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Prevalence of Depression, Depressive Symptoms, and Suicidal Ideation Among Medical Students

A Systematic Review and Meta-Analysis

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IMPORTANCE Medical students are at high risk for depression and suicidal ideation. However, the prevalence estimates of these disorders vary between studies.

OBJECTIVE To estimate the prevalence of depression, depressive symptoms, and suicidal ideation in medical students.

DATA SOURCES AND STUDY SELECTION Systematic search of EMBASE, ERIC, MEDLINE, psycARTICLES, and psycINFO without language restriction for studies on the prevalence of depression, depressive symptoms, or suicidal ideation in medical students published before September 17, 2016. Studies that were published in the peer-reviewed literature and used validated assessment methods were included.

DATA EXTRACTION AND SYNTHESIS Information on study characteristics; prevalence of depression or depressive symptoms and suicidal ideation; and whether students who screened positive for depression sought treatment was extracted independently by 3 investigators. Estimates were pooled using random-effects meta-analysis. Differences by study-level characteristics were estimated using stratified meta-analysis and meta-regression.

MAIN OUTCOMES AND MEASURES Point or period prevalence of depression, depressive symptoms, or suicidal ideation as assessed by validated questionnaire or structured interview.

RESULTS Depression or depressive symptom prevalence data were extracted from 167 cross-sectional studies (n = 116 628) and 16 longitudinal studies (n = 5728) from 43 countries. All but 1 study used self-report instruments. The overall pooled crude prevalence of depression or depressive symptoms was 27.2% (37 933/122 356 individuals; 95% CI, 24.7% to 29.9%, $I^2 = 98.9%$). Summary prevalence estimates ranged across assessment modalities from 9.3% to 55.9%. Depressive symptom prevalence remained relatively constant over the period studied (baseline survey year range of 1982-2015; slope, 0.2% increase per year [95% CI, -0.2% to 0.7%]). In the 9 longitudinal studies that assessed depressive symptoms before and during medical school (n = 2432), the median absolute increase in symptoms was 13.5% (range, 0.6% to 35.3%). Prevalence estimates did not significantly differ between studies of only preclinical students and studies of only clinical students (23.7% [95% CI, 19.5% to 28.5%] vs 22.4% [95% CI, 17.6% to 28.2%]; $P = .72$). The percentage of medical students screening positive for depression who sought psychiatric treatment was 15.7% (110/954 individuals; 95% CI, 10.2% to 23.4%, $I^2 = 70.1%$). Suicidal ideation prevalence data were extracted from 24 cross-sectional studies (n = 21 002) from 15 countries. All but 1 study used self-report instruments. The overall pooled crude prevalence of suicidal ideation was 11.1% (2043/21 002 individuals; 95% CI, 9.0% to 13.7%, $I^2 = 95.8%$). Summary prevalence estimates ranged across assessment modalities from 7.4% to 24.2%.

CONCLUSIONS AND RELEVANCE In this systematic review, the summary estimate of the prevalence of depression or depressive symptoms among medical students was 27.2% and that of suicidal ideation was 11.1%. Further research is needed to identify strategies for preventing and treating these disorders in this population.

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Studies have suggested that medical students experience high rates of depression and suicidal ideation.¹ However, estimates of the prevalence of depression or depressive symptoms among students vary across studies from 1.4% to 73.5%,^{2,3} and those of suicidal ideation vary from 4.9% to 35.6%.^{4,5} Studies also report conflicting findings about whether student depression and suicidality vary by undergraduate year, sex, or other characteristics.⁶⁻¹¹

Reliable estimates of depression and suicidal ideation prevalence during medical training are important for informing efforts to prevent, treat, and identify causes of emotional distress among medical students,¹² especially in light of recent work revealing a high prevalence of depression in resident physicians.¹³ We conducted a systematic review and meta-analysis of published studies of depression, depressive symptoms, and suicidal ideation in undergraduate medical trainees.

Methods

Search Strategy and Study Eligibility

Two authors (M.A.R. and D.A.M.) independently identified cross-sectional and longitudinal studies published prior to September 17, 2016, that reported on the prevalence of depression, depressive symptoms, or suicidal ideation in medical students by systematically searching EMBASE, ERIC, MEDLINE, psycARTICLES, and psycINFO. In addition, the authors screened the reference lists of identified articles and corresponded with study investigators using the approaches implied by the Preferred Reporting Items for Systematic Reviews and Meta-analyses and Meta-analysis of Observational Studies in Epidemiology reporting guidelines.^{14,15}

For the database searches, terms related to medical students and study design were combined with those related to depression and suicide without language restriction (complete details of the search strategy appear in eMethods 1 in the Supplement). Included studies (1) reported data on medical students, (2) were published in peer-reviewed journals, and (3) used a validated method to assess for depression, depressive symptoms, or suicidal ideation.¹⁶ A third author (L.S.R.) resolved discrepancies by discussion and adjudication.

Data Extraction and Quality Assessment

Three authors (L.S.R., M.T., and J.B.S.) independently extracted the following data from each article using a standardized form: study design; geographic location; years of survey; year in school; sample size; average age of participants; number and percentage of male participants; diagnostic or screening method used; outcome definition (ie, specific diagnostic criteria or screening instrument cutoff); and reported prevalence estimates of depression, depressive symptoms, or suicidal ideation. Whether students who screened positive for depression sought psychiatric or other mental health treatment also was extracted. When there were studies involving the same population of students, only the most comprehensive or recent publication was included.

The same 3 authors independently assessed the risk of bias of these nonrandomized studies using a modified ver-

Key Points

Question Are medical students at high risk for depression and suicidal ideation?

Findings In this meta-analysis, the overall prevalence of depression or depressive symptoms among medical students was 27.2%, and the overall prevalence of suicidal ideation was 11.1%. Among medical students who screened positive for depression, 15.7% sought psychiatric treatment.

Meaning The overall prevalence of depressive symptoms among medical students in this study was higher than that reported in the general population, which underscores the need for effective preventive efforts and increased access to care for medical students.

sion of the Newcastle-Ottawa scale, which assesses sample representativeness and size, comparability between respondents and nonrespondents, ascertainment of depressive or suicidal symptoms, and thoroughness of descriptive statistics reporting (complete details regarding scoring appear in eMethods 2 in the Supplement).¹⁷ Studies were judged to be at low risk of bias (≥ 3 points) or high risk of bias (< 3 points). A fourth author (D.A.M.) resolved discrepancies through discussion and adjudication.

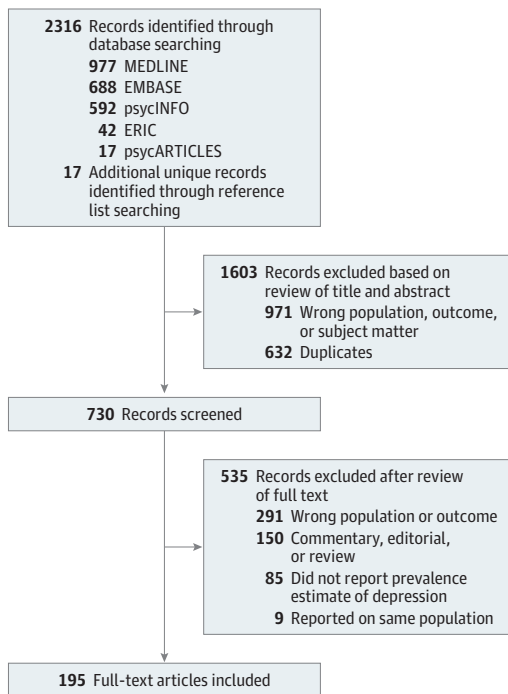
Data Synthesis and Analysis

Prevalence estimates of depression or depressive symptoms and suicidal ideation were calculated by pooling the study-specific estimates using random-effects meta-analyses that accounted for between-study heterogeneity.¹⁸ The same approach was used to estimate the summary percentage of students screening positive for depression who sought treatment. When studies reported point prevalence estimates made at different periods within the year, the overall period prevalence was used. Standard χ^2 tests and the I^2 statistic (ie, the percentage of variability in prevalence estimates due to heterogeneity rather than sampling error, or chance, with values $\geq 75\%$ indicating considerable heterogeneity) were used to assess between-study heterogeneity.^{19,20}

Sensitivity analyses were performed by serially excluding each study to determine the influence of individual studies on the overall prevalence estimates. Results from studies grouped according to prespecified study-level characteristics were compared using stratified meta-analysis (for diagnostic criteria or screening instrument cutoff, study design, undergraduate level, continent or region, country, and Newcastle-Ottawa Scale components) or random-effects meta-regression (for year of baseline survey, age, and sex).^{21,22} To isolate associations within the medical school experience from associations with assessment tools, an analysis restricted to longitudinal studies reporting both pre- and intramedical school depressive symptom prevalence estimates was performed.

Bias secondary to small study effects was investigated using funnel plots and the Egger test.^{23,24} All analyses were performed using R version 3.2.3 (R Foundation for Statistical Computing).²⁵ Statistical tests were 2-sided and used a significance threshold of $P < .05$.

Figure 1. Study Identification and Selection



Results

Study Characteristics

One hundred ninety-five studies^{2-11,26-210} involving a total of 129 123 individuals in 47 countries were included in the analysis (Figure 1). The median number of participants per study was 336 (range, 44-10 140). One hundred sixty-seven cross-sectional studies^{2-4,6-9,11,26-184} (n = 116 628) and 16 longitudinal studies^{10,196-210} (n = 5728) in 43 countries reported on depression or depressive symptom prevalence (Table 1). Twenty-four cross-sectional studies (n = 21 002) in 15 countries reported on the prevalence of suicidal ideation (Table 2).^{4,5,34,62,65,73,74,79,112,160,165,167,174,185-195}

Medical student training level, continent or region, country, diagnostic criteria or screening instrument cutoff, and total Newcastle-Ottawa scores for the studies appear in eTable 1 in the Supplement. Newcastle-Ottawa score components for all 195 individual studies appear in eTable 2 in the Supplement.

Prevalence of Depression or Depressive Symptoms Among Medical Students

Meta-analytic pooling of the prevalence estimates of depression or depressive symptoms reported by 183 studies yielded a crude summary prevalence of 27.2% (37 933/122 356 individuals; 95% CI, 24.7%-29.9%), with significant evidence of between-study heterogeneity ($Q = 16721.1$, $\tau^2 = 0.78$, $I^2 = 98.9\%$, $P < .001$) (Figures 2, 3, 4, 5, and 6). The prevalence estimates reported by the individual studies ranged from 1.4% to 73.5%. Sensitivity analysis, in which

the meta-analysis was serially repeated after exclusion of each study, demonstrated that no individual study affected the overall prevalence estimate by more than 0.3% (eTable 3 in the Supplement).

To further characterize the range of depression or depressive symptom prevalence estimates identified by these methodologically diverse studies, meta-analyses stratified by screening instrument and cutoff score were conducted (Figure 7). Summary prevalence estimates ranged from 9.3% (157/1234 individuals [95% CI, 5.3%-15.7%]; $Q = 19.7$, $\tau^2 = 0.24$, $I^2 = 84.8\%$) for the Hospital Anxiety and Depression Scale with a cutoff score of 11 or greater to 55.9% (540/1039 individuals [95% CI, 45.1%-66.2%]; $Q = 32.9$, $\tau^2 = 0.18$, $I^2 = 90.9\%$) for the Aga Khan University Anxiety and Depression Scale with a cutoff score of 19 or greater. The median summary prevalence was 32.4% (5042/19 160 individuals [95% CI, 25.8%-39.7%]; $Q = 1665.3$, $\tau^2 = 0.62$, $I^2 = 98.6\%$) for the Beck Depression Inventory (BDI) with a cutoff score of 10 or greater.

Among medical students who screened positive for depression, 15.7% (110/954 individuals [95% CI, 10.2%-23.4%]; $Q = 20.1$, $\tau^2 = 0.26$, $I^2 = 70.1\%$) reportedly sought psychiatric or other mental health treatment as assessed by a subset of 7 studies reporting this information (eFigure 1 in the Supplement).

Prevalence of Depression or Depressive Symptoms by Study-Level Characteristics

No statistically significant differences in prevalence estimates were noted between cross-sectional studies (36 632/116 628 [27.3%; 95% CI, 24.7%-30.1%]) and longitudinal studies (1301/5728 [26.7%; 95% CI, 19.1%-36.1%]) (test for subgroup differences, $Q = 0.02$, $P = .90$) or studies performed in the United States (14 356/36 249 [26.7%; 95% CI, 22.5%-31.3%]) compared with those performed outside the United States (23 577/86 107 [27.4%; 95% CI, 24.5%-30.6%]) ($Q = 0.08$, $P = .78$). Studies were further stratified by continent or region in Figure 8. Prevalence estimates from studies limited to preclinical students (4866/25 462 [23.7%; 95% CI, 19.5%-28.5%]) did not significantly differ from estimates from studies limited to clinical students (2917/13 172 [22.4%; 95% CI, 17.6%-28.2%]) ($Q = 0.13$, $P = .72$).

Prevalence estimates did not significantly vary with baseline survey year (survey year range, 1982-2015; slope = 0.2% 1-year increase [95% CI, -0.2% to 0.7%]; $Q = 1.17$, $P = .28$). There were no significant associations between prevalence and mean or median age (slope = 0.2% per 1-year increase [95% CI, -1.4% to 1.8%]; $Q = 0.07$, $P = .79$) or sex (slope = -1.1% per percentage increase in male study participants [95% CI, -15.9% to 13.7%]; $Q = 0.02$, $P = .88$).

When evaluated by Newcastle-Ottawa criteria, higher prevalence estimates were found among studies with more representative participant populations (24 366/68 693; 36.3% [95% CI, 29.9%-43.3%]) compared with those with less representative participant populations (13 567/53 663; 25.4% [95% CI, 22.8%-28.2%]) ($Q = 9.6$, $P = .002$; Figure 9). There were no statistically significant differences in prevalence estimates when studies were stratified by sample size, respondent and nonrespondent comparability, validity of ascertainment of depression or depressive symptoms (details regarding

Table 1. Selected Characteristics of the 183 Studies of Depression or Depressive Symptoms^a

Source	Country	Survey Years	Year of Training	No. of Students	Age, y	Men, No. (%)	Instrument and Cutoff Score
Bore et al, ⁵² 2016	Australia	2013	1-5	127	Mean (SD): 23 (5.6)	32 (25.6)	DASS-21 ≥10
De Sousa Lima et al, ⁶⁷ 2010	Brazil	2001	1-4	80	Range: 18-30	45 (56.3)	BDI ≥10
de Melo Cavestro and Rocha, ⁶⁵ 2006	Brazil	2003	1-6	213	Mean (SD): 23.1 (2.3)	109 (51.2)	MINI ≥ DSM IV criteria
Amaral et al, ³⁹ 2008	Brazil	2006	1-6	287	Mean: 21.3	131 (45.7)	BDI ≥10
Costa et al, ⁶¹ 2012	Brazil	2008	5, 6	84	NR	NR	BDI ≥10
Serra et al, ¹⁴⁷ 2015	Brazil	2012	1-6	657	Mean: 22.7	255 (38.8)	BDI ≥10
Castaldelli-Maia et al, ⁵⁵ 2012	Brazil	2001-2006	1-6	465	NR	NR	BDI ≥15
Alexandrino-Silva et al, ³⁴ 2009	Brazil	2006-2007	1-6	336	Mean (SD): 22.4 (2.5)	105 (31)	BDI ≥21
Paro et al, ¹³⁰ 2010	Brazil	2006-2007	1-6	352	Mean (SD): 22.3 (2.4)	134 (38.4)	BDI >9
Bassols et al, ⁴⁹ 2014	Brazil	2010-2011	1, 6	232	Mean (SD): 23.1 (3.2)	117 (50.4)	BDI ≥11
Del-Ben et al, ²⁰⁰ 2013	Brazil	NR	1	85	Mean (SD): 19.1 (1.6)	58 (68.2)	BDI ≥10
Leão et al, ⁶⁶ 2011	Brazil	NR	6	111	Mean (SD): 24.6 (1.4)	87 (56)	BDI ≥12
Hirata et al, ⁸⁷ 2007	Brazil	NR	1-2	161	Mean (SD): 22.1 (2.1)	77 (47.8)	BDI >10
Baldassin et al, ⁴⁷ 2008	Brazil	NR	1-6	481	Mean (SD): 21.9 (2.4)	195 (40.5)	BDI ≥10
Matheson et al, ¹¹⁷ 2016	Canada	2013	1-4	232	NR	NR	K-10 ≥20
Helmert et al, ⁸⁴ 1997	Canada	1994-1995	1-4	356	Mean (SD): 23.5 (2.6)	185 (52)	DSP >50
Berner et al, ⁵¹ 2014	Chile	2012	1-5	384	Mean (SD): 20.8 (1.8)	224 (58.3)	GHQ-12 ≥5
Tang, ¹⁶³ 2005	China	2003	2	121	NR	0	Zung-SDS ≥50
Shen et al, ¹⁵¹ 2009	China	2006	1	313	Mean (SD): 23.8 (1.8)	NR	Zung-SDS ≥53
Wan et al, ⁴ 2012	China	2010	1-5	4063	Mean (SD): 20.5 (1.1)	1895 (46.6)	Zung-SDS ≥50
Sobowale et al, ¹⁶⁰ 2014	China	2012	2-3	348	NR	NR	PHQ-9 ≥10
Shi et al, ¹⁵⁴ 2015	China	2014	1-5	1738	Mean (SD): 21.4 (1.6)	586 (33.7)	CES-D ≥16
Shi et al, ¹⁵³ 2016	China	2014	1-7	2925	Mean (SD): 21.7 (2)	1028 (35.2)	CES-D ≥16
Pan et al, ¹²⁹ 2016	China	2013-2014	1-5	8819	Mean (SD): 20.7 (1.6)	3415 (37.9)	BDI ≥14
Liao et al, ¹¹⁰ 2010	China	NR	1	487	Mean (SD): 18.5 (0.8)	181 (37.4)	Zung-SDS ≥50
Sun et al, ¹⁶² 2011	China	NR	1-2	10140	Mean (SD): 19.6 (1.3)	4680 (46.2)	BDI ≥10
Yang et al, ⁶ 2014	China	NR	1-5	1137	Range: 17-24	624 (54.9)	SCL-90 >2
Pinzón-Amado et al, ¹³⁷ 2013	Colombia	2006	1-6	973	Mean (SD): 20.3 (2.3)	414 (43)	CES-D ≥16
Amir and Gillany, ⁴⁰ 2010	Egypt	2010	1-6	311	Mean (SD): 20.7 (2.4)	164 (52.7)	HADS-D ≥8
Ibrahim and Abdelreheem, ⁸⁹ 2015	Egypt	2013	1	164	NR	82 (50)	BDI ≥17
Abdel Wahed and Hassan, ²⁷ 2016	Egypt	2015	1-4	442	Mean (SD): 20.2 (1.9)	172 (38.9)	DASS-21 ≥10
Eller et al, ¹⁸⁴ 2006	Estonia	2003	1-6	413	Mean (SD): 21.3 (2.5)	95 (23)	EST-Q ≥12
Vaysse et al, ¹⁷¹ 2014	France	2012-2013	2	197	Mean (SD): 19.7 (0.9)	79 (39.9)	HADS-D ≥8
Prinz et al, ² 2012	Germany	2008	4, 5	73	NR	54 (74)	HADS-D ≥11
Voltmer et al, ¹⁷² 2012	Germany	2010-2011	1, 2, 5	153	Mean (SD): 25.6 (3.1)	44 (28.7)	HADS-D ≥11
Kötter et al, ¹⁰⁷ 2014	Germany	2011-2012	1	350	Mean (SD): 20.9 (3.2)	118 (33.7)	HADS-D ≥8
Wege et al, ¹⁷⁴ 2016	Germany	2012-2013	1	590	Mean (SD): 21.1 (3.9)	177 (29.9)	PHQ-9 >10
Jurkat et al, ¹⁰⁰ 2011	Germany	NR	1, 4	651	NR	252 (38.7)	BDI ≥11
Kohls et al, ¹⁰⁵ 2012	Germany	NR	NR	419	NR	122 (29.1)	ADS-K >17
Nasioudis et al, ¹²⁶ 2015	Greece	2013	1-3	146	Mean (SD): 19.8 (1)	91 (62.3)	Zung-SDS >45
Chan, ⁵⁷ 1992	Hong Kong	NR	1	95	Mean (range): 19.6 (18-29)	64 (67.4)	BDI ≥19
Chan, ⁵⁶ 1991	Hong Kong	NR	1-4	335	Mean (SD): 20.1 (1.6)	239 (71.3)	BDI ≥10
Kumar et al, ²⁶ 2012	India	2008	1-4	400	NR	217 (54.3)	BDI ≥10
Gupta and Basak, ⁸² 2013	India	2008	1-5	150	Range: 18-26	104 (69.3)	BDI ≥10
David and Hamid Hashmi, ⁶⁴ 2013	India	2012	1	128	Mean (range): 17.9 (17-21)	46 (35.9)	BDI ≥17
Vankar et al, ¹⁷⁰ 2014	India	2012	1-4	331	Mean (SD): 19.8 (1.4)	178 (53.8)	PHQ-9 ≥10
Iqbal et al, ⁹⁵ 2015	India	2012	1-5	353	Mean (SD): 20.8 (1.5)	145 (41.1)	DASS-42 ≥10

(continued)

Table 1. Selected Characteristics of the 183 Studies of Depression or Depressive Symptoms^a (continued)

Source	Country	Survey Years	Year of Training	No. of Students	Age, y	Men, No. (%)	Instrument and Cutoff Score
Ali and Vankar, ³⁷ 1994	India	NR	1-3	215	Mean (range): 19.6 (17-25)	132 (61.4)	Zung-SDS \geq 50
Supe, ³ 1998	India	NR	1-3	238	NR	128 (53.8)	Zung-SDS \geq 40
Sidana et al, ¹⁵⁶ 2012	India	NR	1-5	237	NR	126 (53.2)	PHQ-9 \geq 10
Bayati et al, ⁹ 2009	Iran	2008	NR	172	NR	NR	GHQ-28 \geq 23
Akbari et al, ³¹ 2014	Iran	2011	NR	138	NR	NR	GHQ-28 $>$ 6
Farahangiz et al, ⁷⁶ 2016	Iran	2014	1-4	208	Mean (SD): 20.7 (1.1)	82 (39.4)	GHQ-28 \geq 23
Vahdat Shariatpanaahi et al, ¹⁵⁰ 2007	Iran	2004-2005	NR	192	Mean (SD): 24.5 (1.6)	0	BDI \geq 10
Aghakhani et al, ²⁹ 2011	Iran	NR	NR	628	Mean (SD): 22 (0.3)	334 (53.2)	BDI \geq 10
Ashor, ⁴³ 2012	Iraq	2010-2011	1-6	269	NR	147 (54.6)	Zung-SDS \geq 50
Lupo and Strous, ¹¹¹ 2011	Israel	NR	1-6	119	Mean (SD): 25.1 (2.8)	NR	BDI-II \geq 10
Peleg-Sagy and Shahr, ¹³¹ 2012	Israel	NR	1-7	60	Mean (SD): 27 (2.9)	0	CES-D \geq 16
Peleg-Sagy and Shahr, ²⁰⁵ 2013	Israel	NR	1, 4, 7	192	Mean (SD): 26.6 (2.6)	0	CES-D \geq 16
Yoon et al, ¹⁷⁹ 2014	Korea	NR	2, 3, 5	174	Mean (SD): 23.3 (2.8)	96 (55.2)	PHQ-9 \geq 10
Naja et al, ¹²⁵ 2016	Lebanon	2014	2-5	340	NR	145 (42.6)	PHQ-9 \geq 10
Mehanna and Richa, ¹¹⁹ 2006	Lebanon	2003-2004	1-6	356	NR	NR	BDI \geq 8
Bunevicius et al, ⁵³ 2008	Lithuania	2005	NR	338	Mean (SD): 21 (1)	73 (21.6)	HADS-D \geq 8
Mancevska et al, ¹¹⁴ 2008	Macedonia	2007-2008	1-2	354	NR	120 (33.9)	BDI \geq 17
Sherina et al, ¹⁵² 2004	Malaysia	2002	1-5	396	Mean (range): 21.6 (18-29)	152 (38.4)	GHQ-12 \geq 4
Tan et al, ¹⁶⁷ 2015	Malaysia	2013	1-5	537	NR	188 (35)	PHQ-9 \geq 10
Yusoff et al, ⁴⁶ 2011	Malaysia	2008	5	92	NR	25 (27.2)	BDI \geq 9
Yusoff, ¹⁸¹ 2013	Malaysia	2009-2010	1	194	NR	66 (34)	DASS-21 \geq 14
Yusoff et al, ²¹⁰ 2013	Malaysia	2010-2011	1	170	NR	57 (32.8)	DASS-21 \geq 10
Saravanan and Wilks, ¹⁴⁵ 2014	Malaysia	NR	1-5	358	NR	177 (49.4)	DASS-21 \geq 10
Manaf et al, ¹¹³ 2016	Malaysia	NR	2-5	206	Mean (SD): 19.5 (2.6)	0	PHQ-9 \geq 5
Guerrero López et al, ⁷ 2013	Mexico	2007	1	455	Mean (SD): 18.3 (1.2)	139 (30.5)	CES-D \geq 16
Romo-Nava et al, ¹⁴² 2016	Mexico	2011	1-5	1068	NR	421 (39.4)	PHQ-9 \geq 10
Melo-Carrillo et al, ¹²⁰ 2012	Mexico	2006-2007	1-4	302	NR	NR	BDI \geq 10
Nava et al, ¹²⁷ 2013	Mexico	2010-2011	1, 5	1871	NR	707 (37.9)	PHQ-9 \geq 10
El-Gilany et al, ⁷⁵ 2008	Multiple	2007	1-6	588	Mean: 20.8	588 (100)	HADS-D \geq 12
Seweryn et al, ¹⁴⁸ 2015	Multiple	2015	1-6	1262	Median: 22	345 (27.3)	BDI \geq 10
Sreeramareddy et al, ¹⁶¹ 2007	Nepal	2005-2006	NR	407	Mean (SD): 20.7 (1.8)	227 (55.8)	GHQ-12 \geq 4
Basnet et al, ⁴⁸ 2012	Nepal	2008-2009	1, 3	94	Mean (SD): 21.2 (1.7)	57 (60.6)	Zung-SDS \geq 50
Borst et al, ¹⁹⁷ 2015	Netherlands	2010-2011	1-6	951	Mean (SD): 23 (2.6)	279 (29)	BSI-DEP $>$ 0.41
Carter et al, ⁵⁴ 2014	New Zealand	2010	4-6	198	Mean (SD): 23.5 (2.1)	75 (38.1)	DASS-21 \geq 14
Samaranayake and Fernando, ¹⁴⁴ 2011	New Zealand	2008-2009	3	255	Median (range): 20 (18-36)	123 (48.2)	PHQ-9 \geq 10
Oku et al, ¹²⁸ 2015	Nigeria	2010	1, 2, 4, 5	451	Mean (SD): 23.4 (4.4)	288 (63.8)	GHQ-12 \geq 4
Aniebue and Onyema, ⁴² 2008	Nigeria	2008-2009	NR	262	Mean (SD): 23.7 (2.7)	133 (50.8)	Zung-SDS \geq 50
Rab et al, ¹³⁸ 2008	Pakistan	2002	1-5	87	Mean (SD): 20.7 (1.9)	0	HADS-D \geq 8
Jadoon et al, ⁹⁷ 2010	Pakistan	2008	1-5	482	Mean (SD): 20.7 (1.8)	257 (53.3)	AKUADS \geq 19
Marwat, ¹¹⁶ 2013	Pakistan	2011	3	166	NR	73 (28.7)	Zung-SDS \geq 50
Imran et al, ⁹² 2016	Pakistan	2013	NR	527	Mean (SD): 20.2 (2.3)	282 (53.5)	GHQ-12 $>$ 15
Khan et al, ¹⁰³ 2015	Pakistan	2014	3	110	Mean: 21	55 (50)	HADS-D \geq 8
Ali et al, ³⁶ 2015	Pakistan	2014	1-2	182	NR	114 (62.6)	AKUADS $>$ 19
Rizvi et al, ¹⁴⁰ 2015	Pakistan	2014	1-5	66	Mean (SD): 22.2 (1.3)	28 (40)	DASS-42 \geq 10
Alvi et al, ³⁸ 2010	Pakistan	2007-2008	2-5	279	Mean (SD): 21.4 (1.4)	77 (27.6)	BDI-II \geq 14
Waqas et al, ¹⁷³ 2015	Pakistan	2014-2015	1-5	409	Mean (SD): 19.9 (1.3)	123 (30)	HADS-D \geq 8
Inam et al, ⁹³ 2003	Pakistan	NR	1-4	189	NR	60 (31.7)	AKUADS \geq 19

(continued)

Table 1. Selected Characteristics of the 183 Studies of Depression or Depressive Symptoms^a (continued)

Source	Country	Survey Years	Year of Training	No. of Students	Age, y	Men, No. (%)	Instrument and Cutoff Score
Khan et al, ¹¹ 2006	Pakistan	NR	1-5	142	Mean (SD): 21.3 (1.9)	59 (41.5)	AKUADS ≥19
Perveen et al, ¹³³ 2016	Pakistan	NR	1,5	1000	NR	431 (43.1)	QIDS ≥9
Mojs et al, ¹²² 2015	Pakistan	NR	NR	477	NR	NR	KADS ≥6
Phillips et al, ¹³⁴ 2006	Panama	2005	1-6	122	NR	63 (51.6)	Zung-SDS ≥50
Pereyra-Elías et al, ¹³² 2010	Peru	2010	1-4	590	Mean (SD): 19 (2.5)	184 (28.9)	Zung SF ≥22
Valle et al, ¹⁶⁹ 2013	Peru	2010	1-6	615	Mean (SD): 22 (4.5)	357 (58)	Zung-SDS ≥50
Walkiewicz et al, ²⁰⁹ 2012	Poland	1999-2005	2	178	NR	NR (69)	MMPI-D >70
Adamiak et al, ²⁸ 2004	Poland	NR	2, 4	263	Mean: 22.3	NR	BDI ≥12
Inam, ⁹⁴ 2007	Saudi Arabia	2002	1-3	226	NR	149 (65.9)	AKUADS ≥19
Aziz et al, ⁴⁵ 2011	Saudi Arabia	2010	1-5	295	Mean (SD): 21.6 (1.7)	0	BDI-II ≥20
AlFaris et al, ³⁵ 2014	Saudi Arabia	2011	1-2	543	NR	340 (62.6)	BDI-II ≥14
Ibrahim et al, ⁹¹ 2013	Saudi Arabia	2012	2-6	558	Mean (SD): 21.7 (1.8)	300 (50.3)	HADS-D ≥11
Ibrahim et al, ⁹⁰ 2013	Saudi Arabia	2010-2011	2-6	450	Mean (SD): 21.1 (1.4)	0	HADS-D ≥11
Kulsoom and Afsar, ¹⁰⁸ 2015	Saudi Arabia	2012-2013	1-5	442	NR	274 (62)	DASS-21 ≥14
Al-Faris et al, ⁸ 2012	Saudi Arabia	NR	1-5	797	Mean (SD): 21.6 (1.6)	590 (74)	BDI ≥10
Saeed et al, ¹⁴³ 2016	Saudi Arabia	NR	NR	80	Mean (SD): 25.9 (1.5)	55 (68.8)	K-10 ≥20
Ristić-Ignjatović et al, ¹³⁹ 2013	Serbia	2002-2012	4	615	Mean (SD): 23.6 (1.5)	239 (36.8)	BDI ≥10
Miletic et al, ¹²¹ 2015	Serbia	2012-2013	1, 3, 6	1294	Mean (SD): 21.9 (2.8)	500 (38.6)	PHQ-9 ≥10
Pillay et al, ¹³⁶ 2016	South Africa	NR	1-5	230	Mean: 21	66 (28.7)	Zung-SDS >30
Jeong et al, ⁹⁹ 2010	South Korea	2008	1-2	89	NR	0	CES-D ≥16
Kim and Roh, ¹⁰⁴ 2014	South Korea	2011	1-2	122	NR	92 (75.4)	BDI ≥10
Choi et al, ⁶⁰ 2015	South Korea	2013	1-4	534	NR	308 (57.7)	BDI-II ≥17
Roh et al, ¹⁴¹ 2009	South Korea	2006-2007	1-4	7357	NR	NR	BDI ≥16
Dahlin et al, ⁶³ 2011	Sweden	2006	NR	408	Median (range): 24 (22-27)	157 (36.5)	MDI >27
Dahlin et al, ⁶² 2005	Sweden	2001-2002	1, 3, 6	309	Mean (range): 26.1 (18-44)	126 (39.8)	DSM-IV criteria A and C
Kongsomboon, ¹⁰⁶ 2010	Thailand	2008	1-6	593	Mean (range): 20.7 (15-27)	243 (41)	HRSRS ≥25
Angkurawaranon et al, ⁴¹ 2016	Thailand	2013	2-6	1014	Mean (SD): 20.8 (1.5)	476 (46.9)	PHQ-9 ≥9
N Wongpakaran and T Wongpakaran, ¹⁷⁷ 2010	Thailand	NR	1-5	368	Mean (SD): 20.8 (1)	155 (42)	TDI >35
Youssef, ¹⁸⁰ 2016	Trinidad and Tobago	NR	1-3	381	Mean (SD): 22.4 (3)	126 (0.3)	PHQ-9 ≥10
Güleç et al, ⁸¹ 2005	Turkey	1993	1-6	668	Mean (SD): 21.1 (2)	658 (96.2)	BDI ≥17
Akvardar et al, ³² 2003	Turkey	2002	1, 6	447	Mean (SD): 21 (1.2)	272 (39.1)	HADS-D ≥7
Marakoğlu et al, ¹¹⁵ 2006	Turkey	2006	1-2	331	Mean (SD): 19.5 (1.4)	186 (56.2)	BDI ≥10
Mayda et al, ¹¹⁸ 2010	Turkey	2009	1-5	202	Mean (SD): 20.5 (2.2)	85 (40.1)	BDI ≥17
Yılmaz et al, ¹⁷⁸ 2014	Turkey	2010	1-6	995	Mean (SD): 21.1 (1.9)	517 (52)	BDI ≥10
Aktekin et al, ¹⁹⁶ 2001	Turkey	1996-2002	1-2	119	NR	NR	GHQ-12 ≥4
Karaoğlu and Şeker, ¹⁰¹ 2011	Turkey	2008-2009	1-3	485	Mean (SD): 19.5 (1.5)	272 (56.1)	HADS-D ≥8
Baykan et al, ⁵⁰ 2012	Turkey	NR	6	193	Mean (SD): 24.5 (1.5)	107 (55.4)	DASS-42 ≥10
Akvardar et al, ³³ 2004	Turkey	NR	1, 6	166	NR	NR	HADS-D ≥7
Kaya et al, ¹⁰² 2007	Turkey	NR	NR	352	NR	226 (64.2)	BDI ≥17
Ahmed et al, ³⁰ 2009	UAE	2008	1-5	165	NR	0	BDI ≥10
James et al, ⁹⁸ 2013	UK	2007	1	324	NR	194 (60)	GHQ-12 ≥4
Honey et al, ⁸⁸ 2010	UK	2008	NR	553	Mean (SD): 21.6 (3)	220 (39.8)	PHQ-9 ≥10
Ashton and Kamali, ⁴⁴ 1995	UK	1993-1994	2	186	Mean (SD): 20.4 (1.8)	77 (40.7)	HADS-D ≥8
Newbury-Birch et al, ²⁰⁴ 2001	UK	1995, 1998	5	114	NR	38 (33.3)	HADS-D ≥8
Quince et al, ²⁰⁶ 2012	UK	2007-2010	1-6	2155	NR	122 (43.2)	HADS-D ≥8
Guthrie et al, ²⁰¹ 1998	UK	NR	1	172	NR	88 (51.2)	GHQ-12 ≥4
Pickard et al, ¹³⁵ 2000	UK	NR	2	136	NR	46 (33.8)	HADS-D ≥8

(continued)

Table 1. Selected Characteristics of the 183 Studies of Depression or Depressive Symptoms^a (continued)

Source	Country	Survey Years	Year of Training	No. of Students	Age, y	Men, No. (%)	Instrument and Cutoff Score
Herzog et al, ⁸⁶ 1987	US	1985	1-2	200	Mean (range): 23.1 (19-31)	NR	BDI ≥10
Hendryx et al, ⁸⁵ 1991	US	1988	1	110	Mean (SD): 24.1 (3.1)	70 (63.6)	BDI ≥10
Givens and Tjia, ⁷⁸ 2002	US	1994	1-2	194	NR	83 (43)	BDI-SF ≥8
Thomas et al, ¹⁶⁴ 2007	US	2004	1-4	535	NR	248 (45.4)	PRIME-MD
Dyrbye et al, ⁷² 2006	US	2004	NR	545	NR	245 (45)	PRIME-MD
Shah et al, ¹⁴⁹ 2009	US	2005	1-4	2683	Mean (SD): 26 (3.2)	1076 (40)	CES-D ≥19
Dyrbye et al, ⁷¹ 2007	US	2006	1-4	1691	NR	777 (46)	PRIME-MD
Smith et al, ¹⁵⁹ 2011	US	2008	1-5	480	Mean (range): 26.3 (18-51)	480 (100)	CES-D ≥16
Smith et al, ¹⁵⁸ 2010	US	2008	1-5	844	Mean (SD): 25.7 (4.1)	844 (100)	CES-D ≥16
Shindel et al, ¹⁵⁵ 2011	US	2008	1-5	1241	Mean (SD): 25.4 (3.4)	0	CES-D ≥16
Schwenk et al, ¹⁴⁶ 2010	US	2009	1-4	504	NR	210 (41.6)	PHQ-9 ≥10
Wimsatt et al, ¹⁷⁵ 2015	US	2009	1-4	505	NR	210 (41.6)	PHQ-9 ≥10
Dyrbye et al, ⁶⁹ 2010	US	2009	1-4	2661	NR	1352 (51.4)	PRIME-MD
Chang et al, ⁵⁹ 2012	US	2010	1-3	364	NR	160 (44)	PRIME-MD
Jackson et al, ⁹⁶ 2016	US	2012	1-4	4354	Median (range): 25 (22-32)	1957 (45.3)	PRIME-MD
Dyrbye et al, ⁶⁸ 2015	US	2012	2-4	870	NR	442 (50.9)	PRIME-MD
Thompson et al, ¹⁶⁶ 2016	US	2013	1-4	153	NR	75 (46.6)	PHQ-9 ≥10
Gold et al, ⁸⁰ 2015	US	2013	1-5	183	NR	79 (43.2)	PRIME-MD
Lapinski et al, ¹⁰⁹ 2016	US	2014	1-4	1294	NR	681 (52.6)	PHQ-9 ≥5
Zoccolillo et al, ¹⁸³ 1986	US	1982-1984	1-2	304	NR	NR	BDI ≥10
Vitaliano et al, ²⁰⁸ 1988	US	1984-1985	1	312	Mean (SD): 25.6 (3.5)	196 (63)	BDI ≥5
Rosal et al, ²⁰⁷ 1997	US	1987-1993	2	171	NR	140 (51)	CES-D ≥80th percentile
Camp et al, ¹⁹⁸ 1994	US	1991-1993	1	232	NR	153 (65.9)	Zung-SDS ≥50
Mosley et al, ¹²³ 1994	US	1992-1993	3	69	Mean (range): 26 (24-37)	47 (68)	CES-D ≥16
Levine et al, ²⁰² 2006	US	2000-2003	2	330	NR	NR	BDI ≥8
Tjia et al, ¹⁶⁸ 2005	US	2001-2002	1-4	322	Mean (SD): 25.3 (2.6)	175 (54.4)	BDI-SF ≥8
Thompson et al, ¹⁶⁵ 2010	US	2002-2003	3	44	NR	NR	CES-D ≥16
Goebert et al, ⁷⁹ 2009	US	2003-2004	1-4	1184	NR	NR	CES-D ≥16
Dyrbye et al, ⁷⁰ 2011	US	2006, 2007, 2009	4	1428	NR	NR	PRIME-MD
Haglund et al, ¹⁰ 2009	US	2006-2007	3	101	Mean (SD): 25.4 (2.2)	47 (47)	BDI-II ≥14
Dyrbye et al, ⁷³ 2008	US	2006-2007	1-4	2228	NR	1159 (51.6)	PRIME-MD
Ghodasara et al, ⁷⁷ 2011	US	2008-2009	1-3	301	NR	154 (51)	BDI-II ≥14
Hardeman et al, ⁸³ 2015	US	2010-2011	1	3149	NR	1592 (49.4)	PROMIS-T >60
Ludwig et al, ²⁰³ 2015	US	2010-2014	3	336	NR	NR	CES-D >16
Dyrbye et al, ⁷⁴ 2014	US	2011-2012	1-4	4402	Median: 25	1972 (45.1)	PRIME-MD
Wolf and Rosenstock, ¹⁷⁶ 2016	US	2012-2013	1-4	130	NR	NR	PRIME-MD
Mousa et al, ¹²⁴ 2016	US	2013-2014	1-4	336	NR	NR	PRIME-MD
Clark and Zeldow, ¹⁹⁹ 1988	US	NR	2	110	Mean (SD): 23.6 (2.9)	80 (73)	BDI ≥8
MacLean et al, ¹¹² 2016	US	NR	1-4	385	NR	NR	PRIME-MD
Chandavarkar et al, ⁵⁸ 2007	US	NR	1-4	427	NR	145 (34)	BDI-II ≥21
Zeldow et al, ¹⁸² 1987	US	NR	NR	99	Mean: 25.4	67 (67.7)	BDI-II ≥14
Smith et al, ¹⁵⁷ 2007	US	NR	NR	438	Mean (SD): 24.8 (2.8)	318 (72.6)	BDI ≥10

Abbreviations: ADS-K, General Depression Scale Short Form (in German); AKUADS, Aga Khan University Anxiety and Depression Scale; BDI, Beck Depression Inventory; BDI-SF, BDI Short Form; BSI-DEP, Brief Symptom Inventory Depression; CES-D, Center for Epidemiological Studies Depression Scale; DASS, Depression Anxiety Stress Scale; *DSM-IV*, *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*; DSP, Derogatis Stress Profile; EST-Q, Emotional State Questionnaire; GHQ, General Health Questionnaire; HADS-D, Hospital Anxiety and Depression Scale; HRSRS, Health-Related Self-Reported Scale; K-10, Kessler Psychological Distress Scale; KADS, Kutcher Adolescent Depression Scale; MDI, Major Depression Inventory; MINI, Mini

International Neuropsychiatric Interview; MMPI-D, Minnesota Multiphasic Personality Inventory-Depression Scale; NR, not reported; PHQ-9, 9-item Patient Health Questionnaire; PRIME-MD, Primary Care Evaluation of Mental Disorders; PROMIS-T, Patient-Reported Outcomes Measurement Information System; QIDS, Quick Inventory of Depressive Symptomatology; SCL-90, 90-item Symptom Checklist; TDI, Thai Depression Inventory; UAE, United Arab Emirates; UK, United Kingdom; US, United States; Zung-SDS, Zung Self-Rating Depression Scale; Zung-SF, Zung-SDS Short Form.

^a Studies are ordered alphabetically by country and then by year of survey.

Table 2. Selected Characteristics of the 24 Studies of Suicidal Ideation^a

Source	Country	Survey Years	Year of Training	No. of Students	Age, y	Men, No. (%)	Instrument and Cutoff Score or Description ^b
de Melo Cavestro and Rocha, ⁶⁵ 2006	Brazil	2003	1-6	213	Mean (SD): 23.1 (2.3)	109 (51.2)	MINI
Alexandrino-Silva et al, ³⁴ 2009	Brazil	2006-2007	1-6	336	Mean (SD): 22.4 (2.5)	105 (31)	BSI >0
Chen et al, ¹⁸⁸ 2004	China	2002	2-3	892	Mean (SD): 17.5 (0.4)	0	Suicidal ideation over past 12 mo
Wan et al, ⁴ 2012	China	2010	1-5	4063	Mean (SD): 20.5 (1.1)	1895 (46.6)	Suicidal ideation over past 12 mo
Sobowale et al, ¹⁶⁰ 2014	China	2012	2-3	348	NR	NR	Suicidal ideation over past 2 wk (PHQ-9)
Ahmed et al, ¹⁸⁵ 2016	Egypt	2016	NR	612	Mean (SD): 21.2 (1.6)	190 (31)	BSI >24
Okasha et al, ¹⁹² 1981	Egypt	1978-1979	5	516	NR	NR	Suicidal ideation over past 12 mo
Alem et al, ¹⁸⁶ 2005	Ethiopia	2001	NR	273	NR	227 (83.2)	Suicidal ideation over past 1 mo
Wege et al, ¹⁷⁴ 2016	Germany	2012-2013	1	590	Mean (SD): 21.1 (3.9)	177 (29.9)	Suicidal ideation over past 2 wk (PHQ-9)
Tin et al, ¹⁶⁷ 2015	Malaysia	2013	1-5	517	NR	188 (35)	SBQ-R ≥7
Eskin et al, ¹⁸⁹ 2011	Multiple	NR	1-6	646	Mean: 21.4	353 (54.6)	Suicidal ideation over past 12 mo
Menezes et al, ¹⁹¹ 2012	Nepal	2010	2-3	206	Mean (SD): 21 (1.7)	112 (54.4)	Suicidal ideation over past 12 mo (GHQ-28)
Tyssen et al, ¹⁹⁴ 2001	Norway	1993-1994	6	522	Mean (SD): 28 (2.8)	224 (43)	Suicidal ideation over past 12 mo (Paykel Inventory)
Osama et al, ⁵ 2014	Pakistan	2013	1-5	331	Mean (SD): 20.7 (1.7)	135 (41.2)	Suicidal ideation over past 12 mo (GHQ-28)
Khokher and Khan, ¹⁹⁰ 2005	Pakistan	NR	1-5	217	Mean: 22.6	96 (44.2)	Suicidal ideation over past 12 mo (GHQ-28)
Wallin and Runeson, ¹⁹⁵ 2003	Sweden	1998	1, 5	305	Mean: 27.4	127 (41.6)	Suicidal ideation over past 12 mo
Dahlin et al, ⁶² 2005	Sweden	2001-2002	1, 3, 6	296	Mean (range): 26.1 (18-44)	126 (39.8)	Suicidal ideation over past 12 mo (Meehan Inventory)
Amiri et al, ¹⁸⁷ 2013	United Arab Emirates	NR	1-6	115	Mean (SD): 20.7 (2.1)	47 (40.9)	Suicidal ideation over past 12 mo
Thompson et al, ¹⁶⁵ 2010	US	2002-2003	3	43	NR	NR	Suicidal ideation over past 2 wk (PRIME-MD)
Goebert et al, ⁷⁹ 2009	US	2003-2004	1-4	1215	NR	NR	Suicidal ideation over past 2 wk (PRIME-MD)
Dyrbye et al, ⁷³ 2008	US	2006-2007	1-4	2230	NR	1159 (51.6)	Suicidal ideation over past 12 mo (Meehan Inventory)
Dyrbye et al, ⁷⁴ 2014	US	2011-2012	1-4	4032	Median: 25	1972 (45.1)	Suicidal ideation over past 12 mo (Meehan Inventory)
MacLean et al, ¹¹² 2016	US	NR	1-4	385	NR	NR	Suicidal ideation over past 12 mo (Meehan Inventory)
Tran et al, ¹⁹³ 2015	Vietnam	2009	1, 3, 5	2099	Mean (range): 21.5 (18-30)	1052 (50.1)	Suicidal ideation over past 12 mo

Abbreviations: BSI, Beck Scale for Suicidal Ideation; GHQ, General Health Questionnaire; MINI, Mini International Neuropsychiatric Interview; NR, not reported; PHQ-9, 9-item Patient Health Questionnaire; PRIME-MD, Primary Care Evaluation of Mental Disorders; SBQ-R, Revised Suicidal Behaviors Questionnaire; US, United States.

^a Studies are ordered alphabetically by country and then by year of survey.

^b Studies for which a specific instrument is not specified used variably worded short form screening instruments.

determination of screening instrument validity appear in eMethods 2 in the [Supplement](#)), thoroughness of descriptive statistics reporting, or total Newcastle-Ottawa score ($P > .05$ for all comparisons).

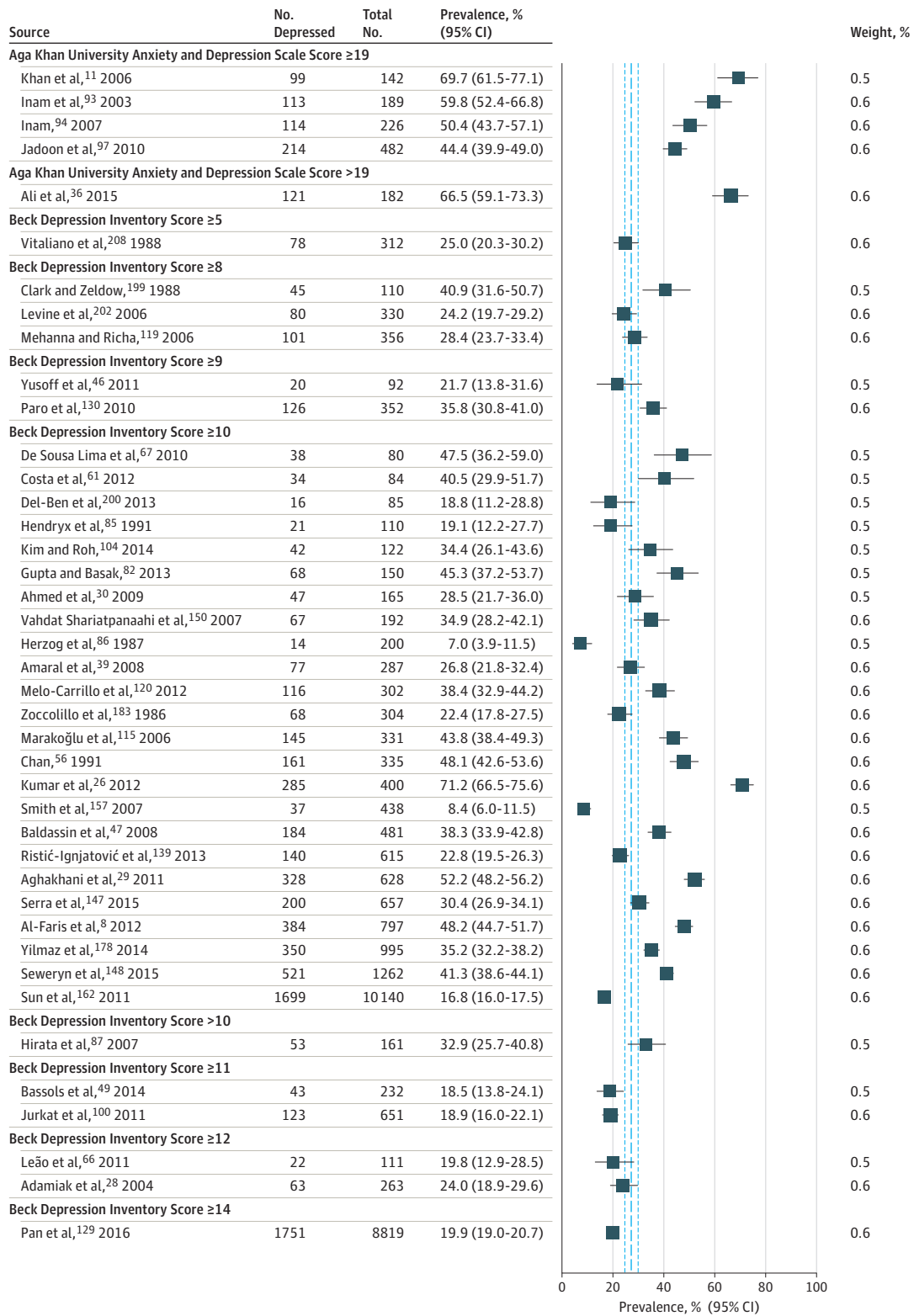
Heterogeneity Within Depression Screening Instruments

To identify potential sources of heterogeneity independent of assessment modality, heterogeneity was examined within subgroups of studies using common instruments when at least 6 studies were available (complete results appear in eTable 4 in the [Supplement](#)). No significant differences between cross-sectional and longitudinal studies were observed within any instruments when at least 3 studies were in each comparator subgroup.

Heterogeneity was partially accounted for by country with US studies yielding lower depression or depressive symptom prevalence estimates than non-US studies among the 24 studies using the BDI and a cutoff score of 10 or greater (13.0% vs 37.5%, respectively; $Q = 12.7, P < .001$) and the 13 studies using the Center for Epidemiological Studies Depression Scale (CES-D) and a cutoff score of 16 or greater (34.4% vs 50.3%; $Q = 3.8, P = .05$). However, this difference was not seen among other instruments.

Level of training did not significantly contribute to between-study heterogeneity among any of the examined instruments. Year of baseline survey significantly contributed to observed statistical heterogeneity among 3 instruments,

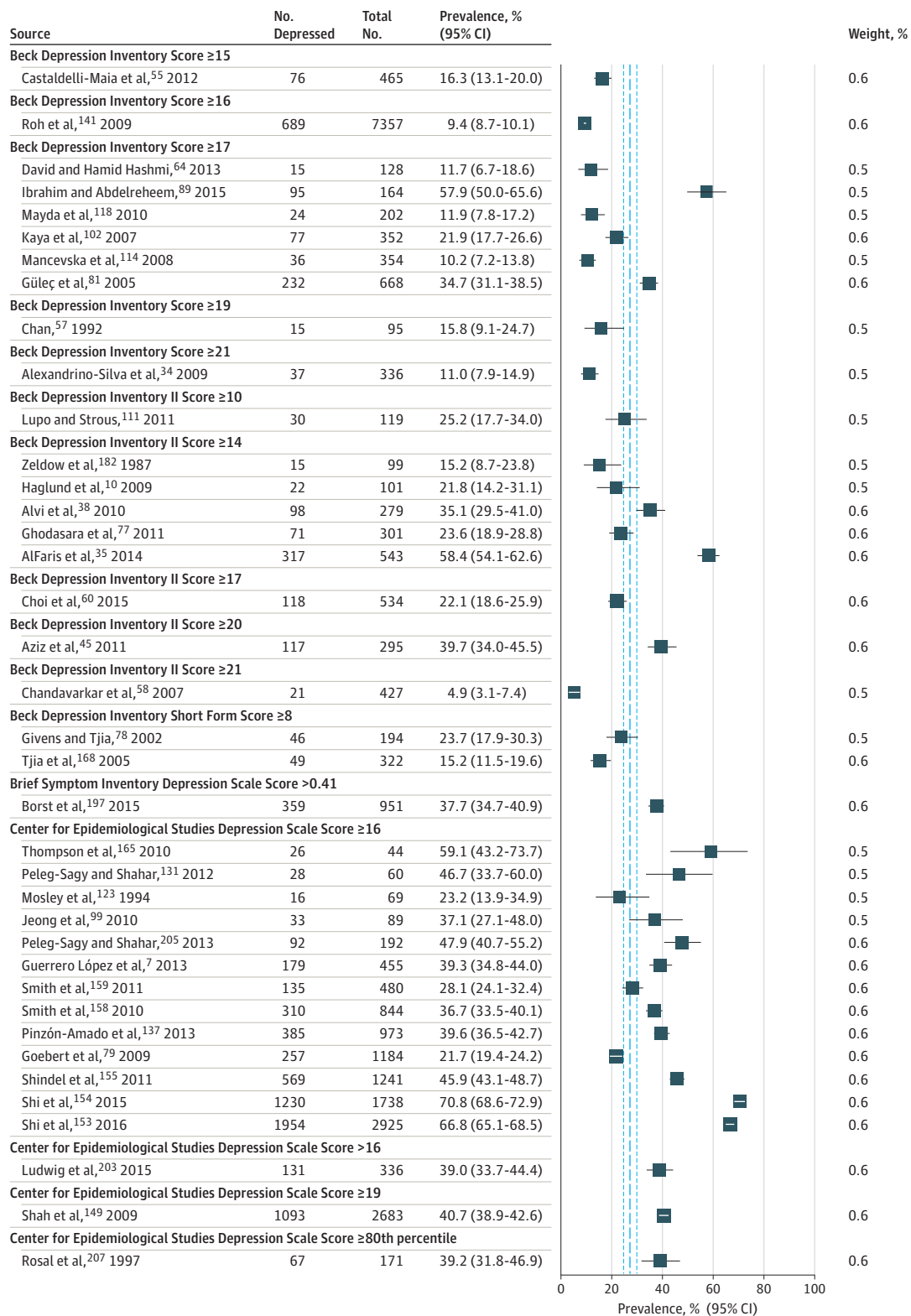
Figure 2. Meta-analysis by Scores on the Aga Khan University Anxiety and Depression Scale and the Beck Depression Inventory



The vertical dashed lines indicate the pooled summary estimate (95% CI) for all studies in Figures 2-6: 27.2% (37 933/122 356 individuals); 95% CI, 24.7%-29.9%; $I^2 = 98.9\%$, $\tau^2 = 0.78$, $P < .001$. The area of each square is proportional to the inverse variance of the estimate. Horizontal lines indicate

95% confidence intervals of the estimate. The studies in Figures 2-6 are ordered alphabetically by screening instrument and then sorted by increasing sample size within each instrument.

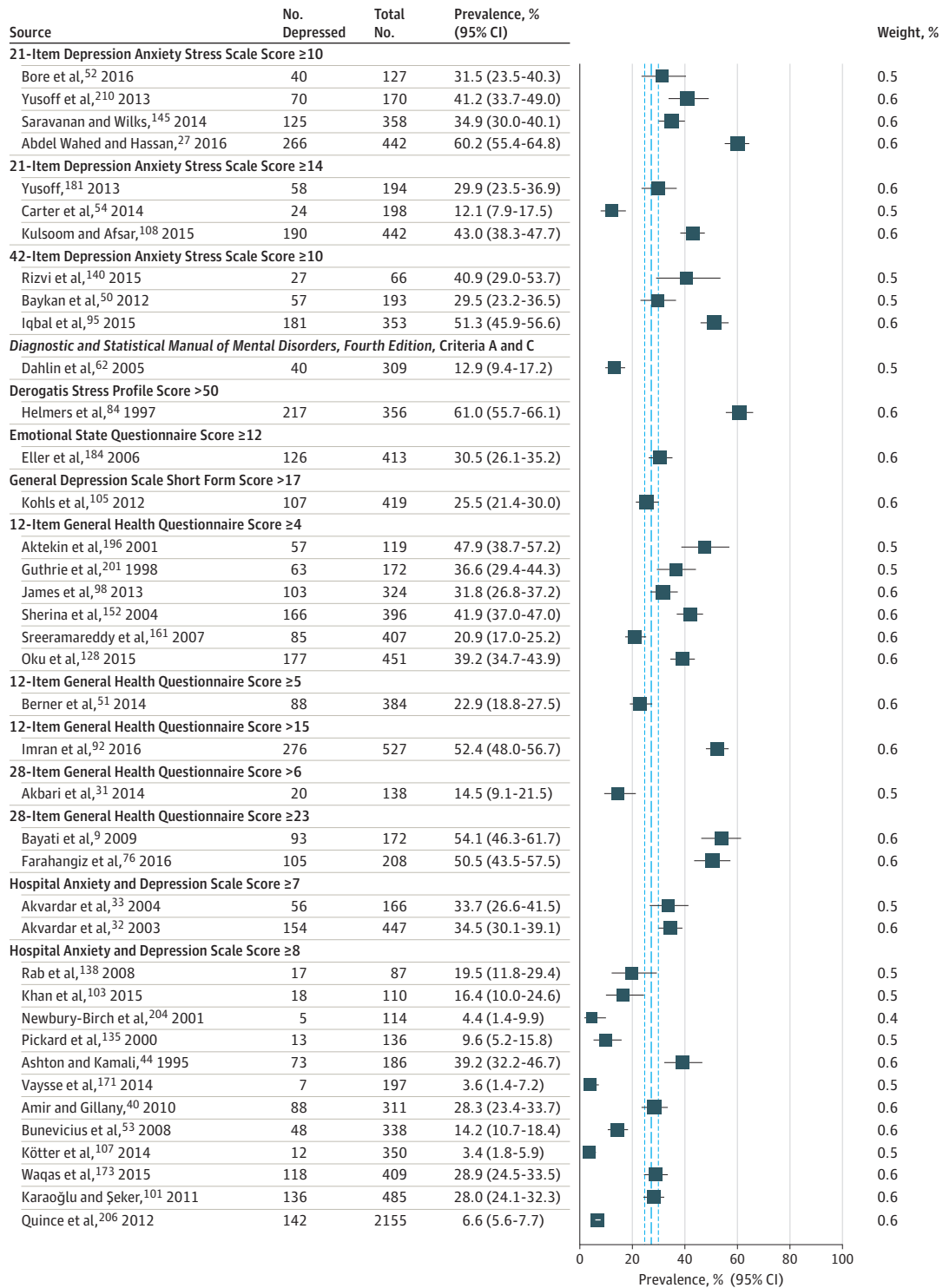
Figure 3. Meta-analysis by Scores on the First, Second, and Short Form Versions of the Beck Depression Inventory, Brief Symptom Inventory Depression Scale, and the Center for Epidemiological Studies Depression Scale



The vertical dashed lines indicate the pooled summary estimate (95% CI) for all studies in Figures 2-6: 27.2% (37 933/122 356 individuals); 95% CI, 24.7%-29.9%; $I^2 = 98.9%$, $\tau^2 = 0.78$, $P < .001$. The area of each square is proportional to the in-

verse variance of the estimate. Horizontal lines indicate 95% confidence intervals of the estimate. The studies in Figures 2-6 are ordered alphabetically by screening instrument and then sorted by increasing sample size within each instrument.

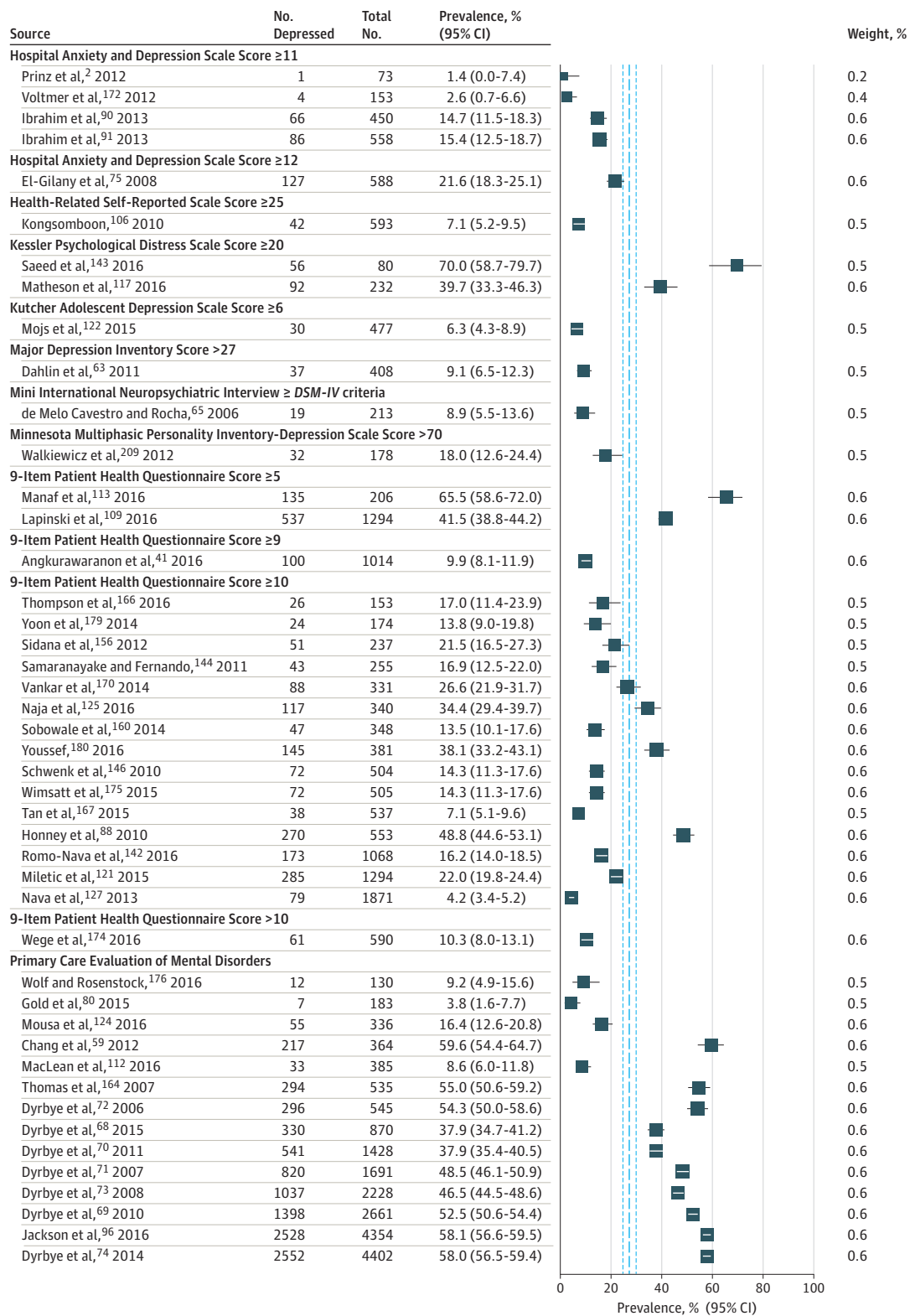
Figure 4. Meta-analysis by Scores on the Depression Anxiety Stress Scale, *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*, Criteria A and C, Derogatis Stress Profile, Emotional State Questionnaire, General Depression Scale Short Form, General Health Questionnaire, and the Hospital Anxiety and Depression Scale



The vertical dashed lines indicate the pooled summary estimate (95% CI) for all studies in Figures 2-6: 27.2% (37 933/122 356 individuals); 95% CI, 24.7%-29.9%; $I^2 = 98.9%$; $\tau^2 = 0.78$, $P < .001$. The area of each square is proportional to the inverse variance of the estimate. Horizontal lines indicate

95% confidence intervals of the estimate. The studies in Figures 2-6 are ordered alphabetically by screening instrument and then sorted by increasing sample size within each instrument.

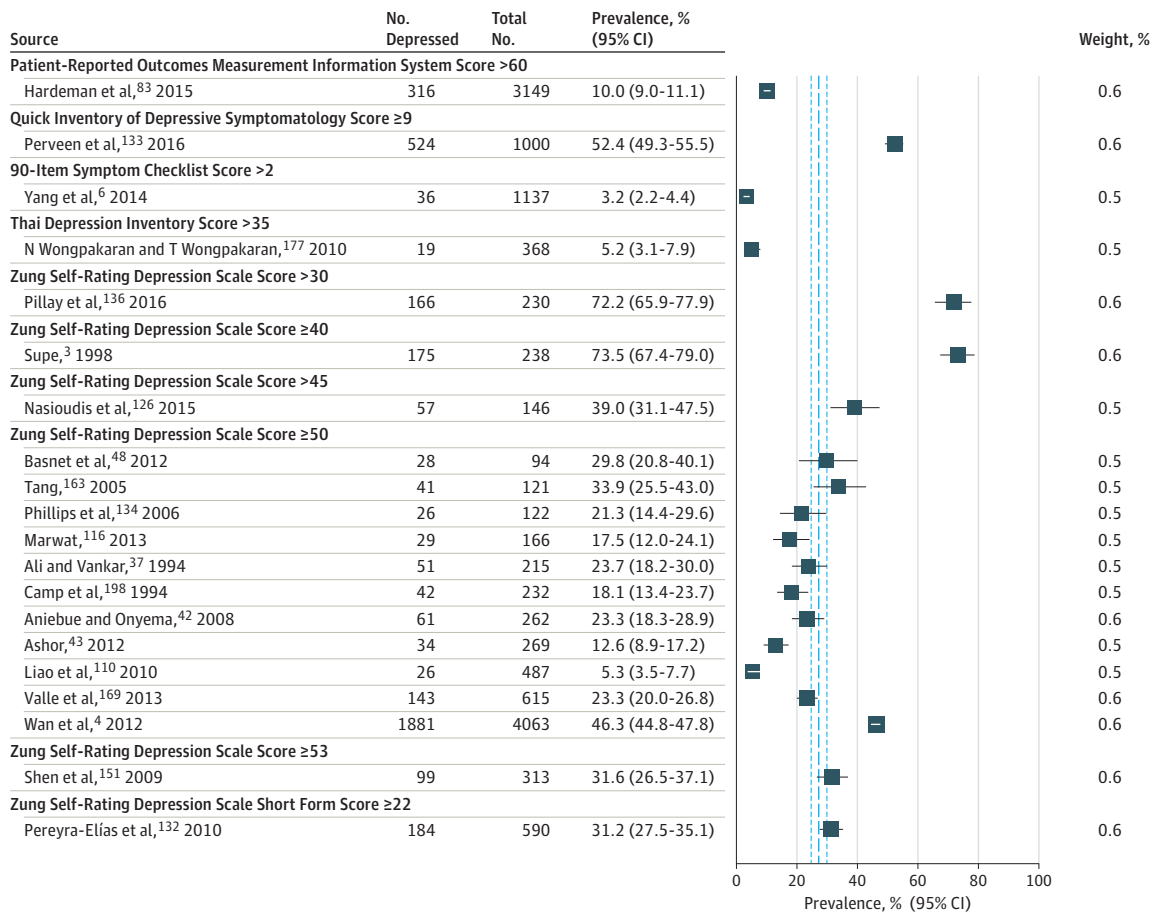
Figure 5. Meta-analysis by Scores on Several Scales



The vertical dashed lines indicate the pooled summary estimate (95% CI) for all studies in Figures 2-6: 27.2% (37 933/122 356 individuals); 95% CI, 24.7%-29.9%; $I^2 = 98.9\%$, $\tau^2 = 0.78$, $P < .001$. The area of each square is proportional to the inverse variance of the estimate. Horizontal lines indicate

95% confidence intervals of the estimate. The studies in Figures 2-6 are ordered alphabetically by screening instrument and then sorted by increasing sample size within each instrument. *DSM-IV, Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition.*

Figure 6. Meta-analysis by Scores on the Patient-Reported Outcomes Measurement Information System, Quick Inventory of Depressive Symptomatology, 90-Item Symptom Checklist, Thai Depression Inventory, and the Zung Self-Rating Depression Scale



The vertical dashed lines indicate the pooled summary estimate (95% CI) for all studies in Figures 2-6: 27.2% (37 933/122 356 individuals); 95% CI, 24.7%-29.9%; $I^2 = 98.9\%$, $\tau^2 = 0.78$, $P < .001$. The area of each square is proportional to the inverse variance of the estimate. Horizontal lines indicate

95% confidence intervals of the estimate. The studies in Figures 2-6 are ordered alphabetically by screening instrument and then sorted by increasing sample size within each instrument.

although the results were inconsistent (ie, 2 analyses suggested that depression was increasing with time, whereas a third suggested it was decreasing). Age and sex were not significantly associated with depression prevalence among any instruments.

Analysis of Longitudinal Studies

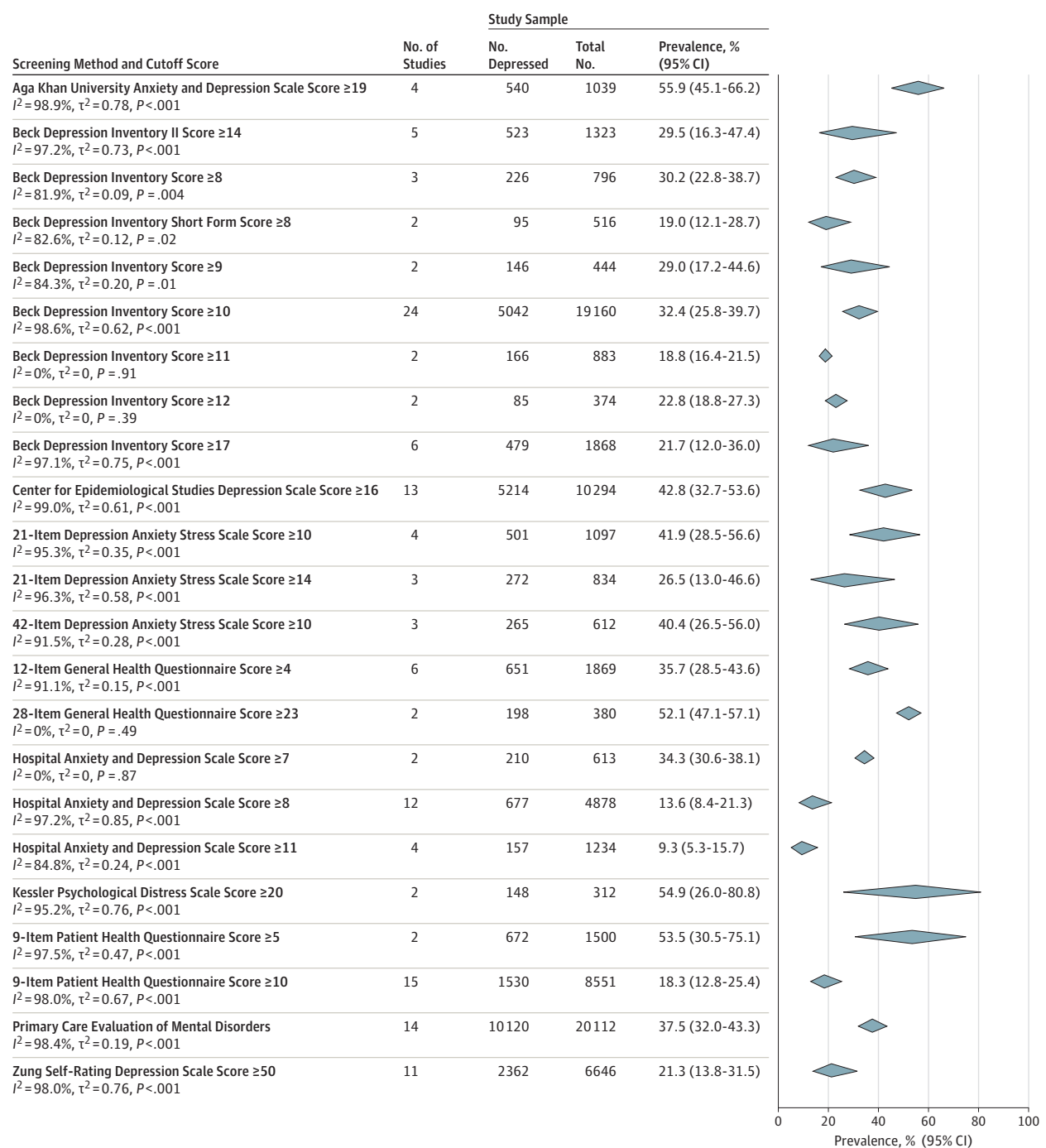
The temporal relationship between exposure to medical school and depressive symptoms was assessed in an analysis of 9 longitudinal studies that measured depressive symptoms before and during medical school (Table 3). Because studies used different assessment instruments, the relative change in depressive symptoms was calculated for each study individually (ie, follow-up prevalence divided by baseline prevalence) and then the relative changes derived from the individual studies were examined. Overall, the median absolute increase in depressive symptoms was 13.5% (range, 0.6%-35.3%) following the onset of medical training.

Prevalence of Suicidal Ideation Among Medical Students

In an analysis of 24 studies, the crude summary prevalence of suicidal ideation, variably reported as having occurred over the past 2 weeks to the past 12 months, was 11.1% (2043/21 002 individuals; 95% CI, 9.0%-13.7%), with significant evidence of between-study heterogeneity ($Q = 547.1$, $\tau^2 = 0.32$, $I^2 = 95.8\%$, $P < .001$) (Figure 10). The prevalence estimates reported by the individual studies ranged from 4.9% to 35.6%. Sensitivity analysis showed that no individual study affected the overall pooled estimate by more than 1.9% (eTable 5 in the Supplement).

To further characterize the range of the suicidal ideation prevalence estimates identified, stratified meta-analyses were performed by screening instrument and cutoff score. Summary prevalence estimates ranged from 7.4% (69/938 individuals [95% CI, 5.9%-9.2%]; $Q = 0.01$, $\tau^2 = 0$, $I^2 = 0\%$) over the past 2 weeks for studies using the 9-item Patient Health Questionnaire (PHQ-9) to 24.2% (208/754 individuals

Figure 7. Meta-analyses of the Prevalence of Depression or Depressive Symptoms Among Medical Students Stratified by Screening Instrument and Cutoff Score



Pooled summary estimates are ordered alphabetically by screening instrument. The individual studies contributing to each summary estimate are reported in Figures 2 through 6. The area of each diamond is proportional to the inverse

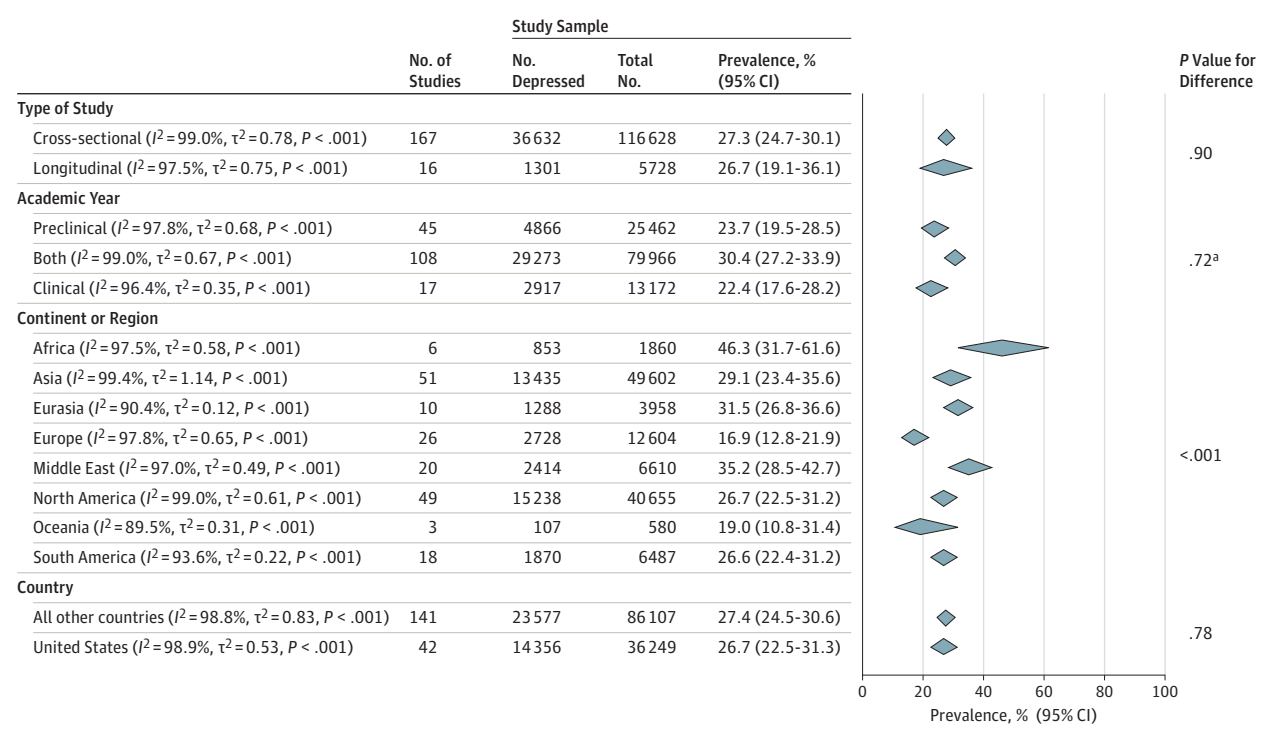
variance of the estimate. Horizontal extremes of the diamonds indicate 95% CIs of the estimate.

[95% CI, 13.0%-40.5%]; $Q = 37.2$, $\tau^2 = 0.42$, $I^2 = 94.6\%$) over the past 12 months for studies using the 28-item General Health Questionnaire.

The median prevalence of suicidal ideation over the past 12 months reported by 7 studies using variably worded

short-form screening instruments was 10.2% (723/8636 individuals [95% CI, 6.8%-15.0%]; $Q = 176.5$, $\tau^2 = 0.33$, $I^2 = 96.6\%$). Among the full set of studies, no statistically significant differences in prevalence estimates were noted by country (United States vs other countries), conti-

Figure 8. Meta-analyses of the Prevalence of Depression or Depressive Symptoms Among Medical Students Stratified by Study-Level Characteristics



The area of each diamond is proportional to the inverse variance of the estimate. Horizontal extremes of the diamonds indicate 95% CIs of the estimate.

^a Comparison of studies reporting only on preclinical students with those studies reporting only on clinical students.

ment or region, level of training, baseline survey year, average age, proportion of male study participants, or total Newcastle-Ottawa score ($P > .05$ for all comparisons). Within-instrument heterogeneity was not examined because there were not enough studies using identical screening instruments (≤ 4 for each assessment modality), precluding meaningful analysis.

Assessment of Publication Bias

Visual inspection of the funnel plot of studies reporting on depression or depressive symptoms revealed significant asymmetry (eFigure 2 in the Supplement). There was evidence of publication bias, with smaller studies yielding more extreme prevalence estimates ($P = .001$ using the Egger test). The funnel plot of studies reporting on suicidal ideation revealed minimal asymmetry (eFigure 3 in the Supplement), suggesting the absence of significant publication bias ($P = .49$ using the Egger test).

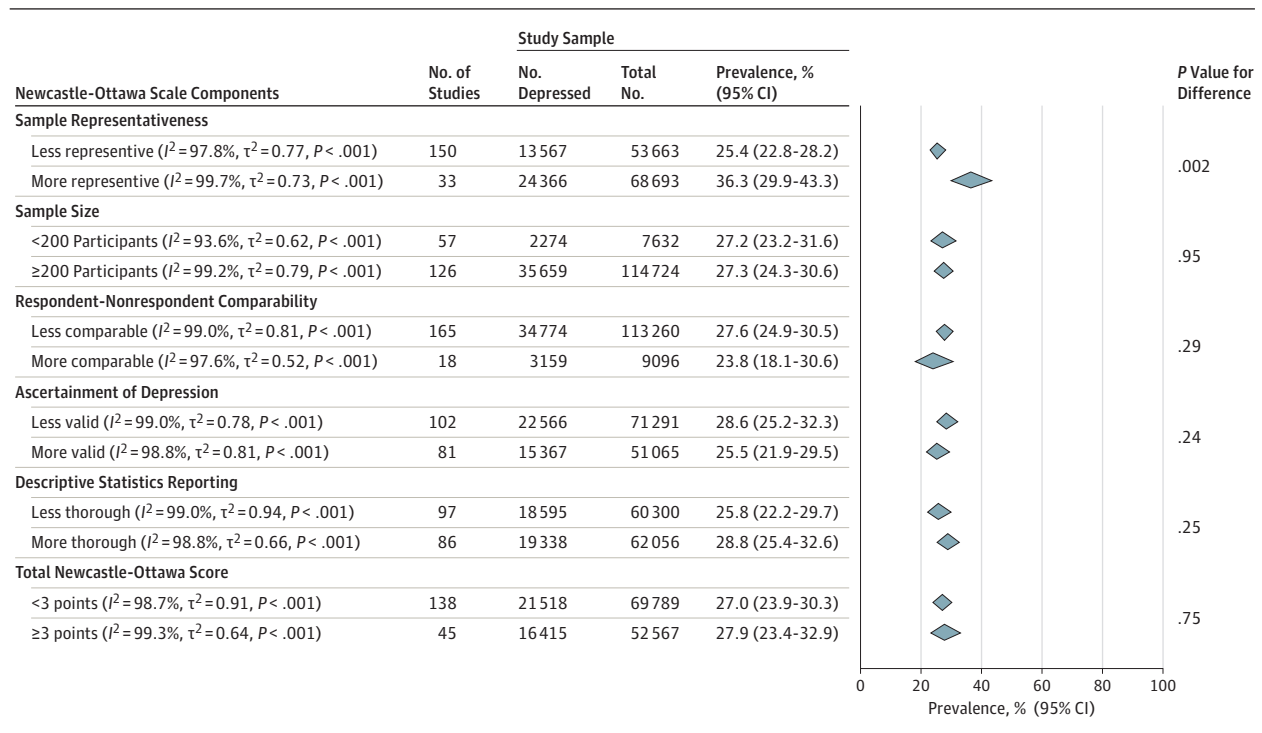
Discussion

This systematic review and meta-analysis of 195 studies involving 129 123 medical students in 47 countries demonstrated that 27.2% (range, 9.3%-55.9%) of students screened positive for depression and that 11.1% (range, 7.4%-24.2%) reported suicidal ideation during medical school. Only 15.7% of students who screened positive for depression

reportedly sought treatment. These findings are concerning given that the development of depression and suicidality has been linked to an increased short-term risk of suicide as well as a higher long-term risk of future depressive episodes and morbidity.^{211,212}

The present analysis builds on recent work demonstrating a high prevalence of depression among resident physicians, and the concordance between the summary prevalence estimates (27.2% in students vs 28.8% in residents) suggests that depression is a problem affecting all levels of medical training.^{13,213} Taken together, these data suggest that depressive and suicidal symptoms in medical trainees may adversely affect the long-term health of physicians as well as the quality of care delivered in academic medical centers.²¹⁴⁻²¹⁶

When interpreting these findings, it is important to recognize that the data synthesized in this study were almost exclusively derived from self-report inventories of depressive symptoms that varied substantially in their sensitivity and specificity for diagnosing major depressive disorder (eTable 6 in the Supplement).²¹⁷ Instruments such as the PHQ-9 have high sensitivity and specificity for diagnosing major depression, whereas others such as the Primary Care Evaluation of Mental Disorders (PRIME-MD) have low specificity and should be viewed as screening tools. Although these self-report measures of depressive symptoms have limitations, they are essential tools for accurately measuring depression in medical trainees because they

Figure 9. Meta-analyses of the Prevalence of Depression or Depressive Symptoms Among Medical Students Stratified by Newcastle-Ottawa Scale Components and Total Score

Full details regarding Newcastle-Ottawa risk of bias scoring are provided in eMethods 2 in the Supplement. Component scores for all individual studies are presented in eTable 2 in the Supplement. The area of each diamond is

proportional to the inverse variance of the estimate. Horizontal extremes of the diamonds indicate 95% CIs of the estimate.

protect anonymity in a manner that is not possible through formal diagnostic interviews.²¹⁸ To control for the differences in these inventories, we stratified our analyses by survey instrument and cutoff score, identifying a range of estimates not captured in another evidence synthesis.²¹⁹

The prevalence of depressive symptoms among medical students in this study was higher than that reported in the general population.²²⁰⁻²²² For example, the National Institute of Mental Health study of behavioral health trends in the United States, including 67 500 nationally representative participants, found that the 12-month prevalence of a major depressive episode was 9.3% among 18- to 25-year-olds and 7.2% among 26- to 49-year-olds.²²⁰ In contrast, the BDI, CES-D, and PHQ-9 summary estimates obtained in the present study were between 2.2 and 5.2 times higher than these estimates. These findings suggest that depressive symptom prevalence is substantially higher among medical students than among individuals of similar age in the general population.

How depression levels in medical students compare with those in nonmedical undergraduate students and professional students is unclear. One review concluded that depressive symptom prevalence did not statistically differ between medical students and nonmedical undergraduate students.²²³ However, this conclusion may be confounded because the analysis did not control for assessment modality and did not include a comprehensive or representative

set of studies (only 12 studies and 4 studies exclusively composed of medical students and nonmedical students, respectively). Two large, representative epidemiological studies have estimated that depressive symptom prevalence in nonmedical students ranges from 13.8% to 21.0%, lower than the estimates reported by many studies of medical students in the present meta-analysis.^{224,225}

Some professional students, such as law students, may not markedly differ from medical students in their susceptibility to depression, although firm conclusions cannot be drawn from the currently available data.^{226,227} Together, these findings suggest that factors responsible for depression in medical students may also be operative in other undergraduate and professional schools. The finding in the longitudinal analysis of an increase in depressive symptom prevalence with the onset of medical school suggests that it is not just that medical students (and other students) are prone to depression, but that the school experience may be a causal factor.

This analysis identified a pooled prevalence of suicidal ideation of 11.1%. Endorsement of suicidal ideation as assessed by the PHQ-9 or other similar instruments increases the cumulative risk of a suicide attempt or completion over the next year by 10- and 100-fold, respectively.²²⁸ Combined with the finding that only 15.7% of medical students who screened positive for depression sought treatment, the high prevalence of suicidal ideation underscores the need for effective preven-

Table 3. Secondary Analysis of 9 Longitudinal Studies Reporting Depression or Depressive Symptom Prevalence Estimates Both Before and During Medical School

Source ^a	Screening Instrument	Cutoff Score	Follow-up, mo	Baseline		Follow-up		Comparison			
				No. Depressed	Sample Size	Prevalence, % (95% CI)	No. Depressed	Sample Size	Prevalence, % (95% CI)	Absolute Increase, % (95% CI)	Relative Increase, Ratio (95% CI)
Walkiewicz et al, ²⁰⁹ 2012	MMPI-D	>70	12	31	178	17.4 (11.8 to 23.0)	32	178	18.0 (12.4 to 23.6)	0.6 (-7.4 to 8.5)	1.0 (0.6 to 1.8)
Quince et al, ²⁰⁶ 2012	HADS-D	≥8	12	38	665	5.7 (3.9 to 7.5)	36	429	8.4 (5.8 to 11.0)	2.7 (-0.4 to 6.1)	1.5 (0.9 to 2.4)
Levine et al, ²⁰² 2006	21-Item BDI	≥8	20	64	376	17.0 (13.2 to 20.8)	80	330	24.2 (19.6 to 28.8)	7.2 (1.3 to 13.2)	1.4 (1.0 to 2.0)
Camp et al, ¹⁹⁸ 1994	Zung-SDS	≥50	3	14	232	6.0 (2.9 to 9.1)	42	232	18.1 (13.2 to 23.1)	12.1 (6.2 to 18.0)	3.0 (1.6 to 5.6)
Vitaliano et al, ²⁰⁸ 1988	BDI	≥5	8	36	312	11.5 (8.0 to 15.0)	78	312	25.0 (20.2 to 29.8)	13.5 (7.4 to 19.4)	2.2 (1.4 to 3.3)
Clark and Zeldow, ¹⁹⁹ 1988	21-item BDI	≥8	14	11	116	9.5 (4.2 to 14.8)	24	88	27.3 (18.0 to 36.6)	17.8 (7.2 to 28.7)	2.9 (1.3 to 6.2)
Rosal et al, ²⁰⁷ 1997	CES-D	≥80th ^b	18	48	264	18.2 (13.6 to 22.9)	67	171	39.2 (31.9 to 46.5)	21.0 (12.3 to 29.6)	2.2 (1.4 to 3.3)
Aktekin et al, ¹⁹⁶ 2001	GHQ	≥4	12	21	119	17.6 (10.8 to 24.4)	57	119	47.9 (38.9 to 56.9)	30.3 (18.5 to 40.9)	2.7 (1.5 to 4.8)
Yusoff et al, ²¹⁰ 2013	DASS-21	≥10	12	10	170	5.9 (2.4 to 9.4)	70	170	41.2 (33.8 to 48.6)	35.3 (26.8 to 43.3)	7.0 (3.5 to 14.0)

Abbreviations: BDI, Beck Depression Inventory; CES-D, Center for Epidemiological Studies Depression Scale; DASS-21, 21-item Depression Anxiety Stress Scale; GHQ, General Health Questionnaire; HADS-D, Hospital Anxiety and Depression Scale; MMPI-D, Minnesota Multiphasic Personality Inventory-Depression Scale; Zung-SDS, Zung Self-Rating Depression Scale.
^a Studies are sorted by the percentage increase in depressive symptoms from baseline to the follow-up survey. The median percentage increase among the studies was 13.5%.
^b Indicates 80th percentile.

tive efforts and increased access to care that accommodate the needs of medical students and the demands of their training.

Limitations

This study has important limitations. First, the data were derived from studies that had different designs, screening instruments, and trainee demographics. The substantial heterogeneity among the studies remained largely unexplained by the variables inspected. Second, many subgroup analyses relied on unpaired cross-sectional data collected at different medical schools, which may cause confounding. Third, because the studies were heterogeneous with respect to screening inventories and student populations, the prevalence of major depression could not be determined. Fourth, the analysis relied on aggregated published data. A multicenter, prospective study using a single validated measure of depression and suicidal ideation with structured diagnostic interviews in a random subset of participants would provide a more accurate estimate of the prevalence of depression and suicidal ideation among medical students.

Future Directions

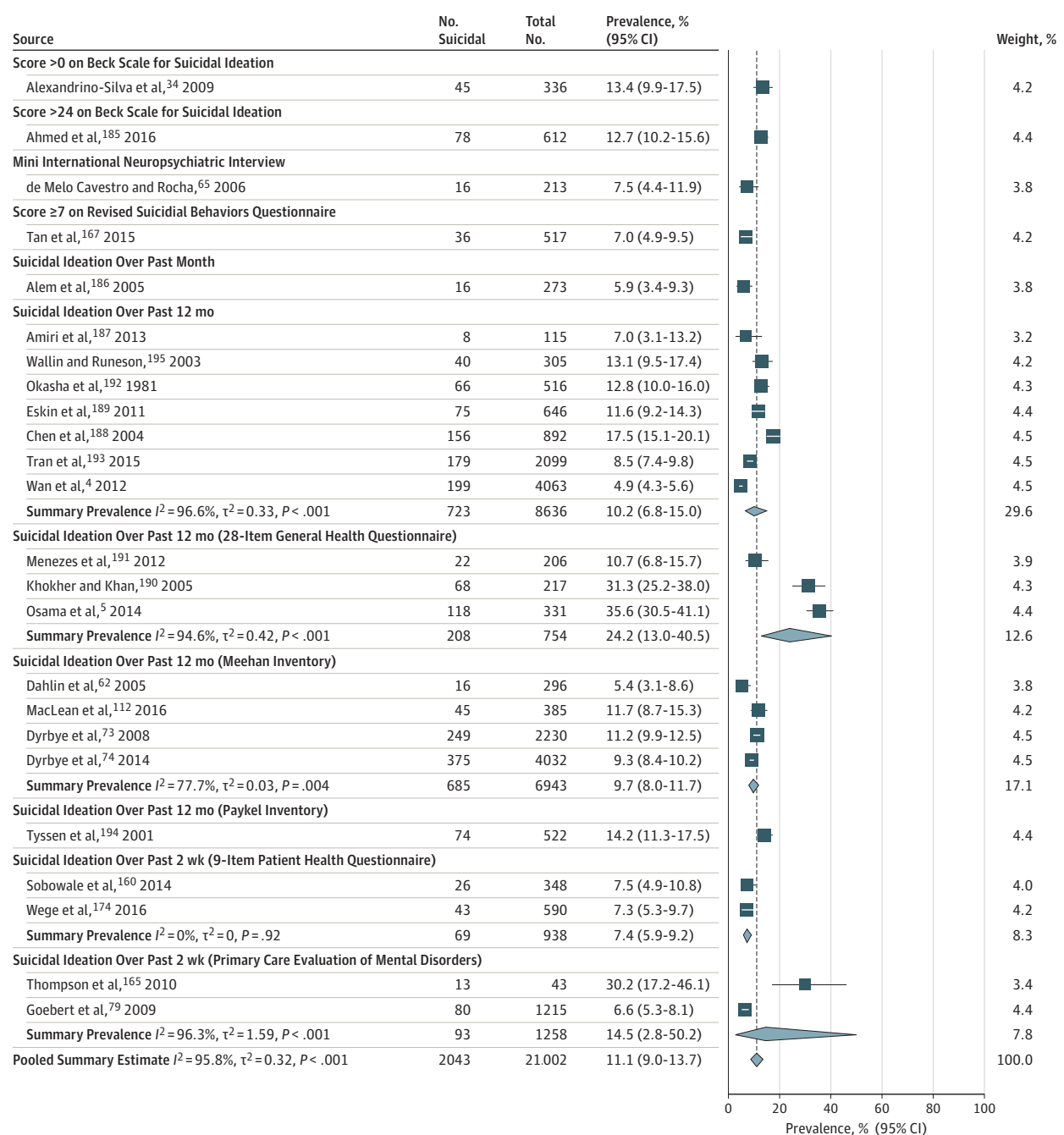
Because of the high prevalence of depressive and suicidal symptomatology in medical students, there is a need for additional studies to identify the root causes of emotional distress in this population. To provide more relevant information, future epidemiological studies should consider adopting prospective study designs so that the same individuals can be assessed over time, use commonly used screening instruments with valid cut-offs for assessing depression in the community (eg, the BDI, CES-D, or PHQ-9), screen for comorbid anxiety disorders, and completely and accurately report their data, for example, by closely following the Strengthening the Reporting of Observational Studies in Epidemiology guidelines.²²⁹

Possible causes of depressive and suicidal symptomatology in medical students likely include stress and anxiety secondary to the competitiveness of medical school.⁶² Restructuring medical school curricula and student evaluations (such as using a pass-fail grading schema rather than a tiered grading schema and fostering collaborative group learning through a “flipped-classroom” education model) might ameliorate these stresses.^{230,231} Future research should also determine how strongly depression in medical school predicts depression during residency and whether interventions that reduce depression in medical students carry over in their effectiveness when those students transition to residency.²³² Furthermore, efforts are continually needed to reduce barriers to mental health services, including addressing the stigma of depression.^{146,233}

Conclusions

In this systematic review, the summary estimate of the prevalence of depression or depressive symptoms among medical students was 27.2% and that of suicidal ideation was 11.1%. Further research is needed to identify strategies for preventing and treating these disorders in this population.

Figure 10. Meta-analysis of the Prevalence of Suicidal Ideation Among Medical Students



Contributing studies are stratified by screening modality and sorted by increasing sample size. The dotted line marks the overall summary estimate for all studies, 11.1% (2043/21002 individuals; 95% CI, 9.0%-13.7%; $Q = 5471$,

$\tau^2 = 0.32$, $I^2 = 95.8\%$, $P < .001$). The area of each square is proportional to the inverse variance of the estimate. Horizontal lines indicate 95% CIs of the estimate.

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Supplementary Online Content

Rotenstein LS, Ramos MA, Torre M, et al. Prevalence of depression, depressive symptoms, and suicidal ideation among medical students: a systematic review and meta-analysis. *JAMA*. doi:10.1001/jama.2016.17324

eMethods 1. Search strategy used in the current systematic review and meta-analysis.

eMethods 2. Modified Newcastle-Ottawa risk of bias scoring guide.

eTable 1. Summary characteristics of the studies included in this systematic review and meta-analysis.

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eTable 3. Sensitivity analysis of the prevalence of depression or depressive symptoms among medical students.

eTable 4. Within-instrument heterogeneity analyses of studies reporting on the prevalence of depression or depressive symptoms among medical students.

eTable 5. Sensitivity analysis of the prevalence of suicidal ideation among medical students.

eTable 6. Sensitivities and specificities of commonly used instruments for diagnosing major depressive disorder.

eFigure 1. Meta-analysis of the percentage of medical students who screened positive for depression and sought psychiatric or other mental health treatment.

eFigure 2. Assessment of small study effects by funnel plot for the 183 studies reporting on depression or depressive symptom prevalence.

eFigure 3. Assessment of small study effects by funnel plot for the 24 studies reporting on suicidal ideation prevalence.

eReferences

This supplementary material has been provided by the authors to give readers additional information about their work.

eMethods 1. Search strategy used in the current systematic review and meta-analysis.

Depression

1. Depress*
2. Depressed
3. Depression
4. Depression [MeSH]
5. Depressive disorder [MeSH]
6. Depressive disorder, major [MeSH]
7. Ideation
8. Major depression
9. Major depressive disorder
10. MDD
11. Sadness
12. Suicid*
13. Suicide [MeSH]
14. OR / 1 – 13

Medical students

15. Clinical student*
16. Education, medical [MeSH]
17. Education, medical, undergraduate [MeSH]
18. Med student*
19. Medical student*
20. Medical trainee*
21. Preclinical student*
22. Student doctor*
23. Student physician*
24. Undergraduate medic*
25. OR / 15 – 24

Study design

26. Cohort design
27. Cohort stud*
28. Cohort studies [MeSH]
29. Cross-sectional analysis
30. Cross-sectional design
31. Cross-sectional stud*
32. Cross-sectional studies [MeSH]
33. Epidemiologic stud*
34. Epidemiologic studies [MeSH]
35. Incidence
36. Longitudinal design
37. Longitudinal stud*
38. Meta-analy*
39. Meta-analysis [Publication Type]
40. Observational stud*
41. Population stud*
42. Prevalence
43. Prospective design
44. Prospective stud*
45. Prospective studies [MeSH]
46. Retrospective design
47. Retrospective stud*
48. Retrospective studies [MeSH]
49. Review
50. Review [Publication Type]
51. OR / 26 – 51

Combined search: #14 AND #25 AND #51

Legend: MeSH indicates Medical Subject Heading in MEDLINE

eMethods 2. Modified Newcastle-Ottawa risk of bias scoring guide.

(1) Sample representativeness:

1 point: Population contained multiple class years at multiple schools.

0 points: Population contained either a single class year, a single school, or both.

(2) Sample size:

1 point: Sample size was greater than or equal to 200 participants.

0 points: Sample size was less than 200 participants.

(3) Non-respondents:

1 point: Comparability between respondent and non-respondent characteristics was established with a satisfactory response rate.

0 points: The comparability between respondents and non-respondents was unsatisfactory, the response rate was unsatisfactory, or there was no description of the response rate or the characteristics of the responders or non-responders.

(4) Ascertainment of depression or depressive symptoms and suicidal ideation:

1 point: The study employed a commonly used measurement tool with a valid cutoff score (*e.g.*, BDI ≥ 10 , BDI-II ≥ 14 , CES-D ≥ 16 , HADS-D ≥ 8 , PHQ-9 ≥ 10 , Zung-SDS ≥ 50).

0 points: The study employed an infrequently used measurement tool, a commonly used measurement tool with an invalid cutoff score, or any tool with published sensitivity/specificity values $< 70\%$ (*e.g.*, the PRIME-MD screening instrument).

(5) Quality of descriptive statistics reporting:

1 point: The study reported descriptive statistics to describe the population (*e.g.*, age, sex, class year) with proper measures of dispersion (*e.g.*, mean, standard deviation).

0 points: The study did not report descriptive statistics, incompletely reported descriptive statistics, or did not report measures of dispersion.

Legend: The individual components listed above are summed to generate a total modified Newcastle-Ottawa risk of bias score for each study. Total scores range from 0 to 5. Figure 5 of the manuscript groups studies by the above-mentioned individual components as well as by total score. For the total score grouping, studies were judged to be of low risk of bias (≥ 3 points) or high risk of bias (< 3 points).

eTable 1. Summary characteristics of the studies included in this systematic review and meta-analysis. (Pages 2-4)

	n	%
Study Design		
Cross-sectional	17	91.8%
	9	%
Longitudinal	16	8.2%
Level of Training		
Both	11	60.0%
	7	%
Clinical	19	9.7%
Not reported	13	6.7%
Preclinical	46	23.6%
		%
Continent or Region		
Africa	9	4.6%
Asia	56	28.7%
		%
Eurasia	11	5.6%
Europe	28	14.4%
		%
Middle East	21	10.8%
		%
North America	49	25.1%
		%
Oceania	3	1.5%
South America	18	9.2%
Country		
Australia	1	0.5%
Brazil	13	6.7%
Canada	2	1.0%
Chile	1	0.5%
China	11	5.6%
Colombia	1	0.5%
Dubai	1	0.5%
Egypt	5	2.6%
Estonia	1	0.5%
Ethiopia	1	0.5%
France	1	0.5%
Germany	6	3.1%
Greece	1	0.5%
Hong Kong	2	1.0%
India	8	4.1%

Iran	5	2.6%
Iraq	1	0.5%
Israel	3	1.5%
Korea	1	0.5%
Lebanon	2	1.0%
Lithuania	1	0.5%
Macedonia	1	0.5%
Malaysia	7	3.6%
Mexico	4	2.1%
Multiple Countries	3	1.5%
Nepal	3	1.5%
Netherlands	1	0.5%
New Zealand	2	1.0%
Nigeria	2	1.0%
Norway	1	0.5%
Pakistan	15	7.7%
Panama	1	0.5%
Peru	2	1.0%
Poland	2	1.0%
Saudi Arabia	8	4.1%
Serbia	2	1.0%
South Africa	1	0.5%
South Korea	4	2.1%
Sweden	3	1.5%
Thailand	3	1.5%
Trinidad and Tobago	1	0.5%
Turkey	10	5.1%
United Arab Emirates	1	0.5%
United Kingdom	7	3.6%
United States	42	21.5%
Vietnam	1	0.5%
Depression Screening Instrument		
Aga Khan University Anxiety and Depression Scale (AKUADS)	5	2.7%
Beck Depression Inventory (BDI)	46	25.1%
Beck Depression Inventory-II (BDI-II)	9	4.9%
Beck Depression Inventory-Short Form (BDI-SF)	2	1.1%
Brief Symptom Inventory-Depression (BSI-DEP)	1	0.5%
Center for Epidemiological Studies Depression (CES-D)	16	8.7%
Depression Anxiety Stress Scale-21 (DASS-21)	7	3.8%
Depression Anxiety Stress Scale-42 (DASS-42)	3	1.6%
Derogatis Stress Profile (DSP)	1	0.5%

Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV) Criteria A and C	1	0.5%
Emotional State Questionnaire (EST-Q)	1	0.5%
General Depression Scale Short Form (ADS-K)	1	0.5%
General Health Questionnaire-12 (GHQ-12)	8	4.4%
General Health Questionnaire-28 (GHQ-28)	3	1.6%
Health-Related Self-Reported Scale (HRSRS)	1	0.5%
Hospital Anxiety and Depression Scale (HADS-D)	19	10.4%
Kessler Psychological Distress Scale (K-10)	2	1.1%
Kutcher Adolescent Depression Scale (KADS)	1	0.5%
Major Depression Inventory (MDI)	1	0.5%
Mini International Neuropsychiatric Interview (MINI)	1	0.5%
Minnesota Multiphasic Personality Inventory-Depression Scale (MMPI-D)	1	0.5%
Patient Health Questionnaire-9 (PHQ-9)	19	10.4%
Patient-Reported Outcomes Measurement Information System (PROMIS-T)	1	0.5%
Primary Care Evaluation of Mental Disorders (PRIME-MD)	14	7.7%
Quick Inventory of Depressive Symptomatology (QIDS)	1	0.5%
Symptom Checklist 90 (SCL-90)	1	0.5%
Thai Depression Inventory (TDI)	1	0.5%
Zung Self-Rating Depression Scale (Zung-SDS)	15	8.2%
Zung Self-Rating Depression Scale-Short Form (Zung-SF)	1	0.5%
Suicide Screening Instrument		
Beck Scale for Suicidal Ideation (BSI)	2	8.3%
Mini International Neuropsychiatric Interview (MINI)	1	4.2%
Suicidal Behaviours Questionnaire-Revised (SBQ-R)	1	4.2%
Suicidal ideation over past 1 month	1	4.2%
Suicidal ideation over past 12 months	7	29.2%
Suicidal ideation over past 12 months (GHQ-28)	3	12.5%
Suicidal ideation over past 12 months (Meehan)	4	16.7%
Suicidal ideation over past 12 months (Paykel)	1	4.2%
Suicidal ideation over past 2 weeks (PHQ)	2	8.3%
Suicidal ideation over past 2 weeks (PRIME-MD)	2	8.3%
Total Newcastle-Ottawa Score		
0	14	7.2%
1	50	25.6%
2	79	40.5%

			%
3		38	19.5%
4		12	6.2%
5		2	1.0%

eTable 2. Newcastle-Ottawa risk of bias scores for the 195 studies included in this systematic review and meta-analysis. (Pages 5-9)

First author, year	Representative-ness	Sample Size	Non-respondents	Ascertainment of Depression	Descriptive Statistics	Total
Abdel Wahed WY, 2016 ¹	0	1	0	0	1	2
Adamiak G, 2004 ²	0	1	0	0	0	1
Aghakhani N, 2011 ³	0	1	0	1	1	3
Ahmed I, 2009 ⁴	0	0	0	1	0	1
Ahmed SA, 2016 ⁵	1	1	0	1	1	4
Akbari V, 2014 ⁶	0	0	0	0	0	0
Aktekin M, 2001 ⁷	0	0	0	0	0	0
Akvardar Y, 2003 ⁸	1	1	0	0	1	3
Akvardar Y, 2004 ⁹	0	0	0	0	0	0
Al Faris EA, 2012 ¹⁰	0	1	0	1	1	3
Alem A, 2005 ¹¹	0	1	0	1	0	2
Alexandrino-Silva C, 2009 ¹²	0	1	0	0	1	2
AlFaris EA, 2014 ¹³	0	1	0	1	0	2
Ali FA, 2015 ¹⁴	0	0	0	0	0	0
Alvi T, 2010 ¹⁵	0	1	0	1	1	3
Amaral GF, 2008 ¹⁶	0	1	0	1	0	2
Amir M, 2010 ¹⁷	0	1	0	1	1	3
Amiri L, 2012 ¹⁸	0	0	0	1	1	2
Angkurawaranon C, 2016 ¹⁹	0	1	0	0	1	2
Aniebue PN, 2008 ²⁰	0	1	0	1	1	3
Ashor AW, 2012 ²¹	0	1	0	1	0	2
Ashton CH, 1995 ²²	0	1	0	1	1	3
Aziz NAHA, 2011 ²³	0	1	0	0	1	2
Bahri Y, 2011 ²⁴	0	0	0	0	0	0
Baldassin S, 2008 ²⁵	0	1	1	1	1	4
Basnet B, 2012 ²⁶	0	0	0	1	1	2
Bassols AM, 2014 ²⁷	0	1	0	0	1	2
Bayati A, 2009 ²⁸	0	0	0	0	1	1
Baykan Z, 2012 ²⁹	0	0	0	0	1	1
Berner JE, 2014 ³⁰	0	1	0	0	1	2
Bore M, 2016 ³¹	0	0	0	0	1	1
Borst JM, 2015 ³²	1	1	0	0	1	3
Bunevicius A, 2008 ³³	0	1	0	1	1	3
Camp DL, 1994 ³⁴	0	1	0	1	0	2
Carter FA, 2014 ³⁵	0	0	0	0	1	1

Castaldelli-Maia JM, 2012 ³⁶	0	1	0	0	0	1
Chan DW, 1991 ³⁷	0	1	1	1	1	4
Chan DW, 1992 ³⁸	0	0	1	0	0	1
Chandavarkar U, 2007 ³⁹	1	1	0	0	0	2
Chang E, 2012 ⁴⁰	0	1	0	0	0	1
Chen JQ, 2004 ⁴¹	0	1	0	1	1	3
Choi J, 2015 ⁴²	0	1	0	0	0	1
Clark DC, 1988 ⁴³	0	0	0	0	1	1
Costa EF, 2012 ⁴⁴	0	0	0	1	0	1
Dahlin M, 2005 ⁴⁵	0	1	1	0	0	2
Dahlin M, 2011 ⁴⁶	0	1	0	0	0	1
David MA, 2013 ⁴⁷	0	0	0	0	0	0
de Melo Cavestro J, 2006 ⁴⁸	0	1	0	1	1	3
de Oliveira e Sousa Leão PB, 2011 ⁴⁹	0	0	0	0	1	1
De Sousa Lima L, 2010 ⁵⁰	0	0	0	1	0	1
Del Ben CM, 2013 ⁵¹	0	0	0	1	1	2
Dyrbye LN, 2006 ⁵²	1	1	0	0	0	2
Dyrbye LN, 2007 ⁵³	1	1	0	0	0	2
Dyrbye LN, 2008 ⁵⁴	1	1	0	0	0	2
Dyrbye LN, 2010 ⁵⁵	1	1	0	0	0	2
Dyrbye LN, 2011 ⁵⁶	1	1	0	0	0	2
Dyrbye LN, 2014 ⁵⁷	1	1	0	0	0	2
Dyrbye LN, 2015 ⁵⁸	1	1	0	0	0	2
El-Gilany AH, 2008 ⁵⁹	1	1	0	0	1	3
Eller T, 2006 ⁶⁰	0	1	0	0	1	2
Eskin M, 2011 ⁶¹	1	1	0	1	1	4
Farahangiz S, 2016 ⁶²	0	1	0	0	1	2
Ghudasara SL, 2011 ⁶³	0	1	0	1	0	2
Givens JL, 2002 ⁶⁴	0	0	1	0	0	1
Goebert D, 2009 ⁶⁵	1	1	0	1	0	3
Gold JA, 2015 ⁶⁶	0	0	0	0	0	0
Guerrero Lopez JB, 2013 ⁶⁷	0	1	0	1	1	3
Gulec M, 2005 ⁶⁸	0	1	0	0	1	2
Gupta S, 2013 ⁶⁹	0	0	0	1	0	1
Guthrie E, 1998 ⁷⁰	0	0	1	0	0	1
Haglund ME, 2009 ⁷¹	0	0	0	1	1	2
Hardeman RR, 2015 ⁷²	0	1	0	0	0	1
Helmerts KF, 1997 ⁷³	0	1	0	0	1	2
Hendryx MS, 1991 ⁷⁴	0	0	0	1	1	2

Herzog DB, 1987 ⁷⁵	0	1	1	1	0	3
Hirata FC, 2007 ⁷⁶	0	0	0	0	1	1
Honney K, 2010 ⁷⁷	0	1	0	1	1	3
Ibrahim MB, 2015 ⁷⁸	0	0	0	0	0	0
Ibrahim N, 2013 ⁷⁹	0	1	0	0	1	2
Ibrahim NK, 2013 ⁸⁰	0	1	0	0	1	2
Imran N, 2016 ⁸¹	0	1	0	0	1	2
Inam SB, 2007 ⁸²	0	1	0	0	0	1
Inam SN, 2003 ⁸³	0	0	0	0	0	0
Iqbal S, 2015 ⁸⁴	0	1	0	0	1	2
Jackson ER, 2016 ⁸⁵	1	1	0	0	0	2
Jadoon NA, 2010 ⁸⁶	0	1	0	0	1	2
James D, 2013 ⁸⁷	0	1	1	0	0	2
Jeong Y, 2010 ⁸⁸	0	0	1	1	0	2
Jurkat HB, 2011 ⁸⁹	0	1	1	0	0	2
Karaoglu N, 2011 ⁹⁰	0	1	0	1	1	3
Kaya M, 2007 ⁹¹	0	1	0	0	0	1
Khan MA, 2015 ⁹²	0	0	0	1	0	1
Khan MS, 2006 ⁹³	0	0	0	0	1	1
Khokher S, 2005 ⁹⁴	0	1	0	1	0	2
Kim B, 2014 ⁹⁵	0	0	0	1	0	1
Kohls N, 2012 ⁹⁶	1	1	0	0	0	2
Kongsomboon K, 2010 ⁹⁷	0	1	0	0	0	1
Kotter T, 2014 ⁹⁸	0	1	0	1	1	3
Kulsoom B, 2015 ⁹⁹	0	1	0	0	0	1
Kumar GS, 2012 ¹⁰⁰	0	1	0	1	0	2
Lapinski J, 2016 ¹⁰¹	1	1	0	0	0	2
Levine RE, 2006 ¹⁰²	0	1	0	0	0	1
Liao Y, 2010 ¹⁰³	0	1	0	1	1	3
Ludwig AB, 2015 ¹⁰⁴	0	1	1	0	0	2
Lupo 2011 ¹⁰⁵	0	0	0	0	1	1
MacLean L, 2015 ¹⁰⁶	0	1	0	0	0	1
Manaf NA, 2016 ¹⁰⁷	0	1	0	0	1	2
Mancevska S, 2008 ¹⁰⁸	0	1	0	0	1	2
Marakoğlu K, 2006 ¹⁰⁹	0	1	0	1	1	3
Marwat MA, 2013 ¹¹⁰	0	0	0	1	0	1
Matheson KM, 2016 ¹¹¹	0	1	0	0	0	1
Mayda AT, 2010 ¹¹²	0	1	0	0	1	2
Mehanna Z, 2006 ¹¹³	0	1	0	0	0	1
Melo-Carrillo A, 2012 ¹¹⁴	0	1	0	1	0	2
Menezes RG, 2012 ¹¹⁵	0	1	0	1	1	3
Miletic V, 2015 ¹¹⁶	0	1	0	1	1	3
Mojs EH, 2015 ¹¹⁷	1	1	0	0	0	2

Mosley TH, 1994 ¹¹⁸	0	0	0	1	0	1
Mousa OY, 2016 ¹¹⁹	0	1	0	0	0	1
Naja WJ, 2016 ¹²⁰	0	1	0	1	0	2
Nasioudis, D, 2015 ¹²¹	0	0	0	0	1	1
Nava FR, 2013 ¹²²	0	1	0	1	0	2
Newbury-Birch D, 2001 ¹²³	0	0	0	1	0	1
Okasha A, 1981 ¹²⁴	0	1	0	1	0	2
Oku A, 2015 ¹²⁵	0	1	0	0	1	2
Osama M, 2014 ¹²⁶	1	1	1	1	1	5
Pan XF, 2015 ¹²⁷	1	1	0	0	1	3
Paro HB, 2010 ¹²⁸	0	1	0	0	1	2
Peleg-Sagy T, 2012 ¹²⁹	0	0	0	1	1	2
Peleg-Sagy T, 2013 ¹³⁰	1	0	0	1	1	3
Pereyra-Eliás R, 2010 ¹³¹	0	1	0	0	1	2
Perveen S, 2016 ¹³²	1	1	0	0	0	2
Phillips LC, 2006 ¹³³	0	0	1	1	0	2
Pickard M, 2000 ¹³⁴	0	0	0	1	0	1
Pillay N, 2016 ¹³⁵	0	1	0	0	0	1
Pinzón-Amado A, 2013 ¹³⁶	1	1	0	1	1	4
Prinz P, 2012 ¹³⁷	0	0	0	0	0	0
Quince TA, 2012 ¹³⁸	0	1	0	1	0	2
Rab F, 2008 ¹³⁹	0	0	0	1	1	2
Ristic-Ignjatovic D, 2013 ¹⁴⁰	0	1	0	1	1	3
Rizvi F, 2015 ¹⁴¹	1	0	0	0	1	2
Roh MS, 2009 ¹⁴²	1	1	0	0	0	2
Romo-Nava F, 2016 ¹⁴³	0	1	0	1	1	3
Rosal MC, 1997 ¹⁴⁴	0	0	0	0	0	0
Saeed AA, 2016 ¹⁴⁵	0	0	0	0	1	1
Samaranayake CB, 2011 ¹⁴⁶	0	1	0	1	0	2
Saravanan C, 2014 ¹⁴⁷	0	1	0	0	0	1
Schwenk TL, 2010 ¹⁴⁸	0	1	0	1	0	2
Serra RD, 2015 ¹⁴⁹	0	1	0	1	0	2
Seweryn M, 2015 ¹⁵⁰	1	1	0	1	0	3
Shah AA, 2009 ¹⁵¹	1	1	0	0	1	3
Shariatpanaahi MV, 2007 ¹⁵²	0	0	0	1	1	2
Shen L, 2009 ¹⁵³	0	1	0	0	0	1
Sherina MS, 2004 ¹⁵⁴	0	1	1	0	1	3
Shi M, 2015 ¹⁵⁵	1	1	0	1	1	4

Shi M, 2016 ¹⁵⁶	1	1	0	1	1	4
Shindel AW, 2011 ¹⁵⁷	1	1	0	1	1	4
Sidana S, 2012 ¹⁵⁸	0	1	0	1	0	2
Smith CK, 2007 ¹⁵⁹	0	1	0	1	1	3
Smith JF, 2010 ¹⁶⁰	1	1	0	1	1	4
Smith JF, 2011 ¹⁶¹	1	1	0	1	0	3
Sobowale K, 2014 ¹⁶²	0	1	1	1	0	3
Sreeramareddy CT, 2007 ¹⁶³	0	1	0	0	1	2
Sun L, 2011 ¹⁶⁴	1	1	0	1	1	4
Supe AN, 1998 ¹⁶⁵	0	1	0	0	0	1
Tang QS, 2005 ¹⁶⁶	0	0	0	1	0	1
Thomas MR, 2006 ¹⁶⁷	1	1	0	0	0	2
Thompson D, 2010 ¹⁶⁸	0	0	0	1	0	1
Thompson G, 2016 ¹⁶⁹	0	0	0	1	0	1
Tin TS, 2015 ¹⁷⁰	0	1	0	1	0	2
Tjia J, 2005 ¹⁷¹	0	1	0	0	1	2
Tran QA, 2015 ¹⁷²	1	1	1	1	0	4
Tyssen R, 2001 ¹⁷³	0	1	0	1	1	3
Valle R, 2013 ¹⁷⁴	0	1	0	1	1	3
Vankar JR, 2014 ¹⁷⁵	0	1	0	1	0	2
Vaysse B, 2014 ¹⁷⁶	0	0	1	1	1	3
Vitaliano PP, 1988 ¹⁷⁷	0	1	0	0	1	2
Voltmer E, 2012 ¹⁷⁸	0	0	0	0	1	1
Walkiewicz M, 2012 ¹⁷⁹	0	0	0	0	0	0
Wallin U, 2003 ¹⁸⁰	0	1	0	1	0	2
Wan YH, 2012 ¹⁸¹	1	1	1	1	1	5
Waqas A, 2015 ¹⁸²	1	1	0	1	1	4
Wege N, 2016 ¹⁸³	0	1	1	0	1	3
Wimsatt LA, 2015 ¹⁸⁴	0	1	0	1	0	2
Wolf MR, 2016 ¹⁸⁵	0	0	0	0	0	0
Wongpakaran N, 2010 ¹⁸⁶	0	1	0	0	1	2
Yang F, 2014 ¹⁸⁷	0	1	0	0	0	1
Yilmaz Y, 2014 ¹⁸⁸	0	1	0	1	1	3
Yoon S, 2014 ¹⁸⁹	0	0	0	1	1	2
Youssef FF, 2016 ¹⁹⁰	0	1	0	1	1	3
Yusoff MS, 2013 ¹⁹¹	0	0	0	0	0	0
Yusoff MS, 2013 ¹⁹²	0	0	1	0	0	1
Zeldow PB, 1987 ¹⁹³	0	0	0	1	0	1
Zoccolillo M, 1986 ¹⁹⁴	0	1	0	1	0	2
Zulfikar Ali RV, 1994 ¹⁹⁵	0	1	0	1	0	2

Legend: Studies are ordered alphabetically by first author. Full details regarding Newcastle-Ottawa risk of bias scoring are provided in eMethods 2.

eTable 3. Sensitivity analysis of the prevalence of depression or depressive symptoms among medical students. (Pages 10-16)

Study Omitted	Prevalence (%)	LCI	UCI	τ^2	I^2
Abdel Wahed WY, 2016 ¹	27.1%	24.6%	29.7%	0.77	98.9%
Adamiak G, 2004 ²	27.3%	24.8%	29.9%	0.78	98.9%
Aghakhani N, 2011 ³	27.1%	24.6%	29.8%	0.78	98.9%
Ahmed I, 2009 ⁴	27.2%	24.7%	29.9%	0.78	98.9%
Akbari V, 2014 ⁶	27.3%	24.8%	30.0%	0.77	98.9%
Aktekin M, 2001 ⁷	27.1%	24.6%	29.8%	0.78	98.9%
Akvardar Y, 2003 ⁸	27.2%	24.7%	29.9%	0.78	98.9%
Akvardar Y, 2004 ⁹	27.2%	24.7%	29.9%	0.78	98.9%
Al Faris EA, 2012 ¹⁰	27.1%	24.6%	29.8%	0.78	98.9%
Alexandrino-Silva C, 2009 ¹²	27.4%	24.9%	30.0%	0.77	98.9%
AlFaris EA, 2014 ¹³	27.1%	24.6%	29.7%	0.77	98.9%
Ali FA, 2015 ¹⁴	27.1%	24.6%	29.7%	0.77	98.9%
Alvi T, 2010 ¹⁵	27.2%	24.7%	29.9%	0.78	98.9%
Amaral GF, 2008 ¹⁶	27.2%	24.7%	29.9%	0.78	98.9%
Amir M, 2010 ¹⁷	27.2%	24.7%	29.9%	0.78	98.9%
Angkurawaranon C, 2016 ¹⁹	27.4%	24.9%	30.0%	0.77	98.9%
Aniebue PN, 2008 ²⁰	27.3%	24.8%	29.9%	0.78	98.9%
Ashor AW, 2012 ²¹	27.3%	24.8%	30.0%	0.77	98.9%
Ashton CH, 1995 ²²	27.2%	24.7%	29.8%	0.78	98.9%
Aziz NAHA, 2011 ²³	27.2%	24.7%	29.8%	0.78	98.9%
Bahri Y, 2011 ²⁴	27.3%	24.8%	29.9%	0.78	98.9%
Baldassin S, 2008 ²⁵	27.2%	24.7%	29.8%	0.78	98.9%
Basnet B, 2012 ²⁶	27.2%	24.7%	29.9%	0.78	98.9%
Bassols AM, 2014 ²⁷	27.3%	24.8%	30.0%	0.78	98.9%
Bayati A, 2009 ²⁸	27.1%	24.6%	29.8%	0.78	98.9%

Baykan Z, 2012 ²⁹	27.2%	24.7%	29.9%	0.78	98.9%
Berner JE, 2014 ³⁰	27.3%	24.8%	29.9%	0.78	98.9%
Bore M, 2016 ³¹	27.2%	24.7%	29.9%	0.78	98.9%
Borst JM, 2015 ³²	27.2%	24.7%	29.9%	0.78	98.9%
Bunevicius A, 2008 ³³	27.3%	24.8%	30.0%	0.77	98.9%
Camp DL, 1994 ³⁴	27.3%	24.8%	30.0%	0.78	98.9%
Carter FA, 2014 ³⁵	27.3%	24.8%	30.0%	0.77	98.9%
Castaldelli-Maia JM, 2012 ³⁶	27.3%	24.8%	30.0%	0.77	98.9%
Chan DW, 1991 ³⁷	27.1%	24.6%	29.8%	0.78	98.9%
Chan DW, 1992 ³⁸	27.3%	24.8%	30.0%	0.78	98.9%
Chandavarkar U, 2007 ³⁹	27.5%	24.9%	30.1%	0.77	98.9%
Chang E, 2012 ⁴⁰	27.1%	24.6%	29.7%	0.77	98.9%
Choi J, 2015 ⁴²	27.3%	24.8%	29.9%	0.78	98.9%
Clark DC, 1988 ⁴³	27.2%	24.7%	29.8%	0.78	98.9%
Costa EF, 2012 ⁴⁴	27.2%	24.7%	29.8%	0.78	98.9%
Dahlin M, 2005 ⁴⁵	27.3%	24.8%	30.0%	0.77	98.9%
Dahlin M, 2011 ⁴⁶	27.4%	24.9%	30.0%	0.77	98.9%
David MA, 2013 ⁴⁷	27.3%	24.8%	30.0%	0.77	98.9%
de Melo Cavestro J, 2006 ⁴⁸	27.4%	24.9%	30.0%	0.77	98.9%
de Oliveira e Sousa Leão PB, 2011 ⁴⁹	27.3%	24.8%	29.9%	0.78	98.9%
De Sousa Lima L, 2010 ⁵⁰	27.1%	24.6%	29.8%	0.78	98.9%
Del Ben CM, 2013 ⁵¹	27.3%	24.8%	30.0%	0.78	98.9%
Dyrbye LN, 2006 ⁵²	27.1%	24.6%	29.8%	0.78	98.9%
Dyrbye LN, 2007 ⁵³	27.1%	24.6%	29.8%	0.78	98.9%
Dyrbye LN, 2008 ⁵⁴	27.1%	24.6%	29.8%	0.79	98.9%
Dyrbye LN, 2010 ⁵⁵	27.1%	24.6%	29.8%	0.78	98.9%
Dyrbye LN, 2011 ⁵⁶	27.2%	24.7%	29.9%	0.79	98.9%

Dyrbye LN, 2014 ⁵⁷	27.1%	24.6%	29.7%	0.76	98.8%
Dyrbye LN, 2015 ⁵⁸	27.2%	24.7%	29.9%	0.78	98.9%
El-Gilany AH, 2008 ⁵⁹	27.3%	24.8%	29.9%	0.78	98.9%
Eller T, 2006 ⁶⁰	27.2%	24.7%	29.9%	0.78	98.9%
Farahangiz S, 2016 ⁶²	27.1%	24.6%	29.8%	0.78	98.9%
Ghomasara SL, 2011 ⁶³	27.3%	24.8%	29.9%	0.78	98.9%
Givens JL, 2002 ⁶⁴	27.3%	24.8%	29.9%	0.78	98.9%
Goebert D, 2009 ⁶⁵	27.3%	24.8%	29.9%	0.78	98.9%
Gold JA, 2015 ⁶⁶	27.5%	24.9%	30.1%	0.77	98.9%
Guerrero Lopez JB, 2013 ⁶⁷	27.2%	24.7%	29.8%	0.78	98.9%
Gulec M, 2005 ⁶⁸	27.2%	24.7%	29.9%	0.78	98.9%
Gupta S, 2013 ⁶⁹	27.2%	24.7%	29.8%	0.78	98.9%
Guthrie E, 1998 ⁷⁰	27.2%	24.7%	29.9%	0.78	98.9%
Haglund ME, 2009 ⁷¹	27.3%	24.8%	29.9%	0.78	98.9%
Hardeman RR, 2015 ⁷²	27.4%	24.9%	30.0%	0.75	98.9%
Helmets KF, 1997 ⁷³	27.1%	24.6%	29.7%	0.77	98.9%
Hendryx MS, 1991 ⁷⁴	27.3%	24.8%	30.0%	0.78	98.9%
Herzog DB, 1987 ⁷⁵	27.4%	24.9%	30.1%	0.77	98.9%
Hirata FC, 2007 ⁷⁶	27.2%	24.7%	29.9%	0.78	98.9%
Honney K, 2010 ⁷⁷	27.1%	24.6%	29.8%	0.78	98.9%
Ibrahim MB, 2015 ⁷⁸	27.1%	24.6%	29.7%	0.78	98.9%
Ibrahim N, 2013 ⁷⁹	27.3%	24.8%	30.0%	0.77	98.9%
Ibrahim NK, 2013 ⁸⁰	27.3%	24.8%	30.0%	0.77	98.9%
Imran N, 2016 ⁸¹	27.1%	24.6%	29.8%	0.78	98.9%
Inam SB, 2007 ⁸²	27.1%	24.6%	29.8%	0.78	98.9%
Inam SN, 2003 ⁸³	27.1%	24.6%	29.7%	0.77	98.9%
Iqbal S, 2015 ⁸⁴	27.1%	24.6%	29.8%	0.78	98.9%

Jackson ER, 2016 ⁸⁵	27.1%	24.6%	29.7%	0.76	98.8%
Jadoon NA, 2010 ⁸⁶	27.2%	24.6%	29.8%	0.78	98.9%
James D, 2013 ⁸⁷	27.2%	24.7%	29.9%	0.78	98.9%
Jeong Y, 2010 ⁸⁸	27.2%	24.7%	29.9%	0.78	98.9%
Jurkat HB, 2011 ⁸⁹	27.3%	24.8%	30.0%	0.78	98.9%
Karaoglu N, 2011 ⁹⁰	27.2%	24.7%	29.9%	0.78	98.9%
Kaya M, 2007 ⁹¹	27.3%	24.8%	29.9%	0.78	98.9%
Khan MA, 2015 ⁹²	27.3%	24.8%	30.0%	0.78	98.9%
Khan MS, 2006 ⁹³	27.0%	24.6%	29.7%	0.77	98.9%
Kim B, 2014 ⁹⁵	27.2%	24.7%	29.9%	0.78	98.9%
Kohls N, 2012 ⁹⁶	27.3%	24.7%	29.9%	0.78	98.9%
Kongsomboon K, 2010 ⁹⁷	27.4%	24.9%	30.1%	0.77	98.9%
Kotter T, 2014 ⁹⁸	27.5%	25.0%	30.1%	0.77	98.9%
Kulsoom B, 2015 ⁹⁹	27.2%	24.7%	29.8%	0.78	98.9%
Kumar GS, 2012 ¹⁰⁰	27.0%	24.6%	29.7%	0.77	98.9%
Lapinski J, 2016 ¹⁰¹	27.2%	24.6%	29.8%	0.79	98.9%
Levine RE, 2006 ¹⁰²	27.3%	24.7%	29.9%	0.78	98.9%
Liao Y, 2010 ¹⁰³	27.4%	24.9%	30.1%	0.77	98.9%
Ludwig AB, 2015 ¹⁰⁴	27.2%	24.7%	29.8%	0.78	98.9%
Lupo 2011 ¹⁰⁵	27.3%	24.7%	29.9%	0.78	98.9%
MacLean L, 2015 ¹⁰⁶	27.4%	24.9%	30.1%	0.77	98.9%
Manaf NA, 2016 ¹⁰⁷	27.1%	24.6%	29.7%	0.77	98.9%
Mancevska S, 2008 ¹⁰⁸	27.4%	24.9%	30.0%	0.77	98.9%
Marakoğlu K, 2006 ¹⁰⁹	27.2%	24.7%	29.8%	0.78	98.9%
Marwat MA, 2013 ¹¹⁰	27.3%	24.8%	30.0%	0.78	98.9%
Matheson KM, 2016 ¹¹¹	27.2%	24.7%	29.8%	0.78	98.9%
Mayda AT, 2010 ¹¹²	27.4%	24.8%	30.0%	0.77	98.9%

Mehanna Z, 2006 ¹¹³	27.2%	24.7%	29.9%	0.78	98.9%
Melo-Carrillo A, 2012 ¹¹⁴	27.2%	24.7%	29.8%	0.78	98.9%
Miletic V, 2015 ¹¹⁶	27.3%	24.8%	29.9%	0.78	98.9%
Mojs EH, 2015 ¹¹⁷	27.4%	24.9%	30.1%	0.77	98.9%
Mosley TH, 1994 ¹¹⁸	27.3%	24.8%	29.9%	0.78	98.9%
Mousa OY, 2016 ¹¹⁹	27.3%	24.8%	30.0%	0.77	98.9%
Naja WJ, 2016 ¹²⁰	27.2%	24.7%	29.9%	0.78	98.9%
Nasioudis, D, 2015 ¹²¹	27.2%	24.7%	29.8%	0.78	98.9%
Nava FR, 2013 ¹²²	27.5%	25.0%	30.1%	0.76	98.9%
Newbury-Birch D, 2001 ¹²³	27.4%	24.9%	30.1%	0.77	98.9%
Oku A, 2015 ¹²⁵	27.2%	24.7%	29.8%	0.78	98.9%
Pan XF, 2015 ¹²⁷	27.3%	24.8%	30.0%	0.78	98.9%
Paro HB, 2010 ¹²⁸	27.2%	24.7%	29.9%	0.78	98.9%
Peleg-Sagy T, 2012 ¹²⁹	27.2%	24.7%	29.8%	0.78	98.9%
Peleg-Sagy T, 2013 ¹³⁰	27.1%	24.6%	29.8%	0.78	98.9%
Pereyra-Eliás R, 2010 ¹³¹	27.2%	24.7%	29.9%	0.78	98.9%
Perveen S, 2016 ¹³²	27.1%	24.6%	29.8%	0.78	98.9%
Phillips LC, 2006 ¹³³	27.3%	24.8%	29.9%	0.78	98.9%
Pickard M, 2000 ¹³⁴	27.4%	24.9%	30.0%	0.77	98.9%
Pillay N, 2016 ¹³⁵	27.0%	24.5%	29.7%	0.77	98.9%
Pinzón-Amado A, 2013 ¹³⁶	27.2%	24.7%	29.8%	0.78	98.9%
Prinz P, 2012 ¹³⁷	27.4%	24.9%	30.1%	0.77	98.9%
Quince TA, 2012 ¹³⁸	27.4%	25.0%	30.1%	0.75	98.9%
Rab F, 2008 ¹³⁹	27.3%	24.8%	29.9%	0.78	98.9%
Ristic-Ignjatovic D, 2013 ¹⁴⁰	27.3%	24.8%	29.9%	0.78	98.9%
Rizvi F, 2015 ¹⁴¹	27.2%	24.7%	29.8%	0.78	98.9%
Roh MS, 2009 ¹⁴²	27.4%	25.0%	30.0%	0.72	98.8%

Romo-Nava F, 2016 ¹⁴³	27.3%	24.8%	30.0%	0.77	98.9%
Rosal MC, 1997 ¹⁴⁴	27.2%	24.7%	29.8%	0.78	98.9%
Saeed AA, 2016 ¹⁴⁵	27.1%	24.6%	29.7%	0.77	98.9%
Samaranayake CB, 2011 ¹⁴⁶	27.3%	24.8%	30.0%	0.78	98.9%
Saravanan C, 2014 ¹⁴⁷	27.2%	24.7%	29.9%	0.78	98.9%
Schwenk TL, 2010 ¹⁴⁸	27.3%	24.8%	30.0%	0.77	98.9%
Serra RD, 2015 ¹⁴⁹	27.2%	24.7%	29.9%	0.78	98.9%
Seweryn M, 2015 ¹⁵⁰	27.2%	24.6%	29.8%	0.79	98.9%
Shah AA, 2009 ¹⁵¹	27.2%	24.6%	29.9%	0.80	98.9%
Shariatpanaahi MV, 2007 ¹⁵²	27.2%	24.7%	29.9%	0.78	98.9%
Shen L, 2009 ¹⁵³	27.2%	24.7%	29.9%	0.78	98.9%
Sherina MS, 2004 ¹⁵⁴	27.2%	24.7%	29.8%	0.78	98.9%
Shi M, 2015 ¹⁵⁵	27.0%	24.6%	29.6%	0.75	98.9%
Shi M, 2016 ¹⁵⁶	27.1%	24.6%	29.7%	0.74	98.8%
Shindel AW, 2011 ¹⁵⁷	27.1%	24.6%	29.8%	0.78	98.9%
Sidana S, 2012 ¹⁵⁸	27.3%	24.8%	29.9%	0.78	98.9%
Smith CK, 2007 ¹⁵⁹	27.4%	24.9%	30.1%	0.77	98.9%
Smith JF, 2010 ¹⁶⁰	27.2%	24.7%	29.9%	0.78	98.9%
Smith JF, 2011 ¹⁶¹	27.2%	24.7%	29.9%	0.78	98.9%
Sobowale K, 2014 ¹⁶²	27.3%	24.8%	30.0%	0.77	98.9%
Sreeramareddy CT, 2007 ¹⁶³	27.3%	24.8%	29.9%	0.78	98.9%
Sun L, 2011 ¹⁶⁴	27.3%	24.8%	30.0%	0.76	98.8%
Supe AN, 1998 ¹⁶⁵	27.0%	24.5%	29.7%	0.77	98.9%
Tang QS, 2005 ¹⁶⁶	27.2%	24.7%	29.9%	0.78	98.9%
Thomas MR, 2006 ¹⁶⁷	27.1%	24.6%	29.8%	0.78	98.9%
Thompson D, 2010 ¹⁶⁸	27.1%	24.6%	29.8%	0.78	98.9%
Thompson G, 2016 ¹⁶⁹	27.3%	24.8%	30.0%	0.78	98.9%

Tin TS, 2015 ¹⁷⁰	27.4%	24.9%	30.1%	0.77	98.9%
Tjia J, 2005 ¹⁷¹	27.3%	24.8%	30.0%	0.77	98.9%
Valle R, 2013 ¹⁷⁴	27.3%	24.8%	29.9%	0.78	98.9%
Vankar JR, 2014 ¹⁷⁵	27.2%	24.7%	29.9%	0.78	98.9%
Vaysse B, 2014 ¹⁷⁶	27.5%	24.9%	30.1%	0.77	98.9%
Vitaliano PP, 1988 ¹⁷⁷	27.3%	24.7%	29.9%	0.78	98.9%
Voltmer E, 2012 ¹⁷⁸	27.5%	25.0%	30.1%	0.77	98.9%
Walkiewicz M, 2012 ¹⁷⁹	27.3%	24.8%	30.0%	0.78	98.9%
Wan YH, 2012 ¹⁸¹	27.1%	24.6%	29.8%	0.80	98.9%
Waqas A, 2015 ¹⁸²	27.2%	24.7%	29.9%	0.78	98.9%
Wege N, 2016 ¹⁸³	27.4%	24.9%	30.0%	0.77	98.9%
Wimsatt LA, 2015 ¹⁸⁴	27.3%	24.8%	30.0%	0.77	98.9%
Wolf MR, 2016 ¹⁸⁵	27.4%	24.9%	30.0%	0.77	98.9%
Wongpakaran N, 2010 ¹⁸⁶	27.4%	24.9%	30.1%	0.77	98.9%
Yang F, 2014 ¹⁸⁷	27.5%	25.0%	30.2%	0.76	98.9%
Yilmaz Y, 2014 ¹⁸⁸	27.2%	24.7%	29.9%	0.78	98.9%
Yoon S, 2014 ¹⁸⁹	27.3%	24.8%	30.0%	0.77	98.9%
Youssef FF, 2016 ¹⁹⁰	27.2%	24.7%	29.8%	0.78	98.9%
Yusoff MS, 2013 ¹⁹¹	27.2%	24.7%	29.8%	0.78	98.9%
Yusoff MS, 2013 ¹⁹²	27.2%	24.7%	29.9%	0.78	98.9%
Zeldow PB, 1987 ¹⁹³	27.3%	24.8%	30.0%	0.78	98.9%
Zoccolillo M, 1986 ¹⁹⁴	27.3%	24.8%	29.9%	0.78	98.9%
Zulfikar Ali RV, 1994 ¹⁹⁵	27.3%	24.8%	29.9%	0.78	98.9%
Pooled estimate	27.2%	24.7%	29.9%	0.78	98.9%

Legend: Studies are ordered alphabetically by first author. Summary estimates were calculated omitting one study at a time using a random effects model.

eTable 4. Within-instrument heterogeneity analyses of studies reporting on the prevalence of depression or depressive symptoms among medical students. (Pages 17-19)

Stratified Meta-Analyses										Meta-regression Analyses																
Beck Depression Inventory (BDI), ≥10										No . Studies	Prevalence	L CI	U CI	Q	t a u ²	I ²	P for difference	Q (d iff)	Slope	SE	Z	P	L CI	U CI	P (m od)	Q (m od)
	Cross-sectional	23	33.0 %	26 .2 %	40 .6 %	16 61 .9	0 .7 %	98	0.0 2	5. 4	Survey Year	0. 9 %	0.3 %	2 .8	0. 0 5	0.3 %	1.5 %	0.0 05	7.9							
	Longitudinal	1	18.8 %	11 .9 %	28 .5 %	0. 0	-- --				Age	- 2. 6 %	2.0 %	- 1 .3	0. 2 0	- 6.6 %	1.4 %	0.2 0	1.6							
											Proportion of Males	4. 9 %	16. 1 %	0 .3	0. 7 6	- 26. 7 %	36. 5 %	0.7 6	0.1							
	United States	4	13.0 %	7. 0 %	22 .8 %	37 .8	0 .4 %	92	0.0 004	1 2. 7																
	Not United States	20	37.5 %	29 .8 %	45 .9 %	15 49 .0	0 .8 %	98																		
	Preclinical students	8	24.0	15	34	22	0	96	0.3	1.																

	only		%	.8 %	.6 %	0.7	.5	.8 %		<i>I</i> [*]	1 *								
	Both	12	41.8 %	35.8 %	48.1 %	26.5	0.6	95.9 %											
	Clinical students only	3	31.7 %	21.6 %	43.9 %	19.0	0.2	89.5 %											
	NOS <3	13	34.6 %	26.5 %	43.6 %	26.1	0.5	95.4 %		0.5	0.5								
	NOS ≥3	11	30.0 %	20.8 %	41.0 %	12.8	0.7	99.2 %											
	Patient Health Questionnaire-9 (PHQ-9), ≥10	No . Studies	Prevalence	L CI	U CI	Q	t a u²	I²	P for difference	Q (diff)		Sl ope	SE	Z	P	L CI	U CI	P (mod)	Q (mod)
	Cross-sectional	15	18.3 %	12.8 %	25.4 %	69.3	0.7	98.0 %	--	--		Survey Year	-0.6 %	1.9 %	-0.7	0.7 %	-3.1 %	0.7 %	0.1
	Longitudinal	--	--	--	--	--	--	--				Age	0.3 %	4.9 %	0.1	0.9 %	-9.9 %	0.9 %	0.0 03
												Proportion of Males	-28	25.0	-1	0.2 77.	20.2	0.2 5	1.3

												.8 %	%	. 2	5	8 %	%		
	United States	3	14.7 %	12 .7 %	16 .8 %	0. 8	0	0	0	0.2 3	1. 4								
	Not United States	12	19.1 %	12 .6 %	28 .0 %	65 9. 7	0	98											
	Preclinical students only	3	21.3 %	9. 8 %	40 .4 %	65 .6	0	96	0.4 6	0. 5									
	Both	11	15.6 %	11 .0 %	21 .8 %	33 5. 4	0	97											
	Clinical students only	--	--	--	--	--	--	--											
	NOS <3	10	15.1 %	9. 6 %	23 .1 %	30 4. 3	0	97	0.1 1	2. 5									
	NOS ≥3	5	25.8 %	15 .5 %	39 .7 %	25 4. 4	0	98											
	Primary Care Evaluation of Mental Disorders (PRIME-MD)	No . St udies	Pre val ence	L C I	U C I	Q	t	I²	P for diff er ence	Q (d iff f)		SI o pe	SE	Z	P	L CI	U CI	P (m od)	Q (m od)
	Cross-sectional	14	37.5	32	43	79	0	98	--	--	Survey	-	1.5	-	0.	-	-	0.0	4.0

			%	.0	.3	8.	.	.4				Year	2.	%	2	0	5.8	0.1	5	
				%	%	6	2	%					9		0	5	%	%		
	Longitudinal	--	--	--	--	--	--	--				Age	--	--	-	--	--	--	--	--
												Proportion of Males	45	17	0	0.	-	39	0.8	0.1
												.2	7.6	.3	8	30	3.3			
												%	%	3	0	3.0	%			
	United States	14	37.5	32	43	79	0	98	--	--										
			%	.0	.3	8.	.	.4												
			%	%	%	6	2	%												
	Not United States	--	--	--	--	--	--	--												
	Preclinical students only	--	--	--	--	--	--	--	0.9	0.										
									2	0										
									1											
	Both	13	37.6	32	43	68	0	98												
			%	.0	.5	8.	.	.3												
			%	%	%	0	2	%												
	Clinical students only	1	37.9	35	40	0	--	--												
			%	.4	.4															
			%	%	%															
	NOS <3	14	37.5	32	43	79	0	98	--	--										
			%	.0	.3	8.	.	.4												
			%	%	%	6	2	%												
	NOS ≥3	--	--	--	--	--	--	--												
	Center for Epidemiologic	No	Pre	L	U	Q	t	I²	P	Q			SI	SE	Z	P	L	U	P	Q

Studies Depression Scale (CES-D), ≥16		. Studies	Prevalence	CI	CI		Number		for difference	(diff)		Open			CI	CI	(mod)	(mod)		
	Cross-sectional	12	42.4%	31.8%	53.8%	11.6%	0.99	0.16%	0.42	0.07		Survey Year	1.9%	0.7%	2.7%	0.01	0.5%	3.2%	0.01	7.5
	Longitudinal	1	47.9%	40.9%	55.0%	0	--	--				Age	-1.7%	1.6%	-0.1%	0.29	-4.9%	1.4%	0.29	1.1
												Proportion of Males	-16.0%	11.8%	-1.4%	0.17	-39.0%	7.1%	0.17	1.8
	United States	6	34.4%	25.1%	45.1%	17.2%	0.97	0.23%	0.05	3.8										
	Not United States	7	50.3%	38.4%	62.0%	40.8%	0.98	0.44%												
	Preclinical students only	2	39.0%	35.0%	43.1%	0.2	0	0%	0.97*	0*										
	Both	9	44.5%	32.1%	57.6%	11.6%	0.99	0.36%												
	Clinical students only	2	39.7%	12.4%	75.3%	14.0%	1.92	0.8												

			%	%		1	%												
	NOS <3	4	40.6%	27.5%	55.2%	15.5%	0.3%	80.6%		0.75	0.1								
	NOS ≥3	9	43.7%	31.7%	56.5%	11.37%	0.96%	99.3%											
Hospital Anxiety and Depression Scale (HADS-D), ≥8		No. Studies	Prevalence	LCI	UCI	Q	t	I²	P for difference	Q (diff)		Slope	SE	Z	P	LCI	UCI	P (mod)	Q (mod)
	Cross-sectional	10	16.4%	11.2%	23.4%	15.76%	0.95%	94.3%	<0.0001	1.85	Survey Year	-0.3%	0.6%	-0.5	0.6	-1.4%	0.8%	0.6	0.3
	Longitudinal	2	6.5%	5.6%	7.6%	0.9%	0.0%	0%			Age	-4.3%	7.7%	-0.6	0.58	-19.5%	10.8%	0.58	0.3
											Proportion of Males	14.4%	25.1%	0.6	0.57	-34.8%	63.6%	0.57	0.3
	United States	--	--	--	--	--	--	--	--	--									
	Not United States	12	13.6%	8.4%	21.3%	38.91%	0.81%	97.2%											

	Preclinical students only	6	10.7 %	4.4 %	23.8 %	29.5 %	1.4 %	98.3 %	0.84*	0.04*									
	Both	3	27.3 %	23.3 %	31.6 %	3.2 %	0.0 %	36.9 %											
	Clinical students only	2	9.1 %	2.4 %	29.1 %	7.6 %	0.9 %	86.9 %											
	NOS <3	5	10.2 %	5.9 %	17.0 %	32.5 %	0.4 %	87.7 %	0.14	2.2									
	NOS ≥3	7	17.1 %	10.8 %	26.0 %	13.9 %	0.5 %	95.6 %											
	Zung Self-Rating Depression Scale (Zung-SDS), ≥50	No . Studies	Prevalence	L C I	U C I	Q	t a u²	I²	P for difference	Q (diff)		Sl ope	SE	Z	P	L CI	U CI	P (mod)	Q (mod)
	Cross-sectional	10	21.7 %	13.7 %	32.5 %	45.3 %	0.8 %	98.0 %	0.49	0.05	Survey Year	0.3 %	0.6 %	0.4	0.6	-1.0 %	1.5 %	0.68	0.2
	Longitudinal	1	18.1 %	13.7 %	23.6 %	0	--	--			Age	2.1 %	3.5 %	0.6	0.5	-4.8 %	9.0 %	0.55	0.36

											Proportion of Males	- 8.1%	20.0%	- 0.4%	0.69	- 47.3%	31.2%	0.69	0.16
	United States	1	18.1%	13.7%	23.6%	0	--	--	0.49	0.5									
	Not United States	10	21.7%	13.7%	32.5%	45.7%	0.3	98.8%											
	Preclinical students only	5	18.3%	9.7%	32.0%	73.5%	0.7	94.6%	0.50	0.5									
	Both	5	24.2%	13.4%	39.8%	23.3%	0.7	98.3%											
	Clinical students only	--	--	--	--	--	--	--											
	NOS <3	7	21.6%	16.7%	27.5%	30.3%	0.1	80.2%	0.93	0.01									
	NOS ≥3	4	20.8%	9.1%	40.8%	30.9%	1.3	99.0%											
	Beck Depression Inventory (BDI), ≥17	No . Stud	Pre valence	L C I	U C I	Q	t a u²	I²	P for differe	Q (d iff)		Sl o pe	SE	Z	P	L CI	U CI	P (m od)	Q (m od)

	ies								nce										
Cross-sectional	6	21.7 %	12 .0 %	36 .0 %	17 3. 5	0 .1 8	97 .1 %		--	--	Survey Year	- 0. 1 %	1.5 %	- 0 1	0. 9 3	- 3.0 %	2.8 %	0.9 3	0.0 1
Longitudinal	--	--	--	--	--	--	--				Age	5. 1 %	6.0 %	0 .3 9	0. 6.6 %	- 7 %	16. %	0.3 9	0.7
											Proportion of Males	34 .5 %	34. 9 %	1 .3 0	0. 33. 9 %	- 3.0 %	10 3.0 %	0.3 2	1.0
United States	--	--	--	--	--	--	--		--	--									
Not United States	6	21.7 %	12 .0 %	36 .0 %	17 3. 5	0 .1 8	97 .1 %												
Preclinical students only	3	21.6 %	4. 5 %	61 .8 %	12 8. 3	2 .4 %	98 .4 %		0.9 9	0									
Both	2	21.4 %	6. 6 %	51 .1 %	35 .0 %	0 .1 9	97 .1 %												
Clinical students only	--	--	--	--	--	--	--												
NOS <3	6	21.7 %	12 .0 %	36 .0 %	17 3. 5	0 .1 8	97 .1 %		--	--									
NOS ≥3	--	--	--	--	--	--	--												

General Health Questionnaire-12 (GHQ-12), ≥4		No . Studies	Prevalence	LCI	UCI	Q	t a u ²	I ²	P for difference	Q (diff)		Slope	SE	Z	P	LCI	UCI	P (mod)	Q (mod)
	Cross-sectional	4	33.0 %	24.3 %	42.9 %	47.2	0.2	93.6 %	0.22	1.5	Survey Year	-1.0 %	1.0 %	-1.3	0.33	-3.0 %	1.0 %	0.33	0.9
	Longitudinal	2	41.9 %	31.4 %	53.2 %	3.7	0.7	72.1 %			Age	5.5 %	6.1 %	0.9	0.36	-6.4 %	17.4 %	0.36	0.8
											Proportion of Males	-29.9 %	45.4 %	-0.7	0.51	-11.8 %	59.1 %	0.51	0.4
	United States	--	--	--	--	--	--	--	--	--									
	Not United States	6	35.7 %	28.5 %	43.6 %	56.0	0.1	91.2 %											
	Preclinical students only	3	38.1 %	29.7 %	47.3 %	9.6	0.1	79.3 %	0.55	0.4									
	Both	3	33.3 %	21.9 %	47.1 %	46.0	0.2	95.7 %											
	Clinical students only	--	--	--	--	--	--	--											
	NOS <3	5	34.5 %	26.0 %	43.1 %	46.0	0.1	91.2 %	0.12	2.0									

			%	.3 %	.7 %	.7	. 2	.4 %		6	0							
	NOS ≥ 3	1	41.9 %	37 .2 %	46 .8 %	0. 0	--	--										

Legend: The *P* value marked by the asterisk (*) denotes a comparison of studies reporting on preclinical students only to those reporting on clinical students only. LCI denotes lower 95% confidence interval; SE, standard error; UCI, upper 95% CI.

eTable 5. Sensitivity analysis of the prevalence of suicidal ideation among medical students.

Study Omitted	Prevalence (%)	LCI	UCI	τ^2	I^2
Ahmed SA, 2016 ⁵	11.0%	8.8%	13.7%	0.34	96.0%
Alem A, 2005 ¹¹	11.4%	9.1%	14.0%	0.32	95.9%
Alexandrino-Silva C, 2009 ¹²	11.0%	8.8%	13.6%	0.33	96.0%
Amiri L, 2012 ¹⁸	11.3%	9.1%	13.9%	0.32	96.0%
Chen JQ, 2004 ⁴¹	10.9%	8.7%	13.4%	0.32	95.6%
Dahlin M, 2005 ⁴⁵	11.4%	9.2%	14.1%	0.32	95.9%
de Melo Cavestro J, 2006 ⁴⁸	11.3%	9.1%	13.9%	0.32	96.0%
Dyrbye LN, 2008 ⁵⁴	11.1%	8.8%	13.9%	0.37	96.0%
Dyrbye LN, 2014 ⁵⁷	11.2%	8.8%	14.1%	0.39	95.9%
Eskin M, 2011 ⁶¹	11.1%	8.9%	13.8%	0.34	96.0%
Goebert D, 2009 ⁶⁵	11.4%	9.1%	14.1%	0.32	95.8%
Khokher S, 2005 ⁹⁴	10.5%	8.6%	12.9%	0.28	95.2%
MacLean L, 2015 ¹⁰⁶	11.1%	8.9%	13.7%	0.33	96.0%
Menezes RG, 2012 ¹¹⁵	11.1%	8.9%	13.8%	0.33	96.0%
Okasha A, 1981 ¹²⁴	11.0%	8.8%	13.7%	0.33	96.0%
Osama M, 2014 ¹²⁶	10.4%	8.7%	12.5%	0.22	93.9%
Sobowale K, 2014 ¹⁶²	11.3%	9.1%	14.0%	0.33	96.0%
Thompson D, 2010 ¹⁶⁸	10.7%	8.6%	13.2%	0.31	95.9%
Tin TS, 2015 ¹⁷⁰	11.3%	9.1%	14.0%	0.32	95.9%
Tran QA, 2015 ¹⁷²	11.2%	8.9%	14.0%	0.35	95.9%
Tyssen R, 2001 ¹⁷³	11.0%	8.8%	13.6%	0.33	95.9%
Wallin U, 2003 ¹⁸⁰	11.0%	8.8%	13.7%	0.33	96.0%
Wan YH, 2012 ¹⁸¹	11.5%	9.5%	14.0%	0.26	94.5%
Wege N, 2016 ¹⁸³	11.3%	9.1%	14.0%	0.33	95.9%
Pooled estimate	11.1%	9.0%	13.7%	0.32	95.8%

Legend: Studies are ordered alphabetically by first author. Summary estimates were calculated omitting one study at a time using a random effects model.

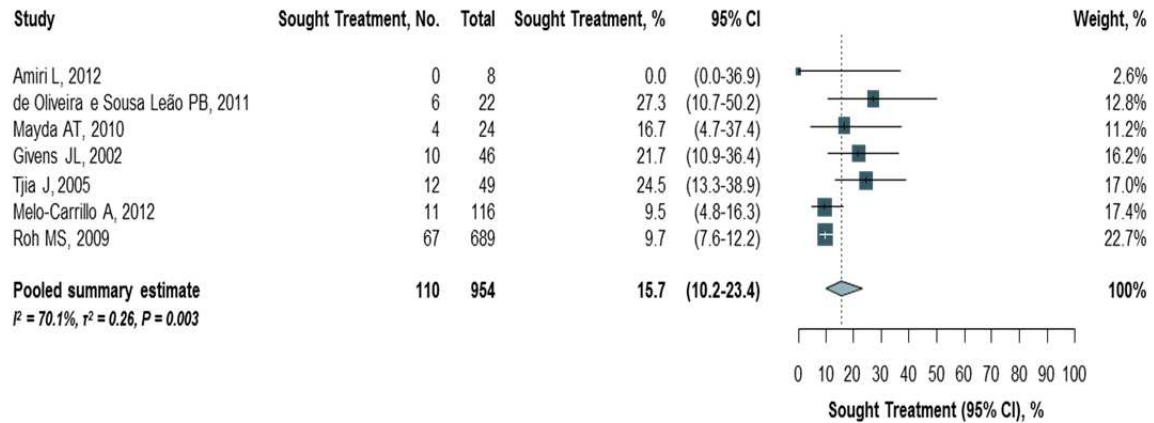
eTable 6. Sensitivities and specificities of commonly used instruments for diagnosing major depressive disorder

Instrument	Cutoff	Sensitivity	Specificity
Aga Khan University Anxiety and Depression Scale (AKUADS) ⁸²	≥19	74	81
Beck Depression Inventory (BDI) ¹⁹⁶	≥10	91 (86 to 96)	79 (52 to 100)
Beck Depression Inventory (BDI) ¹⁹⁷	≥16	79	91
Beck Depression Inventory-II (BDI-II) ¹⁹⁸	≥10	100	75
Beck Depression Inventory-II (BDI-II) ¹⁹⁸	≥14	88	84
Beck Depression Inventory-II (BDI-II) ¹⁹⁸	≥17	81	79
Beck Depression Inventory-II (BDI-II) ¹⁹⁸	≥20	82	75
Center for Epidemiological Studies Depression (CES-D) ¹⁹⁶	≥16	84 (70 to 89)	74 (68 to 80)
Depression Anxiety Stress Scale-21 (DASS-21) ¹⁹⁹	≥10	91	40
Depression Anxiety Stress Scale-42 (DASS-42) ¹⁹⁹	≥10	91	40
General Depression Scale Short Form (ADS-K) ²⁰⁰	>17	89.7	87
General Health Questionnaire-12 (GHQ-12) ¹⁹⁶	≥4	86 (76 to 95)	66 (57 to 74)
Health-Related Self-Reported Scale (HRSRS) ²⁰¹	≥25	75.1	93.4
Hospital Anxiety and Depression Scale (HADS-D) ²⁰²	≥11	61	97
Hospital Anxiety and Depression Scale (HADS-D) ²⁰²	≥12	50	98
Hospital Anxiety and Depression Scale (HADS-D) ²⁰²	≥7	83	84
Hospital Anxiety and Depression Scale (HADS-D) ²⁰²	≥8	80	88
Kutcher Adolescent Depression Scale (KADS) ²⁰³	≥6	92	71
Patient Health Questionnaire-9 (PHQ-9) ²⁰⁴	≥10	88	88
Patient Health Questionnaire-9 (PHQ-9) ²⁰⁴	≥9	95	84
Patient Health Questionnaire-9 (PHQ-9) ²⁰⁴	>10	83	89
Primary Care Evaluation of Mental Disorders (PRIME-MD) ¹⁹⁶	≥1	91 (81 to 100)	66 (48 to 84)
Zung Self-Rating Depression Scale (Zung-SDS) ²⁰⁵	≥40	89	75
Zung Self-Rating Depression Scale (Zung-SDS) ¹⁹⁶	≥50	86 (73 to 100)	76 (57 to 95)

Legend: Sensitivities and specificities (and where available, 95% confidence intervals) for the diagnosis of criterion-defined major depressive disorder (MDD) for selected depression screening instruments at various cutoffs are reported above as published in the contemporary literature.

eFigure 1.

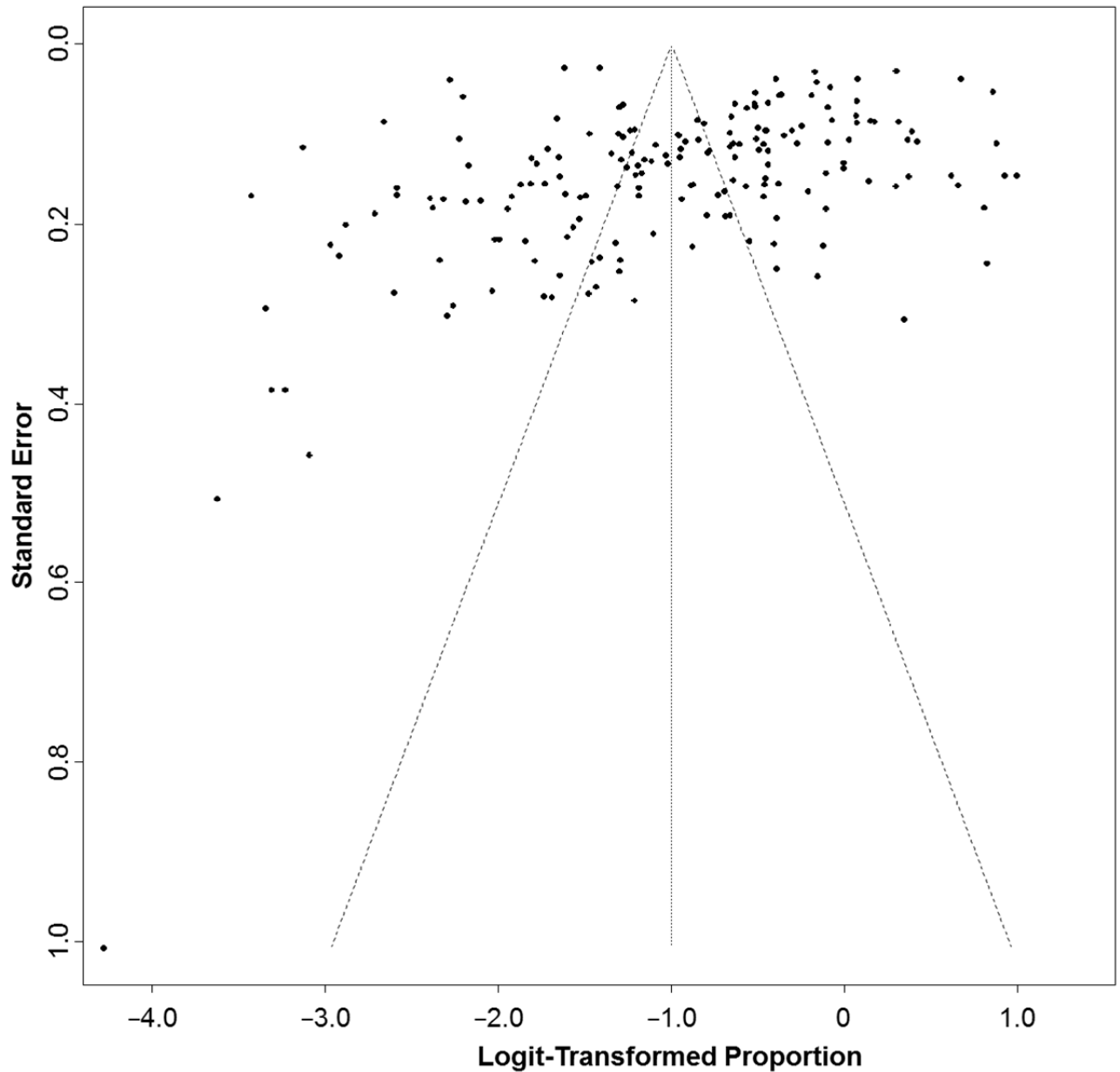
eFigure 1. Meta-analysis of the percentage of medical students who screened positive for depression and sought psychiatric or other mental health treatment



Legend: Contributing studies are sorted by increasing sample size. The dotted line marks the overall summary estimate for all studies, 15.7% (110/954 individuals, 95% CI: 10.3-23.4%, $Q = 20.1$, $\tau^2 = 0.26$, $I^2 = 70.1\%$). The area of each square is proportional to the inverse variance of the estimate. Horizontal lines indicate 95% confidence intervals of the estimate.

eFigure 2.

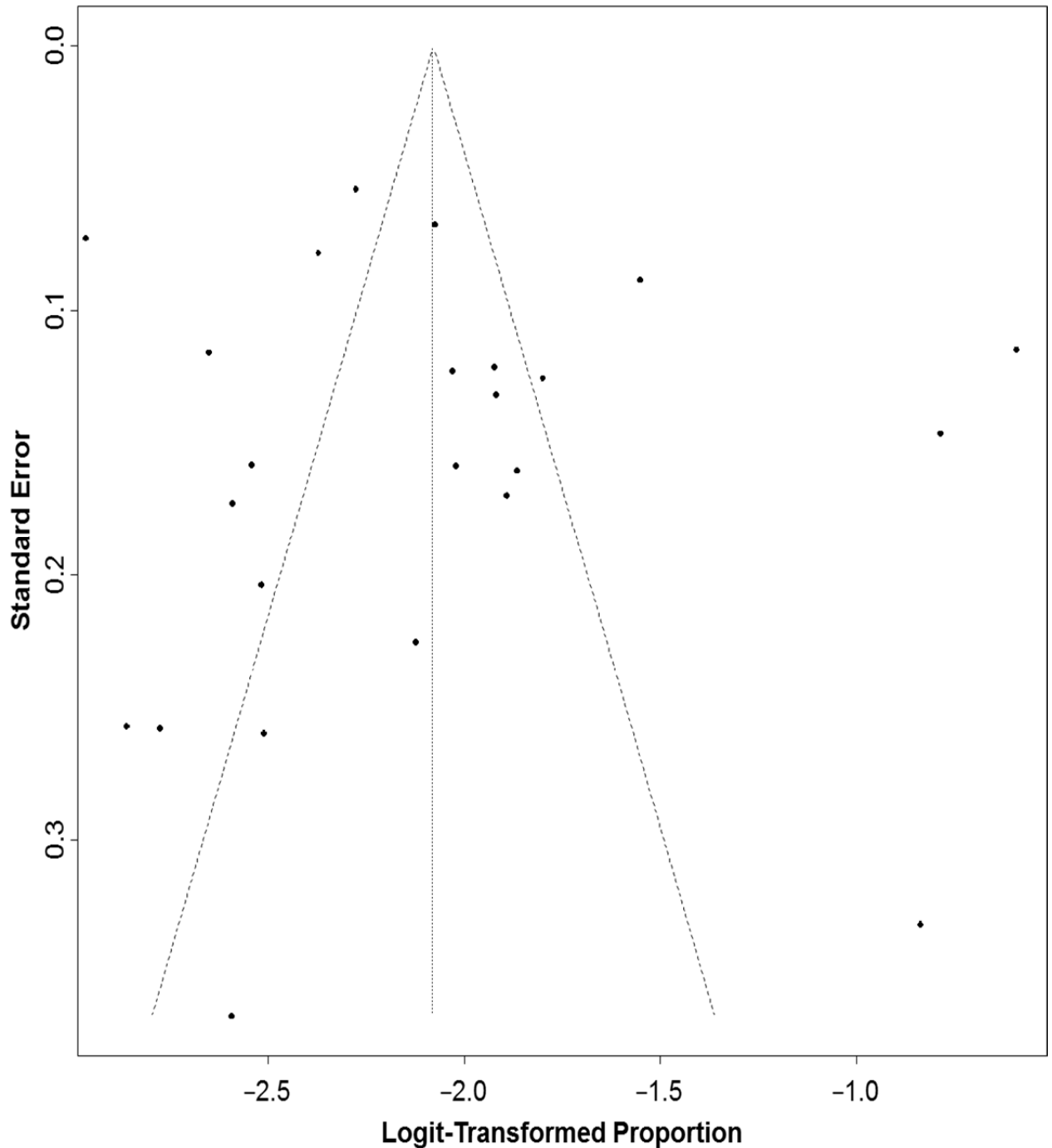
eFigure 2. Assessment of small study effects by funnel plot for the 183 studies reporting on depression or depressive symptom prevalence



Legend: The contour lines define the region within which 95% of points would be expected to lie in the absence of both heterogeneity and publication bias. The total overall estimate of the meta-analysis is represented by the vertical line. There was evidence of significant publication bias (Egger's test $P = 0.001$).

eFigure 3.

eFigure 3. Assessment of small study effects by funnel plot for the 24 studies reporting on suicidal ideation prevalence



Legend: The contour lines define the region within which 95% of points would be expected to lie in the absence of both heterogeneity and publication bias. The total overall estimate of the meta-analysis is represented by the vertical line. There was minimal asymmetry, suggesting the absence of significant publication bias (Egger's test $P = 0.49$).

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