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Epidemiology of schizophrenia and risk factors of schizophrenia-associated aggression from 2011 to 2015

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Abstract

Objective: To investigate the risk factors associated with aggression in patients with schizophrenia.

Methods: Patient clinical, behavioural, and demographic information was collected and reported online to the Beijing Mental Health Information Management System by psychiatrists. We used chi-square tests to analyse information between 2011 and 2015 to determine the prevalence and incidence of schizophrenia and the rate of aggression. We used univariate and binary logistic regression to analyse risk factors of aggressive behaviours.

Results: The prevalence and incidence of schizophrenia, and the proportion of cases displaying aggressive behaviour, increased considerably from 2011 to 2015. Risk of aggression was associated with non-adherence to medication (odds ratio [OR]: 2.92; 95% confidence intervals [CI]: 2.08–4.11), being unmarried (OR: 1.62; 95% CI: 1.03–2.55), having physical disease (OR: 3.26; 95% CI: 2.28–4.66), and higher positive symptom scores (OR: 2.01; 95% CI: 1.06–3.81). Physical disease was a risk factor associated with committing more than one type of aggression.

Conclusion: We confirmed that demographic factors, treatment-related factors, and clinical symptoms were associated with aggression in patients with schizophrenia in Beijing. A focus on improving controllable factors, including medication adherence and physical health status, might help to prevent aggressive behaviour.

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Introduction

Schizophrenia is a chronic mental illness with a range of symptoms that include delusions, depression, conceptual disorganization, and hallucinations.[1,2] According to a recent systematic literature review, from 1990 to 2013 the median estimate of schizophrenia prevalence in 29 studies was 0.48%, with an interquartile range of 0.34% to 0.85%.[3] A 2008 study reported a median incidence of schizophrenia of 15.2/100,000 persons, with the central 80% of estimates varying over a fivefold range from 7.7 to 43.0/100,000.[4] A recent study showed that the prevalence of schizophrenia in urban China was 0.39% (0.37%–0.41%) in 1990, 0.57% (0.55%–0.59%) in 2000, and 0.83% (0.75%–0.91%) in 2010.[5] Wang et al. found that of 1719 students in a rural town in China, 17.9% had shown physical aggression once or more toward their peers in 2013, and the reported rate of peer physical aggression was 24.7% in boys and 10.7% in girls.[6] Clinicians should be concerned about the increasing rate of aggression. Although most aggression occurs in community settings, clinicians can use such behaviours as reference when investigating aggression in individuals with mental illness.

Patients with schizophrenia have a higher rate of aggressive behaviour than the general population. In one study, subjects were defined as aggressive if they exercised physical force or exhibited hostile or spiritually destructive attitude or behaviour, including verbal or physical aggression, auto-aggression, or aggression against others.[7] Recent research suggests that schizophrenia is a risk factor for aggression.[8] Rates of aggressive behaviour are four to six times higher in patients with schizophrenia than in the general population.[9] One study revealed that the incidence of aggressive behaviour in 3,941 patients with schizophrenia in psychiatric wards was between 15.3% and 53.2%.[10] Some studies have found that aggressive behaviour is associated with clinical factors, such as positive symptoms[11] and incomplete adherence to medication,[12] as well as social factors, such as having physical disease[13] and being unmarried.[14]

Since the early 1990s, China has been experiencing rapid economic and social changes.[15] Residents of Beijing, the political, economic, and cultural centre of China, experience a fast pace of life and work, and may experience stress, which can affect their mental health. Therefore, in 2011, the Beijing Mental Health Information Management System (BMHIMS), an Internet-based medical information system, was established to report the epidemiology of mental diseases. Located in south Beijing, the Key Community Alliance is a representative mental health investigation base in Fengtai District, which consists of 10 communities: Fengtai Community, Nanyuan Community, Tieying Community, Wangzuo Community, Dahongmen Community, Huaxiang Community, Puhuangyu Community, Xincun Community, Youanmen Community, and

Youanmenwai Community. Most scientific research is conducted in the Key Community Alliance, which carries out important epidemiological research on patients. Data collected by the BMHIMS show that the incidence and prevalence of schizophrenia in the Key Community Alliance of Fengtai District in Beijing increased from 2011 to 2015, and the rates of aggression in schizophrenia patients increased substantially during these 5 years.

To our knowledge, there are no population-based studies on the risk factors for aggression in schizophrenic patients in China. Therefore, in the present study, we used BMHIMS data from 2011 to 2015 to describe the epidemiology of schizophrenia and analyse the factors associated with aggressive behaviour among patients in the Key Community Alliance. The goal of this study was to determine the factors associated with aggression in schizophrenia patients and provide insight into suitable methods to prevent patients from committing aggressive acts.

Materials and methods

The Ethic Committee of Nanyuan Hospital and Fengtai Community Health Centre of Beijing approved this study; the Chair of the Fengtai District Community Health Center waived the need for written informed consent for the analyses of schizophrenia data. No pathological, clinical, or radiological data were available at the time of patient selection. All data were measured and analysed by researchers who were blind to pathological and clinical records.

Participants

Participants were all schizophrenia patients residing in the jurisdictional area of the Key Community Alliance from January 2011 to December 2015. All patients were permanent outpatients with schizophrenia who were registered in the BMHIMS. Eligible patients were those aged from 18 to 89 years old who met the following criteria: 1) all participants had been diagnosed with schizophrenia and any physical diseases according to the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) by qualified psychiatrists and medical doctors[16] during the past 5 years; 2) all patients were permanent residents of Beijing, China; 3) written informed consent was obtained from the patients or their legal guardians.

Schizophrenia information and BMHIMS

The BMHIMS was developed in 2008. When a patient with schizophrenia goes to a hospital for psychiatric admission or an inpatient stay, qualified psychiatrists are responsible for diagnosing the patient and registering their information, which includes clinical information (positive symptom score, negative symptom score and general psychopathology score), behavioural information (history of aggressive behaviours) and demographic information (sex, age, length of illness). This information is recorded in the patient's protocol and on questionnaire forms and is reported online to the BMHIMS inpatient or serious patient reporting system. When a patient leaves the hospital and is cared for by their family, community nurses are responsible for conducting quarterly online follow-up interviews and recording other information, including treatment information (medication adherence, physical disease) and demographic information (education, marital status and living conditions) into the BMHIMS "Patient Health Condition Document" and "Patient Management Document" according to patients' case reports. When a new aggressive behaviour occurs, district police officers or community members who are

responsible for conducting monthly visits to patients' homes will inform community nurses online or by telephone of the incident and its severity. This information is recorded in the BMHIMS by nursing staff. During the first month of every year, community nurses are responsible for telephoning resident registration police officers, obtaining information about the household population number for the last year and recording it in the BMHIMS "System Basic Information Document".

Study design

In 2015, 623 of 1549 patients with schizophrenia committed aggression. A cross-sectional study was conducted to investigate the risk factors of aggression. We compared demographic factors, clinical symptoms, and treatment-related factors in aggressive and non-aggressive cases. Demographic information on education, living conditions (i.e. living with parents or not) and marriage, as well as information on physical diseases, was obtained from patient records. Written consent was obtained from the patients or their family caregivers. All participants were informed of the study purpose and assured of the confidential status of their personal information.

Definitions

Medication Adherence:[17] Monthly pill counts were obtained from questionnaires used to evaluate patients' medication adherence at each appointment. A global 3-point anchored Likert scale was used for assessment: 0 = non-adherence, defined as taking less than 30% of prescribed medicines; 1 = adherence, defined as taking no less than 30% of prescribed medicines. Higher scores indicate better medication adherence.

Physical disease:[18] In this study, physical disease referred to all chronic physical diseases, such as diseases of the cardiovascular system, endocrine system, nervous system, digestive system, and other systems, diagnosed according to the ICD-10 by qualified hospital clinicians and registered in patients' case reports.

Measurement instruments

Aggressive behaviour: Aggressive behaviour is an important social problem.[7] It can be defined as a psychological state, a hostile physical or verbal act, or behaviour resulting in injuries to persons or damage to objects. Definitions of assault are similarly variable and range from verbal to physical behaviour.[19] The rate of aggressive behaviour during the 12 months was recorded regularly by the psychiatrists. The MOAS (a modified version of the Overt Aggression Scale) was used to assess aggressive behaviours and divide the subjects into aggressive and non-aggressive groups.[20] The MOAS comprises four subscales: verbal aggression, aggression against property, auto-aggression, and aggression toward others. Aggression scores range from 0 to 4: 0 = no aggression; 1 = verbally threatening behaviour; 2 = mild indoor and manageable behaviour; 3 = severe outdoor and unmanageable behaviour; 4 = extreme aggression. The aggression ratings from the MOAS were recoded into binary form to generate a "violence score". If participants scored 0 on all four MOAS subscales, or if their only score exceeding 0 was on the "verbal aggression" subscale, they received a violence score of 0 and were assigned to the non-aggressive group. If participants scored greater than 0, they received a violence score of 1 and were assigned to the aggressive group.

Psychotic symptoms: The Positive and Negative Syndrome Scale (PANSS) is a widely used 30-item 7-point rating instrument that measures the three dimensions of schizophrenia: positive symptoms,

negative symptoms, and general psychopathology.[1] The Positive Scale consists of seven items measuring delusions, conceptual disorganization, hallucinations, excitement, grandiosity, suspiciousness/persecution, and hostility. The Negative Scale consists of seven items assessing blunted affect, emotional withdrawal, poor rapport, passive/apathetic social withdrawal, difficulty in abstract thinking, lack of spontaneity and conversation flow, and stereotyped thinking. The General Psychopathology Scale comprises 16 items assessing disorganization symptoms and severity of schizophrenic illness: somatic concerns, anxiety, guilty feelings, tension, mannerisms and posturing, depression, motor retardation, un-cooperativeness, unusual thoughts, disorientation, poor attention, lack of judgment and insight, disturbance of volition, poor impulse control, preoccupation, and active social avoidance. Each PANSS item is rated on a scale of increasing psychopathology: 1 = absent, 2 = minimal, 3 = mild, 4 = moderate, 5 = moderate to severe, 6 = severe and 7 = extreme. The PANSS is scored by summing up ratings across items; score ranges are 7 to 49 for the Positive and Negative Scales and 16 to 112 for the General Psychopathology Scale.[1] The PANSS has good internal reliability, inter-rater reliability, and test–retest reliability for the positive, negative, and general psychopathology scales.

The researchers were responsible for reviewing the case reports, records, police reports, and hospital incident reports for all patients in the study.

Ethics approval

Ethics approval was obtained from the Nanyuan Hospital Ethics Committee of Fengtai District of Beijing (NHEC13/127) and Fengtai Community Health Centre of Beijing.

Data analysis

SPSS 20.0 (IBM Corp., Armonk, NY, USA) was used to analyse the data. The trends of schizophrenia and aggressive behaviour that occurred in each year from 2011 to 2015 were assessed using the tendency chi-square test. Associations between variables and aggression were analysed using univariate analysis: chi-square tests for category variables or independent t-tests for continuous variables. Variables were entered into a binary logistic regression model for further analysis of their associations. The P value, odds ratio (OR) and 95% confidence intervals (CI) were calculated for each variable. $P<0.05$ was considered significant.

Results

Epidemiology of schizophrenia for the Key Community Alliance in Fengtai District of Beijing from 2011 to 2015

During the 5 years from 2011 to 2015, the prevalence of schizophrenia increased from 0.63% to 0.94% ($P<0.001$); the average annual rate was 0.81%. The incidence of schizophrenia also increased from 0.71/1000 in 2011 to 0.98/1000 in 2015 ($P<0.001$); the average annual rate was 0.79/1000 (Table 1). In addition, the incidence of aggression in schizophrenic patients increased from 30.7% in 2011 to 40.2% in 2015 ($P<0.001$); the average was 34.5%. Of the 1.65 million permanent residents living in the jurisdictional area of the Key Community Alliance in 2015, 1549 schizophrenia cases were reported by the BMHIMS. The mean age of these patients was 52.5 ± 13.5 years (range = 18–89 years). Males accounted for 51.7% (n = 788) of the total cases. There were no significant differences in the distributions of sex and age across the 5 years. Among these cases, 51.0% (n = 790) had education levels of

Table 1. Epidemiology of schizophrenia for the Key Community Alliance from 2011 to 2015

	2011	2012	2013	2014	2015	χ^2	P^d
Population (million)	20.6	18.7	17.6	16.3	16.5		
Schizophrenia cases	1308	1364	1433	1495	1549		
[a]Prevalence (%)	0.63	0.73	0.81	0.92	0.94	21.91	<0.001
New schizophrenia cases	146	111	130	148	161		
[b]Incidence (per 1000)	0.71	0.59	0.74	0.91	0.98	21.52	<0.001
Cases with aggression	402	456	496	503	623		
[c]Rate of aggression (%)	30.7	33.4	34.6	33.6	40.2	23.68	<0.001

[a]Prevalence = Number of schizophrenia cases/population × 100.
[b]Incidence = Number of new schizophrenia cases/population × 1000.
[c]Rate of aggression = Number of cases with aggression/number of schizophrenia cases × 100.
[d]*P*: from tendency chi-square test.

junior high school or below, 82.1% (n = 1272) were unmarried, 21.4% (n = 331) lived separately from their parents, 59.1% (n = 916) had a physical disease, 49.7% (n = 770) reported adherence to medication treatment, and 50.3% (n = 779) reported non-adherence (Table 2).

Risk factors for aggression

In 2015, after excluding 79 patients lost to follow-up interview and 36 patients who failed to provide complete personal information, 1549 patients were enrolled in the study. There were 623 aggressive incidents reported for the 1549 patients: 129 patients committed only one type of aggression, 383 patients committed two, 106 patients committed three, and 5 patients committed four types of aggression. The distributions of verbal aggression, aggression against property, auto-aggression, and aggression against others were 43.3% (n = 534), 32.8% (n = 405), 8.7% (n = 107), and 15.2% (n = 187), respectively.

We identified the factors associated with aggressive behaviour by comparing the distribution of demographic variables (age, sex, level of education, living conditions, and marital status), clinical symptoms (positive symptoms, negative symptoms, and general psychopathology symptoms) and treatment-related factors (length of illness, medication adherence, and physical disease) between the aggressive and non-aggressive groups. The univariate analysis showed that 7 of the 11 variables (level of education, marital status, physical disease, medication adherence, positive symptom score, negative symptom score, and general psychopathology score) were associated with aggression (Table 2). Further analysis of the associations using binary logistic regression analysis showed that non-adherence to medication ($P<0.001$, OR = 2.92 (2.08–4.11)), being unmarried ($P = 0.035$, OR = 1.62 (1.03–2.55)), having physical disease ($P<0.001$, OR = 3.26 (2.28–4.66)), and higher positive symptom score ($P = 0.031$, OR = 2.01(1.06–3.81)) were associated with increased risk of aggression (Table 2).

Among the aggressive cases, 494 patients committed more than one type of aggression. We tried to identify the risk factors for multiple types of aggression by comparing the distributions of the variables in patients with one type and those with more than one type of aggression. We found that physical disease (54.7%) was 1.2% higher in patients with more than one type of aggression than in patients with only one type of aggression (45.3%) ($P = 0.02$). This indicated that having a physical disease was strongly associated

Table 2. Demographic and clinical characteristics of schizophrenia risk factors in 2015 (n = 1549)

Independent variables	Non-aggression (%)	Aggression (%)	P1[a]	P2[b]	Adjusted OR (95% CI)
Age, years (mean ± SD)					
<40	152	109	–	–	–
40–59	507	344	–	–	–
≥60	267	170	0.443	0.939	0.99 (0.78–1.26)
Sex, n (%)					
Male	478	310	–	–	–
Female	448	313	0.473	0.586	1.10 (0.79–1.52)
Length of illness (mean ± SD)	23.86 ± 12.57	34.69 ± 13.78	0.224	0.111	1.01 (1.00–1.02)
Level of education, n (%)					
College or above	380	196	–	–	–
Senior high school	102	81	–	–	–
Junior high school or below	444	346	0.000	0.821	1.02 (0.85–1.23)
Marital status, n (%)					
Married	185	92	–	–	–
Unmarried	741	531	0.009	0.035	1.62 (1.03–2.55)
Living conditions, n (%)					
Yes	726	492	–	–	–
No	200	131	0.788	0.231	0.78 (0.52–1.17)
Medication adherence, n (%)					
Adherence	556	214	–	–	–
Non-adherence	370	409	0.000	0.000	2.92 (2.08–4.11)
Physical disease, n (%)					
No	452	181	–	–	–
Yes	474	442	0.000	0.000	3.26 (2.28–4.66)
PANSS score					
Positive symptoms (mean ± SD)	3.75 ± 2.82	9.27 ± 3.03	0.000	0.031	2.01 (1.06–3.81)
Negative symptoms (mean ± SD)	20.24 ± 3.45	23.17 ± 3.11	0.000	0.411	1.31 (0.69–2.47)
General psychopathology symptoms (mean ± SD)	24.61 ± 2.91	26.88 ± 3.82	0.000	0.461	1.27 (0.67–2.40)

[a]*P1*: unadjusted regression.
[b]*P2*: adjusted regression.
CI: confidence interval; OR: odds ratio; PANSS: Positive and Negative Syndrome Scale; SD: standard deviation.

with an increased risk of committing more than one type of aggression ($\chi^2 = 5.14$, $P = 0.02$). No other factors were associated with more than one type of aggression (data not shown). Table 3 illustrates a breakdown of the types of physical disease among patients with schizophrenia. Of all physical disease types, cardiovascular system disease (38.6%), endocrine system disease (30.2%), and nervous system disease (15.6%) were the three most frequently reported types of physical disease among aggressive patients with schizophrenia.

Discussion

To our knowledge, this is the first Chinese community-based study to investigate the risk factors of aggression among patients with schizophrenia. We found that in the

Table 3. Type of physical disease among aggressive patients with schizophrenia (n = 482)

	Number	%
Cardiovascular system disease	186	38.6%
Endocrine system disease	146	30.2%
Nervous system disease	75	15.6%
Digestive system disease	74	15.4%
Other system disease	1	0.2%
Total	482	100.0%

Key Community Alliance in the Fengtai District of Beijing, the prevalence and incidence of schizophrenia, and the rate of aggressive behaviour, increased from 2011 to 2015 ($P<0.001$). We also found that non-adherence to medication ($P<0.001$, OR = 2.92), being unmarried ($P = 0.035$, OR = 1.62), having physical disease ($P<0.001$, OR = 3.26), and higher positive symptom scores ($P = 0.031$, OR = 2.01) increased the risk of aggression. Moreover, we identified a novel risk factor for aggression: having a physical disease was found to be a risk factor that might increase the likelihood that a patient will commit more than one type of aggression ($\chi^2 = 5.14$, $P = 0.02$). Cardiovascular system disease (n = 186 (38.6%)) was the most frequently reported physical disease among aggressive patients with schizophrenia.

Our study showed that the increased rate of prevalence and incidence of schizophrenia contributed to the increased rate of aggression. Previous studies have found similar results, reporting that patients with schizophrenia have a higher risk of aggression than the general population.[21] This may be because patients with schizophrenia often engage in substance use,[22] have psychopathy, and experience persecutory ideations,[23] which are associated with aggressive behaviour. Therefore, measures are needed to improve symptoms in schizophrenia patients and to decrease the prevalence and incidence rate of schizophrenia to help reduce aggression.

We found that being unmarried is a risk factor for aggression ($P = 0.035$, OR = 1.62). Support from family members, particularly from spouses, could help to avoid aggressive behaviours in patients with schizophrenia.[24] Evidence indicates that unmarried patients have a higher risk of aggressive behaviour, because they have fewer family members or caregivers in their social networks than married patients.[25] In China, most patients are cared for by their families at home. Traditionally, marriage and family support are essential in the treatment and daily care of Chinese patients.[26] Individuals estranged from their spouses may tend to engage in criminal activities. The present findings indicate the potential importance of marriage in prevention of aggressive behaviour.

Previous research indicates that non-adherence to medication is associated with aggressive behaviour.[27] Our findings support this and suggest that medication non-adherence could increase the risk of aggression (OR = 2.92). This may be because antipsychotic medication, particularly clozapine, may be effective in improving psychopathic symptoms and preventing nervous symptom changes in patients, thus reducing aggressive behaviours. Therefore, medication compliance is very important for patients with schizophrenia.

This study found that positive symptoms ($P = 0.031$, OR = 2.01) act as a risk factor for aggressive behaviour, a finding indicated by other international studies.[28–30]

The presence of positive symptoms, such as delusions, hallucinations, and excitement, is a key risk factor for aggressive behaviour. One clinical study of aggression in patients with psychosis[31] reported that hostility (which is also a positive symptom) is associated with aggression. Therefore, rehabilitation therapies are required to increase patients' medication compliance, improve psychotic symptoms, and decrease aggression rate.

It is well known that increased morbidity and mortality are associated with mental disorders. One Nordic study reported that the life expectancy of psychiatric patients was lower than that of the general population by 15 to 20 years, mostly owing to physical diseases.[32] However, to our knowledge, only a few studies have assessed whether comorbid physical disease is associated with aggressive behaviour in schizophrenia patients.[33] Therefore, we examined the frequency of physical disease among aggressive patients with schizophrenia and found that cardiovascular system disease ranked first. This might be because cardiac autonomic imbalance in patients with schizophrenia may be associated with the development of positive symptoms (e.g. delusions),[34] which increase the risk of aggressive behaviour. In addition, our findings show that in patients with physical diseases, the risk of committing more than one type of aggression was 2.99 times the risk for healthy controls. This increased risk might be a result of stress and anxiety caused by the physical disease.[31] Further investigation of this association and the links between physical disease and aggression is needed. A multidisciplinary effort is required to design interventions and treatment strategies in everyday clinical settings to improve physical health and quality of life and thus decrease aggression rates.

The findings of the present study should be considered in light of the following limitations. First, only permanent (rather than emigrant) patients with schizophrenia recorded in the BMHIMS were selected for the study. Second, reports from police officers and self-reports to psychiatric supervisors were the only sources of information in the system. Fear of discrimination may cause family members to avoid reporting to others a patient's symptom or aggressive behaviours toward them. Therefore, population-level interventions are needed to reduce internalized stigma and social avoidance in schizophrenic patients and their families. Third, substance abuse or antisocial personality tendency were not considered as aggression-associated factors in this study. Approaches to managing substance abuse, addiction, and antisocial activities mean that substance abuse or antisocial personality tendency are rarely considered factors related to aggression in China. Fourth, the BMHIMS system does not permit the categorisation of aggression into verbal aggression, aggression against property, auto-aggression, and aggression toward others; therefore, a detailed analysis of these aggression subtypes could not be performed. Future refinement of the indexes of the BMHIMS system (particularly related to aggression data) is desirable to facilitate more complete data collection and analysis. Finally, in addition to aggressive behaviour, physical disease may be related to medication side effects. However, information about such side effects was not analysed in this study. Future research on this issue should be based on more complete data to clarify the relationship between medication and aggressive behaviour in patients with schizophrenia.

Conclusion

Our study demonstrated that schizophrenic patients from the Key Community Alliance in the Fengtai District of Beijing were characterized by a higher prevalence of physical

disease compared with the general population. In addition, more than half of the patients lived without a spouse. These characteristics suggest that these patients need special support from society to improve their medical treatment and spiritual care. We found that the sociodemographic factor of marital status and the clinical factors of medication adherence, physical disease, and positive symptom scores were associated with aggression. Improvements in physical disease treatment and medication adherence could reduce the occurrence of aggressive behaviour.

Authors' contributions

RYK, YXY, ZWL, YQW, XYC and JJ designed the study. YXY, ZWL, YQW, and RYK completed all data collection; JJ compiled the primary statistical analysis; YXY completed statistical analysis for all data; RYK wrote the first draft of the manuscript; JJ and LLX provided clinical assessment; YXY and ZWL corrected and reviewed the final draft of the manuscript and KMG proofread the article. All authors contributed to and have approved the final manuscript.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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