Systematic Review and Meta-Analysis

Medicine®

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Prevalence of depression in myocardial infarction

A PRISMA-compliant meta-analysis

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Abstract

Background: Depression is common in the aftermath of myocardial infarction (MI) and may not only lead to impaired long-term quality of life, but also cause increased mortality among patients with MI. The reported prevalence of depression among patients with MI varied considerably across studies, for which a pooled prevalence was obtained in the only 1 meta-analysis conducted in March 2004. Subsequently, numerous relevant studies have been published, indicating the need for an update on the pooled prevalence. Therefore, this study was aimed at updating the pooled prevalence of depression among patients with MI.

Methods: A comprehensive literature search in 3 electronic databases, PubMed, Embase, and PsycINFO, was performed in April 2018. The heterogeneity across studies was examined by the Cochran's Q test and quantified by the I^2 statistic. If significant heterogeneity was observed, meta-regression analyses and subgroup analyses were performed to identify the source of heterogeneity. Publication bias was assessed by a funnel plot and verified by the Egger's and Begg's tests.

Results: Nineteen eligible studies conducted in 10 countries were included, which consisted of 12,315 patients with MI, among whom 3818 were identified with depression. High heterogeneity was observed across the eligible studies ($I^2 = 98.4\%$), with the reported prevalence of depression ranging from 9.17% to 65.88%. The pooled prevalence of depression among patients with MI was 28.70% (95% CI: 22.39–35.46%) by a random effects model. Subgroup analyses showed that the pooled prevalence differed significantly by region, tool used to identify depression, study quality, sex, race, anterior MI, and diabetes status ($P < .05$). Meta-regression analyses did not identify any moderators of heterogeneity, and the heterogeneity was high within most subgroups. Nonetheless, for unmarried subjects, the heterogeneity was low ($I^2 = 19.5$). The Egger's test and the Begg's test indicated no evidence of publication bias ($P > .05$).

Conclusions: Given the high pooled prevalence of depression found in this study and the association between depression and adverse health outcomes among patients with MI, more psychological resources including early assessment and effective treatment of depression should be allocated to patients with MI.

Abbreviations: BCDRS = Brief Carroll Depression Rating Scale, BDI = Beck Depression Inventory, CES-D = Center for Epidemiologic Studies Depression Scale, CHD = coronary heart disease, CI = confidence interval, CVD = cardiovascular disease, DIS = modified version of the National Institute of Mental Health Diagnostic Interview Schedule, HADS = Hospital Anxiety and Depression Scale, MI = myocardial infarction, PHQ-9 = 9-question Primary Care Evaluation of Mental Disorders Brief Patient Health Questionnaire, RCT = randomized controlled trial, SCID = Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders, Revised Third Edition, SD = standard deviation, SDS = Zung Self-Rating Depression Scale, UK = United Kingdom, USA = United States of America, WHO = World Health Organization.

Keywords: depression, meta-analysis, myocardial infarction, prevalence

1. Introduction

Cardiovascular disease (CVD) is the 1st leading cause of death globally contributing 31% of all mortality.[1] According to the latest statistics released by the World Health Organization (WHO), an estimated number of people who died of CVD in 2015 was 17.7 million, among whom 7.4 million died of coronary heart disease (CHD).[1] Myocardial infarction (MI), characterized by the myocardial cell necrosis due to significant and sustained ischaemia, is the main manifestation of CHD and has been a significant burden of both high-income countries and low-income countries.[2] The MI triggers not only physiological responses such as severe pain, but also psychological responses such as depression.[3–5]

Accumulated evidence has consistently shown that depression is one of the most common psychological reactions in the aftermath of MI which may not only lead to impaired long-term quality of life, but also cause increased mortality among patients with MI.[6–8] For example, Hosseini et al conducted a 5-year follow-up study among 196 hospitalized patients with MI and found that baseline depression was strongly significantly

Editor: Stefano Omboni.

The authors have no conflicts of interest to disclose.

Supplemental Digital Content is available for this article.

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Medicine (2019) 98:8(e14596)

Received: 28 September 2018 / Received in final form: 10 January 2019 / Accepted: 28 January 2019

http://dx.doi.org/10.1097/MD.0000000000014596

associated with reduced long-term quality of life in both the mental and physical domains.[6] Additionally, Meijer et al conducted a meta-analysis exploring the effects of post-MI depression on cardiovascular outcomes and found that post-MI depression could put patients with MI at 2.25 times higher risk of all-cause mortality, 2.71 times higher risk of cardiac mortality, and 1.59 times higher risk of cardiac events within 24 months.[7] Furthermore, Bush et al found that even minimal depressive symptom could lead to an increased mortality risk following MI.[8] Based on these findings, early assessment of depression among patients with MI is imperative, and the implementation of effective psychological interventions for those with depression is necessary.

The reported prevalence of depression among patients with MI in the past 2 decades varied considerably across studies, ranging from 13.5% to 41.6%,[9–13] which may be explained by the differences in socio-demographic characteristics, such as sex, race, and marital status; and the tool used to identify depression.[9,13–17] The differences in MI characteristics, such as a history of previous MI, anterior MI, and Killip class; and the differences in the exposure to cardiovascular risk factors, such as current smoking, diabetes, hypertension and hyperlipidemia, may also explain the variation in the reported prevalence of depression across the previous studies.[9,13–15] Furthermore, social support may affect the occurrence of depression following MI.[18] The inconsistent findings of the prevalence of depression among patients with MI, reported in the previous studies, may result in uncertainty for the service providers to allocate psychological intervention resources. Therefore, an estimate of the pooled prevalence of depression among patients with MI was needed, as it would not only accelerate the efforts to determine the accurate number of subjects who may develop depression following MI, but also facilitate the task of balancing the cost of prevention and treatment of depression.

Thus far, the latest quantitative systematic research regarding depression among patients with MI was conducted by Thombs et al and published in March 2004.[19] They found that the pooled prevalence of depression identified by structured interview and Beck Depression Inventory (BDI), with a cutoff value of 10, was 19.8% (95% confidence interval [CI]: 19.1%–20.6%), and 31.1% (95% CI: 29.2%–33.0%), respectively.[19] However, numerous factors, including socio-demographic characteristics and cardiovascular factors that may be associated with the prevalence of depression among patients with MI were not taken into consideration, which significantly limited the generalizability of their findings. Also, the statistical analyses performed in that study were not adequate in the sense that there was no attempt to examine heterogeneity, publication bias, as well as sensitivity. Moreover, that study was published in March 2004 and subsequently, numerous relevant studies have been published. In this regard, a comprehensive update on the pooled prevalence of depression among patients with MI was warranted. Therefore, this study aimed to update the pooled prevalence of depression among patients with MI by synthesizing relevant evidence. The pooled prevalence of depression among patients with MI stratified by the socio-demographic characteristics, tool used to identify depression, MI characteristics, and cardiovascular factors was also explored.

2. Methods

2.1. Ethical approval

Ethical approval was not necessary for this study since this study utilized published data which were already ethically approved.

2.2. Search strategy

This meta-analysis was in accordance with the checklist of Preferred Reporting Items for Systematic Review and Meta-Analyses (additional file 1, http://links.lww.com/MD/C834). A comprehensive literature search in 3 electronic databases (PubMed, Embase, and PsycINFO) was performed from database inception to April 2018. Subject headings related to MI and depression were used to develop a search strategy which was customized across databases. Full search strategies were listed in the additional file 2, http://links.lww.com/MD/C835. The eligible studies of previous relevant reviews,[7,19–22] and the reference lists of full-text articles were also examined for more relevant articles.

2.3. Study selection

Two investigators independently identified the eligibility of studies for this meta-analysis, and any disagreement between them was resolved via consensus. Articles were included if they: Firstly, were cross-sectional studies, or baseline data of longitudinal studies, or baseline data of randomized controlled trials (RCTs) before group allocation; secondly, focused on patients with MI confirmed by medical records; thirdly, assessed depression among patients with MI using validated tools, including structured interviews and self-report questionnaires with established cutoff values. Fourth, reported the prevalence of depression among patients with MI and the sample size. Fifth, recruited a sample of no less than 200 subjects. Sixth, were published in peer-reviewed journals in English. Additionally, only the 1st publication was included if multiple publications from the same cohort were observed. Studies were excluded if they: First, were case reports, comments, or review articles. Second, reported exclusively the prevalence of depression among specific subgroups of patients with MI, such as those with heart failure, due to the absence of representativeness. Third, aimed to explore the psychometric properties of assessment tools.

2.4. Data collection

The primary outcome for this meta-analysis was the prevalence of depression among patients with MI. For the purpose of this study, 2 investigators independently assessed the quality of the eligible studies and extracted the following data: 1st author, publication year, region, sample source, mean age of participants, percentage of male participants, percentage of participants with 1st-time MI, timing of depression assessment, tool used to identify depression, number of subjects with depression, sample size, and the prevalence of depression among patients with MI. Wherever possible, data on sex, race, marital status, a history of previous MI, anterior MI, Killip class, current smoking, diabetes, hypertension, and hyperlipidemia were also extracted to perform subgroup analyses. Any discrepancies between the foregoing reviewers were resolved via discussion with a 3rd reviewer.

2.5. Quality assessment

The methodological quality of eligible studies was assessed by the checklist of Prevalence Study Quality.[23] This checklist has been widely used to evaluate the methodological quality of studies on the prevalence of health-related outcomes.[24,25] It consists of 11 items each of which with response options of "Yes", "No", or "Unclear". If the response for an item is "Yes", it is scored "1". Otherwise, it is scored "0". Therefore, the total score for this

instrument ranges from 0 to 11, and studies are categorized as low quality, moderate quality, and high quality with a total score of 0 to 3 points, 4 to 7 points, and 8 to 11 points, respectively.

2.6. Statistical analysis

The heterogeneity across studies was examined by the Cochran's Q test and quantified by the I^2 statistic, which describes the percentage of total variation across studies resulting from heterogeneity rather than chance, with its values of 25%, 50%, and 75% indicating low, moderate, and high heterogeneity, respectively.[26] The pooled prevalence of depression among patients with MI was calculated using a random effects model by Freeman-Tukey double arcsine method when significant heterogeneity (P value for Cochran's Q test <.05) was observed. Otherwise, a fixed effects model was applied.[27] For each pooled estimate, its corresponding 95%CI was calculated.

If significant heterogeneity was observed across the eligible studies, meta-regression analyses were performed, using the restricted maximum-likelihood estimator method, to identify the source of heterogeneity according to the following continuous study-level characteristics: mean age of participants, percentage of male participants, percentage of participants with 1st-time MI, and quality assessment score. Furthermore, subgroup analyses were performed to explore the pooled prevalence of depression among patients with MI according to each of the following categorical study-level characteristics: region, study quality, tool used to identify depression, sex, race, marital status, a history of previous MI, anterior MI, Killip class, current smoking, diabetes, hypertension, and hyperlipidemia. Differences in the pooled prevalence of depression within each subgroup were compared using the chi-square test, and a P value of less than .05 was considered significant.

Sensitivity analysis was done to examine the robustness of the pooled prevalence of depression not only by excluding the eligible studies one-by-one but also removing the studies with relatively low quality. Publication bias was assessed by the funnel plot and verified by the Egger's and Begg's tests. All statistical analyses were performed using the R statistical software version 3.4.1.

3. Results

3.1. Literature search and study selection

Initially, a total of 3936 records were identified by the search strategy. After removing duplicates and reviewing titles and abstracts, 65 full-text articles were shortlisted for assessing the eligibility. Among these articles, 1 was excluded for being an RCT which reported results only after group allocation, 1 was excluded for providing no confirmation of MI by medical records, 2 were excluded for not using validated tools to identify depression, 4 were excluded for not reporting the prevalence of depression among patients with MI, 27 were excluded for recruiting a sample size of less than 200, 8 were excluded for repeated data, 2 were excluded for reporting exclusively the prevalence of depression among specific subgroups of patients with MI, and 1 was excluded for aiming to explore the psychometric properties of an assessment tool. Therefore, a total of 19 eligible studies were included in this meta-analysis (Fig. 1).

3.2. Study characteristics

The characteristics of the 19 eligible studies are shown in Table 1. Collectively, 12,315 patients with MI were included, of which 3818 were identified with depression. The 19 eligible studies were conducted in 10 countries including Canada, United Kingdom (UK), United States of America (USA), Iran, Israel, Australia, Denmark, Sweden, Norway, and Japan. Among these 19 eligible studies, 2 were cross-sectional, 3 were RCTs, 14 were longitudinal, 1 was population-based, 18 were hospital-based, 4 used exclusively structured interview to identify depression, 14 used exclusively self-report questionnaire to identify depression, and 1 used both structured interview and self-report questionnaire to identify depression. The mean age of participants ranged from 52 to 67 years, and the percentage of male participants ranged from 57 to 87%. Additionally, the percentage of participants with 1st-time MI ranged from 69 to 100%.

The results of quality assessment are shown in the additional file 3, http://links.lww.com/MD/C836. The overall quality among the eligible studies was moderate to high. According to the checklist of Prevalence Study Quality, 1 was scored 5 points, 1 was scored 7 points, 2 were scored 8 points, 9 were scored 9 points, and 6 were scored 10 points. Therefore, 2 were categorized as moderate quality and 17 were categorized as high quality.

3.3. Pooled prevalence of depression among patients with MI

The reported prevalence of depression among patients with MI ranged from 9.17 to 65.88% among the eligible studies. The highest prevalence was reported in a hospital-based study in Iran which used BDI with a cutoff value of 10 to identify depression,[31] and the lowest prevalence was reported in a hospital-based study in Canada which used the short-form BDI with a cutoff value of 8 to identify depression.[36] Since the overall heterogeneity across the 19 eligible studies was significantly high (I^2 = 98.4%), a random effects model was applied to generate the pooled prevalence of depression among patients with MI and it was 28.70% (95% CI: 22.39–35.46%) (Fig. 2).

3.4. Meta-regression analyses

The results of meta-regression analyses indicated that publication year (β=0.002, P = .690), mean age of participants (β=-0.003, P = .732), percentage of male participants (β=-0.246, P = .557), percentage of participants with 1st-time MI (β=0.120, P = .794), and quality assessment score (β=-0.021, P = .467) were not significant moderators of the overall heterogeneity (Table 2).

3.5. Subgroup analyses

The results of subgroup analyses are shown in Table 3. The pooled prevalence of depression among patients with MI in North America, Europe/UK, and Asia was 25.97% (95% CI: 17.96–34.88%), 23.50% (95% CI: 17.75–29.78%), and 45.03% (95% CI: 24.89–66.07%), respectively; among those assessed by structured interview and self-report questionnaire it was 25.95% (95% CI: 14.40–39.49%) and 29.63% (95% CI: 22.00–37.88%), respectively; among female and male subjects it was 38.64% (95% CI: 30.11–47.54%) and 30.07% (95% CI: 20.98–40.01%), respectively; among those with and without a history of previous MI it was 37.15% (95% CI: 26.95–47.95%) and 31.28% (95% CI: 18.49–45.70%), respectively; among those with and without anterior MI it was 42.62% (95% CI: 15.76–72.05%) and 29.19% (95% CI: 21.59–37.42%), respectively; among those with Killip class equal to I and more than I it was 27.95% (95% CI: 20.48–36.07%) and 34.34% (95% CI:

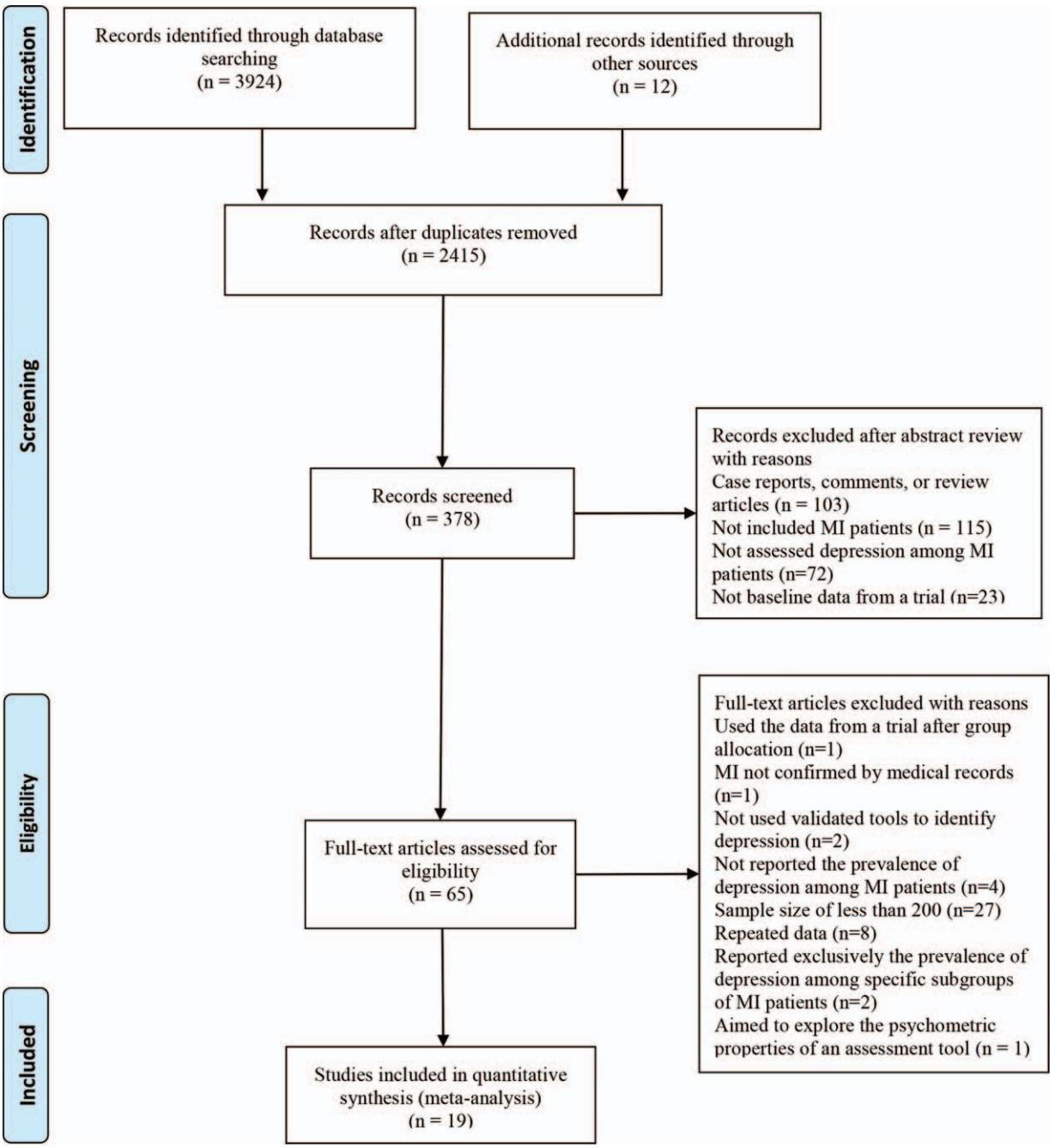

Figure 1. PRISMA flowchart of study selection.

28.11–40.86%), respectively; among those with and without diabetes it was 41.77% (95% CI: 33.27–50.52%) and 33.90% (95% CI: 24.64–43.83%), respectively; and among those with and without hypertension it was 40.85% (95% CI: 32.26–49.72%) and 36.37% (95% CI: 26.40–46.96%) respectively. Moreover, the pooled prevalence of depression among patients with MI differed significantly in subgroups according to region, tool used to identify depression, study quality, sex, race, anterior MI, and diabetes status ($P < .05$). Heterogeneity was high within most subgroups. For unmarried subjects, the heterogeneity was low ($I^2 = 19.5$, $P = .293$, 4 included studies).

3.6. Sensitivity analysis and publication bias

After serially excluding each study, the pooled prevalence of depression among patients with MI ranged from 26.79% (95% CI: 21.65–32.26%) to 30.04% (95% CI: 23.97–36.48%), and the I^2 statistic values ranged from 97.5 to 98.5%. Specifically, after excluding one population-based study, the pooled prevalence was 29.31% (95% CI: 22.71–36.38%), and the I^2 statistic value was 98.4%. Furthermore, after excluding studies with moderate quality, the pooled prevalence decreased slightly from 28.70% (95% CI: 22.39–35.46%) to 27.31% (95% CI: 21.98–32.99%).

Table 1

Characteristics of the eligible studies for this meta-analysis.

First author	Year of publication	Region	Study design	Sample source	Mean age (SD)	Percentage of males (%)	Percentage of first-time MI (%)	Tool used to identify depression		Timing of depression assessment	Subjects with depression	Sample size	Depression prevalence
								Self-report questionnaire	Structured interview				
Lauzon [28]	2003	Canada	Longitudinal	Hospital-based	60	78.9	79.1	BDI≥10	–	2–3 days [b]	191	550	34.7
Dickens [29]	2007	UK	Longitudinal	Hospital-based	60.0 (11.1)	70.4	84	HADS≥17	–	3.6 days [a]	140	588	23.8
Parashar [30]	2009	USA	Longitudinal	Hospital-based	60.5	66.5	78.9	PHQ-9≥10	–	24–72 hours [b]	538	2411	22.3
Hosseini [31]	2011	Iran	Longitudinal	Hospital-based	58 (12.2)	69.0	86.9	BDI≥10	–	≤15 days [a]	531	806	65.9
Kurdyak [10]	2011	Canada	Longitudinal	Hospital-based	62.4 (12.8)	70.4	–	BCDRS≥4	–	≤30 days [c]	807	1941	41.6
Myers[14]	2012	Israel	Longitudinal	Hospital-based	52.3	86	88	BDI≥10	–	1 week [b]	175	632	27.7
Wheeler [32]	2012	Australia	RCT	Hospital-based	59 (12)	74	–	CES-D≥16	–	12 months [c]	132	337	39.2
Larsen [33]	2014	Denmark	Longitudinal	Population-based	67.0 (11.6)	69.2	100	HADS≥8	–	12–14 weeks [c]	167	896	18.6
Schleifer [34]	1989	USA	Longitudinal	Hospital-based	63.7 (0.7)	64	73	–	Schedule for affective disorders and Schizophrenia	8–10 days [a]	128	283	45.2
Lane [15]	2000	UK	Longitudinal	Hospital-based	62.7 (11.5)	74.7	78.4	BDI≥10	–	2–15 days [a]	89	288	30.9
Watkins [17]	2002	USA	Cross-sectional	Hospital-based	58.5	58.3	77.9	-	DIS	6 days [a]	37	204	18.1
Parakh [16]	2008	USA	Longitudinal	Hospital-based	64.8	57	69.4	BDI≥10	SCID	≤5 days [a]	76	284	26.8
Johansson [35]	2010	Sweden	Cross-sectional	Hospital-based	64 (10)	70	76.6	HADS≥8	–	4 months [a]	41	204	20.1
Crowe [36]	1996	Canada	RCT	Hospital-based	61	87	84	Short form BDI>8	–	2–14 days [a]	72	785	9.2
Hanssen [9]	2009	Norway	RCT	Hospital-based	60.2 (12.0)	80.9	88.5	HADS-D≥8	–	<3 months [c]	33	244	13.5
Frasure-Smith [37]	1993	Canada	Longitudinal	Hospital-based	59.6	78	73	–	DIS	5–15 days [a]	35	222	15.8
Kaufmann [38]	1999	USA	Longitudinal	Hospital-based	65 (12.1)	65.6	76.6	–	DIS	3–15 days [a]	90	331	27.2
Shiotani [39]	2002	Japan	Longitudinal	Hospital-based	63 (11)	80.4	87.7	SDS≥40	–	≤3 months [a]	438	1042	42.0
Welin [40]	2000	Sweden	Longitudinal	Hospital-based	–	83.6	100	SDS≥40	–	3 months [a]	98	267	36.7

[a] Post-MI.

[b] Post-admission.

[c] Post-discharge.

BCDRS = Brief Carroll Depression Rating Scale, BDI = Beck Depression Inventory, CES-D = Center for Epidemiologic Studies Depression Scale, DIS = modified version of the National Institute of Mental Health Diagnostic Interview Schedule, HADS = Hospital Anxiety and Depression Scale, MI = myocardial infarction, PHQ-9 = 9-question Primary Care Evaluation of Mental Disorders Brief Patient Health Questionnaire, RCT = randomized controlled trial, SCID = Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders, Revised Third Edition, SD = standard deviation, SDS = Zung Self-Rating Depression Scale, UK = United Kingdom, USA = United States of America.

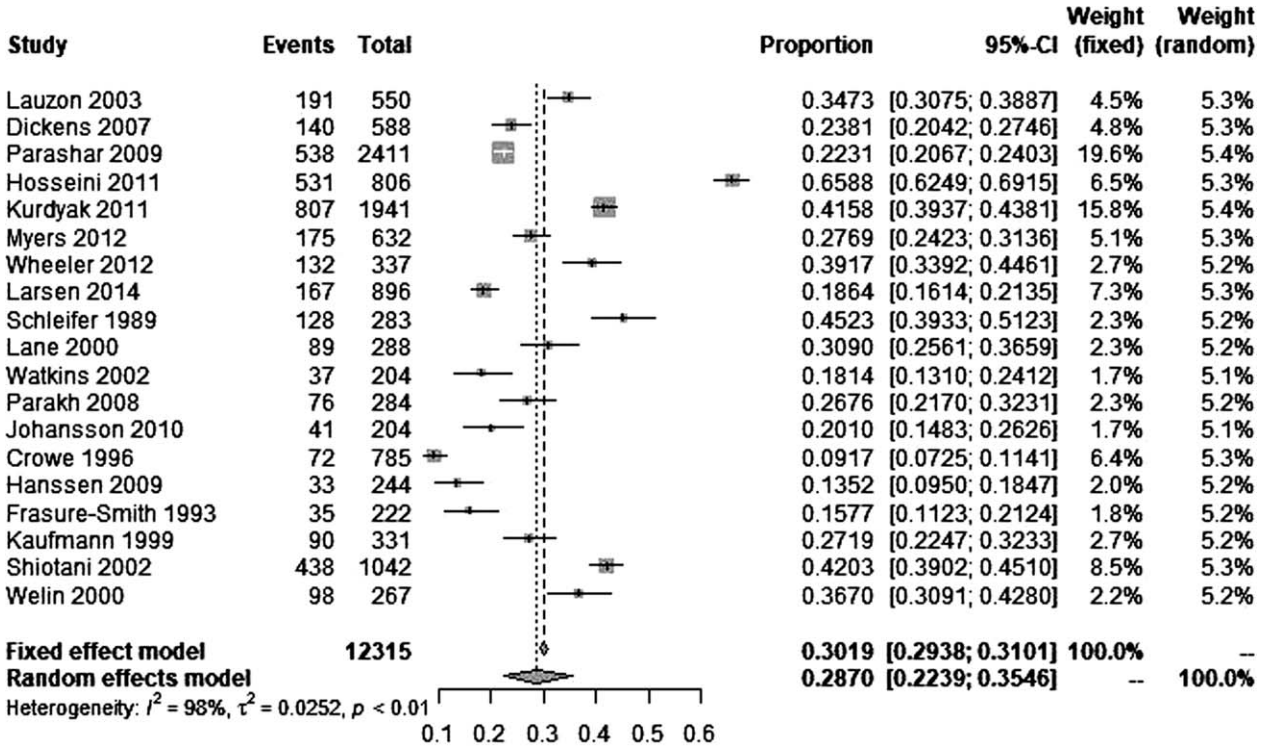

Figure 2. Forest plot of the 19 eligible studies.

Table 2

Meta-regression analyses of the effects of potential moderators on the overall heterogeneity.

	No. of studies	Coefficient	Standard error	*Z* value	*P* value	tau^2
Publication year	19	0.002	0.005	0.399	.690	0.024
Mean age of participants, y	18	−0.003	0.012	−0.342	.732	0.025
Percentage of male participants	19	−0.246	0.420	−0.588	.557	0.023
Percentage of participants with 1st-time MI	17	0.120	0.457	0.262	.794	0.025
Quality assessment score	19	−0.021	0.029	−0.727	.467	0.023

MI = myocardial infarction.

The results of Egger's test (t=-0.435, P=.669) and Begg's test (z=-0.630, P=.529) indicated no evidence of publication bias, and in accordance with these results, the funnel plot was symmetrical (Fig. 3).

4. Discussion

This meta-analysis synthesized the evidence regarding the prevalence of depression among patients with MI and provided an updated estimate on the pooled prevalence. Nineteen eligible studies conducted in 10 countries with a total of 12,315 patients with MI were included, of which 3818 were identified with depression. The reported prevalence of depression ranged from 9.17% to 65.88% across the eligible studies, and the pooled prevalence of depression among patients with MI was 28.70% (95% CI: 22.39–35.46%) by a random effects model.

The pooled prevalence of depression among patients with MI found in this meta-analysis (28.70%) was comparable with that found in previous meta-analyses on patients with multiple sclerosis (30.5%),[41] hypertension (26.8%),[42] and chronic obstructive pulmonary disease (27.1%).[43] However, it was significantly higher than that among patients with cancer (8%–25%),[44–46] osteoarthritis (19.9%),[47] and spinal cord injury (22.2%).[48] Given the high pooled prevalence of depression found in this study and the association between depression and subsequent adverse health outcomes, such as impaired quality of life and increased risk of mortality among patients with MI, more psychological resources including early assessment and effective treatment of depression should be allocated to patients with MI.

This study found that the pooled prevalence of depression among patients with MI differed significantly based on region and race. Regional differences in the pooled prevalence of depression could be explained by the differences in the socio-economic levels, as well as the differences in the socio-demographic and social-cultural characteristics.[49] Similar finding was observed in a meta-analysis exploring the pooled prevalence of paternal depression in pregnancy and postpartum.[49] Racial differences in the pooled prevalence of depression could be mainly accounted for by the differences in social-cultural

Table 3

Subgroup analyses of the prevalence of depression in myocardial infarction.

Subgroup	Category	No. of studies	No. of subjects with depression	Sample size	Pooled prevalence (95% CI) (%)	Heterogeneity test		Chi-squared test	
						I^2 value (%)	*P* value	Chi-squared value	*P* value
Region*									
	North America	9	1974	7011	25.97 (17.96–34.88)	98.3	<.001	268.274	<.001[b]
	Europe/UK	6	568	2487	23.50 (17.75–29.78)	91.6	<.001	298.206	<.001[b]
	Asia	3	1144	2480	45.03 (24.89–66.07)	99.1	<.001		
Study quality								327.530	<.001[b]
	High	17	3250	11305	27.31 (21.98–32.99)	97.6	<.001		
	Moderate	2	568	1010	41.01 (3.83–86.30)	99.4	<.001		
Tool used to assess depression								5.503	.019[b]
	Self-report questionnaire	14	3452	10991	29.63 (22.00–37.88)	98.8	<.001		
	Structured interview	4	290	1040	25.95 (14.40–39.49)	95.5	<.001		
Sex								32.336	<.001[b]
	Male	10	1980	6011	30.07 (20.98–40.01)	98.4	<.001		
	Female	10	936	2369	38.64 (30.11–47.54)	94.0	<.001		
Race								4.993	.025[b]
	White	4	34	155	29.29 (24.67–34.12)	65.9	.032		
	Non-white	4	359	1171	25.99 (9.94–45.97)	83.3	<.001		
Marital status								2.115	.146
	Married	4	849	1933	38.22 (18.34–60.41)	98.9	<.001		
	Unmarried	4	137	345	39.56 (34.38–44.86)[a]	19.5	.293		
A history of previous MI								0.987	.320
	Yes	7	250	635	37.15 (26.95–47.95)	86.8	<.001		
	No	7	1146	2760	31.28 (18.49–45.70)	98.3	<.001		
Anterior MI								62.247	<.001[b]
	Yes	3	256	505	42.62 (15.76–72.05)	97.6	<.001		
	No	3	286	961	29.19 (21.59–37.42)	86.5	<.001		
Killip class								1.599	.206
	I	6	770	2359	27.95 (20.48–36.07)	93.9	<.001		
	>I	6	230	652	34.34 (28.11–40.86)	65.7	.012		
Current smoking								2.127	.145
	Yes	9	1074	2626	35.88 (28.43–43.69)	93.4	<.001		
	No	9	1305	3343	30.62 (20.60–41.64)	97.6	<.001		
Diabetes								20.904	<.001[b]
	Yes	8	641	1393	41.77 (33.27–50.52)	89.5	<.001		
	No	8	1702	4353	33.90 (24.64–43.83)	97.7	<.001		
Hypertension								3.072	.080
	Yes	7	1033	2406	40.85 (32.26–49.72)	94.3	<.001		
	No	7	1273	3136	36.37 (26.40–46.96)	97.1	<.001		
Hyperlipidemia								0.208	.648
	Yes	7	945	2289	38.96 (29.61–48.73)	95.3	<.001		
	No	7	1355	3234	38.28 (28.70–48.33)	96.7	<.001		

CI = confidence interval, MI = myocardial infarction, UK = United Kingdom.

* Asia was the reference group; [a]: data were combined using a fixed effects model; [b]: *P* value for Chi-squared tests <.05.

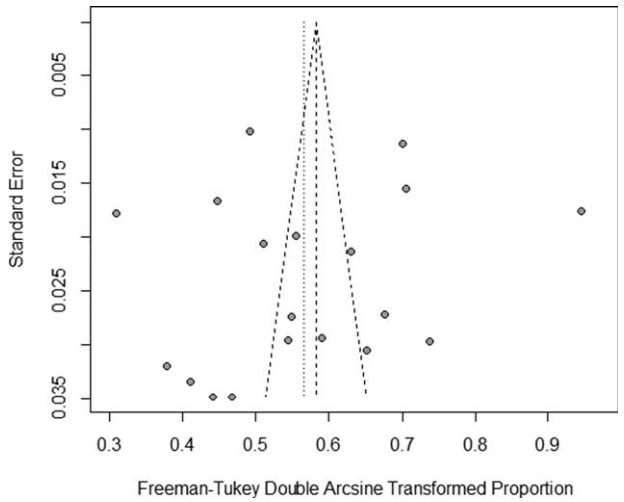

Figure 3. Funnel plot of the 19 eligible studies.

characteristics, as well as racial differences in the genetic background.[50]

This study also found that the pooled prevalence of depression identified by self-report questionnaire (29.63%) was significantly higher than that identified by structured interview (26.13%). Numerous studies have consistently shown that compared with structured interview, self-report questionnaire may overestimate the prevalence of depression.[44,51,52] For example, Li et al found that the pooled prevalence of depression among patients with hypertension identified by structured interview was 21.3%, while for studies using self-report questionnaire to identify depression, it was 29.8%.[42] Zhang et al found that the pooled prevalence of depression among patients with systemic lupus erythematosus identified by structured interview was 24%, while for studies that used BDI with a cutoff value of 11, it was 39%, and for Hospital Anxiety and Depression Scale (HADS) with a cutoff value of 8, it was 30%.[51] Therefore, caution should be applied when using self-report tools to identify depression. However, given the fact that even minimal depressive symptom could lead to an increased mortality risk following MI,[8] it is recommended for future studies on MI populations to identify depression using both self-report questionnaire and structured interview.

Significant sex differences in the pooled prevalence of depression among patients with MI were also observed in this study, which may be explained by the differences in the biological factors, such as hormones; and psychosocial factors, such as coping strategies, personality traits, and role overload.[53,54] Poynter et al conducted a systematic review exploring sex differences in the prevalence of depression among stroke patients and found that, among the 56 eligible studies, 35 reported that the prevalence of depression was higher among females than males.[55] In addition, by pooling the results of 8 eligible studies, Shanmugasegaram et al found that female CHD patients were at 1.77 times higher risk of suffering from major depression compared with males.[56] Based on these findings, special attention should be given to female subjects when implementing prevention strategies and psychological intervention of depression among patients with MI.

Some studies found that the MI characteristics, such as a history of previous MI, anterior MI, and Killip class may affect the prevalence of depression following MI,[14,16,17] while others showed contradictory results.[15,28,37] Furthermore, findings on the association of cardiovascular risk factors, such as smoking status, hypertension and diabetes, with the prevalence of depression were controversial.[9,15–17,37,39] This study showed that a history of previous MI, Killip class, current smoking, hypertension and hyperlipidemia did not contribute significantly to the pooled prevalence of depression, whereas anterior MI and diabetes status did. Subjects with anterior MI or diabetes exhibited higher pooled prevalence of depression than their counterparts. Given the high heterogeneity observed across the included studies of these subgroups, future studies are still needed to clarify the associations of MI characteristics and cardiovascular risk factors with depression following MI.

Though the overall quality of eligible studies was moderate to high, this study found that the pooled prevalence of depression varied significantly according to study quality, with moderate quality studies showing higher pooled prevalence than high quality studies. It has been well established that studies with relatively lower quality are more prone to employ biased sampling frames and induce selection bias, as a consequence of which, the effect size may be overestimated.[57,58] Therefore, more studies with high quality are warranted to obtain an accurate and reliable estimate.

Some limitations should be acknowledged. First, the overall heterogeneity across the eligible studies was high. Meta-regression analyses according to publication year, mean age of participants, percentage of male participants, percentage of participants with 1st-time MI, and quality assessment score did not identify any moderators which significantly affected the heterogeneity, and the heterogeneity within most subgroups was also high, indicating that future studies should explore more factors which may affect the prevalence of depression among patients with MI, such as social support and a history of previous psychiatric disorders. However, subgroup analyses found that the heterogeneity among unmarried subjects was low, suggesting that it is better for future studies exploring depression among patients with MI to stratify the subjects according to marital status to keep homogeneity. Second, meta-regression analysis according to the timing of depression assessment was not performed in this study since the timing of depression assessment varied across studies and hence difficult to classify. Nevertheless, evidence showed that the prevalence of depression did not decrease significantly with the elapse of time since MI.[9,40,50] Furthermore, it is worth noting here that all eligible studies except 1 were hospital-based, which may preclude generalizing the results of this study to population-based studies. Also, caution should be applied since subgroup analyses were performed univariately without adjustment for potential confounders.

5. Conclusions

The pooled prevalence of depression among patients with MI was 28.70% (95% CI: 22.39–35.46%) and differed significantly by region, tool used to identify depression, study quality, sex, race, anterior MI, and diabetes status. High heterogeneity was observed across all included studies. In addition, except for the married subjects, high heterogeneity was observed across studies within all subgroups. Future prospective studies with high quality are still needed to explore more factors affecting the prevalence of depression as well as clarify the associations of MI characteristics and cardiovascular risk factors with depression among patients with MI.

Acknowledgments

The authors are grateful to all authors of the full-text articles included in this meta-analysis. This study was supported by the National Natural Science Foundation of China (Grant No. 81774016).

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