illicit drugs and analgesics, urbanicity was considered a risk factor by four out of six studies. An urban health advantage was described only in one instance. Anxiety disorders were significantly lower in medium-sized cities in Belgium.

The studies reviewed were cross-sectional. All but one controlled for a number

of factors that can confound the effect of urbanicity on mental disorders. The frequently used control variables were age, sex, marital status, and education. As no reviewed study plausibly excluded all possible confounders, the likelihood that the estimated conditional correlations present biased estimates of the impact of urbanicity on mental health remains high. Therefore, this systematic review that summarises complementary findings of independent studies in Europe provides low-level evidence for a causal relationship of urbanicity and mental health.

Furthermore, the urban environment definition varied across the studies reviewed, but researchers argue that 'there is an urgent need for studies to standardise measures of urbanicity' (CYRIL et al. 2013, 10). The majority of studies characterised the degree of urbanicity through the population density in an area. View studies categorised the level of urbanicity of a settlement based on its population size. One study distinguished urban and rural areas by the number of jobs offered and type of dwelling in the area.

5. Conclusion

The emerging evidence is that living in an urban environment in Europe can be a risk factor for mood and anxiety disorders, for psychotic disorders, as well as for substance abuse. Urbanisation was not associated with mental health in several instances, and it is unlikely to be a protective factor. The associations between urbanicity and mental health reviewed are unsuitable to assess which urban environment characteristics cause mental disorders.

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