The Prevalence of Vascular Dementia in China: A Systematic Review and Meta-Analysis from 2009-2019

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Abstract

Background: Vascular dementia (VD), as the second-largest type of dementia, is a serious stage of vascular cognitive impairment. It is significant to conduct retrospective epidemiological studies to characterize further the disease for public health. This study estimated the prevalence of VD among the population aged 18 yr and older in China.
Methods: Epidemiological investigations on VD published in journals and covering the period from 1999 to 2019 were identified manually and online by using Chinese databases (such as Chinese BioMedical Literature Database, Chinese National Knowledge Infrastructure database, Chinese science-technology databases, and the Chinese Wanfang and Chongqing VIP database) and English databases (such as PubMed, Elsevier Science Bibliographic Databases and Cochrane library). Studies were included if the diagnostic criteria for VD are clear and the quality of the included literature was evaluated using the quality evaluation criteria of epidemiological research methods. A random-effects model was employed according to the statistical test of homogeneity.
Results: Twenty-six studies met the inclusion criteria, including 100,923 subjects and 977 VD patients. The pooled prevalence of VD was 0.96% (95% [confidence interval, CI] 0.63%~2.1%). The prevalence of VD increased with increasing age. There was a higher prevalence of VD in the northeast China population, in urban areas and males.
Conclusion: We stratified the included studies based on age, location, gender, and geographical distribution for prevalence. The prevalence of VD has slowly risen since 1999. It is obviously different between the North & South and urban &rural districts. While there are many benefits of systematic reviews, the methods presented have inherent limitations.

Keywords: Chinese population; Vascular dementia; Dementia; Prevalence; Epidemiology; Systematic review; Meta-analysis; China

Introduction

The 21st century features the aging population, which is a problem not avoided in public health. China, as the largest developing country in the world, faces a serious situation (1,2). With the

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increasing life expectancy in China, dementia has become a security and public health issue of common concern (3,4).

Vascular dementia (VD) is an important type of dementia that refers to the acquired cognitive impairment caused by various cerebrovascular diseases and is a serious stage of vascular cognitive impairment (5). Because the etiology of VD is clear, the occurrence of disease can be effectively reduced through early prevention and intervention (6), which means that it is significant to conduct retrospective epidemiological studies to characterize further the disease for public health. Dementia prevalence in developing countries (certain Asian and Latin American countries) estimates are high (≥5%), but consistently low (1%-3%) in India and sub-Saharan Africa; whereas vascular dementia accounts for ~30% of the prevalence (7,8). In developed countries, the prevalence of VD was higher among residents in Korea and Japan (4.2%-6.5%) than residents in USA and Europe (0.9%-1.3%) (9,10). In recent years, there have been many epidemiological studies on VD in China, with different results. These studies were conducted in regional populations by using various study designs and diagnostic evaluations and reported a wide range of estimates on dementia prevalence. However, less attention is paid to the variance in the estimates of VD prevalence reflects regional differences or methodological approaches has never been studied.

However, there has been no systematic review and meta-analysis of VD prevalence in China from 1999 to 2019. Besides, we have conducted a meta-analysis on the prevalence of Alzheimer's disease before, widely considered by clinicians (11). As the most common subtype of dementia after Alzheimer's disease, it is necessary to study the prevalence of VD.

Methods

Search Strategy

To obtain epidemiological data, Chinese databases (such as Chinese BioMedical Literature Da-

tabase, Chinese National Knowledge Infrastructure database, Chinese science-technology databases, and the Chinese Wanfang and Chongqing VIP database) and English databases (such as PubMed, Elsevier Science Bibliographic Databases (EMBASE) and Cochrane library) were selected using free combinations of the terms "vascular dementia (vascular dementia)", "prevalence(prevalence rate)" and "China(Chinese population)" both in English and Chinese languages. The search was limited to studies published between Jan 1, 1999, and Jan 1, 2019. Additionally, we assessed the studies mentioned in the references to find any additional studies. We contacted the author via email to obtain literature and additional information and did our best not to omit relevant studies, if necessary.

Inclusion Criteria

To meet the requirements of the analysis and reduce errors, the included literature should meet the following characteristics.

① Population-based epidemiological studies are representative;

② The research object is the Chinese population;

③ The diagnostic procedures were classified into two steps: screening and reexamination. In the first step, all subjects should be examined by professionally trained staff to recognize this condition using the Mini-Mental State Examination (MMSE), the Hasegawa Dementia Scale (HDS) or the Blessed Dementia Scale (BDS). In the second step, patients who were positive or suspicious were further diagnosed by a senior physician with laboratory tests, clinical features, neuropsychological tests and, if necessary, computed tomography (CT) and magnetic resonance imaging (MRI). The Hachinski ischemic score (HIS) was used to differentiate VD from Alzheimer's disease (AD); and

④ The diagnostic criteria for VD are clear. The diagnostic criteria used in the literature include the American Psychiatric Association's diagnostic and in the third, fourth or fifth edition of the Diagnostic and Statistical Manual of Mental Disor-

ders, International Statistical Classification of Diseases and Related Health Problems 10th Revision, Chinese Classification and Diagnostic Criteria for Mental Disorder and National Institute of Neurological Disorders and Stroke and the Association Internationale pour la Researche et l 'Enseigment en Neurosciences.

Exclusion Criteria

The literature with any one or more of the following characteristics would be excluded:

① Research based on special places, such as hospitals, nursing homes, nursing centers, etc.

② Research on special groups, such as soldiers, retired cadres, railway workers, volunteers, etc.

③ Repeatedly published papers: the research object in the literature has been included by other similar research; or the literature is a periodic report of research, while other literature has reported the complete results of the research;

④ Unable to extract raw data, and it is still not available even after contacting the corresponding author; or

⑤ Review articles, comments, lecture manuscripts, etc.

Data Extraction

Four authors independently extracted data from each literature, and any disagreements were discussed. The information about the literature was extracted and entered into tables as follows: first author (year published), survey time, level (provincial or municipal), geographical area in China (latitude-longitude), rural or urban area, age range, diagnostic criteria, total sample size, total case size and prevalence of VD.

Quality Assessment

The quality of the included literature was evaluated using the quality evaluation criteria of epidemiological research methods. Table 1 shows the criteria for the methodological quality assessment of prevalence studies.

Table 1: Criteria for the methodological quality assessment of prevalence studies

External validity
Source population
(a) Does the method to select and invite participants result in a study population that covers the complete population or a random sample?
Description of eligibility criteria
(b) Is the age range specified?
(c) Are inclusion and exclusion criteria specified?
Participants and nonresponders
(d) Is the response rate >70%, or is the information on nonresponders sufficient to make inference on the representativeness of the study population?
Description of study period
(e) Is the study period specified?
Description of study population
(f) Are important population characteristics a specified?
Internal validity
Data collection
(g) Are the data prospectively collected?
Measurement instrument (questionnaire, interview, additional)
(h) Is the measurement instrument validated?
(i) Is the period covered by the measurement instrument specified?
Definition of diseases
(j) Is a definition of the disease stated?
Reported prevalence
(k) Are age-specific and gender-specific prevalence reported?
(l) Are possible correlates of disease b reported?
Informativity
(m) Is the method of data collection properly described (interview, questionnaire, additional measurement)?
(n) Are the questions and answer possibilities stated?
(o) Are the reported prevalence rates reproducible?
a Two or more of: (i) age distribution; (ii) relevant comorbidity; (iii) lifestyle factors (e.g., smoking and alcohol consumption); and (iv) socioeconomic data (e.g., income, educational level, marital status).

This evaluation standard consists of external validity (ranging from 0 to 6), internal validity (ranging from 0 to 6), and information integrity (ranging from 0 to 3), with a total score of 0 ~ 15. According to the score value, the quality level of the overall and all aspects of the included literature can be judged. Literature screening and quality assessment were carried out by two researchers independently. Disagreements were resolved through consultation or consulting a third party.

If the results of multiple or periods are reported in the same literature, then the literature was divided into multiple studies, and the original data were extracted for analysis.

Statistical Analysis

The meta-analysis was performed to obtain a summary measure of the "prevalence" of VD in the Chinese population. In the present study, to test the statistical heterogeneity of the data and quantify the variance of the study results, we used the chi-square and tau-square tests, respectively. We also adopted the I^2 statistic to test the inconsistency of the literature. The random-effect or fixed-effects model with a 95% confidence interval (CI) in the Review Manager 5.3 was used to combine and conduct subgroup analysis according to the original epidemiological data in the included literature. Either the fixed-effects or the random-effects model was chosen to calculate

the 95% CI depending on the I^2. If I^2 was above 50%, the random model was chosen, or we adopted a fixed-effects model. The detailed plan can refer to our previous publication in this magazine (11). The random effect model was also used by STATA 10.0 software to combine and conduct subgroup analysis from the original epidemiological data in the included literature, that is, to calculate the combined diseases after weighting the original data according to the sample size (%, 95%)

Ethics approval and consent to participate

Not applicable.

Results

The process used to identify the eligible epidemiological studies is summarized in Fig. 1. By combining both the criteria outlined in the Methods section and reviewing the lists of titles and abstracts, studies of VD that did not meet the inclusion criteria or met the exclusion criteria were excluded (n=407), and studies that did not provide separate VD data were also excluded (n=74). Two studies included in another study were excluded (n=20). Therefore, 26 eligible full-text articles based on the full text from all of the databases were included for further review (12-37).
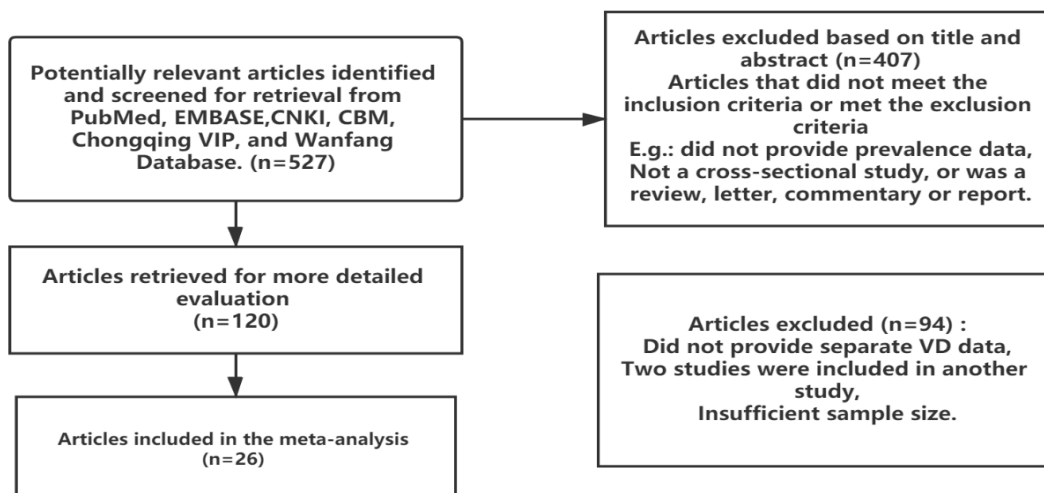

Fig. 1: The process used to identify the eligible epidemiological studies

Description of the studies

The characteristics of all studies in the analysis are shown in Table 2. Overall, 100,923 subjects and 977 VD patients with complete data were included in the analysis, and the included studies were of high quality. All included studies were conducted between 1999 and 2019 and covered 15 provinces and 5 municipalities or cities in China, including Liaoning, Shanghai, Chongqing, Hunan, Guangdong, Hainan, Jiangxi, Fuzhou, Sichuan, Hubei, Guizhou, Shandong, Beijing, Shanxi, Fujian, Jiangsu, Henan and Beijing. The maximum sample size in the analysis was 114,29 from Hubei Province, which was a municipal survey conducted in 2007, and the minimum size was 617 in 2008 from Shandong Province.

Among the included studies, the age of onset was 55 and above in five studies, 60 in 16 studies, and over 60 in the remaining studies. In most studies, the diagnostic criteria of VD were based on the presence of at least two of the four cardinal signs and the exclusion of other diseases. The 6 samples were recruited from rural areas are, and 12 samples were from urban areas. Four studies recruited target populations from both urban and rural areas, and the remaining studies did not refer to the location.

Table 2: The characteristics of all studies in the review

First author (year published)	Survey	Level (National/Provincial/Municipal)	Location	Geographical Area (latitude-longitude)	Rural/Urban	Age range	Diagnostic criteria	Total case size	Total sample size	Prevalence (%)
Sun et al.(2000)	1999	Municipal	Dalian	Northeast	Rural	≥60	DSM-IV	91	2000	4.55
Fei et al.(2000)	1999	Provincial	Shanghai	East	Urban	≥55	DSM-IV	55	2546	2.160251
Zou et al. (2002)	2001	Municipal	Chongqing	Southwest	Urban	>65	DSM-IV-R	9	1525	0.590164
Yang et al.(2003)	2001-2002	Provincial	Hunan	Central	Urban	≥60	DSM-IV	20	2247	0.890076
Shen et al.(2003)	2002	Provincial	Shanghai	East	Rural	≥55	HDS CDR	12	2223	0.539811
Liang et al.(2003)	2002	Provincial	Guangdong	Southeast	Urban	≥60	DSM-IV	14	1414	0.990099
Wu et al.(2003)	2002	Municipal	Hainan	Southeast	Urban	≥60	DSM-IV	28	2170	1.290323
Ma et al.(2005)	2001-2002	Municipal	Guangdong	Southeast	Urban+Rural	≥60	DSM-IV; NINCDS-ADARDA	14	2121	0.660066
Yuan et al.(2005)	2003	Municipal	Jiangxi	Southeast	Urban	≥65	ICD-10	18	3913	0.460005
Tang-1 et al.(2005)	2000-2001	Provincial	Sichuan	Southwest	Urban+Rural	≥60	DSM III; NINDS-AIREN; NINCDS-ADRD	45	5294	0.850019
Tan et al.(2007)	2007	Municipal	Hubei	Southeast	Urban+Rural	>55	DSM -IV; NINDS-AIREN, NINCDS-ADRD	64	11429	0.559979
Huang et al.(2007)	2007	National	Guizhou	Southwest	Rural+Urban	≥60	DSM -IV; NINDS-AIREN, NINCDS-ADRDA	75	6696	1.120072
Wang et al.(2008)	2004-2007	Provincial	Shandong	East	Urban	>60	NINCDS-ADRDA	75	9615	0.780031
Yan et al.(2008)	2004	Municipal	Beijing	Central	Rural	≥60	DSM -IV; NINDS-A	22	1158	1.899827

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Chen et al.(2009)	2006-2007	Provincial	Fujian	Southeast	Urban	>55	IREN, NINCDS-ADRD DSM -IV	35	2381	1.469971
Fan et al.(2011)	2008	Provincial	Shanxi	Southeast	Rural	>60	DSM -IV; NINDS-A IREN, NINCDS-ADRD	18	1818	0.990099
Sun et al.(2012)	2010-2011	Municipal	Shanghai	Northwest	Urban	≥55	DSM -IV; NINDS-A IREN, NINCDS-ADRD	18	1475	1.220339
Liu et al.(2013)	2012	Provincial	Henan	Central	Urban	>60	DSM -IV; NINDS-A IREN, NINCDS-ADRD	25	1838	1.360174
Zhang et al.(2013)	2010-2011	Provincial	Shandong	East	Rural	>60	DSM -IV	34	2464	1.37987
Pei et al.(2015)	2016	Municipal	Tianshui	Northwest	Urban	>60	DSM -IV	46	4742	0.970055
Zhao et al.(2015)	2014	Municipal	Xingtai	Central	Rural	>65	DSM -IV	27	3334	0.809838
Ji et al.(2016)	2012-2013	Provincial	Jiangxi	East	Urban	>60	DSM -IV; NINDS-A IREN, NINCDS-ADRD	31	5536	0.559971
Jiang et al.(2016)	2017	Municipal	Beijing	Central	Urban	>60	DSM -IV; NINDS-A IREN, NINCDS-ADRD	75	6696	1.120072
Zou et al.(2016)	2015-2016	Provincial	Jilin	Northeast	Rural	>65	DSM -IV; NINDS-A IREN, NINCDS-ADRD	29	3258	0.890117
Tian et al.(2017)	2014-2015	Municipal	Guang-zhou	Northeast	Rural	>60	DSM -IV; NINDS-A IREN, NINCDS-ADRD	55	7334	0.749932
Liu et al.(2018)	2014	Provincial	Jiangsu	East	Urban +rural	>60	DSM-IV; NINCDS-ADARDA	32	5079	0.630045

Results of the quality assessment

Table 3 shows the results of the quality assessment. For external and internal validity, the average scores were 5.2 (range 0–6) and 4.6 (range 0–6), respectively. For informativity, the average score of inclusion was 2.7. Four studies received all positive validity criteria.

The estimated prevalence of VD and Subgroup analysis

Our meta-analysis showed that the combined result for the pooled prevalence was 0.0096 (95% CI: 0.0063–0.021) (Table 4) based on a random model over the last 20 years, while the maximum and minimum prevalence in VD were observed in Liaoning (4.55%) and Jiangxi (0.46%), respectively.

Table 3: Year published and quality assessment of selected studies

Reference number	Year[a]	External validity							Internal validity							Informativity				Disagreement[b]
		a	b	c	d	e	f	sum	g	h	i	j	k	l	sum	m	n	o	sum	
12	2000	+	+	-	-	-	-	2	+	-	+	-	-	-	2	+	-	-	1	
13	2000	+	+	+	+	+	+	6	+	+	+	+	+	-	5	+	+	+	3	
14	2002	+	+	+	-	-	-	3	+	+	+	+	+	-	5	+	+	+	3	l
15	2003	+	+	+	+	-	-	4	+	+	+	+	+	-	5	+	+	+	3	
16	2003	+	+	+	+	-	-	4	+	+	+	+	+	-	5	+	+	+	3	M, n, o
17	2003	+	+	+	+	-	-	4	+	+	+	+	+	+	6	+	+	+	3	
18	2003	+	+	+	+	+	+	6	+	+	+	+	+	-	5	+	-	+	2	
19	2005	+	+	+	+	+		5	+	+	+	+	+	+	5	+	-	-	1	
20	2005	+	+	+	+	+	+	6	+	+	+	-	-	-	3	+	+	+	3	J, k, l
21	2005	+	+	+	+	+	+	6	+	+	+	+	+	+	6	+	+	+	3	
22	2007	+	+	+	+	+	+	6	+	+	+	+	+	+	6	+	+	+	3	
23	2007	+	+	+	+	+	+	6	+	+	+	-	-	-	6	+	+	+	3	
24	2008	+	+	+	+	+	+	6	+	+	+	-	-	-	3	+	+	+	3	K, l
25	2008	+	+	+	+	+	-	5	+	+	+	+	-	-	4	+	+	+	3	
26	2009	+	+	+	+	+	+	6	+	+	+	+	-	-	4	+	+	+	3	
27	2011	+	+	+	+	+	+	6	+	+	+	+	-	-	4	+	+	+	3	
28	2012	+	+	+	+	+	+	6	+	+	+	+	+	+	6	+	+	+	3	
29	2013	+	+	+	+	+	+	6	+	+	+	+	+	+	6	+	+	+	3	
30	2013	+	+	+	+	+	-	5	+	+	+	+	-	-	4	+	+	+	3	
31	2015	+	+	+	+	+	-	5	+	+	+	+	-	-	4	+	+	+	3	
32	2015	+	+	+	+	+	-	5	+	+	+	+	-	-	4	+	+	+	3	
33	2016	+	+	+	+	+	-	5	+	+	+	+	-	-	4	+	+	+	3	
34	2016	+	+	+	+	+	-	5	+	+	+	+	+	+	6	+	+	+	3	
35	2016	+	+	+	+	+	-	5	+	+	+	+	-	-	4	+	+	+	3	
36	2017	+	+	+	+	+	+	6	+	+	+	+	-	-	4	+	-	-	1	
37	2018	+	+	+	+	+	+	6	+	+	+	+	-	-	4	+	-	-	1	

Items **a–o** refer to Table 1.
a Year published.
b Items on which the two reviewers disagreed

We stratified the included studies based on age, location, gender, and geographical distribution for prevalence. The prevalence data of the 26 studies showed obvious differences at different ages, including 10,782 patients ranging from 55 yr old to 59, 60-64, 65-69, 70-74, 75-80 and over 80 yr old. The prevalence of VD increased with age (0.23%~ 2.85%). A higher prevalence of VD was found in urban than in rural areas (OR 1.73 vs 0.94, 95% CI 1.56–2.01 vs 0.83-1.12), and the prevalence was 173 per 10,000 and 94 per 10,000 for urban and rural areas, respectively. Two studies investigated the data for both genders, while five studies only reported male or female patients. In the seven studies, which included 1,6259 males and 7,322 females, the rate of VD was slightly higher in males than in females (1.1% vs. 0.8%).

According to the research locations of the included literature, the original research data were combined and analyzed in seven regions, including northeast China, north China, northwest China, east China, central China, south China and southwest China. VD prevalence in northeast China 2.28% (95% CI 3.25%-5.62%)], northwest China [1.73% (95% CI 1.12% - 2.63%)] was significantly higher than that in east China [0.92% (95% CI 1.02%- 1.29%)], central China [0.74% (95% CI 0.98%-1.08%)], southeast China [0.72% (95% CI 0.82%-1.42%)], and southwest China [0.4% (95% CI 0.2%-0.8%)]. The prevalence of VD in northern China was generally higher than that in central and southern China.

Heterogeneity and publication bias

There was considerable heterogeneity among the included studies, such that the result of the Chi[2] test for heterogeneity was highly significant ($P<0.001$). In addition, the I^2 statistic was calculated to be 85% (Fig. 2).

Table 4: Results of stratified combined analysis of VD prevalence rate according to demographic characteristics (%)

Demographic characteristics	Type	Number	Sample	VD prevalence (%)	95% CI
Total		26	100,306	0.96	0.63-1.21
Age	55-59	4	10,782	0.23	0.11-0.43
	60-64	15	47,631	0.26	0.13-0.36
	65-69	17	54,219	0.32	0.29-0.56
	70-74	17	54,219	0.51	0.32-0.77
	75-80	14	37,552	1.26.	0.82-1.59
	80-	4	7,543	2.85	2.17-3.55
Sex	Male	7	16,259	1.12	0.75-1.36
	Female	7	7,322	0.83	0.58-1.25
Residence	Urban	6	9,753	1.71	1.51-2.07
	Rural	18	32,467	0.92	0.83-1.14
Geographical location	Northeast	2	5258	4.04	3.25-5.62
	Northwest	2	6,560	0.96	0.82-1.42
	East	7	28,938	0.82	0.62-1.29
	Central	6	22,534	1.03	0.58-1.08
	Southwest	3	13,515	0.95	0.82-1.42
	Southeast	6	19333	0.85	0.23-0.86

VD: vascular dementia; CI: confidence interval.
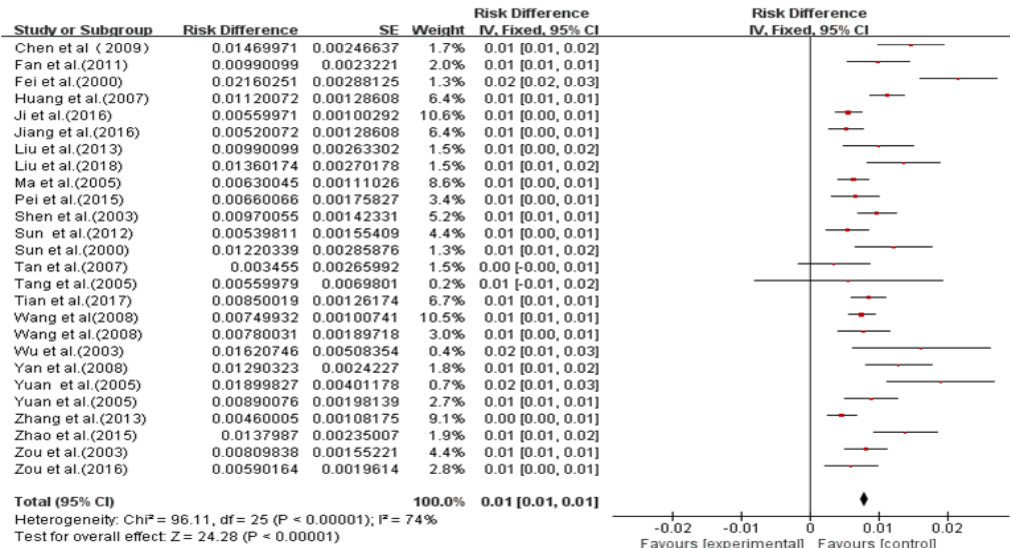
Fig. 2: Forest plot for the pooled prevalence and confidence intervals of AD in China obtained from the meta-analysis (arranged by survey chronologically from 2007 to 2017).

To reduce the heterogeneity, we divided the studies into subgroups according to gender and location to achieve homogeneity. Nonetheless, homogeneity was not achieved. The results of the statistical tests for publication bias, including the Begg and Egger tests, confirmed the presence of publication bias.

Discussion

Research on the national prevalence of VD has been performed for many years. In China, VD has been the subject of epidemiological investigations of different scales, and there is no doubt

that the study by Zhang et al. was unique in its attempt to quantify multicenter epidemiological studies with larger samples (38). The study focused on Chinese large cities, and the prevalence of populations over 55 yr of age was 1.1% (Beijing), 1.2% (Xian), 0.6% (Shanghai) and 0.4% (Chengdu), respectively (38). Another study, with 17 studies from 1990-1999, found that the prevalence showed no difference in gender and location, though the prevalence of VD was 0.71% in women and 0.69% in men and was higher in urban areas (2.29%) than in rural areas (1.67%). The VD prevalence rates for the population aged 60 yr and older were 0.74% (39). However, in a study including 17 studies, the prevalence of VD in the Chinese community population over 60 yr old, from 1990 to 1999, was 0.74%, which stated that the prevalence in rural areas was higher than that in urban areas and that in females was slightly higher than that in males (40). We focused more on vascular dementia and conducted a more detailed analysis. For example, factors such as gender, age, region and urban/rural areas were included to provide a more comprehensive understanding of the prevalence of vascular dementia in China. What's more, dementia, which is a complex of many diseases, includes Alzheimer's disease, vascular dementia and others. We prefer a systematic analysis of a particular type of dementia, because different types of dementia vary greatly from prevalence.

A second, larger systematic review that included 48 studies from 1980 to 2010 found that a higher prevalence occurred more commonly in northern China and the prevalence increased with age (41). This information has been more comprehensively integrated into various regions of China, including Hong Kong and Taiwan. However, this information was also included in sanatoriums for retired cadres, hospitals and other research sites. The current systematic review excluded a large number of low-quality literature while including high-quality literature. Unfortunately, the quality of our included literature before 2000 was indeed not high, which is one of the important reasons why we chose this period.

This study is original, novel and consistent with the previous three meta-analyses in the methodology, and the results are mainly comparable in the article. Because crowding with cerebrovascular disease displays a gradual younger average age trend, VD may also be present in young patients (5,42,43). VD can also occur in people under the age of 60, and many epidemiologic surveys and studies include subjects with a median age of 55. Therefore, the age limit of the subjects included in this study was adjusted to 55 yr old. All of these studies, spanning the last decade or even longer, were included with a larger number of studies, total sample sizes, and total number of patients with VD.

To make the results reflect the epidemic characteristics of the Chinese people more objectively, the included subjects were the community residents of mainland China and did not include the populations from the Hong Kong, Macao and Taiwan regions because of high economic levels, different cultural backgrounds and habits. Our study did not include specific sites, such as hospitals, sanatorium for retired cadres, nursing homes, etc., making it more representative.

The study concluded that the combined value of VD prevalence in the community population increasing from 55 to 80. In mainland China as a whole, the prevalence of VD is higher in northern China than in central and southern China and higher in urban than in rural China. Except for several Latin America and Southeast Asia, VD prevalence in developing countries seems to be low (7,44). In the United States, the prevalence was estimated to be 0.98% in individuals 71–79 yr old, 4.09% in individuals 80–89 yr old, and 6.10% in individuals >90 yr old (45).

In this study, the combined value of VD prevalence was similar to the results of meta-analysis and large-scale epidemiological data in field investigation. Notably, the epidemic trend of cardiovascular and cerebrovascular diseases consistent with VD (46). In China, the incidence of isocardial stroke and cerebrovascular diseases tends to be low in the south and high in the north, and the incidence and mortality of cardiovascular and cerebrovascular diseases increase

significantly with age (47). In addition to aging, urban residents and urbanized farmers in China are exposed to increasing levels of risk factors for chronic non-communicable diseases, such as cardiovascular and cerebrovascular diseases and tumors (47).

In recent years, with the steady economic growth in China, people have enjoyed material abundance and tend to eat more processed foods, have a sedentary lifestyle and bear more psychological pressure, especially in cities, which is the reason for the continuous rise of chronic non-communicable diseases (48). Additionally, the prevalence of VD in the population aged over 55 in Chinese communities presented a slow rising trend in the past 20 years, with a slight fluctuation in the middle but maintained at approximately 0.8%. This aspect demonstrated that the combined VD prevalence in the meta-analyses was consistent with the previous results.

The differences in epidemiologic methods and diagnostic criteria may have an important influence on VD epidemiological findings. In this study, strict screening criteria were adopted, and the included original studies were community-based and randomly sampled. The diagnosis of VD was determined through at least two stages, imaging data should be combined when necessary, and the included studies were of high quality. In other words, the meta-analysis results were of high credibility.

Limitations

This study has several limitations. First, the length of the included studies ranged from 55 yr old to 80 (nearly a 30-year range), and this wide range cannot ensure complete consistency with the prevalence of VD, which was a nonnegligible source of heterogeneity. Therefore, the age span of the population increases the uncertainty of outcomes. Some patients were in different stages of the disease, which may remain stable or even become more severe. For chronic diseases such as VD, the prevalence of VD is largely on the level of living. Undoubtedly, higher-quality medical care in Beijing, Shanghai and Guangdong than in many other cities in China. We should also

take the medical status of the region into account, as individuals in developed countries with higher medical levels can receive more professional training and perform better on neuropsychological tests.

Second, gender, education and other characteristics may be related to potential influencing factors. The general tendency of prevalence for VD should be considered accords with other important disorders of the cardiovascular system. In general, patients with higher education tend to receive more improvement because the compliance of the patients is higher, while male patients tend to receive more risk than females. Men reached much higher percentages in smoking cigarettes and drinking alcohol and started earlier than women. Attention to Gender factors (chromosomal, endocrine, and reproductive factors) and gender-related factors (social and cultural factors) should pay more attention, which may help us to explain of the decline in the incidence or prevalence of VD.

While there are many benefits of systematic reviews, the methods presented have inherent limitations. The quality assessment criteria of the included literature may be different across reviews, which makes it difficult for the overview to give a comprehensive perspective of the research areas it covers. For this report, strict quality standards were used to select the studies to be included.

Furthermore, to ensure the quality of the original research, only published studies were included, but not academic papers, gray literature, etc. Therefore, the possibility of publication bias could not be excluded. In addition, there are few regional studies (such as VD prevalence and mortality in northeast China), and the results may be biased.

Conclusion

We stratified the included studies based on age, location, gender, and geographical distribution for prevalence. The prevalence of VD has slowly risen since 1999 and is different between the North & South and urban & rural districts. While

there are many benefits of systematic reviews, the methods presented have inherent limitations.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that there is no conflict of interests.

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