

# Suicide-related behaviours in schizophrenia in China: a comprehensive meta-analysis

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**Aims.** Suicide-related behaviours are common in schizophrenia and are significantly associated with premature death. The objective of this meta-analysis study was to estimate the pooled prevalence of suicide-related behaviours in schizophrenia patients in China.

**Methods.** The relevant literature was searched systematically via the relevant electronic databases (PubMed, Embase, PsycINFO, Chinese National Knowledge Infrastructure, Wanfang Databases and Chinese Biological Medical Literature Database) from their inception until 14 September 2016. Only original studies that reported the prevalence of suicide-related behaviours including suicidal ideation (SI), suicide plan, suicide attempt (SA) and completed suicide were selected.

**Results.** Nineteen articles met the inclusion criteria and were analysed. The pooled lifetime prevalence of SI and SA were 25.8% (95% CI 14.7–41.1%) and 14.6% (95% CI 9.1–22.8%), respectively. The 1-month prevalence of SI was 22.0% (95% CI 18.2–26.4%). Subgroup analyses of lifetime SI and SA showed that gender, sample size, survey year, study location and source of patients have no significant mediating effects on the results.

**Conclusions.** Suicide-related behaviours are common in Chinese schizophrenia patients. Due to the high mortality risk, regular screening and effective suicide prevention programmes are warranted.

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**Key words:** China, meta-analysis, schizophrenia, suicide.

## Introduction

Suicide, being the act of intentionally ending one's own life, has been a major public health challenge worldwide. Suicide-related behaviours consist of suicidal ideation (SI), suicide plan (SP), suicide attempt (SA) and completed suicide (CS) (Nock *et al.* 2008; Scocco *et al.* 2008). While SI refers to thoughts and fantasies or a wish to die, SP is defined as the plan how to end one's own life and SA refers to a self-destructive act with an intent to end one's life. CS is the act of suicide resulting in death (Ran *et al.* 2004; Suominen *et al.* 2004; Lee *et al.* 2007; Scocco *et al.* 2008; Kao *et al.* 2012). Suicide-related behaviours are significantly associated

with suicide (Harkavy-Friedman *et al.* 1999; WHO, 2012). Understanding the patterns of suicide-related behaviours is important to develop and implement effective measures to reduce the risk of suicide. A large number of studies have been conducted in general populations all over the world. For example, a survey of 84 850 adults in 17 countries found that lifetime prevalence of SI, SP and SA was 9.25, 3.1, 2.7% in the general population, respectively (Nock *et al.* 2008). In the USA, the prevalence of SI, SP and SA was 13.5, 3.9 and 4.6% respectively; 34% of persons with SI proceeded to a SP, and 72% of those with a SP attempted suicide (Kessler *et al.* 1999).

Schizophrenia is a severe psychiatric disorder characterised by a variety of psychotic symptoms coupled with cognitive impairment and behavioural dysfunction. Schizophrenia causes immeasurable suffering for the individual and poses a significant psychosocial and economic burden to families and societies (van Os & Kapur, 2009). Schizophrenia is significantly

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associated with suicide-related behaviours (Pompili *et al.* 2007; Hor & Taylor, 2010), and suicide is a primary cause of death in young patients with schizophrenia (De Hert *et al.* 2001). A meta-analysis found that 4.9% of schizophrenia patients committed suicide during their lifetime. However, a major limitation was that most data included in this meta-analysis came from Western countries (Palmer *et al.* 2005).

China has the largest schizophrenia population (7.16 million) in the world (Phillips *et al.* 2009; Chan *et al.* 2015). There is compelling evidence that sociocultural factors have a strong influence on suicide patterns; therefore, the findings reported in the West may not apply to China (Ran *et al.* 2005; Zhong *et al.* 2016). In the past decade, several studies have examined the prevalence of suicide-related behaviours in Chinese patients with schizophrenia yielding inconsistent results. For example, the lifetime prevalence of SI varied between 7.4% (Zheng *et al.* 2015) and 57.6% (Yan & Wei, 2012), and the figures of SA varied between 3.2% (Xue & Zhang, 2006) and 51.0% (Kao *et al.* 2012). One study (Phillips *et al.* 2004) found that 10.1% of schizophrenia patients died of suicide in China but in another study, the figure was 4.2% (Ran *et al.* 2007). In addition, most studies were done in a single hospital or a particular province; therefore, the findings do not necessarily reflect the nationwide patterns of suicide-related behaviours in schizophrenia patients.

The objective of this meta-analysis was to examine the pooled prevalence of suicide-related behaviours in schizophrenia patients in China and to explore their mediating factors. We hypothesised that schizophrenia patients would have a higher rate of suicide-related behaviours compared with the general population in China.

## Methods

### Search strategy and selection criteria

This meta-analysis was conducted and reported according to the MOOSE recommendations (Stroup *et al.* 2000). The relevant literature was searched systematically via the following electronic databases, including PubMed, Embase, PsycINFO, Chinese National Knowledge Infrastructure (CNKI), Wanfang Databases and Chinese Biological Medical Literature Database from their inception until 14 September 2016. Articles were identified using the following search terms: ('suicide\*' or 'self-injurious behavior' or 'self-mutilation' or 'self-immolation' or 'self-harm' or 'self-inflicted' or 'self-injury' or 'self-slaughter' or 'self-destruction') and ('schizophrenia' or 'psychotic disorder' or 'psychosis') and ('epidemiology' or 'cross-sectional study' or 'prevalence' or 'rate' or 'risk factor' or 'cohort study' or

'observational study') and ('China' or 'Chinese'). The titles and abstracts were screened independently by two investigators (MD and SBW) who both had at least 5 years experiences in clinical research. The full texts of potentially eligible articles were downloaded for further screening. Any disagreement was resolved by discussion with a third investigator to reach a consensus.

### Inclusion and exclusion criteria

The articles included in study fulfilled the following criteria: (1) reporting on inpatients and outpatients with schizophrenia by any diagnostic criteria; (2) cross-sectional or cohort study conducted in China; (3) data reported on prevalence of suicide-related behaviours including SI, SP, SA or CS; (4) suicide-related behaviours assessed with standardised questionnaires or questions; and (5) were published in Chinese or English. If more than one article was based on the same dataset, only the publication with the largest sample size was selected. Studies conducted in specific settings (e.g., prison or nursing home) and retrospective surveys were excluded.

### Data extraction

Two investigators extracted information with a standardised form that included the authors' name, publication and survey year, study site (province), type of region (urban/rural), source of sample (inpatients or outpatients), sampling method, sample size, mean age of the patients, proportion of men, screening method and tools and timeframe (i.e., point, 12-month and lifetime prevalence).

### Quality assessment

The methodological quality of the included studies was evaluated using the 22-item Strengthening the Reporting of Observational Studies in Epidemiology (von Elm *et al.* 2007). Study quality was defined as low quality when the total score was  $\leq 11$ ; high quality was defined as the total score  $> 11$  (Cao *et al.* 2015).

### Statistical analysis

Data were analysed using the Comprehensive Meta-Analysis (CMA), Version 2.0 (Biosta, Inc. Englewood, New Jersey, USA). The pooled prevalence estimates and their 95% confidence intervals (95% CI) were conducted using the random-effects models. The  $I^2$  statistic was calculated to measure heterogeneity (Higgins *et al.* 2003). When heterogeneity was present ( $I^2 > 50\%$ ), sensitivity and subgroup analyses were used to explore the reasons for heterogeneity. Publication bias was assessed by the funnel plot and

Egger's test (Egger *et al.* 1997). Significance level was set at 0.05 (two-sided).

## Results

### Search results

A total of 1136 studies were initially identified (Fig. 1). After excluding the duplications, 670 articles were reviewed by title and abstracts. Finally, 19 articles, which met the inclusion criteria, were included for analyses.

### Study characteristics and quality assessment

Table 1 shows the general characteristics of the studies. Sample sizes ranged from 42 to 1655 and the mean age of patients ranged from 31.0 to 43.9 years. Consecutive sampling was used in ten studies. The total STROBE scores ranged between 8 and 20; 16 articles were rated as high quality and three were low quality.

Seven studies reported lifetime prevalence of SI, three studies reported 1-month prevalence and one study reported the prevalence during hospitalisation. Only one study reported the lifetime prevalence of SP. Thirteen studies reported the lifetime prevalence of SA, while one study reported the 1-month prevalence and another study reported the prevalence during hospitalisation.

### Pooled prevalence of suicide-related behaviours

The lifetime prevalence of SI in seven studies with a total 1017 patients was 25.8% (95% CI 14.7–41.1%,

$I^2=95.49\%$ ) (Fig. 2a). The 1-month prevalence of SI in three studies with 642 patients was 22.0% (95% CI 18.2–26.4%,  $I^2=12.57\%$ ) (Fig. 2b). The lifetime prevalence of SA in 13 studies with 5098 patients was 14.6% (95% CI 9.1–22.8%,  $I^2=97.02\%$ ) (Fig. 2c).

Some results could not be pooled because they were reported only in one study: Zhang (1998) and Wu (2002) reported that the prevalence of SI and SA during hospitalisation was 40.8 and 10.5%, respectively. One study (Deng, 2000) found that the 1-month prevalence of SA was 11.7%; another study (Zhang & Xiao, 2002) found that the lifetime prevalence of SP was 16.7%.

### Sensitivity analysis and publication bias

In sensitivity analyses, after each study was sequentially excluded, the recalculated results did not change significantly indicating that none of the studies significantly influenced the overall results of the meta-analysis. The publication bias concerning the lifetime prevalence of SA was tested with the visual inspection of the funnel plot graphic indicating slight asymmetry (Supplementary Fig. S1), but the Egger's test did not reveal any publication bias ( $t=0.25$ ,  $p=0.81$ ).

### Subgroup analysis

Table 2 shows the results of the subgroup analyses. The lifetime prevalence of SI in men and women was 29.6% (95% CI 12.8–54.7%) and 24.1% (95% CI 9.6–48.9%), respectively. The lifetime prevalence of SA in men was 13.0% (95% CI 5.9–25.9%) and the figure in women was 13.8% (95% CI 6.3–27.3%). Using the median splitting method, the lifetime prevalence of SI was 17.8% (95% CI 7.4–37.0%) in studies with the mean age  $\leq 35.8$  years, while the corresponding figure was 28.8% (95% CI 12.9–52.7%) in studies with the mean age  $>35.8$  years. The lifetime prevalence of SA was 11.0% (95% CI 3.9–27.2%) in studies with the mean age  $\leq 38$  years, while the corresponding figure was 16.2% (95% CI 5.5–39.5%) in studies with the mean age  $>38$  years.

Using the median splitting method, the lifetime prevalence of SI was 17.0% (95% CI 8.3–31.7%) in studies with a sample size  $\leq 145$ , while the corresponding figure was 40.5% (95% CI 21.6–62.7%) in studies with a sample size  $>145$ . The lifetime prevalence of SA was 20.8% (95% CI 11.7–34.2%) in studies with a sample size  $\leq 194$ , and the corresponding figure was 9.8% (95% CI 5.0–18.1%) in studies with a sample size  $>194$ .

The lifetime prevalence of SI was 32.4% (95% CI 13.3–59.8%) in studies conducted during or before May 2002, and 13.1% (95% CI 5.4–28.5%) in those conducted after May 2002. The lifetime prevalence of SA

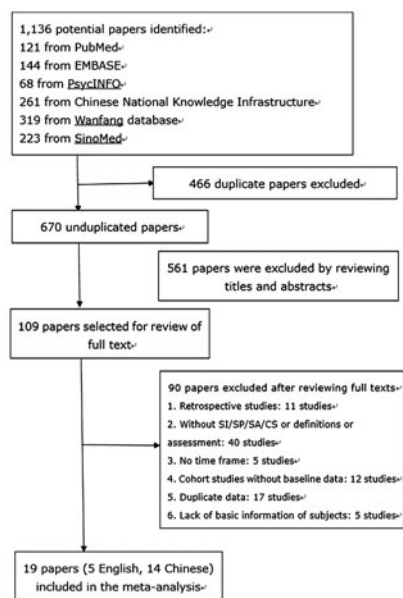
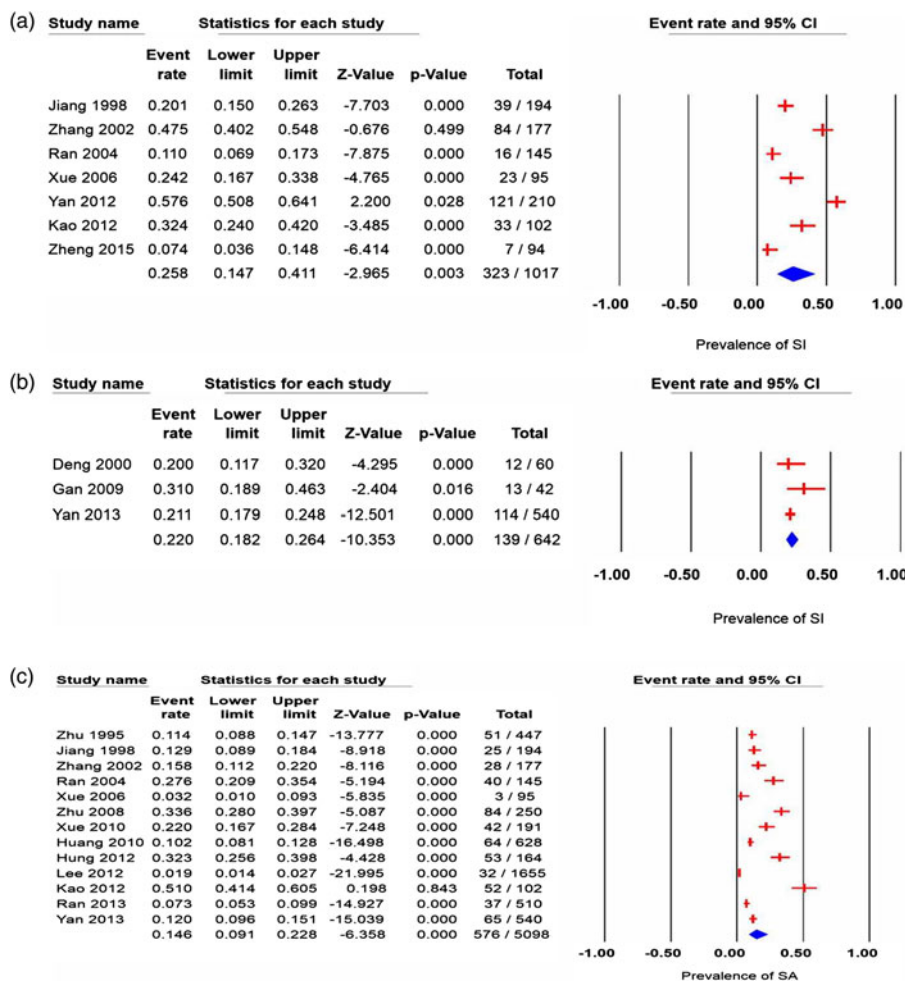


Fig. 1. Flowchart for study selection.

**Table 1.** Summary of the studies included in the meta-analysis

Author	Publication year	Region	Survey year	Source of patients	Sampling	Study design	Assessment of suicide	Age (years)	Sample size	Male (%)	Suicide-related behaviours	STROBE
Zhu	1995	Anhui	1992–1993	Inpatients	Consecutive	Cross-sectional	Self-designed	38.0	447	68.0	SA <sup>LT</sup>	11
Jiang	1998	Hunan	1988	Inpatients	Consecutive	Cohort	Self-designed	NA	194	NA	SI <sup>LT</sup> SA <sup>LT</sup>	12
Zhang	1998	Yunnan	1995–1997	Inpatients	NA	Cross-sectional	Self-designed	31.0	120	NA	SI <sup>DH</sup>	8
Deng	2000	Jiangsu	NA	Inpatients	Cluster	Cohort	Self-designed	NA	60	NA	SI <sup>1M</sup> SA <sup>1M</sup>	12
Zhang	2002	Hubei	1999–2000	Inpatients	Consecutive	Cross-sectional	Self-designed	32.4	177	60.5	SI <sup>LT</sup> SP <sup>LT</sup> SA <sup>LT</sup>	15
Wu	2002	Henan	2000–2002	Inpatients	Consecutive	Cross-sectional	Self-designed	NA	532	NA	SA <sup>DH</sup>	13
Ran	2004	Sichuan	2002	Inpatients	Consecutive	Cross-sectional	Self-designed	32.2	145	51.0	SI <sup>LT</sup> SA <sup>LT</sup>	14
Xue	2006	Shanghai	2004	Outpatients	Consecutive	Cross-sectional	Self-designed	34.2	95	41.1	SI <sup>LT</sup> SA <sup>LT</sup>	17
Zhu	2008	Beijing	2005–2006	Outpatients	Convenience	Cross-sectional	Self-designed	43.7	250	51.6	SA <sup>LT</sup>	14
Gan	2009	Chongqing	2008–2009	Outpatients	Convenience	Cross-sectional	BSS	NA	42	NA	SI <sup>1M</sup>	14
Xue	2010	Liaoning	1999–2000	Inpatients	Consecutive	Cohort	Self-designed	NA	191	NA	SA <sup>LT</sup>	14
Huang	2010	Guangdong	2009	Inpatients	Consecutive	Cross-sectional	Self-designed	NA	628	NA	SA <sup>LT</sup>	15
Yan	2012	Shenyang	NA	Outpatients	Cluster	Cross-sectional	BSI-CV	38.5	210	39.1	SI <sup>LT</sup> SI <sup>1M</sup>	11
Lee	2012	Taiwan	2008	Outpatients	Cluster	Cross-sectional	Self-designed	43.9	1655	59.2	SA <sup>LT</sup>	17
Kao	2012	Taiwan	NA	Outpatients	Consecutive	Cross-sectional	SSI	39.5	102	49.0	SI <sup>LT</sup> SA <sup>LT</sup>	17
Hung	2012	Taiwan	NA	Inpatients	Consecutive	Cross-sectional	Self-designed	NA	164	NA	SA <sup>LT</sup>	15
Ran	2013	Sichuan	1994	Outpatients	Cluster	Cohort	PFS	36.0	510	46.5	SA <sup>LT</sup>	15
Yan	2013	Beijing	2007	Outpatients	Random	Cross-sectional	Self-designed and HAMD	42.8	540	49.4	SA <sup>LT</sup> SI <sup>1M</sup>	20
Zheng	2015	Beijing	2013	Inpatients	Cluster	Cross-sectional	Self-designed	37.4	94	51.1	SI <sup>LT</sup>	20

BSI-CV, Chinese version of the Beck Scale for Suicide Ideation; BSS, Beck Scale for Suicide Ideation; DH, during hospitalisation; HAMD, Hamilton Depression Rating Scale for Depression; LF, lifetime; NA, not applicable; PFS, Patients Follow-up Schedule; SA, suicide attempts; SI, suicidal ideation; SP, suicide plan; SSI, Scale for Suicide Ideation; 1 M, 1 month.



**Fig. 2.** Forest plot of suicide-related behaviours. (a) Lifetime prevalence of suicidal ideation. (b) One-month prevalence of suicidal ideation. (c) Lifetime prevalence of suicide attempts.

was 12.0% (95% CI 5.5–24.2%) in studies conducted during or before May 2002 and 11.5% (95% CI 5.7–21.5%) in studies conducted after May 2002. The lifetime prevalence of SI in the east region (27.3%) was slightly higher than in the middle-west region of China (23.6%), although the difference was not significant. The pooled lifetime prevalence of SA in the east region (14.7%) was similar to that in the middle-west region (14.5%). Lifetime prevalence of SI was higher in outpatients (37.4%) than in inpatients (18.5%), but the lifetime prevalence of SA in inpatients (17.6%) was higher than in outpatients (11.5%).

The lifetime prevalence of SI was 26.8% (95% CI 14.4–44.3%) in cross-sectional studies, and 20.1% (95% CI 3.7–62.1%) in cohort studies. The lifetime prevalence of SA was 12.9% (95% CI 4.4–32.2%) in cross-sectional studies and 15.2% (95% CI 8.6–25.4%) in cohort studies. The lifetime prevalence of SI and SA was 44.9% (95% CI 19.4–73.3%) and 13.6% (95% CI 7.3–23.9%), respectively, in studies using standardised questionnaires, while the

corresponding figures were 19.7% (95% CI 10.0–34.9%) and 22.1% (95% CI 5.8–56.7%), in studies using self-designed questionnaires.

### Discussion

To the best of our knowledge, this was the first meta-analysis on the pooled prevalence of suicide-related behaviours in Chinese patients with schizophrenia. The lifetime prevalence (25.8%) and 1-month prevalence (22.0%) of SI in Chinese schizophrenia patients were lower than their Western counterparts (40%) (Fenton *et al.* 1997). Similarly, the lifetime prevalence of SA in schizophrenia in China (14.6%) was much lower than in India (23.3%), USA (48.3%) and Norway (30.5%) (Bhatia *et al.* 2006; Barrett *et al.* 2011). The discrepancy in the results across studies could be due to differences in demographic, socioeconomic and cultural factors, sampling methods, and criteria for defining suicide-related

**Table 2.** Overall and subgroup prevalence of suicidal ideation and suicide attempts<sup>a</sup>

Classification	Subgroup	Number of studies	Number of cases	Sample (size)	Prevalence (%)	95% CI	I <sup>2</sup> (%)	p value	Q (p value)
Lifetime prevalence of suicidal ideation									
Overall		7	323	1017	25.8	14.7–41.1	95.5	<0.001	
Gender	Female	3	49	168	24.1	9.6–48.9	86.4	0.001	0.13 (0.72)
	Male	3	75	205	29.6	12.8–54.7	89.1	<0.001	
Mean age	Mean age ≤ 35.8	3	78	434	17.8	7.4–37.0	73.6	0.023	0.75 (0.39)
	Mean age > 35.8	3	161	406	28.8	12.9–52.7	96.3	<0.001	
Sample size	Size ≤ 145 <sup>b</sup>	4	79	436	17.0	8.3–31.7	88.3	<0.001	3.73 (0.05)
	Size > 145 <sup>b</sup>	3	244	581	40.5	21.6–62.7	96.5	<0.001	
Survey year	After May 2002 <sup>b</sup>	3	46	334	13.1	5.4–28.5	83.2	0.003	2.29 (0.13)
	In or before May 2002 <sup>b</sup>	2	123	371	32.4	13.3–59.8	96.6	<0.001	
Area	East	4	184	501	27.3	12.0–50.9	95.5	<0.001	0.06 (0.08)
	Mid-west	3	139	516	23.6	8.8–49.5	96.4	<0.001	
Source of patients	Inpatient	4	146	610	18.5	8.1–37.0	95.8	<0.001	1.73 (0.19)
	Outpatient	3	177	407	37.4	16.9–63.9	94.3	<0.001	
Study design	Cross-sectional study	6	284	823	26.8	14.4–44.3	95.5	<0.001	0.13 (0.72)
	Cohort study	1	39	194	20.1	3.7–62.1	0	1	
Assessment	Standardised	2	154	312	44.9	19.4–73.3	94.1	<0.001	2.64 (0.10)
	Self-designed	5	169	705	19.7	10.0–34.9	94.5	<0.001	
Lifetime prevalence of suicide attempts									
Overall		13	576	5098	14.6	9.1–22.8	97.0	<0.001	
Gender	Female	7	153	1672	13.8	6.3–27.3	95.0	<0.001	0.01 (0.91)
	Male	7	178	2104	13.0	5.9–25.9	96.6	<0.001	
Mean age	Mean age ≤ 38	5	159	1374	11.0	3.9–27.2	91.8	<0.001	0.29 (0.60)
	Mean age > 38	4	233	2547	16.2	5.5–39.5	99.0	<0.001	
Sample size	Size ≤ 194 <sup>b</sup>	7	243	1068	20.8	11.7–34.2	92.2	<0.001	3.10 (0.08)
	Size > 194 <sup>b</sup>	6	333	4030	9.8	5.0–18.1	97.8	<0.001	
Survey year	After May 2002 <sup>b</sup>	6	322	3728	11.5	5.7–21.5	98.0	<0.001	0.009 (0.93)
	Before May 2002 <sup>b</sup>	5	149	1104	12.0	5.5–24.2	80.4	<0.001	
Area	East	9	446	4072	14.7	8.0–25.4	97.8	<0.001	0.001 (0.98)
	Mid-west	4	130	1026	14.5	5.8–31.8	92.5	<0.001	
Source of patients	Inpatient	7	303	1946	17.6	9.0–31.7	91.7	<0.001	0.72 (0.40)
	Outpatient	6	273	3152	11.5	5.3–23.3	98.5	<0.001	
Study design	Cross-sectional study	10	104	895	12.9	4.4–32.2	97.6	<0.001	0.08 (0.78)
	Cohort study	3	472	4203	15.2	8.6–25.4	92.7	<0.001	
Assessment	Standardised	2	422	3946	13.6	7.3–23.9	99.0	<0.001	0.47 (0.49)
	Self-designed	10	89	612	22.1	5.8–56.7	97.0	<0.001	

<sup>a</sup>Suicide plan was not included in subgroup analyses due to limited number.

<sup>b</sup>Median splitting method were used to establish the cutoff values.

behaviours. For example, compared with Western countries, under-reporting of suicide-related behaviour is more common in China due to fear of stigmatisation and discrimination associated with suicide in traditional Chinese culture (Ma *et al.* 2009).

The risk factors of suicide-related behaviours in the general population include male gender, being single, young age, having high education level, thoughts of hopelessness and substance abuse. Clinical risk factors of suicide-related behaviours in schizophrenia include insomnia, chronicity of illness, poor treatment adherence, late onset of illness and frequent admissions (Hawton *et al.* 2005; Pompili *et al.* 2009; Popovic *et al.* 2014). Unlike in Western countries, the prevalence of suicide is higher in female Chinese schizophrenia patients than men, and in rural China than in urban areas (Phillips *et al.* 2004). Possible reasons may include the heavy personal and financial impact for women with several mental illness and the easy access to lethal agents, particularly pesticides, in rural areas (Law & Liu, 2008). In this study however, the lifetime prevalence of SI in women was lower than in men (24.1 *v.* 29.6%), which is inconsistent with a previous study in China (Phillips *et al.* 2002). Men may be more likely to be subjected to stigmatisation related to schizophrenia than women (Crisp *et al.* 2005), which may account for the higher risk. In contrast, the lifetime prevalence of SA was similar between the both genders (13.8% in women *v.* 13.0% in men). Although previous studies found that CS was higher in men than in women with schizophrenia (Ran *et al.* 2007; Hor & Taylor, 2010), this could not be examined due to the small number of studies with relevant data.

In this study, the lifetime prevalence of SI and SA was higher in older patients, which is inconsistent with previous findings that younger age was associated with a higher suicide risk in schizophrenia (Popovic *et al.* 2014), which could be partly due to different study designs. This meta-analysis included both cross-sectional and cohort studies, while the previous review mainly had case-control and cohort control studies (Popovic *et al.* 2014). In addition, the previous study examined risk factors of completed suicide in schizophrenia, while the present study explored the moderators of SI and SA using subgroup analyses.

With larger sample size studies, the prevalence of SI was higher and the prevalence of SA was lower than in smaller sample size studies, although no publication bias was found. There is no satisfactory explanation for this result except noting that the results of studies with small sample size were relatively unstable. The prevalence of SI in studies published during and before May 2002 was more than twofold higher compared with studies published after that (32.4 *v.* 13.1%), while the

prevalence of SA was similar between the two periods (12.0 *v.* 11.5%). This is in line with the decreasing trends of suicide rate in both the Chinese general population (Wang *et al.* 2014) and schizophrenia (Miles, 1977; Caldwell & Gottesman, 1990; Inskip *et al.* 1998; Palmer *et al.* 2005; Hor & Taylor, 2010). The falling suicide rate may be related improved socioeconomic conditions (Wang *et al.* 2014), and the increased attention to suicide prevention in China.

Suicide-related behaviours are largely influenced by the sociocultural and economic background (Xiang *et al.* 2008; Ma *et al.* 2009); improvement of economic conditions could possibly be associated with a reduction in suicide rates (Yin *et al.* 2016). Certain gene polymorphisms, such as COMT Val158Met, 5HTR2A-T102C and rs6313 (T102C) (Kia-Keating *et al.* 2007; Calati *et al.* 2011; Gonzalez-Castro *et al.* 2013), are also associated with the risk of suicide. Hence, variations in ethnic composition, geographical area and economic status may influence suicide patterns. Subgroup analyses between different regions defined by the Chinese economic zone found that the lifetime prevalence of SI and SA in the eastern region is slightly higher than the mid-western part of China (SI: 27.3 *v.* 23.6%, SA: 14.7 *v.* 14.5%).

Compared with SI, SA is a more severe suicide-related behaviour that is significantly associated with suicide in schizophrenia (Drake *et al.* 1985). Higher prevalence of SA in inpatient population than in other settings is consistent with the suicide rate with previous studies in inpatient units (Carlborg *et al.* 2010). Severe positive symptoms which often result in inpatient treatment, are risk factors of suicide in schizophrenia (Krupinski *et al.* 2000). In this meta-analysis, only one study reported the lifetime prevalence of SP (16.7%) (Zhang & Xiao, 2002), which was much higher compared with the Chinese general population (0.9%) (Lee *et al.* 2007). This meta-analysis however could not pool the prevalence of CS because no studies met the inclusion criteria for such analysis. In China, the prevalence of CS in schizophrenia over 30 years was 14.3% (Zhao *et al.* 1992). Other studies found that the prevalence of CS in schizophrenia during the first 5 years of illness was 2.4% (Gonzalez-Pinto *et al.* 2007).

Compared with the general population, schizophrenia patients tend to use more violent and lethal methods to commit suicide (Harkavy-Friedman *et al.* 1999; Hunt *et al.* 2006). SI and SA are important predictors for CS (De Leo *et al.* 2005; Kessler *et al.* 2005). The progression from SI, SP and SA into CS requires access to the means for suicide. In China, pesticide indigestion, hanging, cutting wrist, jumping from height and drowning have been the common ways of suicide for

schizophrenia patients (Jiang *et al.* 1998; Xue, 2010). Around 60% of patients with SI made their first SA during the subsequent year (Nock *et al.* 2008). History of SA and frequent psychiatric admissions were major risk factors of suicide in schizophrenia (Popovic *et al.* 2014). According to the results of the subgroup analysis on genders, regions and settings, more attention should be paid to settings in eastern areas, male gender and inpatients with SI and SA.

There are several limitations to this study. First, the pooled point prevalence of SA, and the prevalence of SP and CS could not be analysed due to the small number of studies. Publication bias was not assessed for the lifetime and 1-month prevalence of SI as there were <10 studies with relevant data (Wan *et al.* 2013). Second, important variables related to suicide behaviours, such as economic conditions, place of residence, medical comorbidities, and the level of family and social support, were not reported in most studies. Third, heterogeneity is difficult to avoid in meta-analysis of epidemiological surveys (Winsper *et al.* 2013; Long *et al.* 2014), which remains a major obstacle in interpreting data. Heterogeneity of results was probably due to the discrepancy in measurements on suicide-related behaviours, sampling and the stage of schizophrenia. In addition, relative small sample size could be another reason for heterogeneity (Yan *et al.* 2013). Future studies with standardised assessments on suicide, larger sample sizes and multi-centre design should be conducted to minimise the heterogeneity. Fourth, irrespective of the lack of pre-study registration, the study was conducted strictly according to the PRISMA and MOOSE recommendations to avoid risk of selective bias and incomplete reporting. Finally, recall bias of suicide-related behaviours may exist in the cross-sectional and cohort studies. Different study periods in cohort studies may result in differing prevalence rates for suicide-related behaviours (Wang *et al.* 2006).

In conclusion, suicide-related behaviours are common in Chinese patients with schizophrenia. Given the significant association between suicide-related behaviours and premature death in schizophrenia, regular screening for such behaviours and effective suicide prevention programmes should be implemented.

### Supplementary material

The supplementary material for this article can be found at <https://doi.org/10.1017/S2045796017000476>.

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### Conflict of Interest

The authors have no conflict of interest.

### Ethical Standard

Not applicable.

### Availability of Data and Materials

All the data used in this manuscript have been included in the tables and figures.

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