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# Individual-level and area-level socioeconomic status (SES) and schizophrenia: cross-sectional analyses using the evidence from 1.9 million Chinese adults

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## ABSTRACT

**Objectives** Health disparities in schizophrenia are well established. However, it is less understood whether area-level socioeconomic status (SES) is differentially associated with schizophrenia depending on individual-level SES. Therefore, using a nationally large representative data, this study investigated the association between individual-level SES, area-level SES and their interaction with schizophrenia in Chinese adults from a multilevel perspective.

**Setting** Household interviews in 734 counties (districts), 2980 towns (streets) and 5964 communities (villages) from 31 provinces, People's Republic of China, as part of the cross-sectional survey of Second China National Sample Survey on Disability.

**Participants** 1 909 205 men and women aged 18 years old and above.

**Primary and secondary outcome measures** A screen followed by clinical diagnosis was used to identify schizophrenia, and schizophrenia was ascertained according to the International Statistical Classification of Diseases, 10th Revision (code F20).

**Results** 1-SD increase in individual SES was associated with decreased risk of schizophrenia (*OR*=0.45, *95% CI* 0.43 to 0.46). 1-SD increase in area-level SES was associated with increased risk of schizophrenia (*OR*=1.30, *95% CI* 1.24 to 1.37). The interaction of individual SES and area-level SES was statistically significant (*OR*=1.05, *95% CI* 1.02 to 1.08); as the level of area SES increased, schizophrenia risk of lower SES people grew faster than the risk of higher SES people.

**Conclusions** Area-level SES is particularly important to mental health of low SES individuals, with low SES people in high SES counties having the highest risk of schizophrenia than other groups. Action to reduce SES disparities in schizophrenia will require attention to the area-level context of low SES adults.

## Strengths and limitations of this study

- This study is the first study to report the empirical results of the interaction of individual-level and area-level socioeconomic status (SES) and their association with schizophrenia from a multilevel perspective in mainland China.
- We used a very large-size and population-based design survey to study the relationship between individual-level and area-level SES and schizophrenia.
- The use of International Statistical Classification of Diseases, 10th Revision 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.
- The population migration between the counties may affect our study results, although the impact of population migration on results is small because of the restriction from China's strict migration regulating.
- Further studies need to understand the mechanisms of SES and schizophrenia, because the cross-sectional design in this study cannot draw causal inferences.

## INTRODUCTION

Schizophrenia is global public health concern, causing a total loss of 16.8 million disability adjusted life years (DALY) worldwide[1] and being the leading cause of mental disability.[2] People with schizophrenia have 2–2.5 times mortality rate higher than the general population,[3] and accompanied by decreased physical functioning, social participation and self-care ability.[4] Accumulating evidence reported the social disparities in schizophrenia, which increased the mental health inequalities and high burden for healthcare system.[5]

In considering how to reduce schizophrenia social disparities and perfecting the level of healthcare system, the context in which risk factors are produced needs to be better understood. Robust evidence demonstrates an association between area-level socioeconomic status (SES) and schizophrenia.[6] Individuals who live in more advantaged areas are often accompanied by fewer health risk

factors and lower mortality rates for schizophrenia.[6 7] Many mechanisms, such as the cost of available resources, environmental exposures (eg, social stress and household crowding), elevated inflammation, infections, greater allostatic load and vitamin D deficiency, may contribute to schizophrenia as a function of area-level SES.[7–10]

It is clear that, independent of individual-level SES, area-level SES is associated with the risk of schizophrenia.[11] However, it is unclear whether this linkage of area SES will be stronger or weaker depending on individual SES. Four relevant theoretical models were used to interpret that how area SES and individual SES may interact in relation to health: the double jeopardy hypothesis, collective resources model, fundamental cause theory and the relative deprivation hypothesis.[12 13] The first three models all predict the similar pattern, which indicate that the health of lower SES individuals will be particularly worse off if they reside in lower SES areas. Whereas the relative deprivation hypothesis regards that the health of lower SES individuals may be worse if they live in higher SES areas than if they reside in lower SES areas.

To our best knowledge, little evidence was focusing area-level SES and the cross-level interaction between area-level and individual-level SES with schizophrenia in Chinese mainland. Moreover, no evidence used the counties as the units to study this issue. As the particularly important administrative unit in China, county, with average 500 000persons, is the lowest most basic layer at which the public health policy functioned.[14] Studying the schizophrenia issue at the county level would be very helpful for perfecting the level of mental healthcare system and promoting psychiatric policies in China. Accordingly, this study would use a nationally large representative data to investigate county-level and individual-level SES and their interaction with schizophrenia in Chinese mainland.

## METHODS

### Study population

Participants in this analysis were members of Second National Sample Survey on Disability. This survey is a national sample survey implemented from 1 April to 31 May 2006, designed to be 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. Over 20 000 interviewers, 6000 doctors of various specialties and 50 000 survey assistants attended this survey. This survey used face-to-face household interview to investigate every family member in the selected households. Details could be found elsewhere.[15] Data cannot be shared publicly because of legal restrictions, that is, the data contain potentially sensitive information. The State Council of China imposed the restrictions according to the Statistical Law of the People's Republic of China (1996 Amendment). Data are available from the Data Access committee of China Disabled Persons Federation (http://www.cdpf.org.cn/special/dlzt/cydc/index.htm) for researchers who meet the criteria for access to confidential data.

### Patient and public involvement

It is a population-based survey conducted to ascertain the prevalence, socioeconomic conditions and demand of rehabilitation services of the handicapped persons in China. The results of this survey will help stakeholders to understand the survival status of the disabled and find the useful medical and rehabilitation services for them. A total of 1 909 205 individuals aged 18 years or older from 31 provinces, autonomous regions and municipalities in China participated in this survey. Of these, 7628 patients with schizophrenia were involved. Study subjects only participated the collection of study data. All patients can be informed of the health examinations results in free of charge in this survey.

### Schizophrenia assessment

This survey identified schizophrenia by the combination of self-reports or family members' reports and on-site diagnosis by psychiatrists:

First, this survey used a questionnaire to screen participants who were likely to be meeting thresholds to indicate psychiatric morbidity/difficulties. People meeting thresholds to indicate psychiatric morbidity/difficulties was defined as persons who were affected by psychiatric disorders for more than 1 year and experienced disturbance in cognition, emotion and behaviour that had impacted on their daily living activities and social participation. This survey used a screening questionnaire to identify participants who were meeting thresholds to indicate psychiatric morbidity/difficulties by face-to-face interview. This questionnaire was developed according to the 'Guidelines and Principles for the Development of Disability Statistics', recommended by the United Nations.[16] It had been tested in three pilot studies and had been demonstrated high reliability in Chinese population.[17] The questionnaire includes five questions: (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 behaviour that could not be understood or accepted by a normal person? and (5) fasting drinking (for at least five times per week) or hypnotic drug overdose. If any of the screening questions was positively responded, the identified individual was labelled as likely to be meeting thresholds of disability with mental disorders.

Second, experienced psychiatrists used WHO Disability Assessment Schedule, Version II (WHO DAS II) to diagnose disability with mental disorders. Psychiatrists who have at least 5 years of clinical experience assessed the disabilities with mental disorders at a private quiet room. WHO DAS II was used to evaluate social function

Table 1 Characteristics of participants (n=1 909 205)

| Characteristics | Total | | Schizophrenia | |
|---|---|---|---|---|
| | Median (IQR) or % | Range | Yes Median (IQR) or % | No Median (IQR) or % |
| Schizophrenia | | | | |
| No (%) | 99.60 | | | |
| Yes (%) | 0.40 | | | |
| Area-level SES variables | | | | |
| Per capita income, yuan | 3516 (2572–5498) | 754–20189 | 3328 (2572–5060) | 3516 (2572–5498) |
| Residents with ≥high school (%) | 14.73 (11.16–22.93) | 1.45–70.67 | 14.14 (10.81–20.11) | 14.73 (11.16–22.99) |
| Residents with income below poverty (%) | 2.23 (0.60–5.46) | 0–57.93 | 2.27 (0.71–5.52) | 2.23 (0.60–5.46) |
| Residents with upper class occupations (%) | 11.75 (8.62–19.23) | 2.36–47.89 | 11.11 (8.47–17.73) | 11.75 (8.62–19.23) |
| Area-level SES | 0.00 (–0.56 to 0.41) | –2.83–3.05 | –0.068 (–0.57 to 0.27) | 0.00027 (–0.56 to 0.41) |
| Individual-level SES variables | | | | |
| Per household income, yuan | 3000 (1667–5757) | 0–99999 | 1800(1000–3333) | 3000(1667–5833) |
| Education * | | | | |
| Primary school and below (%) | 15.85 | | 28.89 | 15.80 |
| Junior high school (%) | 28.46 | | 31.02 | 28.45 |
| Senior high school and above (%) | 55.69 | | 40.09 | 55.75 |
| Individual-level SES | 0.00 (-0.57–0.42) | –1.61–12.36 | –0.44 (-1.22–0.0038) | 0.0018 (-0.57–0.42) |
| Sociodemographic variables | | | | |
| Age, years (±SD) | 42 (32–55) | | 44 (32–55) | 42 (35–56) |
| Gender | | | | |
| Female (%) | 49.76 | | 45.01 | 49.78 |
| Male (%) | 50.24 | | 54.99 | 50.22 |
| Residence | | | | |
| Rural (%) | 64.42 | | 70.52 | 64.39 |
| Urban (%) | 35.58 | | 29.48 | 35.61 |
| Marital status | | | | |
| Currently live without spouse (%) | 79.78 | | 70.52 | 79.88 |
| Currently live with spouse (%) | 20.22 | | 29.48 | 20.12 |

*Education was treated as a continuous variable but is presented categorically for descriptive purpose.
SES, socioeconomic status.

limitations of the disability with mental disorders, which has been validated among patients with mental disorders.[18] If needed, the family members or caregivers were allowed to stay in the interview room and answer questions. Individuals who received a score of 52 or higher were diagnosed as being meeting thresholds to indicate psychiatric morbidity/difficulties.

Finally, those diagnosed as disability with mental disorders were assigned to subsequent diagnostic procedures and to determine whether diagnosed disability with mental disorders was due to schizophrenia. The International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10) Symptom Checklist for Mental Disorders was administered to diagnose schizophrenia (ICD-10 code F20).[19] The ICD-10 code F20 diagnostic criteria have been widely used in the ascertainment of schizophrenia among Chinese people and have presented satisfactory reliability and validity.[20]

## Study measures

### Area-level SES

Participants' addresses were linked to county-level data from 734 counties of 2000 China Census. We used 2000 census to estimate per capita income, percentage of residents with high school education, percentage of resident with income below poverty (reverse coded) and percentage of residents with upper class occupation (including manager and technical staff). Then we calculated z-scores for each variable and summed them into an overall index to represent area-level SES. Area-level SES had a mean of zero and SD of 1, and the range of area-level SES was −2.83 to 3.05. Higher values reflected higher area-level SES.

### Individual-level SES

Individual-level SES was defined as a summed of z-scored of educational attainment and household income per capita. Educational attainment was an eight-response

categorical variable, ranging from no school to completion of postgraduate degree. Education was treated as a continuous variable. Categories were a combination of years of schooling and degree attainment (no school=0, primary school=6, junior high school=9, senior high school=12, college=16, postgraduate degree=19). The range of individual-level SES was −1.61/12.36, with a mean of zero and SD of 1. Higher values of the composite score reflected higher individual SES.

### Ethics approval

All survey respondents provided consent to the Chinese government.

### Covariates

Covariates at the individual levels included age, gender (male or female), married (married or unmarried) and residence (urban or rural). Urban areas included both cities and towns in this study. All cities and towns were defined by Chinese government.

### Statistical analysis

Descriptive statistics were provided to present the prevalence of schizophrenia by various demographic characteristics. Multilevel logistic regression models were used to test the independent associations between individual-level SES, area-level SES and their interaction and schizophrenia. Model 1 included individual SES, as well as age, gender, residence, whether having spouse or not. Model 2 adjusted for model 1 criteria and area-level SES. The interaction between individual-level and area-level SES was added in model 3. Interclass correlation coefficient (ICC) was used to interpret the proportion of total variance in schizophrenia that could be attributed to area-level social factors. Statistical significance was set at a two-tailed p value of <0.05. This study used Stata V.13.0 for Windows to conduct all statistical analyses.

## RESULTS

### Characteristics of participants

As shown in table 1, the median age of participants was 42 (IQR=32–55) years old. A percentage of 49.76% of participants were female, 64.42% were living in rural areas and 79.78% were married. Compared with people without schizophrenia, fewer female, less urbanicity and more single were in schizophrenia patients. More details of the characteristics in participants were shown in table 1.

At area level, the median household income per capita, proportion of population above high school, proportion of poverty and upper class occupation residents in 734 counties was 3516 (IQR=2572–5498) yuan, 14.73% (IQR=11.16%–22.93%), 2.23% (IQR=0.60%–5.46%) and 11.75% (IQR=8.62%–19.23%), respectively. At individual level, the median of household income per capita was 3000 (IQR=1667–5757) yuan. A percentage of 55.69 population were in high school education and above. Compared with people without schizophrenia, less income and less education were in schizophrenia patients.

Table 2 presents cross-tabs between tertiles of individual SES and neighbourhood SES tertiles. There were fewer individuals (14.27%) with individuals SES in the top tertile of the distribution residing in areas of the bottom tertile. Nearly half of the individuals in the top tertile of the individual SES distribution resided in areas of the top tertile (61.29%).

### Prevalence of schizophrenia

Table 3 presents the prevalence of schizophrenia by different level of SES. In both advantage and disadvantage SES areas, the prevalence of schizophrenia for participants was decreased with the increased individual SES. The schizophrenia prevalence of low, media and high individual SES in bottom tertile SES areas (0.61%, 0.21% and 0.11%, respectively) was lower than their counterparts in top tertile SES areas (0.94%, 0.40% and 0.23%, respectively).

### The association between individual-level and area-level SES and schizophrenia

Table 4 reports multilevel logistic regression results. Model 1 shows that 1-SD increase in individual SES was associated with decreased risk of schizophrenia (*OR*=0.47, *95% CI* 0.45 to 0.49) after controlling for age, gender, residence and marital status. Model 2 adds the area-level SES, which presents that 1-SD increase in area-level SES was associated with increased schizophrenia (*OR*=1.30, *95% CI* 1.24 to 1.37). The association between individual-level SES and schizophrenia also presents statistically significant (*OR*=0.45, *95% CI* 0.43 to 0.46) in this model. Model 3 adds the interaction between area-level SES

**Table 2** Percentage of individuals of varying individual SES in each tertile of SES areas

| | Area-level SES (% (n)) | | |
|---|---|---|---|
| | **Bottom tertile** | **Middle tertile** | **Top tertile** |
| Individual-level SES | | | |
| Bottom tertile | 51.79 (330 810) | 35.08 (222 941) | 14.27 (90 638) |
| Middle tertile | 34.43 (219 928) | 39.93 (253 746) | 24.44 (155 160) |
| Top tertile | 13.77 (87 973) | 24.99 (158 841) | 61.29 (389 168) |

SES, socioeconomic status.

Table 3 Percentage of individuals of varying individual SES in each tertile of neighbourhood

| Characteristics | Prevalence of schizophrenia (%) |
|---|---|
| Total | 0.40 |
| Area-level SES | |
| Bottom tertile | 0.42 |
| Middle tertile | 0.42 |
| Top tertile | 0.35 |
| Individual-level SES | |
| Bottom tertile | 0.73 |
| Middle tertile | 0.28 |
| Top tertile | 0.19 |
| Area-level SES (=bottom tertile) | |
| Individual-level SES | |
| Bottom tertile | 0.61 |
| Middle tertile | 0.21 |
| Top tertile | 0.11 |
| Area-level SES (=middle tertile) | |
| Individual-level SES | |
| Bottom tertile | 0.86 |
| Middle tertile | 0.26 |
| Top tertile | 0.13 |
| Area-level SES (=top tertile) | |
| Individual-level SES | |
| Bottom tertile | 0.94 |
| Middle tertile | 0.40 |
| Top tertile | 0.23 |

SES, socioeconomic status.

and individual-level SES; this cross-level interaction was statistically significant (*OR*=1.05, *95% CI* 1.02 to 1.08), indicating that, as the level of area SES increased, schizophrenia risk of lower SES people grew faster than the risk of higher SES people. Figure 1 illustrates this interaction between individual-level SES and area-level SES.

## DISCUSSION

The objective of this study was to investigate the association between individual-level, area-level SES and schizophrenia and the ways in which individual-level and area-level SES interact to predict schizophrenia in Chinese adults. Results indicated that both individual-level and area-level SES were associated with schizophrenia, such that lower SES individual and those living in higher SES areas had higher risk of schizophrenia. Most importantly, there was a significant interaction between individual-level and area-level SES in the prediction of schizophrenia.

The importance of SES for schizophrenia has been studied for decades, and most studies focused on the individual-level SES. This study confirmed the association between individual SES and schizophrenia in the setting of England,[21] Denmark[22] and the USA.[23] The possible reason may be that individuals in lower SES are more likely to exposure to everyday hardships and numerous stressful events,[24] which may result in schizophrenia. Also, SES may impact schizophrenia through other SES-related factors, acting by themselves or in combination. For instance, diminished financial resources would limit healthcare and treatment resources access and then lead to disease.[25]

Relative to individual-level SES, area-level SES have been less investigated, particularly in eastern social context. This study demonstrated that higher area SES was line with increased risk of schizophrenia in Chinese adults. One possible reason is that social disadvantage areas are related to excess mortality of schizophrenia,[26] which lead to the lower prevalence of schizophrenia in low SES areas. Furthermore, response biases also could be the possible reason. In lower SES areas, people with schizophrenia are more likely to be living alone. Therefore, the participating rate of the survey for schizophrenia patients are lower in disadvantage SES areas. Our supplementary analyses could support this opinion, which indicated that married schizophrenia patients in lower SES areas are more likely to be picked up by the survey than single people (online supplemental appendix table 1).

A striking finding in this study regarding the relationship between cross-level interaction of individual-level and area-level SES and schizophrenia was that as area SES rose, schizophrenia risk of lower SES people grew faster than the risk of higher SES people. Although little is known about its mechanism, we can speculate some potential reasons as well. For example, compared with higher SES individuals, low SES individuals living in high SES areas exposure to more psychosocial stress, greater isolation and difficulty in social integration, upward social comparisons and unmet expectations.[27 28] Also, low SES individuals may have higher level of unhealthy behaviours than high SES people, which predict higher risk for schizophrenia.[29–31] Furthermore, this finding indicated that the relationship between SES and schizophrenia was not consistent with the social drift hypothesis that people with schizophrenia would drift into poorer areas, because the results of the cross-level interaction showed that people of low SES are more at risk of schizophrenia in richer areas.

### Limitations

A striking strength of this study used a very large-size and population-based design survey to research SES and schizophrenia, which covered 1.9 million people in China. The use of 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 minimised. To our best knowledge, this study is the first study

Table 4 Multilevel logistic regressions of the association between individual-level SES, area-level SES and their interaction and schizophrenia, adjusting for covariates (n=1 909 205)

| Characteristics | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Individual-level SES, OR(95% CI) | 0.47 (0.45 to 0.49)*** | 0.45 (0.43 to 0.46)*** | 0.44 (0.42 to 0.46)*** |
| Area-level SES, OR(95% CI) | | 1.30 (1.24 to 1.37)*** | 1.32 (1.26 to 1.38)*** |
| Individual-level SES * area-level SES, OR(95% CI) | | | 1.05 (1.02 to 1.08)** |
| Age (continuous), OR(95% CI) | 0.99 (0.99 to 0.99)*** | 0.99 (0.99 to 0.99)*** | 0.99 (0.99 to 0.99)*** |
| Gender | | | |
| Male | 1 | 1 | 1 |
| Female, OR(95% CI) | 1.03 (0.98 to 1.08)*** | 1.02 (0.97 to 1.07)*** | 1.02 (0.97 to 1.07) |
| Residence | | | |
| Rural | 1 | 1 | 1 |
| Urban, OR(95% CI) | 1.17 (1.10 to 1.24)*** | 1.07 (1.00 to 1.14)*** | 1.07 (1.00 to 1.15)*** |
| Marital status | | | |
| Currently live without spouse | 1 | 1 | 1 |
| Currently live with spouse, OR(95% CI) | 2.93 (2.80 to 3.07)*** | 2.90 (2.77 to 3.04)* | 2.90 (2.77 to 3.03)*** |
| AIC | 94 600.49 | 94 489.28 | 94 480.00 |
| BIC | 94 687.73 | 94 588.98 | 94 592.16 |
| ICC | 0.071 | 0.059 | 0.059 |

*p<0.05, **p<0.01, ***p<0.001.
ICC, interclass correlation coefficient.

to demonstrated the empirical results of the interaction of individual-level and area-level SES and their association with schizophrenia from a multilevel perspective in mainland China. Most previous studies cannot detect this interaction because of the insufficient numbers of lower SES people in high SES and vice versa. The large sample in this study can provide sufficient power to fill this gap.

However, this study also had limitations. First, there is a discrepancy in the timing of measurement as area-level social factors and individual-level factors. Thus, this study only compared the relative differences of social factors in varying areas and its association with schizophrenia. Second, the population migration between the counties may affect our study results, although the impact of population migration on results is small because of the restriction from China's strict migration regulating by the household registration system called *Hukou* (passport) system. Third, a cross-sectional design in this study cannot draw causal inferences. Further studies need to understand the mechanisms of SES and schizophrenia. Fourth, some schizophrenia patients with their short duration of illness or better social function may not have been identified in this survey. Therefore, these findings may underestimate the overall prevalence of schizophrenia. Fifth, county-level SES may not reflect the true area level SES to the participants in this study. Further studies need to provide more 'ecological' understanding of the levels of social environments to which people exposed by using smaller area-level SES survey materials. Sixth, this study should be interpreted with caution because of the lack of design weights used in the analysis stage.

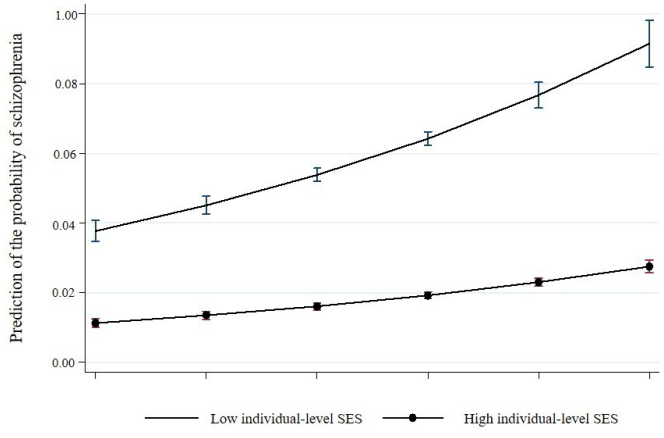


Figure 1 Predicted probability of schizophrenia by area-level SES and individual-level SES. figure 1 illustrates this interaction between individual-level SES and area-level SES. This interaction was statistically significant, indicating that, as the level of area SES increased, the association between individual SES and schizophrenia was increased. SES, socioeconomic status.

## CONCLUSIONS

This study showed that individual-level and area-level SESs were associated with the risk of schizophrenia. Area-level SES is particularly important to mental health of low SES individuals, with low SES people in high SES counties having the highest risk of schizophrenia than other

groups. Further studies need to explore the aetiology and mechanism of this association. This study suggested that individuals do benefit from the equality of resources and knowledge generally associated with SES areas. Action to reduce SES disparities in schizophrenia will require attention to the area-level context of low SES adults in China.

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**Contributors** YL, LZ and PH contributed equally to this study. YL drafting the manuscript, study concept and design, data analysis and interpretation. PH and LZ: study concept and critical revision of article for important intellectual content. LP and CG: revision of article. XZ: study concept and design and critical revision of article for important intellectual content. All authors gave final approval of the version to be published.

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**Competing interests** Not required.

**Patient consent for publication** Parental/guardian consent obtained.

**Ethics 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.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** No data are available.



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