Course outline of HLTH 460: Epidemiology and Critical Appraisal

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Keywords course, syllabus

1 About

The goal of this course of study is to teach Epidemiology and critial appraisal of literature relevant to environmental health. In this course, students will learn about analysis of cause and effect in epidemiology, measurements in epidemiology (measurements of disease distribution and measurements of effects), and different epidemiological study designs. The emphasis of this course will be on understanding environmental health topics. Thus the course will cover a range of environmental exposure and related health outcomes including pollution of air, water, sanitation, hygiene, infectious diseases, and food borne illnesses and outbreaks. Students will also learn about chronic disease epidemiology.

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3 Learning outcomes and graduate attributes

4 Class Sessions and Topic Description

5 Assessments

6 Assessment 1: Appraisal of an Environmental Epidemiological Study (50%, 50 marks, Due Date for 2025, 31/3 soft deadline, 7/4 hard deadline, after 7/4 Learn will auto submit and you will be graded on what Learn submits)

This assessment maps to all the learning outcomes for this course (L1: Identification of relevant research,

Instructions:

- Each of you are assigned an Environmental Epidemiological study on a relevant topic of your interest.

Table 1: Course learning outcomes, graduate attributes and kaupapa

Course Learning Outcome	Related Graduate attributes and Kaupapa
The student will demonstrate critical thinking ability to appraise one or more epidemiological studies (LO1)	A graduate of the UC must be innovative and enterprising and must have analytical, critical thinking skills and problem solving ability in diverse contexts
The student will demonstrate ability to solve Environmental Health problems using knowledge of Epidemiology (LO2)	
The student will be able to use statistical programming language R to conduct Epidemiological Data analysis (LO3)	A graduate will demonstrate digital literacy
The student will be able to interpret line listings and design questionnaires using spreadsheets and draw directed acyclic graphs on computers to solve environmental epidemiological problems (LO4)	The UC graduate must demonstrate bicultural competence and confidence: (Application of bicultural competence and confidence in a chosen discipline and career)
The student must demonstrate awareness of specific environmental issues and health issues related to Māori and connect the two to address environmental health problems (LO5):	

Write the following (you will find the instructions also on Learn)

1. Summarise the main study question, what did the authors study and why? (3)

2. Itemise the key assumptions of the authors of this study (3)

3. Summarise the features of the target population of the study and (3)

4. write a short note on the population characteristics based on your own research about the issue (3)

5. Describe the exposure they studied (3)

6. Describe the comparison groups covered in the study (3)

7. Describe the outcome they studied (3)

8. Write steps of the methods as described by the authors in the study (3)

9. write a short note on whether the methods seem appropriate for the goals of this study and what alternative approaches could be considered and why (3)

10. List at least two points that are potential shortcoming of the research paper based on your understanding of the research method (4)

11. Using your knowledge about cause and effect, draw a causal diagram with dagitty and upload the diagram (2)

12. Describe the diagram (4)

13. Describe the relevant results from the study (3)

14. Then identify from the results (a) one result that was expected and (b) one result that was not expected or surprising (4)

15. Comment why these were expected and why were these unexpected or surprising (4)

Session	Date, time	Classroom	Topic
1	24/2, 12-2:50	Jack Erskine 239	Introduction to the course and Causal Inference in Epidemiology
2	26/2/, 9-11	Jack Erskine 242	Causal Inference in Epideiology
3	10/3, 12-2:50	Jack Erskine 239	Measures of Health or Disease State: Prevalence, Incidence, Hazard, Standardised Mortality and Morbidity calculations, Data Physicalisation and visualisation
4	12/3, 9-11	Jack Erskine 242	Measures of Effect: Ratios, Odds, Odds Ratios, Hazard Ratios, Risk Ratios, Population Attributable Risk and related measures
5	24/3, 12-2:50	Jack Erskine 239 will be booked anyway	No Teaching, students can have a self study session among themselves and finalise the first assessment
A1 Due	31/3, 5:00 PM	Online via Learn	First assessment due (this is a soft deadline, hard deadline one week later 7/4/2025, quiz self submits on 7th April)
6	26/3, 9-11	Jack Erskine 242	Study Design considerations in Environmental Epidemiology: hypotheses, sample size, power
7	28/4, 12-2:50	Jack Erskine 239	Ecological Studies and how to analyse air pollution studies using ecological study design
8	30/4, 9-11	Jack Erskine 242	Principles of Case Control Study Designs, case study of Arsenic Toxicity in West Bengal, India
9	12/5, 12-2:50	Jack Erskine 239	Principles of Cohort Study Design, theory of prospective and retrospective cohort studies in Environmental Epidemiology
10	14/5, 9-11	Jack Erskine 242	Principles of Cross-sectional studies in environmental epidemiology
11	26/5, 12-2:50	Jack Erskine 239	How to critically appraise Case control and cohort studies, use of tools and what to look for writing Environmental Health Research proposals
12	28/5, 9-11	Jack Erskine 242	Final Class, reflection and valediction
A2 Due	31/5, 5PM	Online via Learn	This is a soft deadline,

16. If you were to replicate this study in the context of a New Zealand population, discuss how you would go about it (3)

- Submit the assessment on Learn:
    - On Learn, locate the Assessments tab or Assessments Section
    - Click or Select "Assessment 1"
    - Follow the instructions to submit your assessment on or before the due date
    - You have to complete this assessment on Learn

- Rules about citations
    - Base your answers on facts and reasonings from facts
    - Do not write your opinions
    - Use simple English (write with nouns and verbs, do not use adjectives and adverbs)
    - Facts must be cited, find a reference appropriate for the fact that you state
    - No lower or upper limit of citations
    - Citations are indicated by numbers within parentheses e.g., (1), (2) and so on
    - Copy paste Vancouver style references generated by an online or your favourite reference manager in the textbox titled "References or Works cited" (no marks allocated for the referencing section as this is not graded)

- AI policy
    - If you use AI, then
        * You need to state what AI tools you have used
        * What "prompt engineering" you have used
        * Itemise each AI tool and the relevant prompt engineering you used
        * Mention the date when you used it
        * You can use AI but you need to declare that you have used AI and
            · you need to write all your answers in your own words,
            · do not use AI to write answers to the questions themselves,
            · you can use AI to conduct research for the assignment but
            · do not use AI to summarise content of the research paper.
    - If you have not used AI, then state in the box provided that you have not used AI
    - Marks will not be deducted if you use AI, and you will not get extra credit if you have not used AI.

7   Write an environmental epidemiology related research proposal (50% weight, 50 marks, individual assignment, due date: 31/5 soft deadline, and 7/6 hard deadline)

This assessment also covers ALL learning outcomes, as the students will have to demonstrate their skills of online search of information, critical appraisal of literature, problem solving ability, group work, and competency of understanding the context of Māori and Pasifka experiences.

Instructions:

- Select one of the 10 research question (only one research question per student, once a student selects a research question, this will not be available to another student)

8 List of research questions for Second Assessment

(To be distributed by mid April)

- Then based on the research question you have identified and your understanding of the course contents as covered in this paper, answer the following questions (each question is worth 5 marks)

1. Describe the problem you will study using Environmental epidemiological concepts. In answering this question, write a short fact and data driven account of what is the main issue

2. Write your research question, theory, and the null and alternative hypotheses associated with the research question

3. Describe your study design (what environmental epidemiological study design will you use and why)

4. Describe your target population and the population you will study. For example, if your research is about studying the risk of heart disease from second hand smoking among adults aged 65 years and above, then write about this population and describe the rationale for selecting this population

5. Describe the exposure variable you want to study. For example, if your research is about studying the risk of exposure to second hand smoking and development of heart disease, then describe what is meant by second hand smoking, what is the epidemiology of second hand smoking in the target population and other details that will be useful for the reader to learn about the exposure. How will you find your exposed population?

6. Describe the comparison variable you want to study. For example, if your research is about second hand smoking and heart disease, then describe what will be your comparison group and who will be included in the comparison group. How will you find your comparison group

7. Describe the outcome variable you will study in your research. What is the outcome variable? How will the outcome variable be measured?

8. Describe a step by step process of how you will conduct your study. In this, describe how you will collect data from your sample and target population, and how you will conduct data analysis

9. Describe how the M'aori and Pacific Islander population benefit from your research

10. Describe how your proposed research will have beneficial effects and what are the possible risks of this research?

- Submit the assessment on Learn:
    - On Learn, locate the Assessments tab or Assessments Section
    - Click or Select "Assessment 2"
    - Follow the instructions to submit your assessment on or before the due date
    - You have to complete this assessment on Learn

- Rules about citations
    - Base your answers on facts and reasonings from facts
    - Do not write your opinions that are not backed by facts and reasonings.
    - Use simple English (write with nouns and verbs, do not use adjectives and adverbs)
    - Facts must be cited, find a reference appropriate for the fact that you state
    - No lower or upper limit of citations
    - Citations are indicated by numbers within parentheses e.g., (1), (2) and so on

- Copy paste Vancouver style references generated by an online or your favourite reference manager in the textbox titled "References or Works cited" (no marks allocated for the referencing section as this is not graded)

- AI policy

  - If you use AI, then
    * You need to state what AI tools you have used
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    * Mention the date when you used it
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      · you need to write all your answers in your own words,
      · do not use AI to write answers to the questions themselves,
      · you can use AI to conduct research for the assignment but
      · do not use AI to summarise content of the research paper.
  - If you have not used AI, then state in the box provided that you have not used AI
  - Marks will not be deducted if you use AI, and you will not get extra credit if you have not used AI.

9   Grading Rubric and grading principles and suggested practic

In this course, for your assessments, you will need to answer individual short questions that are connected to a larger theme of either a critical appraisal of a body of work OR writing a research proposal. The idea of grading is to be as objective as possible. All tests are take home tests, and in the form of Learn Quiz that has no time limits. Students will only need to write the assessment on Learn so that all students can access and use the same standardised testing software. Secondly, your grade will be determined by summing up scores of individual questions. Hence, the grading rubric presented here represents a general grading band based rubric for individual questions. Hence, while you may score low at some questions, you can also score high at some other questions making up for your overall grade. Doing not so well at a particular question will not affect your overall grade.

The following will not be assessed:

- a student's English language skills

- Grammatical accuracy and spelling errors

- Number of citations will not determine the grade but their appropriateness is important

- As text boxes have word limits, therefore in each text box, target only up to 250 words.

- You can fewer words but Learn may cut you off at 250 words, so plan accordingly but whether you can limit your answers to specific word count will not be considered for grading

10   Online course reader

The following is a list of primary studies, papers, and course notes and tutorial will be made available. This is a work in progress. There is no prescribed textbook for this course. You can click on the link to download the article or you can download the reader directly from the link below

Session 1: Introduction

Introduction to the course

How to correctly use AI to write a research proposal using smart prompts

Prompt Engineering Playbook

Grade Boundary	Expected
A	The student has provided a factually correct answer to each question. The student has provided appropriate citations, and made use of tables and explanatory diagrams to illustrate the points discussed in the question. The answers are fact based and reasonings that follow facts presented. Each fact is supported by appropriate citations. The student has submitted the assessment by soft deadline
B	The student has provided mostly factually correct answers to the questions, and not all facts are coupled with reasoning or there are occasional faulty reasoning presented. Overall the student has established that the essential learning points are demonstrated. Although the student has made use of citations, the student has not consistently made use of tables and figures where figures and tables would be more appropriate, the student has not used them. The student has submitted by hard deadline
C	Student has provided some factually correct answers but not consistently. Student also demonstrates lack of understanding of environmental epidemiology. Some citations, figures, and tables used. Student has submitted by hard deadline OR the assessment has auto submitted without the student's intervention. Citations are not provided consistently.

https://www.developer.tech.gov.sg/products/collections/data-science-and-artificial-intelligence/playbooks/prompt-engineering-playbook-beta-v3.pdf

Environmental Epidemiology

Hernandez JBR, Kim PY. Epidemiology Morbidity And Mortality. [Updated 2022 Oct 3]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK547668/

HILL AB. THE ENVIRONMENT AND DISEASE: ASSOCIATION OR CAUSATION? Proc R Soc Med. 1965 May;58(5):295-300. doi: 10.1177/003591576505800503. PMID: 14283879; PMCID: PMC1898525.

Rothman KJ, Greenland S. Causation and causal inference in epidemiology. Am J Public Health. 2005;95 Suppl 1:S144-50. doi: 10.2105/AJPH.2004.059204. PMID: 16030331.

Session 2: Causality

Greenland S, Pearl J, Robins JM. Causal diagrams for epidemiologic research. Epidemiology. 1999 Jan;10(1):37-48. PMID: 9888278.

Dagitty software https://www.dagitty.net/dags.html

Session 3 (Measurements)

Basic Epidemiological Methods

https://minnstate.pressbooks.pub/hgantunez/chapter/chapter-3-basic-epidemiological-methods-and-calculations/

Ives, C., Pan, H., Edwards, S.W. *et al.* Linking complex disease and exposure data—insights from an environmental and occupational health study. *J Expo Sci Environ Epidemiol* **33**, 12–16 (2023). Ives et al. (2022)

Session 4 (Measurements of effect)

Levine B. What does the population attributable fraction mean? Prev Chronic Dis. 2007 Jan;4(1):A14. Epub 2006 Dec 15. PMID: 17173722; PMCID: PMC1832135.

Lin, CK., Chen, ST. Estimation and application of population attributable fraction in ecological studies. *Environ Health* **18**, 52 (2019). Lin and Chen (2019)

Szumilas M. Explaining odds ratios. J Can Acad Child Adolesc Psychiatry. 2010 Aug;19(3):227-9. Erratum in: J Can Acad Child Adolesc Psychiatry. 2015 Winter;24(1):58. PMID: 20842279; PMCID: PMC2938757.

Section 6 (Theory, study designs, hypothesis testing)

Greenhalgh T. How to read a paper. Statistics for the non-statistician. I: Different types of data need different statistical tests. BMJ (Clinical Research ed.). 1997 Aug;315(7104):364-366. DOI: 10.1136/bmj.315.7104.364. PMID: 9270463; PMCID: PMC2127256.

Greenhalgh T. How to read a paper. Statistics for the non-statistician. II: "Significant" relations and their pitfalls. BMJ. 1997 Aug 16;315(7105):422-5. doi: 10.1136/bmj.315.7105.422. PMID: 9277611; PMCID: PMC2127270.

Morgenstern, H., & Thomas, D. (1993). Principles of Study Design in Environmental Epidemiology. *Environmental Health Perspectives*, *101*, 23–38. Morgenstern and Thomas (1993)

Section 7: Ecological Study Designs

Dockery, D. W., Pope, C. A., Xu, X., Spengler, J. D., Ware, J. H., Fay, M. E., ... & Speizer, F. E. (1993). An association between air pollution and mortality in six US cities. *New England journal of medicine*, *329*(24), 1753-1759.

Morgenstern, H. (1995). Ecologic studies in epidemiology: concepts, principles, and methods. *Annual review of public health*, *16*(1), 61-81.

Section 8: Case control study designs

Yanagawa, T. (1979). Designing Case-Control Studies. *Environmental Health Perspectives*, *32*, 143–156. Yanagawa (1979)

Mitra, S. R., Mazumder, D. G., Basu, A., Block, G., Haque, R., Samanta, S., ... & Smith, A. H. (2004). Nutritional factors and susceptibility to arsenic-caused skin lesions in West Bengal, India. *Environmental health perspectives*, *112*(10), 1104-1109.

Section 9: Cohort Study

Capili B, Anastasi JK. Cohort Studies. Am J Nurs. 2021 Dec 1;121(12):45-48. doi: 10.1097/01.NAJ.0000803196.49507.08. PMID: 34792504; PMCID: PMC9536647.

de Munter, J.S., Hu, F.B., Spiegelman, D., Franz, M.M., & van Dam, R.M. (2007). Whole Grain, Bran, and Germ Intake and Risk of Type 2 Diabetes: A Prospective Cohort Study and Systematic Review. *PLoS Medicine, 4*.

Manolio, T. A., Bailey-Wilson, J. E., & Collins, F. S. (2006). Genes, environment and the value of prospective cohort studies. *Nature Reviews. Genetics*, *7*(10), 812–820. Manolio et al. (2006)

Section 10: Cross Sectional Studies

Wang, X., & Cheng, Z. (2020). Cross-Sectional Studies: Strengths, Weaknesses, and Recommendations. *Chest, 158 1S*, S65-S71 .

Guha, D., Haque, R., & Smith, A. (1998). Arsenic levels in drinking water and the prevalence of skin lesions in West Bengal, India. *International journal of epidemiology, 27 5*, 871-7 .

Section 11: Critical Appraisal of Environmental Epidemiological Studies

Joana Briggs Institute Critical Appraisal Tools

https://jbi.global/critical-appraisal-tools

Strobe Statements and checklists

https://www.strobe-statement.org

APA research proposal format

https://www.apa.org/pubs/books/supplemental/Designing-Proposing-Research-Project/research_proposal.pdf

List of software tools and websites used for this course:

- Rstudio: All enrolled students will be provided an account on Rstudio free of charge. Students are encouraged to get their own free accounts, for more information, see https://rstudio.cloud

- Juliahub: For data analysis tasks, https://juliahub.com

- Dagitty: This tool will be used to teach students how to use directed acyclic graphs; for more information, see http://dagitty.net/

- Microsoft Teams: This is provided free of charge to all enrolled students at the University of Canterbury; we will use Teams space for keeping files and sharing group work

- Learn: the course materials, lectures, and videos will be stored or linked on Learn

- github: All students will need to create accounts on https://github.com where data sets and files will be kept

References

C. Ives, H. Pan, S. W. Edwards, M. Nelms, H. Covert, M. Y. Lichtveld, E. W. Harville, J. K. Wickliffe, W. Zijlmans, and C. M. Hamilton. Linking complex disease and exposure data—insights from an environmental and occupational health study. *Journal of Exposure Science & Environmental Epidemiology*, 33(1): 12–16, 3 2022. ISSN 1559-064X. doi:10.1038/s41370-022-00428-7. URL http://dx.doi.org/10.1038/s41370-022-00428-7.

C.-K. Lin and S.-T. Chen. Estimation and application of population attributable fraction in ecological studies. *Environmental Health*, 18(1), 6 2019. ISSN 1476-069X. doi:10.1186/s12940-019-0492-4. URL http://dx.doi.org/10.1186/s12940-019-0492-4.

T. A. Manolio, J. E. Bailey-Wilson, and F. S. Collins. Genes, environment and the value of prospective cohort studies. *Nature Reviews Genetics*, 7(10):812–820, 10 2006. ISSN 1471-0064. doi:10.1038/nrg1919. URL http://dx.doi.org/10.1038/nrg1919.

H. Morgenstern and D. Thomas. Principles of Study Design in Environmental Epidemiology. *Environmental Health Perspectives*, 101:23, 12 1993. ISSN 0091-6765. doi:10.2307/3431657. URL http://dx.doi.org/10.2307/3431657.

T. Yanagawa. Designing case-control studies. *Environmental Health Perspectives*, 32:143–156, 10 1979. ISSN 1552-9924. doi:10.1289/ehp.7932143. URL http://dx.doi.org/10.1289/ehp.7932143.