Epidemiology for Environmental Scientists and Engineers

ENVR 601-001 Spring 2015 (3 credits)

Tues, Th from 11-12:15, McGavran Greenberg 2304

Course Description

Epidemiology is the study of patterns of diseases and their risk factors in the population. As a cornerstone of public health research, epidemiologic concepts and methods are used to understand and protect the population's health. In addition, epidemiologic research can help inform evidence-based medicine by identifying risk factors for disease, and determining optimal treatment approaches to clinical practice and for preventive medicine. Environmental epidemiology is a sub-field which focuses on the health effects of environmental exposures in the population. Epidemiologic research studies generally include the following steps: 1) design the study, 2) collect data, 3) statistically analyze data, 4) document results, and 5) submit results for peer review and publication. These results often contribute to scientific knowledge and also can be used to help federal and state agencies set regulations and health policy agendas.

Public health problems are multi-disciplinary and epidemiologists collaborate with a number of other scientific disciplines such as environmental sciences and engineering (to more accurately assess environmental exposures), biology and toxicology (to better understand disease processes), biostatistics (for sophisticated statistical techniques to analyze data), geographic information systems (to map disease and exposure patterns) and social science disciplines (to better understand proximate and distal risk factors such as the effect of socioeconomic factors.) We will use real life research examples from environmental epidemiology to illustrate basic epidemiologic principles.

Course Objectives

This course is intended to provide an introduction to basic epidemiologic concepts within a framework of environmental health. Students will learn and practice key concepts of epidemiology while applying these to environmental issues in soil, air, and water. We will link these concepts with environmental science research and illustrate how they are used to address public health problems.

We will focus on the following learning objectives:

1. Explain the population perspective, key sources of public health data; describe the magnitude, population distribution, and time trends of public health problems locally, nationally, and globally.
2. Describe and evaluate disease variation by person, place, and time.
3. Discuss, apply, and interpret basic epidemiologic concepts and measures of disease occurrence in populations: incidence, prevalence, risk ratios, rate ratios, odds ratios, risk and rate differences;
4. Understand the relative strengths and limitations of different epidemiologic study designs (e.g., cohort, case-control, cross-sectional, ecologic and experimental studies) for studying associations between risk factors and/or exposures in populations and rates of disease occurrence or death;
5. Identify the major sources of potential error in epidemiologic studies;
6. Comprehend basic ethical and legal principles in human subjects research pertaining to the collection, maintenance, use and dissemination of epidemiologic data and results in different cultures.
7. Evaluate epidemiologic evidence by applying criteria for causal inference to information about an association between a population exposure and health outcome;

Throughout the course, we will use the field of aflatoxin research (aflatoxin exposures in human populations and epidemiologic strategies used to identify biomarkers of exposure to understand exposure-disease links, and establish molecular mechanisms of disease) to demonstrate basic epidemiologic concepts.

Students will work in small group settings to practice applying and integrating epidemiologic concepts.

Course Instructors

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Course Resources

Kensler et al. 2010: Aflatoxin: a 50 Year Odyssey of Mechanistic and Translational Toxicology.

Essentials of Epidemiology in Public Health, 3rd Edition. Ann Aschengrau and George R. Seage III

Assignments and Grading

Your grade in the module will be determined as a weighted average of your scores (after each is converted to a 0-100% scale) for the following assignments:

Assignments and Grading		Point Value	Due Date
Quizzes	Individual	10%	Approximately weekly
Topic Selection Presentations	Team Presentation/ Individual grade	15%	March 18, March 20
Study Design Presentations	Team Presentation/ Individual grade	15%	
Epidemiologic Critique	Team Presentation/ Individual grade	20%	April 20, Apr 22
Individual Data Set Analysis	Individual	10%	TBD
Final Exam	Individual	20 % total	TBD and April 29
Class Participation	Individual	10%	All semester
Total		100%	

Assignment Descriptions

Quizzes (10%)

Students will be given a quiz approximately every week.

Topic Selection Presentations (15%)

The class will be divided into teams and student teams will present on a current environmental health contaminant/exposure or "event" of each team's choice (such as fracking, Gulf Oil Spill, Fukushima nuclear reactor spill etc.), using epidemiologic concepts (measures of disease occurrence to describe the occurrence of the exposure, and of the health outcome in the population.

We want you to design an epidemiologic study based in a real geographic location in the world. Define your location. Define the exposure. Define the disease or outcomes you are studying.

Use literature to support (provide at least 2 sources for the each of the following):

1) Justify anticipated measures of exposure based on the literature

2) Justify the outcome selection
3) Justify the exposure-disease relationship

Each team should put together a ppt slide presentation with every student selecting which slides they will present. Individual students names should noted on the slides they present and an accompanying 1 page document provided after the presentation from each student on the content of the slides they present.

Study design presentations (15%)

You will propose a study design for evaluating a key public health question related to the exposure/"event and potential health effect". Propose either a cohort or case control study design, and justify the choice.) Topics will need instructor approval.

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Data Set Analysis (10%)

Students will be given a data set and asked to perform epidemiologic analysis using free software.

Team Epidemiologic Publication Critique (20%)

With your team you will prepare a presentation critiquing an epidemiologic publication. We will assign each team one article from a list of published environmental epidemiologic studies. These studies will cover three different "media"/routes of environmental exposure: air, soil, and water. A sample list of studies within each media category is below. Please use these guidelines to guide you in critiquing the publication.

1. What is the research question?
2. What is the epidemiologic study design?
3. How do the authors measure the exposure (s) of interest?
4. How do the authors measure health outcome(s)?
5. Do the authors address confounding and/or effect modification?
6. What are potential sources of random and non-random error?
7. What are the measures of association used and how do you interpret them?
8. Do the researchers comply with ethical standards for human subjects research?
9. Does this study meet any of the criteria used to establish causality and if so, how?

Example topics and published papers are listed below.

Air: Clark ML, Peel JL, Burch JB, Nelson TL, Robinson MM, Conway S, Bachand AM, Reynolds SJ. Impact of improved cookstoves on indoor air pollution and adverse health effects among Honduran women. Int J Environ Health Res. 2009 Oct;19(5):357-68.

Dockery DW, Pope CA III, Xu X, Spengler JD, Ware JH, Fay ME, Ferris BG Jr, Speizer FE. An association between air pollution and mortality in six U.S. cities. N Engl J Med 329:1753-1759 (1993).

Soil: Bertrand KA, Spiegelman D, Aster JC, Altshul LM, Korrick SA, Rodig SJ, Zhang SM, Kurth T, Laden F. Plasma organochlorine levels and risk of non-Hodgkin lymphoma in a cohort of men. Epidemiology. 2010 Mar;21(2):172-80.

Needleman HL, Riess JA, Tobin Mj, Biesecker GE, Greenhouse JB, Bone Lead Levels and Delinquent Behavior. 1996 JAMA 275:363-369.

Water: Huq A, Yunus M, Sohel SS, Bhuiya A, Emch M, Luby SP, Russek-Cohen E, Nair GB, Sack RB, Colwell RR. Simple sari cloth filtration of water is sustainable and continues to protect villagers from cholera in Matlab, Bangladesh. MBio. 2010 May 18;1(1). pii: e00034-10.

Liaw J, Marshall G, Yuan Y, Ferreccio C, Steinmaus C, Smith AH. Increased Childhood Liver Cancer Mortality and Arsenic in Drinking Water in Northern Chile. *Cancer Epidemiol Biomarkers Prev.* 17(8):1982-87, 2008

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Final Exam (20%)

Students will be given a final exam covering the material described in the learning objectives. Topics may include measures of disease occurrence, study design, measures of occurrence, sources of error, and causal inference

Class Participation (10%)

Participation in class discussions and assignments will be worth 10% of your grade. Classes where you will need to prepare beforehand for discussion of specific material have been asterisked. We are looking for student engagement with the topics and concepts.

Optional: CITI training-on-line IRB training module. (Extra credit, 1 point added to final grade. Only for students who have not completed CITI training before start of course)

The Collaborative Institutional Training Initiative (CITI) is a web-based training package on issues relating to human subjects research. The CITI web site is maintained by the University of Miami, with content developed by a national consortium. CITI contains modules on topics like informed consent, vulnerable populations, ethical principles and IRB regulations. Each module has a short quiz at the end to assess understanding. Over 1300 institutions are using CITI for their mandatory training.

Honor System

As part of the UNC Honor Code, Carolina students pledge to maintain ideals of academic honesty, personal integrity, and responsible citizenship. These ideals are embodied in the Honor Code set forth in the Instrument of Student Judicial government, with the support of students, faculty, and staff. When a student applies to Carolina, he/she undertakes a commitment to the principles embodied in the Honor Code. The University endeavors to instill in each student a love of learning, a commitment to fair and honorable conduct, and respect for the safety and welfare of others. It also strives to protect the community from those who, for whatever reason, do not embody these values in their conduct, and to protect the integrity of the University and its property for the benefit of all. It is our expectation that all students in the class will uphold the UNC Honor System.

Course Evaluations

The School uses an on-line evaluation system to assess the quality of instruction and learning of the courses offered. The system is open for a two week period before the end of classes. An email will notify you that the system is open and a link to access the form. This evaluation

system is anonymous. The instructors will only see the aggregate data with any comments at the end of the course after grades are turned in. It is your responsibility as a student to complete the evaluations. You will be sent multiple emails from the School until it is completed.

We value your feedback on the course. We will conduct in-class evaluations. We will ask you for your (anonymous) feedback about specific class sessions, assignments, guest lecturers, and instructors.

Class Etiquette

Please put cell phone on vibrate (acceptable if you are expecting important call) or turn it OFF (preferable). In case of an emergency call, leave class and return. We ask you not to text in class. When possible, please try to utilize designated course time (such as office hours and class time) for questions and concerns rather than last minute email questions.

Grading scale
90-100 A, H
80-89 B, P
70-79 C, P
60-69 D, L
<59 F, ??