

Urban birth and residence as risk factors for psychoses: an analysis of 1880 data¹

E. Fuller Torrey *, Ann E. Bowler, Kitty Clark

*Stanley Foundation Research Programs, NIMH Neuroscience Center, St. Elizabeths Hospital,
2700 Martin Luther King Avenue, SE, Washington, DC 20032, USA*

Received 16 October 1996; accepted 23 January 1997

Abstract

It is known that social drift to cities increases the urban prevalence for severe mental illnesses. Recent studies in England and Sweden have reported that being born in, or raised in, an urban area is also a risk factor for later developing schizophrenia. The present study utilized 1880 census data, the most complete enumeration of severely mentally ill individuals ever done in the United States, to examine the association of urban residence and severe mental illnesses. Individuals identified as having one of seven forms of 'insanity' ($n=91\,959$) were allocated to their county of origin ($n=2661$) in the census. Rates of 'insane' persons per 1000 population were calculated for each county. The counties were then divided by degree of urbanization based on the largest cities and the percentage of population living in towns of 4000 or more. The point prevalence of 'insanity' in the United States as a whole in 1880 was 1.8 per 1000. There was a significant association between 'insanity' by county and degree of urbanization, with odds ratios of 1.66 for urban, 1.46 for semi-urban, and 1.44 for semi-rural, and 1.37 for rural, using completely rural counties as a baseline. Most completely rural counties with high rates included mining camps, lumbering camps, or fishing villages, and not farming areas. In addition to urban drift, urban birth and residence appear to be risk factors for developing severe mental illnesses. Psychological and biological explanations have both been proposed. However, recent studies reporting winter birth and urban birth or residence as synergistic risk factors favor the latter. © 1997 Elsevier Science B.V.

Keywords: Bipolar disorder; Epidemiology; Prevalence; Risk factors; Schizophrenia; Urban birth

1. Introduction

The clustering of individuals with severe mental illnesses in inner cities in the United States has

been widely recognized since the study by Faris and Dunham (1939) of psychiatric hospital admissions in Chicago. Proposed explanations have focused primarily on social drift hypotheses, in which individuals predisposed to, or who develop, severe mental illnesses selectively migrate to inner cities, and 'breeder' hypotheses, in which urban living per se is thought to cause severe mental illnesses through psychological or biological mechanisms.

* Corresponding author. Tel.: +1 202 3736105; fax: +1 202 3736252; e-mail: millerj@dirpc.nimh.nih.gov

¹This work was presented at the Biennial Winter Workshop on Schizophrenia, Crans Montana, Switzerland, March 16–22, 1996.

In fact the clustering in urban areas of individuals with severe mental illnesses was noted as early as 1848, when Dorothea L. Dix observed that “there are, in proportion to number, more insane in cities than in large towns, and more insane in villages than among the same number of inhabitants dwelling in scattered settlements” (Dix, 1848). Similarly, William A. White (1903), studying the geographical distribution of insanity in the United States, noted “an almost exact parallel” between the prevalence of insanity and “the greatest density of population.”

Since White’s observation, studies in the United States have confirmed a low prevalence of severe mental illnesses in rural areas and a higher prevalence in urban areas. Examples of the former include a 1938 study of rural Tennessee that reported a lifetime prevalence for schizophrenia of 2.0 per 1000 (Luton, 1943) and a 1951 study of rural Hutterites that found a lifetime prevalence of schizophrenia of 1.1 per 1000 (Eaton and Weil, 1955); a recent reanalysis of the Hutterite records using DSM-III-R diagnostic criteria found the lifetime prevalence of bipolar disorder to also be low (0.6 per 1000) (Torrey, 1995). Examples of high prevalence urban studies include the 1980–82 Epidemiologic Catchment Area (ECA) studies in New Haven, Baltimore, and St. Louis in which the lifetime prevalence of schizophrenia was reported to be 20, 19, and 11 per 1000, respectively, and the lifetime prevalence of a manic episode was reported to be 11, 6, and 11 per 1000, respectively (Robins et al., 1984).

Several studies have also compared the prevalence of severe mental illnesses in both rural and urban areas in the United States. Pollock and Nolan (1921), in a study of first admissions to New York State psychiatric hospitals in 1915 and 1920, reported that the first admission rates for urban areas compared with rural areas were 2.5-times higher for dementia praecox and 1.5-times higher for manic-depressive disorder; no such difference existed for other diagnoses such as senile psychosis or cerebral syphilis. Malzberg (1940, 1955) also studied state hospital first admission rates for 1929–31 and 1949–51 and found that the rates for dementia praecox (in the first study) and schizophrenia (in the second study)

were 1.8- and 2.3-times higher for urban compared to rural areas. Similarly, Frumkin (1954) studied first admissions to hospitals in Ohio, Eaton (1974) examined first admissions to hospitals in Maryland, and Jaco (1960) studied the incidence of schizophrenia in Texas, and all reported that schizophrenia was approximately twice as common in urban areas as compared to rural areas. Finally, Torrey and Bowler (1990) reanalyzed data for 9 separate years from the 1880 census of ‘insane’ persons to the 1963 census of resident patients in public mental hospitals and found a direct regional correlation between the prevalence of insanity/schizophrenia and the degree of urbanization.

Two recent European studies have provided new impetus for exploring the relationship between urban residence and severe mental illnesses. In one study Takei et al. (1992, 1995) identified 65 urban areas in England and Wales and compared the place of birth of 6533 individuals with schizophrenia with the place of birth of 18 305 individuals with affective, personality, and neurotic disorders used as a control group. Individuals with schizophrenia had a 14% greater risk of having been born in an urban area compared with controls (odds ratio 1.14). In the other study Lewis et al. (1992) compared the answers given by 49 191 male Swedish army conscripts to the question, “Where did you live mostly while you were growing up?” to the Swedish National Register of Psychiatric Care. They found that the chances of the conscripts later being diagnosed with schizophrenia were 1.65-times higher if the conscript had grown up in a city, 1.39-times higher if in a town of > 50 000 population, and 1.28-times higher if in a town of < 50 000 population, compared to having grown up in a rural area; these differences persisted after adjustment “for other factors associated with city life such as cannabis use, parental divorce, and family history of psychiatric disorder.” For the diagnostic category of ‘other psychoses’ Lewis et al. reported “a similar though weaker trend” with place of upbringing (Lewis et al., 1992).

The United States has no national case register such as that found in Sweden. However, in 1880 the Bureau of the Census carried out the most complete enumeration of severely mentally ill individuals that has ever been done in this country.

Since the census was done at a time when the vast majority of Americans still lived in rural settings, it was examined to ascertain whether it might shed additional light on urban residence as a possible risk factor for severe mental illnesses.

2. Methods

In 1880, because of the widespread belief that the number of severely mentally ill persons was increasing in the United States, Congress commissioned a special enumeration of all 'defective, dependent, and delinquent classes' as part of the decennial census. At each household census, takers made inquiries regarding mentally ill individuals and, if the initial reply was positive, followed up with 'certain definite questions' (United States Census Office, 1888). To supplement this information the census taker was "instructed to counsel with [local] physicians upon this point, to make inquiries of neighbors, and to report all [insane persons] whether the information respecting them should be derived from the family to which they belonged or to other sources." In addition all psychiatric hospitals, general hospitals, jails, almshouses, and other institutions in which mentally disabled individuals might reside were surveyed. Finally, a letter was sent to all 100 000 physicians in the United States asking them to "report to the Census Office all idiots and lunatics within the sphere of their personal knowledge"; 80% of physicians responded. The results from the separate surveys of households, institutions, and physicians were compared "by employing a sufficient number of clerks to scrutinize the returns, with a view to the detection of duplications, to purge the list of duplicates, and great pains was taken with this branch of the work."

A total of 91 959 separate 'insane' individuals were identified in the 1880 special census; 45% of them were in hospitals, jails, almshouses, or other institutions and 55% were living in the community. These individuals were categorized under seven forms of 'insanity' using definitions obtained by "consultation with the members of the New England Psychological Association and with other expert scientists":

- (1) mania (38%), "a state of nervous, intellectual, and emotional exaltation and excitement";
- (2) melancholia (19%), "a state of depression";
- (3) monomania (2%), "fixed delusions on a particular subject";
- (4) dementia (29%), "the condition of imbecility into which mania and melancholia ultimately degenerate";
- (5) paresis (2%), "general paralysis of the insane";
- (6) dipsomania (1%), "alcoholic insanity";
- (7) epilepsy (9%), not defined.

Individuals with mental retardation were enumerated separately and not included under 'insane.' The categories of mania, melancholia, monomania, and dementia thus constituted 88% of 'insane' persons and presumably included most individuals who today would be diagnosed with schizophrenia, bipolar disorder, and severe depression. All 'insane' individuals were allocated to their county of origin. For example, individuals living in hospitals, jails, or almshouses or who were otherwise 'temporarily absent from their homes' were allocated for census purposes to their home county rather than to the county in which they were temporarily living.

General population data were available from the 1880 census for each of the 2661 counties in the United States as well as for the 30 largest cities. The census classified as 'urban' all towns with a population of 4000 or more. Utilizing the 1880 data, therefore, it was possible to classify all counties as follows:

- (1) Urban: includes one of the 30 largest cities, with populations ranging from 1 206 299 (New York) to 55 785 (Kansas City);
- (2) Semi-urban: more than 50% of population living in towns of 4000 or more but not including the urban counties;
- (3) Semi-rural: 25–50% of population living in towns of 4000 or more;
- (4) Rural: 1–25% of population living in towns of 4000 or more;
- (5) Completely rural: none of the population living in towns of 4000 or more.

It is a measure of the rural nature of the United States in 1880 that only 16% of all counties had one or more towns of 4000 or more people. Dade County (Miami) had only 257 total residents, and King County (Seattle) had only 6910.

All data were entered into a computer, and the number of 'insane' individuals per 1000 county residents was calculated. Counties with less than 1000 total residents ($n=154$) were deleted; e.g., Lynn County, TX, had only seven total residents, of which two were said to be 'insane.' Odds ratios were calculated to estimate the association between prevalence rates and the degree of urbanicity by county of origin. The 95% confidence intervals were determined assuming approximate Poisson distribution.

3. Results

The 91 959 identified 'insane' individuals in the total US 1880 population of 50 155 783 yielded an overall point prevalence of 'insanity' of 1.8 per 1000 (see Table 1). The odds ratio for being 'insane' when living in an urban county was 1.66, in a semi-urban county 1.46, in a semi-rural county 1.44, and in a rural county 1.37, using completely rural counties as a baseline measure. This association of insane persons per population with degree of urbanization showed a strong linear trend. It is noteworthy that the biggest differences in rates of insanity were between completely rural counties (nobody living in towns of 4000 or more) and rural counties (1–25% of population living in towns of 4000 or more) and between semi-urban (more than 50% of population living in towns of 4000 or more) and urban counties (included cities

of 55 000 or more). This suggests that any clustering of population is a risk factor for developing psychosis, but that city living is an additional risk factor.

The results of the present study are consistent with the previous study of the 1880 census data in which the United States was divided into nine census regions and a correlation coefficient of $r=0.77$ was found for the rate of 'insanity' and degree of urbanization by census regions (Torrey and Bowler, 1990). In the present study, the odds ratios by type of county are also remarkably similar to the odds ratios reported by Lewis et al. (1992), cited previously, in their study of schizophrenia among Swedish army conscripts who had lived in a city (odds ratio 1.65), large town (1.39), or smaller town (1.28) compared to a baseline rural area (1.00) while they were growing up.

Of particular interest in the present study were completely rural counties (i.e., those that had no town of ≥ 4000 people) that had relatively high rates of 'insane' persons per population. There were 49 such counties with a rate of over 3.0 'insane' persons per 1000 population. In analyzing these counties, it is become clear that the majority of them were in areas where mining (e.g., Amador, Calaveras, Placer, and Tuolumne Counties, CA, and adjacent Douglas County, NV), lumbering (Carroll and Grafton Counties, NH; Piscataquis County, ME; Ontonagon County, MI; and Graham County, NC), or fishing (Dukes and Nantucket Counties, MA) were prominent at that time. Therefore, although there were no towns with a population of 4000 or more in those counties, the population was presumably concentrated in mining or lumbering camps or fishing villages. There are remarkably few counties in which farm-

Table 1
Insane persons by county by degree of urbanization, 1880

Counties	Total population	No. of insane persons	Rate per 1000	Odds ratio (95% CI)
Urban	8 568 338	20 635	2.40	1.66 (1.64–1.70)
Semi-urban	3 442 867	7266	2.11	1.46 (1.43–1.50)
Semi-rural	6 065 771	12 623	2.08	1.44 (1.41–1.47)
Rural	5 738 863	11 352	1.97	1.37 (1.34–1.40)
Completely rural	26 158 781	37 745	1.44	1.00 ^a

^aBaseline.

ing was the predominant occupation among the 49 completely rural counties with a rate of >3.0 'insane' persons per 1000 population.

The counties with the highest rates of 'insane' persons per population in the 1880 census were: Essex, NY, 9.6 (332 'insane'/34 515 population); Mahoning, OH, 7.5 (97/12 871); Clare, MI, 7.2 (30/4187); Jefferson, WA, 6.4 (11/1712); Nantucket, MA, 5.6 (21/3727); Westchester, NY, 5.5 (602/108 988); and San Joaquin, CA, 5.2 (126/24 349).

4. Discussion

The fact that living in a relatively more urbanized county was associated with the risk of being classified as 'insane' in 1880, when most people still lived in rural settings, confirms that this association of urban residence with severe mental illnesses has existed for over 100 years. It may be questioned, however, whether this association is real or merely a methodological artifact due to individuals living in rural areas being less likely to be diagnosed with severe mental illnesses and less likely to be hospitalized.

In this regard Stewart (1953) hypothesized that families in rural areas are stronger and more likely to keep a mentally ill family member at home for a longer period. The only person who appears to have tested this hypothesis was Malzberg (1955), who reported no difference in duration of illness prior to admission to state psychiatric hospitals for individuals admitted from urban and from rural areas. Malzberg also questioned the belief that severely mentally ill individuals are more accepted in rural areas and are therefore less likely to be hospitalized: "Any observant person must be familiar with the many psychopathic types in the city who also manage not to be admitted to a hospital." In addition, the fact that census and key informant surveys of rural areas, such as those in Tennessee (Luton, 1943) and among the Hutterites (Eaton and Weil, 1955), reported low prevalences of severe mental illnesses makes it less likely that selective diagnosis or hospitalization explains the urban–rural differences.

Social drift of severely mentally ill individuals

to urban areas almost certainly explains at least a small portion of the reported urban–rural differences, especially the concentration of mentally ill individuals in the poorest sections of inner cities. A variant of the social drift hypothesis is what Freeman (1994) labeled the social residue hypothesis, whereby psychiatrically healthier individuals selectively migrate from inner cities to suburbs, leaving behind the individuals who are, or are likely to become, severely mentally ill. A recent study of the social drift hypothesis in Nottingham, England, however, reported that most severely mentally ill individuals in the deprived areas of the inner city had in fact been born there (Dauncey et al., 1993). Moreover, the studies by Takei et al. (1992, 1995) and Lewis et al. (1992), cited above, also suggest that being born in or raised in an urban area is a risk factor for severe mental illnesses that cannot be accounted for entirely by social drift.

If social drift explains only part of the higher prevalence rates of severe mental illnesses in urban areas, then 'breeder' hypotheses must explain the other part. What is there about being born or raised in a city that predisposes a person to being diagnosed with a severe mental illness as an adult?

For many years, supporters of the 'breeder' hypothesis proposed psychological mechanisms to explain the higher urban rates for severe mental illnesses. In their original study in Chicago, for example, Faris and Dunham (1939) suggested that social isolation and social disintegration in inner cities were the cause of the higher rates of schizophrenia. More recently, Dunham (1986) acknowledged his own 'growing skepticism' of his original explanation and observed: "I would have to admit that there is hardly a shred of hard evidence in [our] book that supports the hypothesis that a person is more likely to develop schizophrenia because he experiences a higher degree of social isolation in a slum community of a large city than he would in a more socially organized community."

Another psychological mechanism that has been invoked to explain the urban risk factor for severe mental illnesses has been the effects of belonging to a lower socioeconomic class. Kohn (1968) reviewed the studies on this issue within individual

cities and concluded that “some substantial part of the phenomenon [of higher prevalence rates of schizophrenia in inner cities] results from lower class conditions of life being conducive to schizophrenia.” Kohn also found that “the larger the city, the stronger the correlation between rates of schizophrenia and these indices of social class”; in smaller cities (100 000–500 000) the correlation was smaller, and in small cities “the correlation disappears.” Kohn also noted that attempts to correlate social class with rates of mental disorder in rural areas had found no correlation at all. Rather than looking at individual cities, Torrey and Bowler (1990) examined schizophrenia prevalence, urbanization, and socioeconomic status by broad census regions and reported a direct correlation between schizophrenia prevalence and socioeconomic status as measured by mean income. The authors attributed this to the higher mean incomes in urban compared to rural areas and said that it did not contradict Kohn’s data for individual cities.

Crowding and the stress of living in cities have also been cited as possibly predisposing people to severe psychiatric illnesses. For example, in a 1944 study of military recruits in Boston, Hyde and Kingsley (1944) suggested that urban “congestion and overcrowding...lack of privacy...[and] the intensity of economic and social competition” might predispose individuals to developing mental illnesses.

Lower socioeconomic class living conditions and crowding are also consistent with biological explanations of the ‘breeder’ hypothesis, especially theories involving viruses or other infectious agents. Relevant in this regard is the study of Schweitzer and Su (1977) of psychiatric hospital admissions for ‘functional psychoses’ in Brooklyn, in which they found a correlation between psychiatric hospitalization rates and measures of household contact (persons per household and persons per room) but not density of population more broadly defined (people per acre or structures per acre). They concluded that “if density [of population] is pathogenic it is likely that its effect will be routed through family contact.” Similarly in a study in Northern Ireland that examined correlations of psychotropic drug prescriptions with 11 socioeco-

nomic indicators, prescriptions for antipsychotic drugs correlated most highly with overcrowding, defined as the number of persons per room (Spearman correlation coefficient 0.60, $p < 0.02$) (King et al., 1982).

Another suggestion that infectious agents may partly explain the increased prevalence of severe mental illnesses in urban areas is the finding that urban birth and winter birth are synergistic risk factors for severe mental illnesses. Dalén (1975) first reported this in a study in Sweden, and it has since been confirmed in studies by Machon et al. (1983) in Denmark, Takei et al. (1992, 1995) in England, O’Callaghan et al. (1995) in Ireland, Verdoux et al. (1996) in France, and Van Os et al. (1996) in The Netherlands. In these studies the interaction of urban birth and winter birth increased the risk of the person later being diagnosed with schizophrenia. The authors of these studies suggested that infectious agents such as viruses might explain this interaction since many infectious agents occur more commonly in winter months and are more likely to be transmitted in urban areas, especially in crowded living conditions.

In addition to infectious agents, other biological factors should also be considered as possible explanations for the higher prevalence of severe mental illnesses in urban areas. Freeman (1994), for example, cites “exposure to lead or other heavy metals, air-polluting gases, toxic waste sites and industrial effluents, as well as birth complications” as urban factors that might predispose to higher rates of severe mental illnesses. Theories involving industrial pollutants as being of possible etiological importance in severe mental illnesses were put forward as early as the mid-nineteenth century by Dr. Isaac Ray in Massachusetts, who noted that ‘insanity’ was more common in manufacturing regions compared to farming areas (Ray, 1856).

There are three important questions about the urban risk factor for severe mental illnesses that cannot be answered from the studies done to date. First, is this factor specific to schizophrenia or does it also operate for bipolar disorder and other psychoses? Second, what is the magnitude of this factor? The preliminary studies suggest that it is at least as great as some other known risk factors

for developing psychoses such as winter birth, prenatal exposure to influenza, other perinatal complications, low birth weight, or having an infection of the central nervous system during childhood. Finally, the possibility must be considered that the predisposing factor for developing psychoses is in fact not an urban factor at all but rather may be a rural protective factor.

Additional research on the apparent urban risk factor for severe mental illnesses is indicated. One of the most striking demographic changes occurring in the world is rapidly increasing urbanization. Since 1950 the number of people in the world who live in cities has more than tripled, from 0.74 billion to 2.58 billion, and each year it is increasing by 68 million more, mostly in developing nations. Insofar as urban living is a risk factor for developing severe mental illnesses, such illnesses are likely to increase in prevalence in the coming years in those nations.

Acknowledgment

This work was supported by the Theodore and Vada Stanley Foundation.

References

- Dalén, P., 1975. Season of Birth: A Study of Schizophrenia and Other Mental Disorders. North-Holland/American Elsevier, New York, NY.
- Dauncey, K., Gigg, J., Baker, K., Harrison, G., 1993. Schizophrenia in Nottingham: lifelong residential mobility of a cohort. *Br. J. Psychiatry* 163, 613–619.
- Dix, D.L., 1848. Praying a grant of land for the relief and support of the indigent and incurable insane in the United States. Cited in Porter, R. (Ed.), 1991. *The Faber Book of Madness*. Faber and Faber, Boston, p. 8.
- Dunham, H.W., 1986. Mental disorders in urban areas: a retrospective view. In: Weissman, M.M., Myers, J.K., Ross, C.E. (Eds.), *Community Surveys of Psychiatric Disorders*. Rutgers University Press, New Brunswick, pp. 65–76.
- Eaton, J.W., Weil, R.J., 1955. Culture and Mental Disorders: A Comparative Study of the Hutterites and Other Populations. Free Press, Glencoe, IL.
- Eaton, W.W., 1974. Residence, social class, and schizophrenia. *J. Health Soc. Behav.* 15, 289–299.
- Faris, R.E.L., Dunham, H.W., 1939. *Mental Disorders in Urban Areas*. University of Chicago Press, Chicago.
- Freeman, H., 1994. Schizophrenia and city residence. *Br. J. Psychiatry* 164 (Suppl. 23), 39–50.
- Frumkin, R.M., 1954. Comparative rates of mental illnesses for urban and rural populations in Ohio. *Rural Sociol.* 19, 70–72.
- Hyde, R.W., Kingsley, L.V., 1944. Studies in medical sociology: the relation of mental disorders to population density. *N. Engl. J. Med.* 231, 571–577.
- Jaco, E.G. (1960) *The Social Epidemiology of Mental Disorders*. Russell Sage Foundation, New York, NY.
- King, D.J., Griffiths, K., Reilly, P.M., Merrett, J.D., 1982. Psychotropic drug use in Northern Ireland 1966–80: prescribing trends, inter- and intra-regional comparisons and relationships to demographic and socioeconomic variables. *Psychol. Med.* 12, 819–833.
- Kohn, M.L., 1968. Social class and schizophrenia: a critical review. *J. Psychiatr. Res.* 6, 155–173.
- Lewis, G., David, A., Andreasson, S., Allebeck, P., 1992. Schizophrenia and city life. *Lancet* 340, 137–140.
- Luton, F.H., 1943. The mental health program in Tennessee. *Am. J. Psychiatry* 99, 662–675.
- Machon, R.A., Mednick, S.A., Schulsinger, F., 1983. The interaction of seasonality, place of birth, genetic risk and subsequent schizophrenia in a high risk sample. *Br. J. Psychiatry* 143, 383–388.
- Malzberg, B., 1940. *Social and Biological Aspects of Mental Disease*. State Hospital Press, Utica.
- Malzberg, B., 1955. The distribution of mental diseases in New York State, 1949–1951. *Psychiatr. Q.* 29 (Suppl. 2), 209–238.
- O'Callaghan, E., Cotter, D., Colgan, K., Larkin, C., Walsh, D., Waddington, J.L., 1995. Confinement of winter birth excess in schizophrenia to the urban-born and its gender specificity. *Br. J. Psychiatry* 166, 51–54.
- Pollock, H.M., Nolan, W.J., 1921. Mental disease in cities, villages and rural districts of New York State, 1915–1920. *State Hosp. Q.* 7, 38–65.
- Ray, I., 1856. Statistics of insanity in Massachusetts. *N. Am. Rev.* 82, 79–81.
- Robins, L.N., Helzer, J.E., Weissman, M.M., Orvaschel, H., Gruenberg, E., Burke, J.D., Regier, D.A., 1984. Lifetime prevalence of specific psychiatric disorders in three sites. *Arch. Gen. Psychiatry* 41, 949–958.
- Schweitzer, L., Su, W.H., 1977. Population density and the rate of mental illness. *Am. J. Public Health* 67, 1165–1172.
- Stewart, D.D., 1953. A note on mental illness in rural Arkansas. *Social Problems* 1, 57–60.
- Takei, N., Sham, P.C., O'Callaghan, E., Murray, R.M., 1992. Cities, winter birth, and schizophrenia. *Lancet* 340, 558.
- Takei, N., Sham, P.C., O'Callaghan, E., Glover, G., Murray, R.M., 1995. Schizophrenia: increased risk associated with winter and city birth: a case-controlled study in 12 regions within England and Wales. *J. Epidemiol. Community Health* 49, 106–109.
- Torrey, E.F., 1995. Prevalence of psychosis among the Hutterites: a reanalysis of the 1950–53 study. *Schizophr. Res.* 16, 167–170.
- Torrey, E.F., Bowler, A., 1990. Geographical distribution of

- insanity in America: evidence for an urban factor. *Schizophr. Bull.* 16, 591–604.
- United States Census Office, 1888. Report of the Defective, Dependent and Delinquent Classes of the Population of the United States, as Returned at the Tenth Census (June 1, 1880). Superintendent of Documents, Government Printing Office, Washington, DC.
- Van Os, J., Takei, N., Navarro-Mateu, F., Murray, R., 1996. Season and place of birth in a sample of 22361 patients with a diagnosis of schizophrenia. *Eur. Psychiatry* 11 (Suppl. 4), 428
- Verdoux, H., Takei, N., Cassou de Saint Mathurin, R., Murray, R., Bourgeois, M., 1996. Winter birth excess in schizophrenics in French urban areas (abstract). *Schizophr. Res.* 18, 102
- White, W.A., 1903. The geographical distribution of insanity in the United States. *J. Nerv. Ment. Dis.* 30, 376–398.