

Supplementary Material 1. MOOSE checklist for meta-analyses of observational studies

Item No	Recommendation	Reported on Page No
Reporting of background should include		
1	Problem definition	7
2	Hypothesis statement	7-8
3	Description of study outcome(s)	7-8
4	Type of exposure or intervention used	7
5	Type of study designs used	8
6	Study population	7
Reporting of search strategy should include		
7	Qualifications of searchers (e.g., librarians and investigators)	9
8	Search strategy, including time period included in the synthesis and key words	9
9	Effort to include all available studies, including contact with authors	9
10	Databases and registries searched	9
11	Search software used, name and version, including special features used (e.g., explosion)	9
12	Use of hand searching (e.g., reference lists of obtained articles)	9
13	List of citations located and those excluded, including justification	9
14	Method of addressing articles published in languages other than English	9
15	Method of handling abstracts and unpublished studies	9
16	Description of any contact with authors	9
Reporting of methods should include		
17	Description of relevance or appropriateness of studies assembled for assessing the hypothesis to be tested	9-10
18	Rationale for the selection and coding of data (e.g., sound clinical principles or convenience)	10
19	Documentation of how data were classified and coded (e.g., multiple raters, blinding and interrater reliability)	10
20	Assessment of confounding (e.g., comparability of cases and controls in studies where appropriate)	10-11
21	Assessment of study quality, including blinding of quality assessors, stratification or regression on possible predictors of study results	11
22	Assessment of heterogeneity	12
23	Description of statistical methods (e.g., complete description of fixed or random effects models, justification of whether the chosen models	11-12

	account for predictors of study results, dose-response models, or cumulative meta-analysis) in sufficient detail to be replicated	
24	Provision of appropriate tables and graphics	14-15, 17-18
Reporting of results should include		
25	Graphic summarizing individual study estimates and overall estimate	13
26	Table giving descriptive information for each study included	14-15
27	Results of sensitivity testing (e.g., subgroup analysis)	13, 16
28	Indication of statistical uncertainty of findings	16
29	Quantitative assessment of bias (e.g., publication bias)	16
30	Justification for exclusion (e.g., exclusion of non-English language citations)	13
31	Assessment of quality of included studies	13
Reporting of conclusions should include		
32	Consideration of alternative explanations for observed results	19-20
33	Generalization of the conclusions (i.e., appropriate for the data presented and within the domain of the literature review)	22
34	Guidelines for future research	20-21
35	Disclosure of funding source	23

Supplementary Material 2. Search strategies for all databases

1. PubMed
2. Embase
3. Cochrane Library
4. Web of Science

1. PubMed

((((((((((((insomnia[Title/Abstract]) OR (sleep duration[Title/Abstract])) OR (sleep time[Title/Abstract])) OR (sleep restriction[Title/Abstract])) OR (sleep loss[Title/Abstract])) OR (lack of sleep[Title/Abstract])) OR (insufficient sleep[Title/Abstract])) OR (sleep deprivation[Title/Abstract])) OR (sleep disturbances[Title/Abstract])) OR (sleep quality[Title/Abstract])) OR (initiate sleep[Title/Abstract])) OR (initiating sleep[Title/Abstract])) OR (maintain sleep[Title/Abstract])) OR (maintaining sleep[Title/Abstract])) AND (asthma)

2. Embase

(insomnia:ab,ti OR 'sleep duration':ab,ti OR 'sleep time':ab,ti OR 'sleep restriction':ab,ti OR 'sleep loss':ab,ti OR 'lack of sleep':ab,ti OR 'insufficient sleep':ab,ti OR 'sleep deprivation':ab,ti OR 'sleep disturbances':ab,ti OR 'sleep quality':ab,ti OR 'initiate sleep':ab,ti OR 'initiating sleep':ab,ti OR 'maintain sleep':ab,ti OR 'maintaining sleep':ab,ti) AND asthma

3. Cochrane Library

- #1 (insomnia):ti
- #2 (sleep duration):ti
- #3 (sleep time):ti
- #4 (sleep restriction):ti
- #5 (sleep loss):ti
- #6 (lack of sleep):ti
- #7 (sleep deprivation):ti

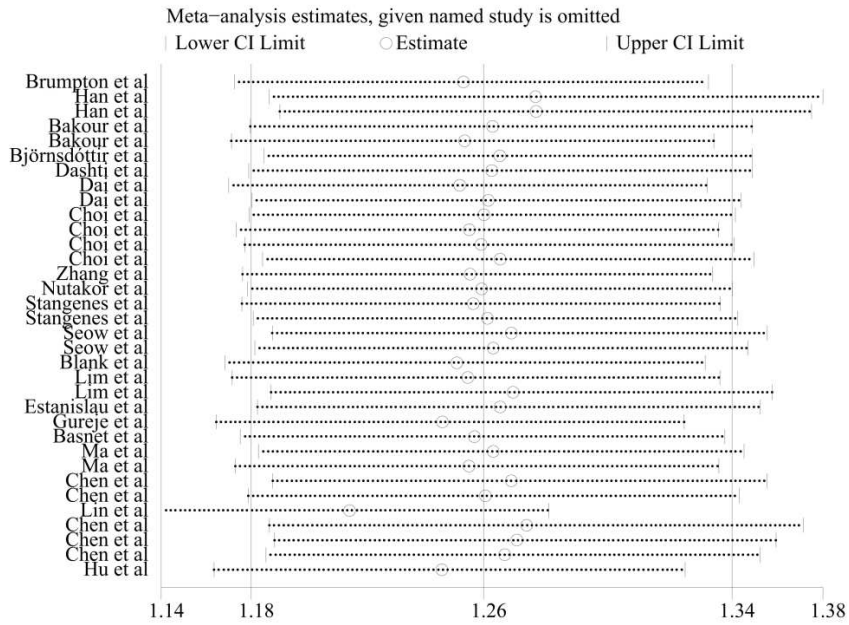
- #8 (sleep disturbances):ti
- #9 (sleep quality):ti
- #10 (initiate sleep):ti
- #11 (initiating sleep):ti
- #12 (maintain sleep):ti
- #13 (maintaining sleep):ti
- #14 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13
- #15 (insomnia):ab
- #16 (sleep duration):ab
- #17 (sleep time):ab
- #18 (sleep restriction):ab
- #19 (sleep loss):ab
- #20 (lack of sleep):ab
- #21 (sleep deprivation):ab
- #22 (sleep disturbances):ab
- #23 (sleep quality):ab
- #24 (initiate sleep):ab
- #25 (initiating sleep):ab
- #26 (maintain sleep):ab
- #27 (maintaining sleep):ab
- #28 #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27
- #29 (asthma)
- #30 (#14 or #28) and #29

4. Web of Science

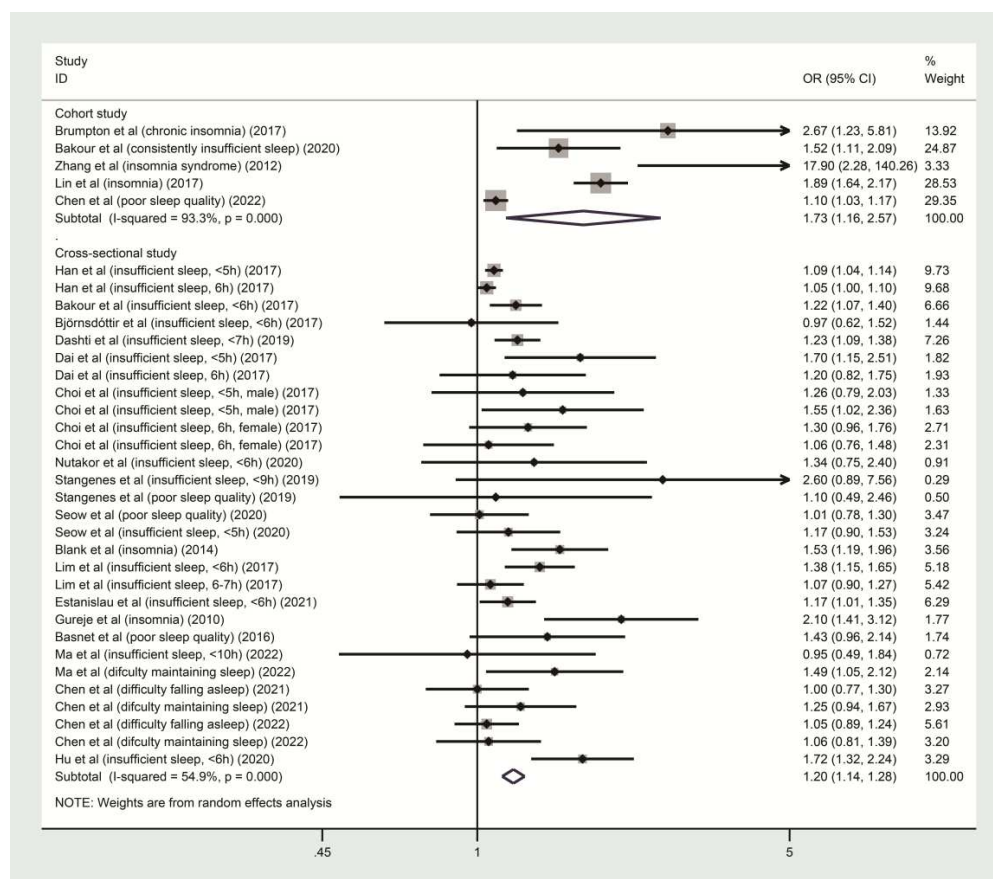
- #1 TI = (insomnia)
- #2 TI = (sleep duration)
- #3 TI = (sleep time)
- #4 TI = (sleep restriction)

- #5 TI = (sleep loss)
- #6 TI = (lack of sleep)
- #7 TI = (sleep deprivation)
- #8 TI = (sleep disturbances)
- #9 TI = (sleep quality)
- #10 TI = (initiate sleep)
- #11 TI = (initiating sleep)
- #12 TI = (maintain sleep)
- #13 TI = (maintaining sleep)
- #14 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13
- #15 AB = (insomnia)
- #16 AB = (sleep duration)
- #17 AB = (sleep time)
- #18 AB = (sleep restriction)
- #19 AB = (sleep loss)
- #20 AB = (lack of sleep)
- #21 AB = (sleep deprivation)
- #22 AB = (sleep disturbances)
- #23 AB = (sleep quality)
- #24 AB = (initiate sleep)
- #25 AB = (initiating sleep)
- #26 AB = (maintain sleep)
- #27 AB = (maintaining sleep)
- #28 #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27
- #29 TI = (asthma)
- #30 AB = (asthma)
- #31 TS = (asthma)
- #32 #29 or #30 or #31
- #33 (#14 or #28) and #32

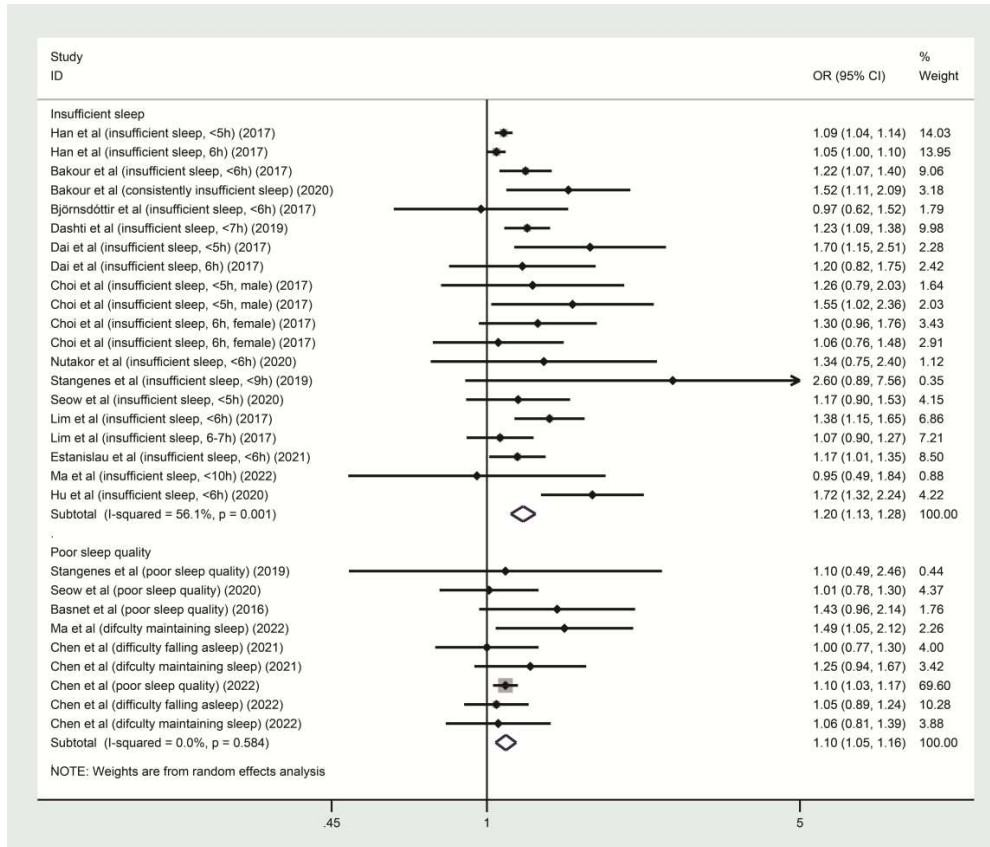
Supplementary Figure 1. Sensitivity analysis for the association between sleep disorders and sleep.



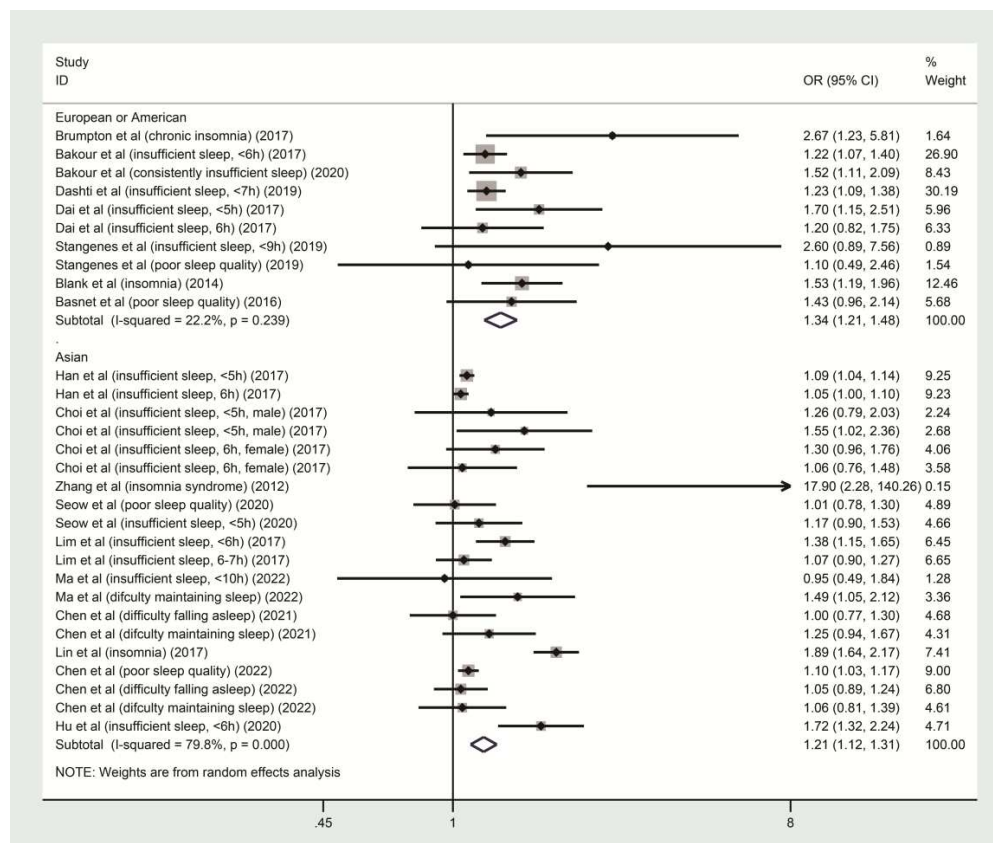
Supplementary Figure 2. Forest plot of the association between insomnia symptoms and asthma in cohort studies and cross-sectional studies.



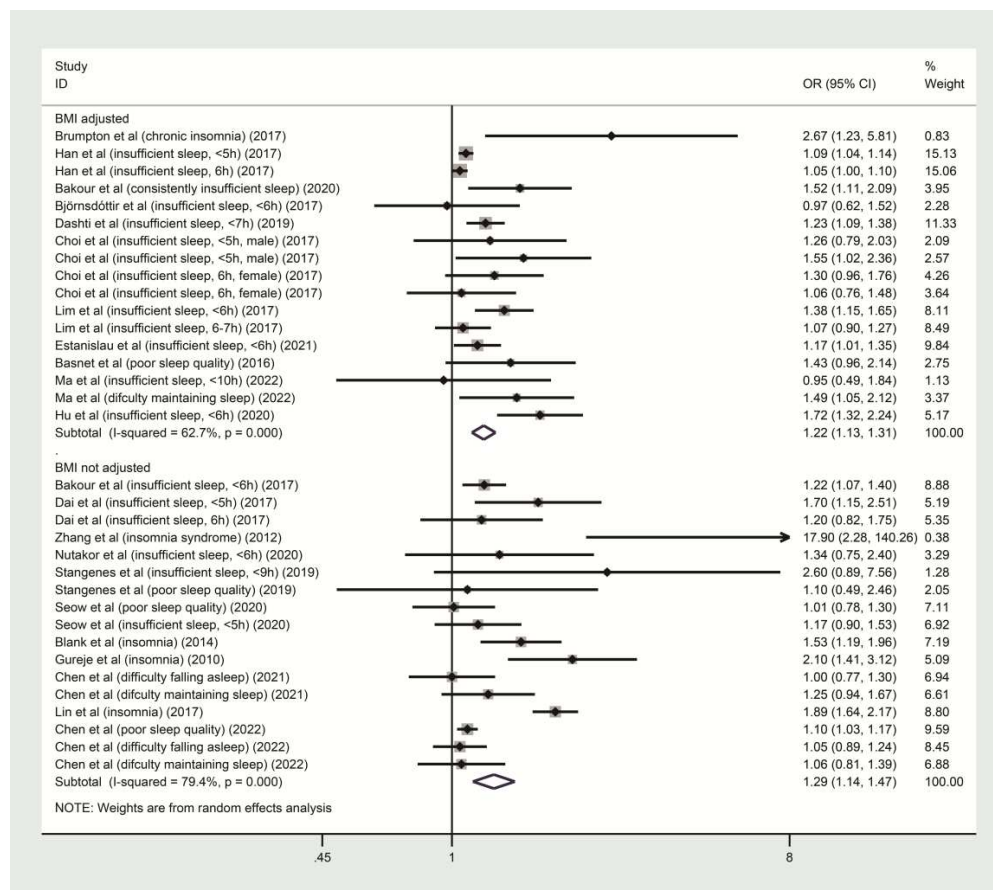
Supplementary Figure 3. Forest plot of the association between insufficient sleep time and asthma, and poor sleep quality and asthma.



Supplementary Figure 4. Forest plot of the association between insomnia symptoms and asthma in European and American, and Asian.



Supplementary Figure 5. Forest plot of the association between insomnia symptoms and asthma in studies where BMI was adjusted and not adjusted.



Supplementary Table 1. Newcastle-Ottawa Quality Assessment Scale

Newcastle-Ottawa Quality Assessment Scale

Case-Control Studies**Selection****(1) Is the case definition adequate?**

- (a) yes, with independent validation ★
- (b) yes, e.g., record linkage or based on self-reports
- (c) no description

(2) Representativeness of the cases

- (a) consecutive or obviously representative series of cases ★
- (b) potential for selection biases or not stated

(3) Selection of Controls

- (a) community controls ★
- (b) hospital controls
- (c) no description

(4) Definition of Controls

- (a) no history of disease (endpoint) ★
- (b) no description of source

Comparability**(1) Comparability of cases and controls on the basis of the design or analysis**

- (a) study controls for ____ (Select the most important factor.) ★
- (b) study controls for any additional factor (These criteria could be modified to indicate specific control for a second important factor.) ★

Exposure**(1) Ascertainment of exposure**

- (a) secure record (eg surgical records) ★
- (b) structured interview where blind to case/control status ★
- (c) interview not blinded to case/control status
- (d) written self-report or medical record only
- (e) no description

(2) Same method of ascertainment for cases and controls

- (a) yes ★
- (b) no

(3) Non-Response rate

- (a) same rate for both groups ★
- (b) non respondents described
- (c) rate different and no designation

Cohort Studies

Selection

(1) Representativeness of the exposed cohort

- (a) truly representative of the average _____ (describe) in the community ★
- (b) somewhat representative of the average _____ in the community ★
- (c) selected group of users e.g., nurses, volunteers
- (d) no description of the derivation of the cohort

(2) Selection of the non-exposed cohort

- (a) drawn from the same community as the exposed cohort ★
- (b) drawn from a different source
- (c) no description of the derivation of the non-exposed cohort

(3) Ascertainment of exposure

- (a) secure record (e.g., surgical records) ★
- (b) structured interview ★

(c) written self-report

(d) no description

(4) Demonstration that outcome of interest was not present at start of study

(a) yes ★

(b) no

Comparability

(1) Comparability of cohorts on the basis of the design or analysis

(a) study controls for _____ (select the most important factor) ★

(b) study controls for any additional factor (These criteria could be modified to indicate specific control for a second important factor.) ★

Outcome

(1) Assessment of outcome

(a) independent blind assessment ★

(b) record linkage ★

(c) self-report

(d) no description

(2) Was follow-up long enough for outcomes to occur

(a) yes (select an adequate follow up period for outcome of interest) ★

(b) no

(3) Adequacy of follow up of cohorts

(a) complete follow up - all subjects accounted for ★

(b) subjects lost to follow up unlikely to introduce bias - small number lost > ____ %

(select an adequate % follow up, or description provided of those lost) ★

(c) follow up rate < ____ % (select an adequate %) and no description of those lost

(d) no statement

Note: A study can be awarded a maximum of one star for each numbered item within

the Selection and Exposure categories. A maximum of two stars can be given for Comparability.

Good quality: 3 or 4 stars in selection domain AND 1 or 2 stars in comparability domain AND 2 or 3 stars in outcome/exposure domain.

Fair quality: 2 stars in selection domain AND 1 or 2 stars in comparability domain AND 2 or 3 stars in outcome/exposure domain.

Poor quality: 0 or 1 star in selection domain OR 0 stars in comparability domain OR 0 or 1 stars in outcome/exposure domain.

Supplementary Table 2. The 11-item Checklist Recommended by Agency for**Healthcare Research and Quality (AHRQ)**

AHRQ - Checklist for cross-sectional studies/ "yes" or "no" or "unclear"

1. Define source of information (survey, record, review).
 2. List inclusion and exclusion criteria for exposed and unexposed subjects (cases and controls) or refer to previous publications.
 3. Indicate time period used for identifying patients.
 4. Indicate whether or not subjects were consecutive if not population-based.
 5. Indicate if evaluators of subjective components of study were masked to other aspects of the status of the participants.
 6. Describe any assessments undertaken for quality assurance purposes (e.g., test/retest of primary outcome measurements).
 7. Explain any patient exclusions from analysis.
 8. Describe how confounding was assessed and/or controlled.
 9. If applicable, explain how missing data were handled in the analysis.
 10. Summarize patient response rates and completeness of data collection.
 11. Clarify what follow-up, if any, was expected and the percentage of patients for which incomplete data or follow-up was obtained.
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Supplementary Table 3. The Newcastle-Ottawa Quality Assessment Scale for Case-Control or Cohort Studies

Cohort Studies									
Study	Representativeness of the exposed cohort	Selection of the non-exposed cohort	Ascertainment of exposure	Demonstration that outcome of interest was not present at start of study	Comparability of cohorts on the basis of the design or analysis	Assessment of outcome	Was follow-up long enough for outcomes to occur	Adequacy of follow up of cohorts	Quality Score
Brumpton et al. ¹	★	★	0	★	★★	★	★	★	8
Bakour et al. ²	★	★	0	★	★★	0	★	★	8
Zhang et al. ³	★	★	0	★	★★	0	★	★	7
Lin et al. ⁴	★	★	★	★	★	★	★	★	8
Chen et al. ⁵	★	★	0	★	★	0	★	★	6

Supplementary Table 4. The AHRQ Checklist for Cross-sectional Studies

	1	2	3	4	5	6	7	8	9	10	11
Han et al. ⁶	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	No	No
Bakour et al. ⁷	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	No
Björnsdóttir et al. ⁸	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	No	No
Dashti et al. ⁹	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	No
Dai et al. ¹⁰	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	No	No
Choi et al. ¹¹	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	No	No
Nutakor et al. ¹²	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	No
Stangenes et al. ¹³	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	No	No
Seow et al. ¹⁴	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	No	No
Blank et al. ¹⁵	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	No
Lim et al. ¹⁶	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	No
Estanislau et al. ¹⁷	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	No	No
Gureje et al. ¹⁸	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	Yes
Basnet et	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	No

al. ¹⁹											
Ma et al. ²⁰	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	No
Chen et al. ²¹	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	No
Chen et al. ²²	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes
Hu et al. ²³	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	No

Reference

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