Supplementary Material

Progression to type 2 diabetes in women with a known history of gestational diabetes: A systematic review and meta-analysis

BMJ-2019-054101

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Medline/Embase Search Strategy

exp Diabetes Mellitus, Type 2/

(type 2 adj5 diabetes).mp.

(type II adj5 diabetes).mp.

non-insulin dependent diabetes.mp.

T2DM.mp

NIDDM.mp

1 OR 2 OR 3 OR 4 OR 5 OR 6

exp Diabetes, Gestational/

gestational diabetes.mp.

pregnancy induced diabetes.mp.

pregnancy-induced diabetes.mp.

GDM.mp.

8 OR 9 OR 10 OR 11 OR 12

7 AND 13

Limit 14 to (english language and humans and yr= ”2000- 2020”)

Table S1: Study quality assessment using the Newcastle-Ottawa tool

Study Name	Selection				Comparability	Outcome			Total Stars
	Representativeness of exposed cohort	Selection of non-exposed cohort	Ascertainment of exposure	Outcome of interest not present at start of study	Comparability of cohorts on the basis of the design or analysis	Assessment of outcome	Follow-up long enough for outcomes to occur	Adequacy of follow-up of cohorts	
Aberg et al., 2002[36]	★	★	★	★	★	★	★	-	7
Albareda et al., 2003[35]	★	★	★	★	★	★	★	-	7
Aziz et al., 2018[37]	★	★	★	★	-	★	★	-	6
Chodick et al., 2010[34]	★	★	★	★	★	★	★	★	8
Daly et al., 2018[38]	★	★	★	★	★	★	★	-	7
Herath et al., 2017[39]	★	★	★	★	★	★	★	-	7
Huopio et al., 2014[28]	★	★	★	★	★	★	★	★	8
Krishnaveni et al., 2007[40]	★	★	★	★	★	★	★	★	8
A.J. Lee et al., 2007[41]	★	★	★	★	★	★	★	★	8
H. Lee et al., 2008[42]	★	-	★	★	★	★	★	★	7
Linne et al., 2002[43]	★	-	★	★	-	★	★	-	5
Madarasz et al., 2009[44]	★	-	★	★	★	★	★	-	6
Minooee et al., 2017[27]	★	★	★	★	★	★	★	-	7
Mukerji et al., 2012[31]	★	★	★	★	★	★	★	★	8
Pintaudi et al., 2015[45]	★	★	★	★	★	★	★	★	8
Retnakaran et al., 2010[46]	★	★	★	★	★	★	★	★	8
Vambergue et al., 2008[33]	★	★	★	★	★	★	★	-	7

Vigneault et al., 2015[47]	★	★	★	★	-	★	★	-	6
Wang et al., 2012[48]	★	★	★	★	★	★	★	★	8
Yefet et al., 2019[49]	★	★	★	★	★	★	★	★	8

Table S2 supplements this quality assessment by including the confounders considered in the analysis of each study.

Table S2: Study confounders considered when assessing comparability with the NOS scale

Study		List of confounders considered
1.	Aberg et al., 2002[36]	adjusted for OGTT values during pregnancy, insulin treatment, maternal age, parity and year of delivery
2.	Albareda et al., 2003[35]	adjusted for age, length of follow-up, family history of diabetes and BMI at follow-up
3.	Aziz et al., 2018[37]	did not adjust for confounders
4.	Chodick et al., 2010[34]	adjusted for age, parity, BMI, socioeconomic status, smoking
5.	Daly et al., 2018[38]	adjusted for age, Townsend (deprivation) quintile, body mass index, and smoking
6.	Herath et al., 2017[39]	adjusted for age at delivery, family history of T2DM in a first degree relative, history of GDM in a previous pregnancy, treatment with insulin during index pregnancy, birth weight, gestational age at delivery and parity
7.	Huopio et al., 2014[28]	adjusted for age, BMI, parity, follow-up time, smoking, physical activity
8.	Krishnaveni et al., 2007[40]	adjusted for age, parity, socio-economic status, family history of diabetes and waist circumference
9.	A.J. Lee et al., 2007[41]	adjusted for age, race, height, parity, BMI, birth weight, gestational age insulin use in pregnancy, family history of diabetes
10.	H. Lee et al., 2008[42]	adjusted for age, family history of diabetes, educational level, income level, smoking drinking status, waist circumference, systolic blood pressure, total cholesterol, triglycerides. HDL- cholesterol
11.	Linne et al., 2002[43]	did not adjust for confounders
12.	Madarasz et al., 2009[44]	adjusted for age and BMI
13.	Minooee et al., 2017[27]	adjusted for age, BMI, family history
14.	Mukerji et al., 2012[31]	adjusted for age, socioeconomic status and comorbidity
15.	Pintaudi et al., 2015[45]	adjusted for age
16.	Retnakaran et al., 2010[46]	adjusted for age, ethnicity, family history of diabetes, breastfeeding, baseline b-cell function, waist circumference, and weight
17.	Vambergue et al., 2008[33]	adjusted for pre-pregnancy BMI, age at delivery, family history of diabetes, low social economical level, race, OGTT values during pregnancy and insulin treatment during pregnancy.
18.	Vigneault et al., 2015[47]	did not adjust for confounders
19.	Wang et al., 2012[48]	adjusted for age, smoking, income, BMI, systolic blood pressure, parity and race
20.	Yefet et al., 2019[49]	adjusted for age, BMI before pregnancy, the number of previous pregnancies, the number of previous births, fasting and 1 h OGTT results and the number of glucose charts for each woman

Figure S1: Relative risk of T2DM in GDM and controls based on study design

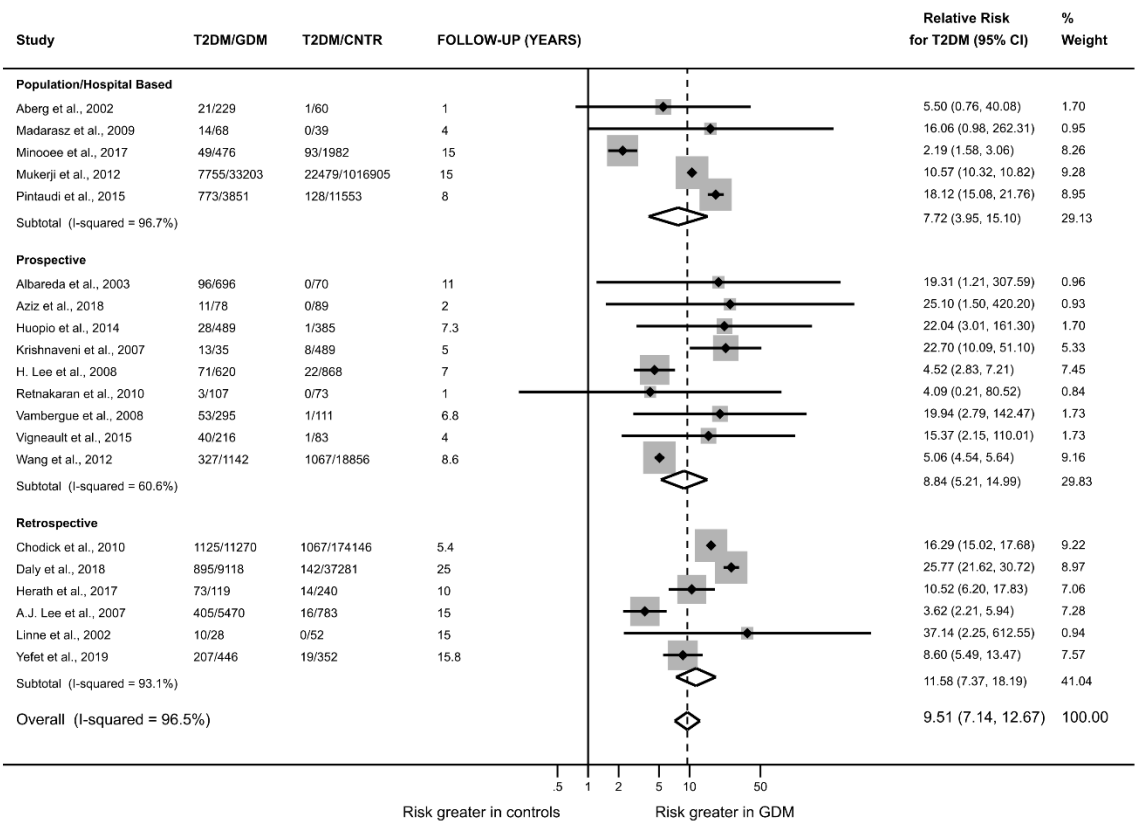


Figure S2: Relative risk of T2DM in GDM and controls based on GDM screening method

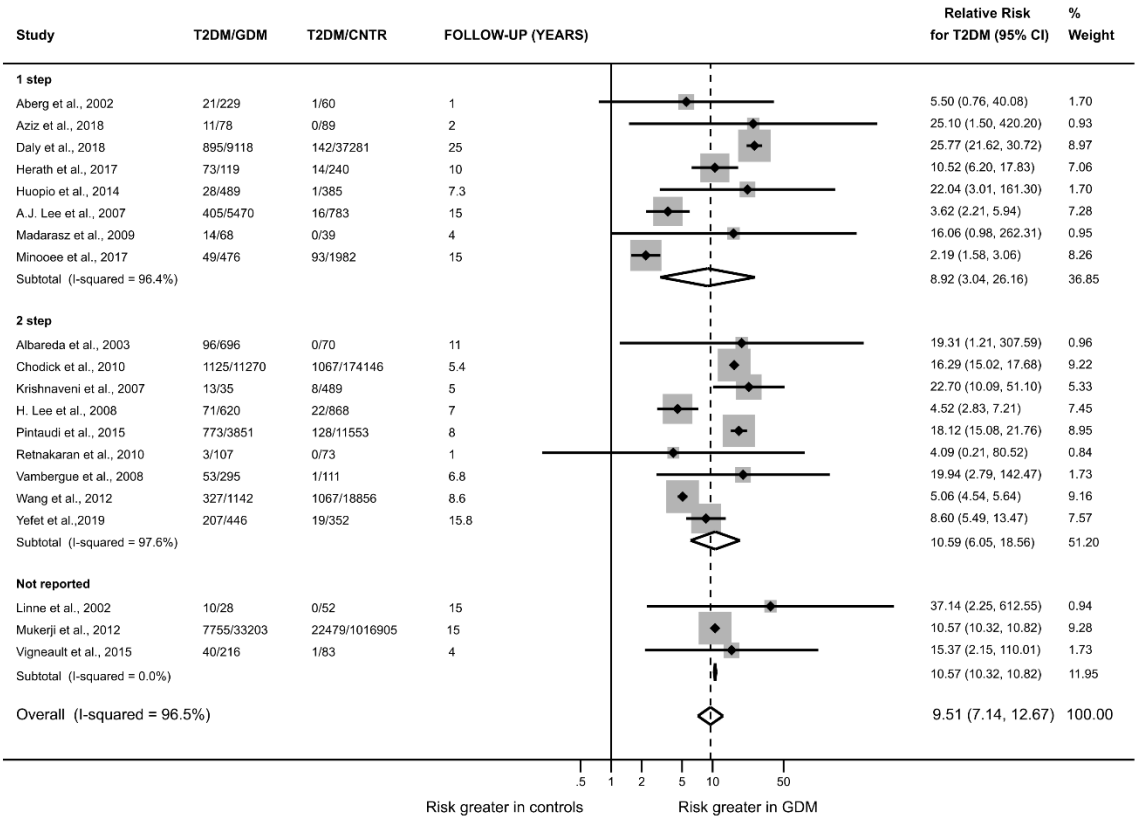


Figure S3: Meta-analysis estimates given named study is omitted

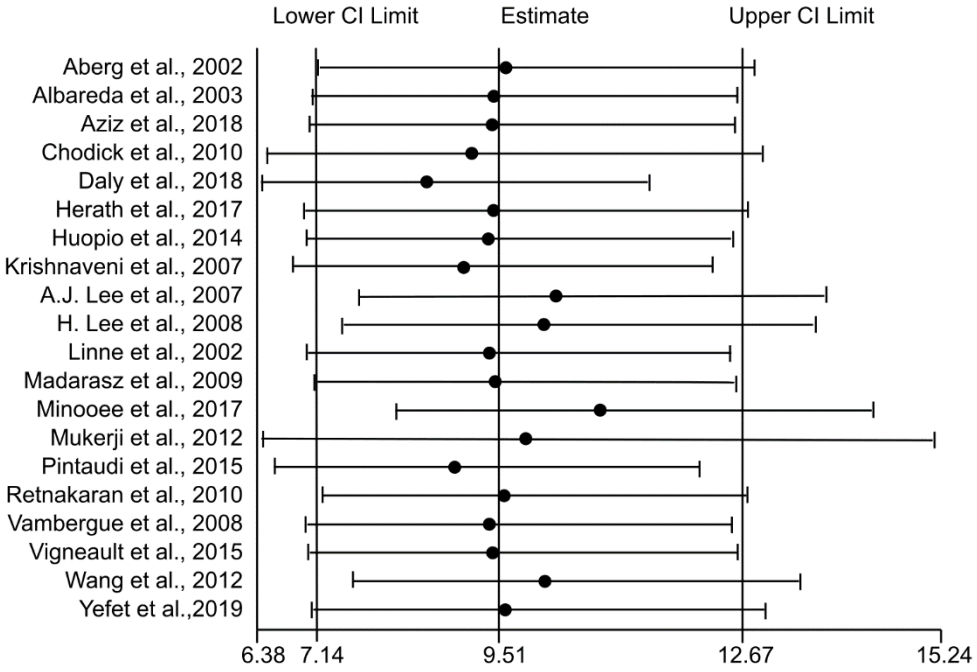
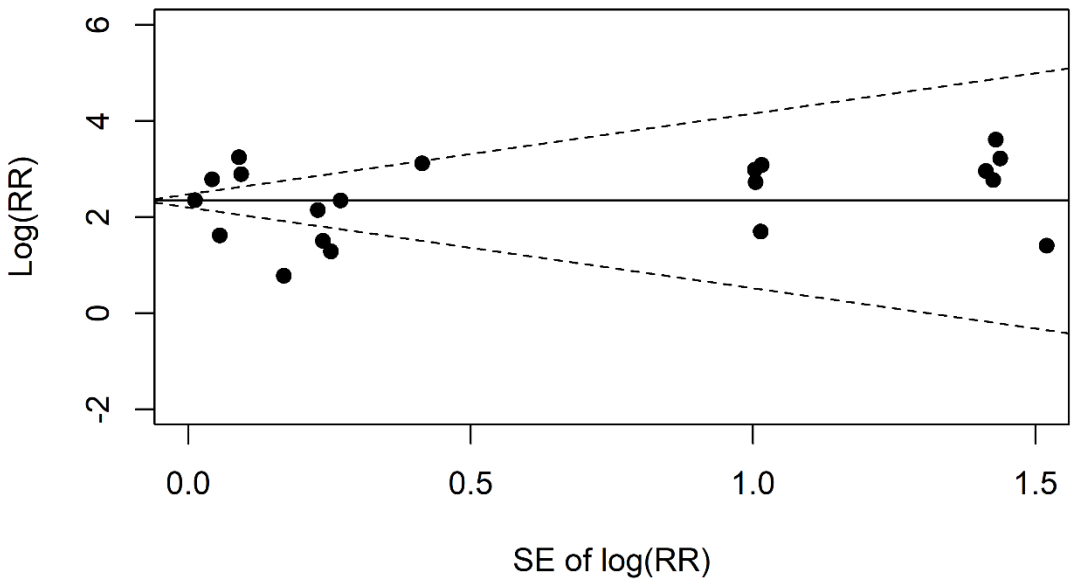


Figure S4: Funnel plot for publication bias



Documentation of how data were classified and coded

Subgroup analysis:

Ethnicity: Classified as White, Mixed and Non-White based on how it was reported by the primary studies and coded as a categorical variable using 1, 2 and 3 respectively.

Follow-Up: Three categories of follow-up length based on how the studies reported it: 1-5 years of follow-up, >5-10 years of follow-up and >10 years of follow- up and coded as a categorical variable using 1, 2 and 3 respectively.

Study Design: Separated into categories based on how the studies reported themselves- Prospective, Retrospective and Population/Hospital Based and coded as a categorical variable using 1, 2 and 3 respectively.

Screening Method for GDM: Separated into categories based on the screening method the study used to diagnose GDM (one step, two step) and coded as 1 and 2 respectively. Studies with no information on GDM screening were assigned missing values and were presented as a separate category entitled “Not reported” in the forest plot of the analysis.

Meta-regressions:

For the meta-regressions, we used publication year of study, mean age of study participants, BMI of study participants and follow-up time.

Table of data in figure 2

Study	T2DM/GDM	T2DM/CNTR	FOLLOW-UP (YEARS)	Relative Risk for T2DM	95% CI		% WEIGHT
Aberg et al., 2002	21/229	1/60	1	5.50	0.76	40.08	1.70
Albareda et al., 2003	96/696	0/70	11	19.31	1.21	307.59	0.96
Aziz et al., 2018	11/78	0/89	2	25.10	1.50	420.20	0.93
Chodick et al., 2010	1125/11270	1067/174146	5.4	16.29	15.02	17.68	9.22
Daly et al., 2018	895/9118	142/37281	25	25.77	21.62	30.72	8.97
Herath et al., 2017	73/119	14/240	10	10.52	6.20	17.83	7.06
Huopio et al., 2014	28/489	1/385	7.3	22.04	3.01	161.30	1.70
Krishnaveni et al., 2007	13/35	8/489	5	22.70	10.09	51.10	5.33
A.J. Lee et al., 2007	405/5470	16/783	15	3.62	2.21	5.94	7.28
H. Lee et al., 2008	71/620	22/868	7	4.52	2.83	7.21	7.45
Linne et al., 2002	10/28	0/52	15	37.14	2.25	612.55	0.94
Madarasz et al., 2009	14/68	0/39	4	16.06	0.98	262.31	0.95
Minooee et al., 2017	49/476	93/1982	15	2.19	1.58	3.06	8.26
Mukerji et al., 2012	7755/33203	22479/1016905	15	10.57	10.32	10.82	9.28
Pintaudi et al., 2015	773/3851	128/11553	8	18.12	15.08	21.76	8.95
Retnakaran et al., 2010	3/107	0/73	1	4.09	0.21	80.52	0.84
Vambergue et al., 2008	53/295	1/111	6.8	19.94	2.79	142.47	1.73
Vigneault et al., 2015	40/216	1/83	4	15.37	2.15	110.01	1.73
Wang et al., 2012	327/1142	1067/18856	8.6	5.06	4.54	5.64	9.16
Yefet et al.,2019	207/446	19/352	15.8	8.60	5.49	13.47	7.57
Overall (I-squared = 96.5%)				9.51	7.14	12.67	100.00

Table of data in figure 3

Study	T2DM/GDM	T2DM/CNTR	FOLLOW-UP (YEARS)	Relative Risk for T2DM	95% CI		% WEIGHT
White							
Aberg et al., 2002	21/229	1/60	1	5.50	0.76	40.08	1.70
Albareda et al., 2003	96/696	0/70	11	19.31	1.21	307.59	0.96
Chodick et al., 2010	1125/11270	1067/174146	5.4	16.29	15.02	17.68	9.22
Huopio et al., 2014	28/489	1/385	7.3	22.04	3.01	161.30	1.70
Linne et al., 2002	10/28	0/52	15	37.14	2.25	612.55	0.94
Madarasz et al., 2009	14/68	0/39	4	16.06	0.98	262.31	0.95
Subtotal (I-squared = 0.0%)				16.28	15.01	17.66	15.46
Non-white							
Aziz et al., 2018	11/78	0/89	2	25.10	1.50	420.20	0.93
Herath et al., 2017	73/119	14/240	10	10.52	6.20	17.83	7.06
Krishnaveni et al., 2007	13/35	8/489	5	22.70	10.09	51.10	5.33
H. Lee et al., 2008	71/620	22/868	7	4.52	2.83	7.21	7.45
Subtotal (I-squared = 78.2%)				10.38	4.61	23.39	20.77
Mixed							
Daly et al., 2018	895/9118	142/37281	25	25.77	21.62	30.72	8.97
A.J. Lee et al., 2007	405/5470	16/783	15	3.62	2.21	5.94	7.28
Minooee et al., 2017	49/476	93/1982	15	2.19	1.58	3.06	8.26
Mukerji et al., 2012	7755/33203	22479/1016905	15	10.57	10.32	10.82	9.28
Pintaudi et al., 2015	773/3851	128/11553	8	18.12	15.08	21.76	8.95
Retnakaran et al., 2010	3/107	0/73	1	4.09	0.21	80.52	0.84
Vambergue et al., 2008	53/295	1/111	6.8	19.94	2.79	142.47	1.73
Vigneault et al., 2015	40/216	1/83	4	15.37	2.15	110.01	1.73
Wang et al., 2012	327/1142	1067/18856	8.6	5.06	4.54	5.64	9.16
Yefet et al.,2019	207/446	19/352	15.8	8.60	5.49	13.47	7.57
Subtotal (I-squared =97.8%)				8.31	5.44	12.69	63.77
Overall (I-squared = 96.5%)				9.51	7.14	12.67	100.00

Table of data in figure 4

Study	T2DM/GDM	T2DM/CNTR	FOLLOW-UP (YEARS)	Relative Risk for T2DM	95% CI		% WEIGHT
1-5 Years							
Aberg et al., 2002	21/229	1/60	1	5.50	0.76	40.08	1.70
Retnakaran et al., 2010	3/107	0/73	1	4.09	0.21	80.52	0.84
Aziz et al., 2018	11/78	0/89	2	25.10	1.50	420.20	0.93
Madarasz et al., 2009	14/68	0/39	4	16.06	0.98	262.31	0.95
Vigneault et al., 2015	40/216	1/83	4	15.37	2.15	110.01	1.73
Krishnaveni et al., 2007	13/35	8/489	5	22.70	10.09	51.10	5.33
Subtotal (I-squared = 0.0%)				17.06	8.95	32.55	11.48
5-10 Years							
Chodick et al., 2010	1125/11270	1067/174146	5.4	16.29	15.02	17.68	9.22
Vambergue et al., 2008	53/295	1/111	6.8	19.94	2.79	142.47	1.73
H. Lee et al., 2008	71/620	22/868	7	4.52	2.83	7.21	7.45
Huopio et al., 2014	28/489	1/385	7.3	22.04	3.01	161.30	1.70
Pintaudi et al., 2015	773/3851	128/11553	8	18.12	15.08	21.76	8.95
Wang et al., 2012	327/1142	1067/18856	8.6	5.06	4.54	5.64	9.16
Herath et al., 2017	73/119	14/240	10	10.52	6.20	17.83	7.06
Subtotal (I-squared = 98.2%)				10.42	5.68	19.11	45.26
More than 10 Years							
Albareda et al., 2003	96/696	0/70	11	19.31	1.21	307.59	0.96
A.J. Lee et al., 2007	405/5470	16/783	15	3.62	2.21	5.94	7.28
Linne et al., 2002	10/28	0/52	15	37.14	2.25	612.55	0.94
Minooee et al., 2017	49/476	93/1982	15	2.19	1.58	3.06	8.26
Mukerji et al., 2012	7755/33203	22479/1016905	15	10.57	10.32	10.82	9.28
Yefet et al.,2019	207/446	19/352	15.8	8.60	5.49	13.47	7.57
Daly et al., 2018	895/9118	142/37281	25	25.77	21.62	30.72	8.97
Subtotal (I-squared = 97.1%)				8.09	4.34	15.08	43.26
Overall (I-squared = 96.5%)				9.51	7.14	12.67	100.00

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Checklist			
Section/topic	**#**	**Checklist item**	**Reported on page #**
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	0
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	2-3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	2-3
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	3
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	3
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	3-4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Supplementary material
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	3-4, Figure 1
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	3-4

Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	3,4,5
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	4-5, Supplementary material
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	4-5
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	4-5

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	4-5, Supplementary material
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	4-5
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	6, Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	6, Table 1
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	6-8, Supplementary material
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	6-8, Figures 2-4
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	7-8
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	6-8,

			Supplementary material
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	7-8
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	9-11
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	9-11
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	11
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	16

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: **www.prisma-statement.org**.

MOOSE (Meta-analyses Of Observational Studies in Epidemiology) Checklist

Reporting Criteria	Reported (Yes/No)	Reported on Page No.
Reporting of Background		
Problem definition	Yes	2
Hypothesis statement	Yes	2-3
Description of Study Outcome(s)	Yes	2-3
Type of exposure or intervention used	Yes	2-3
Type of study design used	Yes	2-3
Study population	Yes	2-3
Reporting of Search Strategy		
Qualifications of searchers (eg, librarians and investigators)	Yes	3
Search strategy, including time period included in the synthesis and keywords	Yes	3, Supplementary Material
Effort to include all available studies, including contact with authors	Yes	3-4
Databases and registries searched	Yes	3
Search software used, name and version, including special features used (eg, explosion)	Yes	3, Supplementary Material
Use of hand searching (eg, reference lists of obtained articles)	Yes	3
List of citations located and those excluded, including justification	Yes	6, Figure 1
Method for addressing articles published in languages other than English	Yes	3,9, Supplementary Material
Method of handling abstracts and unpublished studies	Yes	3
Description of any contact with authors	Yes	3-4
Reporting of Methods		
Description of relevance or appropriateness of studies assembled for assessing the hypothesis to be tested	Yes	3,6
Rationale for the selection and coding of data (eg, sound clinical principles or convenience)	Yes	4-5
Documentation of how data were classified and coded (eg, multiple raters, blinding, and interrater reliability)	Yes	4, Supplementary Material
Assessment of confounding (eg, comparability of cases and controls in studies where appropriate	Yes	4, Supplementary Material

Reporting Criteria	Reported (Yes/No)	Reported on Page No.
Assessment of study quality, including blinding of quality assessors; stratification or regression on possible predictors of study results	Yes	4, 5, 6,7,8, Supplementary Material
Assessment of heterogeneity	Yes	4, 7,8, Tables, Figures
Description of statistical methods (eg, complete description of fixed or random effects models, justification of whether the chosen models account for predictors of study results, dose-response models, or cumulative meta-analysis) in sufficient detail to be replicated	Yes	4, 5, Supplementary Material
Provision of appropriate tables and graphics	Yes	Tables1-3 + Figures 1-4, Supplementary Material
Reporting of Results		
Table giving descriptive information for each study included	Yes	Table 1
Results of sensitivity testing (eg, subgroup analysis)	Yes	7-8, and relevant tables/figures
Indication of statistical uncertainty of findings	Yes	7-8
Reporting of Discussion		
Quantitative assessment of bias (eg, publication bias)	Yes	9-10
Justification for exclusion (eg, exclusion of non–English-language citations)	Yes	9
Assessment of quality of included studies	Yes	9-10
Reporting of Conclusions		
Consideration of alternative explanations for observed results	Yes	9-11
Generalization of the conclusions (ie, appropriate for the data presented and within the domain of the literature review)	Yes	9-11
Guidelines for future research	Yes	11
Disclosure of funding source	Yes	16