Tufts University, Friedman School of Nutrition Science and Policy

NUTR 204 – Principles of Epidemiology

Fall 2018

Class Meetings: Tuesdays 9AM-12PM, consult the syllabus for classroom location

Instructors:

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Office hours: By appointment

Semester hour units: 3 SHUs

Course Description:

This course covers basic epidemiologic methods and concepts, including study design, calculation and interpretation of basic measures of disease frequency and measures of association, sources of inaccuracy in experimental and observational studies, causal inference, and an introduction to the statistical evaluation and interpretation of epidemiological data. Students will discuss past and recent publications in order to apply their understanding of abstract concepts and specific quantitative methods to the interpretation and critique of published work.

Course Objectives:

The overall purpose of this course is to introduce students to the principles of epidemiology and basic epidemiologic methods and concepts. The specific objectives are to:

1. Describe the principles of epidemiology and its major objectives, and explain the scope of epidemiology as a discipline.
2. Discuss the basic concepts in infectious disease epidemiology and the importance and challenges of conducting epidemiologic investigation of chronic diseases.
3. Calculate, interpret, and compare measures of disease frequency and measures of association.
4. Differentiate among various epidemiologic study designs, identify steps to conduct each study design, explain their strengths and limitations, and identify research questions that would be appropriate for each study design.
5. Discuss the concepts of measurement error, bias, and confounding; explain their consequences; and outline strategies to reduce sources of error and to prevent or control for confounding.
6. Discuss the principles of screening and evaluate screening in terms of sensitivity and specificity.
7. Explain causal inference in epidemiologic studies and use causal criteria to assess whether an association is causal.

Texts or Materials:
**Required Textbook:**

**Optional Textbook:**

Course Website:
Lecture slides and other materials are available on the class website at https://canvas.tufts.edu. There will generally be no handouts distributed in class (except exams, last-minute additions, and materials not easily posted to the website). If you have difficulty printing these materials, notify the instructor and/or TA.

Academic Conduct:
Each student is responsible for upholding the highest standards of academic integrity, as specified in the Friedman School’s Policies and Procedures manual (http://www.nutrition.tufts.edu/student/documents/policies-procedures) and Tufts University policies (http://students.tufts.edu/student-affairs/student-life-policies/academic-integrity-policy). It is the responsibility of each student to understand and comply with these standards, as violations will be sanctioned by penalties ranging from failure on an assignment and the course to dismissal from the school.

Classroom Conduct:
**Course Format**
The primary format of this course consists of weekly sessions that include a 2-hour lecture given by the instructor and a 1-hour lab. The lab section is designed to foster interactive
discussion on important concepts and methods illustrated in the lecture. Lab handouts that contain examples and questions will be used to facilitate the discussion. At the same time, students are encouraged to bring questions that they would like to discuss in the lab section.

**PowerPoint Presentations**

PowerPoint presentations are intended to facilitate notetaking, not to serve as an alternative textbook or as an alternative to coming to class. If a student misses a lecture, he/she is encouraged to obtain a copy of notes from someone who is a good note-taker. Students are strongly encouraged to share their notes among each other as they work through understanding the lecture objectives and to form study groups to collaborate on homework assignments.

**Class Readings and Classroom Participation**

Lectures are designed to supplement, not supplant, the readings. Assigned readings for each week are expected to be completed before the lecture. In general, for class readings and exercises, you should expect to spend at least two hours out of class for each hour in class. Class discussion is strongly encouraged. Please try not to feel intimidated by the size of the class or the nature of the material. The only bad question is the one not asked. If something puzzles you, there is an excellent chance that the same thing puzzles several of your classmates. We cannot answer any questions you do not ask.

**Assessment and Grading:**

The overall grade for the course will be based on the following:

1. Class Attendance and Lab Participation (10%)
2. Homeworks (15%)
3. Mid-term Exam (20%)
4. Final Exam (20%)
5. Group Project (15%)
6. Final Paper (20%)

A passing grade in the course is B- or better. Course grades will be based on the following: (subject to revision during the course):

- A > 94%
- A- 90 - <94%
- B+ 87 - <90%
- B 84 - <87%
- B- 80 - <84%
Assignments and Submission Instructions:

Class Attendance and Lab Participation
Class attendance and lab participation will be noted and used to make a final determination of your grade (10%). Lab sessions are designed for students to practice the concepts and methods introduced in lectures. In each one-hour lab session, students will be asked to work on lab exercises either individually or in groups and actively participate in discussions. The instructor will lead the lab sessions and engage students in practices and discussion.

Homework
There will be three homework assignments to be completed during the course (15% of final grade). These homework assignments will include computational exercises (e.g., calculations of measures of disease frequency and association), multiple-choice questions, or short answer questions. These assignments are designed to provide practical application of the concepts presented in lectures and labs. Homework assignments are due prior to class on dates indicated below and should be submitted online using Canvas.

Mid-term and Final Exams
Competency in meeting the objectives of the course will be assessed by a mid-term and final examination (each worth 20% of the final grade). Calculators are permitted during the examination, but books, notes, and other memory aids are not.

Group Project
During the semester, students will work in small groups on a study design project where each group will be asked to design an appropriate study to evaluate a given research question. Each group will briefly present their studies in class. The group project and presentation will account for 15% of your final grade.

Final Paper
At the end of the semester, students will be asked to hand in a final paper (20% of the final grade). This involves a critique of an assigned journal article and will be an independent project (no collaboration allowed). The article will be posted on the course website along with guidelines for the critique. A maximum of 5 pages (typed, 12pt font and double spaced) will be allowed.

Assignments received after their deadline will not be accepted or graded unless an extension is approved in advance. Students who are unable to complete an assignment on time for any reason should notify the instructor by email or phone call prior to the deadline, with a brief explanation for why the extension is needed.

Accommodation of Disabilities:
Tufts University is committed to providing equal access and support to all students through the provision of reasonable accommodations so that each student may access their curricula and achieve their personal and academic potential. If you have a disability that requires reasonable
accommodations please contact the Friedman School Assistant Dean of Student Affairs at 617-636-6719 to make arrangements for determination of appropriate accommodations. Please be aware that accommodations cannot be enacted retroactively, making timeliness a critical aspect for their provision.

We believe that the diversity of student experiences and perspectives is essential to the deepening of knowledge in this course. We consider it part of our responsibility as instructors to address the learning needs of all of the students in this course. We will present materials that are respectful of diversity: race, color, ethnicity, gender, age, disability, religious beliefs, political preference, sexual orientation, gender identity, socioeconomic status, citizenship, language, or national origin among other personal characteristics.
# Course Schedule (Lectures and Labs)*:

<table>
<thead>
<tr>
<th>Week #</th>
<th>Room</th>
<th>Lecture</th>
<th>Lab</th>
<th>Instructor</th>
<th>Assignments Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wk1</td>
<td>Jaharis Behrakis A Rm 130</td>
<td>Introduction to Epidemiology and Concepts in Infectious Disease Epidemiology</td>
<td>Outbreak Investigation</td>
<td>Choumenkovitch</td>
<td></td>
</tr>
<tr>
<td>Wk2</td>
<td>Sackler 812</td>
<td>Concepts in Chronic Disease Epidemiology</td>
<td>Epidemiologic Investigation of Chronic Diseases</td>
<td>Singh</td>
<td></td>
</tr>
<tr>
<td>Wk3</td>
<td>Jaharis Behrakis A Rm 130</td>
<td>Measures of Disease Frequency</td>
<td>Measures of Disease Frequency</td>
<td>Singh</td>
<td></td>
</tr>
<tr>
<td>Wk4</td>
<td>Jaharis Behrakis A Rm 130</td>
<td>Measures of Association</td>
<td>Measures of Association</td>
<td>Singh</td>
<td></td>
</tr>
<tr>
<td>Wk5</td>
<td>Dental Rachel's A Rm 1414</td>
<td>Cohort Studies</td>
<td>Cohort Study</td>
<td>Choumenkovitch</td>
<td></td>
</tr>
<tr>
<td>10/9/18</td>
<td>No class</td>
<td>Substitute MONDAY class Schedule on Tuesday</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wk6</td>
<td>Sackler 216A</td>
<td>Case-control Studies</td>
<td>Case-control Study</td>
<td>Choumenkovitch</td>
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<tr>
<td>Wk7</td>
<td>Dental Rachel's A Rm 1414</td>
<td>Experimental Studies</td>
<td>Randomized Controlled Trial</td>
<td>Singh</td>
<td></td>
</tr>
<tr>
<td>Wk8</td>
<td>Sackler 316</td>
<td>Cross-sectional and Ecologic Studies</td>
<td>Study Designs</td>
<td>Choumenkovitch</td>
<td></td>
</tr>
<tr>
<td>11/6/18</td>
<td>Dental Rachel's A Rm 1414</td>
<td>In-class Mid-term Exam</td>
<td>No lab</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wk10</td>
<td>Dental Rachel's A Rm 1414</td>
<td>Bias</td>
<td>Bias</td>
<td>Choumenkovitch</td>
<td></td>
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<tr>
<td>Wk11</td>
<td>Dental Rachel's A Rm 1414</td>
<td>Confounding</td>
<td>Confounding</td>
<td>Choumenkovitch</td>
<td></td>
</tr>
<tr>
<td>Wk12</td>
<td>Dental Rachel's A Rm 1414</td>
<td>Screening</td>
<td>Screening</td>
<td>Sawicki</td>
<td>Homework due</td>
</tr>
<tr>
<td>Wk13</td>
<td>Dental Rachel's A Rm 1414</td>
<td>Causal Inference</td>
<td>Group Presentations on Study Designs</td>
<td>Singh</td>
<td></td>
</tr>
<tr>
<td>12/11/18</td>
<td>No class</td>
<td>(reading period)</td>
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<tr>
<td>12/18/18</td>
<td>Dental Rachel's A Rm 1414</td>
<td>In-Class Final Exam</td>
<td>No lab</td>
<td></td>
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* This schedule is subject to modification at the instructors’ discretion.
Course Topics, Learning Objectives and Assignments
(This schedule is subject to modification at the instructors’ discretion. Additional readings may be assigned and posted on Canvas.)

Week 1: Introduction to Epidemiology and Concepts in Infectious Disease Epidemiology

Learning Objectives

Upon completion of this week, you will be able to:

- Identify the principles and main objectives of epidemiology.
- Explain basic terms related to the occurrence of disease in a population.
- Discriminate between descriptive epidemiology and analytic epidemiology.
- Explain the meanings of disease frequency, disease distribution, and disease determinants in epidemiology.
- Describe the main concepts in infectious disease epidemiology (mode of transmission, iceberg phenomenon, carrier status, incubation period, epidemic curve, herd immunity).
- Demonstrate how to conduct outbreak investigations (steps in an outbreak investigation).

Readings

- Gordis, Ch. 1 and Ch. 2
- Dworkin MS. How an outbreak is investigated (Ch. 1). In: Outbreak Investigations around the World. Dworkin MS (Editor). Sudbury, MA: Jones and Bartlett Publishers. 2010.

Lab Exercise:

Lab 1: Outbreak Investigation

Homework assignment:

None
Week 2: Epidemiology of Chronic Diseases

Learning Objectives

Upon completion of this week, you will be able to:

- Identify possible contributors to the changing pattern of disease occurrence over the last century, from primarily infectious to chronic diseases.
- Define and compare the different stages of prevention of disease.
- Discuss the challenges of epidemiologic research of chronic diseases, including induction time and latent period.
- Describe the concept of multifactorial causal models for chronic diseases and the complexities of measuring common modifiable risk factors such as diet, physical activity, and obesity.

Readings:


Lab Exercise:

Lab 2: Epidemiologic Investigation of Chronic Diseases

Homework assignment:

None
Week 3: Measures of Disease Frequency

Learning Objectives

Upon completion of this week, you will be able to:

- Describe the important role of epidemiology in disease surveillance.
- Compare different measures of disease frequency, including incidence rate, incidence proportion, prevalence, attack rate, and mortality measures (e.g., case-fatality rate).
- Illustrate why incidence data are necessary for measuring risk.
- Discuss the interrelationship between incidence and prevalence.

Readings:

- Gordis, Ch. 3 and Ch. 4

Lab Exercise:

Lab 3: Measures of Disease Frequency

Homework assignment:

None

Final paper and group project will be assigned
Week 4: Measures of Association

Learning Objectives

Upon completion of this week, you will be able to:

- Explain how to investigate the relationship between a potential exposure and a disease.
- Describe the concepts of rate/risk ratio (i.e., relative risk) and odds ratio and be able to calculate and interpret them.
- Describe the concept of risk/rate difference and attributable risk/rate difference and be able to calculate and interpret them.
- Compare the different measures of association and explain the difference between absolute and relative measures.

Readings:

- Gordis, Ch. 11 and Ch. 12
- Review the text and work through the practice examples in:
  - CDC Principles of Epidemiology in Public Health Practice: An Introduction to Applied Epidemiology and Biostatistics, Section 5: Measures of Association

Lab Exercise for this week:

Lab 4: Measures of Association

Homework assignment:

Homework assignment 1 (due next week): measures of disease frequency and association
Week 5: Cohort Studies

Learning Objectives

Upon completion of this week, you will be able to:

• Describe the design and timing of a cohort study, and the different types of cohort studies.
• Explain the steps in conducting a cohort study.
• Calculate and interpret risk (or rate) differences/risk (or rate) ratios in cohort studies.
• Identify strengths and weaknesses of cohort studies and discuss potential issues in their design.

Readings

• Gordis, Ch. 9
• TBD.

Lab Exercise:
Lab 5: Design and Interpretation of Cohort Studies

Homework assignment:
None
Week 6: Case-control Studies

Learning Objectives

Upon completion of this week, you will be able to:
  • Describe the design features of case-control and nested case-control studies.
  • Explain the appropriate way to select cases and controls in a case-control study.
  • Calculate and interpret an odds ratio in a case-control study, and explain when the odds ratio is a good estimate of the relative risk.
  • Identify strengths and weaknesses of case-control studies.
  • Discuss potential selection biases, information biases, and the use of matching in case-control studies.

Readings:
  • Gordis, Ch. 10 and 13

Lab Exercise:
  Lab 6: Design and Interpretation of Case-Control Studies

Homework assignment:
  None
Week 7: Experimental Studies

Learning Objectives

• Explain the fundamental difference between randomized trials and observational studies.
• Describe the concepts of randomization, placebo effect, and blinding.
• Calculate measures of association from randomized trials.
• Describe the concept of intention-to-treat analysis in randomized trials.
• Explain important issues in conducting experimental studies such as ethics and non-compliance.

Readings:

• Gordis, Ch. 7 and 8

Lab Exercise:

Lab 7: Design and Interpretation of Randomized Controlled Trials

Homework assignment:

Homework assignment 2 (due next week): study designs.
Week 8: Cross-sectional and Ecologic Studies

Learning Objectives:

- Describe the design features of cross-sectional and ecologic studies.
- Calculate and interpret measures of association in cross-sectional and ecologic studies.
- Explain the concept of ecologic fallacy.
- Describe the advantages and disadvantages of cross-sectional and ecologic study designs.
- Calculate direct and indirect age adjustment.

Readings:
- Gordis, Ch. 10

Lab Exercise:
Lab 8: Comparison between Observational and Experimental Studies

Homework assignment:
None
Week 9: In-Class Midterm

Week 10: Bias

Learning Objectives

Upon completion of this week, you will be able to:

- Explain and give examples of possible biases in epidemiologic studies, including selection bias and the various types of observation (i.e., information) bias.
- Describe ways to minimize bias in epidemiologic studies.
- Explain the concept of random error and be able to differentiate it from systematic error.

Readings:

- Gordis, Ch. 15
- Morabia A. Case-control studies in clinical research: mechanism and prevention of selection bias. Preventive Medicine; 1997; 26: 674-677
- Smith AF; Baxter SD; Hardin JW; Guinn CH; Royer JA. Relation of Children's Dietary reporting accuracy to cognitive ability. American Journal of Epidemiology 2011; 173(1):103-9.

Lab Exercise:

Lab 9: Types and Consequences of Bias

Homework assignment:

None
Week 11: Confounding

Learning Objectives

Upon completion of this week, you will be able to:

- Define confounding and be able to explain the conditions a variable must fulfill to be considered a confounder in an epidemiologic study.
- Discuss possible ways to control for confounding in the design and/or analysis of a study.
- Explain how these methods for controlling for confounding may be used through an example.

Readings:

- Gordis, Ch. 15

Lab Exercise:

Lab 10: Evaluation of Confounding in Epidemiologic Studies

Homework assignment:

Homework assignment 3 (due next week): bias and confounding
Week 12: Screening

Learning Objectives:

Upon completion of this week, you will be able to:

- Describe the purpose and benefits of screening in populations and identify conditions that are appropriate for screening.
- Describe different types of screening (sequential/simultaneous).
- Assess the validity and reliability of screening (sensitivity, specificity, positive predictive value), and diagnostic tests.
- Explain the concepts of lead time bias, volunteer bias and length-based sampling and discuss how they affect the evaluation of screening.

Readings:

- Gordis, Ch. 5 and Ch. 18
- TBD

Lab Exercise:

Lab 11: Screening

Homework assignment:

None
Week 13: Causal Inference and Student Presentations on Study Design

Learning Objectives:

Upon completion of this week, you will be able to:
• Define the concept of a cause of disease in epidemiologic studies and describe characteristics of a cause.
• Explain necessary, sufficient, and component causes in the context of a causal relationship.
• Explain how causal inference is central to the role of epidemiology and discuss guidelines for judging whether an association is causal.
• Describe and critique Bradford Hill’s causal criteria.

Readings:
• Gordis, Ch. 14
• Rothman KJ, Greenland S. Causation and Causal Inference in Epidemiology. *AJPH* 2005; 95: S144-S150

Lab Exercise:
None

Homework assignment:
None

Group Project Presentation:
Students will present (within groups) different study designs given a specific research question.

Week 14: Final Paper Due (12/11/2018) (no class)

Week 15: In-Class Final Exam (12/18/2018)