County-level social factors and schizophrenia: A multilevel study of 1.9 million Chinese adults

Luo Yanan[a,b,*], Guo Chao[a,b,*], Zhang Lei[a,b], Pang Lihua[a,b], Zhao Xin[c], Zheng Xiaoying[a,b,*]

[a] Institute of Population Research, Peking University, Beijing, China
[b] APEC Health Science Academy, Peking University, Beijing, China
[c] Department of Psychology, Florida International University, Miami, FL, USA

ARTICLE INFO

ABSTRACT

There is little evidence on the association between area-level social factors and schizophrenia in China. This study aimed to investigate the relationship between county-level social factors and schizophrenia in Chinese adults aged 18 years old and above. We obtained data from the Second China National Sample Survey on Disability, and selected 1,909,205 adults for analysis. Schizophrenia was ascertained according to the International Statistical Classification of Diseases, Tenth Revision. Multilevel logistic regressions showed that areas with higher urbanization rate was associated with increased risk of schizophrenia (areas with moderate urbanization rate: OR = 1.28, 95% CI: 1.15, 1.44; areas with high urbanization rate: OR = 1.48, 95% CI: 1.26, 1.75). Stratified analyses found that, in female adults, urbanization rates, divorce rates and socioeconomic conditions were positively associated with increased risks for schizophrenia. However, in male adults, low socioeconomic conditions was related to decreased risk of schizophrenia, and there was no significant association between rates of divorce and risks for schizophrenia. In conclusion, county-level social factors, in the form of urbanization rate, divorce rate, and socioeconomic conditions, were associated with the risk of schizophrenia in Chinese adults. Gender differences were found in these associations.

1. Introduction

Epidemiological studies have widely documented a strong evidence for social environmental risk factors of schizophrenia recently (Tost and Meyer-Lindenberg, 2012). Although genetic factors are the best established risk factors for schizophrenia, genetic predispositions may only account for a small part of this disease (Mortensen et al., 1999). As geographical variations across areas of schizophrenia prevalence have been identified (Coid et al., 2017; Zammit et al., 2010), area-level social and environmental factors of schizophrenia are proposed (Tost and Meyer-Lindenberg, 2012). Previous studies found that urbanicity, social deprivation, and social fragmentation were the risk factors of schizophrenia (Byrne et al., 2004; Lederbogen et al., 2011; Werner et al., 2007).

In China, studies of schizophrenia evidenced that its prevalence varied across geographical regions. And there were urban-rural differences across geographical regions (Coid et al., 2017; Liu et al., 2015). However, there is little evidence on the association of area-level social factors and schizophrenia in China. Emerging research about

geographical variations of schizophrenia in China were limited to the use of broad "urban" and "rural" categories, which may mask some differences because of the substantial variations in area-level variables at a small geographical scale (e.g., county-level or community-level social factors) (Coid et al., 2017; Liu et al., 2015). The association between county-level social factors and schizophrenia in China is largely unknown.

Using a nationally representative population-based dataset, this study aimed to investigate the relationship between county-level social factors and schizophrenia in Chinese adults aged 18 years old and above. This study will fill the gaps on this issue in China and will contribute to the world literature from the perspective of eastern social context.

2. Methods

2.1. Study population

Data from the Second National Sample Survey on Disability

---

* Corresponding author at: APEC Health Science Academy, Peking University/Institute of Population Research, Peking University, No.5 Yiheyuan Road Haidian District, Beijing, PR China.
  E-mail address: xzheng@pku.edu.cn (X. Zheng).

implemented from 1 April to 31 May 2006 was used in this study. This survey aimed to describe the prevalence, causes and severities of disability, as well as the living conditions and health service utilizations of the disabled, which covered all provincial administrative areas in mainland China. Multistage, stratified random-cluster sampling, with probability proportional to size, was used in 734 counties (districts), 2980 towns (streets) and 5964 communities (villages) from 31 provinces, autonomous regions and municipalities under the Central Government in China. A total of 2,526,145 persons was sampled from randomly 771,797 households, representing 1.9 per 1000 non-institutionalized inhabitants of China. Details could be found elsewhere (Zheng et al., 2011). We restricted our analysis to 1,909,205 participants aged 18 years or older.

More than 20,000 interviewers, 6000 doctors of various specialties, as well as 50,000 survey assistants administrated this measure. In the pre-survey investigations, households, population and suspected disabled people in all sampling communities were investigated. Face-to-face household interview was used to investigate every family member in the selected households when the survey began (Li et al., 2015).

2.2. Schizophrenia assessment

In the Second National Sample Survey on Disability, according to the World Health Organization International Classification of Functioning, Disability and Health (WHO-ICF), schizophrenia was ascertained by the combination of self-reports or family members' reports and on-site diagnosis by psychiatrists (WHO, 2011).

At first, trained interviewers, who were recruited from local primary care institutions, would identify adults aged 18 years or older who were likely to have psychiatric disability using a questionnaire during a face-to-face household interview. The questionnaire was developed for this survey according to the 'Guide-lines and Principles for the Development of Disability Statistics' recommended by UN (2001). The screening questions included five items which had been demonstrated high reliability (Zhang, 2010): (1) Has a poor memory (forgetful)? (2) Has difficulty in concentration their emotions (his/her mind often wanders)? (3) Has difficulty controlling their emotions (moody, too joyful or too joyless)? (4) Has strange language and/ or weird behavior that could not be understood or accepted by a normal person? (5) Fasting drinking (for at least five times per week); or hypnotic drug overdose (Liu et al., 2014). If any of the screening questions was positively responded, the identified individual was labeled as likely to have psychiatric disability.

Then, the doctors at health clinics or community health stations with more than 5 years clinical experience, according to the World Health Organization International Classification of Functioning, Disability and Health (WHO-ICF) (Stephens, 2001), diagnosed the suspected psychiatric disability among older adults. The World Health Organization Disability Assessment Schedule, Version II (WHO DAS II) was used to evaluate social function limitations (WHO, 1999). Individuals with psychiatric disability were defined as WHO DAS scores ≥ 52 (Liu et al., 2014).

Afterwards, individuals with schizophrenia were assessed by psychiatrists based on the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) Symptom Checklist for Mental Disorders for those who were identified as psychiatric disability (WHO, 1992). The ICD-10 diagnostic criteria had been employed in the ascertainment of schizophrenia among Chinese people and presented satisfactory validity in China (St Clair et al., 2005).

2.3. County-level social factors

Urbanization rate, divorce rate and the mean years of education are county-level social factors representing averages and percentages measured at the enumeration area level in 2000 China Census.

Urbanization rate was used to measure the level of urbanicity. Mean years of schooling was used as a proxy for socioeconomic conditions (Liu et al., 2015). Divorce rate was used as an index of social fragmentation (Stack, 1981). The advantage of using census information is that it summarizes characteristics of all residents rather than of a selected number of study participants (Veugelers et al., 2001).

2.4. Ethical approval

The survey was conducted in all provinces by the Leading Group of the National Sample Survey on Disability and the National Bureau of Statistics with approval by the State Council of China. All survey respondents provided consent to the Chinese government.

2.5. Measures

The outcome variable was a binary measure (i.e., whether having schizophrenia). The independent variables were urbanization rate, socioeconomic conditions and divorce rate. Each of these county-level variables was divided into tertiles, representing 'low', 'moderate' and 'high' groups, to allow the examination of associations with schizophrenia. Control variables at the individual levels included age (18–44 years, 45–64 years, or ≥ 65 years), gender (male or female), living with spouse (yes or no), region (east, central or west), residence (urban or rural), household income per capita (tertile1 (the lowest household income per capita), tertile2 or tertile3 (the highest household income per capita)) and educational attainment (illiterate, primary school or less, junior school or above).

2.6. Statistical analysis

Descriptive statistics were provided to present the prevalence of schizophrenia by various demographic characteristics. The association between county-level social factors and schizophrenia was evaluated by using multilevel logistic regression. Individual-level and county-level characteristics were considered to be first-level and second-level covariates, respectively. Interclass correlation coefficient (ICC) was used to interpret the proportion of total variance in schizophrenia that could be attributed to county-level social factors. Statistical significance was set at a two-tailed p value of < 0.05. We used Stata version 13.0 for Windows (Stata Corp, College Station, TX, USA) to conduct all statistical analyses.

3. Results

3.1. Characteristics of participants and prevalence of schizophrenia

This study investigated 1909,205 participants aged 18 years or older (mean age 44.33 years, SD 16.15). Among the respondents, 50.24% were female, 20.22% living without spouse and 35.58% were living in urban areas. The urbanization rate, divorce rate and the mean years of education at county level was 40.08% (SD 31.31), 0.99% (SD 0.67) and 7.59 years (SD 4.19), respectively. Other characteristics of participants can be found in Table 1.

Among all adults, the prevalence of schizophrenia decreased with the increased county-level socioeconomic conditions. Areas with moderate divorce rates and moderate urbanization rates had the highest schizophrenia prevalence. Among female adults, the patterning of the prevalence of schizophrenia was similar to that among all adults by county-level social factors. In contrast with female, the patterning of schizophrenia in male adults showed the different variation in parallel analysis. For example, the prevalence of schizophrenia decreased with increased divorce rate (Table 1).

Table 1
Characteristics and prevalence of schizophrenia with 95% confidence interval (CI) by social factors among Chinese adults.

Characteristics	Total (N = 1,909,205)		Female (N = 959,247)		Male (N = 949,958)	
	Cases	Prevalence (95% CI)	Cases	Prevalence (95% CI)	Cases	Prevalence (95% CI)
Individual level						
Age						
18–44 years	3855	0.37(0.36,0.38)	1879	0.36(0.34,0.37)	1976	0.38(0.36,0.39)
45–64 years	2910	0.48(0.46,0.50)	1741	0.58(0.55,0.61)	1169	0.38(0.36,0.40)
≥ 65 years	863	0.34(0.32,0.37)	575	0.44(0.40,0.47)	288	0.24(0.22,0.27)
Having spouse						
No	4201	0.28(0.27,0.28)	3054	0.40(0.38,0.41)	1147	0.15(0.14,0.16)
Yes	3427	0.89(0.86,0.92)	1141	0.60(0.57,0.64)	2286	1.16(1.11,1.21)
Region						
East	3064	0.40(0.38,0.41)	1664	0.43(0.41,0.45)	1400	0.37(0.35,0.39)
Central	2081	0.37(0.36,0.39)	1205	0.43(0.41,0.46)	876	0.31(0.29,0.34)
West	2483	0.43(0.41,0.44)	1326	0.46(0.43,0.48)	1157	0.40(0.37,0.42)
Residence						
Rural	5379	0.44(0.43,0.45)	3062	0.50(0.48,0.52)	2317	0.37(0.36,0.39)
Urban	2249	0.33(0.32,0.35)	1133	0.33(0.31,0.34)	1116	0.34(0.32,0.36)
Income						
Tertile1(Lowest)	3942	0.69(0.67,0.72)	2102	0.74(0.71,0.77)	1840	0.65(0.62,0.68)
Tertile2(Moderate)	2079	0.35(0.34,0.37)	1198	0.40(0.38,0.43)	881	0.30(0.28,0.32)
Tertile3(Highest)	1607	0.21(0.20,0.22)	895	0.24(0.22,0.25)	712	0.19(0.18,0.21)
Education						
Illiterate	2204	0.73(0.70,0.76)	1593	0.71(0.68,0.75)	611	0.78(0.72,0.84)
Primary school or less	2366	0.44(0.42,0.45)	1295	0.48(0.45,0.50)	1071	0.40(0.37,0.42)
Junior high school or above	3058	0.29(0.28,0.30)	1307	0.28(0.27,0.30)	1751	0.29(0.28,0.31)
County level						
Urbanization rate						
Low	2568	0.40(0.39,0.42)	1452	0.46(0.44,0.48)	1116	0.35(0.33,0.37)
Moderate	2756	0.43(0.42,0.45)	1517	0.48(0.45,0.50)	1239	0.39(0.37,0.41)
High	2304	0.36(0.35,0.38)	1226	0.38(0.36,0.40)	1078	0.34(0.32,0.37)
Percentage divorced						
Low	2527	0.41(0.39,0.42)	1372	0.44(0.42,0.46)	1155	0.38(0.35,0.40)
Moderate	2720	0.42(0.40,0.43)	1537	0.47(0.45,0.50)	1183	0.36(0.34,0.38)
High	2381	0.37(0.36,0.39)	1286	0.40(0.38,0.42)	1095	0.35(0.33,0.37)
Socioeconomic condition						
Low	2772	0.44(0.42,0.45)	1485	0.47(0.45,0.49)	1287	0.40(0.38,0.43)
Moderate	2653	0.42(0.40,0.43)	1498	0.47(0.45,0.49)	1155	0.36(0.34,0.38)
High	2203	0.35(0.33,0.36)	1212	0.37(0.35,0.40)	991	0.32(0.3,0.34)

3.2. Association between county-level social factors and schizophrenia in all adults

Table 2 illustrates the results of the multilevel logistic regression analyses between area-level social determinants and schizophrenia among all adults. Model 1 confirmed the association between urbanization rates and schizophrenia. Model 2 had slightly decreased impact on ORs of urbanization rates. Sequentially, in model 3, higher urbanization rate was associated with increased risk of schizophrenia (moderate urbanization rate: OR = 1.28, 95%CI: 1.15, 1.44; high urbanization rate: OR = 1.48, 95% CI: 1.26, 1.75). However, this significant association does not present in socioeconomic conditions and divorced rate (Model 4).

3.3. Association between county-level social factors and schizophrenia by gender

Table 3 presents the results of the multilevel logistic regression analyses between county-level social factors and schizophrenia among female adults. The results in female sample were different to those in total sample. High urbanization rate, high socioeconomic conditions and high divorce rate were all significantly associated with the risk of schizophrenia.

Table 4 shows the estimated results in male adults. High urbanization rate was still also found to be associated with schizophrenia in model 3. However, we did not observe any significant association between high divorced rate and schizophrenia. Additionally, we found that high socioeconomic conditions was associated with decreased risk of schizophrenia.

Table 2
Multilevel analysis of the association between area-level social factors and schizophrenia (all adults).

Characteristics	Unadjusted ORs (95% CI)[a]	Adjusted ORs (95% CI)[b]	Adjusted ORs (95% CI)[c]
Urbanization rate			
Low	Reference	Reference	Reference
Moderate	1.07(0.97, 1.18)	1.13(1.02,1.24)*	1.28(1.15,1.44)***
High	0.90(0.81, 0.99)*	1.12(0.98,1.29)	1.48(1.26,1.75)***
Percentage divorced			
Low	Reference	Reference	Reference
Moderate	1.01(0.91,1.11)	1.02(0.93,1.12)	1.06(0.95,1.18)
High	0.91(0.83,1.01)	1.01(0.90, 1.13)	1.09(0.96,1.25)
Socioeconomic condition			
Low	Reference	Reference	Reference
Moderate	0.95(0.86,1.04)	0.92(0.83,1.01)	1.05(0.94,1.18)
High	0.77(0.70,0.85)***	0.72(0.63,0.83)***	1.02(0.87,1.19)

Note:
[a] Unadjusted models.
[b] Adjusted for county level indicators (urbanization rate, percentage divorced, socioeconomic condition).
[c] Adjusted for individual level indicators (age groups, having spouse, region, residency, income and education) and county level indicators (urbanization rate, percentage divorced, socioeconomic condition).
* $P < 0.05$, ** $P < 0.01$
*** $P < 0.001$.

Table 3

Multilevel analysis of the association between area-level social factors and schizophrenia (Female adults).

Characteristics	Unadjusted ORs (95% CI)[a]	Adjusted ORs (95% CI)[b]	Adjusted ORs (95% CI)[c]
Urbanization rate			
Low	Reference	Reference	Reference
Moderate	1.05(0.94, 1.17)	1.06(0.94,1.18)	1.21(1.07,1.36)**
High	0.83(0.75, 0.93)**	0.96(0.82,1.12)	1.29(1.08,1.54)**
Percentage divorced			
Low	Reference	Reference	Reference
Moderate	1.06(0.95, 1.18)	1.08(0.97,1.20)	1.13(1.00,1.27)*
High	0.90(0.81, 1.01)	1.02(0.90, 1.15)	1.19(1.03,1.38)*
Socioeconomic condition			
Low	Reference	Reference	Reference
Moderate	1.06(0.95, 1.17)	1.05(0.94,1.17)	1.20(1.06,1.36)**
High	0.80(0.72, 0.90)***	0.84(0.72,0.97)*	1.22(1.03,1.45)*

Note:

[a] Unadjusted models.

[b] Adjusted for county level indicators (urbanization rate, percentage divorced, socioeconomic condition).

[c] Adjusted for individual level indicators (age groups, having spouse, region, residency, income and education) and county level indicators (urbanization rate, percentage divorced, socioeconomic condition).

* $P < 0.05$,

** $P < 0.01$,

*** $P < 0.001$.

Table 4

Multilevel analysis of the association between area-level social factors and schizophrenia (Male adults).

Characteristics	Unadjusted ORs (95% CI)[a]	Adjusted ORs (95% CI)[b]	Adjusted ORs (95% CI)[c]
Urbanization rate			
Low	Reference	Reference	Reference
Moderate	1.10(0.98,1.25)	1.22(1.08, 1.38)**	1.37(1.20,1.57)***
High	0.98(0.86,1.11)	1.36(1.14,1.62)**	1.73(1.42,2.11)***
Percentage divorced			
Low	Reference	Reference	Reference
Moderate	0.96 (0.85,1.08)	0.97(0.86,1.09)	0.97(0.85,1.11)
High	0.93(0.82, 1.05)	1.00(0.87,1.15)	0.98(0.84,1.15)
Socioeconomic condition			
Low	Reference	Reference	Reference
Moderate	0.83(0.74,0.94)**	0.78(0.69,0.88)***	0.88(0.77,1.00)
High	0.73(0.65,0.83)***	0.60(0.51,0.71)***	0.79(0.65,0.95)*

Note:

[a] Unadjusted models.

[b] Adjusted for county level indicators (urbanization rate, percentage divorced, socioeconomic condition).

[c] Adjusted for individual level indicators (age groups, having spouse, region, residency, income and education) and county level indicators (urbanization rate, percentage divorced, socioeconomic condition).

* $P < 0.05$.

** $P < 0.01$.

*** $P < 0.001$.

4. Discussion

This study investigated the association of county-level social factors and schizophrenia by using a nationally population-based survey in China. After the identification of mental disability according to the WHO-ICF by psychiatrists, final schizophrenia cases were ascertained through medical diagnoses based on the ICD-10. This study found that county-level social factors, in the form of urbanization rate, socioeconomic conditions and divorce rate, were associated with the risk of schizophrenia. There were gender differences among these associations.

We found that higher urbanization rates were associated with increased risk of schizophrenia, which was consistent with previous finding (Krabbendam et al., 2005). On the one hand, studies on

biological pathways suggested that city living or urban upbringing affected the perigenual anterior cingulate cortex, which was the key region for the regulation of negative affect and stress (Lederbogen et al., 2011). On the other hand, epidemiology interpretation for this link indicated that, although urban inhabitants often receive better nutrition, health care and improved sanitation, they are more likely to have chronic disorders and live in stressful or social disparities environment (Lederbogen et al., 2011; Selten and Cantor-Graae, 2005). Also, high urbanization rates are associated with higher migration rates. Individuals in areas with higher migration rates are more likely to experience higher levels of stress and anxiety from new environment adoption and socializing (Pedersen and Mortensen, 2001).

This study demonstrated a significant association between high divorce rates and decreased risk of schizophrenia, which was only present in female adults, not in male adults. Divorce rate is often used as an index of social fragmentation (Stack, 1981). Areas with higher divorce rate had higher levels of economic disruption, higher single parent family upbringing rates and higher suicide rates, which may mediate the increased risk of schizophrenia (Burr et al., 1997). The divorcees, especially female divorcees, tend to experience social isolation, loss of regularized supportive companionship and separation from extended families (Stack, 1981). One of the reasons for the gender difference on the association between divorce rates and risk of schizophrenia may result from the gender differences in coping with stress (Haug et al., 2015). Compared to men, women tend to ruminate more about stressors and have negative thoughts. The gender difference in rumination and coping explains the gender difference in the prevalence of psychosis (Assari and Lankarani, 2016).

Our findings indicated that there was a gender difference in the association between socioeconomic conditions and schizophrenia. Although male adults in high socioeconomic conditions areas was related to decreased risk of schizophrenia, female adults in high socioeconomic conditions areas were related to increased risk of schizophrenia. As the common proxy for socioeconomic conditions, education has been recognized as an important and modifiable socioeconomic determinant of schizophrenia. One explanation is that the association between education and health varies in sociocultural contexts (Galobardes et al., 2007). For instance, although Chinese women's status is steadily rising, China is still a traditional male-dominated society. Higher socioeconomic conditions areas may be connected with more utilization of health services, which was only reflected in male due to son preference and male-dominated society in China. Additionally, the role of education in labor force participation is more

important to female than to male (Bank, 2012). For vulnerable groups (such as female adults) with lower social background, achieving success in a career may have exposed them to occupational stress and work-life imbalance (Makikyro et al., 1997).

A striking strength of this study is the very large sample, which is representative of the 1.9 million Chinese people. The use of the WHODAS II and the ICD-10 Symptom Checklist for Mental Disorders as diagnostic tools, as well as the use of experienced clinical psychiatrists as interviewers, improved the comparability of the diagnostic process; therefore, information bias that might have resulted from the use of different diagnostic procedures was minimized. To our best knowledge, this study is the first study to report the empirical results of county-level social factors in relation to schizophrenia from a multilevel perspective in mainland China.

However, our study also had limitations. First, there is a discrepancy in the timing of measurement as county-level social factors and individual-level factors. Thus, we only compared the relative differences of social factors in varying areas and its association with schizophrenia. Secondly, as considered from a county-level perspective, the population migration between the counties may affect our study results. However, although population migration was restricted from the establishment of China's strict *Hukou* (passport) system in the 1950s. Therefore, the impact of population migration on results from the current study is small. Thirdly, a cross-section design for schizophrenia disability in this study cannot draw causal inferences. Longitudinal research is to understand the mechanisms of area-level social factors and schizophrenia. Fourthly, some schizophrenia patients without disabilities may not have been identified in this survey. Therefore, our findings may underestimate the overall prevalence of schizophrenia. Fifthly, our survey did not collect the information of some confounders, such as county-level income, mental disorders and psychiatric management policies. Therefore, the associations between county-level risk factors and schizophrenia should be interpreted cautiously.

In conclusion, this research suggested that county-level social factors, in the form of socioeconomic conditions, divorce rate and urbanization rate, were associated with the risk of schizophrenia. There were gender differences in these associations. This study contributes to the literature on schizophrenia in developing nations of a non-western context. This study indicates that action to reduce the disparities in schizophrenia will require attention to the area-level context of high urbanization rates. Strategies for improving the access to health services for individuals in areas with high urbanization rates are needed. Furthermore, public policies that seek to promote gender equality especially in areas with high socioeconomic conditions and divorce rates will play a fundamental role in improving the mental health of females. Future research is needed to confirm the findings, understand the reasons for the variations, and identify area-specific policy implications.

References

Assari, S., Lankarani, M.M., 2016. Stressful life events and risk of depression 25 years later: race and gender differences. Front Public Health 4, 49.

Bank, T.W., 2012. World Development Report 2012. Washington D, 39, 1145–1161.

Burr, J.A., Mccall, P.L., Powell-Griner, E., 1997. Female labor force participation and suicide. Soc. Sci. Med. 44, 1847–1859.

Byrne, M., Agerbo, E., Eaton, W.W., Mortensen, P.B., 2004. Parental socioeconomic status and risk of first admission with schizophrenia-a Danish national register based study. Soc. Psychiatry Psychiat. Epidemiol. 39, 87.

Coid, J., Hu, J., Kallis, C., Ping, Y., Zhang, J., Hu, Y., Zhang, T., Gonzalez, R., Ullrich, S., Peter, P.B., Kirkbride, J.B., 2017. Urban birth, urban living, and work migrancy: differential effects on psychotic experiences among young chinese men. Schizophrinia Bullutin. https://doi.org/10.1093/schbul/sbx152.

Galobardes, B., Lynch, J., Smith, G.D., 2007. Measuring socioeconomic position in health research. Br. Med. Bull. 81, 21.

Haug, E., Oie, M., Andreassen, O.A., Bratlien, U., Nelson, B., Aas, M., et al., 2005. Anomalous self-experience and childhood trauma in first-episode schizophrenia. Compr. Psychiatry. 56, 35–41.

Krabbendam, L., Van, O.J., 2005. Schizophrenia and urbanicity: a major environmental influence-conditional on genetic risk. Schizophr. Bull. 31, 795–799.

Lederbogen, F., Kirsch, P., Haddad, L., Streit, F., Tost, H., Schuch, P., Wu, S., Pruessner, J.C., Rietschel, M., Deuschle, M., Meyer-Lindenberg, A., 2011. City living and urban upbringing affect neural social stress processing in humans. Nature 474, 498–501.

Li, N., Zhang, L., Du, W., Pang, L., Guo, C., Chen, G., Zheng, X., 2015. Prevalence of dementia-associated disability among Chinese older adults: results from a national sample survey. Am. J. Geriatr. Psychiatry 23, 320.

Liu, T., Song, X., Chen, G., Paradis, A.D., Zheng, X., 2014. Prevalence of schizophrenia disability and associated mortality among Chinese men and women. Psychiatry Res. 220, 181–187.

Liu, T., Zhang, L., Pang, L., Li, N., Chen, G., Zheng, X., 2015. Schizophrenia-related disability in China: prevalence, gender, and geographic location. Psychiatr. Serv. 66, 249–257.

Mäkikyrö, T., Isohanni, M., Moring, J., Oja, H., Hakko, H., Jones, P., Rantakallio, P., 1997. Is a child's risk of early onset schizophrenia increased in the highest social class? Schizophr. Res. 23, 245–252.

Mortensen, P.B., Pedersen, C.B., Westergaard, T., Wohlfahrt, J., Ewald, H., Mors, O., Andersen, P.K., Melbye, M., 1999. Effects of family history and place and season of birth on the risk of schizophrenia. N. Engl. J. Med. 340, 603–608.

Pedersen, C.B., Mortensen, P.B., 2001. Evidence of a dose-response relationship between urbanicity during upbringing and schizophrenia risk. Arch. Gen. Psychiatry 58, 1039–1046.

Selten, J.P., Cantor-Graae, E., 2005. Social defeat: risk factor for schizophrenia? Br. J. Psychiatry 187, 101–102.

St Clair, D., Xu, M., Wang, P., Yu, Y., Fang, Y., Zhang, F., Zheng, X., Gu, N., Feng, G., Sham, P., He, L., 2005. Rates of adult schizophrenia following prenatal exposure to the Chinese famine of 1959–1961. JAMA 294, 557–562.

Stack, S., 1981. Divorce and suicide: a time series analysis, 1933-1970. J. Famil. Issues 2, 77.

Stephens, D., 2001. World Health Organization's international classification of functioning, disability and health - ICF. Paper presented at the EGS General Assembly Conference.

Tost, H., Meyer-Lindenberg, A., 2012. Puzzling over schizophrenia: schizophrenia, social environment and the brain. Nat. Med. 18, 211–213.

United Nations, 2001. Guidelines and Principles for the Development of Disability Statistics. United Nations Publication, New York.

Veugelers, P.J., Yip, A.M., Kephart, G., 2001. Proximate and contextual socioeconomic determinants of mortality: multilevel approaches in a setting with universal health care coverage. Am. J. Epidemiol. 154, 725–732.

Werner, S., Malaspina, D., Rabinowitz, J., 2007. Socioeconomic status at birth is associated with risk of schizophrenia: population-based multilevel study. Schizophr. Bull. 33, 1373–1378.

World Health Organization, 1992. The ICD-10 Classification of Mental and Behavioural disorders: Clinical Descriptions and Diagnostic Guidelines. The World Health Organization, Geneva, Switzerland.

World Health Organization, 1999. The World Health Organization Disability Assessment Schedule Phase II Field Trial Instrument. The World Health Organization, Geneva, Switzerland.

World Health Organization, 2011. International Classification of Functioning, Disability, and Health (ICF). The World Health Organization, Geneva, Switzerland.

Zammit, S., Lewis, G., Rasbash, J., Dalman, C., Gustafsson, J.E., Allebeck, P., 2010. Individuals, schools, and neighborhood: a multilevel longitudinal study of variation in incidence of psychotic disorders. Arch. Gen. Psychiatry 67, 914–922.

Zhang, J., 2010. Study of Disability Survey Method Institute of Population Research (in Chinese). Peking University, Beijing, China.

Zheng, X., Chen, G., Song, X., Liu, J., Yan, L., Du, W., Pang, L., Zhang, L., Wu, J., Zhang, B., Zhang, J., 2011. Twenty-year trends in the prevalence of disability in China. Bull. World Health Org. 89, 788–797.