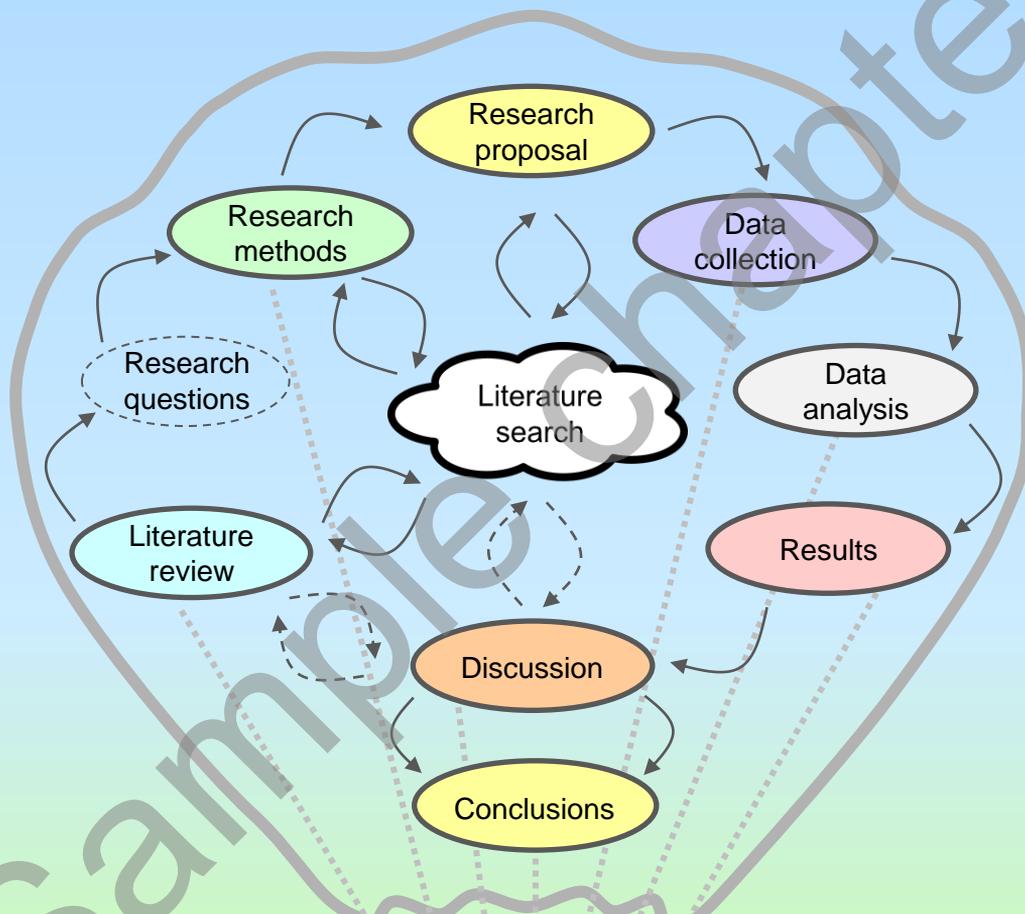


COMPASS GUIDE

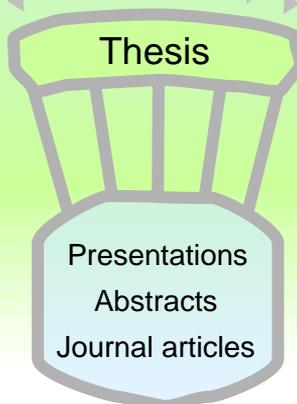
FOR POSTGRADUATE STUDENTS (AND THEIR SUPERVISORS):

How to Navigate Your Research Journey



Second
Edition

Dr Sandra Mandic,
PhD, PMP
AGILE Research Ltd.



**Compass Guide
Research Training**

By AGILE Research Ltd.

AGILE Research Ltd., 3/43 Cooper Street, Karori, Wellington, 6012, New Zealand

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2.2 Writing Research Methods

Research methods describe how the research was done and why the research was done in a particular way.

The terms ‘research methodology’ and ‘research methods’ are sometimes used interchangeably but they are actually different. ‘Research methodology’ is a theoretical or philosophical positioning of the study. ‘Research methods’ are the tools that researchers use to conduct their study including study design, research procedures, statistical approaches, etc. You cannot have one without the other.

Research methods are informed by literature review and overarching research methodology. Research methods are designed to answer chosen research question(s). The chosen research methods are further shaped by funding constraints, available equipment and expertise, time constraints and specific constraints associated with the setting where the study is conducted (e.g., availability of eligible participants for the study).

The research methods section is one of the key sections of any research proposal and research report (including thesis and scientific journal article). This section answers the questions about who was involved in the research, where the research was conducted, and how the research was conducted.

As a result, the methods section should provide information on research question(s), study design, the setting, study participants (if applicable), research procedures, equipment used, description of intervention(s) and comparisons (if applicable), and details about data analysis. If applicable, this section should also include information about ethical approval and procedures used for obtaining informed consent from human participants.

The chosen research methods should be appropriate for answering the research question(s). It is beyond the scope of this guide to discuss research methods and process of choosing appropriate research methods and suitable data analysis procedures. As part of your postgraduate research journey, you will probably take a course on research methods specific to your discipline. You will also need to work closely with your supervisor to select appropriate research methods to enable you to answer your research question(s).



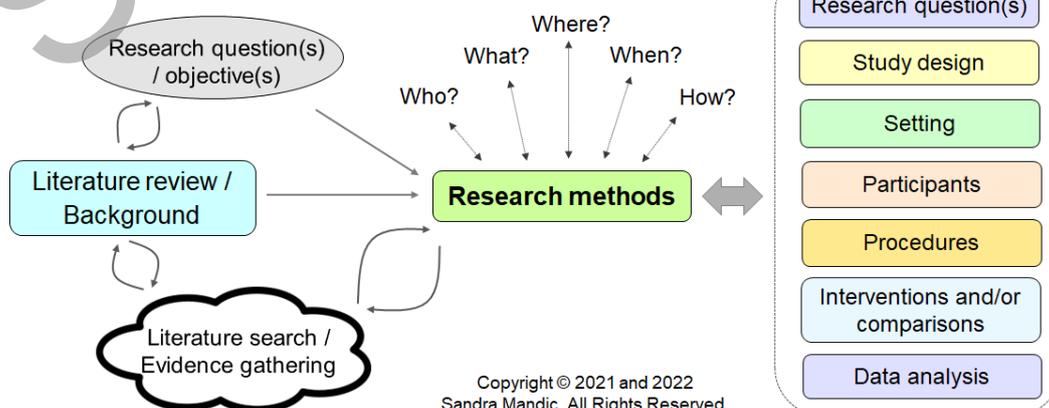
[YouTube video link](#)

Watch a 6-min video:

[How to Write up Research Methods](#)

Available at
the AGILE Research YouTube Channel
www.youtube.com/@agileresearch

Putting Together a Research Methods Section



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Develop Your Research Questions and Methods with Your Supervisor

Your postgraduate degree supervisor will be the best person to advise you on appropriate research methodology.

Work closely with your supervisor to develop your research question(s) and research methods for your research project.

Ask your supervisors about relevant books, book chapters, journal articles and other materials – such as Compass Guide Research Training Resources – to familiarise yourself with guideline for writing research methods in your scientific discipline.

You could also ask your supervisor about example of well-written research methods sections by students in your scientific discipline.

Familiarising yourself with the guidelines and checking out relevant examples will help you gain insights on how to approach describing research methods for your project.



Ask Your Supervisor about...



Relevant research methods books, book chapters and journal articles to assist you in developing research methodology for your project



Guidelines for writing research methods sections in your scientific discipline



Example(s) of well-written research methods sections prepared by research students enrolled in the same degree in your discipline



Example(s) of well-written research methods sections within research articles published in your discipline

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Planning Your Data Analysis

When planning your research, you will also need to plan the details of data analysis.

You will learn about different data analysis approaches in research methods course(s) and/or through guidance from your supervisor.

Data analysis approaches vary greatly between scientific disciplines and also within scientific disciplines based on research question(s) and chosen research methods.

Data analysis can be a daunting task for some postgraduate research students, especially if statistical analysis is involved.



Get the training you need to conduct your data analysis

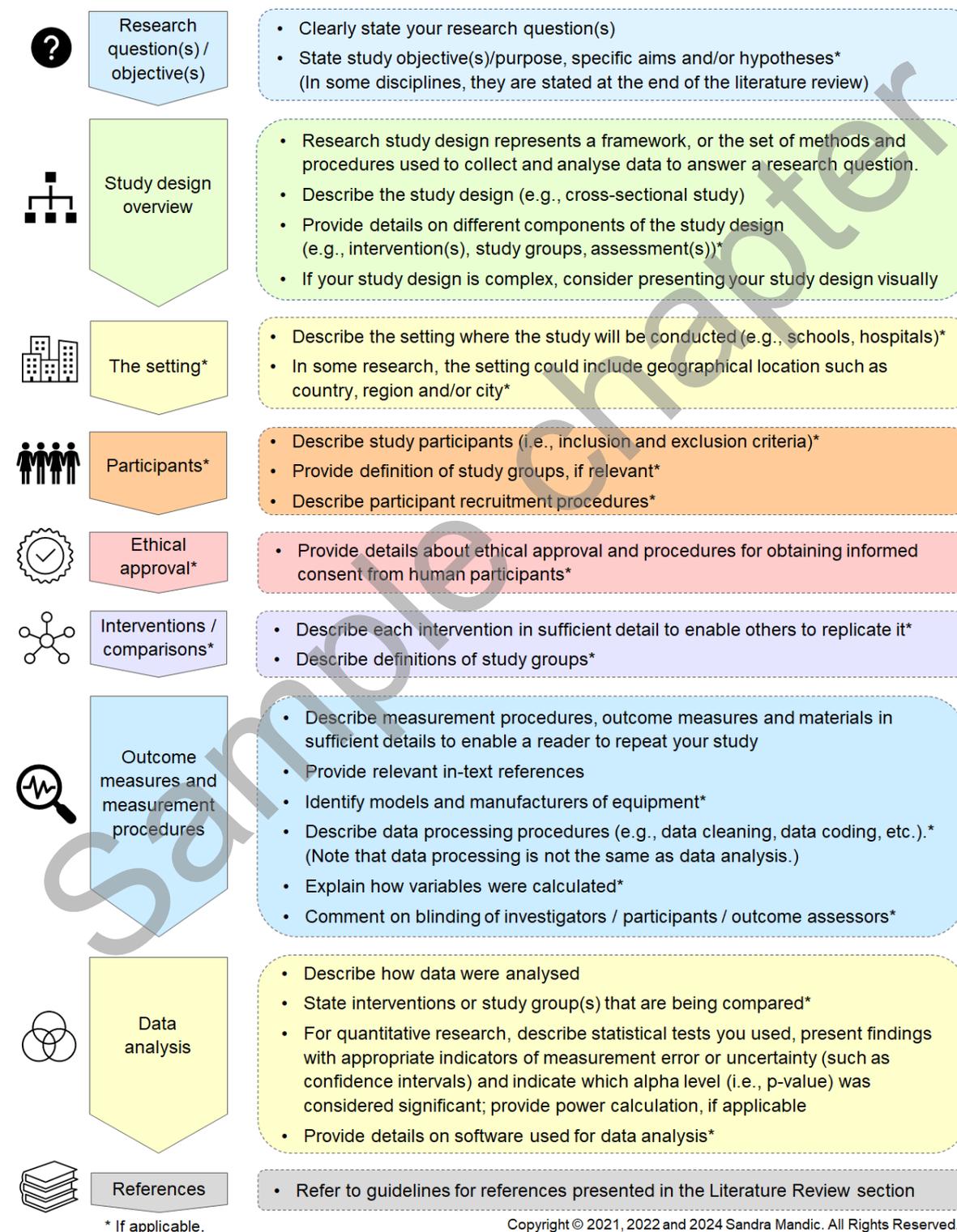
Ask you supervisor about course(s) that you can take at your institution or online to gain the necessary knowledge to conduct data analysis for your postgraduate research.

Work closely with your supervisor when planning your data analysis.

Guidelines for Writing Research Methods Section

The methods section should be written clearly and succinctly. In principle, the methods section should provide sufficient detail to allow the reader to replicate the study. Every research study is different and therefore

research methods sections vary across different studies. Regardless of your research topic, you should follow generic guidelines for writing up research methods in your discipline. See infographic below for more details.



* If applicable.

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Examples of Research Methods Sections

Methods Section from a Research Grant Proposal

On the next two pages, you will see an example of a research methods section from a real-world research grant proposal.

Research methods section for your thesis will likely be much longer and include more details.



Research Proposal Title:

Long-Term Effects of Cardiac Rehabilitation in Elderly Individuals

Summary: Advancing age is associated with progressive impairment of cardiovascular function, decreased exercise capacity and reduced quality of life. These age-related changes may be attenuated by regular exercise, irrespective of the presence or absence of cardiovascular disease (CVD). Yet cardiac rehabilitation remains an underutilized intervention in elderly individuals with CVD and long-term effects of such programs remain unknown. This study will examine the long-term effects of community-based cardiac rehabilitation on exercise capacity, cardiovascular function, and quality of life in elderly individuals with CVD. Comparison groups will include age-matched sedentary and active healthy individuals and sedentary CVD patients.

RESEARCH DESIGN AND METHODS

Study Design Overview. This cross-sectional study will enrol a total of 160 elderly individuals in four groups: healthy sedentary, healthy active, CVD sedentary, and CVD active ($n=40$ per group).

Study Population. Elderly individuals ≥ 60 years of age will be recruited. Apparently healthy individuals with no history of CVD will be recruited for the healthy groups. Individuals with a history of CVD and at least 6 months after myocardial infarction, stent placement or coronary artery bypass surgery will be recruited in the CVD groups.

Sample size calculation. Previous studies of male CVD patients reported exercise capacity measured as peak oxygen consumption of $19.3 \pm 6.1 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ at the beginning of cardiac rehabilitation program¹² and 15% to 20% (2.9 to $3.9 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$) increase in exercise capacity following a 12-week cardiac rehabilitation.¹³ An increase in peak oxygen consumption of $3.5 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ is associated with 12% improvement in survival in individuals with CVD and without CVD.^{14,15} A minimum sample of 38 patients per group will provide a power of 80% at a 5% significance level to detect a difference in peak oxygen consumption of $3.5 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ between active and sedentary CVD patients. This sample size is also powered to detect 15% difference in exercise capacity between active CVD and sedentary healthy individuals.

Recruitment procedures. Active elderly individuals with CVD and without CVD will be recruited from ongoing community cardiac rehabilitation programs: A) Programme A (140+ members) and B) Programme B (80+ members). Elderly sedentary individuals with and without CVD will be recruited from local cardiologists and general practitioners. Participants will receive written and verbal information about the study and asked to sign consent.

Study Design. In this cross-sectional study, participants will attend 2 visits.

Visit 1. During the first visit (2.5 hours), participants will complete questionnaires about their medical history and physical activity. Additional assessments will include resting measures of vascular function, body composition, physical function, muscular strength, 6-minute walk test and a 10-meter shuttle walk test. Participants will also be asked to complete at home a 7-day physical activity log and questionnaires pertaining to physical activity, quality of life and psychosocial health and bring them to the next study visit.

Visit 2. During the second visit (1.5 hours), participants will perform an exercise stress test with expired gas analysis and non-invasive assessment of cardiovascular function during exercise.

Outcome Measures. The primary outcome measure will be exercise capacity measured as peak oxygen consumption during maximal exercise stress test. Secondary outcome measures will include cardiovascular response to exercise (i.e., cardiac output, and stroke volume), cardiac and vascular function at rest, physical function, muscle strength, body composition, physical activity patterns, quality of life and psychosocial health.

Measurement Procedures

Exercise stress test. Peak oxygen consumption obtained during symptom-limited incremental exercise testing is a gold standard for determining exercise capacity.¹⁶ Exercise testing with expired gas analysis (Quark CPET, Cosmed) and continuous ECG monitoring (Quark C12x, Cosmed) will be performed on a bicycle ergometer (Ergo 100K, Cosmed) using a ramp protocol with a test duration of 8 to 12 minutes.¹⁷

Cardiovascular response to exercise. Cardiovascular response to exercise will be assessed in a non-invasive manner using bioimpedance technology (Physioflow device, Manatec Biomedical). Bioimpedance technology is based on the concept that flow can be measured by electrical resistance of tissue to the flow of electrical current. The Physioflow device provides an accurate, reliable and continuous estimate of stroke volume and cardiac output at rest and during incremental exercise.^{18,19}

Shuttle Walk Test.²⁰ During this test, participants will walk up and down a 10-meter course for up to 12 minutes. The speed of walking will be dictated by an audio signal played on a tape cassette.

6-Minute Walk Test.²¹ Using a standardized protocol, this test will be conducted on a 30-meter flat, obstacle-free corridor, with cones placed at each end. Participants will be instructed to walk up and down the course and cover as much distance as they can in 6 minutes. After 10 minutes of rest, participants will perform this test again.

Short Physical Performance Battery.^{22,23} This validated and standardized assessment of physical function consists of a timed “usual pace” 4-meter walk, repeated chair stands, and a balance test. Each test is scored on a scale 0 to 4. A summary score ranging from 0 (worst performers) to 12 (best performers) is calculated by adding the three individual scores together.

Vascular function assessment. Arterial stiffness will be assessed by applanation tonometry using SphygmoCor system (AtCor Medical, Sydney, Australia).

Muscular strength and body composition. Upper- and lower-extremity muscle strength will be assessed using handgrip dynamometer and 30-second chair stand test, respectively. Body composition will be assessed using a bioimpedance scale (Biospace InBody 230).

Physical activity. Self-reported physical activity in the previous week will be assessed using a combination of a questionnaire and 7-day physical activity log. Attitudes, motivations and barriers to physical activity will be assessed using a modified SPARC's Obstacles to Action questionnaire.²⁴

Quality of life and psychosocial health. Physical and mental quality of life will be assessed using a SF-36 questionnaire.²⁵ Assessments of psychosocial health will include stress²⁶, anxiety and depressive symptoms²⁷, self-efficacy²⁸, and social support.²⁹ These measures have been used previously in cardiac and asymptomatic populations with acceptable validity and reliability.

Statistical Analysis. Differences between the groups for continuous variables will be compared using t-test or ANOVA with Tukey post-hoc multiple comparisons. Categorical variables will be compared using χ^2 test. Correlations will be determined using Pearson correlation coefficient or the Spearman rank correlation coefficient.

Project Timeline and Key Milestones. Ethics application submitted: May 2010; Recruitment and data collection: Jan 2011 to Dec 2011; Data entry and analysis: Aug 2011 to Jan 2012; Manuscript preparations: Feb-Apr 2011.

References: Omitted from this example

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Examples of Published Research Study Protocols

In some scientific disciplines, researchers publish detailed research methods for large and/or complex studies as study protocol articles. If such articles are published in your scientific discipline, use them to guide the preparation of your research methods section.

This table shows several examples of study protocol articles co-authored by Dr Sandra Mandic that are available as open access. Follow the links provided and check out those published study protocols for different study types. Note down ideas for writing your research methods section.

Cross-sectional study using quantitative and qualitative approaches

Mandic S, Williams J, Moore A, Hopkins D, Flaherty C, Wilson G, García Bengoechea E, Spence JC. *Built Environment and Active Transport to School (BEATS) Study: protocol for a cross-sectional study*. *BMJ Open*. 2016;6:e011196. DOI: <https://doi.org/10.1136/bmjopen-2016-011196>

Cross-sectional qualitative study

Egli V, Mandic S, Pocock T, Narayanan A, Williams L, Clark T, Spasic L, Wilson A, Witten K, Smith M. *Understanding Children's Perceptions of, and Priorities for, Healthy Neighbourhoods in Aotearoa, New Zealand: Study Protocol for a Cross-sectional Study*. *BMJ Open*. 2021;11:e047368. DOI: <https://doi.org/10.1136/bmjopen-2020-047368>

Intervention study

Chillón P, Gálvez-Fernández P, Huertas-Delgado FJ, Herrador-Colmenero M, Barranco-Ruiz Y, Villa-González E, Aranda-Balboa MJ, Saucedo-Araujo RG, Campos-Garzón P, Molina-Soberanes D, Segura-Díaz JM, Rodríguez-Rodríguez F, Lara-Sánchez AJ, Queralt A, Molina-García J, García Bengoechea E, Mandic S. *A school-based randomized controlled trial to promote cycling to school in adolescents: The PACO study*. *International Journal of Environmental Research and Public Health*. 2021, 18, 2066; DOI: <https://doi.org/10.3390/ijerph18042066>

Natural experiment study

Mandic S, Hopkins D, García Bengoechea E, Moore A, Sandretto S, Coppell K, Ergler C, Keall M, Rolleston A, Kidd G, Wilson G, Spence JC. *Built Environment Changes and Active Transport to School among Adolescents: BEATS Natural Experiment Study Protocol*. *BMJ Open*. 2020;10:e034899. DOI: <https://doi.org/10.1136/bmjopen-2019-034899>



Tip: Published reporting guidelines for main study types

Some scientific disciplines have established guidelines for reporting research from main study types: such as CONSORT checklist for randomised controlled trials, STROBE checklist for observational studies and PRISMA checklist for systematic reviews.

Check out the EQUATOR Network website for more details and links to reporting guidelines for main study types:

- Enhancing the QUALity and Transparency Of health Research (EQUATOR Network): <https://www.equator-network.org/>

If such guidelines are used in your scientific discipline, familiarise yourself with those guidelines and prepare your research methods accordingly.

Consider Presenting Your Research Methods Visually

If your study design or other components of your research methods are complex, consider presenting that information visually. Your reader(s) will greatly appreciate it – and your reviewers and examiners will look on it favourably.

For example, you could try creating a figure, diagram, table or an infographic to summarise different aspects of your research methods and/or study design. Check out examples provided below.

You know your research study the best. Think about how would you communicate your research project design to the readers visually to be easily understood in 30-60 seconds?

If you have based your research on an established concept, theory, or framework, you could consider present your study design within such concept, theory, or framework.

You could use such a figure or an infographic for scholarship and research grant applications, in your thesis, scientific presentations, conference posters and potentially in a scientific publication.

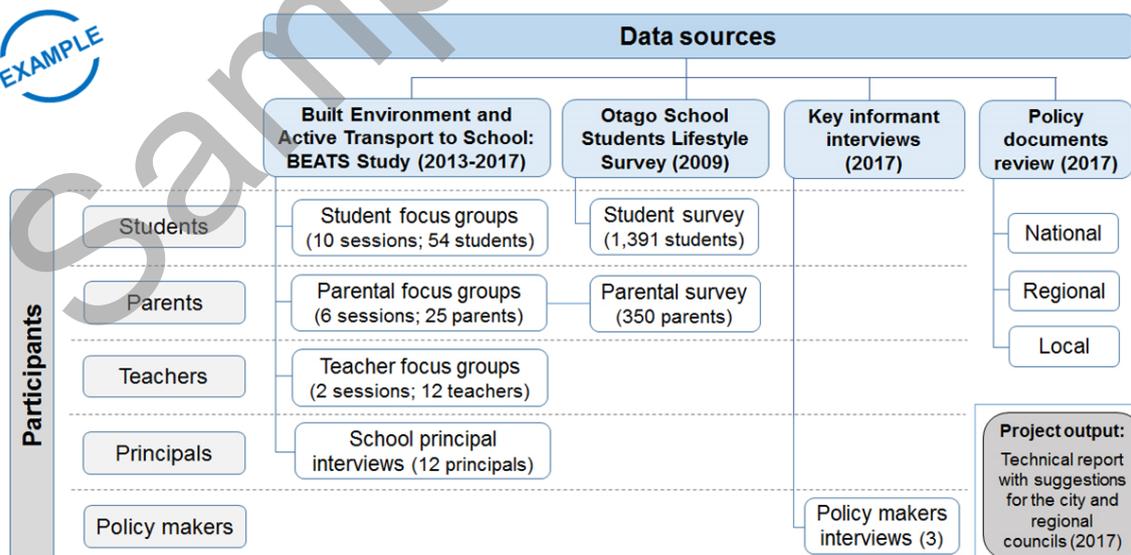
Take on the challenge – and have fun! 😊

Examples of Visual Presentation of Research Methods

This and next page provide four examples of a visual presentation of research data:

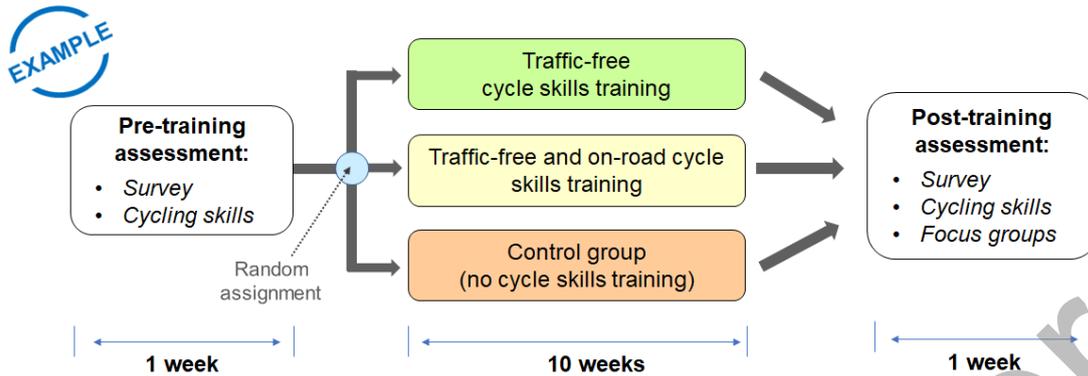
- **Example A:** Overview of data sources, participants, and a project output (figure)
- **Example B:** Study design overview (diagram)
- **Example C:** Overview of data collection procedures and study participant groups (table)
- **Example D:** Overview of data categorisation and data analysis (figure)

Example A: Overview of data sources, participants, and a project output



Reprinted from Mindell JS, Ergler C, Hopkins D, Mandic S. Taking the bus? Barriers and facilitators for adolescent use of public buses to school. *Travel Behaviour and Society*. 2021;22:48-58. DOI: <https://doi.org/10.1016/j.tbs.2020.08.006> under [Creative Commons Attribution 4.0 License](https://creativecommons.org/licenses/by/4.0/) (CC BY 4.0).

Example B: Study design overview



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Example C: Overview of data collection procedures and study participant groups in a table format

EXAMPLE

	Research participants		
	Adolescents	Parents	Teachers
Online survey			
Demographic characteristics	✓	✓	
Travel to school patterns	✓	✓	
Transport in general	✓	✓	
Health behaviours	✓		
Focus groups	✓	✓	
Interviews			✓
Physical activity assessment	✓		
Mapping route to school	✓		

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Example D: Overview of data categorisation and data analysis

EXAMPLE

Urbanisation categories	Definitions	Study data	Data analysis by urbanisation category			Data analysis by school and/or home location
			4-category variable	3-category variable	2-category variable	
Urban centre	Population ≥100,000	✗				By <u>school</u> location
Large urban area	Population 30,000-99,999	✓	Large urban area	Large urban area	Urban (large/medium/small urban area)	By <u>home</u> location
Medium urban area	Population 10,000-29,999	✓	Medium urban area	Small-to-medium urban area		
Small urban area	Population 1,000-9,999	✓	Small urban area			By <u>matched school and home</u> location
Rural settlement	Population <1,000	✓	Rural settlement	Rural settlement	Rural (rural settlement)	
Rural	Other rural areas	✓				

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Writing and Revising Your Research Methods Section

When writing and revising your research methods, reflect on the information included in this section of the guide.

If you are new to research, it is always a good idea to refer to research methods sections in journal articles that you are reading as well as examples of well-written research methods in theses in your discipline.

Take the time to review an example of methods section included in this guide and analyse research methods sections from several published journal articles. Note specific points to consider when writing research methods section for your research proposal and/or thesis. See activity below.

Pay attention to the list of specific points that you came up with while working through the activity below and incorporate those insights when writing your own methods section.

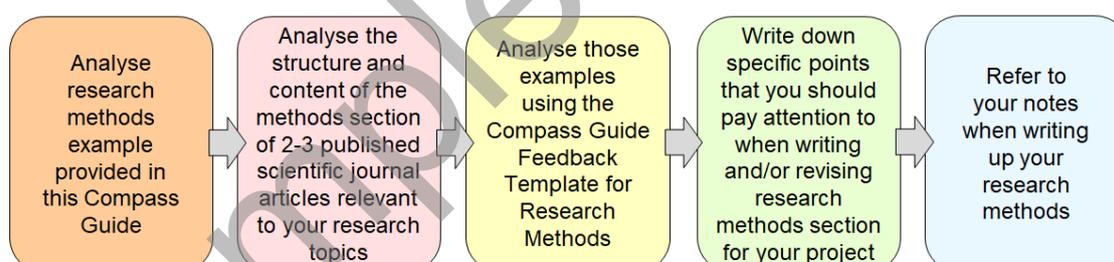
Keep in mind that your supervisor does not expect that your first draft of the methods section will be complete without need for further changes.

Once you receive feedback on a draft of your methods sections, review it carefully, learn from it and do your best to integrate it in your next draft. And then repeat the process again for future drafts of your work.

See next page for tips on getting feedback on your research methods section and information about the [Compass Guide Feedback Template on Research Methods](#) included in this book.



Activity: Study Examples of Research Methods Sections



Questions to ask yourself when analysing research methods examples

- How is the research methods section structured?
- Which information is included?
- Have the authors provided sufficient information so you could repeat their study if you wanted to?
- Is something missing in the methods section?
- What suggestions would you give to the authors to improve their methods section?

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Getting Feedback on Your Research Methods Section

Have a look at the [Compass Guide Feedback Template on Research Methods](#) presented on the following two pages.

This template includes assessment of specific items related to the quality, structure and writing style of the research methods section. In addition, the template includes items related to study design, description of research participants (if applicable), outcome measures and measurement procedures, interventions and comparisons (if applicable), data analysis, reporting of project timeline and budget and referencing of relevant sources.

As for all Compass Guide Feedback Templates, each aspect of research methods is assessed items rated on a 5-response scale ranging from 'poor' to 'excellent'. The results of this assessment will highlight the strengths of the research methods section as well as areas for minor and major improvements. Additional relevant items could be added to meet specific requirements of your degree or scientific discipline.

Use this template to organise, write, assess and further improve a draft of your research methods section before submitting it to your supervisor for feedback.

It is a good idea to complete your own assessment of your work using that template and submit your self-assessment to your supervisor with each draft of your research methods section.

Ask your supervisor to consider completing supervisory assessment of your research methods draft using the same template too. If you receive such feedback from your supervisor, compare it to your own assessment. Look for discrepancies and ask your supervisor for clarification if necessary.

It is always a good idea to ask your peers to read and provide comments on your work before sending it for your supervisor's review. You could your peers to provide their feedback using the Compass Guide Feedback Template on Research Methods. It is likely that your fellow students will find that process helpful for themselves and your will get another pair of eyes looking through your work and sharing their thoughts.

Writing up the research methods will still take several drafts and several rounds of feedback from your supervisor. Be patient and keep learning!



Compass Guide Feedback Template for Research Methods

Various components of research methods are assessed on a 5-response scale ranging from 'poor' to 'excellent'

Response	Interpretation
Excellent	<i>Strengths</i>
Very good	
Good	<i>Areas for <u>minor</u> improvement</i>
Fair	<i>Areas for <u>major</u> improvement</i>
Poor	

The results highlight the strengths of the research methods as well as areas for minor and major improvements

Aspects Assessed

- | | |
|--|--|
| <ul style="list-style-type: none"> ✓ Quality ✓ Structure ✓ Study design ✓ Participants ✓ Outcome measures and measurement procedures | <ul style="list-style-type: none"> ✓ Interventions and comparisons ✓ Data analysis ✓ Timeline and budget ✓ References ✓ Writing style ✓ Overall comments |
|--|--|

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Compass Guide Feedback Template for Research Methods



Student name: _____ Date: _____

Research topic: _____

Reviewed by: _____

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Providing feedback and interpreting feedback using this template: <ul style="list-style-type: none"> Areas assessed as 'very good' or 'excellent' indicate strengths Areas assessed as 'good' indicate areas for <u>minor</u> improvement Areas assessed as 'poor' or 'fair' indicate areas for <u>major</u> improvement 		Poor	Fair	Good	Very good	Excellent
--	--	------	------	------	-----------	-----------

Quality

The study design is appropriate for answering the research question(s)			Good	Very good	Excellent
The outcome measures and measurement procedures are appropriate			Good	Very good	Excellent
Data analysis is appropriate			Good	Very good	Excellent

Structure

Includes all required components of the research methods section			Good	Very good	Excellent
Components are presented in a logical sequence			Good	Very good	Excellent
Effective use of subheadings throughout methods section			Good	Very good	Excellent

Study design

Study design is described in sufficient detail			Good	Very good	Excellent
--	--	--	------	-----------	-----------

Participants

Describes study participants (i.e., number of participants, inclusion and exclusion criteria) and participant recruitment procedures, if applicable			Good	Very good	Excellent
Provides detail of the research ethical approval and obtaining consent, if applicable			Good	Very good	Excellent

Outcome measures and measurement procedures

Describes outcome measures and measurement procedures in sufficient detail to be repeated			Good	Very good	Excellent
States relevant references for the chosen outcome measures and measurement procedures			Good	Very good	Excellent
Describes study materials in sufficient detail (e.g., models and manufacturer details for equipment)			Good	Very good	Excellent
Describes data cleaning and/or coding procedures, if applicable			Good	Very good	Excellent
Describes procedures for calculating study variables from collected data, if applicable			Good	Very good	Excellent
Describes blinding of investigators, participants, and outcome assessors, if applicable			Good	Very good	Excellent

Interventions and comparisons

Describes interventions in sufficient detail to be repeated, if applicable			Good	Very good	Excellent
Provides definition of study groups, if applicable			Good	Very good	Excellent

Data analysis

Describes data analysis in sufficient detail					
Describes details of statistical analysis, if applicable					
Describes which groups/interventions were compared, if applicable					
States the significance level for p-value					
Includes statistical software package used for data analysis					
Includes sample size and power calculation, if applicable					

Timeline and budget

States project timelines for specific parts of the project					
For research proposals only: Provides budget details and justification					

References

Correct format of in-text referencing					
Use of academic conventions for reporting references					

Writing style

Ideas are presented clearly, and section is easy to read					
Writing style complies with academic writing standards					
All abbreviations are spelled out the first time					
Limited use of abbreviations throughout the document					
Numbers spelled out if they were the first word in a sentence					
Proof-read (i.e., no spelling or grammar mistakes)					

Other discipline-specific requirements for the methods section

Major strengths:**Suggestions for improvement:****Overall comment:**

Summary

Planning your research methods and writing them up is like putting together a puzzle: once every piece of the puzzle is in its place, the puzzle is complete. But pieces of the puzzle do not fall into their place all at once.

The same will happen with your research methods. Your chosen research question(s) and decisions related to specific aspects of your research methods (including constraints such as research funding availability and the duration of your degree) will determine other aspects of your research methods.

Be patient as you work on developing and writing up your research methods. Work closely with your supervisor. Appropriate and

feasible research methods will ensure that you are able to answer your research question(s) and complete your postgraduate degree on time.

Keep writing your methods section as you plan your research project. Writing will help you clarify your thoughts and will provide the opportunity for your supervisor to offer feedback on your written work.

Learn from your supervisor's feedback, integrate it into your next draft and get ready for more feedback - and more learning - from your next draft. Enjoy the exciting learning journey and many insights about research gained along the way!



Key Points for Writing up Research Methods

Chosen methods should be appropriate for answering your research question

Write clearly and succinctly

Include all relevant components

Provide sufficient detail to allow others to replicate your research

Follow the guidelines from your field or scientific discipline

Keep writing research methods as you plan your research project

Consider other relevant factors (e.g., availability of funding, equipment and time)

Designing and writing research methods is like putting together a puzzle

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Suggested Reading

International Committee of Medical Journal Editors (ICMJE). (2023) *Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals*. Available at <http://www.icmje.org/recommendations/>

Section: *Preparing a Manuscript for Submission to a Medical Journal* → *Manuscript Sections* → *Methods*: <https://www.icmje.org/recommendations/browse/manuscript-preparation/preparing-for-submission.html#d>

Seals, D. R., & Tanaka, H. (2000). Manuscript peer review: a helpful checklist for students and novice referees. *Advances in Physiology Education*. 23(1), 52-58. DOI: <https://doi.org/10.1152/advances.2000.23.1.S52> (Methods section)