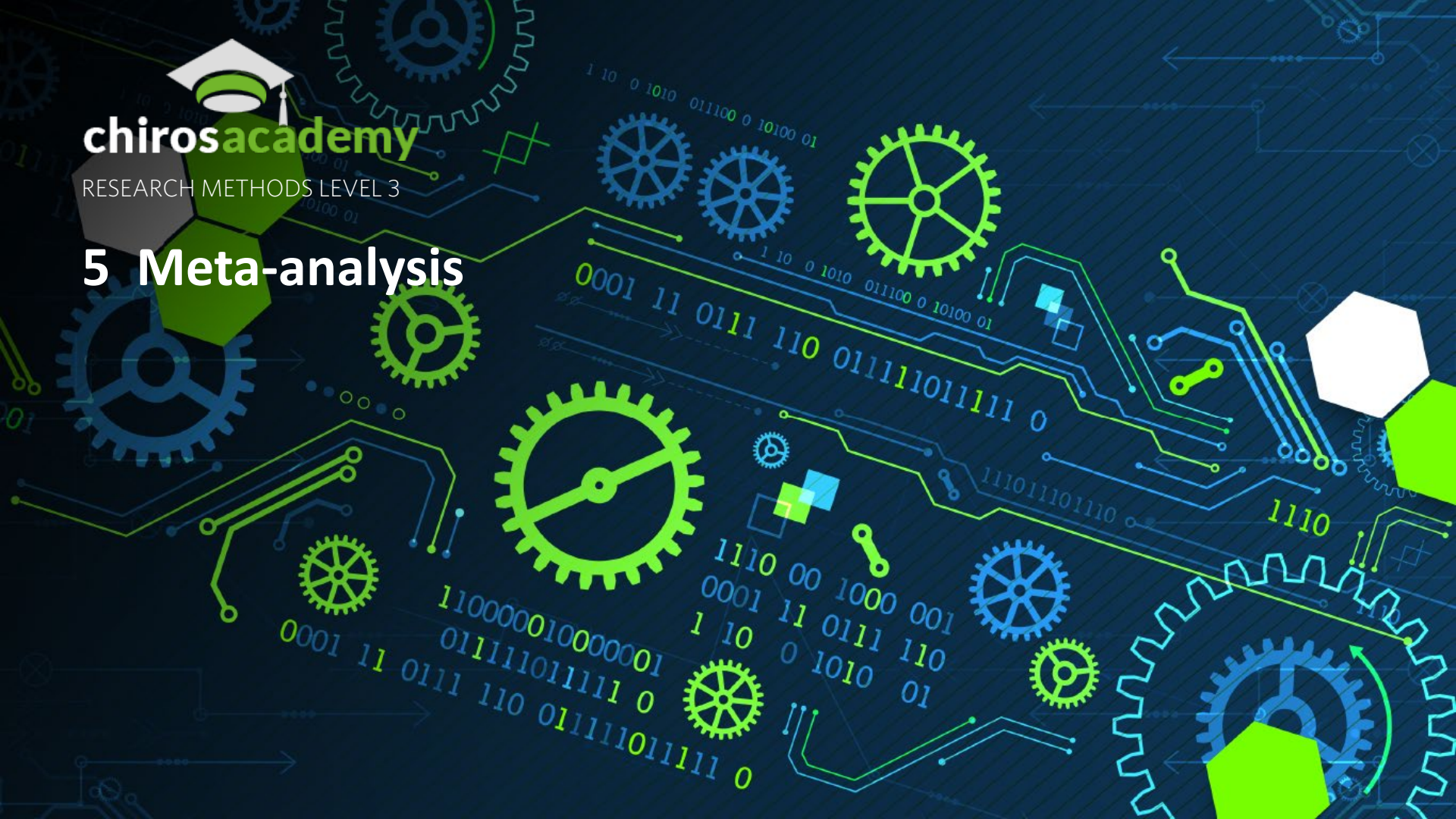
chirosacademy
RESEARCH METHODS LEVEL 3
5 Meta-analysis

Content

- What is Meta-analysis and why do we need it?
- Two main types of Meta-analyses; RCTs vs Observational studies.
- A good vs bad Meta-analysis.
- Quality assessment and reporting guidelines for meta-analyses:
  - PRISMA - RCTs
  - MOOSE – Observational
- Steps in Meta-analysis.
- Research question.
- Literature search and bias and strategies to minimize bias.
- Study selection with inclusion and exclusion criteria.
- Quality assessment and affecting factors.
- Data extraction and analysis:
  - Blinding and analysis
  - Combining studies
  - Odds ratios and relative risk
  - Overall effect
- Heterogeny.
- Plotting data and sensitivity analysis.
- Advantages and disadvantages of Meta-analysis.
- Summary.

References

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- CChalmers, T.C., Matta, R.J., Smith, H. & Kunzler, A.M. (1977). Evidence favoring the use of anticoagulants in the hospital phase of acute myocardial infarction. The New England journal of medicine. [Online]. 297 (20). pp. 1091–6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/909566.
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- **PRISMA** 2020 checklist https://www.equator-network.org/reporting-guidelines/prisma/
- **MOOSE** checklist https://www.elsevier.com/__data/promis_misc/ISSM_MOOSE_Checklist.pdf

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What is a Meta-Analysis?

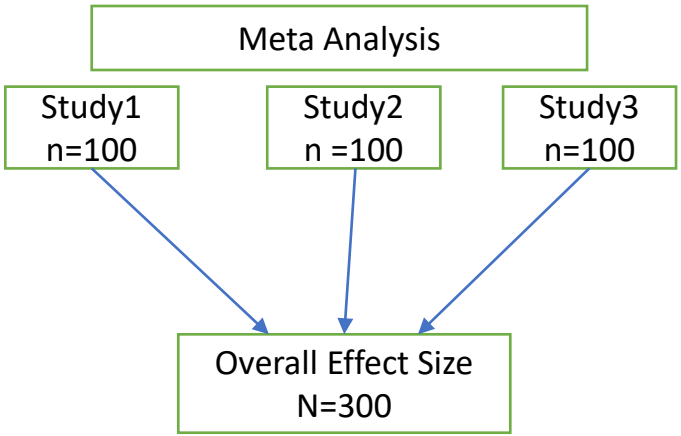
A Meta-analysis is the statistical analysis that **combines or integrates** the result of independent research studies and **synthesize** the conclusion to evaluate the **effectiveness** of an intervention for a particular health outcome.

Studies must be “combinable”. For example, studies used similar intervention and similar outcome measure for a certain clinical question.

A Meta-analysis can be performed when there are multiple scientific studies addressing the same clinical research question. Not appropriate for Basic Science research questions (for these Narrative Review).

What is a Meta-Analysis?
Let us look at an example

- You want to conduct a study exploring whether chiropractic interventions help relieve neck pain.
- So, you collect data from individual participants (100 participants = 100 “data points”). **You conducted a study.**
- Another 2 groups may also explore how chiropractic interventions help relieve neck pain by conducting another 2 studies. So, they collect data from another two groups of individuals (e.g., 100 individuals each = 100 “data points” each).
- A third group **conducted a meta-analysis.** Combining all three studies, so does an analysis of 300 datapoints.
- So, Meta-analysis looks at the similar outcome measures (neck pain) across multiple studies and provide the overall effect of the intervention for that outcome measure.



Need of Meta-Analyses

Why We Need Meta-analyses

- Gold standard for answering associations or cause-and-effect questions of intervention effect on health outcome.
- Improved power and precision due to larger sample size.
- Quantify inconsistency in results between studies.
- Generalizability of results.
- Health decisions made based on many studies.
- Investigate presence of publication bias.

Two Main Types of Meta-Analyses

Meta-Analyses of randomised controlled trials (RCTs)

- Address cause-and-effect questions about an intervention for a health outcome.

Meta-Analyses of observational studies

- Addresses associations – what happens in real life when people chose one intervention for a health outcome.

A Bad Meta-Analysis

- May be biased owing to exclusion of relevant studies or inclusion of inadequate studies (you select a study without explicitly mentioning why this study is included).
- Other than selection bias, there may be wrong estimates or calculation flaw (for example, effect size not calculated correctly for studies).
- Comparing ‘apples’ with ‘oranges’.
- Answering basic science questions.
- Can always be avoided if the basic principles and the steps involved in conducting a meta-analysis are adhered to.

PRISMA

x

Quality Assessment of and Reporting Guidelines for

x

- For Systematic Reviews and Meta-Analyses of **randomized controlled trials (RCTs)**

- **PRISMA** 2020 checklist https://www.equator-network.org/reporting-guidelines/prisma/

(Moher et al 2009)

PRISMA 2020 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.	
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 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.	
	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 synthesized 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.	

MOOSE

Quality Assessment of and Reporting Guidelines for

- For Systematic Reviews and Meta-Analyses of **Observational studies**
- Observational study:
  - Cross-sectional study
  - Case-control design
  - Cohort design
  - Case series
- **MOOSE** checklist https://www.elsevier.com/__data/promis_misc/ISSM_MOOSE_Checklist.pdf

(Stroup et al 2000)

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

A reporting checklist for Authors, Editors, and Reviewers of Meta-analyses of Observational Studies. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Reporting Criteria	Reported (Yes/No)	Reported on Page No.
Reporting of Background		
Problem definition	Yes	
Hypothesis statement	Yes	
Description of Study Outcome(s)	Yes	
Type of exposure or intervention used	Yes	
Type of study design used	Yes	
Study population	Yes	
Reporting of Search Strategy		
Qualifications of searchers (eg, librarians and investigators)	Yes	
Search strategy, including time period included in the synthesis and keywords	Yes	
Effort to include all available studies, including contact with authors	Yes	
Databases and registries searched	Yes	
Search software used, name and version, including special features used (eg, explosion)	Yes	
Use of hand searching (eg, reference lists of obtained articles)	Yes	
List of citations located and those excluded, including justification	Yes	
Method for addressing articles published in languages other than English	Yes	
Method of handling abstracts and unpublished studies	Yes	
Description of any contact with authors	Yes	
Reporting of Methods		
Description of relevance or appropriateness of studies assembled for assessing the hypothesis to be tested	Yes	
Rationale for the selection and coding of data (eg, sound clinical principles or convenience)	Yes	
Documentation of how data were classified and coded (eg, multiple raters, blinding, and interrater reliability)	Yes	
Assessment of confounding (eg, comparability of cases and controls in studies where appropriate	Yes	
Assessment of study quality, including blinding of quality assessors; stratification or regression on possible predictors of study results	Yes	
Assessment of heterogeneity	Yes	
Description of statistical methods (eg, complete description of fixed or random effects models, justification of whether the chosen models account for predictors of study results, dose-response models, or cumulative meta-analysis) in sufficient detail to be replicated	Yes	
Provision of appropriate tables and graphics	Yes	
Reporting of Results		
Table giving descriptive information for each study included	Yes	
Results of sensitivity testing (eg, subgroup analysis)	Yes	
Indication of statistical uncertainty of findings	Yes	
Reporting of Discussion		
Quantitative assessment of bias (eg, publication bias)	Yes	
Justification for exclusion (eg, exclusion of non–English-language citations)	Yes	
Assessment of quality of included studies	Yes	
Reporting of Conclusions		
Consideration of alternative explanations for observed results	Yes	
Generalization of the conclusions (ie, appropriate for the data presented and within the domain of the literature review)	Yes	
Guidelines for future research	Yes	
Disclosure of funding source	Yes	

Once you have completed this checklist, please save a copy and upload it as part of your submission. DO NOT include this checklist as part of the main manuscript document. It must be uploaded as a separate file.

Research Protocol for Meta-Analysis

1. Writing a research question
2. Literature search
3. Study selection
4. Quality assessment
5. Data extraction and analysis

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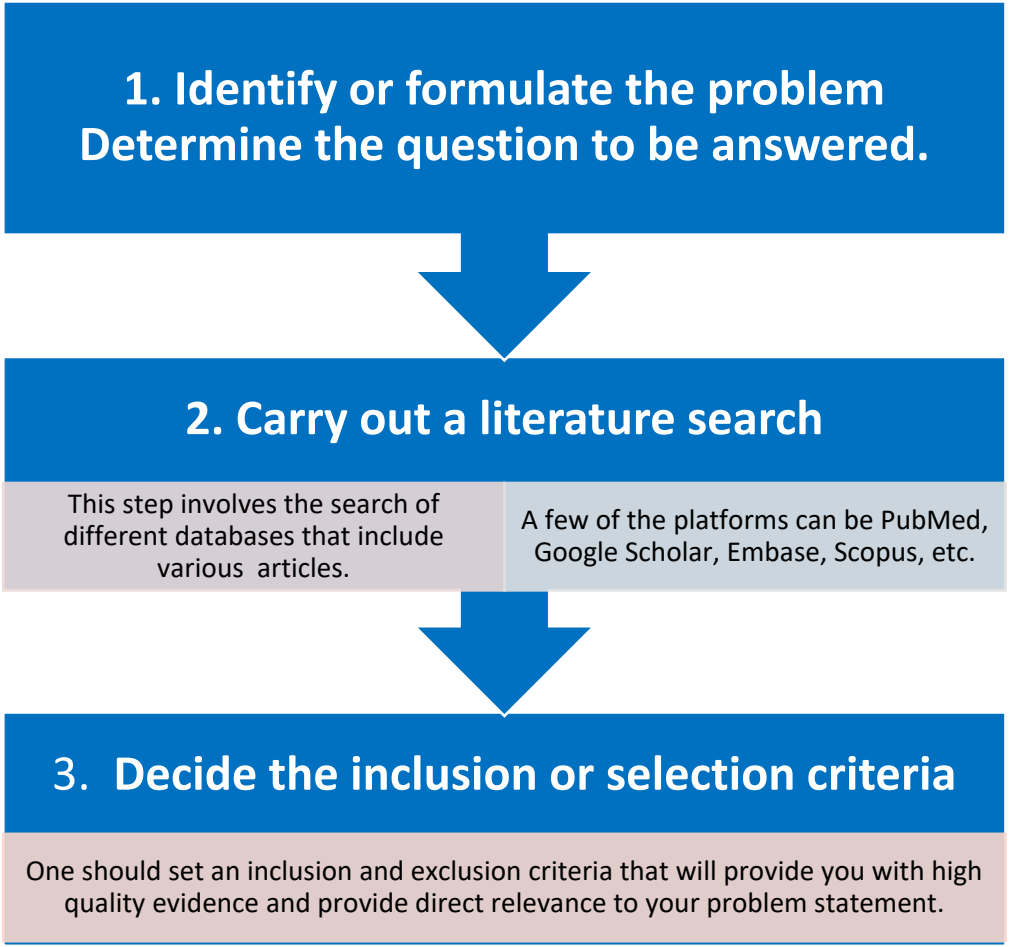
Research Protocol for Meta-Analysis



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Research Protocol for meta-analysis

4. Data Extraction

One needs to extract data that highlights the results of your area of interest that need to be combined in the final step of analysis Meta – Analysis.

5. Carry out Basic Meta-analysis

One can select from the multiple software that are available to carry out the process.	Review Manager and Comprehensive Meta-Analysis Software are a few of them

Research Protocol:
Writing a Research Question

- Meta-analyses begins with defining the research question that should be a well framed and identify a specific problem.
- PICO method is used to define key words from a research question.
- PICO stands for:
  - **P**: Population, Patient, Problem
  - **I:** Intervention
  - **C:** Comparisons or control
  - **0:** Outcome(s)
- According to this model, your research question must have above mentioned four components of PICO.
- Let us look at an example question.

Research Protocol: Writing a Research Question

Chiro care for Colic?

Example

In babies who cry excessively for no apparent reason (i.e., babies with colic) **(P)**, does chiropractic care **(I)** compared with reassurance only **(C),** reduce crying time per day **(O)**?

This question defines the population as babies with colic, and it identifies crying time per day as the outcome of the intervention that we are interested in, and it identifies that we want to compare this with colicky babies whose parents just receive reassurance.

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Research Protocol: Literature Search

- Reviewing the literature for studies that answer your research question comes after your research question has been defined.
- Do not restrict your search to single database i.e., Medline. This can cause **database bias** (will study later in this lesson).
- Searching across multiple computerized databases:
  - Google Scholar
  - PubMed/Medline
  - EMBASE
  - ScienceDirect
  - Scirus
  - Scopus
- Personal references and emails.
- Web e.g., google scholar , ISI web knowledge.

Research Protocol: Literature Search

- Conference programs.
- Dissertations.
- Review articles.
- Government reports, bibliographies.
- Use both automated and manual searches to look for all the relevant studies.
- While searching for relevant studies, combining manual and automated searches help you reduce **bias,** which is one of the major issues in conducting a good meta-analysis.

Research Protocol: Literature Search: Bias

- Main reason why meta-analysis can end up being biased = publication bias.
- **Publication bias** occurs because studies with ‘positive’ findings are more likely to be published — and they tend to be published faster — than studies with ‘negative’ findings.
- This means that any meta analysis or literature reviews based only on published data will be biased, so researchers should make sure to include unpublished reports in their data as well.
- Another form of bias is **database bias** which occurs when you only use certain databases in your search and include studies from only one or two databases in your meta-analysis.

Research Protocol: Literature Search: Bias

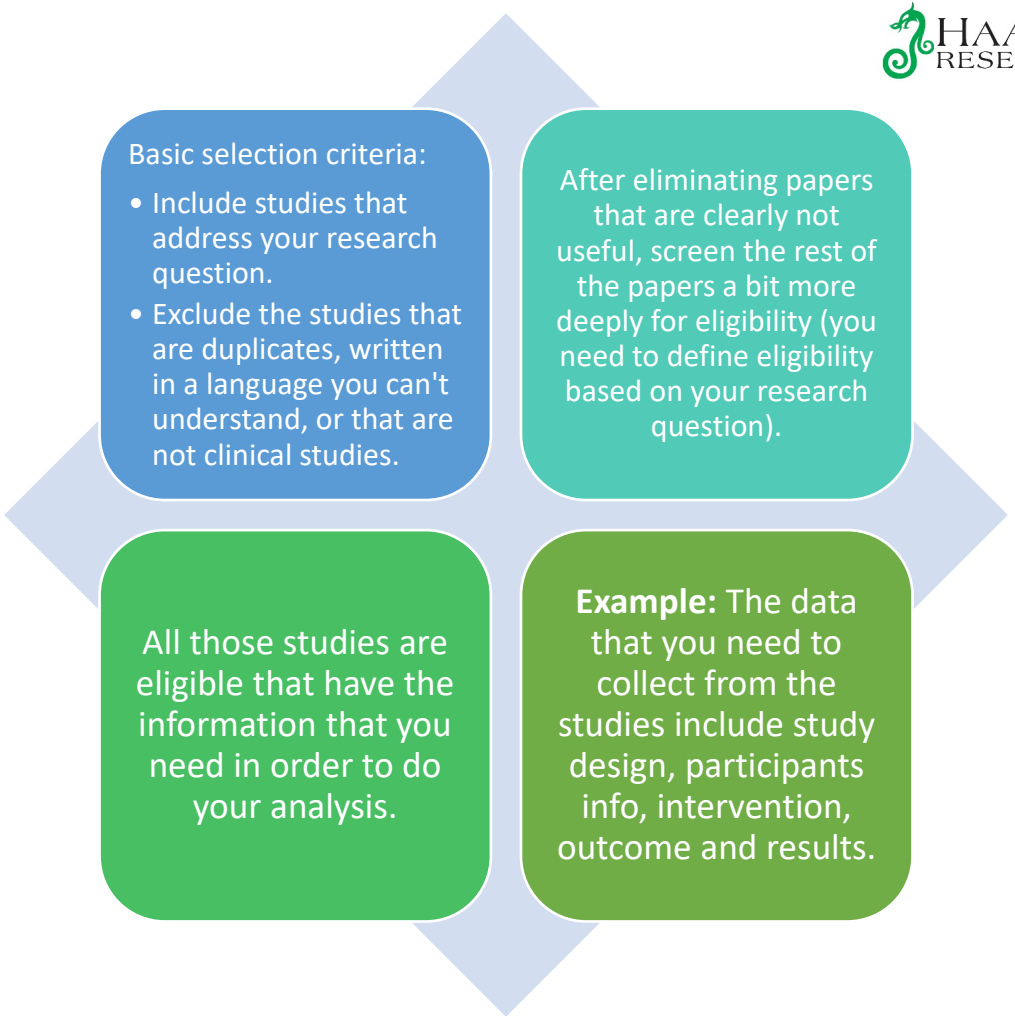
- Grey literature bias.
- Language bias.

- **Gray-literature bias:** ignoring literature that's harder to find, like government reports or unpublished clinical studies.
- **Language bias:** the exclusion of foreign language studies from your analysis.
- As mentioned earlier, all reviews and meta-analysis are biased in some sense so including multiple resources in your literature search help reduce bias.

Research Protocol:
Literature Search: Strategies to minimize Bias

- Avoid publication bias by including unpublished studies, as their results may differ from published trials.
- Search for unpublished clinical trials by searching various clinical trials registries.
- When conducing your literature search, to avoid database bias, use multiple different electronic databases.
- The Cochrane Collaboration has an extensive manual search of medical journals published in English and many other languages, so use these to avoid language bias.
- The Cochrane Controlled Trials Register is probably the best single electronic source of trials (but don't just rely on this).
- Look through/search the citations and references of all the relevant articles you find.

Research Protocol: Study Selection



Research Protocol:

Study Selection:

Inclusion & Exclusion Criteria

- Eligibility criteria for inclusion and exclusion of studies or data must be defined before study selection.
- Issues to consider are how similar or comparable the interventions are, the patients, the outcome measures used, and lengths of follow up, etc.
- Quality and design features of a study can influence the results (discussed later in this class).
- Ideally, include only high quality randomised controlled trials or only high-quality observational studies.

Research Protocol: Study Selection: Inclusion Criteria

What are important parameters to define these criteria?

Parameters to define inclusion criteria:

- Language
- Journal
- Authors
- Setting
- Participants or subjects
- Research Design
- Date of publication

Reliability of inclusion decisions

When two or more researchers assess each paper, agreement between researchers can be measured using predefined methods.

Research Protocol: Study Selection: Inclusion & Exclusions Criteria

Example:

Study design: RCT (randomized controlled trials or controlled trials CT) with control group.

Participants: Female>18 years of age.

Publication types: Journal articles, dissertations, Thesis.

Languages: English.

Interventions: applying high-velocity, low amplitude thrusts directed at vertebral subluxations

Define vertebral subluxation; e.g., vertebral motion segment that displays clinical indicators of dysfunction, such as decreased intersegmental range of motion, tenderness to the touch, altered joint play and/or end feel, etc.

Time Frame: studies indexed between 2000-2021.

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Research Protocol: Quality Assessment

Quality assessment of primary studies to evaluate the reliability of study results is an essential and mandatory part of meta-analyses.

Quality assessment is **the data collection and analysis through which the degree of conformity to predetermined standards and criteria are exemplified**.

If the quality, through this process is found to be unsatisfactory, attempts are made to discover the reason for this.

There are numerous quality assessment tools available; they can be classified into checklists, scales and component ratings.

Research Protocol:

Quality Assessment:

Factors

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Factors that can affect the quality of data.

Non-randomized trials:

Intervention allocation.

Randomized controlled trials(RCTs)

Inadequate randomization.

Lack of stratification of important factors.

Lack of or non-effective blinding.

Research Protocol: Quality Assessment: Factors

Factors to look for:

- Randomization
- Blinding
- Patients drop-outs
- Missing data
- Improper statistical analysis
- Potential bias

- **Every single study needs to be quality assessed according to the appropriate quality assessment tool.**

- **Each study design has its own quality assessment tools.**

Research Protocol: Quality Assessment tool

- There are different checklists available to assess the quality of the data (selection depend on study design).
- One such tool mostly used in health research in Cochrane tool to assess bias in study selection.
- Example of one of Cochrane domain to asses a risk of bias during randomization in RCT is shown.
- Quality can be improved by using more reviewers.

Signalling questions	Response options
1.1 Was the allocation sequence random?	Y / PY / PN / N / NI
1.2 Was the allocation sequence concealed until participants were enrolled and assigned to interventions?	Y / PY / PN / N / NI
1.3 Did baseline differences between intervention groups suggest a problem with the randomization process?	Y / PY / PN / N / NI
Risk-of-bias judgement	Low / High / Some concerns
Optional: What is the predicted direction of bias arising from the randomization process?	NA / Favours experimental / Favours comparator / Towards null /Away from null / Unpredictable

Research Protocol: Data Extraction and Analysis

- This step involves extracting the data for analysis and synthesis.
- The extracted data can be in a form of a spreadsheet, table, or some other form which makes this process easier.
- The extracted data depends on the research question, but it may include information such as sample size, patient characteristics, length of study, and a statistical measure, such as confidence interval, odds ratio, risk ratio, mean difference, and hazard ratio.
- Pilot a draft data extraction form. A data extraction form is usually a table including all the key features (related to your research question) of the included studies.

Research Protocol:
Data Extraction and Analysis: Blinding

It is useful if two independent observers extract the data, to avoid errors.

At this stage, the quality of the studies may be rated, with one of several specially designed scales.

Blinding observers to the names of the authors and their institutions, the names of the journals, sources of funding, and acknowledgments leads to more consistent scores.

Entails either photocopying papers, removing the title page, and concealing journal identifications and other characteristics with a black marker, or scanning the text of papers into a computer and preparing standardized formats.

Research protocol:
Data Extraction and Analysis: Analysis

- This step involves performing statistical analysis of extracted data.
- Two staged statistical process used in meta-analysis to analyze the data.

- 1) **Intervention effect of each study:**
  - P-value, Odd ratio, Relative risk, Confidence Interval, Number needed to treat
- 2) **Overall Intervention Effect:**
  - Calculated as weighted average of individual statistics.

Research Protocol:
Data Extraction and Analysis: Combining Studies

- Let us look at the outcome measures that are used in a meta-analysis for **combining studies.**
- Individual results are expressed in a standard format to allow comparison between studies.
- If the **outcome measure is continuous data**—for example, blood pressure—the mean difference between the intervention and control groups is used.
- The size of a mean difference, however, is influenced by the underlying **population**:
  - E.g., an antihypertensive drug is likely to have a greater absolute effect on blood pressure in overtly hypertensive patients than in borderline hypertensive patients.
- Therefore, differences are therefore often presented in units of **standard deviation (SD).**
- If the **outcome measure is binary**—for example, **disease versus no disease**, or **dead versus alive**—then **odds ratios** or **relative risks** are calculated.
- The **odds ratio** has convenient mathematical properties, allow combining data and testing the **overall effect for significance.**

Effect Size

- If your data is continuous in nature, like cm or gr then you usually calculate the difference in means or change of means in the two groups (intervention and control).
- From this you calculate the **effect size**, which is a number measuring the strength of the relationship between two variables.
- It is calculated by taking the difference between the two means, i.e., the mean of the intervention group minus the mean of the control group and dividing it by the standard deviation of one of the groups.

Interpretation of effect sizes:

- < 0.1 = trivial effect
- 0.1 - 0.3 = small effect
- 0.3 - 0.5 = moderate effect
- > 0.5 = large difference effect

Odds Ratio

- **Odds and odds ratio:**
  - The odds is the number of participants who fulfil the criteria for a given endpoint divided by the number of patients who do not.
- **Example:** The odds of depression after 12 weeks of spinal adjustments in a group of 10 patients may be 4 to 6 (4 with depression divided by 6 without, 0.66); in a control group (healthy people) the odds may be 9 to 1 (9 with depression divided by 1 without, 9).
- **The odds ratio of intervention (chiro care) to control group would be 0.07 (0.66÷9).**
- **The odds of depression after chiropractic care are 93% less likely.**

Risk and Relative Risk

- **Risk**, as opposed to odds, is calculated as the number of patients in the group who achieve the stated end point divided by the *total* number of patients in the group.
- **Risk ratio or relative risk** is a ratio of two "risks". In the example of previous slide, the risks would be 4 in 10 in the intervention group (4 divided by 10 = 0.4) and 9 in 10 in the control group (0.9), giving a risk ratio, or **relative risk of 0.4** (0.4 divided by 0.9 = 0.4).
- **Meaning the risk of remaining depressed is 60% less if you receive chiropractic care compared to the control.**

Research Protocol:
Data Extraction and Analysis: Overall Effect

The last step consists in calculating the overall effect by combining the data.

A **simple arithmetic average** of the results from all the trials would give **misleading** results.

The results from small studies are more subject to the play of chance and should therefore be given less weight.

Methods used for meta-analysis use a weighted average of the results, in which the larger trials have more influence than the smaller ones.

The statistical techniques to do this can be broadly classified into two models based on how the variability between the studies is looked at.

Fixed effect models

Random effect models

Research Protocol: Data Extraction and Analysis: Overall Effect

- The "**fixed effects**" model considers the variability of the results as ‘random variation’ and individual studies are simply weighted by their precision (inverse of the variance). In other words, this looks only at within-study variation.
- The "**random effects**" assumes a different underlying effect for each study and takes this as an additional source of variation, being randomly distributed. In other words, this takes into account between-study variations, as well as within-study variation.
- Which leads to somewhat wider confidence intervals than the fixed effects model.
- Although neither of two models can be said to be "correct," a substantial difference in the combined effect calculated by the fixed and random effects models will be seen only if studies are markedly **heterogeneous.**

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Research Protocol: Data Extraction and Analysis: Heterogeneity

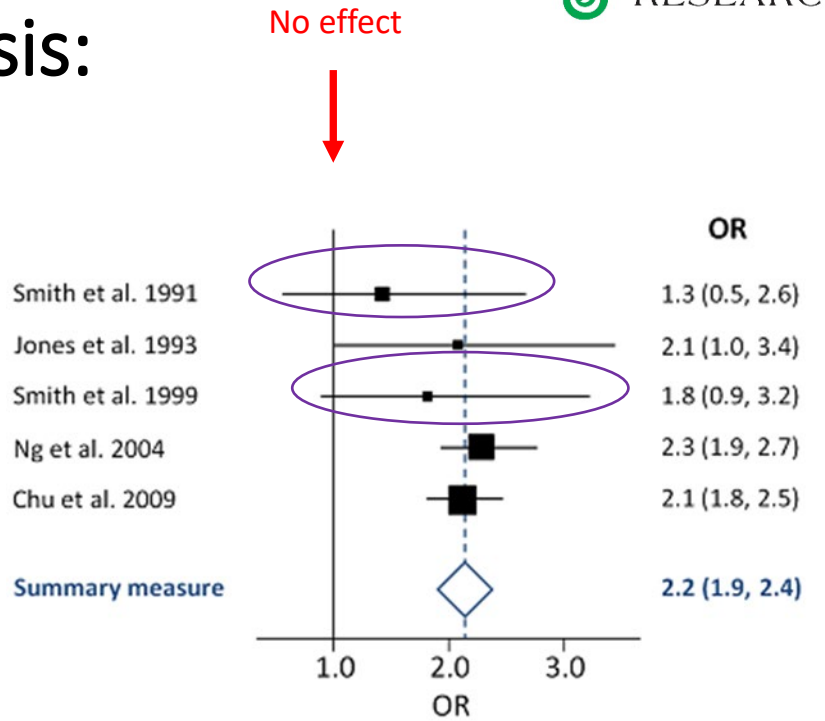
- If the results of the studies differ greatly (Heterogeneous) then it may not be appropriate to combine the results.
- One approach is to examine **statistically** the degree of similarity in the studies' outcomes. In other words, to test for heterogeneity across studies.
- A major limitation with this approach is that the statistical tests lack power—they often fail to reject the null hypothesis of homogeneous results even if substantial differences between studies exist.
- Although there is no statistical solution to this issue, heterogeneity between study results should not be seen as purely a problem for meta-analysis it also provides an opportunity for examining why treatment effects differ in different circumstances.

Research protocol: Data extraction and analysis: Plotting Data

- A **blobbogram** (AKA **forest plot**) is a graph that compares several clinical or scientific studies studying the same thing.
- Originally developed for meta-analysis of randomized controlled trials, the forest plot is now also used for a variety of observational studies. It's called a forest plot because of the forest of lines it produces.
- They play an important role in identifying beneficial drugs, procedures, or other interventions that can have a big impact on health outcomes.
- These charts allow us to look at all the available information, not just cherry-pick the results we like the look of

Research Protocol:
Data Extraction and Analysis:
Plotting Data

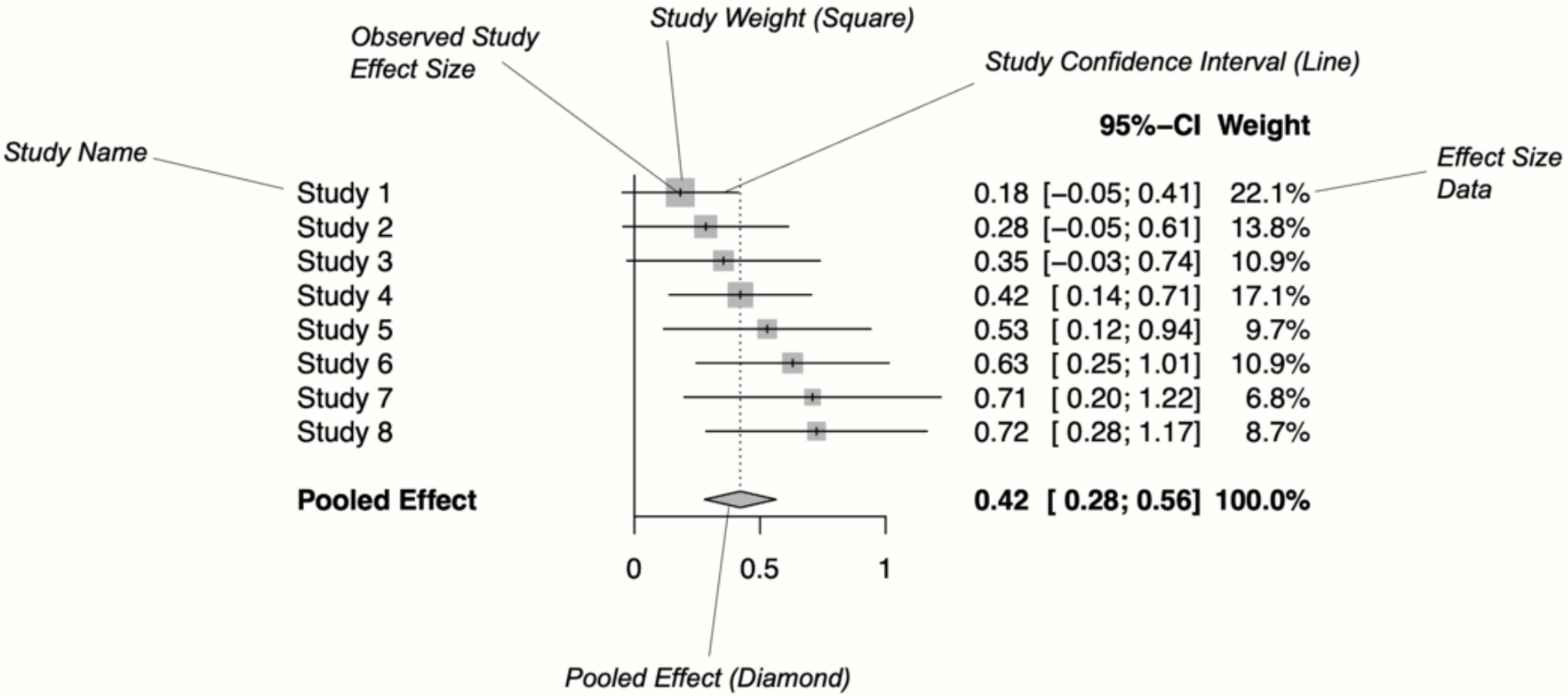
- A vertical line in the center. This is the line of no effect (or equality). For example, odds ratio = 1.
- A horizontal line or bar representing each study. The width of the line or bar represents the confidence interval, usually the 95% interval. This is the range where the true value is likely to fall.
- The diamond/point/square in the center of the line is a point estimate of the true value. The bigger the shape, the larger the sample size.



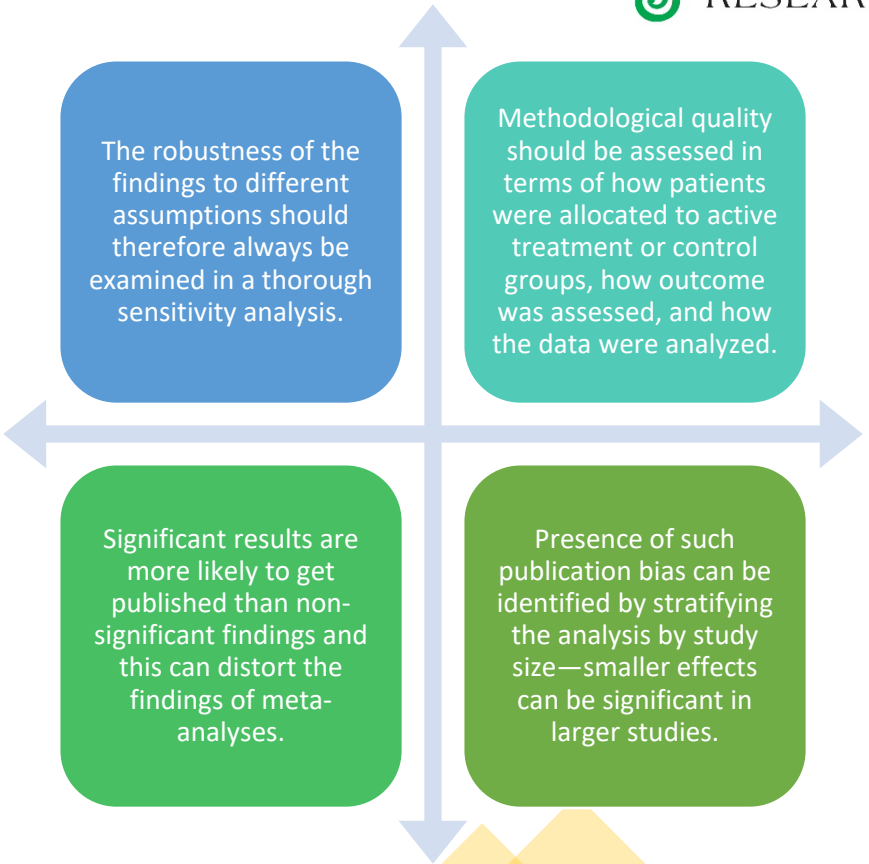
If an individual study crosses vertical line = no significant result

- **Reference:**

Stephanie Glen. "Blobbogram / Forest Plot: Definition, Simple Example" From **StatisticsHowTo.com**: Elementary Statistics for the rest of us! https://www.statisticshowto.com/forest-plot-blobbogram/


Study Weight (Square)
Observed Study Effect Size
Study Confidence Interval (Line)
Study Name
95%−CI
Weight
Effect Size Data
Study 1
Study 2
Study 3
Study 4
Study 5
Study 6
Study 7
Study 8
0.18 [−0.05; 0.41] 22.1%
0.28 [−0.05; 0.61] 13.8%
0.35 [−0.03; 0.74] 10.9%
0.42 [0.14; 0.71] 17.1%
0.53 [0.12; 0.94] 9.7%
0.63 [0.25; 1.01] 10.9%
0.71 [0.20; 1.22] 6.8%
0.72 [0.28; 1.17] 8.7%
Pooled Effect
0.42 [0.28; 0.56] 100.0%
0
0.5
1
Pooled Effect (Diamond)

Research Protocol: Data Extraction and Analysis: Sensitivity Analysis



Advantages of Meta-analysis

- Greater statistical power.
- Greater ability to extrapolate to general population affected.
- Considered an evidence-based resource.

Disadvantages of Meta-analysis

- Difficult and time consuming to identify appropriate studies.
- Not all studies provide adequate data for inclusion and analysis.
- Requires advanced statistical techniques.
- Heterogeneity of study populations.

Summary & Take-home Messages

- Meta-analysis should be as carefully planned with a detailed written protocol in advance.
- *A priori* eligibility criteria for inclusion & a thorough search for such studies make high quality meta-analysis.
- The graphical display of results from individual studies on a common scale is an important step of a meta-analysis:
  - ➢allowing examination of degree of heterogeneity between studies.
- Different statistical methods exist for combining the data, but there is no single "correct" method.
- A thorough sensitivity analysis is essential to assess the robustness of combined estimates to different assumptions and inclusion criteria.

Summary & Take-home Messages

- **PRISMA** is the checklist to assess the quality of a systematic review and meta-analysis of randomized controlled trials.

- **MOOSE** is the checklist to assess the quality of a meta-analysis of observational studies.

Common Terms Used in Meta-analysis

- **Effect size (ES)** is a measure of the magnitude of a relationship or a difference between groups (for continuous data).
- **Coding** is procedure that consists in extracting from primary studies information necessary to perform a meta-analysis.
- **Confidence interval** (CI) indicates the range within which the true effect size is likely to lie. Usually, a 95% CI is computed for each study effect size and for the overall (combined) effect size.
- **Forest plot** is plot of effect sizes (with confidence intervals) of all the studies included in the meta-analysis.

Common Terms Used in Meta-analysis

- **Moderator** is a variable that might explain differences in the effect sizes.
- **Inclusion criteria** is a criteria that define which studies should be included in a meta-analysis.
- **Exclusion criteria** is a criteria that define which studies should be excluded from a meta-analysis.
- **Odds ratio** is a measure of association between an exposure and an outcome. It represents the odds of an outcome occurring given a particular exposure/intervention, compared to the odds of the outcome occurring in the absence of that exposure/intervention.
- **Relative risk** is the ratio of the risks of an event occurring if a group is given a particular exposure/intervention compared to the risks for the non-exposure (no intervention) group.

Thank You

DR. HEIDI HAAVIK

ENLIGHTENING THE WORLD ABOUT THE SCIENCE OF CHIROPRACTIC

HAAVIK RESEARCH

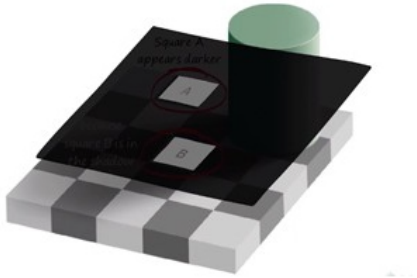
Introduction to Chiropractic Care

The introduction to chiropractic video series is the perfect way to gain an understanding of why chiropractic care may help you and your family.

The Beginners Guide to Chiropractic

In this first introductory video we explore what chiropractic is all about, and how it works, then we briefly explore the evidence informed effects of chiropractic care.

View video ›



How the Brain Perceives the World

Did you know that your brain and central nervous system are constantly changing? It's quite amazing – from one day to the next your brain is not the same.

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The Beginners Guide to Chiropractic

The Beginners Guide to Chiropractic

The word chiropractic derives from the Greek words "cheir", meaning hand, and "practikos" meaning skilled in or concerned with. The origin of the word chiropractic can be traced back to D.D. Palmer who coined it in 1895 when he founded chiropractic.

> Chiropractic care is really about total health and wellbeing

What does a Chiropractor do?

A chiropractor is a healthcare professional who specializes in the health and function of the spine and nervous system. Because of this focus on the spine, many people think chiropractors can only help with problems such as back pain, neck pain and headaches. They can often help with these issues but there is much more to chiropractic than just pain.

This is the first video in our animated series "Introduction to Chiropractic". In this video, we outline what a chiropractor does, then we briefly explore the effects of care. It is a perfect one to watch for anyone that is curious about chiropractic care, and how it can help their family.

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7. Herzog W, Zhang YT, Conway PJ, et al. Cavitation sounds during spinal manipulative treatments. Journal of Manipulative & Physiological Therapeutics 1993;16(8):523-6.

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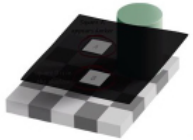


How the Brain Perceives the World

Did you know that your brain and central nervous system are constantly changing? It's quite amazing – from one day to the next your brain is not the same.

View video ›

Break the Pain Cycle

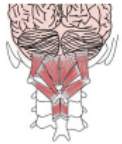
Did you know that pain is created in your brain to let you know that something is not ok within your body? Feeling pain is good because it is actually helpful and informative.

View video ›

Chiropractic Care and Migraines

Did you know that 1 in 6 people in the world experience migraines regularly? The World Health Organisation consider them to be the most debilitating of all neurological disorders.

View video ›



Chiropractic Affects your Brain

Your brain receives information about your body from the environment and your organs. Did you know that the muscles in your body are also sensory organs?

View video ›

What is that Pop?

If you have been adjusted before by a chiropractor you may have noticed a strange popping sound. Don't worry – it is just the formation of gas within a joint.

View video ›

Lower Back Pain

Scientists have worked out that at any one time, over 500,000,000 people around the world are suffering from low back pain and it is now the leading cause of disability worldwide.

View video ›

Growing Pains

We've all heard of growing pains right? But did you know that what we call growing pains aren't associated with growing? So they're not actually growing pains at all.

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Pain and the Immune System

Research studies have shown that the way you feel pain all depends on what's going on for you – and most importantly – what you think and feel about the situation.

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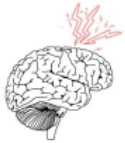

Chiropractic and Headaches

Headaches are a sign that something is not right. Your brain will create for you the sensation of pain if it thinks there is something wrong or if there is a potential problem.

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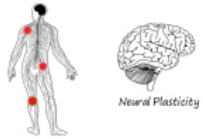

Pain is Created in Your Brain

Did you know that the scientists now know that the feeling of pain is something your brain decides that you should experience – if it believes that there is a problem?

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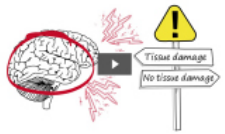

Chronic Pain

Chronic pain is the second-most common reason people see a doctor and miss work. More than one-third of people with chronic pain become disabled by their pain to some degree.

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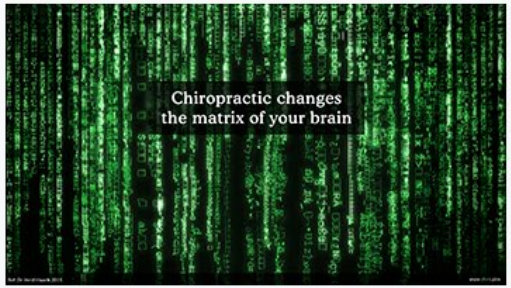

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Chiropractic Research

Research summary articles to read, download and print (members only) all backed by the latest scientific research studies.

Chronic Pain

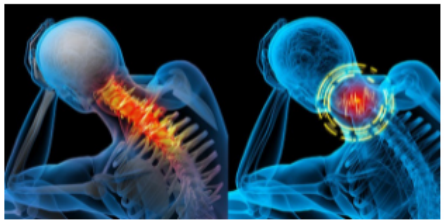
Chronic pain that has persisted for more than 3 months is no longer protective, nor informative. So, what is chronic pain and what can you do about it?

Read more »

Pain is in the Brain

Sometimes pain persists long after tissue damage has actually healed. When pain persists for more than three months we call this chronic pain.

Read more »



Neck Pain

Up to half the world's population suffers from neck pain at some stage. For some, one big problem is that it just keeps coming back, or becomes chronic.

Read more »

UNDERSTANDING PAIN

Dr. Kelly Holt
BSc, BSc(Chiro), PGDipHSc, PhD

Dr. Heidi Haavik
BSc(Physiol), BSc(Chiro) PhD

Experiencing pain is normal. Everyone experiences pain now and then.[1] Pain is supposed to be protective to make you stop doing things that may be dangerous.[2] But chronic pain that has persisted for more than 3 m hs is no longer protective, nor tive.[3] So, what is chronic pain and ut it if you suffer from it?

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PAIN IS CREATED IN THE BRAIN

Dr. Kelly Holt
BSc, BSc(Chiro), PGDipHSc, PhD

Dr. Heidi Haavik
BSc(Physiol), BSc(Chiro) PhD

Did you know that scientists now know the feeling of pain is something your brain decides you should experience if it believes there is some tissue damage in your body?[1] In fact, your brain can decide that you should feel pain even if it only thinks there is a potential threat of tissue damage!!![2-5]

It may seem strange, but it's totally up to your brain to decide whether you should feel pain or not. Your brain may decide you should experience pain even if you have no actual tissue damage yet,[6] or your brain may not create the feeling of pain for you when tissue damage has actually occurred![7,8]

"pain paradox". It means
s reflect

heals the problem.[1] This pain is helpful and informative.[1] If we listen to our body these pain experiences can be a good thing.

But for some people, pain can persist even after the initial injury that caused it healed.[9-11,12] And for some people, the pain areas that are not injured at become non-

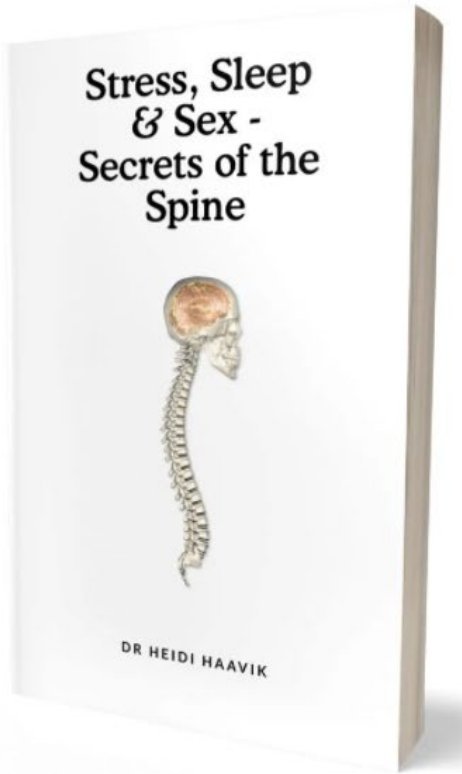
NECK PAIN AND FALLS RISK

Dr. Kelly Holt
BSc, BSc(Chiro), PGDipHSc, PhD

Dr. Heidi Haavik
BSc(Physiol), BSc(Chiro) PhD

Neck pain is very common throughout the world.[1] Up to half of all people around the world suffer from neck pain at some stage each year.[2-5] For some people, one big problem with neck pain is that it just keeps coming back, or becomes chronic, and may even increase their risk of suffering from a fall.[2,4,6,7]

Scientists know that your brain uses sensory information from your muscles and joints around your spine to help control your balance and posture and to make sure you're moving properly.[1,2] When your brain takes sensory information and uses it to help guide movements and control muscles we call this sensorimotor function.[8] One particular study looked at whether neck pain has an impact on proper sensorimotor function in older people.[7] In this study, the researchers ran a whole lot of tests of sensorimotor function, like how well the study participants controlled the movement of their eyes and how good their balance was, and they took into account their age and other conditions that they suffered from.[7]



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