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SYSTEMATIC REVIEW AND META-ANALYSIS

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Prevalence of Depression in Patients With Hypertension

A Systematic Review and Meta-Analysis

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Abstract: Prevalence estimates of depression in hypertensive patients varied widely in existing studies. We conducted a systematic review and meta-analysis of observational studies to summarize the point prevalence of depressive symptoms in adults with hypertension.

Comprehensive electronic searches of PubMed, Web of Knowledge, China National Knowledge Internet (CNKI), Wangfang, and Weipu databases were conducted to identify any study in each database published from initial state to November 31, 2014, reporting the prevalence of depression in hypertensive patients. Random-effects model was used to estimate the prevalence of depressive symptoms. We also limited the analyses to studies using clinical interview and prespecified criteria for diagnosis. All statistical calculations were made by using the Stata Version 12.0 (College Station, TX) and Statsdirect Version 2.7.9.

We identified 41 studies with a total population of 30,796 in the present meta-analysis. The summarized prevalence of depression among hypertensive patients is 26.8% (95% confidence interval (CI): 21.7%–32.3%). Subgroup analysis shows the following results: for male 24.6%, 95% CI: 14.8%–35.9%, for female 24.4%, 95% CI: 14.6%–35.8%. For China: 28.5% (95% CI: 22.2%–35.3%); for other region (22.1%, 95% CI: 12.1%–34.1%); for community: 26.3% (95% CI: 17.7%–36.0%), for hospital: 27.2% (95% CI: 20.6%–34.5%). Estimated prevalence by interview was 21.3% (95% CI: 14.2%–30.0%); prevalence of depressive symptoms adjudicated by self-rating scales was 29.8% (95% CI: 23.3%–36.7%).

The observed heterogeneity in depression prevalence of hypertension may be attributed to differences in method of evaluation. Self-report scales should be cautious of estimating the presence of depression. Thus, interview-defined depression affects approximately one third of hypertensive patients. Effective interventions for depression on patient-centered are needed.

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Abbreviations: BDI = Beck Depression Inventory, CI = confidence interval, CIDI-3.0 = Composite International Diagnostic Interview Version 3.0, CNKI = China National Knowledge Internet, DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, GDS = Geriatric Depression Scale, HADS-A = Hospital Anxiety and Depression Scale-Anxiety, HAMD = Hamilton Depression Scale, PCP = primary care providers, PHQ-9 = Patient Health Questionnaire-9, SDS = Self-Rating Depression Scale.

INTRODUCTION

Depression is a significant contributor to the global burden of disease. The World Mental Health Survey conducted in 17 countries found that on average about 1 in 20 people reported having an episode of depression in the previous experience. It is estimated that depression affects 350 million people around the world,[1] with a lifetime risk of 7%.[2] It will be likely to increase 5.7% of global burden of disease by 2020 and become the second one after ischemic heart disease. People with hypertension were at higher risk of all kinds of cardiovascular diseases.[3–6] Approximately one fourth of the adults were diagnosed with hypertension, and the proportion will reach about 1/3 by 2025.[7] Many people diagnosed with hypertension usually have tough experience such as somatic symptoms, lower quality of life, and role impairment.[8] Above all of these factors may make them easier to get psychological distress, especially depression.[9] Improving psychosocial aspects of living have been becoming an important part of building better health care, particularly for patients with hypertension. More and more psychologist have recognized addressing patients' mental needs as their priority research fields.[10] However, the prevalence situation of depression in hypertensive patients is still unclear. For a widely prevalent disease such as hypertension, even modest improvements in some targeted interventions of hypertensive patients may well have a significant impact at the whole population level.

Many studies had reported the prevalence of depression in hypertensive patients, but quantitative estimation for the overall prevalence of depression is scarce. Little is known about depression prevalence in hypertensive patients. Although it has become more convenient to assess depression situation through self-rating scales,[11] such methods may focus on somatic symptoms, and these symptoms may be not a prominent symptom of depression and consequently. This may overestimate or underestimate depression prevalence in hypertensive patients.[12] Thus, estimating the prevalence of depression in hypertensive patients is the first step toward understanding the burden of disease. We conducted a systematic review and meta-analysis of cross-sectional studies in patients with hypertension to estimate the prevalence of depression and the effects of diagnostic methods on estimation prevalence of depression.

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METHODS

Literature Search Strategy

Retrieval online were conducted in the following databases: PubMed, Web of Knowledge, China National Knowledge Internet (CNKI), WanFang, and Weipu. The date of search was from initial state to April 31, 2015. The following search terms were used to identify the potential study: (''hypertension'' or ''high blood pressure'') and (''prevalence'' or ''epidemiologic studies'') and (''depression'' or ''depressive disorder'' or ''mood disorder'' or ''affective disorders'' or ''psychotic'' or in all databases. We also retrieved the references of all publications to obtain all studies as possible as we can. Y.L. and P.C. conducted the literatures screening according to inclusion and excluding criteria. L.C. judged the disagreement.

Criteria for Inclusion

The following criteria were used for screening literature. First, study design included cross-sectional study, case-control, and baseline data of a cohort study. Second, sample size and point prevalence of depression were provided. Third, each paper should give a diagnose criteria for depression according to concrete depression scales. Fourth, investigation were conducted in hypertensive patients. The search language is limited in English and Chinese. We excluded studies in children and those reporting period prevalence rates.

Data Extraction and Quality Assessment

The following information was extracted for included study: first author, publication year, study design, sample selection method, sample source, diagnostic criteria, and method of measurement, sex ratio, sample, point prevalence of depression. We used the observational criteria to evaluate the study quality.[13] These criteria included 11 items. One score was added when the study was conformed.

Statistical Analysis

We used Stata 11.0 (College Station, TX) and Statsdirect 2.7.9 to conduct all statistical analyses. The original point prevalence is transformed by back-transform of the weight mean (DerSimonian-Laird weights and inverse arcsine variance weights).[14,15] The χ^2 and the I^2 statistic were used to evaluate the heterogeneity (low: $I^2 < 25\%$ low, moderate: 25%–50%, high: $I^2 > 50\%$).[16,17] In the present meta-analysis, the random effects model was used to pool estimation of point prevalence. Subgroup analysis was also conducted in order to know the prevalence of different category (region, sex, source of population, and types of depression assessment). Meta-regression was performed to explore effects of some potential variables on the pooled prevalence: cut-point score for diagnosis, mean age, sex, race, and region, sex, source of population and types of depression assessment. Begg Test and Egger Test were used to test the publication bias. P value of less than 0.05 was considered statistically significant. Ethical approval was not necessary as this study is a Systematic Review and Meta-Analysis.

RESULTS

Study Flow and Characteristics

Table 1 shows detailed information from the 41 studies selected. The first searches give 3890 records. In total, 3380 studies entered into the second screening stage after excluding some republication. In total, 475 studies were reviewed in full text. Finally, 41 studies were included in the meta-analysis. Figure 1 exhibits the screening process. In the surveys with samples, more than 80% of the studies are cross-sectional. In most of the studies, depression in patients with hypertension was reported using rating instruments either administered by clinicians and researchers or self-administered by participants. Diagnostic cut-point scores to define depression using self-administered questionnaires were widely heterogeneous (Table 1).

Prevalence

All results of meta-analysis are shown in Table 2.

The point prevalence of depressive symptoms with 41 (see word document, Supplemental Content, which lists all studies included in the meta-analysis) individual study populations ranged between 0.5 and 73.0%, with an overall meta-analysis prevalence of 26.8% and evidence of high-level heterogeneity ($I^2 = 98.9\%$, $P < 0.001$).

In the region setting, the prevalence of depressive symptom in China's studies ranged between 0.5 and 73.0% in 31 populations comprising 14,505 participants. The summary prevalence of depression was 28.5% (95% CI: 22.2%–35.3%) with high-level heterogeneity ($I^2 = 98.7\%$). The estimated prevalence of depression from other regions (22.1%, 95% CI: 12.1%–34.1%) was statistically lower than was reported in China, P for subgroup difference <0.001.

In the sex setting, the pooled prevalence of depression for male (24.6%, 95% CI: 14.8%–35.9%) was almost equal to the prevalence for female (24.4%, 95% CI: 14.6%–35.8%). In the source of population setting, the pooled prevalence of depression from community was 26.3% (95% CI: 17.7%–36.0%), and was 27.2% (95% CI: 20.6%–34.5%) from hospital. The 2 subgroups have high-level heterogeneity ($I^2 = 99.3\%$, and $I^2 = 98.4\%$).

In the types of depression assessment setting, the summary meta-analytical prevalence of depressive symptoms adjudicated by self-rating scales in 27 studies (10,194 participants) was 29.8% (95% CI: 23.3%–36.7%), although tests for heterogeneity showed high-level inconsistency ($I^2 = 98.1\%$). Depression was assessed by interview in 14 studies on 20,782 hypertensive patients, and estimated prevalence was 21.3% (95% CI: 14.2%–30.0%) with high-level heterogeneity ($I^2 = 99.2\%$).

Meta-Regression Analysis, Publication Bias, and Sensitivity Analysis

We conducted a meta-regression analysis to explore the potential heterogeneity among studies. Table 3 shows the results of meta-regression analysis. Cut-off value of depression, sex (male), source of study population, and different region had no influence on the pooled prevalence. However, mean age ($P = 0.005$) and methods of depression evaluation ($P = 0.011$) were positively associated with the pooled prevalence. The 1% growth of mean age went with 4.83% of depression in hypertensive. The methods of depression evaluation (clinician questionnaire) also affected the estimated prevalence. The funnel plot found an apparent publication bias. Both P for Begg and Egger test was less than 0.001. The sensitivity analysis was conducted by excluding 6 case-control studies, and the results kept stable.

DISCUSSION

Thus far, there is a lack of pooled estimation regarding the prevalence of depression in hypertensive patients. This is the

TABLE 1. Characteristic of Studies on the Prevalence of Depression Among Patients With Hypertension

Author, Year	Study Design	Consecutive Or Random Sampling	Source of Sample	Mean Age (Yrs)	Men (%)	Screening Criteria for Depression	Country	No. With Depression	Sample Size	Prevalence (%)	Score of Quality
Sun et al, 2009	Cross-sectional	Yes	Hospital	20–95	51.5	DSM-IV	China	149	3083	4.8	8
Li et al, 2012	Cross-sectional	Yes	Hospital	60–80	100.00	SDS	China	37	112	33.0	7
Li et al, 2011	Cross-sectional	Yes	Hospital	51.5	57.1	SDS	China	20	126	15.9	9
Li et al, 2011	Cross-sectional	Yes	Community	72.53	38.9	SDS	China	49	270	18.2	9
Hu et al, 2013	Case-control	No	Community	58.6	42.6	SDS	China	74	340	21.8	7
Zhang et al, 2005	Cross-sectional	Yes	Hospital	–	45.1	SDS	China	130	2274	5.7	9
Liu et al, 2008	Cross-sectional	Yes	Hospital	35–75	–	SDS	China	204	1000	20.4	9
Zhang et al, 2012	Cross-sectional	Yes	Hospital	–	48.6	SDS	China	26	140	18.6	9
Wang et al, 2012	Cross-sectional	Yes	Hospital	58.6	45.0	SDS	China	13	100	13.01	7
Han et al, 2008	Case-control	Yes	Community	66.52	35.0	Zung SDS	China	58	326	17.8	7
Zhang et al, 2012	Cross-sectional	Yes	Hospital	–	55.4	HAMD	China	38	148	25.7	8
Zheng et al, 2006	Cross-sectional	Yes	Hospital	65.2	30.0	GDS	China	22	30	73.3	9
Yang et al, 2008	Case-control	Yes	Community	69.4	51.8	GDS	China	175	415	42.2	8
Wang et al, 2013	Cross-sectional	Yes	Hospital	78.4	67.7	SDS	China	78	223	35.0	9
Zhang et al, 2011	Cross-sectional	Yes	Hospital	–	48.8	SDS	China	63	160	39.4	9
Huang et al, 2006	Cross-sectional	Yes	Hospital	68.2	66.7	SDS	China	53	126	42.1	9
Zhang et al, 2007	Cross-sectional	Yes	Community	62.1	43.7	SDS	China	143	206	69.4	8
Yu et al,2007	Cross-sectional	Yes	Community	67	56.5	SDS	China	59	186	31.7	6
Chai et al, 2013	Cross-sectional	Yes	Community	–	46.5	GDS	China	181	320	56.6	7
Ma et al, 2010	Cross-sectional	Yes	Community	–	45.1	DSM-IV	China	96	170	56.5	10
Liao et al, 2014	Cross-sectional	Yes	Community	61	35.6	DSM-IV	China	46	807	5.7	7
Zhang et al, 2013	Cross-sectional	No	Community	62.3	36.5	SDS	China	60	230	26.1	8
Shi et al, 2013	Cross-sectional	Yes	Hospital	58.4	49.8	SDS	China	182	1012	18.0	7
Hu et al, 2011	Cross-sectional	Yes	Hospital	69.3	51.5	SDS	China	123	196	62.8	9
Wang et al, 2007	Cross-sectional	Yes	Community	30–75	48.5	SDS	China	139	891	15.6	9
Le et al, 2007	Cross-sectional	Yes	Community	60.61	48.5	SDS	China	91	536	17.0	7
Chen et al, 2007	Cross-sectional	Yes	Community	34–86	62.0	SDS	China	27	157	17.2	9
Zheng et al, 2014	Cross-sectional	Yes	Community	–	48.3	HRSD	China	65	147	44.2	9
Jiang et al, 2006	Cross-sectional	Yes	Hospital	72.8	100.0	SDS	China	112	312	35.9	9
Diminic et al, 2014	Case-control	No	Hospital	–	42.3	BDI	Croatia	134	452	29.6	7
Hu et al, 2014	Cross-sectional	Yes	Community	–	50.1	SDS	China	49	318	15.4	7
Irene et al, 2014	Cross-sectional	No	Hospital	50–59	37.3	DSM-IV	Ghana	42	400	10.5	8
Michal et al, 2013	Cross-sectional	Yes	Hospital	35–74	43.9	DSM-IV	Brazil	49	406	12.1	9
Igwe et al, 2013	Case-control	Yes	Hospital	20–64	46.3	DSM-IV	Nigeria	72	270	26.7	8
Johansen et al, 2012	Case-control	Yes	Community	18–74	34.2	HADS-A	Norwegian	767	12287	6.2	9
Green et al, 2012	Cross-sectional	Yes	Community	61.4	34.6	PHQ-9	USA	519	1292	40.2	9
Alberto et al, 2013	Cross-sectional	Yes	Hospital	61	30.0	Zung SDS	Mexico	23	40	57.5	9
Bernard et al, 2005	Cross-sectional	Yes	Hospital	50.1	49.6	HADS-A	China	56	144	39.0	8
Mosie et al, 2014	Cross-sectional	Yes	Hospital	–	25.9	PCP document	USA	71	158	44.9	6
Ginty et al, 2013	Cross-sectional	Yes	Hospital	58.6	45.0	HADS-A	Netherlands	25	219	11.4	7
Grimsurd et al, 2009	Cross-sectional	Yes	Community	18–29	28.0	CIDI-3.0	Africa	46	767	6.00	10

BDI = Beck Depression Inventory; CIDI-3.0 = Composite International Diagnostic Interview Version 3.0; DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition; GDS = Geriatric Depression Scale; HADS-A = Hospital Anxiety and Depression Scale-Anxiety; HAMD = Hamilton Depression Scale; PCP = primary care providers; PHQ-9 = Patient Health Questionnaire-9; SDS = Self-Rating Depression Scale.

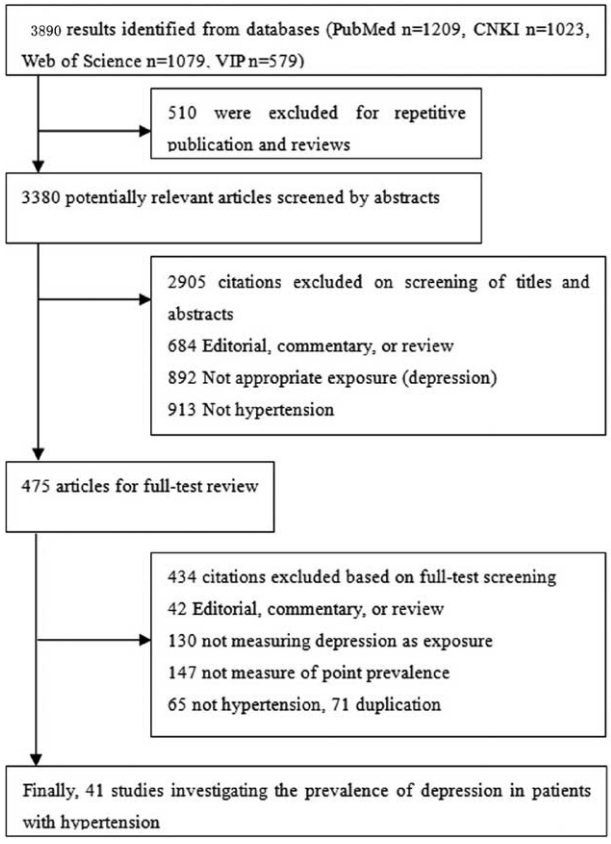

FIGURE 1. Flow diagram of included/excluded studies.

first systematical evaluation of published studies on the prevalence of depression in hypertensive patients. The present meta-analysis found that prevalence of depression is common in patients with hypertension and estimated prevalence was significantly associated with the diagnosis methods used to screen depression. The clinical interview showed approximately one-third (21.3%) of hypertensive patients have depressive symptoms, which was lower than screening scales-based tools (29.8%).

Our estimated prevalence of depression by clinical interview in hypertensive patients is 21.3%. This result is close to the prevalence of depression from patients with chronic kidney disease (20.3%),[18] and also falls into the range of other clinical settings, such as heart failure (19.3%),[19] primary care (17.3%),[20] and cancer (16.3% 95% CI).[21] But, obviously, this is higher than observed in settings of type 1 and type 2 diabetes (13.6% and 10.9%, respectively)[22] and slightly lower than investigated in obstructive respiratory disease (27.6%). Above of all are apparently higher than result of a recent study supported by WHO revealed that around 5% of people in the community had depression during the last year,[23] suggested that chronic disease is a crucial and common underlying determinant for depression, regardless of the biological mechanism.

The screening tools for evaluating depression mainly include 2 types: self-assessment and clinician-completed. Our study with 41 studies suggested that self-assessed screening tools of depression or depressive symptoms might overestimate the prevalence of depression in hypertensive patients to some extent, which is indicated by much higher point estimation of depression prevalence derived using self-administered diagnostic scales (30%) compared with pooled prevalence used by clinical-interviewed tools (21%). The reason could be that self-assessed report methods have some limitations. Specifically, the hypertensive patients may be confused about depression and hypertension symptoms such as poor appetite, sleep disorders, and fatigue symptoms. They probably considered these symptoms commonly suffered from hypertension as indication of depression or depressive symptoms and classified themselves as patients with depression. The method of clinical interview identified depression or depressive symptoms through clinical diagnostic criteria and can give a more precise estimation of depression prevalence.

Depression in hypertensive patients is associated with poorer health status, including lower quality of life,[24–26] increased medical sources,[27] lower rate of treatment compliance,[28] and even increased mortality.[29] People with depression could suffer from the lack of occupational and social role function.[30] It is easier for hypertensive patients with depression to further develop depressive symptoms. Although depression combined with hypertension could have additional adverse impact on physical function and quality of life of patients, there are still no sufficient data to prove that screening of

TABLE 2. Summary of Prevalence and Heterogeneity Findings for Depressive Symptoms in Patients With Hypertension

Category	Subgroup	NO. of Studies	Prevalence (95% CI) (%)	N	I^2 (%)	*P*	Publication Bias Test	
							P (Begg Test)	*P*(Egger's Test)
Total		41	26.8 [21.7–32.3]	30,796	98.9	<0.0001	<0.001	<0.001
Region	China	31	28.5 [22.2–35.3]	14,505	98.7	<0.0001	0.034	0.156
	Other	10	22.1 [12.1–34.1]	16,291	99.3	<0.0001	0.199	0.064
Sex	Male	11	24.6 [14.8–35.9]	3743	99.3	<0.0001	0.201	0.341
	Female	10	24.4 [14.6–35.8]	3914	98.0	<0.0001	0.052	0.186
Source of population								
	Community	18	26.3 [17.7–36.0]	19,665	99.3	<0.0001	0.234	0.158
	Hospital	23	27.2 [20.6–34.5]	11,131	98.4	<0.0001	0.117	0.042
Types of depression assessment								
	Clinician questionnaire	27	29.8 [23.3–36.7]	10,194	98.1	<0.0001	0.001	0.005
	Interview-based assessment	14	21.5 [14.2–30.0]	20,782	99.2	<0.0001	0.023	0.128

CI = confidence interval.

TABLE 3. Meta-Regression Analysis for the Prevalence of Depressive Symptoms in Patients With Hypertension

Covariate	Meta-Regression Coefficient (%)	Proportional Change in Prevalence (95% CI)	*P* Value
Univariate meta-regression			
Cut point score	−1.07	−3.11 to 0.96	0.286
Mean age	4.83	1.61–8.05	0.005
Proportion of men	−0.65	−2.82 to 1.52	0.552
Types of assessment	5.35	1.27–11.98	0.011
Source of population	−7.06	−72.55 to 58.43	0.828
Region	0.45	−2.34 to 1.16	0.186

CI = confidence interval.

depression in hypertensive patients can have positive effects in the improvement of clinical symptoms and physical health. As far as we know, systematic evaluation of depression in hypertensive patients has not been done, implementation of available screening methods for depression has not been done, and existing randomized trials of interventions still have some limitations such as smaller sample size, shorter duration, and lack of reliance on related clinical outcomes.[31–33] Besides, it is probably inappropriate to carry out effective interventions for depression from other chronic diseases into the hypertensive patients. The eluting period of different drug and the cardiovascular events frequency could have some impact on effectiveness and risk of the treatment in hypertensive patients.

Limitations

Although this meta-analysis includes more studies and a larger number of sample sizes than individual studies, some limitations needed to be illustrated clearly. The main limitations were the limited amount of information, as well as the marked and largely unexplained heterogeneity in estimation between contributing studies. First, most of the studies included in the meta-analysis were from China. This prevalence of depression among hypertension may be more typical in Chinese population. Second, the prespecified subgroup analysis suggested significant differences in the prevalence estimation based on region in individual studies; they should be interpreted with caution. Third, the studies included in the meta-analysis had some methodological differences. These limitations may make patients in single study different from those excluded patients in some significant ways. Finally, we also did not estimate the prevalence of other common psychological symptoms.

CONCLUSIONS

The observed heterogeneity in depression prevalence of hypertension may be attributed to differences in method of evaluation. Self-report scales should be cautious of estimating the presence of depression. Thus, interview-defined depression affects approximately one third of hypertensive patients. Effective interventions for depression on patient-centered are needed.

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