



Trends in violent offending among people with schizophrenia: A 10-year ecological study

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ABSTRACT

Violent offending committed by people with schizophrenia has been a public concern. The present study aims to examine the incidence of violent offending among people with schizophrenia and its correlations with mental health resources and economic factors. In this study, an examination of violent offending by people with schizophrenia and those identified as not criminally responsible on account of mental disorder (NCRMD) between 2010 and 2019 in China's Hunan province was undertaken. Principal component analysis (PCA) and regression analyses were used to explore the association of violent offending in people with schizophrenia and those identified as NCRMD with violent offending in the general population, mental health medical resources, and provincial GDP. Between 2010 and 2019, a total of 2,093 people with schizophrenia committed violent offending in Hunan province, including 1,374 (65.6%) cases identified as NCRMD. Over the period, the incidence of violent offending in people with schizophrenia and those identified as NCRMD has been decreasing. The incidences were positively correlated with the incidence of violent offending in the general population and negatively associated with mental health resources and provincial GDP. These findings may be valuable in helping to develop strategies for violence prevention and risk management for people with schizophrenia.

1. Introduction

Violence related to mental disorders has been a public health concern across the world. Evidence suggests that the risk of violent offending in people with schizophrenia is higher than that in the general population (Fazel et al., 2014; Whiting et al., 2022), although most people with schizophrenia never engage in violence throughout their life (Nielsen and Large, 2010; Strassnig et al., 2020). The consequences of violent behavior perpetrated by people with schizophrenia may impose a high economic burden on public healthcare services (Senior et al., 2020). Therefore, it is critical to understand the trends in violent offending by people with schizophrenia as well as the systems-level factors including health and socio-economic characteristics, which will

be valuable in helping to develop strategies for violence prevention and risk management for people with schizophrenia.

Existing studies examining the trends and patterns of violent offending related to mental disorders are mainly based in Western developed countries, and they also yielded inconsistent results. Earlier evidence suggested that the incidence of homicide related to mental disorders tended to remain stable, regardless of whether the overall rate of homicide in the general population decreased (Flynn et al., 2021; Penney et al., 2018) or increased (Taylor and Gunn, 1999). Some other studies have shown that the incidence of mental illness-related homicide rises in tandem with an increase in homicides in the general population (Gottlieb et al., 1987; Gudjonsson and Petursson, 1986). A 40-year study based in the Chuvash Republic of the Russian Federation revealed that

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the rate of homicide associated with schizophrenia was significantly correlated with that in people without schizophrenia over this period (Golenkov et al., 2021).

There are also studies exploring the associated factors with violent offending committed by people with mental disorders on a macro level. For instance, studies in the United Kingdom and the United States showed that the decrease in the rate of violent offending associated with mental disorders could be attributed to improvement in psychiatric care and service organizations (Large et al., 2008) and was negatively correlated with the quality of mental health services (Segal, 2012). Contrary to expectations, a 25-year study based in Ontario, Canada found that the homicide rate amongst individuals with serious mental illnesses did not decrease alongside that of the general population and was also unrelated to the utilization and availability of psychiatric services and facilities (Penney et al., 2018).

To date, evidence on the trend of violent offending associated with mental disorders in low and middle developing countries, including China, has still been limited. The difference between developing countries and Western developed countries is not only in economic level, but also there still have not yet implemented the de-institutionalized system in developing countries, so the relevant research conclusions of Western developed countries cannot represent the current situation of developing countries. As one of the developing countries, China's economy has been developing and mental health resources have been increasing rapidly. Thus, it is critical to conduct similar research in China in understanding the current situation of violent offending among people with mental disorders in developing countries. During the past two decades, China has made substantial progress in building a comprehensive mental health framework, from establishing a three-tiered prevention and treatment network to forming community-centered rehabilitation initiatives (Xu et al., 2022), and have trained a large number of psychiatric practitioners. However, it is currently unknown what trends in the incidence of violent offending by people with schizophrenia and how the trends correlate with economic levels and mental health resources over time.

The present study is a 10-year ecological study on the trends in violent offending committed by people with schizophrenia in Hunan province, China, with a hypothesis that the incidence of violent offending by people with schizophrenia may be declining over the past decade. We also hypothesized that the declines might be positively associated with the decrease in the incidence of violent offending in the general population, improvement in the economic level, and expansion of mental health resources.

2. Methods

2.1. Data collection and setting

This was a longitudinal ecological study conducted in Hunan Province. Located in southern China, it encompasses a land area of approximately 211,800 square kilometers, has a population of 73.3 million people, and boasts the 8th highest GDP among a total of 34 provinces and municipalities in China. We collected information on the index offense (i.e., crime type), the diagnoses of mental disorders, and the criminal responsibility of all cases between January 1, 2010, to December 31, 2019 from all eight forensic psychiatric institutions, which were located in seven cities in Hunan Province, for forensic psychiatric assessment. We also collected information on the provincial-level gross domestic product (GDP) and mental health resources during the same period.

Patients who met the following criteria were included in this study: (1) diagnosed with schizophrenia according to the 10th Revision of the International Classification of Diseases (ICD-10), (2) engaged in one of the following offenses: homicide, intentional injury, rape/incest, or robbery, (3) aged 15 years and above, and (4) with registered residence in Hunan Province. Patients with incomplete information, duplicate

identification, or registered residence outside Hunan Province were excluded.

The outcomes of this study were the incidences of violent offending in people with schizophrenia (Y1) and in those identified as Not Criminally Responsible on account of Mental Disorder (NCRMD) (Y2). The incidence of violent offending in the general population (X1), mental health resources (including the number of psychiatric hospitals (X2), psychiatric beds (X3), annual psychiatric visits (X4), licensed psychiatrists (X5), licensed psychiatric nurses (X6)), and provincial-level GDP (X7) were used as associated factors.

For estimation of the incidences of violent offending in the general population (X1), people with schizophrenia (Y1), and those identified as NCRMD (Y2), exact figures were not publicly available. Thus, we used publicly reported data for an indirect estimation with the following procedure: for the estimation of Y1 and Y2, the total number of people with schizophrenia was estimated using the total population aged 15 years and above in Hunan and the national weighted prevalence of schizophrenia, which was 0.6% based on the China Mental Health Survey (Huang et al., 2019). The above estimation was based on the assumptions that the prevalence of schizophrenia in Hunan Province was similar to the national prevalence and that the prevalence of schizophrenia remained constant throughout the study period; and the data on violent offending in people with schizophrenia and those identified as NCRMD were obtained based on forensic psychiatric assessment. For the estimation of X1, we used the number of suspected violent criminal cases filed by the public security organs published in the National Bureau of Statistics (<http://www.stats.gov.cn/>) to represent the number of violent offenses in the general population nationwide. Based on these data, we calculated the incidence of violent offending in the general population nationwide and used the obtained national data to represent X1. The data on provincial GDP and mental health resource indicators (X2-X7) were obtained from the Hunan Provincial Bureau of Statistics (<http://tjj.hunan.gov.cn/>), as shown in Supplemental information: Appendix Table 1.

2.2. Definitions and description

Violent offending refers to all cases involving violence, deliberate endangering of the safety of others, and/or disruption of social order. Specifically, violent offending includes homicide, intentional injury, rape/incest, and robbery in the present study. For individuals who committed more than one violent offense, the most prominent one would be selected for analysis.

Not criminally responsible on account of mental disorder (NCRMD) refers to the state in which the perpetrator is unable to control their behavior, nor understand or foresee the consequences of their behavior due to ongoing psychosis. Whether an individual should bear criminal responsibility needs to undergo forensic psychiatric assessment. In the context of China's legal system, criminal responsibilities are divided into three categories, i.e., full, diminished, and no responsibility (Hu et al., 2011).

The incidence of violent offending refers to the rate of new cases of violent offending over the period of the study.

The calculation formula for the incidence of violent offending in people with schizophrenia (Y1) is as follows:

$$Y1 = \frac{A1}{B * 0.6\%},$$

where A1 refers to the number of violent offenses committed by people diagnosed with schizophrenia through forensic psychiatric assessment, and B refers to the total population of Hunan Province obtained through official government sources. The denominator represents the theoretical total number of people in Hunan Province diagnosed with schizophrenia.

The formula for the incidence of violent offending in patients iden-

Table 1

Numbers, rates and trends of violent offenses in the general population, people with schizophrenia, and people with schizophrenia who were identified as NCRMD from 2010 to 2019 in Hunan Province, China.

Year	Numbers of violent offenses in the general population nationwide ^{a,b}	National population aged 15 years and above ^{a,b,c}	Incidence of violent offending in the general population ^{b,d}	Population aged 15 years and above ^{e,f}	Number of people with SCZ ^{c,f}	Number of violent offenses by people with SCZ ^f	Incidence of violent offending in people with SCZ ^{d,f}	Number of violent offenses by people with SCZ identified as NCRMD ^f	Incidence of violent offending in people with SCZ identified as NCRMD ^{d,f}	Relative risk for violent offending (people with SCZ/the general population) ^f
2010	459,354	111,832	41.08	5840.66	35.04	276	78.76	221	63.06	1.92
2011	413,094	112,571	36.70	5858.31	35.15	230	65.43	179	50.92	1.78
2012	388,900	113,117	34.38	5841.08	35.05	226	64.49	172	49.08	1.88
2013	352,845	113,743	31.02	5841.54	35.05	245	69.90	171	48.79	2.25
2014	295,396	114,224	25.86	5884.12	35.30	245	69.40	151	42.77	2.68
2015	258,137	114,747	22.50	5908.72	35.45	176	49.64	120	33.85	2.21
2016	221,647	115,263	19.23	5986.71	35.92	188	52.34	120	33.41	2.72
2017	221,647	115,660	19.16	5953.24	35.72	172	48.15	80	22.40	2.51
2018	186,008	116,015	16.03	5898.92	35.39	171	48.31	91	25.71	3.01
2019	160,136	116,513	13.74	5856.47	35.14	164	46.67	69	19.64	3.40

^a : The data were obtained from the National Bureau of Statistics of the People’s Republic of China,.

^b : the data was based on the national level,.

^c :unit: 10,000 persons per year,.

^d :unit: per 100,000 person-years,.

^e : the data were obtained from the Hunan Provincial Bureau of Statistics,.

^f : the data was based on the provincial level

SCZ: schizophrenia; NCRMD: Not Criminally Responsible on Account of Mental Disorder.

tified as NCRMD (Y2) is

$$Y2 = \frac{A2}{B * 0.6\%}$$

where A2 refers to the number of violent offenses committed by individuals diagnosed with schizophrenia through forensic psychiatric assessment and subsequently identified as NCRMD. The denominator and its interpretation are the same as those in Y1.

For the incidence of violent offending in the general population (X1), the formula is

$$X1 \approx C \approx \frac{D}{E} \approx \frac{D1}{E}$$

We assumed that there was no significant difference between the incidences of violent offending in the general population of Hunan Province (X1) and the general population of China (C), and we also assumed that the number of violent offenses committed by the resident population nationwide (D) would be accurately represented by the number of suspected violent criminal cases filed by the public security organizations (D1), according to the National Bureau of Statistics. E refers to the number of the national resident population.

2.3. Ethics

All procedures in this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2013. Ethical approval was obtained from the Human Ethics Committee of the Second Xiangya Hospital, Central South University. This study was launched by the Forensic Assessment Institution of the Second Xiangya Hospital of Central South University and was approved and supported by the other seven qualified forensic psychiatric institutions in Hunan Province.

2.4. Statistical analysis

The characteristics and incidences of violent offending in people with schizophrenia and the general population were described using counts and proportions. The relative risk of violent offending in people with schizophrenia and those identified as NCRMD to violent offending

in the general population was calculated. Scatter plots were used to illustrate the distribution of the incidence of violent offending in the three groups between 2010 and 2019, and Pearson correlation analyses were performed to explore the association of the incidences of violent offending in people with schizophrenia and those identified as NCRMD with the incidence of violent offending in the general population, mental health resources, and provincial GDP. In order to ensure the robustness of the results, we used Bofenronni correction, the test level $\alpha=0.05/7 = 0.007$, which means that $p < 0.007$ indicates a statistically significant difference.

Due to high collinearity (VIF >10) among the independent variables, we then conducted principal component analysis (PCA) to reduce the dimensionality of variables and extract principal components. The main purpose of principal component analysis is to use a smaller number of comprehensive indicators to reflect the main information in all original indicators. Due to the different dimensions (units) of variables, the original indicator variables from 2010 to 2019 were standardized to eliminate the impact of dimensions on model accuracy, with standardized variables denoted as ZXi. The number of principal components (PCs), ranging from 1 to 7, was tested, and eigenvalues were obtained (Crawford and Ferguson, 1970; Kaiser, 1960; Stevens, 2012). A varimax rotation and the eigenvalue-one criterion (eigenvalue ≥1) were used to decide the number of PCs to be included. Multiple linear regression analysis was used to identify factors associated with the incidences of violent offending in people with schizophrenia (Y1) and those identified as NCRMD in Hunan Province (Y2). All statistical analyses were performed using SPSS 23.0 and R, with $p < 0.05$ indicating statistical significance (two-tailed).

3. Results

3.1. The incidence of violent offending in people with schizophrenia

A total of 2093 people with schizophrenia were found to have committed violent offending in Hunan Province between 2010 and 2019, including 1374 (65.6%) cases identified as NCRMD. During this period, the incidence of violent offending in people with schizophrenia ranged from 78.76/100,000 in 2010 to 46.67/100,000 in 2019, exhibiting a consistent year-by-year decline (slope=-0.23), with an overall decrease of 40.74%. A similar decline (slope=-0.21) was found for

people with schizophrenia identified as NCRMD, decreasing from 63.06/100,000 in 2010 to 19.64/100,000 in 2019, with an overall reduction of 68.86%. In addition, there was a consistent decline (slope=-0.32) in the rate of violent offending committed by the general population nationwide, from 41.08/100,000 in 2010 to 13.74/100,000 in 2019, representing a reduction of 66.55%. The above trends in the incidences of violent offending in different populations and the general population are summarised in Table 1 and Fig. 1.

Overall, the risk of violent offending among individuals with schizophrenia was 2.44 times higher than that in the general population, and the relative risk of violent offending among individuals with schizophrenia compared to the general population increased from 1.92 in 2010 to 3.40 in 2019, indicating that the decline in the incidence of violent people with schizophrenia was less pronounced than that in the general population.

3.2. Association of the incidence of violent offending in people with schizophrenia with economic indicators and mental health resources

3.2.1. The pearson correlation analysis

As shown in Table 2, the incidence of violent offending in people with schizophrenia was positively associated with the incidence of violent offending in the general population ($r = 0.897, P < 0.001$) but negatively associated with the number of psychiatric hospitals ($r = -0.858, P = 0.001$), psychiatric beds ($r = -0.875, P = 0.001$), annual psychiatric visits ($r = -0.807, P = 0.001$), licensed psychiatrists ($r = -0.857, P = 0.002$), and the provincial GDP ($r = -0.889, P = 0.001$). The incidence of violent offending in people with schizophrenia subsequently identified as NCRMD was also positively associated with the incidence of violent offending in the general population ($r = 0.969, P < 0.001$) but negatively associated with the number of psychiatric hospitals ($r = -0.938, P < 0.001$), psychiatric beds ($r = -0.960, P < 0.001$), annual psychiatric visits ($r = -0.928, P < 0.001$), licensed psychiatrists ($r = -0.943, P < 0.001$), and licensed psychiatric nurses ($r = -0.887, P = 0.001$), as well as the provincial GDP ($r = -0.976, P < 0.001$).

3.2.2. Principal component analysis and regression analyses

The PCA analysis identified seven different PCs accounting for a total of 100% of the variance (Table 3). The eigenvalue of PC1 was greater than 1.0; PC1 explained 97.28% of the variance, with a cumulative contribution rate reaching 97.278%, indicating that it was sufficient to reflect most of the information about the original indicators. PC2 explained 1.82% of the variance, with a cumulative contribution rate

being 99.10%. Therefore, only PC1 was retained for dimensionality reduction. Based on the corresponding feature vectors of each principal component, PC1 included the information of all original indicators. The following expression was obtained:

$$PC_1 = -0.372ZX_1 + 0.381ZX_2 + 0.382ZX_3 + 0.379ZX_4 + 0.381ZX_5 + 0.370ZX_6 + 0.380ZX_7.$$

Linear regression analysis was conducted using PC1 as the independent variable and the incidence of violent offending in people with schizophrenia (Y1) as the dependent variable. The results showed that the correlation coefficient β was -10.006 ($R^2=0.749$, adjusted $R^2=0.717, F = 23.824, P = 0.001$), as shown in table 4.

The principal component regression model is presented as follows:

$$Y_1 = 59.310 - 10.006 PC_1 = 59.310 - 10.006 * (-0.372ZX_1 + 0.381ZX_2 + 0.382ZX_3 + 0.379ZX_4 + 0.381ZX_5 + 0.370ZX_6 + 0.380ZX_7).$$

The principal component regression equation was restored to the original data, as follows:

$$Y_1 = 2.581 + 0.397X_1 - 1022.03X_2 - 2.73X_3 - 0.079X_4 - 42.516X_5 - 17.158X_6 - 0.001X_7.$$

The adjusted PC regression equation indicated that only X1 was positively correlated with the incidence of violent offending in people with schizophrenia (Y1), whereas the correlation between X2-X7 and Y1 was negative.

Linear regression was also conducted using PC1 as the independent variable and the incidence of violent offending in people with schizophrenia identified as NCRMD (Y2) as the dependent variable. The correlation coefficient β was -13.592 ($R^2= 0.915$, adjusted $R^2=0.904, F = 85.733, P < 0.001$), as shown in Table 4.

The principal component regression model is as follows:

$$Y_2 = 38.962 - 13.592 PC_1 = 38.962 - 13.592 * (-0.372ZX_1 + 0.381ZX_2 + 0.382ZX_3 + 0.379ZX_4 + 0.381ZX_5 + 0.370ZX_6 + 0.380ZX_7).$$

The principal component regression equation was restored to the original data, as follows:

$$Y_2 = -38.098 + 0.539 X_1 - 1388.311 X_2 - 3.708 X_3 - 0.107 X_4 - 57.753 X_5 - 23.307 X_6 - 0.001 X_7.$$

The PC regression equation indicated that X1 was positively correlated with the incidence of violent offending in people with

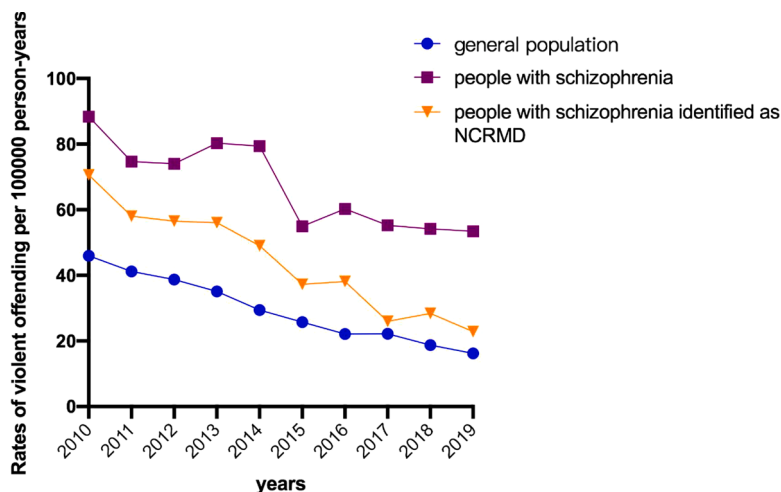


Fig. 1. Incidences of violent offending (per 100,000 person-years) in the general population, people with schizophrenia, and people with schizophrenia identified as NCRMD between 2010 and 2019 in Hunan Province, China.

NCRMD: Not criminally responsible on account of mental disorder

Table 2
The results of Pearson correlation analysis.

Variable	Pearson correlation	The incidence of violent offending in the general population	Number of psychiatric hospitals	Number of beds	Annual psychiatric visits	Number of licensed psychiatrists	Number of psychiatric nurses	Provincial GDP
Incidence of violent offending in people with schizophrenia/100,000	r p	0.897 <0.001*	-0.858 0.001*	-0.875 0.001*	-0.807 0.001*	-0.857 0.002*	-0.789 0.007	-0.889 0.001*
Incidence of violent offending in people with schizophrenia identified as NCRMD/100,000	r p	0.969 <0.001*	-0.938 <0.001*	-0.960 <0.001*	-0.928 <0.001*	-0.943 <0.001*	-0.887 0.001*	-0.976 <0.001*

NCRMD: not criminally responsible on account of mental disorder;
* : $p < 0.05/7 = 0.007$, corrected by Bonferroni.

Table 3
Initial eigenvalues and contribution rates of principal component analysis.

Principal component (PC)	Eigenvalues	Variance %	Cumulative contribution rate
PC1	6.81	97.28	97.28
PC2	0.13	1.82	99.10
PC3	0.04	0.55	99.65
PC4	0.02	0.21	99.86
PC5	0.01	0.08	99.94
PC6	0.00	0.04	99.98
PC7	0.00	0.02	100.00

Table 4
The incidence of violent offending in people with schizophrenia and those identified as not criminally responsible on account of mental disorder in Hunan Province, China obtained from principal component regression analysis.

Principal component	β	SD	Standardization β	t	p
Model 1^a					
Intercept ^a	59.310	1.945	-	30.498	<0.001
F1 ^a	-10.006	2.050	-0.865	-4.881	0.001
R2 ^a	0.865				
Adj.R2 ^a	0.749				
F ^a	23.824				
Model 2^b					
Intercept ^b	38.962	1.393	-	27.978	<0.001
F1 ^b	-13.592	1.468	-0.956	-9.259	<0.001
R2 ^b	0.956				
Adj.R2 ^b	0.915				
F ^b	85.733				

^a : The incidence of violent offending in people with schizophrenia was set as the dependent variable.

^b : the incidence of violent offending in people with schizophrenia who have been identified as NCRMD was set as the dependent variable.

schizophrenia identified as NCRMD (Y2), while X2-X7 were negatively associated with the incidence of violent offending in the same group.

4. Discussion

To our knowledge, this is the first ecological study on the trends in violent offending in people with schizophrenia in China. This study found a decreasing trend of violent offending in people with schizophrenia and those identified as NCRMD over the past ten years, and that the incidences were strongly and positively correlated with the incidence of violent offending in the general population. Our study also revealed associations between the incidence of violent offending in people with schizophrenia and associated ecological factors, such as provincial economic development and available mental health resources, which may help policymakers formulate strategies for the prevention of violence and risk management for people with

schizophrenia.

The present study found that the rates of violent offending in people with schizophrenia and those identified as NCRMD decreased with the decline in the rate of violent offending in the general population, which was consistent with our hypothesis. It was also in line with the results of a large-scale systematic review of the trends in violent offending in high-income countries (Large et al., 2009). Our findings imply that violent offenses by people with schizophrenia and those in the general population may have common risk factors. Macro-level factors that contribute to the reduction of violent offending in the general population include investment in healthcare and social infrastructure, treatment and rehabilitation of substance abuse, and regulation of access to weapons (Bonta et al., 1998; Fisher et al., 2006; Junginger et al., 2006). These factors may also be effective in reducing the incidence of violent offending by people with schizophrenia. Therefore, understanding the relationship between the incidence of violent offending related to schizophrenia and the incidence of violent offending in the general population may be of great significance for preventing violent offenses associated with schizophrenia and other psychosis.

Although the crime rate associated with schizophrenia has decreased, the risk relative to the general population has increased, which suggests that there are specific factors related to schizophrenia and its treatment, distinct from factors affecting the crime rate in the general population. Earlier studies suggested an elevated risk of engaging in violent offenses during the initial episode and untreated phase of schizophrenia (Large and Nielssen, 2008; Nielssen et al., 2011). A case-control study (Zhong et al., 2023) suggested that episodes of serious mental disorders were associated with violent offending, which also underscores the critical need for early identification and effective treatment to prevent violent offending related to schizophrenia.

In the present study, we found that indicators of mental health resources, such as the number of psychiatric hospitals and psychiatric beds, annual psychiatric visits, and the number of licensed psychiatric healthcare workers, were negatively correlated with the incidences of violent offending in people with schizophrenia and those identified as NCRMD. These results corroborate previous studies based in England and Wales and the US, which showed that improvement in psychiatric care and services played an important role in reducing the incidence of violent offending in people with schizophrenia (Large et al., 2008; Segal, 2012). In China, the National Continuing Management and Prevention Program for Psychoses in 2004 (Project 686) (Ma, 2012) has provided financial support for community mental health services for patients with severe mental disorders (Good and Good, 2012). In addition, since the first-ever national Mental Health Law came into effect in 2013 (Chen et al., 2012), there have been increasing mental health resources in China. According to the provincial government statistics, since 2010, Hunan Province has witnessed an increase of 65 psychiatric hospitals, 24,139 psychiatric beds, and 1570 licensed psychiatrists by the year 2019, indicating that the above strategies and changes have a positive effect in reducing violent offending related to schizophrenia. These

findings suggest that improving mental health resources may help more people with schizophrenia receive standardized diagnosis and treatment, or to some extent reduce the occurrence of violent offending among them.

Our study also revealed that provincial GDP was negatively associated with the incidences of violent offending in people with schizophrenia and those identified as NCRMD, which further supports the role of structural inequities, such as low financial status and food insecurity, as social determinants of health in psychiatric disorders and crime (Kornhauser, 1975; Samspon and Groves, 1989). Throughout the study period, Hunan Province experienced significant economic growth, with the provincial GDP increasing by over 2371.42 billion yuan. As a natural consequence of economic development, government investment in the healthcare and social assistance industry increased, providing patients more access to quality psychiatric services, thereby reducing the risk of violence among patients with mental disorders.

5. Limitations

The limitations of this study also need to be mentioned. Firstly, the data on violent offending in people with schizophrenia and those identified as NCRMD were based on forensic psychiatric assessment, which may underestimate the incidence of violent offending in people with schizophrenia. Secondly, due to lack of data on index offence of the general population in Hunan Province, we have used the national-level data to estimate the incidence of violent offending in general population in the province, which may also introduce bias to the results, the results should be interpreted with caution. Future prospective studies are warranted to verify our findings.

6. Conclusions

Our study showed that the incidences of violent offending in people with schizophrenia and those identified as NCRMD have been decreasing from 2010 to 2019 in Hunan Province, China. The incidences were found to be significantly correlated with the incidence of violent offending in the general population over this period. The increase in mental health resources and the developing economy may play important roles in reducing violent offending associated with schizophrenia. This indicates that the prevention of violent offending in people with schizophrenia involves not only providing enhanced mental health resources and reinforcing treatment measures, but also addressing factors influence general violent offending. Our findings may have critical implications for the prevention and management of violent offending in people with schizophrenia.

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Author statement

I certify that all authors have seen and approved the final version of the manuscript being submitted. They warrant that the article is the authors' original work, hasn't received prior publication and isn't under consideration for publication elsewhere. The following declarations are also included in this statement:

Ethic

The protocol of the study was approved by the Animal Care and Use Committee of the Second Xiangya Hospital of Central South University and was in accordance with the institution's guidelines for the care and use of laboratory animals.

CRedit authorship contribution statement

Huijuan Guo: Writing – review & editing, Writing – original draft, Methodology, Funding acquisition, Data curation, Conceptualization. **Shaoling Zhong:** Writing – review & editing, Writing – original draft, Methodology, Funding acquisition, Data curation, Conceptualization. **Sze Tung LAM:** Writing – review & editing, Methodology, Formal analysis. **Nan Wang:** Writing – review & editing, Methodology, Data curation. **Jun Wang:** Writing – review & editing, Methodology, Data curation. **Qiaoling Sun:** Writing – review & editing. **Siyuan Wang:** Writing – review & editing. **Jiansong Zhou:** Writing – review & editing. **Xiaoping Wang:** Writing – review & editing, Supervision, Project administration, Methodology, Funding acquisition, Data curation, Conceptualization.

Declaration of competing interest

There are no conflicts of interest to declare.

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None.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.psychres.2024.115935](https://doi.org/10.1016/j.psychres.2024.115935).

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