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Worldwide prevalence of falls in older adults with psychiatric disorders: A meta-analysis of observational studies

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ABSTRACT

Falls are common in older adults with psychiatric disorders, but the epidemiological findings have been inconsistent. This meta-analysis examined the prevalence of falls in older psychiatric patients and its moderating factors. PubMed, EMBASE, Web of Science and PsycINFO databases were independently searched by three investigators from their inception date to Nov 31, 2017. The random effects meta-analysis was used to synthesize the prevalence of falls, while meta-regression and subgroup analyses were conducted to explore the moderating factors. Sixteen of the 2061 potentially relevant papers met the entry criteria for the meta-analysis. The pooled lifetime prevalence of falls was 17.25% (95% confidence interval: 13.14%–21.35%). Neither univariate and nor multivariate meta-regression analyses revealed any moderating effects of the study region, duration, sample size, and quality on the prevalence of falls (P values > 0.05). Falls in older adults with psychiatric disorders are common.

1. Introduction

Falls are a major risk factor for morbidity and mortality in older adults, accounting for around 40% of all injury-related deaths (Rubenstein, 2006). For example, the death rate from falls in older adults (≥65 years) is 36.8 per 100,000 population in the USA (Centers for Disease Control and Prevention, 2006). Approximately 28%−32% of older adults have at least one or more falls per year (Blake et al., 1988; Campbell et al., 1981; Prudham and Evans, 1981), while for those over 70 years of age this figure is increased by 4%−7% (Downton and Andrews, 1991; Stalenhoef et al., 2002; Tinetti et al., 1988). Falls are a major hospital incident and are common in elderly patients (Bouldin et al., 2013; Healey et al., 2008; Roughead and Semple, 2009). Falls in older adults lead to physical injury, lowered quality of life, reduced physical and social activities (Painter et al., 2012), psychological symptoms (Boyd and Stevens, 2009) and heavy economic burden (Roudsari et al., 2005; Scott et al., 2005).

Older patients in psychiatric settings have an increased risk of falls (Blair and Gruman, 2006) compared to those in general hospitals (Keech, 2010) due to, among others, the impact of psychiatric symptoms, cognitive disturbances and side effects of psychotropic medications (De Hert et al., 2016; Eriksson et al., 2009; Oepen et al., 2018; Oliver et al., 2004). Severe injuries including fractures and head trauma and even death occur in 3.4% of the falls in older psychiatric patients (Scheffel and Pantelatos, 1997).

The lifetime prevalence of psychiatric disorders in older adults is high, ranging from 38.8% to 56.3% in an European survey (Andreas et al., 2017). The prevalence of falls in older psychiatric patients varies widely across studies (Buchner and Larson, 1987; Oepen et al., 2018). It is imperative to determine the prevalence of falls in this

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particularly vulnerable population in order to identify risk factors and preventive strategies. To the best of our knowledge, no meta-analysis on the prevalence of falls in this population has been published, which gave the impetus to conduct a meta-analysis of the pooled prevalence of falls in older adults with psychiatric disorders and explore its associated factors.

2. Methods

This meta-analysis was registered with the International Prospective Register of Systematic Reviews, University of York Centre for Reviews and Dissemination (PROSPERO registration No.: CRD42018087275).

2.1. Data sources and search strategies

Following the PRISMA (preferred reporting items for systematic reviews and meta-analyses) statement (Moher et al., 2009), PubMed, EMBASE, Web of Science and PsycINFO databases were independently searched from their inception date until November 31, 2017 by three investigators (WWR, LNZ, JWZ). The following search terms were used: ("fall" OR "accidental falls") AND ("epidemiology" OR "cross-sectional" OR "prevalence" OR "rate") AND ("mental disorders" or "psychiatr*" or "insanity") AND ("old*" OR elderly). The reference lists of the identified publications were also checked manually to ascertain additional studies that may have been missed. Corresponding authors were contacted by emails if further information was needed.

2.2. Inclusion and exclusion criteria

Three investigators (WWR, LNZ, JWZ) independently reviewed titles and abstracts, followed by the full review of the texts. Full texts of four papers (Czernuszenko, 2007; Glazer et al., 1993; Herve et al., 1984; Vieweg et al., 1993) were not accessible, therefore were not included in the analyses. The eligibility of studies was independently examined by two investigators (LNZ, JWZ). Discrepancies were resolved by a discussion between them, or involving another investigator (YTX) if necessary. If more than one paper was published based on the same database, only the paper with the largest sample size was included.

Inclusion criteria were: (1) cross-sectional, retrospective surveys or cohort studies (only baseline data were included) conducted in psychiatric settings; (2) older adults aged ≥60 years; (3) time-frame was reported (e.g., one week, or one month); (4) percentage of falls or relevant information was reported. There is no universally accepted agreement on the definition of fall, therefore falls were defined by the studies included in the meta-analysis. Exclusion criteria were: (1) survey without information on time-frame; (2) reviews and meta-analyses.

2.3. Data extraction

Relevant information was independently retrieved by two investigators (LNZ, QQZ). If there were any disagreements, a separate assessment was made by a third investigator (WWR). The following data were retrieved: the first author, study location, year of survey, study duration, sample size, gender, mean age, diagnostic criteria of psychiatric disorders, country, area and number of patients with falls, were extracted and entered into a spreadsheet.

2.4. Quality assessment

Two investigators (LNZ, QQZ) independently evaluated the methodological quality of included studies using the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist, which has a total score ranging from 0 to 22 (Von Elm et al., 2007). The STROBE total score ≥12 was considered as "high quality" (Lu et al., 2017). Any disagreements were resolved by involving a third investigator (WWR).

2.5. Statistical analysis

Homogeneity of prevalence of falls across studies was examined with the Higgins' I^2 statistic. A I^2 value of ≥50% indicates high heterogeneity (Higgins et al., 2003). The DerSimonian and Laird random effects model was used to synthesize the prevalence of falls and their 95% confidence intervals (95% CI). Subgroup and meta-regression analyses were conducted to examine the possible sources of heterogeneity. Funnel plots and Begg's test of asymmetry were performed to test publication bias. Binary logistic regression analysis was used to explore potentially independent associations of high fall rate (fall rate was dichotomized using median splitting method) with study region, study duration, year of publication, sample size, and STROBE score. High fall rate was the dependent variable, while the above variables were entered as independent variables. All calculations were done using R, Version 3.3.0 and RStudio, version 0.99.903. The level of significance was set at 0.05 (two-sided).

3. Results

3.1. Study selection and characteristics

Sixteen of the 2,061 potentially eligible publications as identified in the literature review comprising 7,355 older adult psychiatric patients were included in the meta-analysis. The study selection is illustrated in Fig. 1.

3.2. Study characteristics

Table 1 presents the study characteristics. Six studies were conducted in North America, 5 in Asia, 3 in Europe, and 2 in Oceania. The sample size varied from 29 to 1,834, with a median of 183. The year of survey ranged between 1986 and 2016. Psychiatric diagnoses were established using the Diagnostic and Statistical Manual of Mental Disorders, Third Edition (DSM-III, $n = 2$), Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV, $n = 1$), the International Classification of Diseases, 10th version (ICD-10, $n = 4$), the Diagnostic and Statistical Manual of Mental Disorders, Third Edition, Revised and the International Classification of Diseases, Ninth Revision, Clinical Modification (DSM-III-R and ICD-9-CM, $n = 1$), while 8 studies did not report diagnostic criteria.

3.3. Quality assessment and publication bias

The STROBE scores ranged from 12 to 19, with a median score of 16.5. All studies were rated as high quality. The funnel plot and Begg's test did not reveal publication bias ($z = 1.62$, $P = 0.11$; Fig. 3).

3.4. Prevalence of falls, subgroup analyses and meta regression

The pooled lifetime prevalence of falls was 17.25% (95% CI: 13.14%–21.35%, $I^2 = 96.5\%$) (Fig. 2). The pooled annual fall rate was 8.74% (95% CI: 6.87%–10.62%, $I^2 = 97.6\%$). Table 2 presents the results of meta-regression and subgroup analyses. Neither the univariate nor the multivariate meta-regression found any moderating effects of study region, study duration, sample size, and the STROBE score on the prevalence of falls (P values >0.05). Binary logistic regression analysis did not reveal significant associations between high fall rate and study region, study duration, year of publication, sample size, and STROBE score (all P values of >0.05).

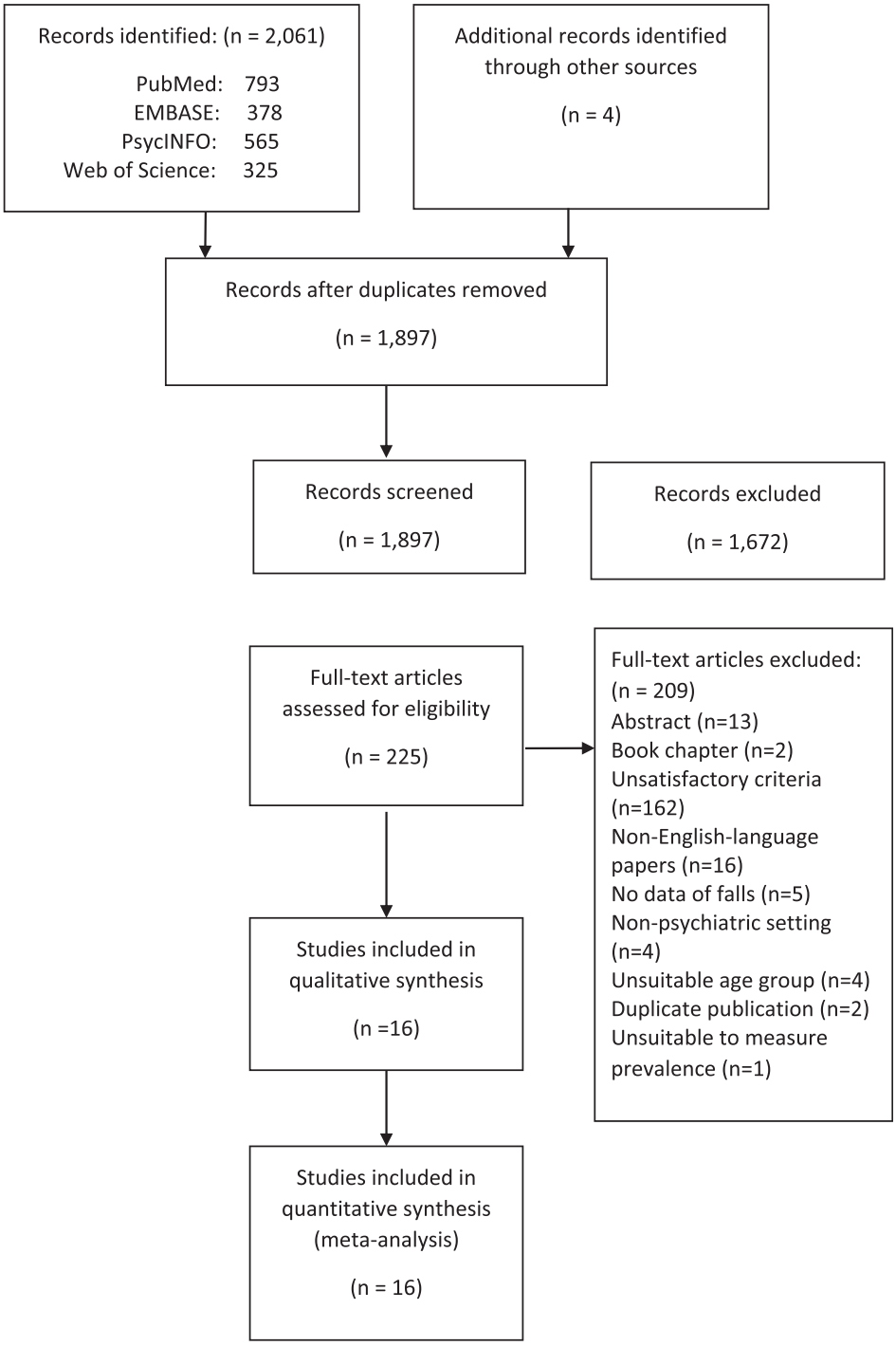

Fig. 1. Flowchart of the study selection.

4. Discussion

To the best of our knowledge, this was the first meta-analysis of studies on the prevalence of falls in older adults with psychiatric disorders. The pooled lifetime prevalence of falls was 17.25% which is within the range (2%–39%) reported previously (Buchner and Larson, 1987; Oepen et al., 2018). It is estimated that approximately 15% of adults aged 60 years and above experience a psychiatric disorder in their lifetime (World Health Organization, 2018), which translates to approximately 144.3 million older psychiatric patients globally (United Nations, 2017). Of this population, over 24 million would experience at least one fall in their lifetime.

The pooled lifetime prevalence of falls was highest in the studies conducted in the three European countries (24.9%), followed by those in Oceania (16.31%), Asia (15.81%) and North America (14.9%). However, the difference between survey locations did not reach significant level. The lifetime prevalence of falls in this study is significantly higher than the corresponding figure (7.3%; 95%CI: 5.0%–10.6%) in older Chinese psychiatric patients (Rao et al., 2018). This could partly be due to different sampling methods, definition of falls, local clinical practice and nursing care guidelines (Heinze et al., 2007). For example, there are different regular training and education on prevention of falls and their reporting system between regions and countries, which could affect the awareness, identification, risk and

Table 1
Characteristics of studies included in the meta-analysis.

No.	First author (Publication year)	Survey year	Study duration (months)	Diagnostic criteria	Sample size	Age (Mean ± SD)	Age range	Category of major psychiatric disorders	Female (N, %)	Country	Area	Number of patients who fell	STROBE score
1	Buchner (1987)	1980–1982	36	DSM-III and EC	157	79 ± NR	62–93	ATD	104 (66.0)	USA	America	48	15
2	Poster (1991)	1986–1988	34	DSM-III	1215	NR	≥60	DP; DE; BD; PS	NR	USA	America	182	15
3	Murdock (1998)	1993–1994	24	NR	791	NR	>70	NR	NR	Australia	Oceania	133	12
4	Tsai (1998)	NR	7	NR	29	NR	>60	DP	NR	China	Asia	4	14
5	Carle (2001)	1992–1995	48	DSM-III-R and ICD-9-CM	1834	74.8 ± 7.8	>60	PD; AFD; DE; PCD	1330 (72.5)	USA	America	175	18
6	Lim (2001)	NR	12	NR	384	NR	>65	SCH; DE; DP	NR	Singapore	Asia	67	17
7	Greene (2001)	NR	36	ICD-10	150	NR	66–95	AFD; DP	113 (75.3)	Ireland	Europe	16	17
8	Aizenberg (2002)	1997–2000	48	MMSE > 27	414	NR	>65	DD; SCH	NR	Israel	Asia	34	14
9	Blair (2006)	NR	6	Axis 1	174	74.1 ± 9.78	≥60	DP; DE; SAD; BD; SCH	100 (57.5)	USA	America	28	15
10	An (2009)	2002–2005	36	ICD-10	721	NR	≥60	SCH; MD	NR	China	Asia	30	19
11	Eriksson (2009)	2001–2003	24	DSM-IV	191	78.6 ± 7.5	60–94	DE	NR	Sweden	Europe	75	18
12	Lu (2010)	2002–2008	82	ICD-10	131	79.1 ± 6.19	65–90	DM	77 (58.8)	Australia	Oceania	18	18
13	Manu (2013)	2010	4	NR	30	NR	≥65	DE	NR	USA	America	8	19
14	Tseng (2013)	2007–2013	68	NR	91	NR	≥60	SCH;BD;DE;SD;NS	NR	China	Asia	57	17
15	Brown (2017)	2015–2016	12	NR	133	NR	60–80	MDD	NR	USA	America	3	14
16	Oepen (2018)	2013	12	ICD-10	853	NR	>65	DE; AD; SCH; MD	NR	Germany	Europe	217	16

ICD-10 = International Classification of Diseases, Tenth Revision; ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification; MMSE = Mini-Mental State Examination (Folstein et al., 1975); DSM-III = Diagnostic and Statistical Manual of Mental Disorders, Third Edition; DSM-III-R = Diagnostic and Statistical Manual of Mental Disorders, Third Edition, Revised; DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition;
EC = criteria of Eisdorfer and Cohen (1980);
SD = Standard deviation; NR = Not Reported;
DE = Dementia; DP = Depression; PS = Psychosis; PCD = Psychotic disorder; PD = Parkinson's disease; DD = Depressive disorder; SAD = Schizoaffective disorder; DM = Delirium; SCH = Schizophrenia; MD = Mood disorder; AD = Alzheimer's disease; AFD = Affective disorder; SMD = Senile mental disorder; BD = Bipolar disorder; PP = Paranoid psychosis; MDD = Major depressive disorder; ATD = Alzheimer-type dementia; SD = Substance-dependence; NPD = Neurotic personality disorder; CD = Childhood disturbance; NS = Neurosis

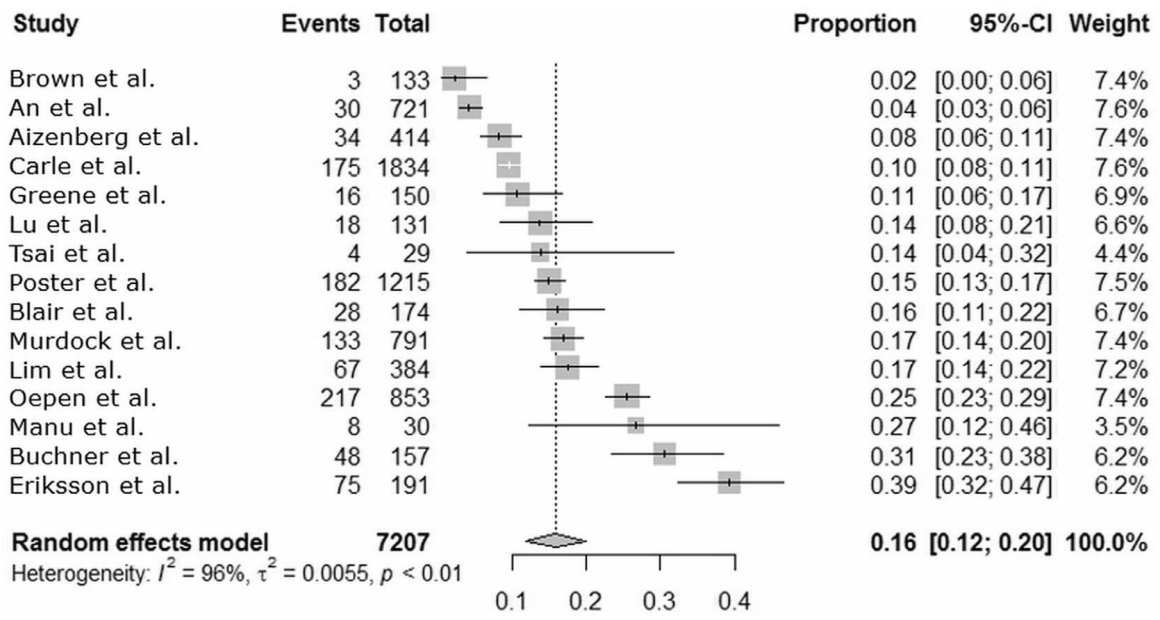

Fig. 2. Forest plot of prevalence of falls in older adults with psychiatric disorders.

reported number of falls. Another possibility is that most studies included in the meta-analysis were conducted in developed countries where falls in geriatric psychiatric settings are likely to be better identified, addressed and monitored, which may results in an apparent higher rate of falls. Although one study found that the sample size was a moderating factor in the prevalence of falls (Bischoff-Ferrari et al., 2004), this was not confirmed in this study. There were no significant moderating effects caused by study duration or the quality of studies as measured with the STROBE on the prevalence of falls either.

A main strength of this study is its large pooled sample size. However, the results need to be interpreted with caution due to several methodological limitations. First, the 16 studies involved only 8 countries, which restricts the generalizability of the findings. Second, similar to previous studies (Li et al., 2016; Long et al., 2014; Winsper et al., 2013), the unavoidable substantial heterogeneity characterized the studies in the meta-analysis although subgroup analyses somewhat mitigated this limitation. Third, several factors relevant to falls, such as universally applied definitions of fall, well-defined study time, psychiatric diagnoses, use of psychotropic medications and physical comorbidities, were not provided in most studies. Fourth, the full texts of four papers were not accessible, which may have biased the findings to an uncertain degree. Lastly, important factors related to falls in older adults including the use of electroconvulsive treatment and psychotropic drugs and their side effects, were not recorded in most studies.

In conclusion, this meta-analysis found that the prevalence of falls in older adults with psychiatric disorders was common. Preventive

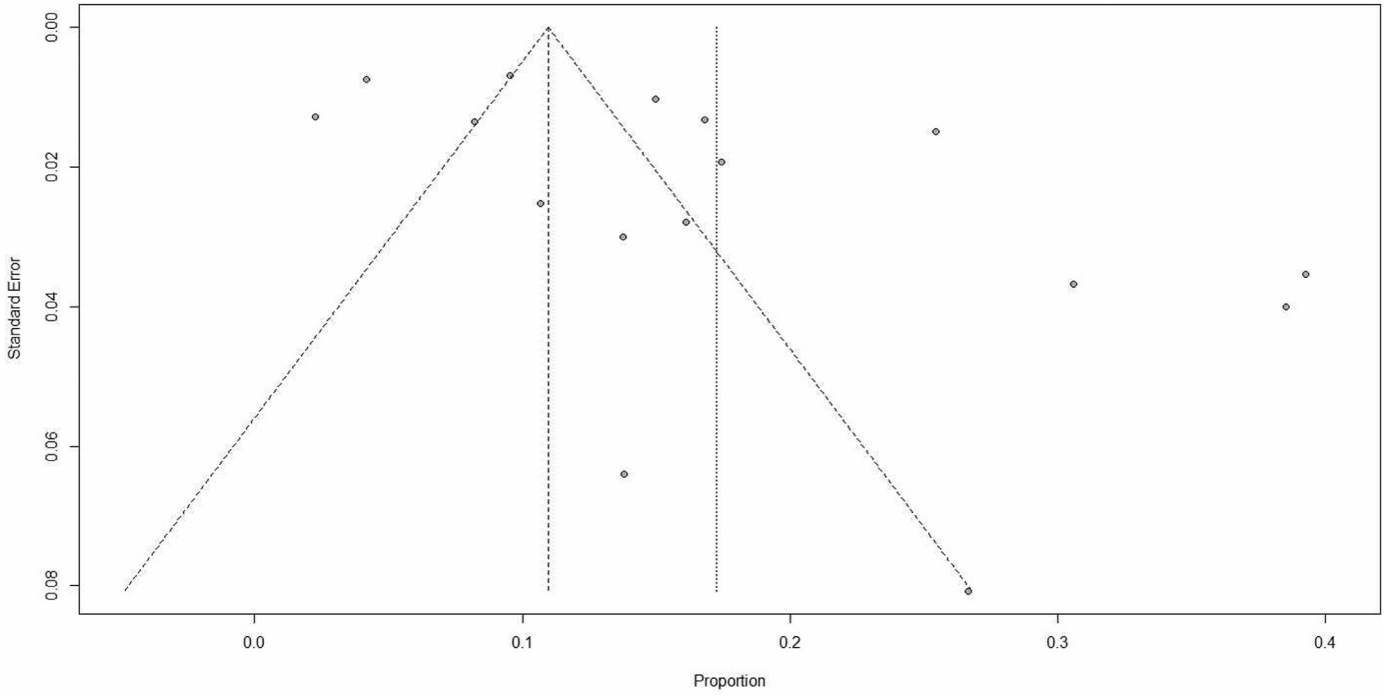

Fig. 3. Funnel plot of publication bias.

Table 2
Meta regression and subgroup analyses of the prevalence of falls.

Category	Variable	Tau^2	slope	se	Z	P	95%CI
Univariate analysis	Study duration	0.007	0.0001	0.001	0.147	0.883	−0.002–0.002
	Sample size	0.008	−0.001	< 0.001	−1.176	0.240	−0.0001– < 0.001
	STROBE score	0.006	0.009	0.011	0.779	0.436	−0.013-0.030
Multivariate analysis	Study duration	0.009	0.0001	0.001	0.046	0.964	−0.002–0.003
	Sample size		−0.0001	0.0001	−1.132	0.258	−0.0002– < 0.0001
	STROBE score		0.010	0.013	0.730	0.465	−0.017–0.036

Subgroup analysis	Category	Tau^2	Sample Size	Effect Size	95%CI		I^2	*P across subgroups*
Continent	America (6)	0.004	3543	14.9	0.093	0.204	95.0	0.595
	Asia (5)	0.008	1696	15.81	7.67	23.95	96.3	
	Europe (3)	0.013	1194	24.93	11.64	38.21	95.8	
	Oceania (2)	0.00	922	16.31	13.93	18.70	0	
Year of publication*	>/=2004 (8)	0.016	2324	20.24	11.20	29.27	97.9	0.259
	<2004 (8)	0.002	4974	14.65	11.14	18.16	90.8	

Bolded values: <0.05
*year of publication using median splitting method.

measures of falls should be developed and implemented in psychiatric settings to reduce the risk of falls in this population.

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Conflicts of interest

The authors have no conflicts of interest concerning this article.

Description of authors' roles

Study design: Feng-Rong An, Yu-Tao Xiang. Data collection, analysis and interpretation: Wen-Wang Rao, Liang-Nan Zeng, Ji-Wen Zhang, Qian-Qian Zong, Juan Zhang, Kelly Z. Peng. Drafting of the manuscript: Wen-Wang Rao, Yu-Tao Xiang. Critical revision of the manuscript: Gabor S. Ungvari, Chee H. Ng, Fang-Yu Yang. Approval of the final version for publication: all co-authors.

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