

Contents

	About the Author	v
	Preface	vii
SECTION I	Concepts and Methods in Environmental Epidemiology	1
CHAPTER 1	Introduction to Environmental Epidemiology	3
CHAPTER 2	Basic Elements of Research, Exposure, and Outcome Assessment	27
CHAPTER 3	Monitoring Environmental Health	45
CHAPTER 4	Epidemiologic Study Designs	65
CHAPTER 5	Statistical Modeling and Inference	93
CHAPTER 6	Causal Inference	141
SECTION II	Environmental Epidemiology According to Person, Place, and Time	157
CHAPTER 7	Disease Clusters	159
CHAPTER 8	Mapping and Geographic Information Systems	187
CHAPTER 9	Time Series	201
SECTION III	Applications of Environmental Epidemiology	223
CHAPTER 10	Indoor and Ambient Air Quality and Health	225
CHAPTER 11	Soil and Food Contaminants and Health	259

CHAPTER 12	Water and Health	283
CHAPTER 13	Radiation and Health	305
CHAPTER 14	Climate Change and Health	325
APPENDIX I	Measures and Data Sources for Environmental Public Health Indicators	373
APPENDIX II	Potential Sources of Data and Information for Environmental Public Health Indicators	395
APPENDIX III	Selected Statistical Techniques and Tests	407
APPENDIX IV	Exposure History Questionnaire	417
APPENDIX V	Answers to Odd-Numbered Chapter Questions	423
	Glossary	439
	Index	00

About the Author

Ray M. Merrill, Ph.D., M.P.H., is a professor of biostatistics and epidemiology at Brigham Young University. He has taught biostatistics and epidemiology classes in the Department of Health Science since coming to BYU in 1998. His graduate training includes an M.S. in managerial economics from BYU, a Ph.D. in applied statistics from Arizona State University, and an M.P.H. in quantitative methods from Harvard University. In 1995, he became a Cancer Prevention Fellow at the National Cancer Institute, where he worked with leading researchers in the area of cancer epidemiology. Since 1999, he has also held an adjunct faculty position in the Department of Family and Preventive Medicine at the University of Utah. In 2001, he spent a sabbatical working in the Unit of Epidemiology for Cancer Prevention at the International Agency for Research on Cancer in Lyon, France. He is the author of *Introduction to Epidemiology*, Fourth Edition, and more than 150 professional publications in epidemiology and public health journals.

Preface

Environmental epidemiologists study the frequency and pattern of disease and health-related events and attempt to explain the environmental factors that influence these conditions. The study of why and how environmental factors affect peoples' health is the essence of environmental epidemiology. Environmental epidemiology emphasizes the notion that health is largely influenced by environmental factors, and that by identifying these factors and the modes of their transmission, the public's health can be better protected.

Originally, environmental epidemiology focused on biological agents (pathogens) and factors such as water supply and sanitation, sewage disposal, housing conditions, and food handling. Regulations and monitoring efforts to improve water, food, and housing quality and sewage treatment and disposal have greatly reduced the burden of diseases associated with biological agents. More recently, environmental epidemiology has expanded its focus by studying the health effects of physical and chemical agents such as radiation, lead, mercury, volatile organic compounds, and pesticides. There has also been some emphasis on studying the health effects of psychosocial factors like family, neighborhood, community, and social groups. Some environmental epidemiologic studies have examined the frequency and patterns of disease and injury in populations struck by natural disasters like flooding, mudslides, fires, earthquakes, and volcanoes. Essentially, the environment studied in environmental epidemiologic studies includes biological, physical, and chemical agents; social settings and factors affecting human contact with these agents; and social environments.

The purpose of this book is to present basic concepts and research methods used in environmental epidemiology and the application of environmental epidemiology to influencing human health and well-being. The first section (chapters 1–6)

covers basic concepts and methods used in environmental epidemiology; the second section (chapters 7–9) covers approaches for describing disease by person, place, and time; and the third section (chapters 10–14) involves applications of environmental epidemiology.

In Chapter 1, environmental epidemiology is defined and discussed, a “systems approach” to assessing environmental health problems is presented, and ways are identified that environmental epidemiology contributes to public health.

In Chapter 2, the research process is presented, from developing a statement of the research problem to identifying appropriate variables, data, and hypotheses, in the context of environmental epidemiology. Methods for assessing exposure and outcome variables are presented.

In Chapter 3, selected types and purposes of environmental monitoring programs are presented, along with indicators commonly used in monitoring programs and some alternative approaches to monitoring in situations where public health indicators are not readily available. Suggested measures of selected environmental health indicators along with potential data sources are presented in Appendices I and II.

In Chapter 4, study designs and factors to consider when selecting a study design are presented. Issues related to internal and external validity are also covered.

In Chapter 5, statistical inference and reliability are discussed, along with a presentation of the statistical models and tests that correspond with the study designs presented in the previous chapter. The Statistical Analysis System (SAS) software programming language is introduced for performing selected analyses. SAS procedure codes and output interpretation are further developed in Appendix III.

In Chapter 6, the important role of causal inference, along with criteria commonly used in causal inference, is presented in the context of environmental epidemiology.

In Chapter 7, concepts and methods of disease clusters are presented, along with the four-stage process for cluster investigation recommended by the Centers for Disease Control and Prevention. The public health role of responding to cluster investigations is discussed, statistical challenges commonly associated with cluster investigations are described, and some alternative approaches for assessment are given for the case where the cluster occurs before the causal hypothesis.

In Chapter 8, mapping and geographic information systems for assessing the relationship between disease clusters and environmental contaminants are presented, with examples and application.

In Chapter 9, the focus is on organizing counts or rates of health-related states or events by time. Time–trend analysis is presented as a useful means for identifying disease outbreaks, for determining incubation or latency periods, and for generating hypotheses about causal relationships.

In Chapter 10, common forms of ambient and indoor air pollution are presented; standards and methods for monitoring ambient and indoor air pollution discussed. Selected health effects from environmental air pollution and monitoring efforts are described.

In Chapter 11, hazardous substances that may contaminate soil and affect the health of animals and humans are identified. Monitoring efforts are described.

In Chapter 12, the role of water in human health is explored. The chapter identifies common waterborne diseases and discusses some of the monitoring efforts used to ensure that safe water standards are met.

In Chapter 13, the electromagnetic spectrum is described, pathways by which people are exposed to radiation are discussed, common health problems associated with radiation exposure are presented, and challenges associated with epidemiologic radiation studies are explored. Radiation monitoring efforts are also considered.

In Chapter 14, the focus is on natural and human sources of global warming, sources and the extent of stratospheric ozone depletion, sources and the extent of deforestation, and policy aimed at curbing human caused global warming, stratospheric ozone depletion, and deforestation. Epidemiologic evidence of adverse health effects associated with weather changes and ozone depletion are explored.

This book was developed for an introductory course in environmental epidemiology. It is designed for upper-division undergraduate and graduate students in public health, as well as for field public health workers. The chapter topics were selected to represent fundamental concepts, research methods, and application areas in environmental epidemiology. Learning objectives are presented at the beginning of each chapter. The chapters are divided into concise sections with several examples. Tables and figures are used to summarize and clarify important concepts and information. Key words are bolded in the text and defined. Study questions are provided at the end of each chapter.

