NUTR 319: Intermediate Epidemiology

Spring 2019

TIME and Location: Fridays 9am-12pm @ SK514

Note: Time Change: Class meets on Wednesday 9am-12pm for Week 5 (Feb.13) @ SK604

Location Change: Class meets @ SK604 on Jan.18, Jan.25, Mar.8, and Apr.19.

FACULTY:
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TEACHING ASSISTANT
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Office Hour: By appointment

PREREQUISITES: NUTR 204, NUTR 209, and NUTR 309 or equivalents, or concurrently taking NUTR 309 or equivalents

COURSE CREDIT: 1 Credit Hour

COURSE GOALS:

Intermediate Epidemiology exposes students to a variety of key concepts and methods when carrying out epidemiologic studies and teaches students applied skills in analyzing epidemiologic data and interpreting study findings appropriately.

This course includes a 2-hour lecture session followed by a 1-hour lab session. The lecture session will present epidemiologic methods and concepts beyond the Principles of Epidemiology, and review relevant statistical methods and their applications in epidemiologic studies. The lab session will prepare students with practical skills in conducting and analyzing epidemiologic studies using SAS. The lab session will be taught in a computer lab equipped with SAS.

After completing the course, students should be expected to demonstrate mastery in the following areas:

1. Study design
2. Measures of disease occurrence
3. Measures of association
4. Precision and validity
5. Confounding
6. Mediation
7. Effect measure modification
8. Bias
9. Causal inference
10. Communicating scientific results

Students should also be expected to acquire the following data analysis skills:

1. To perform descriptive analysis, produce 2 × 2 table, and calculate odds ratio (OR) and relative risk (RR);
2. To evaluate dose-response relationship, select between continuous and categorical variables, and determine cut-points for categorical variables;
3. To estimate sample size and statistical power, and perform sensitivity analysis in power calculation;
4. To assess Kappa as a reliability measure, and evaluate the consequence of misclassification;
5. To determine whether a variable fulfills the criteria for a confounder, and control confounding through stratification and adjustment;
6. To examine effect modification, and understand the difference in the evaluation of confounding, mediation and interaction;
7. Perform linear regression and logistic regression, and evaluate confounding and effect modification in regression models;
8. Perform conditional logistic regression in matched studies and polytomous logistic regression for polytomous outcomes;
10. Perform Cox proportional hazard and Poisson regression in cohort studies

TEXTBOOKS:
Recommended:

Additional readings will be assigned. These readings will be available on reserve in the library and, if available in electronic format, on the course web site.

COURSE MATERIAL:
Lecture notes, lab exercises, homework and data sets used for lab and homework exercises will be posted on the class website at Canvas. Students are expected to print and bring lecture notes to each lecture, print and bring lab exercises and download and bring data sets to each lab session.

HOMEWORK:
Each week students will be asked to perform certain steps of analysis on topics that are covered in the lecture and lab sessions using the datasets provided. These homework exercises will be graded and you will receive credit for completed exercise (3 points for each completed homework; 1.5 points for each partially completed homework; and 0 point for late homework). Students can consult Dr. Zhang and/or the Teaching Assistant regarding problems you face with these analyses. All homework assignments must be typed and submitted online at the Canvas website by Friday 9 AM (before class).

COURSE GRADE:
Course grade is based on the following:
- 30% Homework (3 pts each completed homework, 1.5 pt each partially completed homework, 0pt for late homework or not handed in)
- 10% Lab and class participation
- 20% Mid-term exam
- 40% Take-home final
Week-by-week Course Learning Objectives

Week 1
Lecture 1: Causality in Epidemiology and Study Design Strategies
Learning Objectives of Lecture 1:
◼ To review five important concepts in epidemiologic studies including study design, confounding, bias, effect modification and causal inference

Lab 1: Data Cleaning, Editing and Summarization using SAS
Learning Objectives of Lab 1:
□ To review basic SAS procedures for data cleaning and editing
□ To perform descriptive analysis

Homework Distributed: Homework 1: Descriptive analysis
Homework Due: None
Reading Assignment: Szklo & Nieto Epidemiology beyond the Basics. Chapter 1, and Chapter 10 Section 10.2, pp.376-392

Week 2
Lecture 2: Precision and Validity
Learning Objectives of Lecture 2:
◼ To understand which factors determine power and sample size
◼ To understand how selection bias occurs and how it affects measures of association
◼ To understand the consequence of differential and non-differential misclassification

Lab 2: Sample size, power, and misclassification
Learning Objectives of Lab 2:
□ To estimate power and sample size for epidemiologic studies using SAS
□ To evaluate the consequence of misclassification

Homework Distributed: Homework 2: Sample size and power, measurement errors
Homework Due: Homework 1
Reading Assignment:
(1) Szklo & Nieto Epidemiology beyond the Basics. Chapter 4

Week 3
Lecture 3: Measures of Disease Occurrence and Association
Learning Objectives of Lecture 3:
◼ To understand the relation among different measures of disease occurrence (cumulative incidence, incidence rate, incidence density, prevalence and odds)
◼ To understand the relation among different measures of association (risk ratio, attributable risk, odds ratio and rate ratio and risk/rate difference)

Lab 3: Estimating Measures of Association from Two-by-two Tables
Learning Objectives of Lab 3:
□ To produce measures of association (risk ratio and odds ratio) using two-by-two tables
□ To investigate further the relationship among different measures of association
□ To learn when and how to perform ANOVA and chi-square analysis using SAS
**Homework Distributed:** None  
**Homework Due:** Homework 2  
**Reading Assignment:** Szklo & Nieto Epidemiology beyond the Basics. Chapters 2 and 3

### Week 4  
**Lecture 4: Confounding**

**Learning Objectives of Lecture 4:**
- To understand criteria to evaluate confounding
- To learn ways to control for confounding using stratification
- To understand the difference between confounding and mediation

**Lab 4: Evaluation of confounding in stratified analysis, difference between confounding and mediation**

**Learning Objectives of Lab 4:**
- To determine whether a potential confounder fulfills the criteria for being a confounder
- To evaluate confounding in a stratified analysis and produce weighted summary (M-H)
- To understand the difference between confounding and mediation

**Homework Distributed:** Homework 3: Confounding  
**Homework Due:** None  
**Reading Assignment:**  
1. Szklo & Nieto Epidemiology beyond the Basics. Chapter 5  

### Week 5  
**Lecture 5: Heterogeneity of Effects: Effect Modification/Interaction**

**Learning Objectives of Lecture 5:**
- To learn how to evaluate interaction in stratified analysis on additive and multiplicative scales
- To understand the difference between interaction on an additive scale and interaction on a multiplicative scale
- To understand interaction fallacy
- To understand the difference among confounding, mediation and effect modification

**Lab 5: Evaluation of effect modification/interaction in stratified analysis**

**Learning Objectives of Lab 5:**
- To evaluate additive and multiplicative interaction in stratified analysis using SAS
- To explore interaction fallacy
- To understand the difference in the evaluation of confounding, mediation and effect modification

**Homework Distributed:** Homework 4: Effect modification/Interaction  
**Homework Due:** Homework 3  
**Reading Assignment:**  
1. Szklo & Nieto Epidemiology beyond the Basics. Chapter 6  

### Week 6  
**Lecture 6: More on Confounding, Mediation and Effect Modification**

**Learning Objectives of Lecture 6:**
- To know the difference in the causes and consequences of confounding, mediation and effect modification and how to handle them appropriately in statistical analysis

No Lab.
Homework Due: Homework 4
*Midterm study questions distributed

Week 7
Mid-term

Week 8
Lecture 7: Stratification and Regression Modeling
Learning Objectives of Lecture 7:
◼ To understand the difference between stratification and regression modeling
◼ To learn different forms of regression modeling in epidemiologic studies, their assumptions and when to use them

Lab 6: Linear Regression
Learning Objectives of Lab 6:
☐ To learn basic SAS procedures for simple and multiple linear regression
☐ To evaluate confounding and effect modification/interaction in linear regression
☐ To evaluate linearity assumptions and modeling of non-linear relations with linear models

Homework Distributed: Homework 5: Linear regression and linearity assumption
Homework Due: None
Reading Assignment: Szklo & Nieto Epidemiology beyond the Basics Chapter 7, pp.227-258 and pp.274-279

Week 9
Lecture 8: Case-control Studies and Data Analysis in Case-control Studies I
Learning Objectives of Lecture 8:
◼ To understand how different types of control sampling relate to the measures of association estimated in case-control studies
◼ To understand the difference between the nested case-control design and the case-cohort design and the advantages and disadvantages of these designs
◼ To understand the basic procedures for logistic regression modeling

Lab 7: Logistic Regression in Case-control Studies
Learning Objectives of Lab 7:
◼ To perform logistic regression analyzing data collected from case-control studies
◼ To assess confounding and interaction in logistic regression models

Homework Distributed: Homework 6: Logistic regression modeling in case-control studies
Homework Due: Homework 5
Reading Assignment: Szklo & Nieto Epidemiology beyond the Basics Chapter 7, Section 7.4.3., pp.258-265
Optional reading: Hosmer & Lemeshow 2000 Applied Logistic Regression (Chapter 1) – library reserve

Week 10
Lecture 9: Case-control Studies and Data Analysis in Case-control Studies II
Learning Objectives:
◼ To learn the principles of choosing between a categorical or continuous variable for exposure in case-control studies
◼ To learn when to apply and how to use polytomous/multinomial logistic regression for polytomous outcomes in case-control studies

Lab 8: Dose-response relationship and polytomous logistic regression
Learning Objectives of Lab 8:
☐ To evaluate dose-response relationship in logistic regression
To perform polytomous logistic regression
To understand the difference among linear regression, logistic regression and polytomous logistic regression

Homework Distributed: Homework 7: Dose-response relationship and polytomous logistic regression
Homework Due: Homework 6
Optional reading: Rothman, Greenland & Lash, Modern Epidemiology, Section on Expansion of Logistic Models, pp.413-415– library reserve

Week 11
Lecture 10: Matching
Learning Objectives of Lecture 10:
- To understand the advantages and disadvantages of matching
- To understand the differences between matching in a cohort study and matching in a case-control study

Lab 9: Conditional logistic regression in matched case-control studies
Learning Objectives of Lab 9:
- To learn to conduct matched data analysis

Homework Distributed: Homework 8: Conditional logistic regression in matched case-control studies
Homework Due: Homework 7
Reading Assignment: Rothman, Greenland & Lash, Modern Epidemiology Chapter 11

Week 12
Lecture 11: Cohort studies and Data Analysis in Cohort Studies I
Learning Objectives of Lecture 11:
- To learn steps to conduct cohort studies and understand the difference between open cohort and closed cohort studies
- To understand how to estimate measures of associations in cohort studies
- To understand the fundamentals of survival analyses

Lab 10: Life-table and Kaplan-Meier Methods
Learning Objectives of Lab 10
- To learn basic SAS procedures for life-table and Kaplan-Meier methods in cohort studies

Homework Distributed: Homework 9: Life-table and Kaplan-Meier methods
Homework Due: Homework 8
Reading Assignment: Szklo & Nieto Epidemiology beyond the Basics. Chapter 2, pp. 50-57

Week 13
Lecture 12: Cohort Studies and Data Analysis in Cohort Studies II
Learning Objectives of Lecture 12:
- To understand the difference between non-parametric, semi-parametric and parametric approaches to survival analysis in cohort studies
- To understand the fundamentals of Cox Proportional Hazard Modeling
- To learn how to apply and when to use Poisson regression in cohort studies

Lab 11: Cox Proportional Hazard Regression and Poisson Regression
Learning Objectives of Lab 11:
- To perform Cox Proportional Hazard Model in cohort studies
- To examine the assumption of proportional hazard
- To perform Poisson regression in cohort studies

Homework Distributed: Homework 10: Cox proportional hazard model and Poisson regression
Homework Due: Homework 9
Reading Assignment: Szklo & Nieto Epidemiology beyond the Basics. Chapter 7, Sections 7.4.4 and 7.4.5, pp.265-270
Optional reading: Hosmer & Lemeshow 2000 Applied Survival Analysis (Chapter 1-4) – library reserve
*Final study questions distributed

Week 14
Lecture 13: Communicating Epidemiologic Findings and Final Review
Reading Assignment: Szklo & Nieto Epidemiology beyond the Basics. Chapter 9
Homework Due: Homework 10
*Take-home Final distributed

Week 15-Week 16
Take-home Final

Final Due on May 10, 2019 @9am
# Intermediate Epidemiology

## Course Outline

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<tr>
<th>Week #</th>
<th>Date &amp; Location</th>
<th>Lecture Topic</th>
<th>Lab Topic</th>
<th>Homework Due</th>
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<td>Week 1</td>
<td>1/18/19 Sackler 604</td>
<td>Lecture 1: Causality in Epidemiology and Study Design Strategies</td>
<td>Lab 1: Data Cleaning, Editing and Summarization</td>
<td>None</td>
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<tr>
<td>Week 2</td>
<td>1/25/19 Sackler 604</td>
<td>Lecture 2: Precision and Validity</td>
<td>Lab 2: Sample size, Power and Misclassification</td>
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<td>Week 3</td>
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<td>Lecture 3: Measures of Disease Occurrence and Association</td>
<td>Lab 3: Estimating Measures of Association from Two-by-two Table</td>
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<td>Lecture 4: Confounding</td>
<td>Lab 4: Evaluation of Confounding in Stratified Analysis</td>
<td>None</td>
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<td>Week 6</td>
<td>2/22/19 Sackler 514</td>
<td>Lecture 6: More on Confounding, Mediation and Effect Modification</td>
<td>No Lab</td>
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<td>Week 7</td>
<td>3/1/19 Sackler 514</td>
<td>Mid-term</td>
<td>No lab</td>
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<td>Week 8</td>
<td>3/8/19 Sackler 604</td>
<td>Lecture 7: Stratification and Regression Modeling</td>
<td>Lab 6: Linear Regression</td>
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<td>Lecture 8: Case-control Studies and Data Analysis in Case-control Studies I</td>
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<td><strong>3/29/19 Sackler 514</strong></td>
<td>Lecture 9: Case-control Studies and Data Analysis in Case-control Studies II</td>
<td>Lab 8: Dose-response Relationship and Polytomous Logistic Regression</td>
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<td>Lecture 10: Matching</td>
<td>Lab 9: Matched Data Analysis (Student Presentations #1)</td>
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<td>Week 12</td>
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<td>Lecture 11: Cohort Studies and Data Analysis in Cohort Studies I</td>
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<td>4/19/19 Sackler 604</td>
<td>Lecture 12: Cohort Studies and Data Analysis in Cohort Studies II</td>
<td>Lab 11: Cox Proportional Hazard Regression and Poisson Regression (Final study guide distributed)</td>
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<td>4/26/19 Sackler 514</td>
<td>Lecture 13: Communicating Epidemiologic Findings and Final Review</td>
<td>No Lab (Student Presentations #2) (Final exam distributed)</td>
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<td>No Class – Study/Reading Day</td>
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