# Supplementary Material

**The Role of Microelectrode Recording in Deep Brain Stimulation Surgery for Parkinson's Disease: A Systematic Review and Meta-Analysis**

**Search Strategy**
**Date**: 26-08-2021

**PubMed (764)**
*("Parkinson Disease"[Mesh] OR Parkinson*[tiab]) AND ("Deep Brain Stimulation"[Mesh] OR Deep Brain Stimulation*[tiab]) AND ("Subthalamic Nucleus"[Mesh] OR subthalamic*[tiab]) AND (Unified Parkinson's Disease Rating Scale[tiab] OR UPDRS*[tiab] OR Unified PD Rating Scale[tiab])*

**Embase (1963)**
*[(Parkinson disease/) OR ("parkinson*".ab,kw,ti.)] AND [(brain depth stimulation/) OR (deep brain stimulation*.ab,kw,ti.)] AND [(subthalamic nucleus/) OR ("subthalamic*".ab,kw,ti.)] AND [(unified parkinson disease rating scale/) OR (unified parkinson disease rating scale.ab,kw,ti.) OR (Unified PD Rating Scale.ab,kw,ti.) OR ("updrs*".ab,kw,ti.)]*

**Cochrane Library (198)**
*[MeSH=(Parkinson Disease) OR (Parkinson*:ti,ab,kw)] AND [MeSH=(Deep Brain Stimulation) OR (Deep Brain Stimulation*:ti,ab,kw)] AND [MeSH=(subthalamic) OR (subthalamic*:ti,ab,kw)] AND [(Unified Parkinson's Disease Rating Scale:ti,ab,kw) OR (UPDRS*:ti,ab,kw) OR (Unified PD Rating Scale:ti,ab,kw)]*

**Web of Science (887)**
*TS=(Parkinson*) AND TS=("Deep Brain Stimulation" OR "Deep Brain Stimulations") AND TS=(Subthalamic*) AND TS=("Unified Parkinson's disease Rating Scale" OR UPDRS* OR "Unified PD Rating Scale")*

***Results in total** = 3812*
***Results in total with duplicates removed** = 2129*

**ABSTRACT SCREENING** *(2129 abstracts)*
*(Conference) abstract (88)*
*Not meeting inclusion criteria (1753)*
*Language different than English (12)*

***FULL TEXT REVIEW*** *(276 articles)*
- *article unavailable (2)*
- *same data set as other included (original) article (2)*
- *not meeting in-/exclusion criteria (242)*

SELECTED ORIGINAL ARTICLES FOR ANALYSIS (30)

**Inclusion and exclusion criteria**

- English language
- Parkinson's Disease
- Bilateral STN-DBS (mixed populations, e.g., STN and GPi or uni- and bilateral grouped in one population/analysis were excluded)
- Data collection started from 2000
- Randomized clinical trial or consecutive cohort
- Minimal number of patients = 10
- No per-operative intervention as object of this study, expect there is a normal treated control group
- No postoperative intervention as objective of this research, expect there is a normal treated control group
- Effect measurement 6-24 months after surgery, preferred 12 months
- Surgical procedure must be described, specifying whether MER was used
- Demographic data, and primary outcome (UPDRS III, pre and postop) must be mentioned
- Exclusion: same study population than other study

**Extracted variables**
Variables that were extracted from each study were:

- Year
- First author
- Journal
- PMID
- Study Design
- Consecutive
- Group
- Total Number of Patients
- Number of Male Patients
- Number of Female Patients
- Percentage Male Patients (calculated percentage)
- Age + Standard Deviation
- Disease Duration + Standard Deviation
- Medication Use Duration
- Medication Use Standard Deviation
- Follow Up + Standard Deviation
- Pre-operative UPDRS III (ON and OFF medication)
- Pre-operative LEDD + Standard Deviation
- Pre-operative PDQ-39
- Hoehn & Yahr stage
- DBS unilateral or bilateral
- Use of Micro-electrode Recording (Y/N)
- Post-operative UPDRS III (ON/OFF Medication and ON/OFF DBS)
- Post-operative LEDD + Standard Deviation
- Post-operative PDQ-39
- Hemorrhage
- Adverse Events
- Complications

**Supplementary Table 1. Quality assessment of non-randomized studies using the modified Newcastle-Ottawa scale***

| First author, year | Adequate case description | Representativeness of the case | Assessment of outcome | Was follow-up long enough for outcomes to occurs? | Adequacy of follow-up cohorts | Total score |
|---|---|---|---|---|---|---|
| **Altug et al., 2014** | * | 0 | 0 | 0 | * | 2/5 |
| **Aviles-Olmos et al., 2014** | * | * | 0 | * | * | 4/5 |
| **Capecci et al., 2005** | * | 0 | * | * | 0 | 3/5 |
| **Chan et al., 2016** | * | 0 | 0 | * | 0 | 2/5 |
| **Charles et al., 2014** | * | 0 | 0 | * | * | 3/5 |
| **Chen et al. ,2011** | * | * | 0 | * | * | 4/5 |
| **Cheng et al., 2013** | * | * | 0 | * | * | 4/5 |
| **Chiou, 2016** | * | * | 0 | 0 | * | 3/5 |
| **Fluchere et al., 2014** | * | * | * | * | * | 5/5 |
| **Foltynie et al., 2011** | * | * | 0 | * | 0 | 3/5 |
| **Hung et al., 2013** | * | 0 | 0 | * | 0 | 2/5 |
| **Jiang et al,. 2019** | * | 0 | * | * | * | 4/5 |
| **Lefranc et al., 2017** | * | 0 | 0 | * | * | 3/5 |
| **Lemaire et al., 2016** | * | * | 0 | * | * | 4/5 |
| **Lhommee et al., 2012** | * | * | 0 | 0 | * | 3/5 |
| **Li et al., 2015** | * | * | 0 | * | 0 | 3/5 |
| **Lyons et al., 2005** | * | 0 | 0 | * | * | 3/5 |
| **Moran et al., 2020** | * | * | * | * | * | 5/5 |
| **Nakajima et al., 2011** | * | * | 0 | * | * | 4/5 |
| **Rabie et al., 2006** | * | * | * | * | * | 5/5 |
| **Rahmani et al., 2018** | * | 0 | * | * | * | 4/5 |
| **Ryu et al., 2005** | * | 0 | 0 | * | * | 4/5 |
| **Shin et al., 2020** | * | * | 0 | * | * | 4/5 |
| **Simuni et al., 2002** | * | 0 | 0 | * | * | 3/5 |
| **Tai et al., 2010** | * | 0 | 0 | * | * | 3/5 |
| **Tandra et al., 2019** | * | 0 | 0 | 0 | * | 1/5 |
| **Zhang et al., 2006** | * | 0 | 0 | * | 0 | 2/5 |

* Items “Selection of the non-exposed cohort” and “comparability of cohorts” were not suitable for assessing the quality of uncontrolled studies

**Most occurring quality problems:**

- No description of measurement procedure (independent?)
- Too short follow-up period
- High drop-out with no reasons given

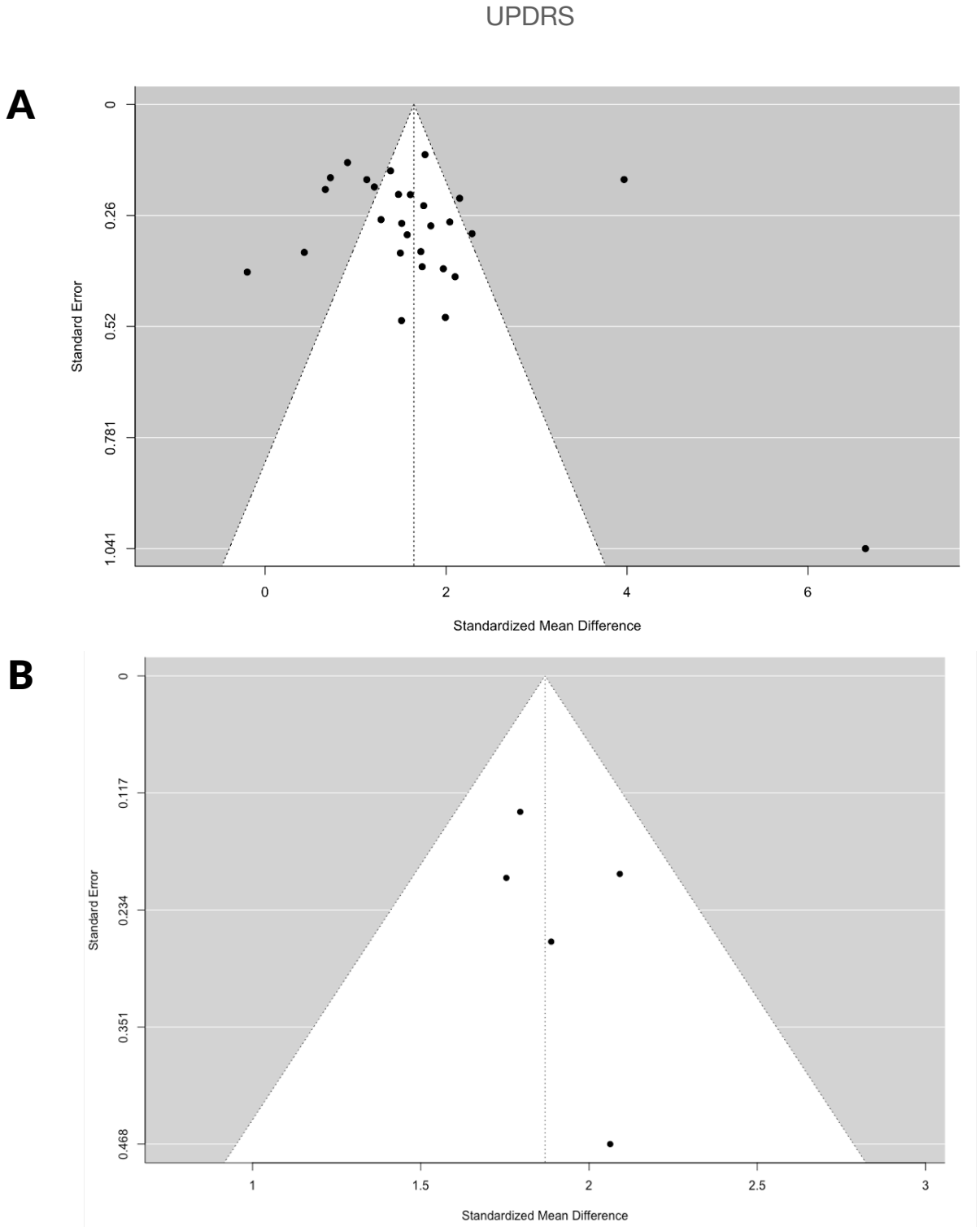
**Supplementary Table 2.** Quality Assessment

## Quality assessment of randomized controlled trials using Cochrane Handbook for Systematic Reviews of Interventions

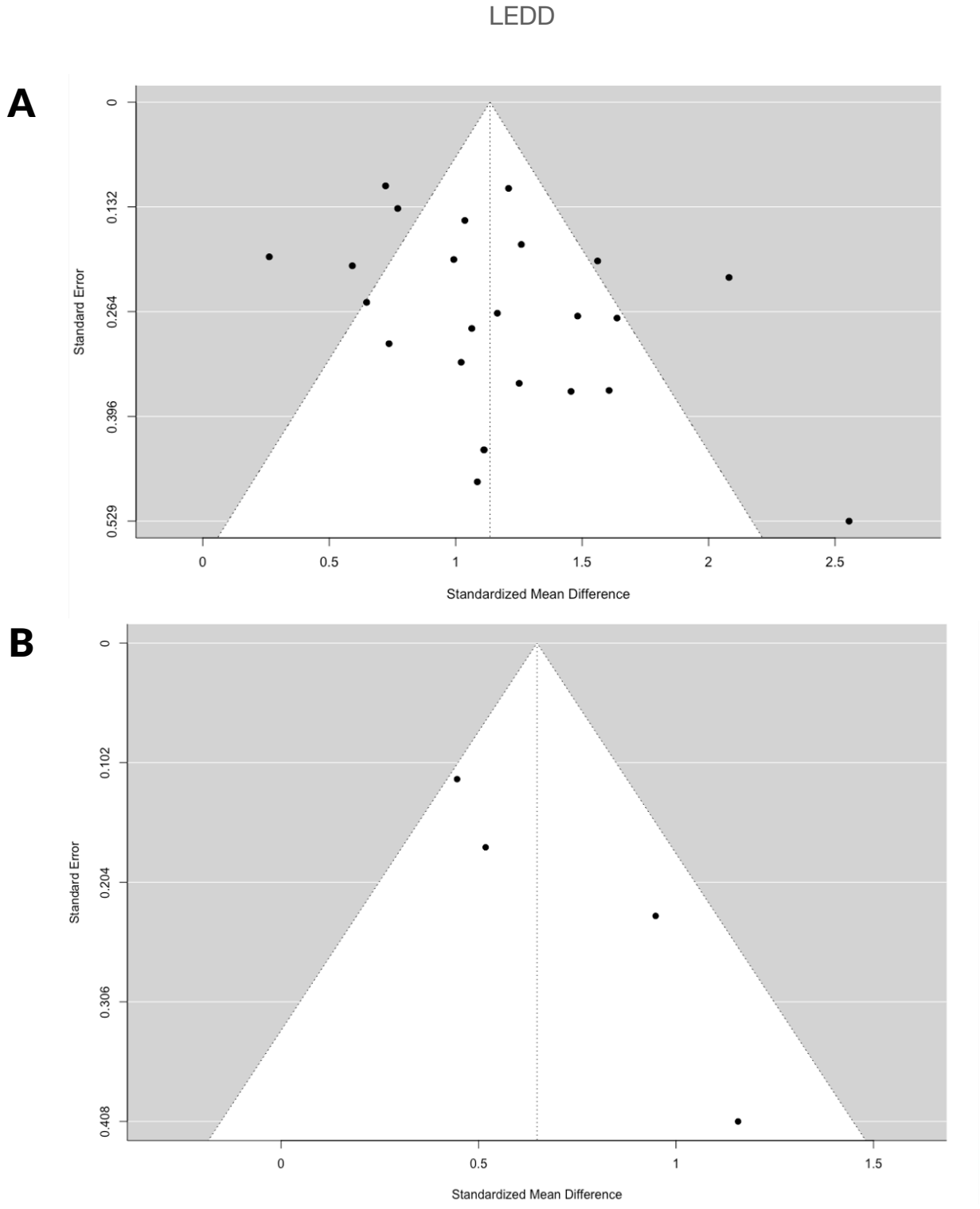
| | **Random sequence generation** (selection bias) | **Allocation concealment** (selection bias) | **Blinding of participants and personnel** (performance bias) | **Blinding of outcome assessment** (detection bias) | **Incomplete outcome data** (attrition bias) | **Selective reporting** (reporting bias) | **Other sources of bias** (other bias)* |
|---|---|---|---|---|---|---|---|
| **Deutschl et al., 2006** | + | + | - | - | + | + | + |
| **Schuepbach et al., 2013** | + | + | =/- | - | + | + | + |

**Low risk of bias = +, high risk of bias = -, unclear risk of bias = ?**

**Supplementary Figure 1.** Funnel plot of the standardized mean difference of the UPDRS-III of A) MER group and B) non-MER group.



**Supplementary Figure 2.** Funnel plot of the standardized mean difference of the LEDD of A) MER group and B) non-MER group.



# PRISMA 2020 Checklist

| Section and Topic | Item # | Checklist item | Location where item is reported |
|---|---|---|---|
| **TITLE** | | | |
| Title | 1 | Identify the report as a systematic review. | Page 1 |
| **ABSTRACT** | | | |
| Abstract | 2 | See the PRISMA 2020 for Abstracts checklist. | |
| **INTRODUCTION** | | | |
| Rationale | 3 | Describe the rationale for the review in the context of existing knowledge. | Page 5 |
| Objectives | 4 | Provide an explicit statement of the objective(s) or question(s) the review addresses. | Page 5 |
| **METHODS** | | | |
| Eligibility criteria | 5 | Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses. | Page 6 |
| 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. | Page 6 |
| Search strategy | 7 | Present the full search strategies for all databases, registers and websites, including any filters and limits used. | Page 6 |
| 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. | Page 6 |
| 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. | Page 7 |
| 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. | Page 7 |
| | 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. | Page 7 |
| 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. | Page 7 |
| 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. | Page 8 |
| 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)). | Page 7 |
| | 13b | Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions. | Page 7 + 8 |
| | 13c | Describe any methods used to tabulate or visually display results of individual studies and syntheses. | Page 7 |
| | 13d | Describe any methods used to synthesize 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. | Page 8 |
| | 13e | Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression). | Page 8 |
| | 13f | Describe any sensitivity analyses conducted to assess robustness of the synthesized results. | Page 7 |
| Reporting bias assessment | 14 | Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases). | Page 7 |
| Certainty assessment | 15 | Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome. | Page 7 + 8 |

# PRISMA 2020 Checklist

| Section and Topic | Item # | Checklist item | Location where item is reported |
|---|---|---|---|
| **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. | Page 9 |
| | 16b | Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded. | Page 9 |
| Study characteristics | 17 | Cite each included study and present its characteristics. | Table 1 |
| Risk of bias in studies | 18 | Present assessments of risk of bias for each included study. | Page 10 |
| 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. | Page 9 |
| Results of syntheses | 20a | For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies. | Page 10 |
| | 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. | Page 10 |
| | 20c | Present results of all investigations of possible causes of heterogeneity among study results. | Page 10 |
| | 20d | Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results. | Page 9 |
| Reporting biases | 21 | Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed. | Appendix 3 |
| Certainty of evidence | 22 | Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed. | Page 9 |
| **DISCUSSION** | | | |
| Discussion | 23a | Provide a general interpretation of the results in the context of other evidence. | Page 11 |
| | 23b | Discuss any limitations of the evidence included in the review. | Page 13 |
| | 23c | Discuss any limitations of the review processes used. | Page 13 |
| | 23d | Discuss implications of the results for practice, policy, and future research. | P 11, 12, 14 |
| **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. | Page 1 |
| Competing interests | 26 | Declare any competing interests of review authors. | Page 15 |
| 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. | Appendix |

*From:* Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

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