

# Scoping Review, Systematic Review & Meta-Analysis


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PART 1

**SCOPING REVIEW**

PART 2

**SYSTEMATIC REVIEW & META-ANALYSIS**

TODAY

PART 2



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# Systematic Review & Meta-Analysis

# Today's Focus

## 1 What

What is Systematic Review & Meta-Analysis?

Definition

## 2 Why

Why Systematic Review & Meta-Analysis?

- Indication
- Scoping review vs Systematic review

## 3 How

How to conduct Systematic Review & Meta-Analysis?

- 5 tips
- 7 steps

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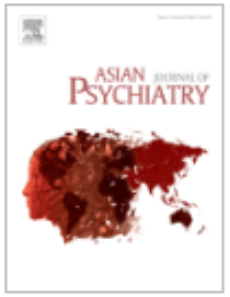
Asian Journal of Psychiatry

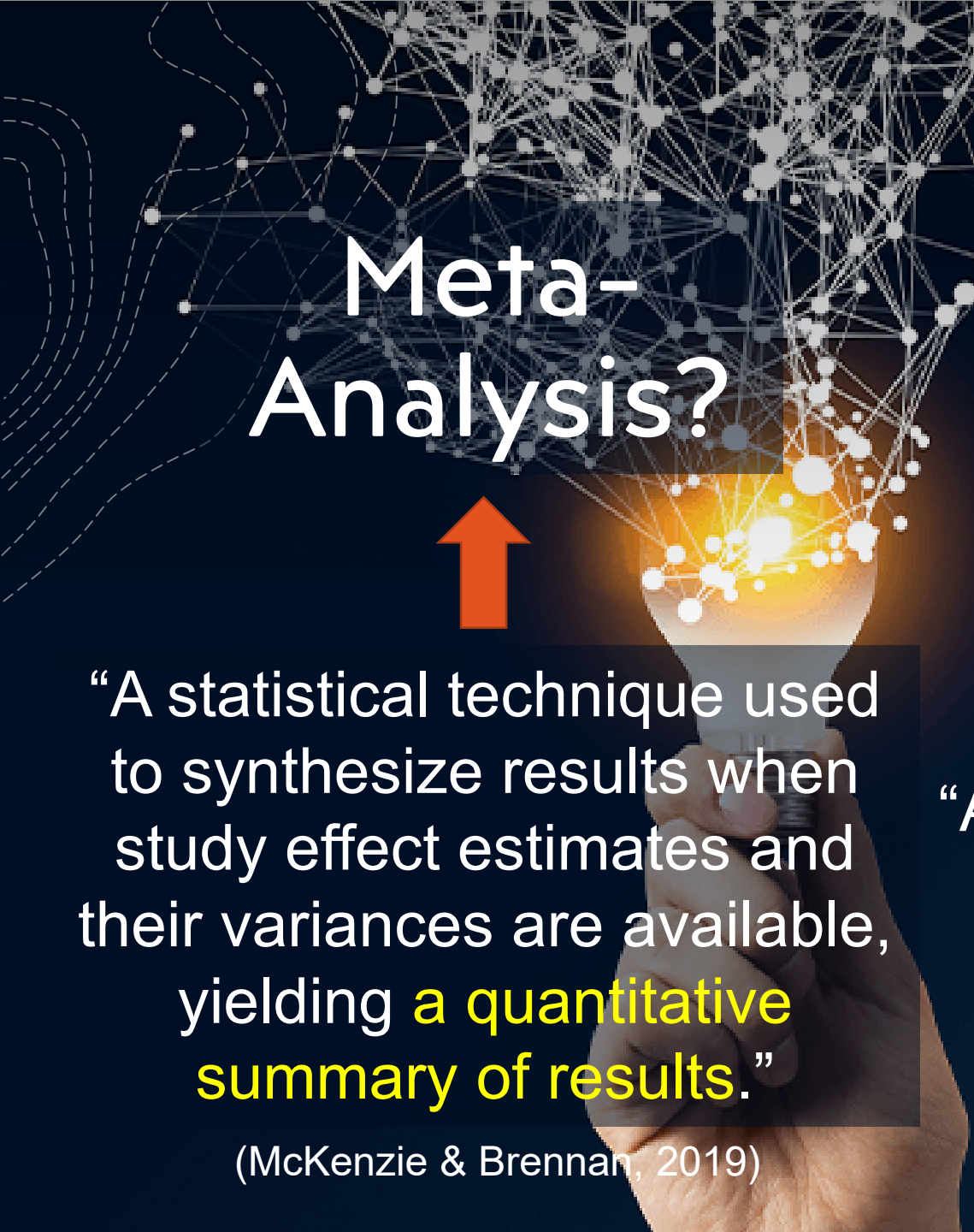
Volume 69, March 2022, 102997




# Mindfulness-based interventions reducing and preventing stress and burnout in medical students: A systematic review and meta-analysis

Chayamai Hathaisaard [a b 1], Kamonporn Wannarit [a], Keerati Pattanaseri [a 2]

Aneez Esmail, professor [1], Maria Panagioti,, senior lecturer [1 2]



1 What is SRMA?

# Meta-Analysis?

"A statistical technique used to synthesize results when study effect estimates and their variances are available, yielding a quantitative summary of results."

(McKenzie & Brennan, 2019)

# Systematic Review?

## 'Systematic' & 'Review'

"A review that uses explicit, systematic methods to collate and synthesise findings of studies that address a clearly formulated question."

(Higgins et al., 2019)

# How to get a topic?

Think about clinical or research areas that you are passionate about and would like to explore in depth

**Clinical or Research Interest**

Choose areas that have the potential to inform decision-making, fill knowledge gaps, or address important research questions in your field

**Potential Impact**

Choose an area that is sufficiently narrow and focused to be manageable within the available resources and time frame.

**Scope and Manageability**

Consider areas where research is lacking, conflicting evidence, or outdated findings.

**Gap in the Literature**

Discuss potential topics with experts or collaborators who may offer insights, expertise, or alternative perspectives on relevant research questions.

**Consultation and Collaboration**

# 2 Scoping review vs Systematic review

| Features | Scoping review | Systematic review |
|---|---|---|
| Review question | What are the effective teaching strategies in surface anatomy? | What are the roles of work-based learning in surface anatomy curriculum? |
| Sources | All literature related to teaching strategies in surface anatomy that has been proven effective | Literature limited to work-based learning in surface anatomy |
| Selection criteria | ▪ Arskey & O'Malley (2005)<br>▪ Extended SR protocol (Levac et al. 2010)<br>▪ PRISMA-ScR (Tricco et al., 2018)<br>▪ JBI scoping review methodology (JBI, 2015, 2022) | The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) |
| Data evaluation and synthesis | A standalone review or a precursor for a systematic review | A standalone review or a pre-requisite for meta-analysis |
| Provision of implications for practice | Systematic review should be conducted if the authors want to make specific recommendation for practice | |

# Important Notice!

**Explore systematic review registries** such as PROSPERO (for health-related systematic reviews) **to identify ongoing or recently completed reviews on similar topics**. This can help avoid duplication of effort and identify areas where additional research is needed.

3 Conducting SRMA

# How to produce a publishable systematic review and/or meta-analysis?

- Tip 1: Explore the area of SRMA
- Tip 2: Provide a clear title
- Tip 3: Comply to the latest guideline
- Tip 4: Publish your protocol
- Tip 5: Write a good SRMA

# Tip 1: Explore Area

# Tip 2: Clear Title

**Example:**
Mindfulness-based interventions reducing and preventing stress and burnout in medical students: A systematic review and meta-

Intervention

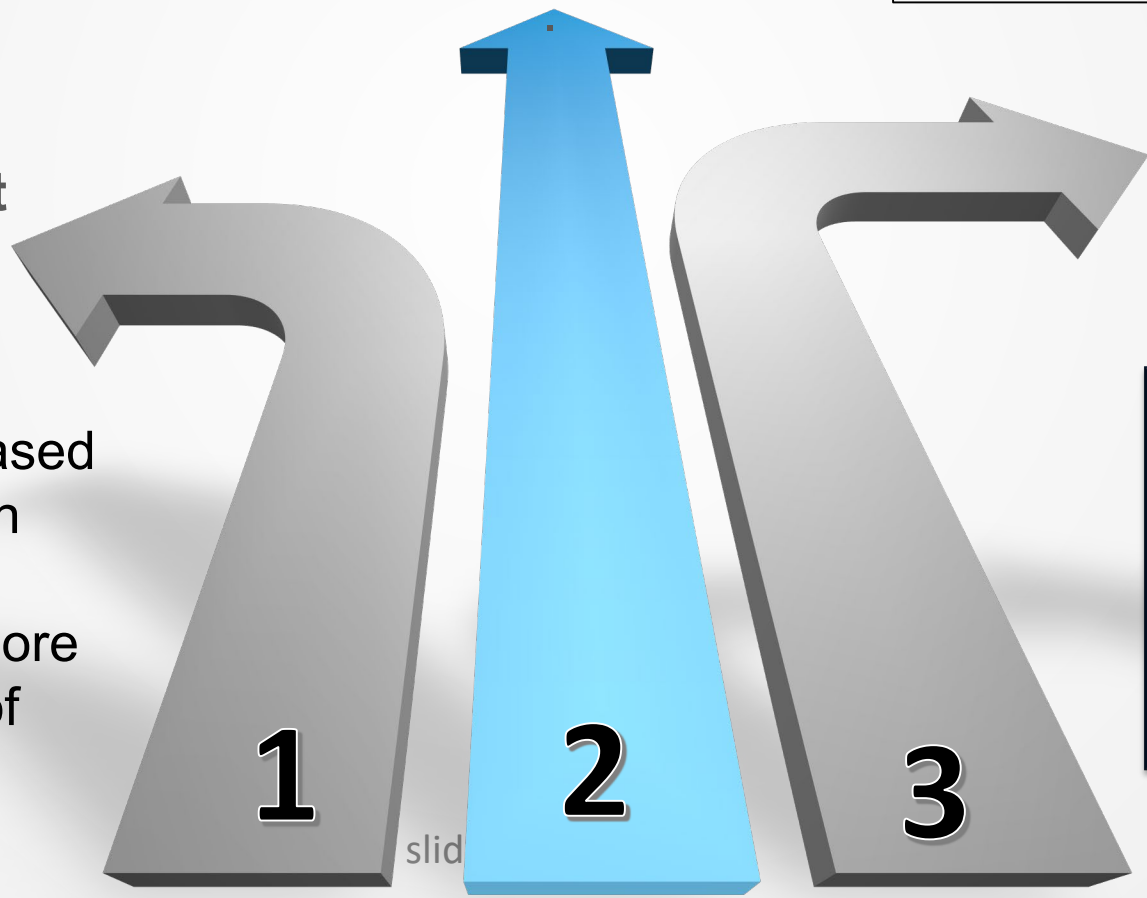
Outcome

Population

The title should include the phrase: "…: **a systematic review**".

**Clear, explicit** and reflect the **core elements** of the review

- Titles should **not** be phrased as question or conclusion
- The title should not be more than 25 words for ease of understanding




**Congruent with the review objectives, questions, and inclusion criteria (PICO mnemonic)**

"PICO" mnemonic:
- Population
- Intervention
- Comparison
- Outcome

# Tip 3: Comply with latest guideline

PRISMA 2009
(Moher et al., 2009)

It is a systematic approach to the conduct and reporting of the review and allows transparency of process (From authors' details until writing conclusion)

PRISMA 2020
(Page et al., 2021)

The PRISMA 2020 statement replaces the 2009 statement and includes new reporting guidance that reflects advances in methods to identify, select, appraise, and synthesise studies.

# The PRISMA 2020 statement: an updated guideline for reporting systematic reviews

Matthew J Page,[1] Joanne E McKenzie,[1] Patrick M Bossuyt,[2] Isabelle Boutron,[3] Tammy C Hoffmann,[4] Cynthia D Mulrow,[5] Larissa Shamseer,[6] Jennifer M Tetzlaff,[7] Elie A Akl,[8] Sue E Brennan,[1] Roger Chou,[9] Julie Glanville,[10] Jeremy M Grimshaw,[11] Asbjørn Hróbjartsson,[12] Manoj M Lalu,[13] Tianjing Li,[14] Elizabeth W Loder,[15] Evan Mayo-Wilson,[16] Steve McDonald,[1] Luke A McGuinness,[17] Lesley A Stewart,[18] James Thomas,[19] Andrea C Tricco,[20] Vivian A Welch,[21] Penny Whiting,[17] David Moher[22]

For numbered affiliations see end of the article.

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Additional material is published online only. To view please visit the journal online.

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**Accepted:** 4 January 2021

The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement, published in 2009, was designed to help systematic reviewers transparently report why the review was done, what the authors did, and what they found. Over the past decade, advances in systematic review methodology and terminology have necessitated an update to the guideline. The PRISMA 2020 statement replaces the 2009 statement and includes new reporting guidance that reflects advances in methods to identify, select, appraise, and synthesise studies. The structure and presentation of the items have been modified to facilitate implementation. In this article, we present the PRISMA 2020 27-item checklist, an expanded checklist that details reporting recommendations for each item, the PRISMA 2020 abstract checklist, and the revised flow diagrams for original and updated reviews.

Systematic reviews serve many critical roles. They can provide syntheses of the state of knowledge in a field, from which future research priorities can be identified; they can address questions that otherwise could not be answered by individual studies; they can identify problems in primary research that should be rectified in future studies; and they can generate or evaluate theories about how or why phenomena occur. Systematic reviews therefore generate various types of knowledge for different users of reviews (such as patients, healthcare providers, researchers, and policy makers).[1 2] To ensure a systematic review is valuable to users, authors should prepare a transparent, complete, and accurate account of why the review was done, what they did (such as how studies were identified and selected) and what they found (such as characteristics of contributing studies and results of meta-analyses). Up-to-date reporting guidance facilitates authors achieving this.[3]

The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement published in 2009 (hereafter referred to as PRISMA 2009)[4-10] is a reporting guideline designed to address poor reporting of systematic reviews.[11] The PRISMA 2009 statement comprised a checklist of 27 items recommended for reporting in systematic reviews and an "explanation and elaboration" paper[12-16] providing additional reporting guidance for each item, along with

# 7 Steps to conduct systematic review and meta-analysis (PRISMA 2020):

- Step 1: Develop a protocol
- Step 2: Formulate research objectives/question
- Step 3: Searching for relevant studies
- Step 4: Screening and study selection
- Step 5: Data extraction
- Step 6: Quality assessment
- Step 7: Data synthesis and meta-analysis

# Steps to conduct SRMA (PRISMA 2020):

**Step 1: Develop a protocol**

Step 2: Formulate research objectives/questions

Step 3: Searching for relevant studies

Step 4: Screening and study selection

Step 5: Data extraction

Step 6: Quality assessment

Step 7: Data synthesis and meta-analysis

Moher *et al. Systematic Reviews* 2015, 4:1
http://www.systematicreviewsjournal.com/content/4/1/1

SYSTEMATIC REVIEWS

RESEARCH Open Access

## Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement

David Moher[1*], Larissa Shamseer[1], Mike Clarke[2], Davina Ghersi[3], Alessandro Liberati[^], Mark Petticrew[4], Paul Shekelle[5], Lesley A Stewart[6] and PRISMA-P Group

**Abstract**

Systematic reviews should build on a protocol that describes the rationale, hypothesis, and planned methods of the review; few reviews report whether a protocol exists. Detailed, well-described protocols can facilitate the understanding and appraisal of the review methods, as well as the detection of modifications to methods and selective reporting in completed reviews. We describe the development of a reporting guideline, the Preferred Reporting Items for Systematic reviews and Meta-Analyses for Protocols 2015 (PRISMA-P 2015). PRISMA-P consists of a 17-item checklist intended to facilitate the preparation and reporting of a robust protocol for the systematic review. Funders and those commissioning reviews might consider mandating the use of the checklist to facilitate the submission of relevant protocol information in funding applications. Similarly, peer reviewers and editors can use the guidance to gauge the completeness and transparency of a systematic review protocol submitted for publication in a journal or other medium.

**2) REGISTER OR PUBLISH THE PROTOCOL:**

- Review teams should indicate where this can be accessed (Journal or Open Access Repository)

# Steps to conduct SRMA (PRISMA 2020):

**Step 1: Develop a protocol**

Step 2: Formulate research objectives/questions

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Step 5: Data extraction

Step 6: Quality assessment

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## PRISMA-P 2015 Checklist

This checklist has been adapted for use with systematic review protocol submissions to BioMed Central journals from Table 3 in Moher D et al: Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic Reviews* 2015 4:1

An Editorial from the Editors-in-Chief of *Systematic Reviews* details why this checklist was adapted - Moher D, Stewart L & Shekelle P: Implementing PRISMA-P: recommendations for prospective authors. *Systematic Reviews* 2016 5:15

| Section/topic | # | Checklist item | Information reported | | Line number(s) |
|---|---|---|---|---|---|
| | | | Yes | No | |
| **ADMINISTRATIVE INFORMATION** | | | | | |
| **Title** | | | | | |
| Identification | 1a | Identify the report as a protocol of a systematic review | ☒ | ☐ | 2-3 |
| Update | 1b | If the protocol is for an update of a previous systematic review, identify as such | ☐ | ☒ | |
| **Registration** | 2 | If registered, provide the name of the registry (e.g., PROSPERO) and registration number in the Abstract | ☒ | ☐ | 60-61 |
| **Authors** | | | | | |
| Contact | 3a | Provide name, institutional affiliation, and e-mail address of all protocol authors; provide physical mailing address of corresponding author | ☒ | ☐ | 5-32 |
| Contributions | 3b | Describe contributions of protocol authors and identify the guarantor of the review | ☒ | ☐ | 342 |
| **Amendments** | 4 | If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments | ☐ | ☒ | |
| **Support** | | | | | |
| Sources | 5a | Indicate sources of financial or other support for the review | ☒ | ☐ | 337-339 |
| Sponsor | 5b | Provide name for the review funder and/or sponsor | ☒ | ☐ | 339 |
| Role of sponsor/funder | 5c | Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol | ☒ | ☐ | 339-340 |
| **INTRODUCTION** | | | | | |
| **Rationale** | 6 | Describe the rationale for the review in the context of what is already known | ☒ | ☐ | 65-165 |

BioMed Central
The Open Access Publisher

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- Review teams should indicate where this can be accessed (Journal or Open Access Repository)

# Steps to conduct SRMA (PRISMA 2020):

**Step 1: Develop a protocol**

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| Section/topic | # | Checklist item | Information reported | | Line number(s) |
|---|---|---|---|---|---|
| | | | Yes | No | |
| **Objectives** | 7 | Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO) | ☒ | ☐ | 138-165 |
| **METHODS** | | | | | |
| **Eligibility criteria** | 8 | Specify the study characteristics (e.g., PICO, study design, setting, time frame) and report characteristics (e.g., years considered, language, publication status) to be used as criteria for eligibility for the review | ☒ | ☐ | 198-222 |
| **Information sources** | 9 | Describe all intended information sources (e.g., electronic databases, contact with study authors, trial registers, or other grey literature sources) with planned dates of coverage | ☒ | ☐ | 177-184 |
| **Search strategy** | 10 | Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated | ☒ | ☐ | 186-196 |
| ***STUDY RECORDS*** | | | | | |
| Data management | 11a | Describe the mechanism(s) that will be used to manage records and data throughout the review | ☒ | ☐ | 194-196 |
| Selection process | 11b | State the process that will be used for selecting studies (e.g., two independent reviewers) through each phase of the review (i.e., screening, eligibility, and inclusion in meta-analysis) | ☒ | ☐ | 224-231 |
| Data collection process | 11c | Describe planned method of extracting data from reports (e.g., piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators | ☒ | ☐ | 233-250 |
| **Data items** | 12 | List and define all variables for which data will be sought (e.g., PICO items, funding sources), any pre-planned data assumptions and simplifications | ☒ | ☐ | 241-249 |
| **Outcomes and prioritization** | 13 | List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale | ☒ | ☐ | 141-159, 263-264, 273-287 |
| **Risk of bias in individual studies** | 14 | Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis | ☒ | ☐ | 252-260 |
| ***DATA*** | | | | | |
| **Synthesis** | 15a | Describe criteria under which study data will be quantitatively synthesized | ☒ | ☐ | 262-287 |
| | 15b | If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data, and methods of combining data from studies, including any planned exploration of consistency (e.g., $I^2$, Kendall's tau) | ☒ | ☐ | 262-301 |

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**2) REGISTER OR PUBLISH THE PROTOCOL:**

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# Steps to conduct SRMA (PRISMA 2020):

**Step 1: Develop a protocol**

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Step 5: Data extraction

Step 6: Quality assessment

Step 7: Data synthesis and meta-analysis

| Section/topic | # | Checklist item | Information reported | | Line number(s) |
|---|---|---|---|---|---|
| | | | Yes | No | |
| | 15c | Describe any proposed additional analyses (e.g., sensitivity or subgroup analyses, meta-regression) | ☒ | ☐ | 273-287 |
| | 15d | If quantitative synthesis is not appropriate, describe the type of summary planned | ☐ | ☒ | |
| **Meta-bias(es)** | 16 | Specify any planned assessment of meta-bias(es) (e.g., publication bias across studies, selective reporting within studies) | ☒ | ☐ | 296-301 |
| **Confidence in cumulative evidence** | 17 | Describe how the strength of the body of evidence will be assessed (e.g., GRADE) | ☒ | ☐ | 298-301 |

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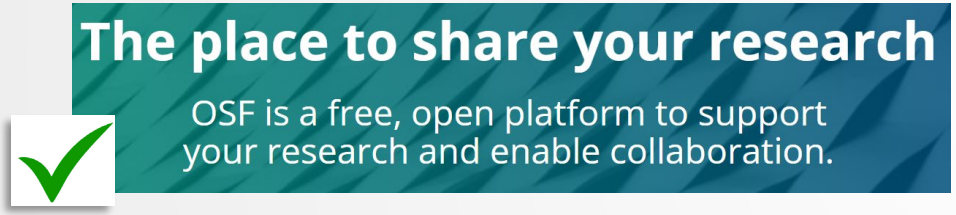
**2) REGISTER OR PUBLISH THE PROTOCOL:**

- Review teams should indicate where this can be accessed (Journal or Open Access Repository)

# Where to register the protocol?


SRMA is commonly registered in the PROSPERO




**Open Science Framework** ( https://osf.io/)


**figshare** (https://osf.io/)


**Research gate**


**Protocol exchange**


**Scientific Protocols**

# Example of Registered Protocol

https://www.crd.york.ac.uk/PROSPERO/

NIHR | National Institute for Health and Care Research

PROSPERO
International prospective register of systematic reviews

Home | About PROSPERO | How to register | Service information | Search | Log in | Join

Click to **show your search history and hide search results**. Open the **Filters** panel to find records with specific characteristics (e.g. all reviews about cancer or all diagnostic reviews etc). See our **Guide to Searching** for more details.

Click to **hide the standard search and use the Covid-19 filters.**

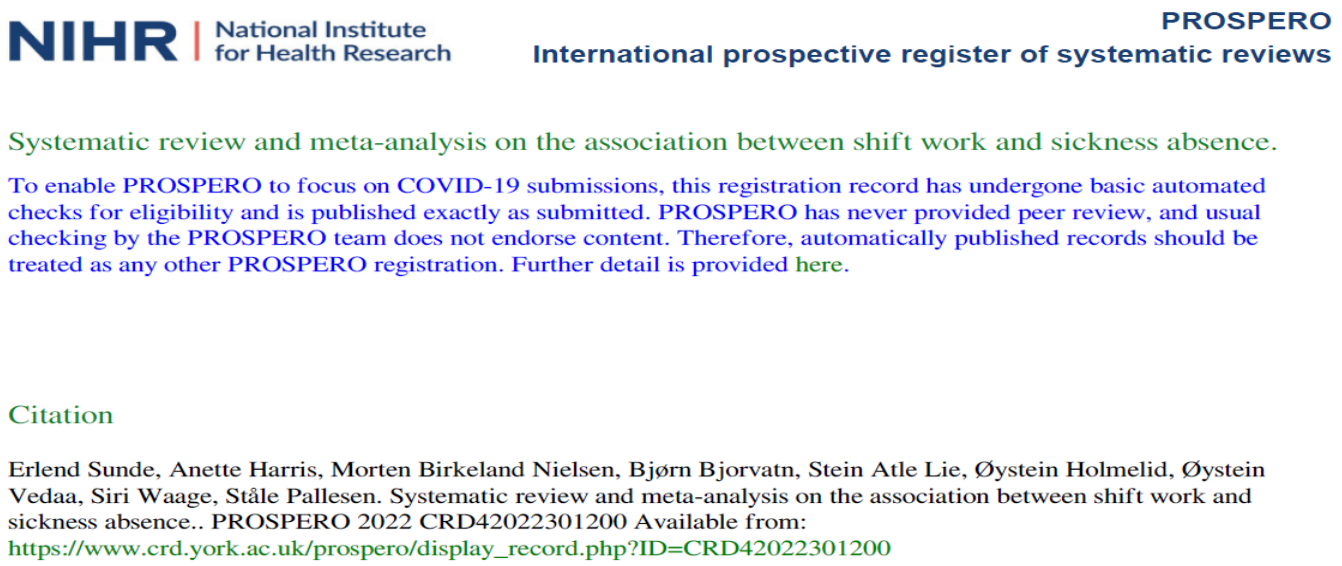
CRD42022301200 | Go | MeSH | Clear filters | Show filters

First | Previous | Next | Last (page 1 of 1)

**1** record found for **CRD42022301200**

Show checked records only | Export

| Registered | Title | Type | Review status |
|---|---|---|---|
| 04/03/2022 | Systematic review and meta-analysis on the association between shift work and sickness absence. [CRD42022301200] | | Review Ongoing |



NIHR | National Institute for Health Research

PROSPERO
International prospective register of systematic reviews

## Systematic review and meta-analysis on the association between shift work and sickness absence.

To enable PROSPERO to focus on COVID-19 submissions, this registration record has undergone basic automated checks for eligibility and is published exactly as submitted. PROSPERO has never provided peer review, and usual checking by the PROSPERO team does not endorse content. Therefore, automatically published records should be treated as any other PROSPERO registration. Further detail is provided here.

## Citation

Erlend Sunde, Anette Harris, Morten Birkeland Nielsen, Bjørn Bjorvatn, Stein Atle Lie, Øystein Holmelid, Øystein Vedaa, Siri Waage, Ståle Pallesen. Systematic review and meta-analysis on the association between shift work and sickness absence.. PROSPERO 2022 CRD42022301200 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42022301200

# Example of Published Protocol

Sunde *et al. Systematic Reviews* (2022) 11:143
https://doi.org/10.1186/s13643-022-02020-4

Systematic Reviews

PROTOCOL Open Access

## Protocol for a systematic review and meta-analysis on the associations between shift work and sickness absence

Erlend Sunde[1*], Anette Harris[1], Morten Birkeland Nielsen[1,2], Bjørn Bjorvatn[3,4], Stein Atle Lie[5,6], Øystein Holmelid[1], Øystein Vedaa[1,7], Siri Waage[1,4] and Ståle Pallesen[1,4,8]

**Abstract**

**Background:** Shift work, i.e., non-standard work hours, has been associated with both short- and long-term sickness absence. However, findings are inconsistent and inconclusive. Thus far, no comprehensive meta-analytic synthesis on the relationship between shift work and sickness absence has been published. The aims of the planned systematic review and meta-analysis are (1) to establish whether shift work is associated with sickness absence, (2) to determine if specific shift work characteristics relate to sickness absence (e.g., length and frequency of spells), and (3) to identify moderating factors affecting the relationship between shift work and sickness absence.

**Methods:** Eligible studies will be identified using a predefined search strategy in several electronic databases (MEDLINE, Web of Science, PsychInfo, EMBASE, and ProQuest) and comprise peer-reviewed papers reporting original empirical findings on the association between shift work and sickness absence. Mainly observational studies with cross-sectional, prospective, or retrospective research design and case-control studies will be included. Risk of bias will be assessed using an adapted checklist previously employed to evaluate studies on sickness absence. To carry out the meta-analytic synthesis, a random effects meta-analysis will be conducted using the Comprehensive Meta-Analysis software. The review and meta-analysis will be reported according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines. Heterogeneity will be evaluated by *Cochran's Q test* and the $I^2$ statistics.

**Discussion:** The review and meta-analysis will be the first to conduct a meta-analytic synthesis of the evidence on the association between exposure to shift work and sickness absence, as well as identify relevant moderators affecting the relationship between shift work and sickness absence. Aggregation of the existing evidence will improve the knowledge on the association between shift work and sickness absence. Such knowledge can be used to guide scheduling of shift work to promote work schedules that are less detrimental to health and contribute to reduced sickness absence and higher work- and leisure-time productivity.

**Systematic review registration:** PROSPERO CRD42022301200

**Keywords:** Working time, Work hour, Sick leave, Absenteeism, Presenteeism

# Where to publish the SRMA protocol ?

BMC Part of Springer Nature

Search Explore journals

## Systematic Reviews

Home About Articles Submission Guidelines

Search articles within this journal

### Call for papers: The role of systematic reviews in evidence-based research

*Systematic Reviews* invites submissions of manuscripts to our new thematic series highlighting the contribution that systematic reviews make in evidence-based research.

We welcome submissions of research articles, systematic reviews, methodology and commentaries.

## BMJ Open

Latest content Archive For authors

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### About

| Acceptance rate: | Time to first decision with review (median): | Impact Factor (JCR): | Impact Factor rank: | 2021 total content views: |
|---|---|---|---|---|
| 43% | 126 days* | 3.007 | 85/172 | 8,743,575 |

Step 1: Develop a protocol

**Step 2: Formulate research objectives/questions**

Step 3: Searching for relevant studies

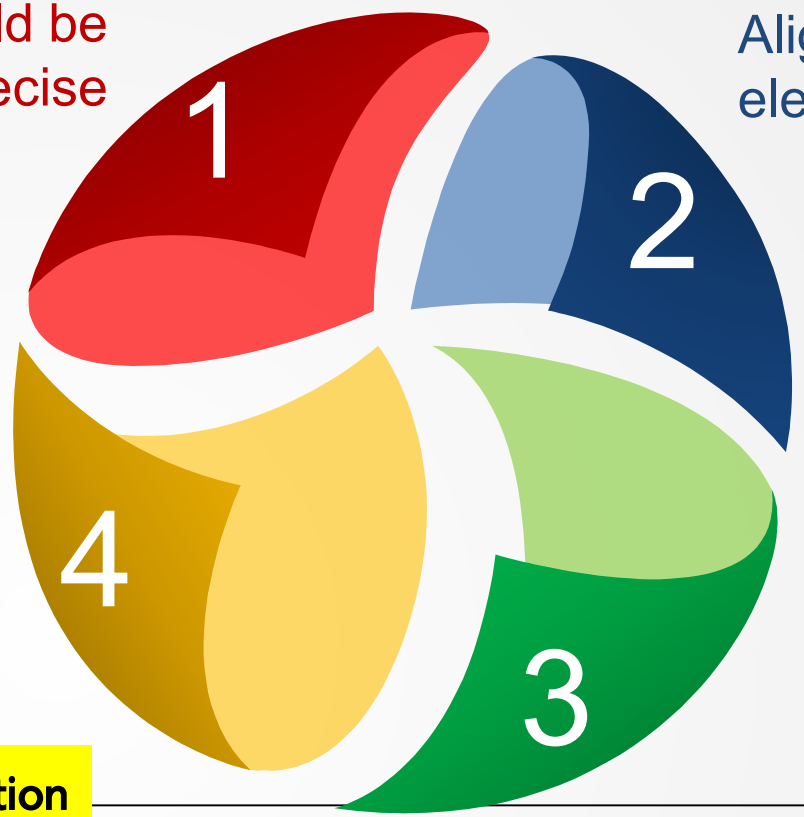
Step 4: Screening and study selection

Step 5: Data extraction

Step 6: Quality assessment

Step 7: Data synthesis and meta-analysis

RQ should be clear & precise




Align RO/RQ with PICO elements (just like title)

Use RO/RQ to inform inclusion criteria

1 primary RO/RQ is adequate (add sub-RO/RQ if want to emphasize more attribute)

**Topic:**

Mindfulness-based interventions reducing and preventing stress and burnout in medical students: A systematic review and meta-analy

Intervention

Outcome

Population

**RESEARCH QUESTION:**

"The aims were to obtain more reliable outcomes and to precisely summarize the specific interventions which effectively reduce the stress levels and burnout of medical students."

Intervention

Outcome

Population

## CONSTRUCT INCLUSION CRITERIA

- Use **PICO (Population, Intervention, Comparison & Intervention)** & include inclusion criteria for **evidence sources.**

1) **Population (P):** Important characteristics of participants or group being studied (e.g. age, gender, setting, and other criteria related to RQ).

1) **Intervention (I):** the intervention or exposure being evaluated.

2) **Comparison (C):** the comparison group or intervention against which the intervention or exposure is being evaluated.

3) **Outcome (O):** the outcome(s) of interest that the researcher wants to measure or observe (e.g., academic performance, quality of life and other outcome related to RQ).

# Interventions on medical students' psychological health: A meta-analysis

**RQ: To what extent are stress management interventions for training medical students associated with improved psychological outcomes in comparison to no intervention?**

**EXAMPLE OF INCLUSION CRITERIA**

1) **Population (P):** Medical students at any stage in medical training

2) **Intervention (I):** Stress management intervention

3) **Comparison (C):** Not receive any intervention

4) **Outcomes (O)**: Psychological outcomes - GPD, stress, anxiety and depression

# Steps to conduct SRMA (PRISMA 2020):

Step 1: Develop a protocol

Step 2: Formulate research objectives/questions

**Step 3: Searching for relevant studies**

Step 4: Screening and study selection

Step 5: Data extraction

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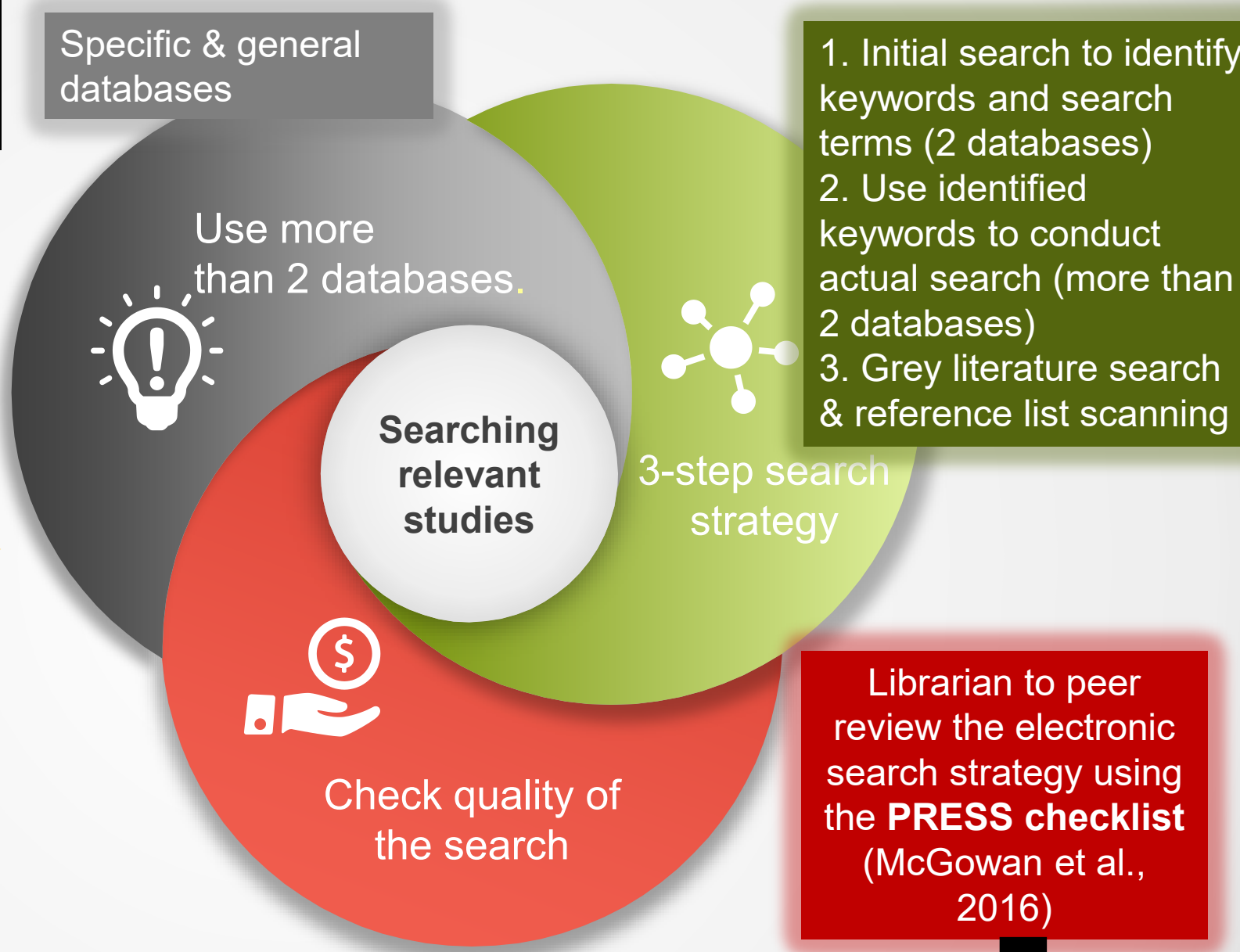
Step 7: Data synthesis and meta-analysis




1. Initial search to identify keywords and search terms (2 databases)
2. Use identified keywords to conduct actual search (more than 2 databases)
3. Grey literature search & reference list scanning

Librarian to peer review the electronic search strategy using the **PRESS checklist** (McGowan et al., 2016)

**Peer-reviewed Electronic Search Strategies (PRESS) checklist**

# Steps to conduct SRMA (PRISMA 2020):

Step 1: Develop a protocol

Step 2: Formulate research objectives/questions

Step 3: Searching for relevant studies

**Step 4: Screening and study selection**

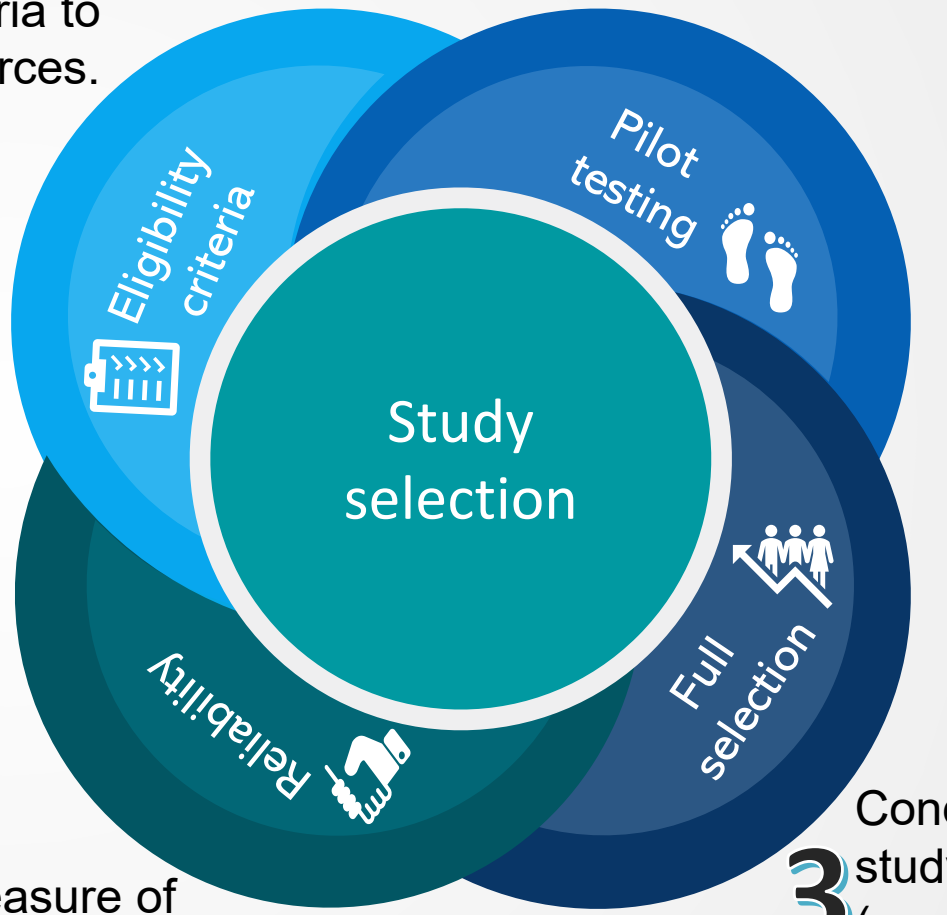
Step 5: Data extraction

Step 6: Quality assessment

Step 7: Data synthesis and meta-analysis

**1** Use predefined eligibility criteria to select resources.

**2**
- 2 researchers independently screen the titles & abstracts
- Disagreement is resolved through discussion or involvement of 3rd researcher




**3** Conduct actual study selection (same procedure to search for title, abstract and full articles)

**4** Include a measure of agreement (Kappa)

# Steps to conduct SRMA (PRISMA 2020):

Step 1: Develop a protocol

Step 2: Formulate research objectives/questions

Step 3: Searching for relevant studies

Step 4: Screening and study selection

**Step 5: Data extraction**

Step 6: Quality assessment

Step 7: Data synthesis and meta-analysis

Construct a predefined Data extraction form

↓

Construct a pilot data charting (similar as in study selection)

↓

Conduct data charting

- Authors
- Title
- Year published
- Study population (& sample size)
- Geographical distribution
- Methodology adopted
- Study aim
- Key findings
- Study duration
- Gaps
- Intervention type

# Example of data extraction form

**Table 2: Example of a basic draft extraction tool**

| Source of evidence (citation) | Year | Country | Participants | | Cancer | | Treat-ment/s | Screening tool/s (+ validated Y/N) | Assessment tool/s (+ validated Y/N) |
|---|---|---|---|---|---|---|---|---|---|
| | | | Sex | Age | Type | Stage | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

Example of quantitative data extraction table for meta-analysis

**Table 2: Types of intervention and data extracted for each study.**

| Study | Types of intervention (duration) | Types of data extracted for effect size calculation |
|---|---|---|
| Kelly et al. (1982) | Stress Management Seminar (short) | Mean, SD, sample size |
| Holtzworth-Munroe et al. (1985) | Stress Management Training Course (medium) | *F*-statistical value, sample size |
| Michie and Sandhu (1994) | Stress Management Course (short) | Mean, SD, sample size |
| Whitehouse et al. (1996) | Self-Hypnosis Training (long) | *t*-statistical value, sample size (Stress)<br>*F*-statistical value, sample size (Anxiety) |
| Shapiro et al. (1998) | The Mindfulness Based Stress Reduction (medium) | *F*-statistical value, sample size |
| Rosenwieg et al. (2003) | The Mindfulness Based Stress Reduction (long) | Mean, SD, sample size |
| Jain et al. (2007) | 1. Mindfulness Meditation (short)<br>2. Somatic Relaxation (short) | Mean, SD, sample size |
| Finkelstein et al. (2007) | The Mind–Body Medicine: An Experiential Elective (long) | *F*-statistical value, sample size |
| Holm et al. (2010) | 1. Self-Development Group (long)<br>2. Discussion Group (long) | Mean, SD, sample size |
| Yusoff (2011) | Medical Student Wellbeing Workshop (brief) | Mean, SD, sample size |
| Warnecke et al. (2011) | Mindfulness Practice (medium) | Mean difference, 95% confidence interval of mean difference, sample size |
| McGrady et al. (2012) | A Wellness Program (long) | Mean, SD, sample size |
| Yusoff et al. (unpublished) | A workshop based on the DEAL Model (brief) | Mean, SD, sample size |

SD = standard deviation.

# Steps to conduct SRMA (PRISMA 2020):

Step 1: Develop a protocol

Step 2: Formulate research objectives/questions

Step 3: Searching for relevant studies

Step 4: Screening and study selection

Step 5: Data extraction

**Step 6: Quality assessment**

Step 7: Data synthesis and meta-analysis

Whiting *et al. Systematic Reviews* (2017) 6:204
DOI 10.1186/s13643-017-0604-6

Systematic Reviews

METHODOLOGY Open Access

## A proposed framework for developing quality assessment tools

Penny Whiting[1,2*], Robert Wolff[3], Susan Mallett[4,5], Iveta Simera[6] and Jelena Savović[1,2]

**Abstract**

**Background:** Assessment of the quality of included studies is an essential component of any systematic review. A formal quality assessment is facilitated by using a structured tool. There are currently no guidelines available for researchers wanting to develop a new quality assessment tool.

**Methods:** This paper provides a framework for developing quality assessment tools based on our experiences of developing a variety of quality assessment tools for studies of differing designs over the last 14 years. We have also drawn on experience from the work of the EQUATOR Network in producing guidance for developing reporting guidelines.

**Results:** We do not recommend a single 'best' approach. Instead, we provide a general framework with suggestions as to how the different stages can be approached. Our proposed framework is based around three key stages: initial steps, tool development and dissemination.

**Conclusions:** We recommend that anyone who would like to develop a new quality assessment tool follow the stages outlined in this paper. We hope that our proposed framework will increase the number of tools developed using robust methods.

**Keywords:** Risk of bias, Systematic reviews, Quality

# Quality Assessment

"The validity of a systematic review ultimately depends on the scientific method of the retrieved studies and the reporting of data."

Margaliot, Zvi, Kevin C. Chung. "Systematic Reviews: A Primer for Plastic Surgery Research." PRS Journal. 120/7 (2007) p.1839

Check for updates

# PRISMA 2020 explanation and elaboration: updated guidance and exemplars for reporting systematic reviews

Matthew J Page,[1] David Moher,[2] Patrick M Bossuyt,[3] Isabelle Boutron,[4] Tammy C Hoffmann,[5]

**Box 4: Assessment of risk of bias in studies and bias due to missing**

**Terminology**

The terms "quality assessment" and "critical appraisal" are often use eporting of studies.[76] In PRISMA 2020, we distinguish "quality" from "risk of b Risk of bias refers to the potential for study findings to systematically ct or analysis.[72] Quality is not well defined, but has been shown to encomp example, imprecision, reporting completeness, ethics, and applicability.[77-79] In analysis features that may lead to important bias in the findings.

Risk of bias in the results of the individual studies included in a systematic review

**Different types of risk of bias**

In PRISMA 2020, two aspects of risk of bias are considered. The first aspect is risk of bias in the results of the individual studies included in a systematic review. Empirical evidence and theoretical considerations suggest that several features of study design are associated with larger intervention effect estimates in studies; these features include inadequate generation and concealment of a random sequence to assign participants to groups, substantial loss to follow-up of participants, and unblinded outcome assessment.[80]

The second aspect is risk of bias in the result of a synthesis (such as meta-analysis) due to missing studies or results within studies. Missing studies/results may introduce bias when the decision to publish a study/result is influenced by the observed P value or magnitude or direction of the effect.[81] For example, studies wit tically non-significant results may not have been submitted for publication (publication bias), or particular results that were statistical may have been omitted from study reports (selective non-reporting bias).[82 83]

Risk of bias in the result of a synthesis (such as meta-analysis) due to missing studies or results within studies.

**Tools fo**

Many to as due to missing results.[84] Existing tools typically take the form of compos ple items which each have a numeric score attached, from which an over rs to judge risk of bias within specific domains, and to record the info onents/domains in the tool used in the review can help readers determ lity" constructs. Presenting assessments for each component/domain enables users to understand the specific components/domains that are at risk of bias in each study.

**Incorporating assessments of risk of bias in studies into the analysis**

The risk of bias in included studies should be considered in the presentation and interpretation of results of individual studies and syntheses. Different analytic strategies may be used to examine whether the risks of bias of the studies may influence the study results: (i) restricting the primary analysis to studies judged to be at low risk of bias (sensitivity analysis); (ii) stratifying studies according to risk of bias using subgroup analysis or meta-regression; or (iii) adjusting the result from each study in an attempt to remove the bias. Further details about each approach are available elsewhere.[72]

# Quality Assessment tools by study design

Appendix 1

**Table: Quality assessment of systematic reviews**

| | Type of Systematic Review Based on Primary Studies | Risk of Bias Assessment | Certainly of Evidence (Quality of Evidence) | Critical Appraisal (Quality Appraisal/Quality Assessment) | Reporting Guideline Based on Primary Studies |
|---|---|---|---|---|---|
| 1 | Prevalence/ Incidence | Assessing Risk of Bias in Prevalence Studies (Hoy et al.)[1] | Does not apply. | 1. The JBI Critical Appraisal Tool[2, 3]<br>2. AHRQ<br>3. Giannakopoulos[4] Loney[5] | STROBE and its extensions |
| 2 | Case Reports/ Case Series | Does not apply. | Does not apply. | The JBI Critical Appraisal Tools[6] | CARE |
| 3 | Observational Studies | ROBINS-E[7] | GRADE[8] | 1. NOS[5]<br>2. The JBI Critical Appraisal Tools[6]<br>3. The CASP checklist[9]<br>4. SIGN[9]<br>5. AXIS[10]<br>6. AHRQ[11]<br>7. The NIH Critical Appraisal Tools[12]<br>8. The Downs and Black Checklist[13] | STROBE and its extensions |
| 4 | Randomized Controlled Trial | The Cochrane ROB tool versions 1[14] and 2[15] | GRADE[8] | 1. The Downs and Black Checklist[13]<br>2. The CASP Checklist for RCT[9]<br>3. The NIH quality assessment tool[12]<br>4. NICE[9, 16]<br>5. Jadad[9, 17]<br>6. SIGN[18] | CONSORT[19] and its extensions |
| 5 | Non-Randomized Interventional Studies | ROBINS-I[20] | GRADE[8] | 1. The JBI Critical Appraisal tool[21]<br>2. The PEDro scale[22]<br>3. MINORS[9] | |
| 6 | Diagnostic Accuracy and prediction model | 1. QUADAS-2[23] (diagnostic accuracy studies)<br>2. PROBAST[24] (prediction model studies) | GRADE [8] | 1. The JBI Critical Appraisal tool[25]<br>2. QUADAS-1[26] & 2[23]<br>3. SIGN[18]<br>4. The CASP Checklist for diagnostic accuracy studies[9] | STARD[27] and its extensions, TRIPOD[28] |
| 7 | Animal/ *in vivo*/ pre-experimental/ preclinical | CAMARADES,[29] SYRCLE's[30] | GRADE<br>As applied by Hooijmans, de Vries et al. 2018[31] | 1. STAIR[32]<br>2. Updated STAIR[33] | ARRIVE,[34] VET-STROBE Checklist,[35] REFLECT[36] |
| 8 | Qualitative | None | GRADE-CERqual[37] | 1. The JBI Critical Appraisal tool[38]<br>2. CASP for Qualitative Studies[9, 39]<br>3. NICE[9] | SRQR,[40] COREQ[41] |
| 9 | Systematic Reviews | ROBIS | GRADE | 1. AMSTAR<br>2. JBI | PRISMA |
| 10 | Guidelines | Does not apply. | | 1. AGREE II[42, 43] | AGREE Reporting Checklist[44] |
| 11 | General Tools (May be used flexibly for different study designs) | Does not apply. | GRADE | 1. MERSQI(Medical Education)[45]<br>2. MMAT (Mixed Methods)[46]<br>3. The NIH quality assessment tool[12] | - |

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Assessment quality tool for medical education research



# Appraising the Quality of Medical Education Research Methods: The Medical Education Research Study Quality Instrument and the Newcastle–Ottawa Scale-Education

David A. Cook, MD, MHPE, and Darcy A. Reed, MD, MPH


## Abstract

**Purpose**
The Medical Education Research Study Quality Instrument (MERSQI) and the Newcastle–Ottawa Scale-Education (NOS-E) were developed to appraise methodological quality in medical education research. The study objective was to evaluate the interrater reliability, normative scores, and between-instrument correlation for these two instruments.

**Method**
In 2014, the authors searched PubMed and Google for articles using the MERSQI or NOS-E. They obtained or extracted data for interrater reliability—using the intraclass correlation coefficient (ICC)—and normative scores. They calculated between-scale correlation using Spearman rho.

**Results**
Each instrument contains items concerning sampling, controlling for confounders, and integrity of outcomes. Interrater reliability for overall scores ranged from 0.68 to 0.95. Interrater reliability was "substantial" or better (ICC > 0.60) for nearly all domain-specific items on both instruments. Most instances of low interrater reliability were associated with restriction of range, and raw agreement was usually good. Across 26 studies evaluating published research, the median overall MERSQI score was 11.3 (range 8.9–15.1, of possible 18). Across six studies, the median overall NOS-E score was 3.22 (range 2.08–3.82, of possible 6). Overall MERSQI and NOS-E scores correlated reasonably well (rho 0.49–0.72).

**Conclusions**
The MERSQI and NOS-E are useful, reliable, complementary tools for appraising methodological quality of medical education research. Interpretation and use of their scores should focus on item-specific codes rather than overall scores. Normative scores should be used for relative rather than absolute judgments because different research questions require different study designs.

# MERSQI

The Medical Education Research Study Quality Instrument

| Domain: item | Response options: scores[b] | Operational definitions |
|---|---|---|
| **MERSQI[c]** | | |
| Study design | • Single-group cross-sectional or single-group posttest only: 1<br>• Single-group pretest and posttest: 1.5<br>• Nonrandomized, 2 group: 2<br>• Randomized controlled trial: 3 | • Survey studies are cross-sectional.<br>• Case–control and cohort studies (2 or more defined cohorts) are considered 2-group nonrandomized. |
| Sampling: institutions | • 1 institution: 0.5<br>• 2 institutions: 1<br>• 3 or more institutions: 1.5 | • Number of institutions refers to origin of study participants (not study authors). |
| Sampling: response rate | • Not applicable<br>• < 50% or not reported: 0.5<br>• 50%–74%: 1<br>• ≥ 75%: 1.5 | • Response rate is the proportion of those eligible who completed the posttest or survey. For intervention studies, this is the proportion of those enrolled who completed the intervention evaluation.<br>• Use "not applicable" only if a response rate truly does not apply (e.g., data obtained from a medical record or professional organization database). |
| Type of data | • Assessment by study participant: 1<br>• Objective: 3 | • Observer ratings are considered objective. |
| Validity evidence for evaluation instrument scores | • Not applicable<br>• Content: 1<br>• Internal structure: 1<br>• Relationships to other variables: 1 | • Relevant content evidence would include using theory, guidelines, experts, and existing instruments to identify or refine the instrument.<br>• Relevant internal structure evidence would include all reliability (internal consistency, interrater, interstation, and test–retest) and factor analysis.<br>• Relevant evidence of relationships to other variables would include expert–novice comparisons and concurrent or predictive correlation with other variables.<br>• Use "not applicable" only if the study does not measure a psychological construct *and* there is no instrument to rate (e.g., gender as the sole outcome); should be used very rarely. |
| Data analysis: sophistication | • Descriptive analysis only: 1<br>• Beyond descriptive analysis: 2 | • Descriptive analyses include frequency, mean, and median.<br>• Any test of statistical inference is considered "beyond descriptive." |
| Data analysis: appropriate | • Data analysis appropriate for study design and type of data: 1 | • Considered "no" if there is a statistical error or if authors failed to analyze data at all. |
| Outcome | • Satisfaction, attitudes, perceptions, opinions, general facts: 1<br>• Knowledge, skills: 1.5<br>• Behaviors: 2<br>• Patient/health care outcome: 3 | • General facts include participant demographics.<br>• Knowledge/skills are in a test setting (paper, computer, simulation, or patients in a nonauthentic setting).<br>• Behaviors are physician actions with real patients in a clinical context, or other activities in a real context.<br>• Patient/health care outcomes are actual effects on real patients, programs, or society. |

# Steps to conduct SRMA (PRISMA 2020):

- Step 1: Develop a protocol
- Step 2: Formulate research objectives/questions
- Step 3: Searching for relevant studies
- Step 4: Screening and study selection
- Step 5: Data extraction
- Step 6: Quality assessment
- **Step 7: Data synthesis and meta-analysis**

Data synthesis focuses on charting evidence and identifying gaps

**PRISMA flow diagram**

- It maps out the number of records identified, included and excluded, and the reasons for exclusions.

**Descriptive analysis**

- Table
- Maps (Evidence gap map, bubble chart, mapping of key concept)
- Figure (Integrative framework, Analytical framework)
- Categorizing evidence into categories (thematic constructions of evidence)

**Meta-analysis**

- Quantitative summary of results using statistical analysis software (effect size, odd ratio, relative risk, mean, etc)

# PRISMA 2020 flow diagram

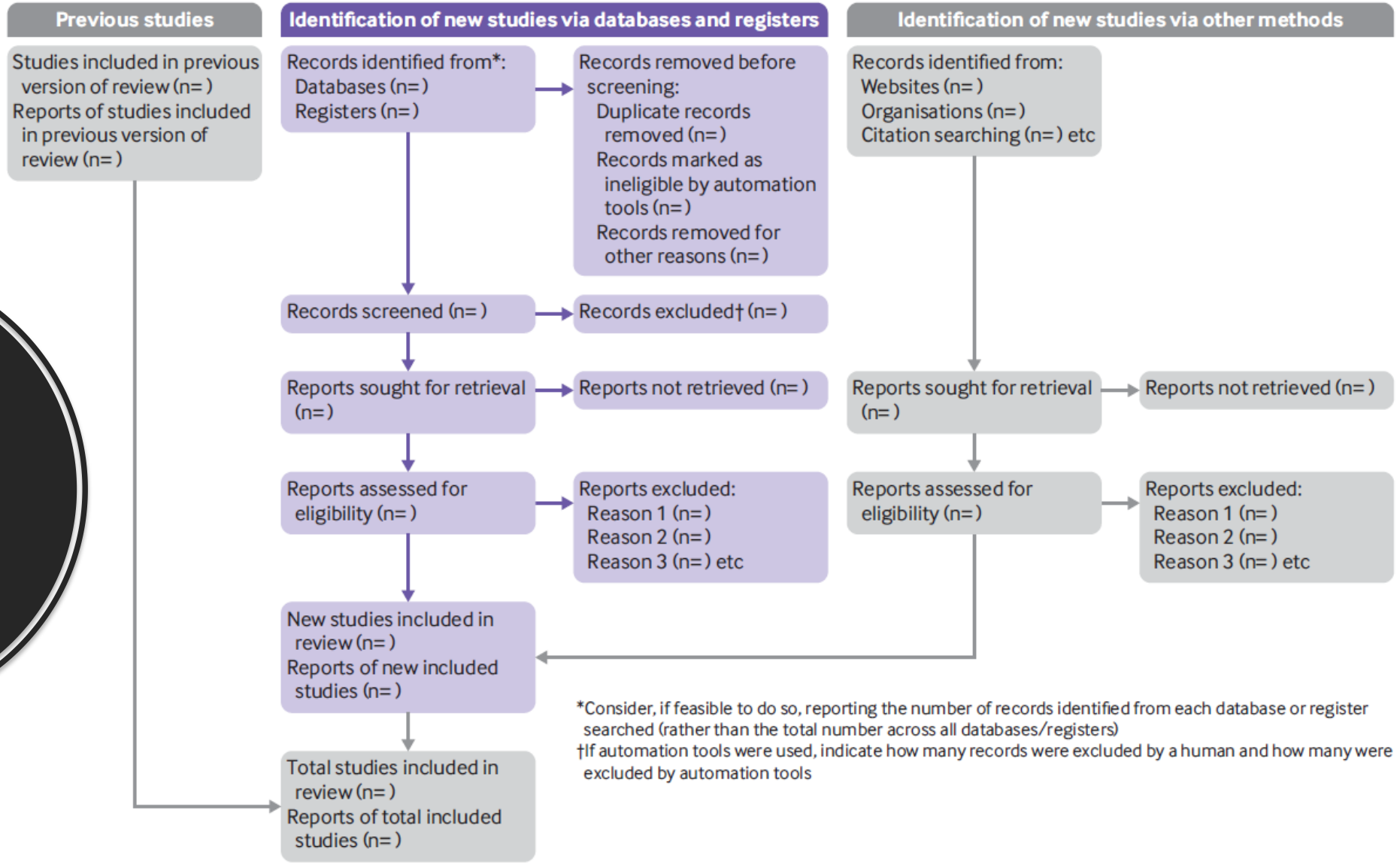



Fig 1 | PRISMA 2020 flow diagram template for systematic reviews. The new design is adapted from flow diagrams proposed by Boers,[55] Mayo-Wilson et al.[56] and Stovold et al.[57] The boxes in grey should only be completed if applicable; otherwise they should be removed from the flow diagram. Note that a "report" could be a journal article, preprint, conference abstract, study register entry, clinical study report, dissertation, unpublished manuscript, government report or any other document providing relevant information.

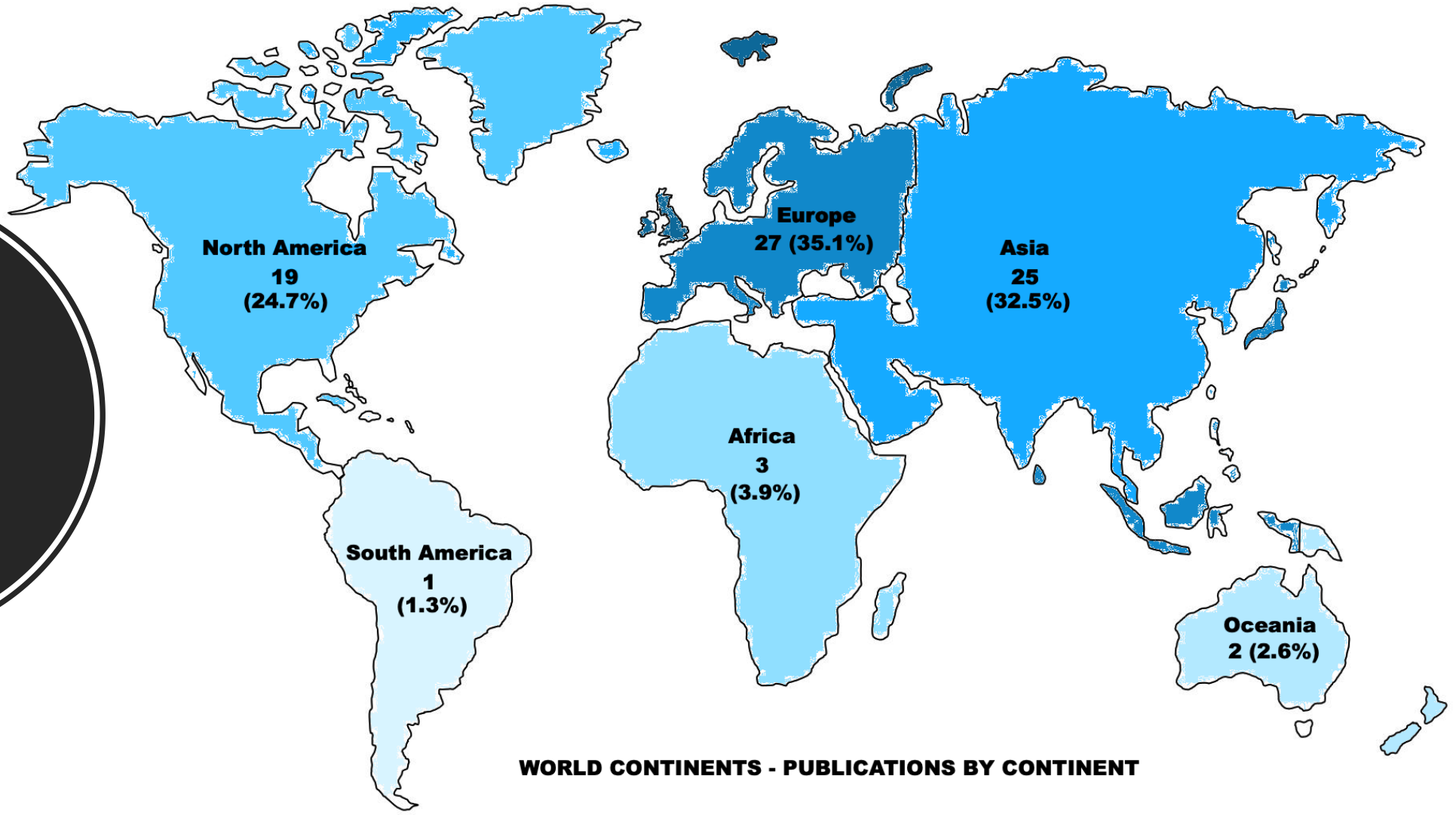
Example of tabular presentation

**Table 1: Characteristics of studies included.**

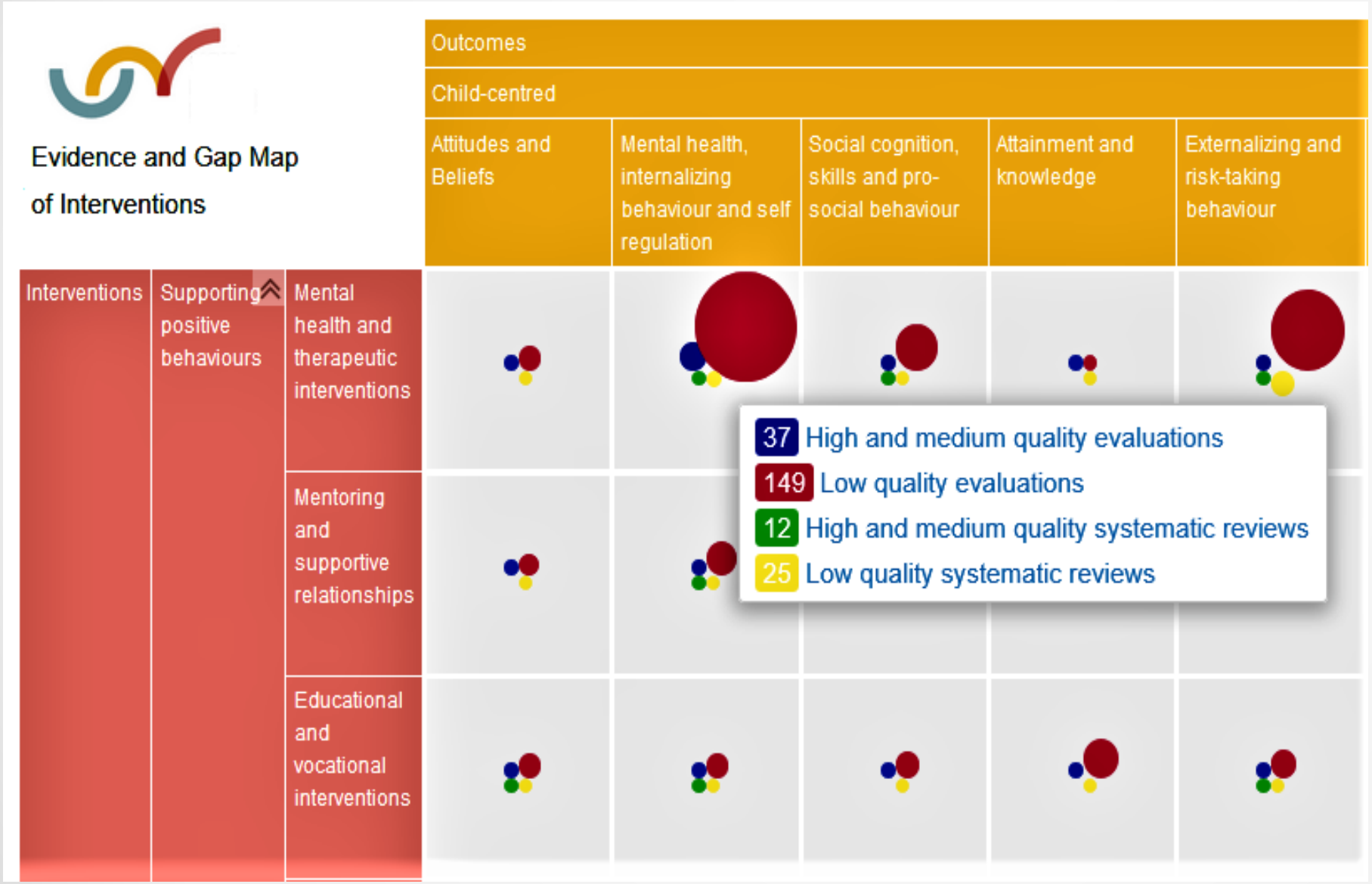
| Study characteristics | No. of studies | No. of participants |
|---|---|---|
| All studies | 13 | 1428 |
| Study design | | |
| Randomized controlled | 7 | 627 |
| Non-randomized controlled | 6 | 801 |
| Duration of intervention | | |
| Brief (less than 2 days) | 2 | 201 |
| Short (2 days but less than 4 weeks) | 3 | 123 |
| Medium (4 weeks but less than 8 weeks) | 3 | 153 |
| Long (8 weeks and more) | 5 | 862 |
| Outcomes[a] | | |
| General psychological distress (GPD) | 5 | 557 |
| Stress | 8 | 591 |
| Anxiety | 10 | 985 |
| Depression | 7 | 852 |
| Psychological measurements for GPD | | |
| Distress subscale of Symptom Checklist Revised (SCL-90R) | 2 | 127 |
| Depression Anxiety Stress Scale (DASS-21) | 1 | 153 |
| Perceived Stress Scale (PSS) | 1 | 56 |
| Symptom Checklist (SCL-5) | 1 | 180 |
| Psychological measurements for stress | | |
| Depression Anxiety Stress Scale (DASS-21) | 2 | 201 |
| Perceived Medical School Stress (PMSS) | 2 | 227 |
| Stressful situations rating (SSR) | 1 | 48 |
| Rating scales of the frequency and intensity of weekly tension and depression (RSFIWTD) | 1 | 24 |
| Brief symptoms inventory (BSI) | 1 | 35 |
| Depression Anxiety Stress Scale (DASS-42) | 1 | 56 |
| Psychological measurements for anxiety | | |
| State-Trait Anxiety Inventory (STAI) | 3 | 139 |
| Depression Anxiety Stress Scale (DASS-21) | 2 | 201 |
| Brief Symptom Inventory (BSI) | 1 | 35 |
| Anxiety subscale of Symptom Checklist Revised (SCL-90R) | 1 | 48 |
| Profiles of Mood States (POMS) | 1 | 277 |
| Beck's Anxiety Inventory (BAI) | 1 | 227 |
| Depression Anxiety Stress Scale (DASS-42) | 1 | 56 |
| Psychological measurements for depression | | |
| Depression Anxiety Stress Scale (DASS-21) | 2 | 201 |
| Profiles of Mood States (POMS) | 1 | 277 |
| 7 Questions covered on anxiety, depression and satisfaction (7QADS) | 1 | 18 |
| Depression subscale of Symptom Checklist Revised (SCL-90R) | 1 | 73 |
| Beck's Depression Inventory-II (BDI-II) | 1 | 227 |
| Depression Anxiety Stress Scale (DASS-42) | 1 | 56 |
| Quality of study | | |
| Kirkpatrick's level of evidence ($\geq 2$) | 13 | 1428 |

[a] One study may measure several outcomes.

# Example of Geographical Map



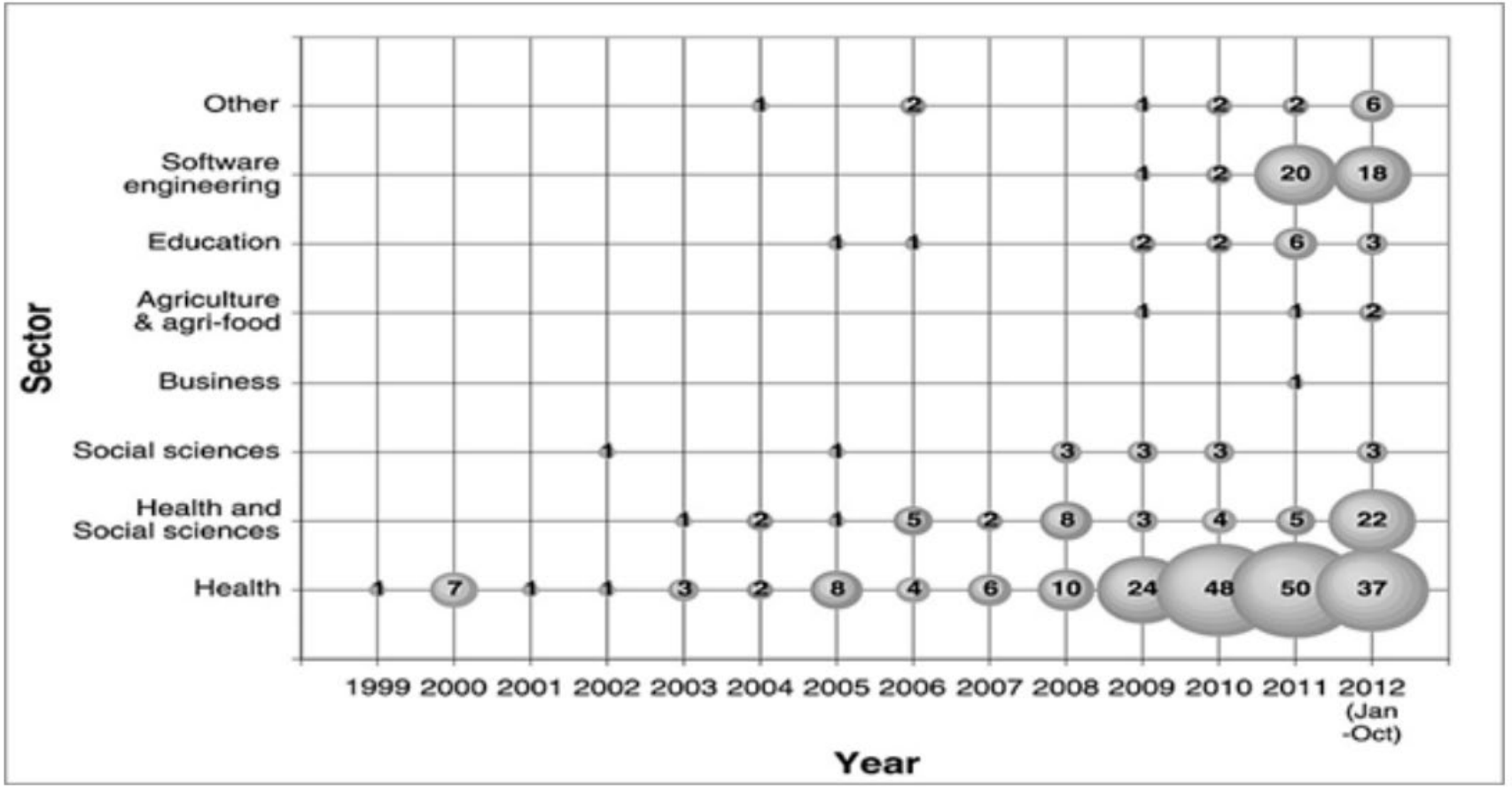
# Example of Evidence Gap Map




An Evidence Gap Map is a visual tool that provides an overview of the existing evidence on a topic. It highlights gaps in the evidence and shows where evidence is more abundant. The map can be variously used and configured.

# Example of Bubble chart

The size of each ‘bubble’ is representative of the number of sources of evidence published in each year

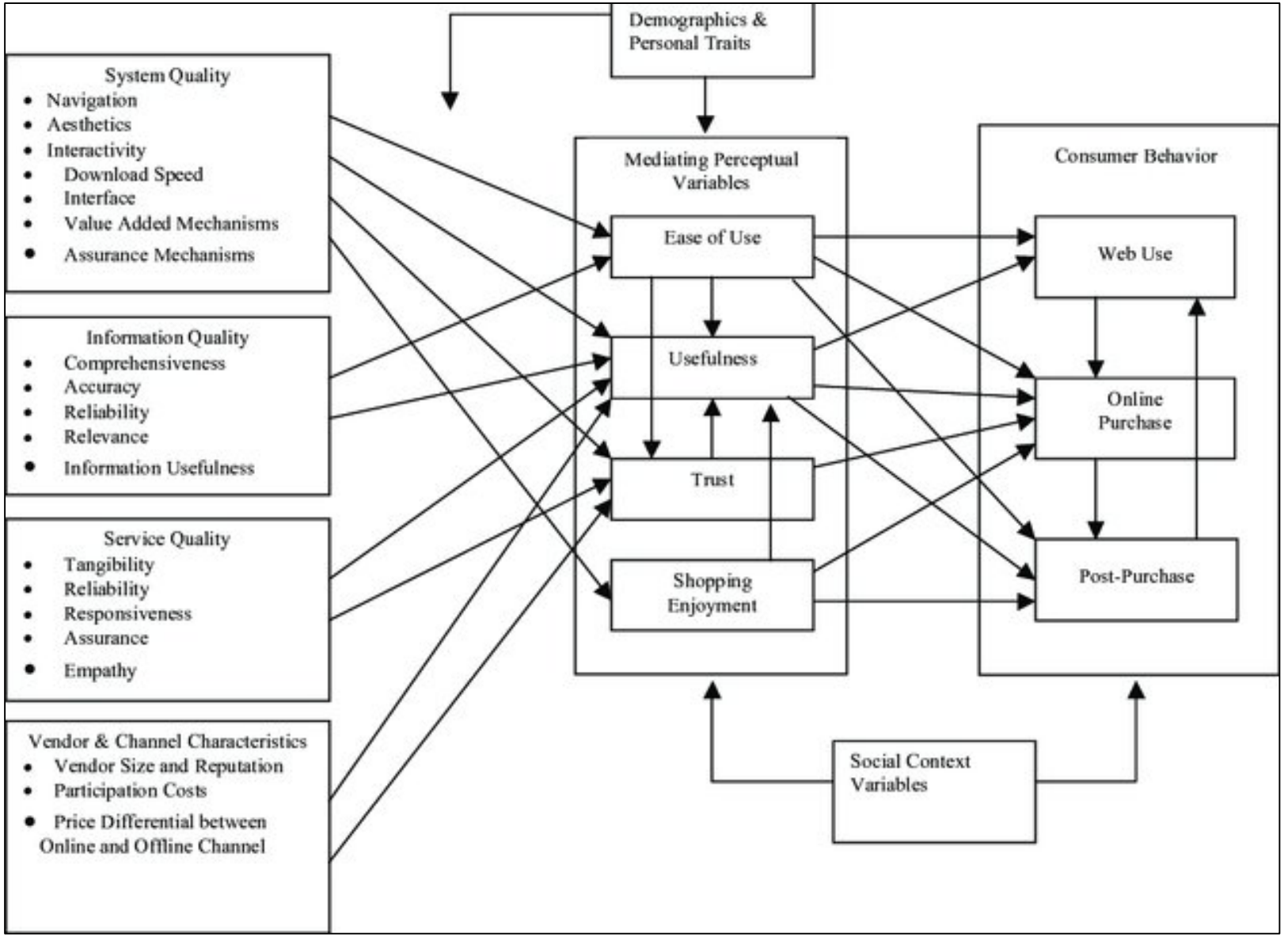


Example of mapping of key concept

| Reference | Evidence used: Primary studies: Human, observational | Human, experimental | Animal, experimental | Cell-culture | Other reviews | Intense sweeteners considered: Unspecified or grouped | Acesulfame K | Aspartame | Cyclamate | Saccharin | Sucralose | Stevia | Other | Comparator: Sugar, other saccharides | Water | Intake levels | Nothing/placebo | Unclear | Outcomes presented: Body weight | Clinical outcomes | Energy/food intake | Appetite/hunger | Hormone secretion | Intestinal glucose absorption | Microbiome |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bellisle 2007 [31] | x | x | x | | | x | | | | | | | | x | x | x | x | | x | | x | x | | | |
| Mattes 2009 [3] | x | x | x | | | x | x | x | | x | x | | | x | x | | x | | x | | x | x | x | | |
| Yang 2010 [2] | x | x | x | | | x | x | x | | x | x | | | x | x | | x | | x | | x | x | | | |
| EFSA 2011 [32] | x | x | | | x | x | | x | | | | | | x | | | | | x | | | | | | |
| Pepino 2011 [33] | x | x | x | x | | x | x | x | | x | x | x | | x | | x | x | x | x | x | x | | x | x | x |
| Sylvetsky 2011 [34] | x | x | x | x | | x | | x | | x | x | | | x | x | x | | | x | | x | x | x | | |
| Andersen 2012 [35] | x | x | | | x | x | | | | | | | | x | | x | | x | x | | x | | | | |
| Brown 2012 [36] | x | x | x | | | x | x | x | | x | x | x | x | x | x | x | x | x | | | | | x | x | x |
| Raben 2012 [37] | x | x | | | x | x | x | x | | x | x | x | | x | x | | | | x | x | x | x | x | | |
| Swithers 2013 [38] | x | x | | | | x | | x | | | x | x | | x | x | | | | x | x | | | x | | |
| Araurjo 2014 [39] | x | x | x | | x | x | x | x | | x | x | | | x | | x | x | x | x | x | x | | x | x | x |
| Ferreira 2014 [40] | x | x | x | | | x | | x | | | | | | x | x | x | x | | x | | x | x | | | |
| Freswick 2014 [41] | x | x | | | | x | x | x | | | x | | | x | x | | x | | x | | x | | | | |
| Gardner 2014 [42] | x | x | | | | x | | x | | | | | | x | x | x | x | x | x | x | x | | | | |
| Bellisle 2015 [43] | x | x | | | | x | | | | | | | | x | x | | x | | | | | x | | | |
| Bruke 2015 [44] | x | x | x | | | x | x | x | | | x | | x | | | | | x | | | | | x | x | x |
| Fernstrom 2015 [45] | x | x | x | | | x | x | x | | x | x | x | | x | x | x | x | | x | | | x | | | |
| Pepino 2015 [46] | x | x | x | x | x | x | x | x | | x | x | x | | x | x | x | x | | | x | | | x | x | x |
| Roberts 2015 [47] | x | x | | | | x | | | | | | | | x | x | | | | x | x | x | x | x | | |
| Swithers 2015 [48] | x | x | x | | x | x | | x | | x | x | | | x | x | | x | x | x | | | | x | | x |
| Fowler 2016 [49] | x | x | x | | | x | x | x | x | x | x | | | x | | x | x | | x | | x | | | | |
| Glendinning 2016 [50] | | | x | | x | x | | x | | | | | | x | | | x | | x | | x | | x | | x |
| Nettleton 2016 [51] | x | x | x | | | x | | x | | x | x | | | | x | x | x | | x | x | x | x | x | x | x |
| Peters 2016 [52] | x | x | x | | x | x | | x | | | | | | x | x | x | | | x | | x | x | | | |
| Shearer 2016 [53] | x | x | x | | x | x | | x | | x | x | | | | x | x | x | x | x | | | | x | x | x |
| Swithers 2016 [54] | x | x | x | | x | x | | | | x | | | | x | x | | | | x | | | | x | | x |

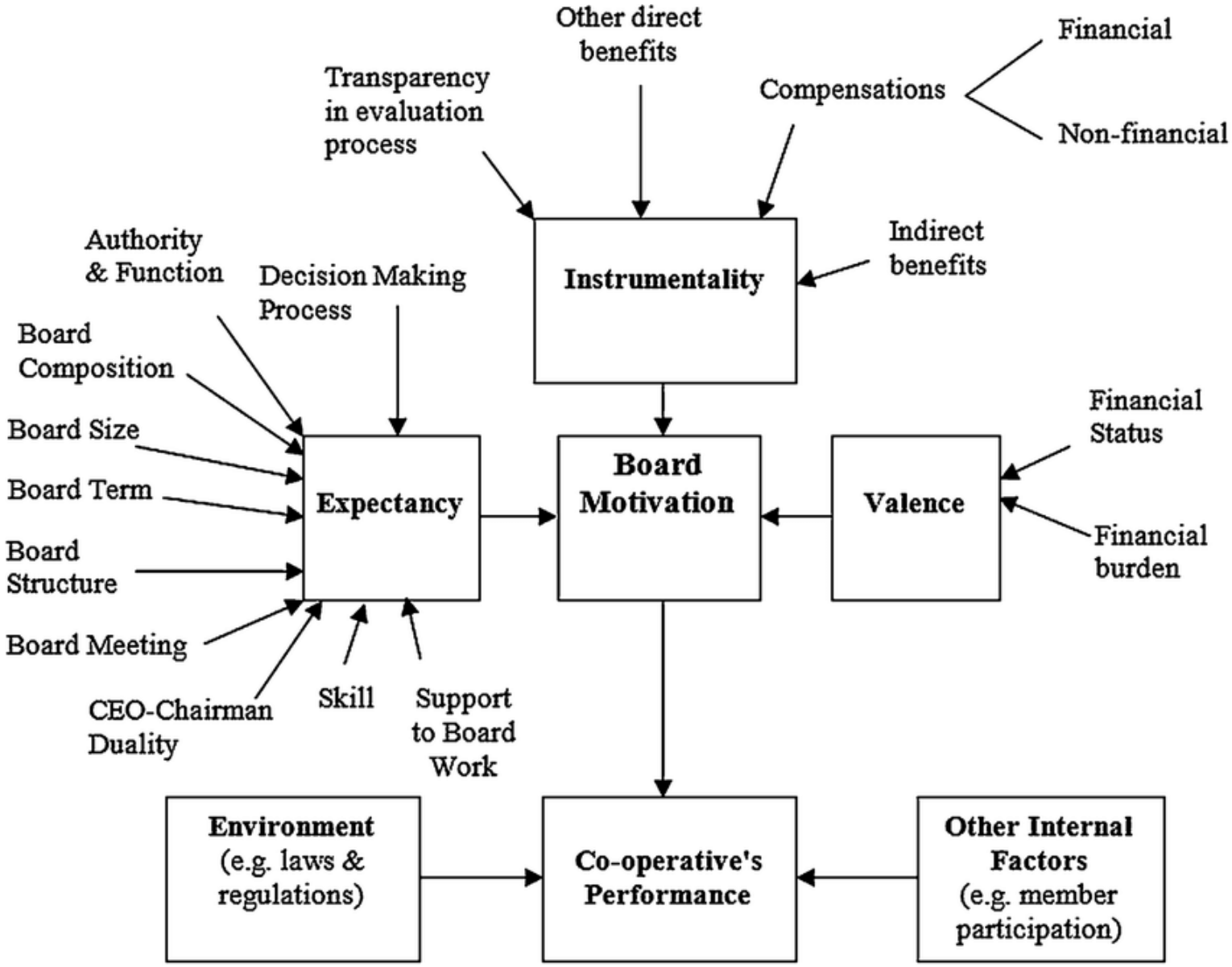
# Example of integrative framework

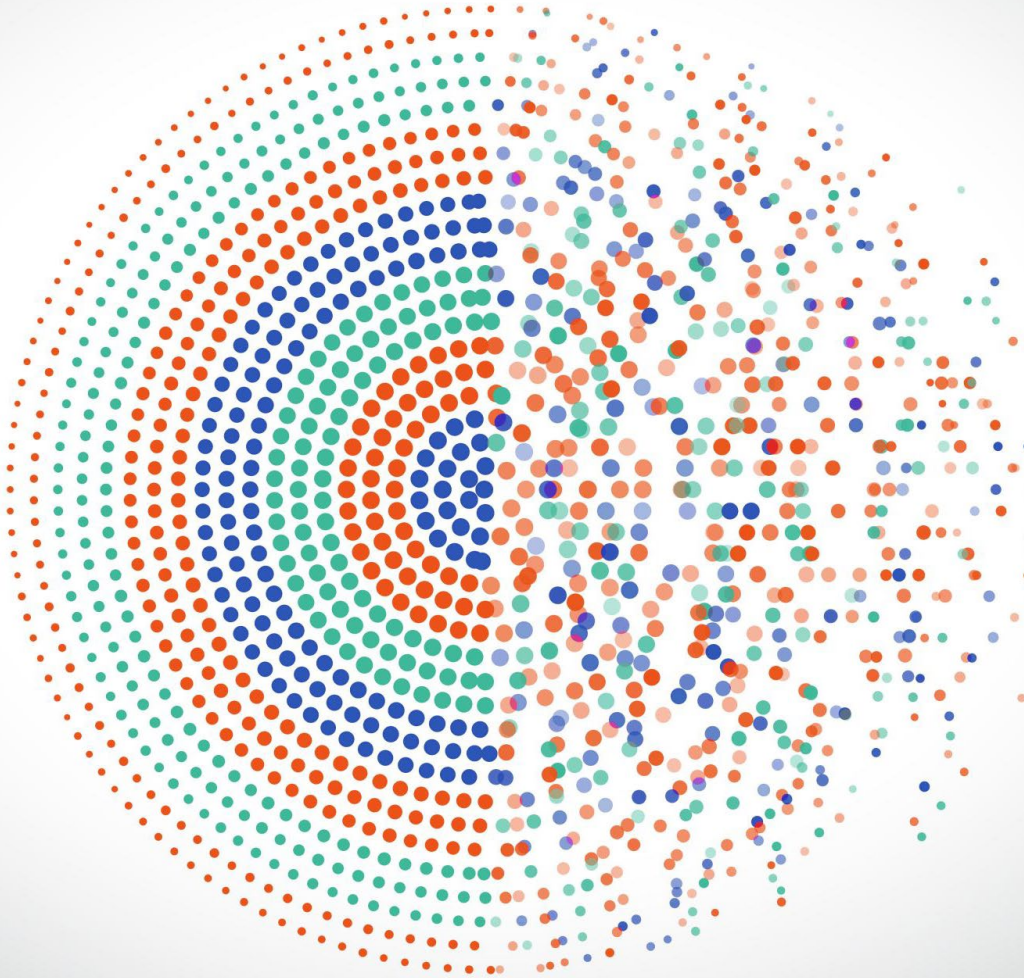
Integrative framework integrates the information gathered in systematic review



# Example of analytical framework

Analytical framework integrates the information gathered in a





# Meta-Analysis – WHY perform it?

- Increase power (precision) of estimates
- Quantify effect sizes and their uncertainty
- Improve applicability
- Assess consistency of results
- Answer questions not posed by individual studies (factors that differ across studies)
- Settle controversies from conflicting studies or generate new hypotheses

# Meta-Analysis – is it a must?

- **Not all systematic reviews can include a meta-analysis** because sometimes the studies are too different (heterogenous) from each other, making it hard to combine their results.
- However, **every meta-analysis should always follow a rigorous systematic review.**
- Studies must be sufficiently similar regarding populations, interventions, comparisons, outcomes, and timing (PICOT) to be pooled for meta-analysis.

# Meta-Analysis – which effect models?

- **Random effects models** consider both within-study and between-study variability and assumes that studies included in the meta-analysis are a random sample from all possible studies.
  - Generally, the preferred model for meta-analysis.
- **Fixed effects models** consider only within-study variability which assumes that studies use identical methods, patients, and measurements.

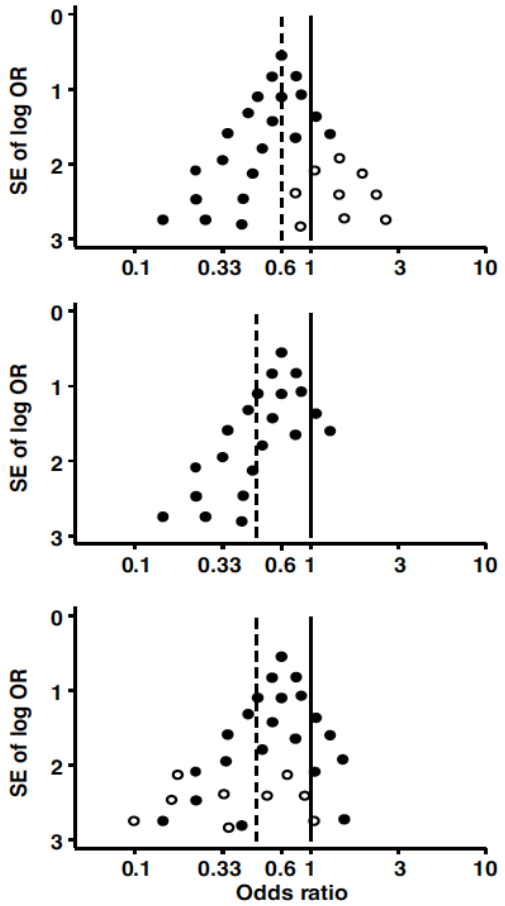
# Meta-Analysis – consideration for the results

- **Magnitude of effect** – The farther from the null line, the greater the magnitude of effect of an intervention. The overall effect estimate may be skewed by studies with outlying point estimates.
- **Confidence Interval** – A confidence interval that crosses 1, visually indicated by the null line, indicates no statistically significant difference.
- **Weighting** – Meta-analyses are weighted by the sample size of each included study, so a large study will provide greater weight to the overall estimate than smaller studies. The overall effect estimate may be skewed by studies with atypical sample sizes.
- **Heterogeneity** ($I^2$) – A measure of inconsistency across included studies ranging from 0-100% where lower numbers indicate less heterogeneity (i.e. more consistent).

# Meta-Analysis – consideration for the results

- **Sensitivity Analyses** – A sensitivity analysis selectively removes studies that may artificially influence the results.
  - Examples of studies that may be removed for sensitivity analysis include incomparable interventions, different demographic characteristics of patients, poor quality studies, temporality (i.e. studies published years ago may not be applicable to current practice).
- **Subgroup analyses** – Stratified analysis of studies exploring the same outcome of interest.
  - Subgroup analyses may be done by patient demographics, interventions, or timing.
  - Subgroup analyses to be performed should be defined beforehand in the protocol and be limited in numbers to avoid spurious findings.
- **Publication bias** – it arises when trials with statistically significant results are more likely to be published and cited and are preferentially published in English language journals and those indexed in Medline.
  - A funnel plot is a simple scatter plot of the intervention effect estimates from individual studies against some measure of each study's size or precision. The best choice of x axis for detecting the small sample effect is the log odds ratio.

# Meta-Analysis – funnel plot for publication bias




**Symmetrical plot in the absence of bias** (open circles indicate smaller studies showing no beneficial effects)

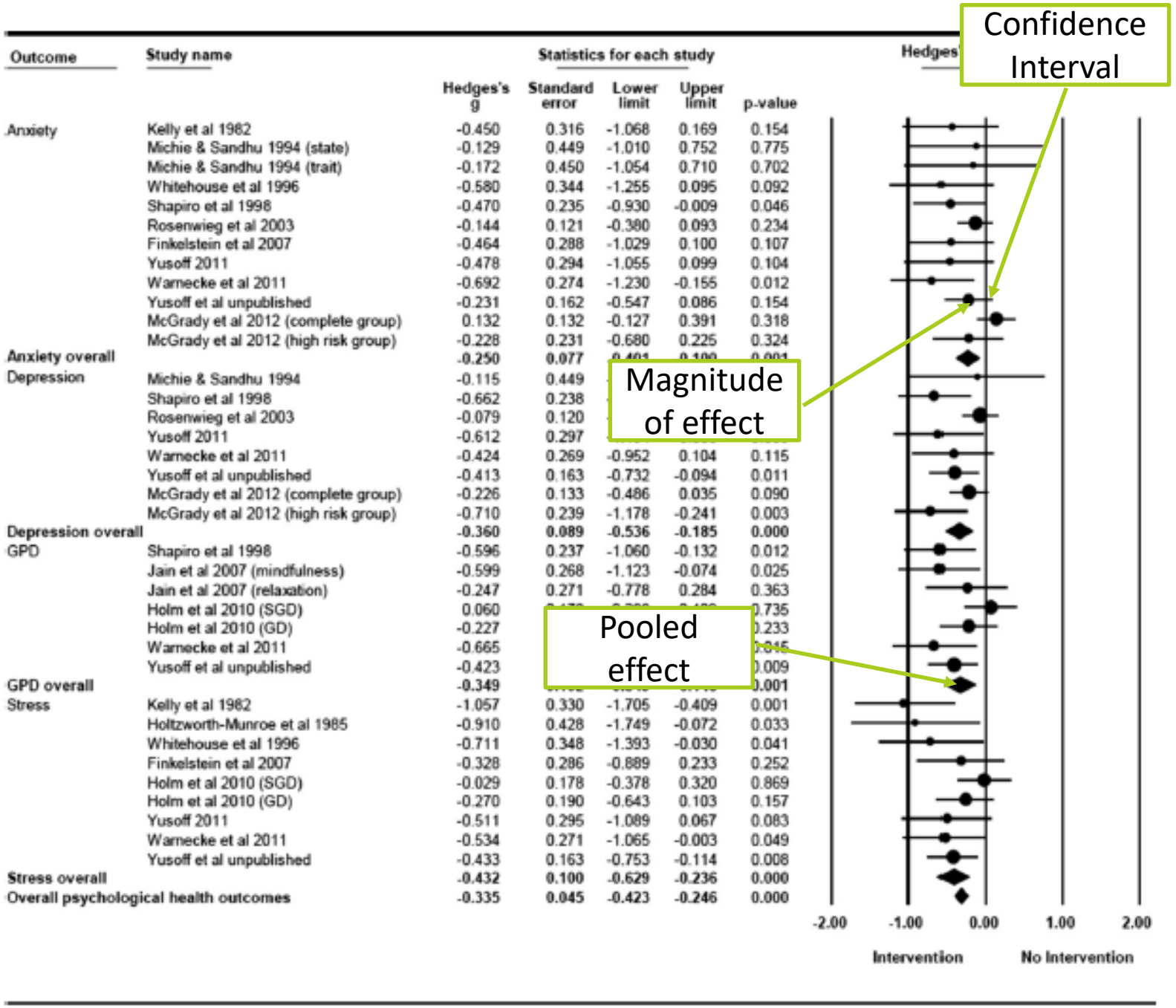
**Asymmetrical plot in the presence of publication bias** (smaller studies showing no beneficial effects are missing)

**Asymmetrical plot in the presence of bias due to low methodological quality of smaller studies** (open circles indicate small studies of inadequate quality whose results are biased towards larger beneficial effects)

Jonathan A et al. The Stata Journal 2004; 4:127

Yusoff, M. S. B. (2014, March). Interventions on medical students' psychological health: A meta-analysis. *Journal of Taibah University Medical Sciences.* https://doi.org/10.1016/j.jtumed.2013.09.010

# Example of meta-analysis result (forest plot)




| Outcome | Study name | Hedges's g | Standard error | Lower limit | Upper limit | p-value |
|---|---|---|---|---|---|---|
| Anxiety | Kelly et al 1982 | -0.450 | 0.316 | -1.068 | 0.169 | 0.154 |
| | Michie & Sandhu 1994 (state) | -0.129 | 0.449 | -1.010 | 0.752 | 0.775 |
| | Michie & Sandhu 1994 (trait) | -0.172 | 0.450 | -1.054 | 0.710 | 0.702 |
| | Whitehouse et al 1996 | -0.580 | 0.344 | -1.255 | 0.095 | 0.092 |
| | Shapiro et al 1998 | -0.470 | 0.235 | -0.930 | -0.009 | 0.046 |
| | Rosenwieg et al 2003 | -0.144 | 0.121 | -0.380 | 0.093 | 0.234 |
| | Finkelstein et al 2007 | -0.464 | 0.288 | -1.029 | 0.100 | 0.107 |
| | Yusoff 2011 | -0.478 | 0.294 | -1.055 | 0.099 | 0.104 |
| | Warnecke et al 2011 | -0.692 | 0.274 | -1.230 | -0.155 | 0.012 |
| | Yusoff et al unpublished | -0.231 | 0.162 | -0.547 | 0.086 | 0.154 |
| | McGrady et al 2012 (complete group) | 0.132 | 0.132 | -0.127 | 0.391 | 0.318 |
| | McGrady et al 2012 (high risk group) | -0.228 | 0.231 | -0.680 | 0.225 | 0.324 |
| **Anxiety overall** | | **-0.250** | **0.077** | | | |
| Depression | Michie & Sandhu 1994 | -0.115 | 0.449 | | | |
| | Shapiro et al 1998 | -0.662 | 0.238 | | | |
| | Rosenwieg et al 2003 | -0.079 | 0.120 | | | |
| | Yusoff 2011 | -0.612 | 0.297 | | | |
| | Warnecke et al 2011 | -0.424 | 0.269 | -0.952 | 0.104 | 0.115 |
| | Yusoff et al unpublished | -0.413 | 0.163 | -0.732 | -0.094 | 0.011 |
| | McGrady et al 2012 (complete group) | -0.226 | 0.133 | -0.486 | 0.035 | 0.090 |
| | McGrady et al 2012 (high risk group) | -0.710 | 0.239 | -1.178 | -0.241 | 0.003 |
| **Depression overall** | | **-0.360** | **0.089** | **-0.536** | **-0.185** | **0.000** |
| GPD | Shapiro et al 1998 | -0.596 | 0.237 | -1.060 | -0.132 | 0.012 |
| | Jain et al 2007 (mindfulness) | -0.599 | 0.268 | -1.123 | -0.074 | 0.025 |
| | Jain et al 2007 (relaxation) | -0.247 | 0.271 | -0.778 | 0.284 | 0.363 |
| | Holm et al 2010 (SGD) | 0.060 | | | | 0.735 |
| | Holm et al 2010 (GD) | -0.227 | | | | 0.233 |
| | Warnecke et al 2011 | -0.665 | | | | |
| | Yusoff et al unpublished | -0.423 | | | | 0.009 |
| **GPD overall** | | **-0.349** | | | | **0.001** |
| Stress | Kelly et al 1982 | -1.057 | 0.330 | -1.705 | -0.409 | 0.001 |
| | Holtzworth-Munroe et al 1985 | -0.910 | 0.428 | -1.749 | -0.072 | 0.033 |
| | Whitehouse et al 1996 | -0.711 | 0.348 | -1.393 | -0.030 | 0.041 |
| | Finkelstein et al 2007 | -0.328 | 0.286 | -0.889 | 0.233 | 0.252 |
| | Holm et al 2010 (SGD) | -0.029 | 0.178 | -0.378 | 0.320 | 0.869 |
| | Holm et al 2010 (GD) | -0.270 | 0.190 | -0.643 | 0.103 | 0.157 |
| | Yusoff 2011 | -0.511 | 0.295 | -1.089 | 0.067 | 0.083 |
| | Warnecke et al 2011 | -0.534 | 0.271 | -1.065 | -0.003 | 0.049 |
| | Yusoff et al unpublished | -0.433 | 0.163 | -0.753 | -0.114 | 0.008 |
| **Stress overall** | | **-0.432** | **0.100** | **-0.629** | **-0.236** | **0.000** |
| **Overall psychological health outcomes** | | **-0.335** | **0.045** | **-0.423** | **-0.246** | **0.000** |

Figure 6: Random-effects meta-analyses of stress reduction interventions vs. no intervention: Psychological health. $I^2$= 30.46, p-value = 0.045, Q-value (df)= 50.33 (35). Interaction between different psychological outcomes: Q-value (df)= 2.25 (3), p= 0.521. The circle symbol indicated the individual effect size and the triangle symbol indicated the pooled effect size.

# Tip 5: Write a good review

**Step 1:**
Find a published SRMA to be used as guidance

**Step 2:**
Plan what to write for each subheading

**Step 3:**
Write a detail methodology (Follow PRISMA 2020 guideline)

**Step 4:**
Report results using PRISMA checklist.

**Step 5:**
Interpret results & integrate findings with current practice and policy (For discussion)

**Step 6:**
Cite landmark articles and resources published outside study time frame (for discussion)

**Step 7:**
Estimate degree to which the review answers the research questions

**Step 8:**
Include limitations of the review

**Step 9:**
Provide a solid conclusion

# The PRISMA 2020 statement: an updated guideline for reporting systematic reviews

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Accepted: 4 January 2021

The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement, published in 2009, was designed to help systematic reviewers transparently report why the review was done, what the authors did, and what they found. Over the past decade, advances in systematic review methodology and terminology have necessitated an update to the guideline. The PRISMA 2020 statement replaces the 2009 statement and includes new reporting guidance that reflects advances in methods to identify, select, appraise, and synthesise studies. The structure and presentation of the items have been modified to facilitate implementation. In this article, we present the PRISMA 2020 27-item checklist, an expanded checklist that details reporting recommendations for each item, the PRISMA 2020 abstract checklist, and the revised flow diagrams for original and updated reviews.

## SUMMARY POINTS

To ensure a systematic review is valuable to users, authors should prepare a transparent, complete, and accurate account of why the review was done, what they did, and what they found

The PRISMA 2020 statement provides updated reporting guidance for systematic reviews that reflects advances in methods to identify, select, appraise, and synthesise studies

The PRISMA 2020 statement consists of a 27-item checklist, an expanded checklist that details reporting recommendations for each item, the PRISMA 2020 abstract checklist, and revised flow diagrams for original and updated reviews

We anticipate that the PRISMA 2020 statement will benefit authors, editors, and peer reviewers of systematic reviews, and different users of reviews, including guideline developers, policy makers, healthcare providers, patients, and other stakeholders

Systematic reviews serve many critical roles. They can provide syntheses of the state of knowledge in a field, from which future research priorities can be identified; they can address questions that otherwise could not be answered by individual studies; they can identify problems in primary research that should be rectified in future studies; and they can generate or evaluate theories about how or why phenomena occur. Systematic reviews therefore generate various types of knowledge for different users of reviews (such as patients, healthcare providers, researchers, and policy makers).[1 2] To ensure a systematic review is valuable to users, authors should prepare a transparent, complete, and accurate account of why the review was done, what they did (such as how studies were identified and selected) and what they found (such as characteristics of contributing studies and results of meta-analyses). Up-to-date reporting guidance facilitates authors achieving this.[3]

The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement published in 2009 (hereafter referred to as PRISMA 2009)[4-10] is a reporting guideline designed to address poor reporting of systematic reviews.[11] The PRISMA 2009 statement comprised a checklist of 27 items recommended for reporting in systematic reviews and an "explanation and elaboration" paper[12-16] providing additional reporting guidance for each item, along with exemplars of reporting. The recommendations have been widely endorsed and adopted, as evidenced by its co-publication in multiple journals, citation in over 60 000 reports (Scopus, August 2020), endorsement from almost 200 journals and systematic review organisations, and adoption in various disciplines. Evidence from observational studies suggests that use of the PRISMA 2009 statement is associated with more complete reporting of systematic reviews,[17-20] although more could be done to improve adherence to the guideline.[21]

Many innovations in the conduct of systematic reviews have occurred since publication of the PRISMA 2009 statement. For example, technological advances have enabled the use of natural language processing and machine learning to identify relevant evidence,[22-24] methods have been proposed to

**Table 1 | PRISMA 2020 item checklist**

| Section and topic | Item # | Checklist item | Location where item is reported |
|---|---|---|---|
| **Title** | | | |
| Title | 1 | Identify the report as a systematic review. | |
| **Abstract** | | | |
| Abstract | 2 | See the PRISMA 2020 for Abstracts checklist (table 2). | |
| **Introduction** | | | |
| Rationale | 3 | Describe the rationale for the review in the context of existing knowledge. | |
| Objectives | 4 | Provide an explicit statement of the objective(s) or question(s) the review addresses. | |
| **Methods** | | | |
| Eligibility criteria | 5 | Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses. | |
| Information sources | 6 | Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted. | |
| Search strategy | 7 | Present the full search strategies for all databases, registers and websites, including any filters and limits used. | |
| Selection process | 8 | Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process. | |
| Data collection process | 9 | Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process. | |
| Data items | 10a | List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect. | |
| | 10b | List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information. | |
| Study risk of bias assessment | 11 | Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process. | |
| Effect measures | 12 | Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results. | |
| Synthesis methods | 13a | Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)). | |
| | 13b | Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions. | |
| | 13c | Describe any methods used to tabulate or visually display results of individual studies and syntheses. | |
| | 13d | Describe any methods used to synthesise results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used. | |
| | 13e | Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression). | |
| | 13f | Describe any sensitivity analyses conducted to assess robustness of the synthesised results. | |
| Reporting bias assessment | 14 | Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases). | |
| Certainty assessment | 15 | Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome. | |
| **Results** | | | |
| Study selection | 16a | Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram (see fig 1). | |
| | 16b | Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded. | |
| Study characteristics | 17 | Cite each included study and present its characteristics. | |
| Risk of bias in studies | 18 | Present assessments of risk of bias for each included study. | |
| Results of individual studies | 19 | For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots. | |
| Results of syntheses | 20a | For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies. | |
| | 20b | Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect. | |
| | 20c | Present results of all investigations of possible causes of heterogeneity among study results. | |
| | 20d | Present results of all sensitivity analyses conducted to assess the robustness of the synthesised results. | |
| Reporting biases | 21 | Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed. | |
| Certainty of evidence | 22 | Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed. | |
| **Discussion** | | | |
| Discussion | 23a | Provide a general interpretation of the results in the context of other evidence. | |
| | 23b | Discuss any limitations of the evidence included in the review. | |
| | 23c | Discuss any limitations of the review processes used. | |
| | 23d | Discuss implications of the results for practice, policy, and future research. | |
| **Other information** | | | |
| Registration and protocol | 24a | Provide registration information for the review, including register name and registration number, or state that the review was not registered. | |
| | 24b | Indicate where the review protocol can be accessed, or state that a protocol was not prepared. | |
| | 24c | Describe and explain any amendments to information provided at registration or in the protocol. | |
| Support | 25 | Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review. | |
| Competing interests | 26 | Declare any competing interests of review authors. | |
| Availability of data, code, and other materials | 27 | Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review. | |

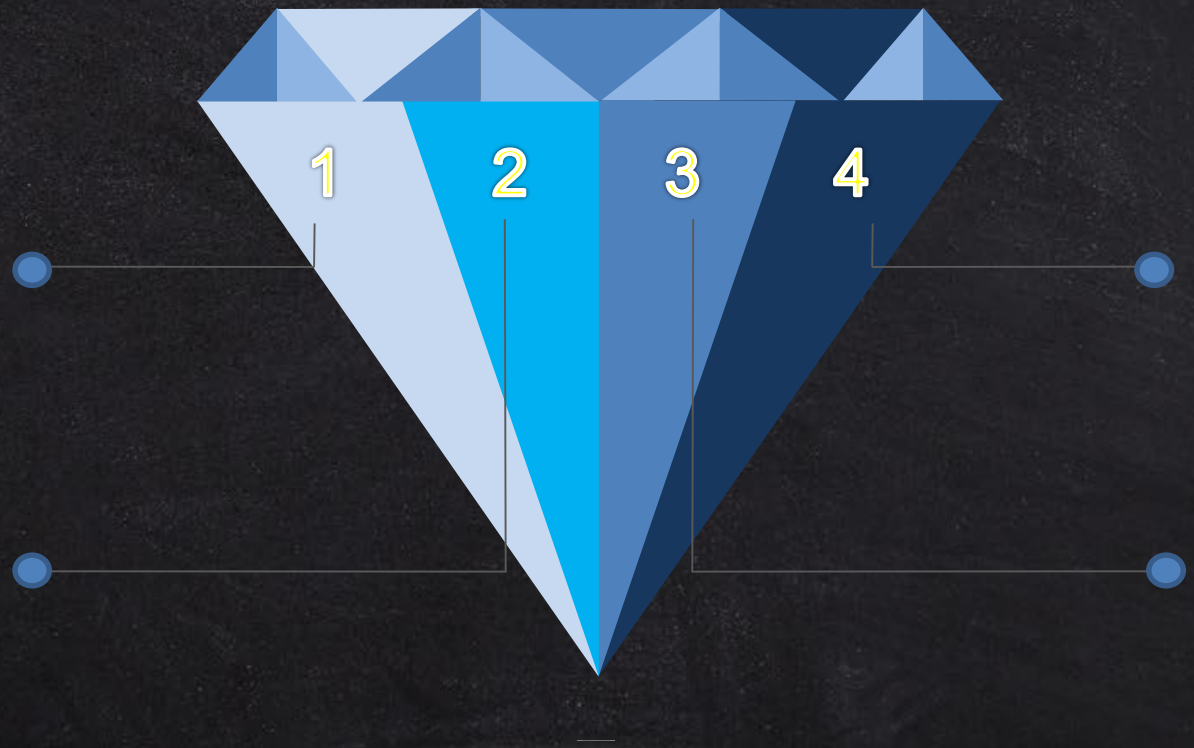
# Take home message

**Indication of SRMA**

Understand when to use SRMA and familiarize yourself with SRMA

**Comply to the latest guideline**

Use the PRISMA 2020 to conduct the review & to report the results

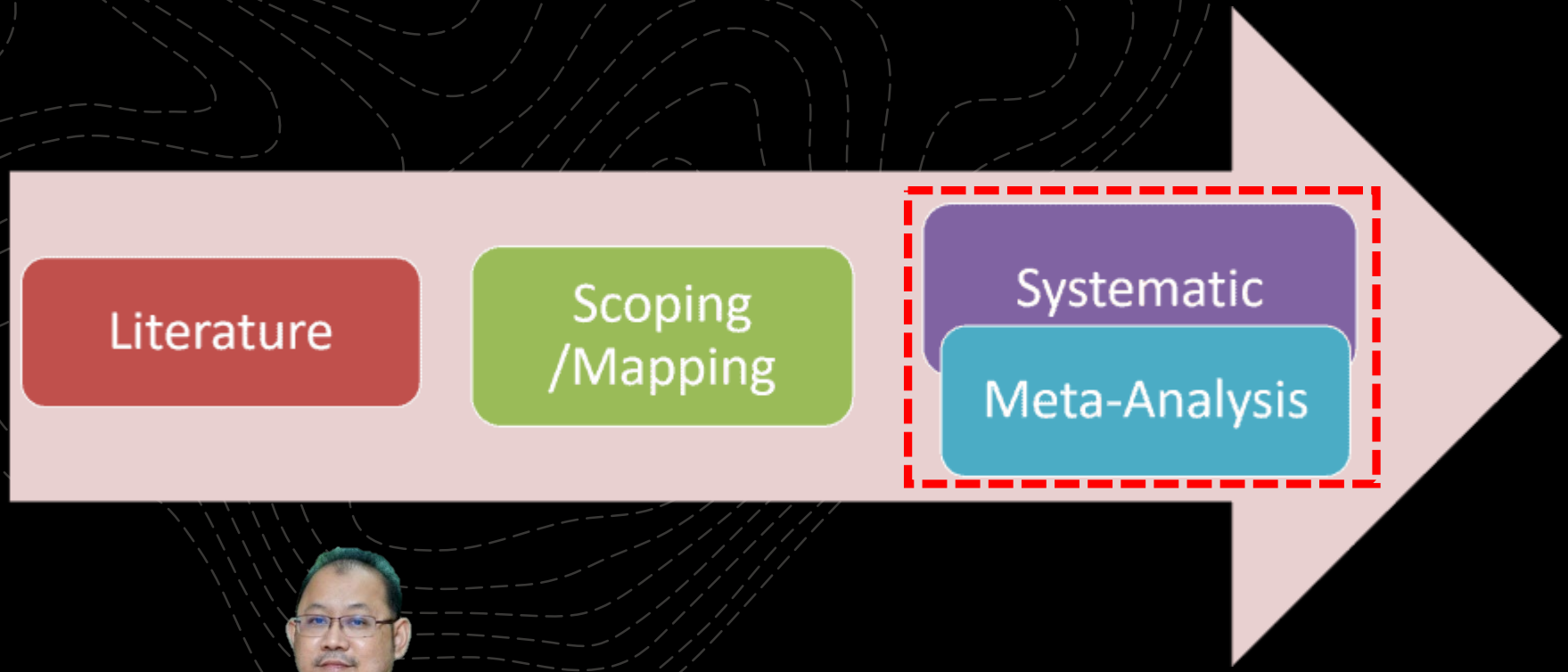



**Plan your SRMA**

Plan your SRMA according to the 5 tips and 7 steps of SRMA

**Publish your SRMA protocol and results**

Peer-reviewed journal & open access repositories




## SRMA Guidelines

Page M J, McKenzie J E, Bossuyt P M, Boutron I, Hoffmann T C, Mulrow C D et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews *BMJ* 2021; 372 :n71 https://www.bmj.com/content/372/bmj.n71

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# Thank you for your attention