LITHUANIAN UNIVERSITY OF HEALTH SCIENCES

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METHODOLOGICAL RECOMMENDATIONS FOR FINAL MASTER'S THESES IN THE MEDICINE STUDY PROGRAMME

Teaching book

LSMU Academic Publishing House

CONTENTS

1. INTRODUCTION

The publication provides recommendations that regulate the process of preparing a final Master's thesis (henceforth, FMT) in the integrated study programme *Medicine*. The document defines the principles of work planning, research ethics, methodological requirements, and scientific communication that ensure academic quality and the reliability of the research.

Requirements for final Master's thesis (Chapter II)

This chapter provides structural and editorial requirements: the scope of the work, the language, the title page, the contents, the abstract, the bibliography, citation rules, and the presentation of tables and figures.

Planning the final Master's thesis from the 4th to the 6th year (Chapter III)

This chapter describes the sequence of FMT preparation from the fourth to the sixth year, detailing the stages during the 7th to the 12th semesters. It explains how to draw up an individual plan, conduct literature search and analysis, and prepare documents for approval by the *Bioethics Centre*. Specific dates and a table listing the tasks by semester are provided.

Research ethics (Chapter IV)

This chapter outlines the ethical requirements for student research in accordance with the provisions of the *LSMU Regulation of Studies*. It describes the application submission procedure and its structural elements, as well as the required documents and attachments. It emphasises the completeness and validity of information, which are necessary for a successful ethical evaluation. This chapter also presents the stages of the ethical evaluation process and the principles of status monitoring.

Study designs (Chapter V)

This chapter classifies research studies according to their aim, nature, and design. It discusses descriptive and analytical study designs, their advantages and disadvantages, as well as the time perspective – i.e., prospective, retrospective, cross-sectional, and longitudinal studies.

Systematic literature review (Chapter VI)

The recommendations presented in this chapter define the concept of a systematic literature review and the methodological steps involved: formulation of the PICOS question, protocol development, literature search, data recording, quality assessment, analysis, and interpretation of the results. In addition, this chapter discusses aspects of the risk of bias and presents the statistical meta-analysis method, as well as a description of the results.

Statistical analysis of quantitative research data (Chapter VII)

This chapter provides recommendations on how to calculate the minimum sample size required for the study and describes specific examples of the most commonly used formulas. It also provides

recommendations on how to describe the results of statistical analysis of quantitative research data. The main focus here is placed on descriptive statistics: the main numerical characteristics describing the analysed features are outlined, and examples of descriptions of results obtained using statistical methods most commonly used in student work are discussed.

Qualitative research (Chapter VIII)

This chapter presents the main purposes of applying qualitative research as well as the most important characteristics and significance of this study design. It details the methods of sampling and validity in qualitative research and reviews data collection and processing methods.

Preparation of a scientific publication. Most common mistakes (Chapter IX)

This chapter describes the principles of preparing a publication, the most common mistakes, and the requirements for a coherent text. Emphasis is placed on the structural clarity of the introduction, methods, results, and discussion, as well as on the conciseness of the conclusions.

The recommendations provide a systematic basis for the preparation of a final Master's thesis, defining aspects of planning, ethics, methodology, and scientific communication.

Defence of the final Master's thesis (Chapter X)

This chapter provides concise recommendations on how to defend a final Master's thesis. The first part discusses the structure of the student's thesis presentation. The second part highlights the most important design and technical requirements for the presentation. The third part discusses the course of the oral presentation.

2. REQUIREMENTS FOR FINAL MASTER'S THESIS

2.1. Structural requirements

Scope. The minimum scope of a final master's thesis is 30-45 pages (excluding appendices).

Language. Final Master's theses are written in Lithuanian or English.

Structure. 1. Title page; 2. Table of contents; 3. Abstract (in Lithuanian and English); 4. Acknowledgements; 5. List of scientific publications; 6. Conflict of interest; 7. Approval of the Bioethics Centre; 8. Abbreviations (if necessary); 9. Definitions; 10. Introduction; 11. Aim and objectives of the work; 12. Literature review; 13. Research methodology and methods; 14. Results; 15. Discussion of the results; 16. Conclusions; 17. Practical recommendations (if necessary); 18. List of references; 19. Appendices (if necessary).

Title page. It contains basic information about the work: the faculty and department where the work was done, the author of the work, the title of the work, the study program, the name and degree of the scientific supervisor, the consultant, and the place and year of preparation of the work.

Contents. The contents page is placed after the title page. The contents list the titles of the chapters, sections, and subsections of the work, indicating the page on which they begin. Chapter titles are written in uppercase, while titles of sections and subsections – in sentence case. Each chapter in the table of contents has its own number (e.g., 1, 2, 3, etc.), sections are numbered with two digits separated by a period (e.g., 1.1, 1.2, etc.), and sections are numbered with three digits separated by a period (e.g., 1.1.1, 1.1.2, etc.). The numbers of the smaller parts of the sections consist of four digits. Numbering is done using Arabic numerals.

Abstract. This chapter briefly summarises the content of the work, presenting its key aspects. This chapter is numbered in the table of contents and is included in the total number of pages. The abstract is written in Lithuanian and English on a separate page. Its length should be up to one page (up to 2700 characters with spaces). The abstract should begin with the author's name and surname, the title of the work, followed by the text, which must indicate the aim of the study, its objectives, methods, participants, results, conclusions, and recommendations (if any).

Acknowledgements (an optional part of the thesis). They may be given to those who contributed to the research; this may include technical assistance or participation in a clinical study.

List of scientific publications (an optional part of the thesis). The list of publications prepared by the author of the thesis (together with co-authors) is presented in accordance with the Vancouver citation style (see List of references).

Conflict of interest. Sponsors, material suppliers, and funds must be indicated. The name of the company, city, country, or fund and its number must be included. If the scientific work was not sponsored, it should be noted that *there was no conflict of interest*.

Approval from the Bioethics Centre. The number and date of approval of the study by the *Bioethics Centre* must be indicated. Acknowledgements, conflicts of interest, and details of approval from the *Bioethics Centre* are presented on a separate page after the abstract. This page is numbered, and the chapters are included in the table of contents.

Abbreviations. Abbreviations are listed on a separate page, which is numbered, and this chapter is included in the table of contents. Both well-known and common terms, as well as terms proposed by the author him/herself, which are used in the text, are provided here. The first time a term appears in the text, it is written out in full, with its abbreviation given in parentheses. Abbreviations are written without periods.

Terms. This chapter lists specific, less commonly used terms in alphabetical order. The pages are numbered, and the chapter is included in the table of contents.

Introduction. The recommended length of the introduction is up to one page (up to 2,700 characters with spaces). It briefly discusses the relevance of the topic, its theoretical and practical significance, and justifies the connection between the chosen topic and the research methodology and results. At the end of the chapter, the aim of the work and the objectives (or the research questions, if it is a qualitative study) is clearly formulated.

Aim and objectives of the study. Here, the area of the study and the problems being analysed are specified, and the course of the scientific study and the research tools are defined. The same aim of the work as stated in the introduction is repeated. It is recommended to formulate only one aim of the work. The purpose of the chapter *Objectives of the study* is to indicate how to achieve the intended aim of the scientific research. Several (3-5) objectives that can be accomplished under the given conditions should be indicated. They should be numbered and listed in order of importance. In qualitative research, research questions are formulated instead of objectives.

Literature review. It should describe practical and theoretical studies conducted in Lithuania and abroad on the topic of the thesis. First, research material from Lithuania should be described, followed by material from other countries. At least 30-50 literature sources should be cited. At least 70% of the scientific publications cited must be no more than 10 years old. It is not recommended to cite textbooks, popular magazines, or newspapers intended for the general public. This chapter should not exceed 25% of the total scope of the thesis.

Research methodology. The following must be provided: research planning (organisation), research object, subject selection (population, sample), research methods, and data analysis methods.

Results. Here, the research data are analysed and summarised. This chapter may be divided into sections and subsections. It is recommended to include tables or figures presenting the results (tables and figures should not duplicate each other). The results of a quantitative study must be based on statistical data analysis used in the work. The results of a qualitative study are presented according to the topics analysed by the researcher, confirming the statements with quotes from the respondents or with observation data.

Discussion. When discussing the results of the thesis, it is necessary to compare them with the results obtained by other researchers in this field. The scope of this chapter is up to 3 pages (up to 8,100 characters with spaces).

Depending on the specifics of the work, the chapters *Results* and *Discussion* may be combined. In this case, the title of this chapter is *Results and discussion*.

Conclusions. This chapter presents conclusions based on the results of the study and, in qualitative research, on insights. Conclusions are the answer to the aim and objectives formulated at the beginning of the thesis. Conclusions should be specific, concise, and numbered. Their number does not always have to correspond to the number of the objectives (there may be more conclusions), but they must reflect all the objectives formulated. The conclusions must state what was studied, what method was used, and what was found, as well as indicate the statistical reliability of the results.

Practical recommendations. The thesis may include specific measures for solving the problem or problems under investigation.

List of references. The list should be started on a new page. It should contain at least 30-50 sources. Only sources used in the paper should be included in the list of references. Sources should be listed in the order in which they are cited in the text. Scientific literature is cited according to the Vancouver citation style (https://lsmu.lt/biblioteka/studijoms/). To avoid errors in compiling the list of references, it is recommended to use one of the bibliography storage and management software applications: *Mendeley; RefWorks, EndNote Online,* etc.

Appendices (an optional part of the thesis) Appendices may contain additional, supplementary information prepared independently by the author (e.g., questionnaires, maps, etc.). Each appendix is presented on a new page and is numbered consecutively. The text is linked to the appendices by references.

2.2. Methodological requirements

Spelling and punctuation. The final Master's thesis must be written in correct Lithuanian or English, without typing errors.

Foreign nouns are written in the original language according to the standards set by the State Commission of the Lithuanian Language. Personal names originating from languages that use non-Latin characters are transliterated into the Latin character system. References to scientific literature cited in the text (number in the list of references) are written using the template[2], e.g., (1); [1]; or [1].

Requirements for the text. The theses must be typed (28–30 lines per page) on one side of a white (A4) sheet of paper. The page orientation must be portrait. Margins must be as follows: 20 mm at the top and bottom, 25 mm on the left, and 10 mm on the right. The text must be typed using Times New Roman or Arial font, font size – 12 points. If the Master's thesis contains special symbols or characters that cannot be entered on a computer, they must be written by hand. The thesis should be printed with 1.5 line spacing. Chapter titles should be written in uppercase (size 16 points) in bold. Section and subsection titles should be written in sentence case (size 14 points) in bold. Requirements for the text. The theses must be typed (28–30 lines per page) on one side of a white (A4) sheet of paper. The page orientation must be portrait. Margins must be as follows: 20 mm at the top and bottom, 25 mm on the left, and 10 mm on the right. The text must be typed using Times New Roman or Arial font, font size – 12 points. If the Master's thesis contains special symbols or characters that cannot be entered on a computer, they must be written by hand. The thesis should be printed with 1.5 line spacing. Chapter titles should be written in uppercase (size 16 points) in bold. Section and subsection titles should be written in sentence case (size 14 points) in bold. The text alignment should be justified. There should be one blank line between the title and the first line of the text, which should be indented 1.5 cm from the left margin. At the end of a chapter or a section, there should be two blank lines. Chapter titles are centred, while section and subsection titles are aligned to the left margin. Chapter titles are started on a new page, while sections and subsections are started on the same page. *Microsoft Word* should be used for text formatting.

Page numbering. The pages of the thesis must be numbered starting from the title page. Pages are marked with Arabic numerals in the lower right corner of the page, without dots or dashes. The number is not written on the title page.

Tables. Tables are numbered consecutively with Arabic numerals, indicating the number of the chapter (e.g., ***Table 1***), subchapter (e.g., ***Table 1.1***), or subsection (e.g., ***Table 1.1.1***). The title of the table is written above the table in sentence case, in italics, with the word "Table" in bold. The title is aligned to the left side of the page (e.g., ***Table 1.1.*** *Description of the research sample*). If the title does not fit on one line, single (or smaller) spacing can be used. If the table is taken from other sources, the author or authors of the cited table must be indicated in parentheses after the table title. Explanations are written below the table. The text of the table should be written in 12pt, and explanations – in 10pt, with single spacing. Each column of the table must have a title. A new row should be created in the

table for each piece of data. There should not be more tables than there is text. Where necessary, they should be explained in more detail. When referring to a table in the text, its number must be indicated.

Citations and references. Verbatim quotations are written in quotation marks. Texts must be cited strictly in accordance with the source being cited. Cited sources and authors are indicated in the text itself, in square brackets. When citing several authors, the surname of the first author is written with the note *et al.* or *and co-authors*, and the number of the cited source is indicated in square brackets next to it. The full bibliographic description of the cited source is compiled and presented in accordance with the Vancouver citation system in the list of references.[2] If the cited work is not written in Latin letters, the references must be transliterated: e.g., *Lukov et al.* [19]. If several (more than two) sources are listed in sequence, the numbers referring to them are separated by a dash (e.g., [8-9, 13]).

Footnotes. Footnotes are intended for notes. They must be numbered and typed in a 10-point font with 1.5 line spacing.

Computer illustrations. Computer illustrations (diagrams, drawings, photographs, etc.) must be of good quality and sufficiently clear. All illustrations are referred to as figures. Figures are numbered according to the chapter (e.g.***, Fig. 1***), subchapter (e.g., ***Fig. 1.1***), or subsection (e.g., ***Fig. 1.1.1***). The title of the figure should be written below the figure, in italics (in sentence case), with the word "Fig." in bold, and it should be centred (e.g., ***Fig. 1.1.*** *Research selection diagram*). If the title does not fit on one line, single (or smaller) spacing can be used. When referring to a figure in the text, its number should be indicated. If the illustrations are taken from other publications, the source should be indicated in parentheses, and the author should be indicated below the title of the figure.

Abbreviations, symbols, and nomenclature. The symbol % should be used to denote percentages (when the number is written in digits), h for hours, min for minutes, and s for seconds. *In vitro, in vivo, in situ*, and other Latin expressions should be written in italics. Only standard abbreviations should be used. All units should be marked with symbols from the metric system. Avoid abbreviations in titles. When an abbreviation is used for the first time in the text, its full name must be given with the abbreviation given in parentheses (except for standard units of measurement). In case of doubt regarding the spelling of terms, refer to the *Merriam-Webster, Oxford or other dictionaries*.

Scientific names. When mentioning the names of bacteria in the text, they should be written in italics, without abbreviations – in two words (e.g., *Streptococcus sanguinis*). When repeated, the species name may be indicated by a single capital letter (e.g., *S. sanguinis*). If the species name is not clear, the full name should be written. Medicines, equipment, and devices should be referred to by their generic names, not their trade (patented) names. If a trade name is used, the following information

should be provided when it is first mentioned in the text: manufacturer, city, and country (e.g., Inagel F-13® (Ina Food Industry Co., Ltd. Nagano, Japan).

3. PLANNING OF THE FINAL MASTER'S THESIS FROM THE FOURTH TO THE SIXTH YEAR OF STUDIES

Stages of preparation of a final Master's thesis

A student writes an FMT in accordance with the requirements of the study plan modules.

When preparing an FMT, a student must account for the work done within the deadlines specified in the study programme (Table 3.1).

Table 3.1. *Progress of the final Master's thesis*

Year	Semester	Work completed
FOURTH	7	1. A research work plan is drawn up and approved; 2. The collection and analysis of literature related to the research topic begins.
	8	3. The theoretical research is being conducted: a. continued collection and analysis of literature; b. beginning of the preparation of the theoretical part; c. justification of the research methodology. 4. Documents are being prepared for the LSMU Bioethics Centre for the approval of the research. The application is submitted to the *Bioethics Centre* via the https://lsmusis.lsmu.lt system. The documents are prepared and applications are completed according to the instructions provided in these recommendations and on the LSMU *Bioethics Centre* website *Students' Educational Research*. The research may only be initiated after receiving approval from the *Bioethics Centre*. 5. At the end of the 8th semester: a. a preliminary literature review is submitted to the supervisor; b. data collection or an experiment is planned. 6. At the end of the 8th semester, students receive the final assessment of the course *Final Master Thesis: research design, scientific style and language*, which consists of a) supervisor's assessment of the submitted literature review (40%) and b) the cumulative assessment of the parts of the course attended (60%) (see course description).

FIFTH	9-10	7. The research is being carried out according to the approved plan: a. the research methodology is described; b. approval has been obtained from the *Bioethics Centre*, and therefore the data necessary for the research are collected; c. the collected data are systematised, and a preliminary analysis is conducted. 8. At the end of the 10th semester, a description of the research methodology and preliminary research results is submitted to the supervisor, and an assessment of the work completed is received.
SIXTH	11	9. The analysis of the research data is completed, and the results are evaluated. 10. A description of the final Master's thesis is being prepared. 11. By the end of the 11th semester, the initial version of the FMT is submitted to the supervisor, and the supervisor's evaluation is received.
	12	12. At the beginning of the semester, the work is reviewed and evaluated. If any shortcomings are identified in the work, they are corrected in accordance with the supervisor's comments by the date specified in the *Regulations*. 13. The work is submitted for the final review by the supervisor. 14. Supervisor reviews the thesis using plagiarism and AI detection systems. 15. With the supervisor's permission, the student uploads the work to the *DSpace CRIS* system. 16. The work is submitted to the reviewer. 17. The review of the work is received and, if there are any comments, the work is corrected. 18. The departments submit lists of students who have been granted permission to defend their FMT to the Dean's Office of the *Faculty of Medicine*. The Dean's Office prepares an order (regarding the defence of the FMT in the *Medicine* Study Programme) for the Rector's approval. 19. The final version of the work is uploaded to the *DSpace CRIS* system. 20. The FMT defence takes place. 21. After defending the work, a grade is received, which is the average of the marks given by the reviewer and the members of the commission.

4. RESEARCH ETHICS

4.1. Ethical requirements for research conducted by students

Research ethics is an important area of academic ethics. Research ethics is designed not only to ensure the reliability and integrity of the final thesis research, but also to protect the rights and well-being of research participants and to shape the responsibility of the student as a researcher. Compliance with the principles of research ethics is much more than an effort to avoid legal or ethical violations—it is a conscious effort to create meaningful, sound, and socially valuable science.

The fundamental principles and provisions of research ethics have been set out in a number of international documents, starting with the *Nuremberg Code* (1947), followed by the *World Medical Association* (WMA) *Declaration of Helsinki* (1964), the *Belmont Report* (1979), and ending with the *Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine* (in short, *the Oviedo Convention on Human Rights and Biomedicine*)[3] (1997) among others.

Essentially, these documents stipulate that any person planning to conduct scientific research (whether for the purposes of preparing a thesis, conference abstracts, or scientific publications), must prepare a detailed research plan (in the case of biomedical research, a protocol) for an independent ethics review board and obtain its approval or permission, depending on the legal regulations.

According to the LSMU *Regulation of Studies* (22.4), "Students and listeners have a duty to comply with the general requirements of research ethics and **obtain approval of the University's *Bioethics Centre* for the student's research**" (LSMU *Regulation of Studies*, No. 190-03 of 29 May 2025). This requirement is essential in order to ensure that all research, especially that involving personal data or biological material, complies with national and international ethical standards, protects the rights and welfare of research subjects, and upholds the principles of scientific integrity.

All LSMU students must obtain prior approval from the *Bioethics Centre of the Lithuanian University of Health Sciences* (LSMU BC) before commencing any training or scientific research, regardless of the methods and nature of the research (including literature reviews). This requirement is primarily intended to assess whether the planned research complies with the following:

- the student's competence to conduct research;
- general principles of research ethics;
- educational objectives, including learning to conduct scientific research, analysing data and publishing them.

Note: In cases where the student's planned research exceeds the student's competence, referral to national, regional, or university-level committees is required.

Application procedure and structural elements

In order to obtain ethical approval, the researcher (i.e., the student) must submit a formal application. This application is a comprehensive document consisting of three main components:

a) **The application form:** this is a standardised electronic form designed to record essential information about the researcher and the research.

b) **The Ethical Self-Assessment Questionnaire:** this is a critical component that requires the researcher to reflect in detail on the ethical aspects of the research, possible risks, anticipated benefits, data confidentiality, and mechanisms for protecting research subjects. This questionnaire encourages proactive ethical thinking based on ethical guidelines. This questionnaire promotes an approach based on the principles of research ethics and scientific integrity.

c) **Supporting documents (appendices) for the study:** these are various supplements that confirm the information provided in the application. Their list will be described in detail below.

The user must select the category *Individuals* → *Applications*, enter his or her personal information and select the type of request → *Regarding Research Approval by the Bioethics Centre*. The system provides step-by-step instructions on how to answer the questions in the Ethical Self-Assessment Questionnaire and how to attach the necessary additional documents (recommended formats: *.pdf or other widely used formats) that are required for a comprehensive ethical assessment.

Recommendations for the content and formal aspects of the application

For a successful ethical review process, it is important that the information provided in the application is specific, detailed, and clearly argued. It is recommended to provide factual information about the planned research in order to achieve the greatest possible clarity and detail, supporting each statement with reliable arguments.

Particular attention must be paid to ensuring that the completed application submitted by the researcher is approved by the thesis supervisor. The supervisor, after logging into the LSMU *Study Information System*, must review the application and, after assessing its suitability, approve it by clicking on *Save Visa*. This step introduces an additional level of academic supervision and responsibility, ensuring the ethical quality of the research from the planning stage onwards. Researchers must follow both the instructions provided in the LSMU *Study Information System* and the detailed recommendations set out below.

1. If the research is planned for the purposes of a final thesis or other purposes (e.g., preparation of conference abstracts or scientific publications), the approval of the LSMU *Bioethics Centre* must be obtained before starting the research.

2. In order to obtain approval to conduct research, the student should submit an *Application* consisting of (a) the **application** form, (b) the **Ethical Self-Assessment Questionnaire**, and (c) **documents** confirming the information provided in the Application.

3. The student can start filling in the application form by logging into the LSMU *Study Information System*: lsmusis.lsmu.lt → Persons (Asmenys) → Applications (Prašymai), entering all your personal details and selecting the type of request → ***Regarding Research Approval by the Bioethics Centre***.

4. After selecting the request *Regarding Research Approval by the Bioethics Centre,* the student should: 1) answer the questions in the *Ethical Self-Assessment Questionnaire* provided in the form; 2) attach the necessary documents (*.pdf or other widely used format, in separate files) that are required for the ethical evaluation of your planned study.

4.2. Application status monitoring and process management

The LSMU *Study Information System* allows for continuous monitoring of the status of the application, which reflects the different stages of the ethical review process. Detailed instructions on how to submit an application and use the LSMU *Study Information System* can be found on the webpage of the *Bioethics Centre*: LSMU Bioethics Centre.

In order to obtain approval from the *Bioethics Centre*, the applicant(s) must submit the following attachments, which are essential for a comprehensive ethical assessment:

- **Appendix No. 1. Copy of the research instrument(s).** This includes all survey forms, questionnaires, measurement scales, and other data collection tools that will be used in the study. This appendix is attached when responding to question No. 11.
- **Appendix No. 2. A copy of the consent of the authors of the approved research instrument.** If standardised, copyrighted instruments are used for the research, a copy of the authors' consent must be submitted. This appendix is attached when responding to question No. 12.
- **Appendix No. 3. Informed consent form for research subjects.** This is a fundamental document that ensures compliance with the principle of informed consent. Although the form can be freely designed, it is recommended to follow the guidelines provided by the Bioethics Centre. The form should include signatures of the researcher and supervisor. This appendix is attached when responding to question No. 21.
- **Appendix No. 4. Consent of the head of the institution or its division to conduct the research.** If the scientific research work is to be carried out at a specific institution or its division, the consent of the head of that institution is required. This consent may be in free form or using the

institution's template, but it must include the student's name, surname, study programme, faculty, research title, purpose, methods, and other circumstances relevant to the research. This appendix is attached when responding to question No. 6.

- **Specific provisions:**

  - If the study is planned to be conducted at the Hospital of the Lithuanian University of Health Sciences *Kauno klinikos* (LSMUL KK), the approval/consent of the head of the relevant clinical department(s) is required.
  - If the study is planned to be conducted at the *Kaunas Hospital* of the Lithuanian University of Health Sciences (LSMU KL), no approval from the institution's administration is required.
  - If the study is planned to be conducted at at other institutions, their internal regulations must be followed.

- **Appendix No. 5. Other documents.** This includes certificates, documents confirming qualifications, or other information necessary for the ethical evaluation of the research project. These appendices may be attached when responding to question No. 18 and/or other questions, depending on the nature of the investigation.

- **Appendix No. 6. A copy of the permit issued by the *Lithuanian Bioethics Committee* (LBK) or the *Regional Biomedical Research Ethics Committee* (RBTEK)**. If the student's research is part of a broader biomedical study that has already been approved by other higher ethical institutions, a copy of this permit must be submitted.

4.3. Practical recommendations

It is recommended to prepare all necessary documents in advance, before starting to fill in the application. This will ensure a smooth process; otherwise, if not all appendices are available, the application will not be submitted, although the data entered will be saved. To facilitate document identification and administration, it is recommended to name the attached documents using the researcher's surname, the date of the attachment, and the type of document, for example: *Surname_11.05_application, Surname_11.05_ESA*, or *Surname_11.05_institution_consent*.

ATTENTION! With regard to permits for biomedical research, as well as for research whose results the researchers plan to publish in scientific journals in the field of biomedicine, it is recommended to contact the ***Regional Biomedical Research Ethics Committee.***

According to the *Republic of Lithuania Law on Ethics of Biomedical Research* [4], biomedical research is defined as "verification of hypotheses of biomedical sciences by means of methods of scientific research pursuing the aim of developing scientific knowledge about human health, diseases,

diagnosis, medical treatment or prevention thereof" All biomedical research, without exception, is subject to the specific requirements set out in the *Law on Ethics of Biomedical Research*, which differ from other scientific research involving humans in that they impose even stricter ethical requirements on researchers (necessary qualifications, etc.) and the ethical supervision of the research itself.

If the student is involved in a scientific study that has been granted a permit, he or she should contact the *Bioethics Centre* and submit an application that reflects his or her role and activities. The *Bioethics Centre* will issue approval specifically for the student's part of the study.

The *Bioethics Centre* may:

– give the approval if the documentation and study design meet all the requirements,

– or (b) request that the student supplement, correct, or modify the documents if they do not meet certain ethical criteria or applicable requirements

– or (c) recommend applying to the regional committee.

In cases (a) and (b), approval from the *Bioethics Centre* grants the student(s) the right to conduct research as part of their study programme using patient data from the *LSMUL KK*, but this data may only be used for the preparation of the final thesis or for research whose results will be published in *eLABa*, student conference proceedings, or popular science sources.

In what cases may the *Bioethics Centre* recommend contacting Kaunas or Vilnius Regional Biomedical Research Ethics Committee (RBTEK).

It is recommended to always contact RBTEK if signs of biomedical research are identified (see questions 4 and 5 for more details). This is also recommended if an LSMU student is planning to conduct research whose nature raises doubts as to whether it should be classified as biomedical research, or if he or she intends to publish the results of biomedical research in peer-reviewed scientific journals, either individually or together with the research supervisor or other co-authors. The principal investigator must apply for approval from the RBTEK and may include the student in the list of other persons participating in the research, which will be attached to the permit.

If all questions in the questionnaire are anonymous (i.e., the respondents are asked about their opinions, views, beliefs, etc.), if no objective health or personal data are collected, and if the anonymity of the respondents is ensured during the survey itself (i.e., they are not identifiable), in such cases, a form of informed consent is not required, but it is necessary to prepare a separate information sheet or a short but informative preamble to the questionnaire, which should include the name and surname of the researcher, the institution, the title of the study, and/or the purpose of the study, a summary of the research methods, the nature of the research instrument (e.g., an anonymous questionnaire), a declaration of guarantees to ensure the confidentiality of the respondents and the data collected, as well as the contact details of the researcher and/or supervisor (optionally, an e-mail address and/or

telephone number) that the research participants could use to contact them if they had any questions or concerns. The preamble or the text of the message is individual, therefore there are no templates.

The consent of the head of each institution or other responsible person (representing the institution) must be obtained. If the study is planned to be conducted at the LSMUL KK, the consent of the head of the LSMUL KK clinical department must be obtained before applying to the *Bioethics Centre*.

It is necessary to always obtain the consent of the head of the institution if the student plans to conduct any kind of research (survey, interview, or document analysis) at that institution. It is necessary to obtain the consent of the head of the institution in cases where the student plans to directly or indirectly collect data about the employees or patients of that institution, or if he or she intends to contact them for the purposes of the research by official telephone or email. In other unforeseen cases, it is also recommended to contact the institution's administration to obtain the consent of the head of the institution.

Taking into account the provisions of the Guidelines for the Assessment of Compliance with Research Ethics[5] (see Guidelines for the Assessment of Compliance with Research Ethics) approved by the Ombudsperson for Academic Ethics and Procedures of the Republic of Lithuania, the essential reasons for compliance with research ethics are as follows:

7.1. To ensure the rights, dignity, and well-being of individuals participating in scientific research,

7.2. To ensure compliance with high academic ethical values and principles and the proper processing of (personal) data,

7.3. To reduce risks associated with research subjects, researchers, and third parties,

7.4. To agree on common criteria for conducting high-quality and scientifically sound research,

7.5. To increase the public benefit of scientific research and public trust in the academic community conducting such research.

4.4. Guidelines for the ethical use of artificial intelligence

The use of artificial intelligence (AI) tools in scientific research also raises challenges in terms of research ethics. In order to ensure academic integrity and the quality of the study process, it is necessary to comply with certain fundamental ethical requirements set out in both international documents and national or institutional recommendations.

The most important ethical principles when using artificial intelligence tools in scientific research are academic integrity, transparency (of the AI tools used), and researcher responsibility for results,

personal data protection, and confidentiality. As stated in the *UNESCO Guidance for generative AI in education and research*[6], direct copying of AI-generated text without critical reworking and proper attribution is considered plagiarism:

"GenAI might allow students to pass off text that they did not write as their own work, a new type of 'plagiarism'. GenAI providers are required to label their outputs with 'generated by AI' watermarks, while tools are being developed to identify material that has been produced by AI".

Therefore, the transparent declaration of how and when AI tools have been used is becoming an essential requirement. students must declare the name and version of the AI tool and its specific purpose. For example, whether the tool was used for information retrieval, text generation, language editing, data analysis, or idea generation. This information should be provided in the introduction, footnotes, or a special methodology section of the work.[7] In summary, students must take responsibility for their own learning and clearly indicate when ideas, words, or data are not their own. "[7] This means that students must clearly and unambiguously indicate when and which AI tools (e.g., *ChatGPT, Midjourney, DALL-E*, etc.) they used in preparing their academic work. This includes not only final thesis papers, but also smaller assignments such as essays, lab reports, or presentations.

Despite the assistance provided by AI tools, the ultimate responsibility for the content of the submitted work, its accuracy, originality, and any factual or ethical errors lies with the student. The ENAI Recommendations on the ethical use of Artificial Intelligence in Education[8] state that "An AI tool cannot be listed as a co-author in a publication as it cannot take responsibility for the content and findings reported. The person (human being or legal entity) is always accountable for the content, whether or not it was generated by AI. The outputs of AI tools can include biased, inaccurate, or incorrect content that users should be aware of."

The use of AI tools may also pose potential risks to data privacy and confidentiality. Students and teachers should not enter any sensitive, personal, or confidential information into DI systems. This includes personal data, non-public research data, trade secrets, or any other information whose disclosure could have negative consequences. Before using the AI tool, it is necessary to familiarise oneself with its privacy policy and data usage terms in order to understand how the entered data will be processed and stored.

In order to implement the above guidelines in practice, students by taking a researcher's role and their supervisors are advised to do the following before starting their research:

1. **Conduct a risk assessment.** All scientific research involving the development, implementation, or use of AI systems must be evaluated by the relevant ethics committee (note: at LSMU, this function is performed by the *Bioethics Centre*). This assessment must also cover specific risks associated with AI.

2. **Respect copyright.** When using AI for data collection or other purposes, it is necessary to ensure that copyright and other intellectual property laws are not infringed.

3. **Ensure human autonomy.** AI systems must enhance human capabilities rather than limit them or exert undue influence on decisions. The final decision and its evaluation must always remain the prerogative of the human (researcher).

In summary, the ethical use of AI in scientific research requires constant vigilance, critical thinking, and a firm commitment to the highest standards of scientific integrity. Technology is only a tool, and the responsibility for its proper and socially beneficial application lies with the research community. A more detailed explanation of the aforementioned ethical principles and practical recommendations for their implementation are provided to students and researchers by the *Guidelines of the Lithuanian University of Health Sciences for the use of artificial intelligence in studies, research, innovation and clinical practice*[9]. To maintain the highest standards of academic and research integrity, it is imperative that every LSMU student adheres to these established ethical guidelines. If having any questions or request, you should consult with the Bioethics Center at LSMU.

5. STUDY DESIGNS

The aims of scientific research are to collect, process, and present measurable and verifiable data, thereby gradually increasing the accumulation of human knowledge. Scientific research is classified into types according to its aim (investigative, descriptive, or explanatory/applied), methodology (quantitative, qualitative, or mixed methods), and fundamental nature (basic or applied). The main types include experimental studies, which establish cause-and-effect relationships, observational studies, which document naturally occurring phenomena, and correlational studies, which establish relationships between variables. Different study designs differ in their levels of reliability (Figure 5.1). The possible study designs are shown in Figure 5.2.

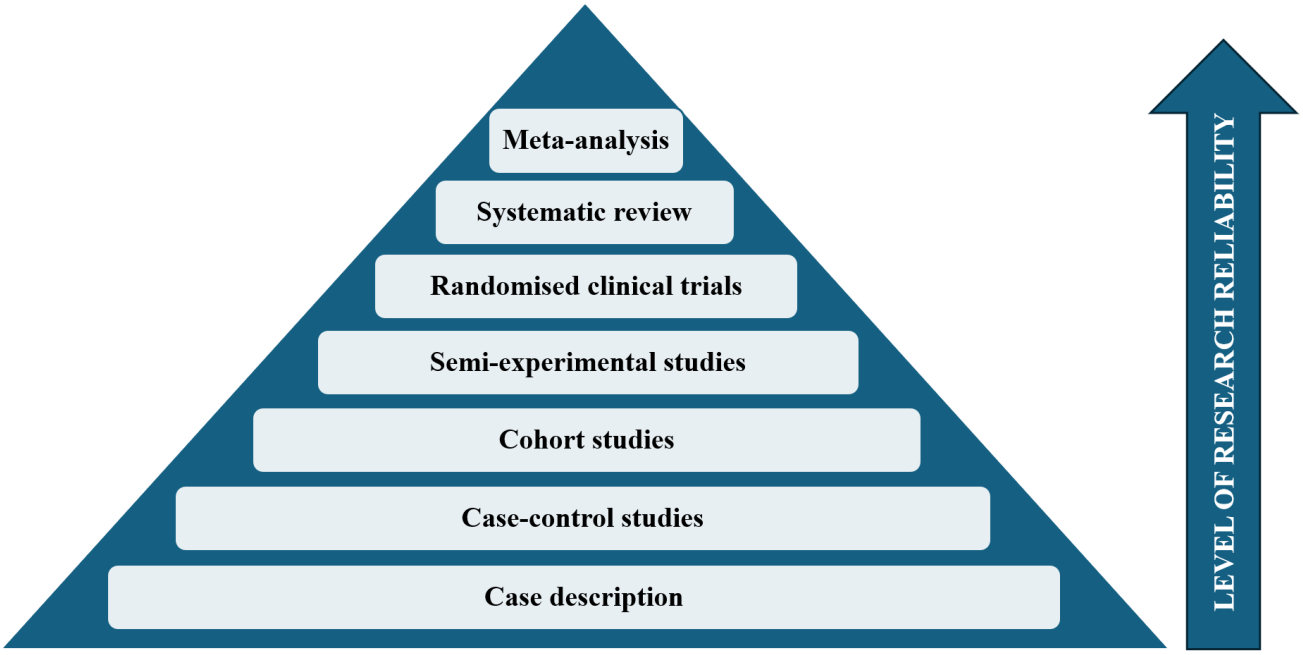


Fig. 5.1. *Levels of research reliability*[10]

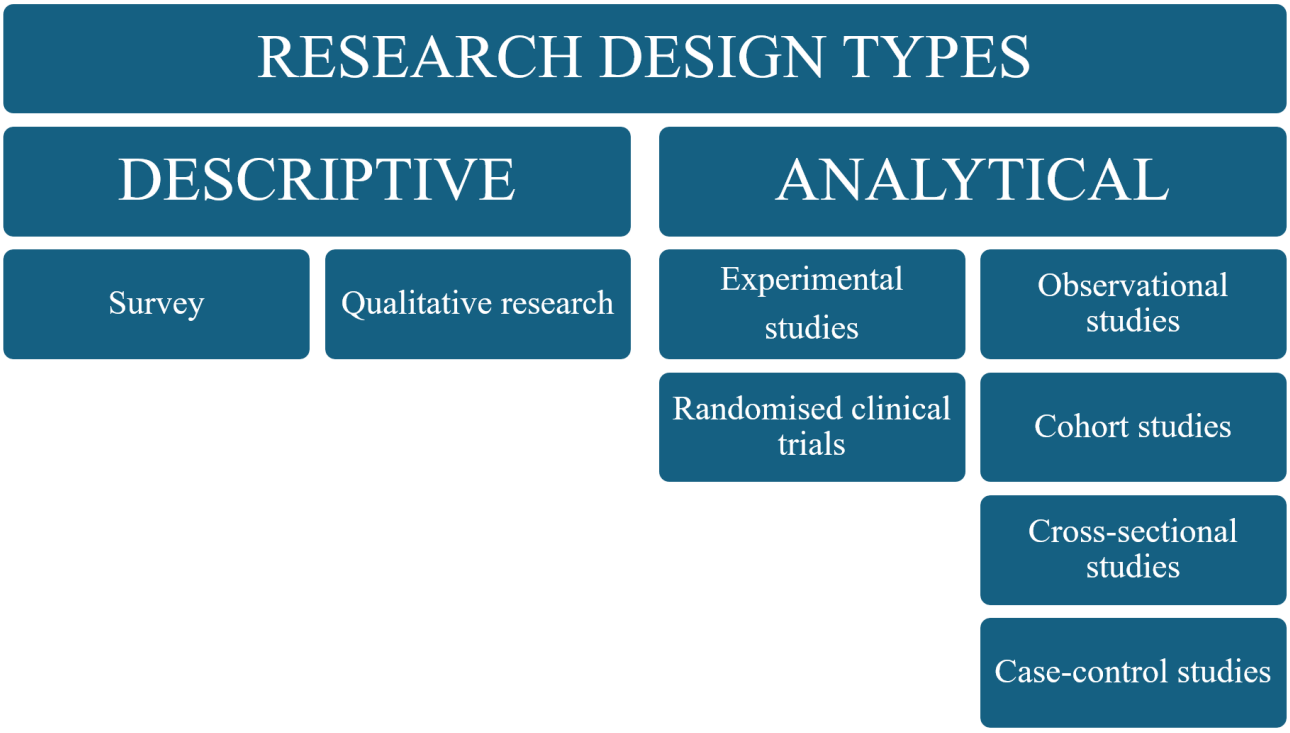


Fig. 5.2. *Types of research designs*

Descriptive studies collect and describe accumulated data. One example of such a study is a questionnaire survey, where data are collected at a specific point in time. **Qualitative descriptive studies** describe a specific situation and collect data from a specific cohort of patients selected on the basis of a specific common characteristic.

Analytical studies are experimental or epidemiological observational studies designed to identify and explain the relationship between diseases and certain risk factors.

Experimental studies are epidemiological studies in which interventions are implemented to control risk factors or delay the onset of disease, and the effectiveness of these interventions is then evaluated.

Clinical randomised trials are based on scientific experiments that compare interventions, usually treatments, by randomly assigning participants to different groups. Two groups are formed: an experimental group, which receives the intervention (treatment), and a control group, which receives a placebo or standard treatment. When the assignment of subjects to groups is random, researcher bias is reduced, ensuring the most reliable method of determining whether the intervention is effective and safe, that the groups are similar, and that any difference in outcome between the groups is due to the intervention itself.

Double-blind randomised clinical trials are studies in which participants are randomly assigned to either an experimental or a control group, and neither the participants nor the researchers know who is receiving which intervention (receiving the drug, placebo, or standard treatment) until the study is

completed. A double-blind randomised trial is considered the gold standard because it reduces researcher bias and links the results to the effectiveness of the intervention (treatment) rather than to the researchers' expectations or preconceptions.

During **observational studies,** researchers collect scientific data (on behaviour, etc.) by observing study participants without interfering or influencing the variables. The subjects are not divided into groups, no intervention is applied to them, and only the relationships between variables are analysed as they occur naturally. This research method may be chosen when the use of experimental research is unethical.

Cohort studies are studies in which a group of subjects (cohort) with a common characteristic or trait is observed over a period of time. For example, subjects are observed, and changes after exposure to X are evaluated. Patterns, causes, and consequences of the changes that occur are analysed. The subjects are observed for weeks, months, or years. These studies allow conclusions to be drawn about the causes of diseases, environmental factors, and social trends.

In **cross-sectional studies**, data in a cohort (study population) are collected at a single point in time to determine the prevalence of an outcome or effect. These are purely "snapshot" studies designed to determine the prevalence of a variable X, but do not allow for an assessment of cause and effect.

Case-control studies compare subjects with a specific characteristic or disease with a similar group of subjects who do not have the selected characteristic or disease. The aim of these studies is to assess factors and past exposures that occurred more frequently and could have led to the development of the trait or disease under investigation. These studies are effective in investigating rare diseases or outbreaks and are often used to establish associations, but they cannot prove a causal relationship.

The study designs in terms of time are shown in Figure 5.3.

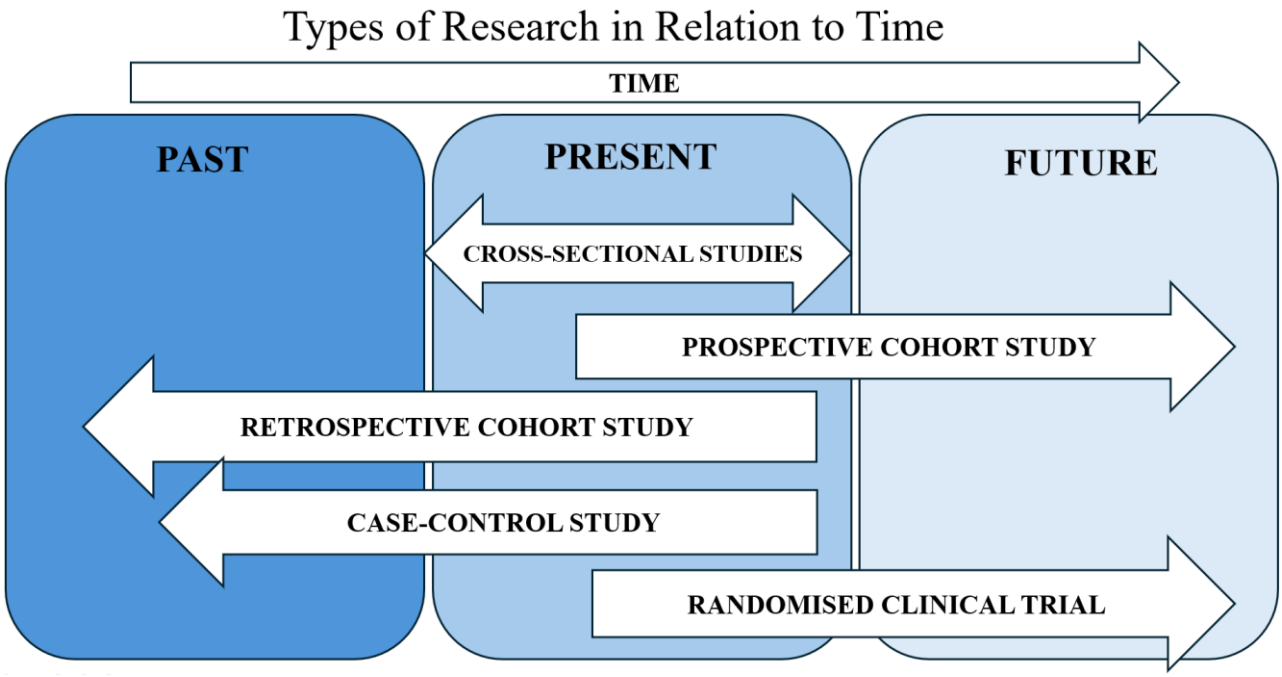


Fig. 5.3. *Study designs in terms of time*[11]

Table 5.1. *Summary of the advantages and disadvantages of study designs*[10]

Study design	Advantages	Disadvantages
Observational	Existing data can be used to investigate benefits and harms.	It is difficult to establish causal relationships.
Experimental	Suitable for answering specific scientific questions.	Subjects may withdraw from the study.
Prospective	Specific risk factors can be investigated.	Studies take time. Patient follow-up may be interrupted.
Retrospective	Relatively inexpensive and easy to perform.	Incomplete data. Data are subjective.
Cross-sectional	A large amount of information.	Possible *confounding* factors.
Cohort	The relationship between exposure and outcome can be determined.	Prospective studies. Expensive.

6. SYSTEMATIC LITERATURE REVIEW AND META-ANALYSIS

6.1. What is a systematic literature review?

A systematic literature review (SLR) is a methodical way to find, select, evaluate, and summarise all studies that answer a specific question. SLR helps to make evidence-based decisions and avoid bias, critically evaluate the quality of the research, and analyse and summarise the results and available evidence. The use of standardised methods is what distinguishes a systematic literature review from a simple literature review.

A *meta-analysis* is part of a systematic literature review in which statistical methods are used to summarise and evaluate the results of two or more similar studies that assessed the same hypothesis. Depending on the studies included in the systematic literature review, a *meta-analysis* is not always possible.

Example: You want to know whether prophylactic antibiotics reduce the risk of infection after surgery – SLR and meta-analysis will help you find the most accurate answer.

Aims of SLR:

- To conduct a thorough and methodical literature search.
- To identify the strengths and weaknesses of the scientific literature on the topic under consideration.
- To summarise a large amount of scientific literature.
- To resolve contradictions in the literature.
- To identify the need for large-scale clinical trials.
- To avoid unnecessary research.
- To increase the statistical power of smaller trials.
- To identify small differences in treatment outcomes.
- To improve the application of treatment outcomes.

Reasons for performing SLR

- Ensuring evidence-based practice.
- Personal professional development.
- Healthcare policy formation.
- Writing an introduction to scientific research.
- Preparing a scientific report.
- Technical reports and many other reasons.

6.2. Systemic review: preparation and key steps

The student's supervisor will usually be an expert in the field in which the systematic review is being conducted. The student is the main executor and coordinator of the SLR. A statistician can help if a *meta-analysis* is planned. A medical librarian contributes if specific knowledge that researchers do not have is required to search for literature in various databases.

It is necessary to have sufficient time and to plan in advance what resources are needed to conduct the review, for example, access to various databases and the ability to obtain full-text articles, special software for managing literature sources, sometimes translation services, etc.

Tip: When conducting a systematic review and preparing it for publication, it is necessary to use the PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) checklist (www.equator-network.org or www.prisma-statement.org) and conduct the systematic review in accordance with the PRISMA recommendations.

6.2.1. Step 1. Formulating the PICOS question

SLR begins with the formulation of a structured and meaningful (clinically or in the context of the study) question. Sufficient time and effort should be devoted to this step, as the subsequent course and smoothness of the review depend directly on a properly formulated question. A structured question must contain all the PICOS elements:

P - Population – indicates the characteristics of the study population, patients, and their clinical problems.

I - Intervention – treatment, nursing care, social intervention or training, risk factors, tests, etc. (a new method whose effectiveness we want to evaluate).

C - Comparison – indicates what the intervention under investigation is being compared with (usually a commonly used research, treatment, or other method).

O - Outcome – changes in health status (morbidity, mortality), use of health resources, etc.

S – Study designs – a suitable study in which patients undergo a specific intervention and the results are evaluated.

Tip: Use the PICOS form to define exactly what you will be looking for in the literature. You can start with a free-form question, which you will then structure.

A free-form question: Does antibiotic prophylaxis administered prior to planned hernia repair surgery reduce the incidence of infections during the postoperative period?

A structured question:

P – adults undergoing elective hernia repair surgery;

I – antibiotic prophylaxis;

C – compared with placebo, or with a group without prophylaxis, or with other antibiotics;

O – infection occurring during the postoperative period, confirmed by appropriate methods;

S – experimental studies.

When formulating the question, it is very important to specify the characteristics of the patients as precisely as possible (e.g., age limits, stages of life, severity of the disease, etc.), the interventions applied, and the clinically meaningful and important outcomes to be assessed. This determines the choice of study designs. Some authors of systematic reviews focus only on clinical randomised trials (as more reliable), but when evaluating long-term or rare outcomes (especially the safety of an intervention), observational (cohort or case-control) studies are more appropriate.

Other similar acronyms/models may also be used when formulating structural questions:

- **The PEO model** is often used in qualitative research, psychosocial, public health, or nursing contexts when examining experiences, phenomena, or opinions. **PEO = Population + Exposure/Experience + Outcome (qualitative, experiential research).**
- **PIO** is more suitable for analysing interventions, healthcare practices, and educational or social programmes when the aim is to assess the impact of a particular action. **PIO = Population + Intervention + Outcome (practical, applied research).**

6.2.2. Step 2. Preparation and registration of the protocol

All SLR steps must be planned and described (as precisely as possible) in the protocol in advance. Once the question has been formulated, it is necessary to plan a strategy for searching and reviewing the literature, criteria for including and excluding studies in the review, criteria for assessing their quality, and aspects of data selection and analysis. During the review, it allows the researcher to stay on track with his or her goals and enables other experts to evaluate the research methodology and suggest corrections before analysis begins.

The completed protocol can be registered in special databases, e.g., **PROSPERO** (https://www.crd.york.ac.uk/prospero/). This helps to avoid bias and demonstrates the transparency of the work. To publish a systematic review, one of the requirements of a potential journal may be that the systematic review must be registered in this or similar databases.

6.2.3. Step 3. Literature search and article selection

The accuracy of SLR results and the impartiality of the conclusions depend directly on a thorough literature search. The assistance of a medical librarian is important at this stage. It is essential to keep accurate records of the literature search strategy used.

Possible sources for literature search:

• Electronic databases: general (*MEDLINE, EMBASE, Science Citation Index, Scopus*) or specialised, dedicated to a specific field (*CENTRAL, CINAHL, PsycINFO, MIDIRIS*). When searching

electronic databases, it is particularly important to use the right combination of search words and controlled terms (e.g., *MeSH*).

• Peer-reviewed medical journals;

• Article bibliographies;

• Conference proceedings;

• Ongoing and unpublished research (http://controlled-trials.com);

• Other sources (theses, dissertations, non-peer-reviewed journals, technical reports of pharmaceutical companies).

It is recommended to manage the references of selected articles using special software (e.g., *EndNote, Reference Manager*).

Example: Search for literature in several databases: *PubMed, Embase, Cochrane Library, Scopus*. Use keywords and controlled terms (*MeSH, Emtree*). The PRISMA guidelines recommend clearly describing how and where you searched for literature sources. Example: *PubMed* query: ("antibiotic prophylaxis"[MeSH Terms]) AND ("postoperative complications"[MeSH Terms]).

The selection of eligible studies in SLR (Figure 6.2.2.1) can be done manually or using specialised tools such as *Rayyan* (https://rayyan.ai). Abstracts and full articles should be assessed **based on clear criteria:**

• **Criteria for the inclusion/exclusion of studies in the review** are established, which would allow answering the formulated structural question and would correspond to its parts (e.g., PICOS).

• **First review.** The researcher reviews the titles and abstracts of all the selected articles and selects the studies that are suitable for the review.

• **Second review.** The researcher analyses the entire text of the article and selects the sources to be included in the review.

• **The reasons for not including studies in the review** must be stated.

Important: reasons why each article was rejected should be documented.

How to avoid bias when searching for literature sources?

- Studies that do not show a positive effect of intervention are less likely to be published or are published in less accessible journals, therefore the search must be comprehensive and not limited to just a few electronic databases.
- Studies with positive results are more often published in English, while studies with negative results are published in the local language in non-English-speaking countries. Therefore, it is not advisable to limit the literature search to articles in English only. Colleagues who speak other languages or a translator can help here.

- Large-scale studies are often published several times. All of them need to be analysed at the selection stage, but only the most comprehensive article should be included in the review.

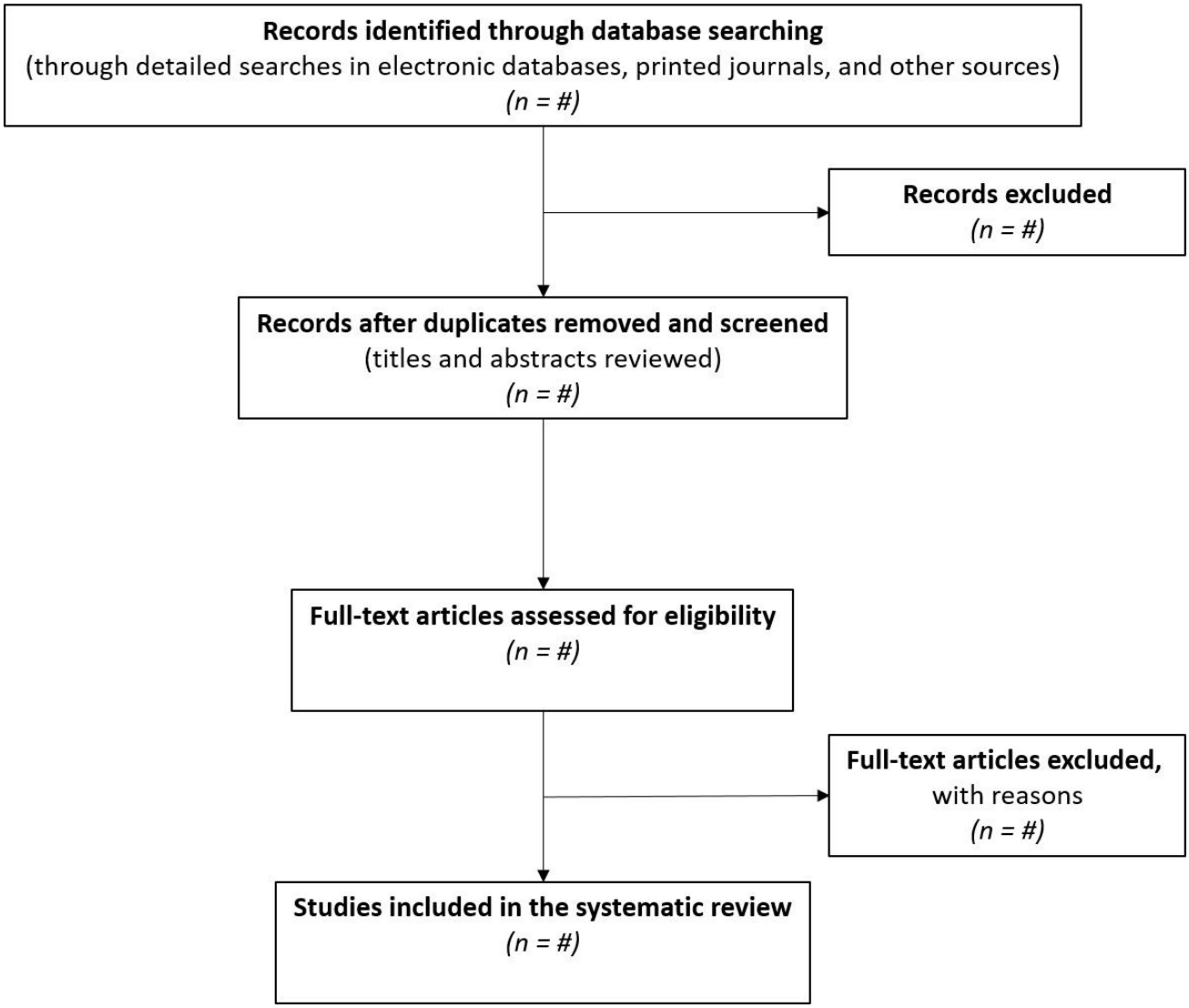


Fig. 6.2.3.1. *Research selection process*

6.2.4. Step 4. Data collection and registration

It is advisable to create standardised forms (paper or electronic) in which the collected data should be recorded. The following data should be included in all systematic reviews:

1. **Literature source** – the author, title of the article, journal, volume, page numbers;
2. **Aim** – the aim of the study as stated by the author;
3. **Date of study** – the date of the study (publication);
4. **Type of study** – type and location of the study;
5. **Population** – characteristics of the study participants, and sample size;
6. **Intervention** – a detailed description of the intervention;

7. **Control** – description of the control group or an alternative intervention;

8. **Results** – results of the intervention (main and additional), how they were evaluated, and statistical data;

9. **Comments** – comments on the quality of the study.

Depending on the scope of the review, there may be more data, which may be described in greater detail. It should be decided in advance whether only the results shown in graphs and figures will be used.

Tip: Create a simple table with columns for the author, source, year, population, intervention, control, and results. You can use *MS Excel* or special tools (e.g., *Covidence*).

6.2.5. Step 5. Quality assessment

The quality assessment of research already begins in steps 1 and 3: the study design is determined when formulating the question, and the criteria for including or excluding studies in the review are determined when conducting the literature search. This establishes minimum requirements for studies, but they are not sufficient on their own – a more detailed assessment of the quality of the studies included in the review is required This step is the last chance to exclude studies of inadequate quality from the review.

Phases of the quality assessment of studies included in the systematic review

1. **Description of the question and research selection criteria:**

- Assessment of the aspects of the formulated question;
- Determination of the type of study that allows the question to be answered;
- Determination of the minimum reliability of studies that will be acceptable (study design threshold) for inclusion in the review.

2. **Selection or creation of a research quality assessment checklist**

Checklists for assessing the quality of various studies are available on the website *Equator Network* (www.equator-network.org). After assessing the aspects of the issue under consideration (PICOS, PEO, PIO), it may be necessary to modify the proposed general checklists. It is particularly important to assess the research methodology and possible bias (tendency).

3. **Verification of the suitability of the checklist by evaluating the quality of several studies**

4. **Inclusion of the results of the research quality assessment into the description and interpretation of the systematic review:**

- Description of the quality of the studies;
- Analysis of how the quality of different studies may have influenced their results;
- Decision on whether a meta-analysis of the study results is possible;

- Assessment of the reliability of the conclusions;
- Presentation of recommendations on how to plan a better-quality study.

Tip: Use quality assessment tools (e.g., RoB 2 for randomised trials, ROBINS-I for observational studies). This helps to assess bias and reliability.

6.2.6. Step 6. Data analysis and results

At this stage, it is important to answer the following questions:

- Does the intervention that is being studied have an effect?
- What is that effect, and is it clinically significant?
- Are you sure that the effect observed was due to the intervention you studied?
- Is the observed effect similar in all studies included in the review?
- What factors could increase or decrease the effect of the intervention?

If the studies are similar and there are sufficient statistical data, a *meta-analysis* can be performed, and the results can be combined; if not, a narrative synthesis of the studies can be presented. Data analysis begins with a description of the results of the studies included in the review, i.e., tables provide information about patients, interventions, outcomes, study type, and quality. Analysis of such tables reveals the heterogeneity of the studies in terms of clinical and quality aspects and allows for a decision on whether it is possible to combine the results of different studies, calculate the overall effect of the intervention, and perform a *meta-analysis*. In this case, the results should be illustrated using *Forest plot* or *Funnel plot* diagrams. The help of a statistician is particularly important here.

6.2.7. Step 7. Interpretation of the results

The interpretation of the results usually begins with an analysis of tables of data and results. The strengths and weaknesses of the studies included in the review and of the systematic review itself should be discussed here. Conclusions should be based on the results obtained and on scientific evidence. If it is difficult to draw conclusions (due to a lack of studies, differences, or insufficient quality), the need for and directions of further scientific research can be indicated.

6.3. Assistance from artificial intelligence (AI)

AI tools can assist researchers, but should not determine final decisions:

- *ChatGPT* can help formulate a PICOS question or keywords.
- *Rayyan AI* can suggest which articles are potentially suitable.

Always review and verify AI recommendations. Describe the use of AI tools and their specific areas of application in the methodology and/or a special reference. The LUHS has adopted guidelines

entitled "Guidelines of the Lithuanian University of Health Sciences for the use of artificial intelligence in studies, research, innovation and clinical practice," which are available on the university's website.

6.4. Key messages and useful resources

A systematic literature review (with or without *meta-analysis*) is the most reliable form of obtaining scientific evidence. A literature review should be conducted using only the principles of a systematic literature review, i.e., its seven basic steps.

Tools for systematic literature reviews:

- PRISMA 2020 – https://prisma-statement.org/
- PRISMA-S – https://osf.io/7qr3y/
- Cochrane Handbook – https://training.cochrane.org/handbook/current
- Rayyan – https://rayyan.ai/
- GRADEpro – https://gradepro.org/

6.5. Meta-analysis in systematic literature review

A systematic literature review is often concluded with a quantitative assessment of estimates, allowing for the analysis and summary of the results of individual studies. *Meta-analysis*, as a statistical method, makes it possible to integrate these estimates into a single analytical whole, thereby strengthening the conclusions of the systematic review and increasing their reliability and overall scientific value.

Meta-analysis is a statistical method that allows the results of statistical analyses from several independent (but similar) quantitative studies on a specific topic to be combined and analysed together. It helps to draw conclusions about the overall quantitative assessment of the dominant effect. This assessment is called the ***effect size***. It is a standardised indicator showing the strength of the result of the study.

Effect size measures are *measures of difference* (e.g., difference in means or standardised difference in means) or *measures of ratio* (e.g., relative risk (RR) or odds ratio (OR)).

Measures of difference when examining a *quantitative characteristic*: Cohen's d, Hedges' g, and Glass's Δ;

Measures of ratio when examining a *qualitative dichotomous characteristic*: Log OR, Log RR, and risk difference.

Effect sizes are calculated for each individual study and are summarised into a ***pooled (grand, overall) effect size***. The effect sizes of individual studies and the overall effect size, together with 95% confidence intervals (CI), are the main *numerical characteristics of a meta-analysis*.

Example: meta-analysis of quantitative variables

For example, a *meta-analysis* is performed to compare the effect of diet X on the body mass index (BMI) between the control and the experimental groups. **Cohen's d** effect size is calculated for each (of the five) studies, and the overall effect is presented in a *forest plot*, which shows the effect size of each study, 95% CI, statistical significance (p-value), and weight (Fig. 6.5.1).

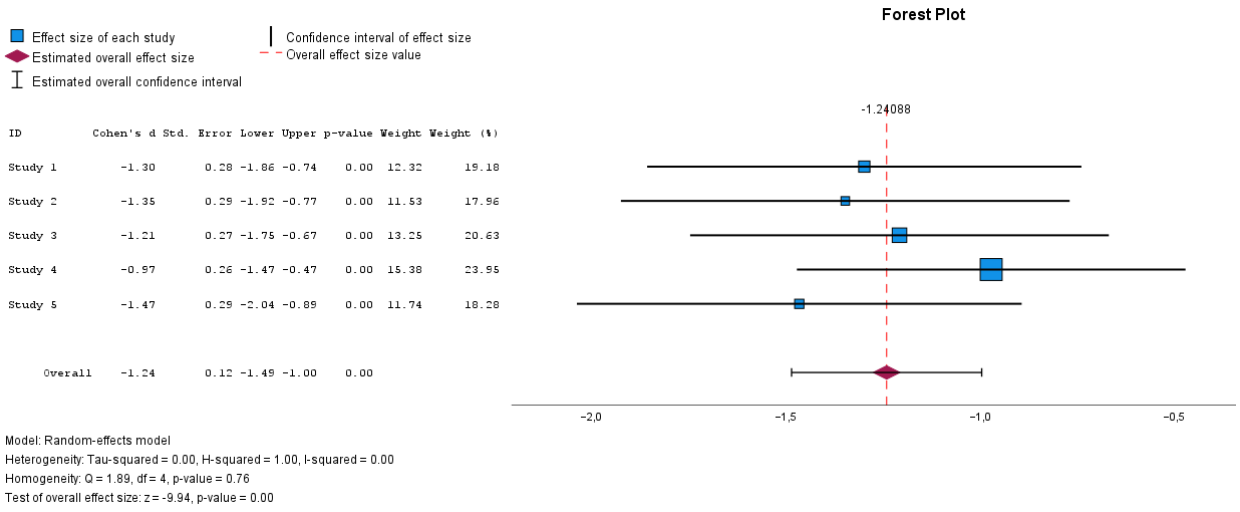


Fig. 6.5.1. *Meta-analysis of the effect of Diet X on the BMI: results from five independent studies*

Most studies show a negative effect size, meaning that following diet X is associated with a lower BMI in treatment group compared to the control group. The low heterogeneity of the study results (I^2 = 0.0%) is not statistically significant (Q = 1.89, p = 0.76). The overall effect size of 1.24 (95% CI 1.0-1.49) is statistically significantly different from zero (z = 9.94, p <0.001). Thus, most studies show that BMIs were on average lower in the treatment group that followed diet X, and the overall result of the *meta-analysis* confirms a statistically significant effect.

Example: meta-analysis of qualitative variables

For example, a *meta-analysis* is performed to assess satisfaction with diet X (liked/disliked) in the control and the treatment groups. For each (of the four studies), the odds ratio (OR) effect size is calculated, which shows how many times more likely the treatment group is to like the diet (compared to the control group). The overall effect is presented in a *forest plot*, which visualises the effect size of each study, 95% CI, statistical significance (p-value), and the weight of each study in the overall assessment (Fig. 6.5.2).

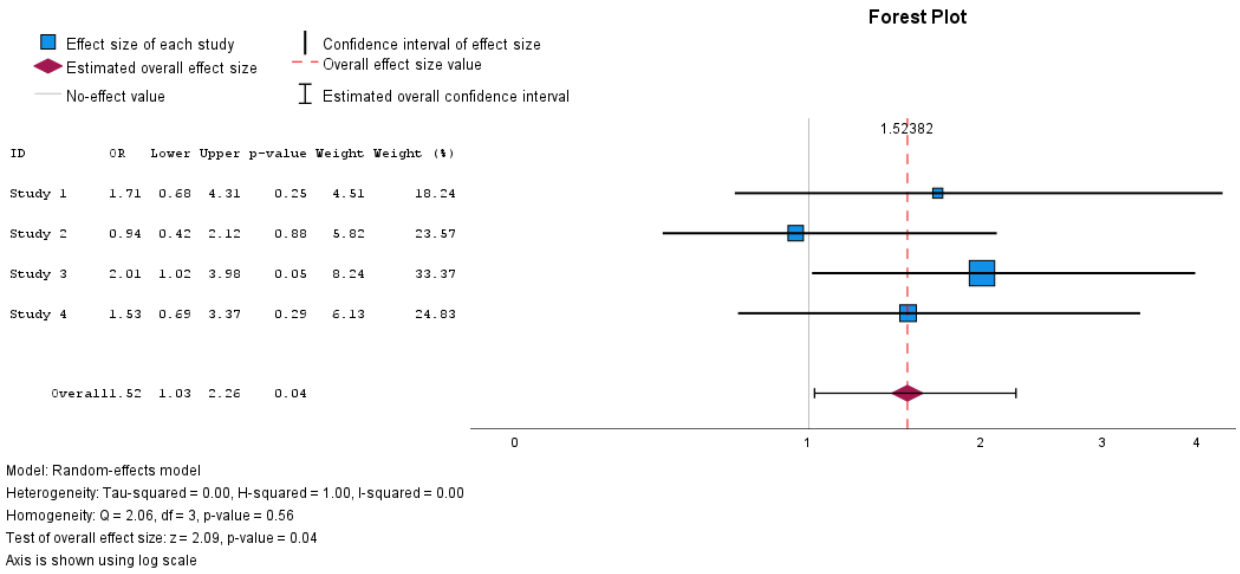


Fig. 6.5.2. *Meta-analysis of satisfaction with diet X: estimation of odds ratio (OR) in four studies*

The *forest plot* shows that the odds ratio (OR) values for most studies are >1, and 1 does not fall within the 95% CI, meaning that satisfaction with diet X was more common in the treatment group. The observed low heterogeneity of the study results (I^2 = 0.0%) is not statistically significant (Q = 2.06, p = 0.56). The overall effect size of 1.52 (95% CI 1.03-2.26) is statistically significantly different from zero (z = 2.09, p = 0.04). Thus, most studies show that diet X was rated more favourably in the treatment group, and the overall result of the *meta-analysis* confirms a statistically significant effect. In summary, *meta-analysis* helps to increase the reliability of different study results, to reveal general trends, and to assess the heterogeneity of the results.

7. STATISTICAL ANALYSIS OF QUANTITATIVE RESEARCH DATA

7.1. Introduction

If quantitative research is being conducted, the data collected will require statistical analysis. This is a very important part of scientific research. The success or failure of any research project depends on the researcher's ability to work with data.

Statistics is the science of collecting, systemization, analysing and interpreting information.

There are two parts to statistical data analysis:

- descriptive statistics (methods of data systemization);
- inferential statistics (methods of analysis and interpretation).

Population is the totality of people, other living organisms, or inanimate objects under investigation.

For example: LSMU students, people suffering from a certain disease, or cells of cultures of interest.

If the population is finite, the number of its elements is denoted by N and is called the **population size**. A population can also be infinite.

For example, in cancer research, scientists study how genetic mutations occur in cancer cells. The number of possible mutations or cell divisions during the life cycle of a cancer cell can be considered infinite, as cell division and mutation are continuous biological processes.

Sample is a part of the population selected for statistical research. The number of sample elements is called the **sample size** and is denoted by n.

For example: the population is all LSMU students, and the sample is the 150 students who participated in the study (n = 150).

The aim of statistical research ***is to draw conclusions about the entire population from sample data*** by applying mathematical (probability theory) methods to their analysis.

In order for conclusions to be statistically reliable, ***the sample must be representative and random***. A sample is representative if it *accurately reflects the entire population* (e.g., in terms of age, sex, education, etc.), i.e., the sample must reflect the essential structure of the population and the proportions of the values of the characteristics under study so that the conclusions obtained are valid for the entire population. To ensure the randomness of the sample, it must be selected using random sampling so that each unit of the population has an *equal probability of being included in the study*.

7.2. Sample size required for the study

The ***sample size must be large enough to ensure sufficient statistical power*** and reliable conclusions. Too small sample increases the risk of random error and reduces the statistical power of the study, which may lead to unreliable results. An overly large sample may result in statistically significant differences being identified even when their practical or theoretical significance is negligible.

There is no single universal formula for the minimum sample size that is suitable for all research cases. It depends on the *statistical data analysis methods* planned to be used, which in turn depend on the *type of variables* under consideration (**variables** are the characteristics of the population measured in the sample and are classified into quantitative and qualitative (categorical) ones), the *variation in the values* of the variables, the *type of the samples* being compared (independent (comparison of groups) or related samples (repeated measurements, when the same group of subjects is measured several times)), on whether it is assumed that the *distribution* of the quantitative characteristic under study in the population is *normal*, the *aim and objectives of the study*, and the issues to be addressed (to estimate the parameter of the population, to estimate the differences between the compared populations, to estimate the relationships between the characteristics under consideration, to develop predictive models, etc.).

This chapter provides only a few examples of situations and recommendations for calculating the minimum required sample size.

The smallest sample size required to estimate the population mean with the desired precision

Let us assume that we are observing a ***quantitative*** variable X, whose values in the population are normally distributed with an unknown mean and variance. In order to estimate the population mean with statistical reliability, the minimum required sample size is calculated using the following formula (1):

$$n = \frac{z_q^2 \cdot s^2}{\Delta^2}, \qquad (1)$$

where

- z_q is the quantile of the standard normal distribution $q = (1+P)/2$, which depends on the chosen confidence level (reliability). Usually P = 0.95 (or 95%), then $z_q = 1.96$;
- s is the standard deviation of the values of the quantitative variable (usually calculated using data from a pilot study or previous studies);
- Δ is the desired precision of the estimate of the population mean (allowable error) chosen by the researcher.

Example: What is the minimum sample size required to estimate the mean weight of the population of full-term newborns with a precision of 100 g at a 95% confidence level? Let us assume that the weight values in the population follows a normal distribution and that the standard deviation of the weight of full-term newborns calculated from the pilot study data is 550 g.

In this case, $P = 0.95$, then $z_q = 1.96$, and $\Delta = 100$ and $s = 550$, then the minimum sample size required is:

$$n = \frac{z_q^2 \cdot s^2}{\Delta^2} = \frac{1.96^2 \cdot 550^2}{100^2} = 116.2 \Rightarrow n = 117.$$

The minimum sample size required to estimate the population mean with the desired precision, if ***the population size N is known***, is calculated using the following formula (2):

$$n = \frac{z_q^2 \cdot s^2}{\Delta^2 + \frac{z_q^2 \cdot s^2}{N}} \quad (2)$$

The smallest sample size required to estimate the probability (proportion) in the population with the desired precision

Let us assume that we are observing a ***qualitative nominal*** variable X. In order to statistically reliably estimate the probability (proportion) of the value of the nominal variable of interest in the population, the minimum required sample size is calculated using the following formula (3):

$$n = \frac{z_q^2 \cdot \nu \cdot (1-\nu)}{\Delta^2}, \quad (3)$$

where

- z_q is the quantile of the standard normal distribution $q = (1+P)/2$ (if the selected confidence level is $P = 0.95$, then $z_q = 1.96$);
- ν is the relative frequency (proportion) of the nominal variable of interest in the sample (usually calculated using data from a pilot study or previous studies; if such information is not available, $\nu = 0.5$ is used);
- Δ is the desired precision of the estimate of the frequency (proportion) chosen by the researcher (usually, $\Delta = 0.05$ (or 5%.)).

Example: Let us assume that we want to estimate the proportion (prevalence) of people who have acquired immunity to COVID-19 in the population with 95% confidence. Previous studies have shown that 40% of people are immune to this disease. What is the minimum number of people that need to be tested in order to estimate the proportion of interest in the population with 5% precision?

In this case, $P = 0.95$, then $z_q = 1.96$, and $\Delta = 0.05$ and $\nu = 0.4$, then the minimum sample size required is:

$$n = \frac{z_q^2 \cdot \nu \cdot (1-\nu)}{\Delta^2} = \frac{1.96^2 \cdot 0.4 \cdot (1-0.4)}{0.05^2} = 368.8 \Rightarrow n = 369.$$

The minimum sample size required to estimate the probability (proportion) in the population with the desired precision, if ***the population size N is known***, is calculated using the following formula (4):

$$n = \frac{z_q^2 \cdot \nu \cdot (1-\nu)}{\left(1-\frac{1}{N}\right) \cdot \Delta^2 + \frac{z_q^2 \cdot \nu \cdot (1-\nu)}{N}} \quad (4)$$

In other cases (depending on the study design and the methods of statistical analysis chosen), other formulas for the minimum required sample size are used. Calculations can be performed using special software, such as *IBM SPSS Statistics (Power Analysis)* or *G*Power*, which automatically estimates the required sample size based on the specified parameters.

7.3. Description of research results (descriptive statistics)

The description of the research results is an important part of the final thesis, allowing the main characteristics of the collected data to be conveyed clearly and accurately. It should be clear, consistent, and in line with the nature of the data being analysed. It is recommended to describe each variable according to its type and distribution of values. Variables can be quantitative or qualitative, which can be nominal or ordinal.

Quantitative variables are variables whose values are numerical and allow mathematical calculations to be performed (e.g., age, height, weight, income, blood pressure, etc.). The distribution of the variable is particularly important for describing the characteristics of these variables.

The **normal distribution** is one of the most important statistical distributions, also known as the *Gaussian distribution*. It describes the distribution of quantitative variables when most values are concentrated around the mean, and values further away from it gradually decrease (by approximately one standard deviation).

The *Kolmogorov-Smirnov* and *Shapiro-Wilk* tests are most commonly used to test the assumption of normality. The *Shapiro-Wilk* test is more suitable (more powerful) for medium-sized samples ($30 \leq n < 50$). The normality assumption is satisfied when the calculated p-value of the applied test is greater than the selected significance level α (usually $\alpha = 0.05$). When the sample is small ($n < 30$), the normality assumption is not tested because statistical criteria become unreliable, and the distribution of data may be overly influenced by random fluctuations, thus it is recommended to use non-parametric (rank) tests for analysis or to increase the sample size.

Descriptive statistics and quantitative variables

- If the values of a quantitative variable follows a normal distribution, it is described by presenting its mean and standard deviation (SD): mean (SD). It is also recommended to present the 95% confidence interval (CI) of the mean.
- If the values of a quantitative variable does not follow a normal distribution, it is described by presenting its median value together with the minimum (min) and maximum (max) values, or the median together with the lower (Q_1) and upper (Q_3) quartiles, and it is also recommended to present the 95% CI of the median.

Qualitative nominal variables are variables whose values are used to describe groups, types, or categories rather than numerical values. They do not have a natural order or the possibility of size comparison. Qualitative variables are fundamental in descriptive statistics, especially when analysing demographic or qualitative data (e.g., sex, place of residence, economic status, blood type, etc.). These variables are described by presenting the frequency of their values and the relative frequency (%). It is recommended to also present the 95% confidence interval (CI) for probability.

Qualitative ordinal variables are variables whose values have an order, but the distances between the values are not precisely known or uniform. They can be compared, but their means cannot be precisely calculated (unless they are considered approximate quantitative variables). Ordinal variables can be described in the same way as nominal variables, but their order must be preserved. When these variables take on 5 or more different numerical values, they can be described as quantitative variables that do not satisfy the assumption of normal distribution (if appropriate in terms of meaning). Even though the calculation of the mean is not usually applied to ordinal variables due to the limitations of their measurement level, in certain cases, especially when the number of ranks is large, the mean can be presented as an additional numerical characteristic. However, the use of this characteristic should be justified, taking into account the aim of the study and the nature of the data. In addition to point numerical characteristics, it is recommended to present the corresponding 95% CI.

Example. Let us assume that the following variables were assessed in the study sample: the subjects' age, diastolic blood pressure, and cholesterol level group. It is known that age is a quantitative variable that satisfies the normality assumption, diastolic blood pressure is a quantitative variable that does not satisfy the normality assumption, and grouped cholesterol levels are an ordinal variable that takes three values. The numerical characteristics describing these variables are presented in Table 7.3.1.

Table 7.3.1. *Numerical characteristics of variables*

Variable		Numerical characteristics	95% CI
Age (years)[a]		38.0 (8.1)	35.9–39.8
Diastolic blood pressure (mmHg)[b]		80 (50; 100)	74.6–80.5
Cholesterol level group[c]	Normal	50 (46.2)	36.6–55.3
	Elevated	35 (31.6)	23.3–40.9
	High	24 (22.2)	14.2–29.8
Sex	Female	60 (55.2)	45.6–64.4
	Male	49 (44.8)	35.6–54.4

[a]mean (standard deviation) and its CI; [b]median (minimum and maximum values) and its CI; [c]frequency (percentage) and proportion CI expressed in percentage

7.4. Selection of the most common statistical methods used in student work and description of the results

The application and interpretation of statistical tests is a key part of the analysis of research results. They help to assess whether the observed differences and relationships between variables are statistically significant. The choice of the statistical method depends on the type of samples being compared (dependent or independent), the type of the data (quantitative or qualitative), their distribution (normal or not), the sample size, and the aim and objectives of the study. Table 7.4.1 presents a diagram of the selection of statistical methods most commonly used in students' final theses, followed by examples of the application of these methods and a description of their results.

Table 7.4.1. *Statistical method selection scheme*

Problem	**Data (variables)**		
	Quantitative normal	*Quantitative non-normal or ordinal*	*Nominal*
Characteristics of numerical samples	Mean, standard deviation	Median, minimum and maximum values	Frequency, relative frequency (percentage)
Confidence intervals (CI)	Mean CI	Median CI	Probability CI
Comparison of two independent samples	Student's t test for independent samples	Asymptotic or Exact Mann-Whitney U test	Chi-Square Test for Homogeneity
Comparison of three or more independent samples	One-Way ANOVA	Kruskal-Wallis test	Chi-Square Test for Homogeneity
Comparison of two dependent samples (repeated measurements)	Paired Student's t test	Asymptotic or Exact Wilcoxon test	McNemar's test
Comparison of three or more dependent samples (repeated measurements)	Repeated Measures ANOVA	Friedman's test	Cochran's Q test
Assessment of the dependence between two variables	Pearson's correlation	Spearman's correlation	Chi-square test of independence; Cramer's coefficient
Prediction of variable values based on the values of other variable(s)	Linear regression		Logistic regression Cox regression (survival analysis)

Note: Clicking on the name of the method will take you to an example of the description of the results.

Comparison between two independent samples

Student's t test for independent samples

Example: *The purpose of the study was to determine whether the mean time spent on homework differs between girls and boys ($\alpha = 0.05$). The times of 41 boys and 41 girls in a random sample were measured. Let us assume that, based on the study data, we can conclude that the time spent on homework by boys and girls is normally distributed.*

Description of the results: The 41 girls who participated in the survey spent a mean of 20.2 (SD = 7.29) minutes doing their homework, while the 41 boys spent a mean of 30.2 (SD = 8.01) minutes. Based on the survey data, it can be concluded that the mean time spent by boys and girls on homework differed statistically significantly ($t = 5.945$; $df = 80$; $p < 0.001$).

Asymptotic ($n_1 > 20$, $n_2 > 20$) Mann-Whitney U test

Example: *Seniors ($n_1 = 21$) and middle-aged individuals ($n_2 = 22$) were asked how many times they had visited their family doctor in the past year. Based on the survey data, can we say that the number of visits to the doctor by seniors and middle-aged people was the same ($\alpha = 0.05$)?*

Description of the results: The study included 21 seniors and 22 middle-aged participants. The median number of visits to the doctor for seniors was 3 (minimum value 0; maximum value 6), while the median number of visits to the doctor for middle-aged individuals was 8 (minimum value 2; maximum value 12). Based on the study data, it can be concluded that the number of visits to the doctor by seniors and middle-aged people was statistically significantly different. ($|Z| = 4.386$; $p < 0.001$).

Exact ($n_1 \leq 20$, $n_2 \leq 20$) Mann-Whitney U test

Example: *Seniors ($n_1 = 4$) and middle-aged individuals ($n_2 = 5$) were asked how many times they had visited their family doctor in the past year. Based on the survey data, can we conclude that the number of visits to the doctor by seniors and middle-aged people was the same ($\alpha = 0.05$)?*

Description of the results: Four seniors and five middle-aged individuals participated in the study. The median number of visits to the doctor for seniors was 10 (minimum value 5; maximum value 17), while the median number of visits to the doctor for middle-aged individuals was 12 (minimum value 4; maximum value 20). Based on the study data, it can be concluded that there was no statistically significant difference in the number of visits to the doctor between seniors and middle-aged people. ($U = 7.5$; $p = 0.595$).

Comparison of three or more independent samples

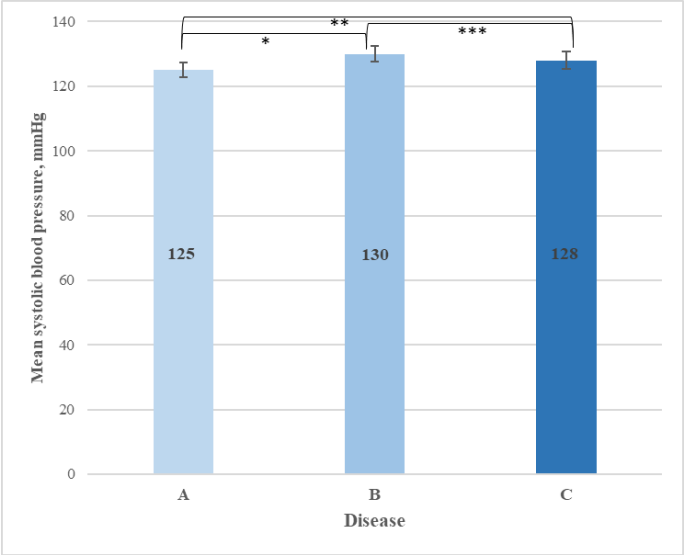
One-Way ANOVA

Example: *A random sample consisted of 100 people: 34 people with disease A, 36 people with disease B, and 30 people with disease C. All subjects had their systolic blood pressure (SBP) measured. Let us assume that the SBP measurements in the three populations are known to be normally distributed. Based on the random sample data, can we say that the mean SBP measurements of people with diseases A, B, and C did not differ statistically significantly ($\alpha = 0.05$)? If they did differ, patients with which diseases had statistically significantly different mean SBP measurements?*

Description of the results: The sample included 34 individuals with disease A, 36 with disease B, and 30 with disease C. The mean SBP was 125 (SD = 2.22) mmHg, 130 (SD = 2.33) mmHg, and 128 (SD = 2.68) mmHg, respectively. Based on the study data, it can be concluded that the mean SBP of people suffering from at least two different diseases differed statistically significantly ($F = 38.194$; $p < 0.001$). Pairwise ANOVA comparisons showed that the mean SBP values were statistically significantly different between all three diseases (comparing the mean SBP of patients with disease A

and disease B – $p < 0.001$, disease A and disease C – $p < 0.001$, and disease B versus disease C – $p = 0.003$).

A graphical representation of these results is shown in Figure 7.4.1.



*disease A vs disease B, $p < 0.001$; **disease A vs disease C, $p < 0.001$; ***disease B vs disease C, $p = 0.003$

Note: The vertical lines ("error bars") in the graph indicate one standard deviation.

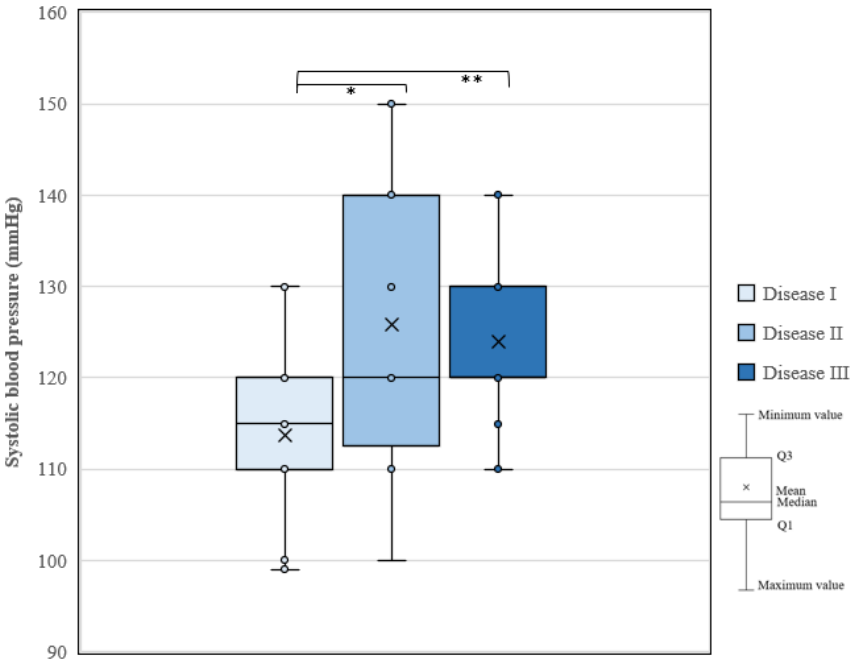
Fig. 7.4.1. *Comparison of mean systolic blood pressure in patients with different diseases*

Kruskal-Wallis test

Example: *In a random sample of 64 patients, the subjects were divided into three groups according to their diseases ($n_1 = 25$, $n_2 = 12$, $n_3 = 27$). The subjects' systolic blood pressure (SBP) was measured. Based on the study data, can we conclude that there was no statistically significant difference in systolic blood pressure between patients with different diseases ($\alpha = 0.05$)? If there was a difference, for which diseases were the SBP differences statistically significant?*

Description of the results: In the first group of patients ($n_1 = 25$), the median SBP was 115 (minimum value 99; maximum value 130) mmHg, in the second group ($n_2 = 12$, the median SBP was 120 (minimum value 100; maximum value 150) mmHg, and in the third group ($n_3 = 27$), the median SBP was 120 (minimum value 110; maximum value 140) mmHg. Based on the study data, it can be stated that systolic blood pressure differed statistically significantly between at least two disease groups ($H = 12.128$; $df = 2$; $p = 0.002$). Pairwise comparisons revealed statistically significant differences in systolic blood pressure between the first and the second disease groups ($p = 0.033$) and between the first and the third disease groups ($p = 0.004$).

A graphical representation of these results is shown in Figure 7.4.2.



*Disease I *vs.* Disease II, p = 0.033; ** Disease I *vs.* Disease III, p = 0.004

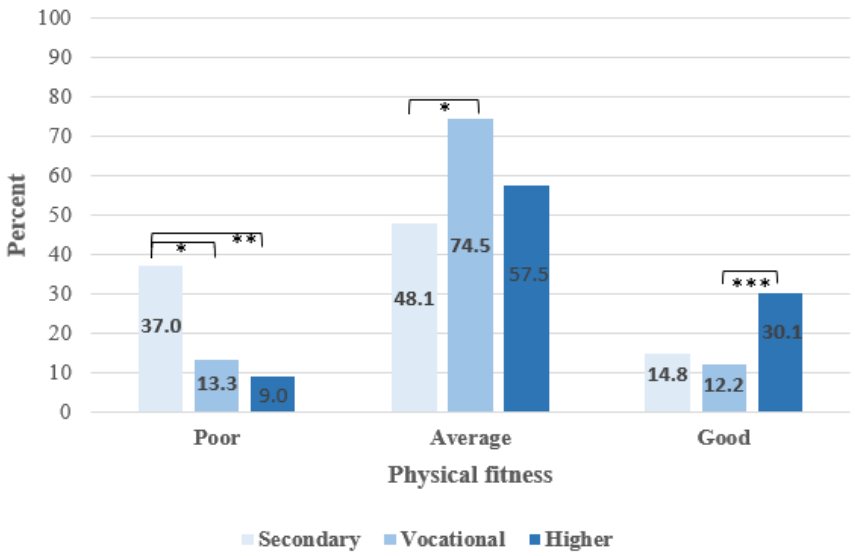
Fig. 7.4.2. *Comparison of mean systolic blood pressure in patients with different diseases*

Chi-Square Test for Homogeneity

Example: *The survey involved 198 participants. The aim of the study was to test, based on sample data, whether people with different levels of education (Education: Secondary/Vocational/Higher) had the same perception of their physical fitness (Fitness: Poor/Average/Good) (α = 0.05).*

Description of the results: Based on the study data, it can be stated that the assessment of physical fitness differed between at least two educational groups ($\chi^2 = 18.920$; df = 4; $p < 0.001$). Pairwise comparisons using the z criterion showed that the proportion of people who rated their physical fitness as poor differed statistically significantly between those with *secondary* and *vocational* education (37.0% compared to 13.3%, $p < 0.05$) and between people with *secondary* and *higher* education (37.0% compared to 12.3%, $p < 0.05$). The proportion of people who rated their physical fitness as average differed statistically significantly only between people with *secondary* and *vocational* education (48.1% compared to 74.5%, $p < 0.05$), while the proportion of people who rated their physical fitness as good differed statistically significantly only between people with *vocational* and *higher* education (12.2% compared to 30.1%, $p < 0.05$).

A graphical representation of these results is shown in Figure 7.4.3.



*secondary *vs.* vocational, p < 0.001; **secondary *vs.* higher, p < 0.001;

***vocational *vs.* higher, p < 0.001

Fig. 7.4.3. *Distribution of physical fitness across educational groups*

Comparison of two dependent samples (repeated measurements)

Paired Student's t test

Example: *The weight of 30 subjects was measured before and after their vacation. Let us assume that it is known that weight values in the population are normally distributed. Can we state that the mean weight of the subjects differed statistically significantly before and after their vacation? (α = 0.05)?*

Description of the results: The mean weight of the subjects (n = 30) before the vacation was 80.7 (SD = 3.47) kg, and after the vacation – 85.6 (SD = 3.72) kg. The mean weight difference was 4.9 (SD = 0.83) kg. Based on the study data, it can be concluded that the observed mean weight change was statistically significant (|t| = 32.651; df = 29; p < 0.001).

Asymptotic (n > 25) Wilcoxon test

Example: *The survey involved 28 people who had started exercising. They were asked to rate their well-being before and after starting to exercise. Their well-being was rated on a 10-point scale (1 – very poor, 10 – excellent). Based on the data, can we state that there was no statistically significant difference between the participants' ratings of their well-being before and after starting to exercise (α = 0.05)?*

Description of the results: In the sample of 28 people, the median score for well-being before starting to exercise was 3 (minimum value 1; maximum value 9), and after starting to exercise, the median was 5 (minimum value 2; maximum value 10). Based on the study data, it can be concluded

that there was a statistically significant difference between well-being scores before and after starting to exercise ($|Z| = 3.831$; $p < 0.001$).

Exact ($n \leq 25$) Wilcoxon's test

Example: *The survey involved 13 people who had started exercising. They were asked to rate their well-being before and after starting to exercise. Well-being was rated on a 10-point scale (1 – very poor, 10 – excellent). Based on the survey data, can we say that there was no statistically significant difference between people's assessments of their well-being before and after starting to exercise ($\alpha = 0.05$)?*

Description of the results: In the sample of 13 individuals, the median score for well-being before starting to exercise was 3 (minimum value 1; maximum value 9), and after starting to exercise, the median was 4 (minimum value 2; maximum value 10). Based on the study data, it can be concluded that there was a statistically significant difference in well-being scores before and after starting to exercise ($T = 5$; $p = 0.005$).

McNemar's test

Example: *100 people were asked – before and after treatment for depression – how they felt ("well" or "poorly"). Before the treatment, 25 patients said they felt well, while 75 said they felt poorly. After the treatment, 70 people said that their health was good, while 30 patients said it was poor. It is also known that after the treatment, the health of 5 people deteriorated, while the health of 50 people improved. Can we conclude that the treatment for depression had a significant impact on the health of the patients? Did the health of the patients change statistically significantly? ($\alpha = 0.05$)?*

Description of the results: Based on the sample data, 25 (25.0%) patients rated their health as good before treatment for depression. After the treatment for depression, 70 (70.0%) patients rated their health as good. The patients' health assessment changed statistically significantly ($\chi^2 = 35.2$; $df = 1$; $p < 0.001$).

Comparison of three or more dependent samples (repeated measurements)

Repeated Measures ANOVA

Example: *Let us assume that the systolic blood pressure (SBP) of subjects in a random sample ($n = 120$) was measured three times: before taking the medication, 60 minutes after taking the medication, and 120 minutes after taking the medication. The aim was to test whether the effect of the medication was effective. Suppose that it is known that SBP values in the population follow a normal distribution.*

Description of the results: The systolic blood pressure of 120 randomly selected subjects was measured three times: before taking the medication, 60 minutes after taking the medication, and 120 minutes after taking the medication. The mean SBP was 140.2 (SD = 3.08) mmHg during the first measurement, 132.8 (SD = 2.92) mmHg during the second measurement, and 124.6 (SD = 2.54) mmHg during the third measurement. Based on the study data, it can be concluded that the mean systolic blood pressure values of at least two measurements differed statistically significantly ($F = 1\ 149.673$; $p < 0.001$). The results of pairwise comparisons show that the mean SBP of all measurements differed statistically significantly ($p < 0.001$ for all comparisons).

Friedman's test

Example: *The study monitored how many calories the same 27 people in a random sample burned while walking outdoors in spring, summer, autumn, and winter. Based on the study data, can we say that the number of calories burnt remained the same throughout the different seasons? If not, in which seasons did it differ ($\alpha = 0.05$)?*

Description of the results: In a random sample of 27 subjects, the median number of calories burned in spring was 51 (minimum value 47; maximum value 65), in summer – 54 (minimum value 49; maximum value 67), in autumn – 55 (minimum value 46; maximum value 76), and in winter – 58 (minimum value 50; maximum value 93). Based on the study data, it can be concluded that the distributions of calorie counts for at least two seasons were not equal ($S = 17.853$; $df = 3$; $p < 0.001$). There was a statistically significant difference in the number of calories burnt between spring and winter ($p = 0.001$) and between summer and winter ($p = 0.005$).

Cochran's Q test

Example: *A random sample of 30 subjects were asked three times (before the therapy, during the therapy, and after the therapy) how they rated their overall well-being (poor/good). The aim of the study was to test the hypothesis that the probability of feeling well remained the same in all three stages. If the null hypothesis were rejected, then to identify the stages between which the probability of feeling well differed ($\alpha = 0.05$).*

Description of the results: The study data showed that before the therapy, 14 (46.7%) participants said they felt well, during the therapy, 13 (43.3%) said they felt well, and after the therapy, 24 (80.0%) said they felt well. Based on the study data, it can be concluded that the probability of feeling well before, during, and after the therapy was not the same for the same individuals ($Q = 9.652$, $df = 2$, $p = 0.008$). Pairwise comparisons revealed a statistically significant difference in the probability of feeling well during and after the therapy ($p = 0.015$) and before and after the therapy ($p = 0.032$).

Correlation analysis

Pearson's and Spearman's correlation coefficients

Example: *The study sample consisted of 100 people. Their systolic blood pressure (SBP), time spent exercising (hours per week), and age were measured. The aim was to assess how strongly SBP depended on age and time spent exercising and whether the dependence was statistically significant. Suppose that, after checking, SBP and age values in the population were found to be distributed according to a normal distribution, while the values for time spent exercising were not.*

Description of the results:

Example of a description of the results if a table of correlation coefficients is not provided:

Based on the study data, it can be stated that there was a weak statistically significant linear relationship between SBP and age among the study participants ($r = 0.47$; $p < 0.001$; 95% CI 0.31–0.60). The positive sign of the correlation coefficient indicates that the higher the age, the higher the SBP. In addition, it can be stated that there was a strong statistically significant linear relationship between the SBP of the subjects and the time they spent exercising ($r = -0.84$; $p < 0.001$; 95% CI -0.89– -0.77). The negative sign of the correlation coefficient indicates that the longer the time spent exercising, the lower the SBP.

Example of a description of the results if the correlation coefficients are presented in a table (Table 7.4.2).

Table 7.4.2. *Results of the analysis of the relationship between systolic blood pressure (SBP) and age and time spent exercising*

Relationship between the SBP and:	Corelation coefficient	p-value	95% CI
Age*	0.47	< 0.001	0.31–0.60
Time spent exercising **	-0.84	< 0.001	(-0.89)–(-0.77)

*Pearson's correlation coefficient; **Spearman's correlation coefficient

The results should be commented on in a similar way as if the table were not presented, but to avoid duplication of the information, it is not necessary to additionally indicate the correlation coefficient, p-value, and 95% confidence interval in the text, as this information is already presented in the table.

To graphically represent the relationship between two quantitative variables, a scatter diagram is drawn (see example in Figure 7.4.4).

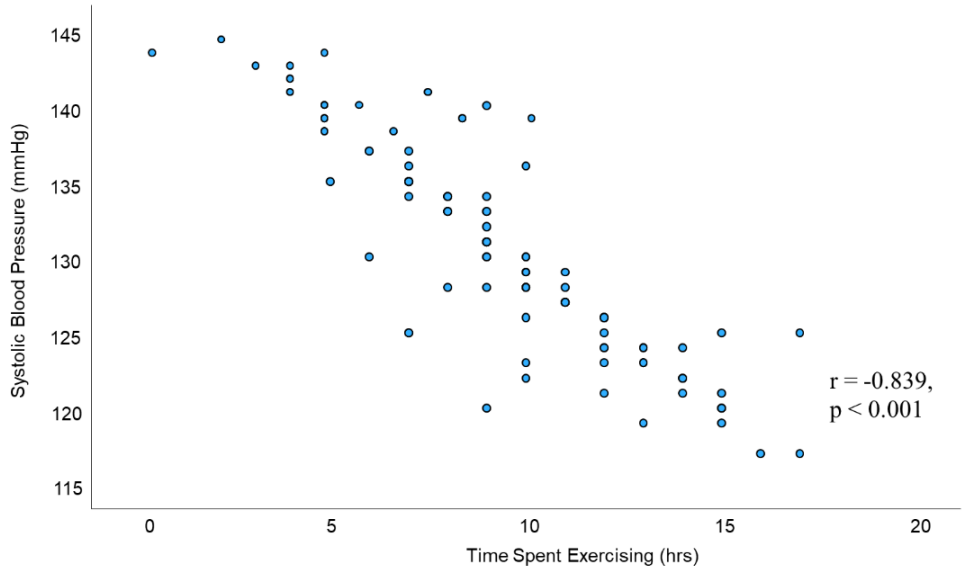


Fig. 7.4.4. *Relationship between variables: Systolic blood pressure and Time spent exercising*

Sample assessment of correlations between qualitative variables

During the analysis of the research data, we want to check whether there is a statistically significant correlation between the prevalence of allergies among the respondents (affected/not affected) and their place of residence (city/town/village).

Description of the results *(Table 7.4.3):*

Table 7.4.3. *Results of the analysis of the correlation between the prevalence of allergies and the place of residence*

Prevalence of allergies	**Place of residence**		
	City	*Town*	*Village*
Affected	33 (68.8)	15 (35.7)	14 (41.2)
Not affected	15 (31.3)	27 (64.3)	20 (58.8)

r_{Cr} = 0.288, χ^2 =11.237; df = 2; p = 0.004. Data: n (%)

Based on the study data, it can be concluded that there was a weak statistically significant correlation between the prevalence of allergies and the place of residence.

Regression analysis

Linear regression

Example: *The sample consists of 110 people. Based on their data, we want to create a regression model that would allow us to predict a person's average systolic blood pressure based on that person's age, time spent exercising, and whether he or she smokes (code 1) or does not smoke (code 0).*

Description of the results *(Table 7.4.4):*

Table 7.4.4. *Results of the linear multiple regression model for predicting the mean systolic blood pressure value*

	Coefficient B	**Coefficient B 95% CI**	**Standardised coefficient B**	**Test statistics**	**p-value**
Age	0.072	(0.015; 0.126)	0.138	2.504	0.014
Time spent exercising	-1.670	(-1.906; -1.435)	0.105	-14.048	< 0.001
Smoking	1.403	(0.069; 2.737)	-0.773	2.085	0.039
Constant	141.742	(137.125; 146.358)	–	60.878	< 0.001

Using the multiple linear regression method, a model was created with the following parameters for data suitability: coefficient of determination $R^2 = 0.735$, and the ANOVA test $F = 98.173$; $p < 0.001$. Therefore, it can be stated that this model is sufficiently well aligned with the data and the forecast will be sufficiently accurate. All three variables included in the model, *Age* ($p = 0.014$), *Time spent exercising* ($p < 0.001$), and *Smoking* ($p = 0.039$), were statistically significant factors for predicting the mean value of systolic blood pressure. The signs of the coefficients of the variables included in the model indicate that increasing age and smoking statistically significantly increased the predicted mean SBP, while one additional hour of exercise decreased it. The values of the standardised coefficients show that the fact that a person smokes (*Smoking*) had the greatest impact on predicting the mean value of systolic blood pressure.

The results of the model can also be presented in a line:

Mean SBP = 0.072 × Age – 1.670 × Time spent exercising + 1.403 (if the person smokes) + 141.742.

However, when commenting on the results obtained, the coefficients should be presented in the text with their 95% confidence intervals. For example: The results of the model show that an increase in age over the years statistically significantly increased (B = 0.072; 95% CI: 0.015–0.126) the mean SBP value.

Binary logistic regression

Example: *The researcher wants to create a binary logistic regression model that can be used to predict the likelihood of complications after illness (0 – no complications; 1 – experienced complications) based on the variables Age (years), Vitamin intake (1 – takes vitamins, 0 – does not take vitamins) and Exercise (0 – does not exercise, 1 – exercises occasionally, 2 – exercises frequently).*

Description of the results: Before describing the results of the model, it is always recommended to present the parameters of the model's suitability for the data. The constructed binary logistic regression model (Table 7.4.5), which allows predicting the probability of complications after surgery, fit the data quite well: the statistics of the Omnibus test $\chi^2 = 18.303$; df = 4; $p = 0.001$; Hosmer-

Lemeshow test χ^2 = 5.972; df = 8; p = 0.650; Nagelkerke's pseudo-R-squared 0.206. The model correctly classified 73.0% of people who did not experience complications and 59.6% of people who did experience complications. The overall percentage of correct predictions by the model was 67.3%.

Table 7.4.5. *Results of the binary logistic regression model for predicting the probability of postoperative complications*

Variables	Coefficient B	Test statistics	p-value	Odds ratio (OR)	95% confidence interval (CI)
Age	0.036	4.408	0.036	1.037	1.002–1.074
*Vitamin intake**	-1.340	9.164	0.002	0.262	0.110–0.624
*Exercise***		6.329	0.048	-	-
Does not exercise	1.212	4.995	0.025	3.360	1.161–9.728
Exercises occasionally	0.063	0.015	0.904	1.065	0.386–2.937
Constant	-1.947	3.186	0.074	0.143	-

*Does not take vitamins and **Exercises frequently – reference groups

All three variables included in the model, *Age* (p = 0.036), *Vitamin intake* (p = 0.002), and *Exercise* (p = 0.048), were significant factors in predicting the likelihood of complications. The sample data show that increasing age statistically significantly increased the odds of complications, while people who consumed vitamins had a statistically significantly lower likelihood of complications compared to those who did not. The likelihood of complications was statistically significantly higher among people who did not exercise compared to those who exercised frequently, while there was no statistically significant difference in the likelihood of complications between those who exercised occasionally and those who exercised frequently (p = 0.904).

Survival Analysis

The Kaplan-Meier Curve

Example: *During the study, 140 randomly selected people were monitored to see how long (time, hours) it took for a certain type of adverse drug reaction (event) to occur after they received treatment. They were also asked how often they smoked (never/sometimes/often). Based on the study data, can we say that people with different smoking habits have the same survival time the development of adverse drug reactions (ADR)? If there is a difference, people with which smoking habits have a different survival to ADR?*

Description of the results: The sample consisted of 140 individuals. Of these, 75 (53.6%) experienced some form of adverse reaction to the medication. The sample of non-smokers consisted of 52 individuals (37.1%), of whom 25 (48.1%) experienced an adverse reaction to the medication. The group of occasional smokers included 36 people (25.7%), of whom 17 (47.2%) experienced an

adverse reaction to the drug, and the group of frequent smokers included 52 people (37.1%), of whom 33 (63.5%) experienced an adverse reaction to the drug. The data showed that 50% of non-smokers experienced an adverse reaction to the drug within the first 16.6 hours after the injection, 50% of occasional smokers experienced an adverse reaction within 15.1 hours, and 50% of frequent smokers experienced an adverse reaction within 11.3 hours. Based on the sample data, it can be concluded that in at least two groups, the probabilities of experiencing an ADR within a certain period of time (survival functions) differed statistically significantly ($\chi 2 = 22.169$; $df = 2$; $p < 0.001$). Pairwise comparisons of the probabilities of a reaction occurring within a certain period (survival functions) showed that they differed statistically significantly when comparing frequent smokers with never smokers ($\chi 2 = 19.837$; $p < 0.001$) and occasional smokers ($\chi 2 = 5.838$; $p = 0.016$) (Figure 7.4.5).

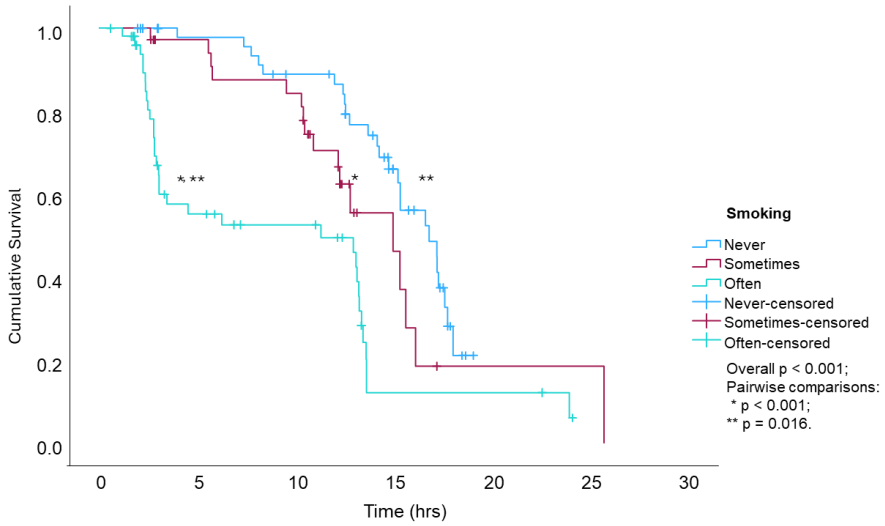


Fig. 7.4.5. *Comparison of survival rates in people with different smoking habits before the onset of adverse reactions to medication*

Cox Proportional Hazards Model

Example: *During the study, 140 randomly selected people were monitored to see how long (Time, hours) it took for a certain type of adverse drug reaction (Event) to occur after they received treatment. They were also asked how often they smoked (never/occasionally/frequently), their biological sex, and their body mass index. The aim of the analysis was to develop a model for predicting the hazard of an adverse drug reaction and to assess the influence of the variables included in the model on the prediction and the suitability of the model for the data.*

Description of the results: The study sample consisted of 140 individuals. Of these, 75 (53.6%) experienced some form of adverse reaction to the medication. A Cox regression model was developed (Table 7.4.6) to predict the hazard of experiencing an adverse drug reaction over a certain period based

on an individual's smoking habits, sex, and body mass index. The model fit the data: the Omnibus test was $\chi^2 = 36.212$, df = 4, $p < 0.001$.

Table 7.4.6. *Results of the Cox regression model for predicting the hazard of developing an adverse drug reaction over time*

Variables	Coefficient B	Test statistics	p-value	HR***	95% CI of HR
BMI	0.071	3.862	0.049	1.074	1.002–1.152
*Sex**	-0.908	12.414	< 0.001	0.403	0.243–0.668
*Smoking***	-	20.086	<0.001	-	-
Occasionally	0.632	3.478	0.062	1.882	0.968–3.656
Frequently	1.249	19.889	<0.001	3.487	2.014–6.036

*Men; **Never smokers – reference groups; ***HR – hazard ratio

All three variables included in the model, *BMI* ($p = 0.049$), *Sex* ($p < 0.001$), and *Smoking* ($p < 0.001$), were significant factors in predicting the hazard of an adverse drug reaction occurring over a given period. The sample data in the model showed that a one-unit increase in the body mass index statistically significantly increased the hazard ratio of an adverse reaction, and that the hazard ratio of an adverse reaction in women was statistically lower than in men. The hazard ratio of adverse drug reactions was statistically significantly higher in frequent smokers than in non-smokers, while the hazard ratio of adverse drug reactions in occasional smokers and non-smokers did not differ statistically significantly ($p = 0.062$).

8. QUALITATIVE RESEARCH

Qualitative research is a systematic research method that aims to gain a detailed understanding of people's experiences, attitudes, and behaviours in their natural environment. It uses methods such as interviews, observation, and group discussions to collect detailed, non-numerical information such as text, sound, and images. This method is particularly useful for investigating complex social phenomena such as beliefs, feelings, and well-being, where understanding context and subjective meaning is paramount.

Key features of qualitative research[12]:

- **Aim:** to understand the causes and meaning of the phenomenon under investigation, rather than simply to summarise the data.
- **Data collection:** information is collected in various ways, usually in a natural environment, and may be textual, visual, or audio.
- **Sample:** usually smaller, but accurate and purposefully selected.
- **Analysis:** inductive analysis is used to find internal connections and themes, and the results are interpreted in their context.
- **Results:** the conclusions are often hypothetical and only applicable to the case studied, therefore quantitative research may be conducted to confirm them.
- **Application:** often used in social sciences and market research to reveal deeper causes or to formulate new research questions.

Qualitative research is most commonly used in social sciences. Its wider application began at the end of the 20th century.

It examines how individuals or groups of individuals understand and evaluate the world around them and construct meaning based on personal experience. Qualitative research takes place in a natural environment, where the researcher is the data collector. The researcher spends a lot of time in the field, collecting detailed data, looking for internal connections, and then generalising them. Information is collected in the form of words and images and is analysed inductively in order to describe the process in vivid and persuasive language. The most important thing is the opinion of the participants (narrative, experience) when seeking to interpret the phenomenon under investigation in terms expressed by the subjects.

Qualitative research includes case studies, life histories, observational, historical, interactive, visual, and other texts (such as written, visual, and interactive materials) that describe ordinary and problematic moments and meanings in individuals' lives.

Qualitative research uses inductive analysis, where individual differences are particularly important. Qualitative research involves an interpretive and naturalistic approach to the subject being studied.

In order to investigate and identify the deeper causes of a social phenomenon or to raise questions for further research, qualitative research is sometimes used in conjunction with quantitative research. Qualitative research differs from quantitative research in that it works with a few cases and many variables rather than with a few variables and many cases. Qualitative research is more flexible than quantitative research.[13] Qualitative research is characterised by non-statistical generalisation, a small sample size, and non-probability purposive sampling.

In qualitative research, the researcher selects one or more units from the general population (a specific case, organisation, phenomenon (e.g., the case of COVID-19) and seeks to understand them comprehensively. In the case of COVID-19, the most notable change in primary healthcare institutions and the activities of family doctors was the introduction of contactless patient treatment and innovations. The changed environment, the extreme situation, and the new disease were analysed. The results of such research may be useful to other researchers interested in non-standard solutions and the study of non-standard situations. The researcher, in studying the activities of family doctors in a specific institution under COVID-19 conditions, does not aim to apply the results of the study to all primary healthcare institutions.

In the case of qualitative research, analogical generalisation is applied, which does not claim to apply the research conclusions to the entire general population. Forms of analogical generalisation are the following:[13,14]

- *Case-to-case*;
- *Communicative*;
- *Exemplary*.

Qualitative research methodology is most often based on M. Patton's (1990) methods of qualitative research sampling (Fig. 8.1). In qualitative research, it is necessary to select cases that are informative from the research perspective. In each study, the sample size and specific sample units selected for the study depend largely on the aims of the study. In qualitative research, purposive sampling is most commonly used.[13]

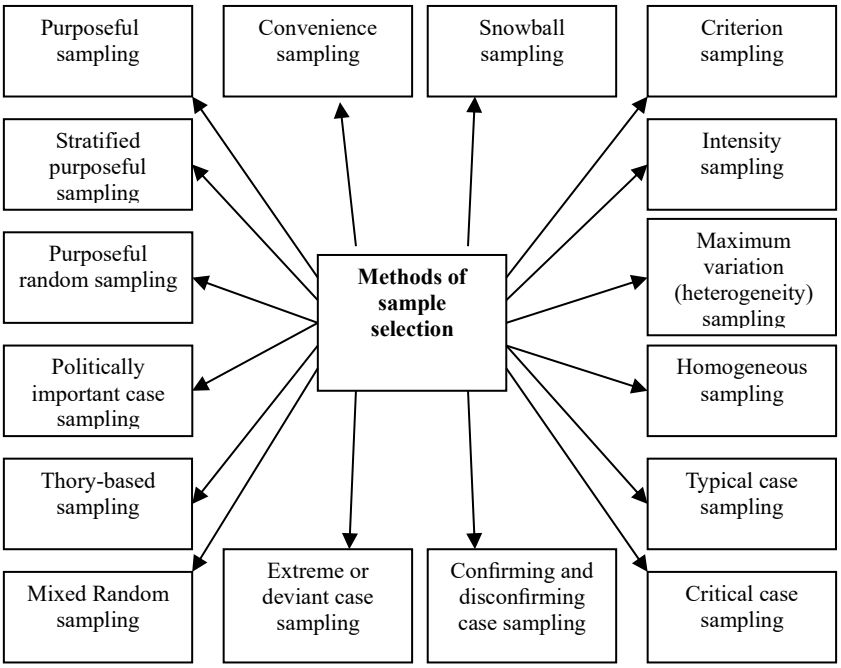


Fig. 8.1. *Targeted sampling techniques*[13]

In qualitative research, the concept of validity is related to the principles of naturalistic research (Lincoln, Guba, 1985; Bogdan, Biklen, 1992): the natural environment as the primary source of data; comprehensiveness of the research; context-boundedness; and thick description. The researcher is part of the world being studied, the "primary research instrument." The researcher seeks to understand another person's life, to comprehend his or her world, the feelings in a specific situation (i.e., the research process is as important as the research results, which are socially situated). Descriptive data are socially/culturally saturated data; the data are presented using the terms of the informants rather than those of the researchers; the data are analysed inductively, without applying predefined categories; the situation is assessed from the participants' perspectives.[13]

Methods of qualitative data collection: observation, oral histories, biographies, video material, analysis of diaries and personal documents, various informal interviews, group discussions, etc. All qualitative data collection methods can be divided into three groups, depending on the main actions performed by the researcher:

1. Data are collected through observation (observation).
2. Data are collected through questioning (interviews).
3. Data are collected from products created by people – documents (document collection).

In qualitative research, interviews are the primary method of data collection, regardless of the chosen research strategy. An essential condition for qualitative research is listening: not imposing one's own terminology and preconceived notions, but rather relying on the terms used by the informants. In

qualitative research, such interviews also involve observation: the researcher not only hears what the informant says, but also sees how he or she speaks and behaves at that moment. Methodological literature (Frechtling, Sharp, 1997; Cohen, Manion, 1994) usually distinguishes between two types of interviews: informal interviews and formal interviews. Depending on the number of informants, interviews can be: individual (one informant) dyadic (two informants) and group (three or more informants). There are methodologies that help to conduct interviews, e.g., by recommending how to ask questions, how to observe, etc. Research data is also processed according to instructions to ensure that the results are as accurate as possible. Qualitative research involves working with large volumes of text, therefore special computer programs (weft-qda, MAXQDA, etc.) can be used for data processing. This not only saves time, but also allows for deeper analysis. The results of verbal interviews are usually presented in tables (Table 8.1).

***Table 8.1**. Processed qualitative data. An example*

Categories	Subcategories	Contextual content
Students notice changes (9)	A frightening change (5)	"...some students experience stress due to the need to work with different platforms and tools..." "...students often feel anxious about technical issues that could disrupt the learning process..."
	The need to adapt to constantly changing circumstances (4)	"...I noticed that people reading books in my environment have almost disappeared, while the use of information technology and the time spent with it has increased significantly..." "...there is a need to adapt to the constantly changing information environment..."
Communication in a virtual environment (1)	Interactive IT solutions (2)	"...interactive <...> elements <...> increase interest and help to better memorise the material..."
	Augmented reality (1)	"...virtual and augmented reality can be used in laboratories, architectural simulations, or medical practice..."
	Remote communication (2)	"Digital platforms help share materials and assignments faster and make it easier to get feedback." "...you can study from anywhere in the world..."
	Data security (2)	"...insecure platforms can compromise student data..."
	Gamification (1)	"...game elements (e.g., *Quizlet* or *Kahoot*) increase interest and improve information retention..."
Requirements for improving teacher competencies (2)		"...it is necessary to invest in teacher training so that they can use the tools effectively and ensure the quality of learning..."
The need to learn (3)		"...there is a need to adapt to the constantly changing information environment..."
Generation Z is in a hurry (1)		"...they often choose quick and convenient solutions because they are accustomed to rapid access to information..."
Attitude towards studies (3)		"...I was pleasantly surprised and intrigued by the section on the aims of higher education institutions, which are not only to provide information and training, but also, as the author states, to prepare students for lifelong learning..." "...to develop <...> the ability to search for, find, critically evaluate, and use information for problem solving, decision making, continuous knowledge updating, and professional and personal development..."
Critical thinking (3)		"...the concept of critical thinking is now more important than ever before..."
Information literacy (1)		"...I would disagree that libraries play a fundamental role in developing information literacy. In my opinion, this should be done in lessons and lectures..."
Use of diagrams and models (1)		"...I had never heard of mind mapping apps, so I learned how to use them..."

9. PREPARING SCIENTIFIC PUBLICATIONS. MOST COMMON MISTAKES

9.1. Language of the final Master's thesis

The subject matter of scientific works must be presented objectively, comprehensively, accurately, correctly, and coherently. Scientific works are written in professional language, using specific concepts and precise terminology.

Scientific language is characterised by generalisation, factual accuracy, logical presentation, objectivity, conciseness, comprehensiveness, and clarity. The factual accuracy of scientific language is determined by the use of terms and unambiguous words. No broader context is needed to define the meaning of a scientific word.

The syntax of scientific language is characterised by constructions that emphasise the logical structure of the text (e.g., *first, second, on the other hand*, etc.), insertions (e.g., *that is, therefore, for example*, etc.) and compound conjunctive sentences.

Objectivity is highlighted by impersonal and passive constructions. The disadvantages of scientific style are long sentences, an abundance of nouns, and the use vague words and certain templates.

Although scientific language is characterised by a nominative style, many abstract nouns are sometimes used. This type of writing makes the language complex and difficult to understand, but it is the most important distinguishing feature of scientific language. Nevertheless, in scientific work, one should try to use as few verbal and adjectival nouns with such suffixes as *-ation, -ition,* or *-ing* as possible.

It is advisable to write the paper in the present or past tense rather than in the future tense. The present or past tense can also be used in the introduction, as the introduction is written when the entire paper has already been completed. Avoid writing in the first person in academic papers. However, in some cases (when explaining the choice of the topic or methods, or describing an experiment), the first person may be used (e.g., I chose this topic because... Therefore, I believe that these methods are the most appropriate)). The individuality of the text is determined by the richness of the language, the ability to choose the most accurate term, the variety of grammatical forms, and the structure of the sentence.

9.2. Most common mistakes

The most common mistakes made when preparing an FMT or a scientific publication are summarised in Table 9.2.1.

***Table 9.2.1**. Recommendations for correcting the most common mistakes*

Introduction: • **Novelty and significance of the work;** • **Review of previous research – identification of the problem;** • **Formulation of aim and objectives of the study.**	
Most common mistakes	**How to write correctly**
Too long Introduction	The Introduction should not exceed 10% of the total volume of the manuscript.
Consistency issues (many different topics are covered)	The text must be coherent, guiding the reader toward the aim of the study, which is always presented in the last paragraph of the introduction. Ideas are arranged in such a way that (even before the aim of the work is stated) the reader understands the relevance of the topic and can predict whether the information presented will be relevant.
The entire Introduction is one endless quotation.	Long quotations from literature reviews should be avoided. Literature should be used to emphasise the relevance of the problem, quoting only as much as necessary.
Heavy use of quotations (referencing to other authors)	Try to provide references to other studies while avoiding the names of researchers: emphasise the importance of the fact itself, not who said it. Too many quotations do not reveal anything new, but only repeat what is already known. When more than a third of the text consists of long direct quotations (sequentially copied paragraphs) and there are no comments, explanations, or interpretations by the author, this indicates a lack of critical analysis (the information has not been sufficiently processed). As a result, the text loses its argumentative balance and original contribution.
Methods: • **Research methods (type, participants, etc.);** • **Research procedures, interventions, etc.;** • **Statistical analysis;** • **Ethical issues;** • **If hypotheses are proposed, they are described in this section.**	
Most common mistakes	**How to write correctly**
The chapter on research methods is written in the present/future tense.	When scientific research turns into a manuscript, the Methods chapter is written in the present tense.
Permits for research are not provided	The approval of the Bioethics Centre for the study and the protocol number are indicated (ideally, in the first paragraph). A copy of the Bioethics Centre approval is provided in the appendices.
Research methods are presented incompletely	All research methods are described in detail. Scientific research must always be reproducible, which means that another researcher reading the methodology of this study should be able to conduct a similar study. This chapter must contain information about the selection of the subjects, their division into groups, the methods used to select the literature sources, the materials used, their doses, instruments, etc., depending on

	the nature of the scientific work. It is also advisable to avoid describing the methods in a style that resembles advertising for a particular material or device.
Statistical methods used in the work are not described or are insufficiently described.	This chapter should describe all statistical methods used in analysing the research data.
Results: • **Concise but clear presentation;** • **Great attention paid to tables and figures;** • **A combination of text, tables, and figures in order to highlight the identified trends;** • **Numbering of tables/figures;** • **Good quality of the images.**	
Most common mistakes	**How to write correctly**
A paradox – some authors describe the results too briefly, while others use too many words.	Briefly describe the most important results and conclusions, providing references to tables and graphs containing detailed data. If the data is presented in tables and/or graphs, there is no need to describe this data in detail in the paper. Information should not be duplicated.
In scientific publications, bar and line graphs are often presented incorrectly.	Bar and line charts are better replaced with tables, as they can present a wider variety of information.
The text does not contain references to tables or figures.	It is necessary to check the numbering of tables, graphs, and figures: the numbering style must be consistent throughout the work.
The title of the table or figure is not specified or is unclear and incomprehensible without contextual information.	Titles should be clear, informative, and concisely describing the purpose or content of the table/figure, drawing the reader's attention to what is to be emphasised.
The table contains too much information and is difficult to read.	There should be sufficient spacing between columns and rows, and the table should be orderly and not overloaded with information.
Inappropriate colour selection (colour blindness), poor-quality visual material	Figures and graphs must be of good resolution.
Discussion: • **Discussion is the essence of all scientific research;** • **Discussion of the results and comparison with data from other researchers;** • **Interpretation of the results;** • **Presentation of innovative interpretations.**	
Most common mistakes	**How to write correctly**
Written as if it were a literary review	The results should be compared with data from other studies, explaining the differences and similarities.
Limitations of the study are not described	Honest presentation of limitations shows that the topic has been thoroughly analysed. The "absence" of limitations may signal that the researcher did not fully understand the topic.

The Discussion does not cover all the results presented in the results chapter.	The Discussion should cover all the research results described in the Results chapter in chronological order.
Conclusions	
Most common mistakes	**How to write correctly**
The conclusions do not address all of the aims and objectives set out.	The conclusions provide a concise and clear response to the aim of the work and all of the objectives.
Additional conclusions are presented that are not part of the research plan (the set aim).	The conclusions only answer the questions formulated in the work; additional results obtained during the study are not discussed.
Title	
Most common mistakes	**How to write correctly**
Too long title	The aim is to have a title that is as short as possible but reveals the essence of the study.
Title written in the form of a question	A question as a title in a scientific paper looks unprofessional and does not correspond to scientific style.

10. DEFENCE OF THE FINAL MASTER'S THESIS

The defence of a Master's thesis is a public academic presentation during which the student presents the essence of his or her scientific work, presents the results of the research and is able to defend them with arguments. The defence takes place in front of a commission and lasts an average of 15 minutes. During this time, the student must present the aim, objectives, methodology, results, and conclusions of the work. *Microsoft PowerPoint* or another visual presentation software is used for the presentation.

10.1. Recommended structure of the presentation

The presentation should be logical, consistent, and clearly show the course of the research. The following sections are recommended for inclusion:

Title slide: it must correspond to the title page of the work and should indicate the title of the work, the author, the supervisor, the study programme, the institution, and the date of the defence.

Relevance of the topic: briefly justifies the importance of the chosen topic and its relationship to practical or theoretical problems.

Aim and objectives of the study: the aim and objectives that helped achieve the aim are clearly stated.

Research methodology: describes the subjects (their number, age, professional group, etc.), the location of the study, the methods used, and the data collection process.

Research results: present the empirical data obtained, key trends, and the most significant observations. It is important to show the links to the theoretical part of the work.

Conclusions: briefly and clearly summarise the results of the study. Conclusions must be based on facts and correspond to the objectives.

Practical recommendations: practical suggestions are provided on how the research results could be applied in professional activities or further scientific research.

10.2. Design and technical requirements for the presentation

Visual aids are very important, and therefore their use is just as crucial as the creation and planning of the defence speech. Visual aids make the verbal presentation more interesting and the information easier to understand.

When preparing a presentation, it is recommended to use the University logo and the official presentation template. When choosing slide colours, it is recommended to pay attention to the harmony

between the background, the text, and the accents. It is recommended to use neutral shades for the background of the presentation; dark blue is considered most suitable because it is less tiring for the eyes and creates a softer contrast with the text. The text should contrast clearly with the background: light text on a dark background and dark text on a light background. Accents may be brighter to highlight important elements.

The text linking images with information is also important for a good presentation. Therefore, it is necessary to choose the right font and size. It is recommended to use no more than two different fonts in one visual aid: one for the title and the other for the main text. When you want to emphasise an important idea, it is advisable to use *italics* of the same font. Recommended font sizes for visual aids: 44 + / - 4 for headings, and 32 + / - 4 for the main text. Animations should only be used in the presentation when it is necessary to clarify a statement or emphasise something.

The presentation must be discussed with the supervisor before the defence and should be saved in several formats (e.g., PPT and PDF) to avoid technical issues.

10.3. Course of the presentation

Briefly present the topic of the work, its relevance, problems, and the main aim of the study. In this section, it is necessary to explain why the chosen topic is significant and what value it has for the academic or practical field.

When presenting the aim and main objectives of the work, it is recommended to emphasise the novelty of the research, justify its relevance, and logically link this part to the theoretical context.

When presenting the methodology, it is necessary to indicate what research methods were used, how the sample was selected, and what data collection and analysis methods were used. In this section, it is important to reveal that the research was planned consistently, was scientifically sound, and was in line with the aims and objectives set.

The results of the study and their analysis are the most important parts of the defence. The results obtained must be presented in a summarised form, explaining what insights they provide. It is recommended to use diagrams, tables, graphs, or other visual elements.

The conclusions should be concise, clearly linked to the objectives of the work, and logically correlated with the results of the study.

Recommendations should be oriented towards the practical application of research results or their use in further scientific research.

Questions and discussion

After presenting the work, the student hears the supervisor's feedback and review and responds concisely and reasonably to questions posed by the committee members. The student's ability to defend his or her position and to substantiate the content of the work is thus assessed.

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APPENDICES

APPENDIX 1

LITHUANIAN UNIVERSITY OF HEALTH SCIENCES
MEDICAL ACADEMY
FACULTY OF MEDICINE
Clinical / theoretical department of _____

NAME SURNAME

TITLE

Final Master's Thesis of the Medicine Study Programme

Supervisor: Name Surname

KAUNAS, 2025