Sex difference in the association between education and schizophrenia in Chinese adults

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Abstract

Objective: Improving education level was evidenced to decrease the risk of schizophrenia, but whether this strength of education role depends on gender is not. This study aimed to investigate whether there is sex difference in the association between education and schizophrenia in Chinese adults. **Methods:** Data was obtained from the Second China National Sample Survey on Disability in 2006, and restricted our analysis to 1,909,205 participants aged 18 years or older, which covered 31 provinces (administrative districts) in China. Schizophrenia was ascertained according to the International Statistical Classification of Diseases, Tenth Revision. Logistics regression models was fitted to examine the combined effect of sex and education on schizophrenia. **Results:** The prevalence of schizophrenia in female groups was higher than in male groups, with 0.44% (95% CI : 0.42%, 0.45%) and 0.36% (95% CI : 0.35%, 0.37%), respectively. There is a statistical significant difference that more females experienced severe or extreme difficulty in understanding and communicating. However, more males suffered from severe or extreme difficulty in the function of daily activities and participation in society. The combined effect of education and schizophrenia was statistically significant (OR =1.05, 95%CI =1.02, 1.08), indicating that, as the level of education level increased, schizophrenia risk of females decreased faster than the risk of males. **Conclusions:** This study showed that additional years of education reduce the risk of schizophrenia for both men and women while also closing the gender gap between them. As education elevated, the risk of schizophrenia decreased more for women than for men. The findings indicated that improving education level may have an effect on reducing gender gaps in schizophrenia in China. Action to prevent schizophrenia and close its gender gap will require attention to the improving educational opportunities. **Keywords :** Schizophrenia; education ; sex difference

Introduction

Schizophrenia is a chronic and frequently disabling mental disorder [1]. Although its incidence is relatively low, the burden of schizophrenia is substantial [2]. Schizophrenia can often be shaped by both socio-environment and biological risk factors[1]. Recent studies suggest that socioeconomic risk factors play a causal role in the aetiology of schizophrenia [3]. As one of the common proxies for SES, education serves an important role in the development of schizophrenia [4]. Evidence highlights that not completing primary school and receiving low school marks were associated with a higher risk of schizophrenia [5-7].

Sex difference in the prevalence of schizophrenia was found in established evidence. In developed countries generally shows that men are more likely to be affected by schizophrenia than women, while studies from China highlighted an apparently higher prevalence of schizophrenia in females [8, 9]. The reason why more women than men living with schizophrenia is that women obtained less health insurance and less likely to receive effective treatment compared with men in China [10]. In considering to how to promote the mental health equality in China, it is very necessary to explore the way of closing gender gap in schizophrenia.

It was established that improving education level can decreasing the risk of schizophrenia, but whether this strength of education role depends on gender is not. Although several studies on physical health, mortality, and depression suggested the gender difference of education benefits on health [11-14], there is less research on schizophrenia. In this study, using nationally large representative data, we investigate whether there is sex difference in the association between education and schizophrenia in Chinese adults. This study addresses the limitations in previous studies on education and schizophrenia in developing countries, which would be very helpful for reducing the gender gap in schizophrenia and promoting psychiatric policies in China.

Methods

Study population

This study used data from the Second National Sample Survey on Disability implemented from 1 April to 31 May 2006. This survey covered all provincial administrative areas in mainland China and aimed to describe the prevalence, causes, and severities of disability, as well as the living conditions and health service utilizations of the disabled. Multistage, stratified random-cluster sampling, with probability proportional to size, was used in 734 counties (districts), 2,980 towns (streets) and 5,964 communities (villages) from 31 provinces, autonomous regions, and municipalities under the Central Government in China. A total of 2,526,145 persons was randomly sampled from 771,797 households, representing 1.9 per 1000 inhabitants of China. Details on this survey have been published in previous literature [15]. In the present study, analysis was composed of 1909205 participants aged 18 years or older.

More than 20,000 interviewers, 6,000 doctors of various specialties, and 50,000 survey assistants administered this survey. In the pre-survey phase, households, populations, and suspected disabled people in all sampling communities were investigated. Face-to-face household interview was conducted with every family member in the selected households [16].

Schizophrenia assessment

Schizophrenia was identified by experienced psychiatrists using The International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) Symptom Checklist for Mental Disorders (ICD-10 code F20) [19]. The ICD-10 diagnostic criteria had been employed in the ascertainment of schizophrenia among Chinese people and presented satisfactory validity in China [20].

Study measures

We defined the outcome variable as a binary measure (i.e., whether having schizophrenia). The independent variable was education, as defined by four categorical variables: primary school and below, junior high school, senior high school and above. Previous evidence showed that demographic characteristics (such as age, marital status, residence) and income are the risk factors of schizophrenia [21, 22]. Therefore, in this study, controlled variables included the age (continuous variable), gender

(male/female), spouse (yes/no), residence (urban/ rural), and household income per capita (tertiles, with the first tertile being the lowest household income per capita and the third being the highest household income per capita).

Statistical analysis

Descriptive statistics were used to characterize the proportion of schizophrenia by various demographic characteristics and educational attainment. Logistic regression models were used to evaluate the association between education and schizophrenia, and the odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. Each regression was controlled for age, gender, spouse, residence and household income per capita. To test the association between education and schizophrenia by gender differed with varying area-level SES, the analyses were stratified by areas with different level of SES. Wald chi-square test was used to determine whether the education attainment or a confounding factor is significant or not in logistic regressions, and likelihood ratio chi-square test was used to test the fit of the overall models. A *P*-value less than 0.05 was considered statistically significant. The software Stata version 13.0 for Windows (Stata Corp, College Station, TX, USA) was used for statistical analysis.

Results

This sample included 1,909,205 individuals, of whom 959,247(50.24%) were female and 949,958(49.76%) were male. More men were educated to senior high school and above level than women, while more women had primary school and below in both individuals with and without schizophrenia. Among individuals without schizophrenia, male adults were more likely to be rural residents, single, and unemployment than female. Among individuals with schizophrenia, more urban residents, more single individuals, and more unemployment individuals were in males than in females. More details can be found in Table 1.

Table 2 shows the prevalence of schizophrenia in adults among males and females. The prevalence of schizophrenia in female groups was higher than in male groups, with 0.44% (95% *CI*: 0.42%, 0.45%) and 0.36% (95% *CI*: 0.35%, 0.37%), respectively. In both males and females, the prevalence of schizophrenia decreased with the increasing income. Rural residents had higher prevalence of schizophrenia compared with urban residents in both males and females. Employment individuals had lower prevalence of schizophrenia compared with unemployment groups in both males and females. In females, higher education level group had lower prevalence of schizophrenia. While in males, the prevalence of schizophrenia had slightly difference between senior high school and above individuals and junior high school individuals.

Table 3 presents the physical and social functions of schizophrenia patients by males and females. There is a statistical significant difference that more females experienced severe or extreme difficulty in understanding and communicating. However, more males suffered from severe or extreme difficulty in the function of daily activities and participation in society.

Table 4 illustrates the logistic regression results of the association between education and schizophrenia. Model 1 shows that junior high school and senior high school and above educational attainment groups were less likely than their peers with primary school and below to have schizophrenia, with odds ratios of 0.68 (95% *CI*: 0.64, 0.72) and 0.55 (95% *CI*: 0.51, 0.60), respectively. Model 2 adds the interaction between gender and education; the interaction was statistically significant ($OR=1.05$, 95%*CI*=1.02, 1.08), indicating that, as the level of education level increased, schizophrenia risk of females decreased faster than the risk of males. Figure 1 illustrates this interaction between gender and education, which presents that schizophrenia's negative slope with respect to education is steeper for female than for male.

Discussion

The objective of this study was to investigate whether there is sex difference in the association between education and schizophrenia in Chinese adults. Schizophrenia was ascertained through clinical diagnosis based on the ICD-10. To our best knowledge, this is the first study to report empirical results of whether the relationship of education and schizophrenia vary according to gender in China. Our results showed that female groups in China had higher prevalence of schizophrenia than male groups. Females with schizophrenia faced more severe or extreme difficulty in understanding and communicating than male groups, while male patients faced more difficulties in the function of daily activities and participation in society.

Our results re-verified the important role of improving education in schizophrenia prevention in Chinese adults, and observed a combined role of gender and education in schizophrenia prediction. The combined effects between sex and education on the risk of schizophrenia showed in this study. Education reduces schizophrenia for both men and women, but more so for women. In groups with junior high school and below, women have higher average levels of schizophrenia, but the gender gap diminishes as education levels increase. While in groups with senior high school and above, the risk of schizophrenia in women is lower than the risk in men. Resource substitution hypothesis evidenced the results. This hypothesis indicates that education can fill the resources gap for those who have fewer alternatives and substitute other resources to decrease mental disorders[23]. As a consequence, compared with men, women who own less socioeconomic resources input of mental health, depending more on the resources of the education [11].

Previous evidence indicated two mediating interactions which can explain the sex difference of education role on schizophrenia. One is the work creativity, and the other is the sense of control [12]. Although higher education increased the management authority and earnings to men, education can enhance work creativity more for women than for men. The larger convergence of work creativity from women help to close the gender gap of socioeconomic resources at higher levels of education [12]. Additional years of education is associated positively with a sense of personal control, which helps to reduce the gender gap in schizophrenia at higher levels of education[24].

Limitations

This study is the first time to explore the sex difference of the relationship between education and schizophrenia in China, which implied that improving education level could help to close mental health gender gaps. However, our study still had limitations. Firstly, a cross-section design for schizophrenia in this study cannot draw causal inferences. In the future, the longitudinal research need to understand the mechanisms of education and schizophrenia, and its gender difference. Secondly, some modified factors, such as occupation categories, migration status, mental health services and family history, may modify the association between the education level and schizophrenia, could not be considered in this study due to the data restricts. Thirdly, some schizophrenia patients without disabilities may not have been identified in this survey. Therefore, our findings may underestimate the overall prevalence of schizophrenia.

Conclusions

Our finding showed that additional years of education reduce the risk of schizophrenia for both men and women while also closing the gender gap between them. As education elevated, the risk of schizophrenia decreased more for women than for men. The findings indicated that improving education level may have an effect on reducing gender gaps in schizophrenia in China. Action to prevent schizophrenia and close its gender gap will require attention to the improving educational opportunities.

Declarations

Ethics approval and consent to participate

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.

Consent for publication

All authors gave final approval of the version to be published.

Availability of data and materials

There are legal restrictions on sharing a de-identified data set according to the Statistics Law of the People's Republic of China and the regulation of the data access committee – China Disabled Persons' Federation. The website of China Disabled Persons' Federation is www.cdpf.org.cn, and the telephone is +86-010-66580228.

Competing interests

The authors declare no potential conflicts of interest with respect to the authorship and/or publication of this article.

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Authors' contributions

YL and LP contributed equally to this study. YL: study concept and design, drafting the manuscript, data analysis and interpretation. LP: study concept, critical revision of article for important intellectual content. YZ, CG, and LZ: revision of article. XZ: study concept and design, critical revision of article for important intellectual content.

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Tables

Table 1
Characteristics of participants, by male and female (n = 1909205)

Characteristics	Female (n, /%)	Male (n, /%)		
	Not having schizophrenia	Having schizophrenia	Not having schizophrenia	Having schizophrenia
Education				
Primary school and below (%)	493547(51.68)	2888(68.84)	347923(36.76)	1682(49.00)
Junior high school (%)	286367(29.98)	911(21.72)	369950(39.09)	1133(33.00)
Senior high school and above (%)	175138(18.34)	396(9.44)	228652(24.16)	618(18.00)
Age, years ()	955000(44.51)	4195(47.97)	947000(44.13)	3433(43.63)
Residence				
Rural (%)	607754(63.64)	3062(72.99)	616735(65.16)	2317(67.49)
Urban (%)	347298(36.36)	1133(27.01)	329790(34.84)	1116(32.51)
Marital Status				
Currently live with spouse (%)	767397(80.35)	3054(72.80)	751515(79.40)	2286(66.59)
Currently live without spouse (%)	187655(19.65)	1141(27.20)	195010(20.60)	1147(33.41)
Employment				
Yes	926682(97.03)	3942(93.97)	909225(96.06)	2991(87.12)
No	28370(2.97)	253(6.03)	37300(3.94)	442(12.88)
Income				
Tertile 1(Lowest)	281115(29.43)	2102(50.11)	282332(29.83)	1840(53.60)
Tertile 2	295645(30.96)	1198(28.56)	291342(30.78)	881(25.66)
Tertile 3(Highest)	378292(39.61)	895(21.33)	372851(39.39)	712(20.74)

Table 2
Prevalence with 95% confidential intervals of schizophrenia in adults aged
18 years old and above, by male and female (n = 1,909,205)

Characteristics	Female Prevalence(95%CI)	Male Prevalence(95%CI)
Total	0.44(0.42,0.45)	0.36(0.35,0.37)
Education		
Primary school and below	0.58(0.56,0.60)	0.48(0.46,0.50)
Junior high school	0.32(0.30,0.34)	0.30(0.29,0.32)
Senior high school and above	0.23(0.20,0.25)	0.27(0.25,0.29)
Residence		
Rural	0.50(0.48,0.52)	0.37(0.36,0.39)
Urban	0.33(0.31,0.34)	0.34(0.32,0.36)
Marital Status		
Currently live with spouse	0.40(0.38,0.41)	0.15(0.14,0.16)
Currently live without spouse	0.60(0.57,0.64)	1.16(1.11,1.21)
Employment		
Yes	0.42(0.41,0.44)	0.33(0.32,0.34)
No	0.88(0.78,1.00)	1.17(1.07,1.28)
Income		
Tertile 1(Lowest)	0.74(0.71,0.77)	0.65(0.62,0.68)
Tertile 2	0.40(0.38,0.43)	0.30(0.28,0.32)
Tertile 3(Highest)	0.24(0.22,0.25)	0.19(0.18,0.21)

Table 3

Physical and social functions of schizophrenia patients, by male and female (n = 7628)

Functions(with severe or extreme difficulty)	Male	Female	P-value
Understanding and communicating	1084(31.58)	1450(34.56)	0.006
Physical movement	107(3.12)	152(3.62)	0.224
Self-care	323(9.41)	435(10.37)	0.163
Getting along with people	1489(43.37)	1726(41.14)	0.050
Daily activities	2116(61.64)	2430(57.93)	0.001
Participation in society	2116(61.64)	2430(57.93)	0.001

Table 4
Sex difference of the association between education and schizophrenia (n = 1909205)

Characteristics	Model 1	Model 1
Education		
Primary school and below		
Junior high school	0.68(0.64,0.72)***	0.72(0.67,0.78)***
Senior high school and above	0.55(0.51,0.60)***	0.68(0.61,0.75)***
Education × Gender		
Primary school and below × male		
Junior high school × female		0.88(0.79,0.98)**
Senior high school and above × female		0.63(0.55,0.73)***
Age, years ()	1.00(1.00,1.00)	1.00(1.00,1.00)
Gender		
Male (%)		
Female (%)	1.19(1.13,1.24)***	1.31(1.23,1.39)***
Residence		
Rural (%)		
Urban (%)	1.16(1.09,1.23)***	1.16(1.09,1.23)***
Marital Status		
Currently live with spouse (%)		
Currently live without spouse (%)	2.99(2.86,3.13)***	3.00(2.86,3.14)***
Employment		
Yes		
No	2.84(2.62,3.09)***	2.85(2.62,3.10)***
Income		
Tertile 1(Lowest)		
Tertile 2	0.55(0.52,0.58)***	0.55(0.52,0.58)***

Note: *P < 0.05, **P < 0.01, ***P < 0.001.

Characteristics	Model 1	Model 1
Tertile 3(Highest)	0.36(0.34,0.39)***	0.36(0.34,0.39)***
Note: *P < 0.05, **P < 0.01, ***P < 0.001.		

Figures

Figure 1

Predicted probability of schizophrenia by gender and education. Schizophrenia's negative slope with respect to education is steeper for female than for male. As the level of education level increased, schizophrenia risk of females decreased faster than the risk of males.