SECTION

ONE

Foundations and Methods in Reproductive Epidemiology

CHAPTER

ONE

Foundations of Reproductive Epidemiology

Learning Objectives

After completing this chapter, you should be able to:

1. Define and describe reproductive epidemiology.
2. Discuss the scientific method as it relates to reproductive epidemiology.
3. Discuss ways reproductive epidemiology contributes to public health.

Human health is complex and involves multiple factors. In 1948, the World Health Organization defined **health** as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."[1] This definition identified physical, social, and mental dimensions of health as indicators of the functionality of an individual. Later, emotional, spiritual, and environmental dimensions of health were added to the definition. The six dimensions of health are described as follows:

Physical—The ability of the human body structure to function properly
Social—The ability to interact with other individuals

Mental—The ability to process information and act properly
Emotional—The ability to cope, adjust, and adapt
Spiritual—A belief in some force or dynamic other than humans
Environmental—External conditions and influences affecting life and development

A number of health surveys and health indicators have been developed to monitor and assess these various dimensions of health. These are addressed in later chapters.

Public health is concerned with the overall health of a community. The mission of public health is to ensure conditions that promote the dimensions of health in the community as a whole. In order to fulfill this mission, three core public health functions have been established, which are:

1. Assessing and monitoring the health of populations at risk and identifying health problems and priorities.
2. Formulating of policies and priorities designed to solve identified health problems.
3. Assuring that all populations have access to appropriate and cost-effective care, including prevention, protection, and health promotion services.[2]

Epidemiology is the basic science of public health, providing the tools for monitoring and evaluating the facts that enable public health officials to identify public health problems and plan and evaluate intervention control measures.

Reproductive health is an important area of public health that is related to each of the six dimensions of health. In 1994, the International Conference on Population Development and the World Conference on Women defined **reproductive health** as a "state of complete physical, mental and social well-being in all matters relating to the reproductive system and to its functions and processes."[3] In other words, reproductive health is a primary component of general health, influencing physical and mental health, human development, and personal relationships at all stages of life. It may also influence emotional, spiritual, and environmental aspects of our lives. Implicit in the definition of reproductive health is the right of men and women to receive effective and affordable family

planning, skilled attendance at delivery, and timely emergency obstetric care when complications arise. Reproductive health care also includes sexual health, the purpose of which is the enhancement of life and personal relationships.

Although men may experience reproductive health problems, women bear a far greater burden of such problems, including complications from pregnancy and childbirth, risks associated with birth control, complications from unsafe abortions, contraception use, reproductive tract infections, sexually transmitted diseases, and complications from treatments for maternal and infant complications.

In this book we explore the role of epidemiology in reproductive health. The purpose of this first chapter is to define reproductive epidemiology and present how it contributes to public health.

What Is Epidemiology?

Epidemiology has a long history, with many key individuals contributing to its development. Hippocrates (460–377 BC), a Greek physician who became known as the father of medicine, attempted to explain how diseases affect people and how they spread. He observed that diseases were related to time, season, place, and environmental conditions. He referred to the condition in which disease occurred more frequently than expected as an **epidemic** and the ongoing, expected frequency of disease as **endemic**.[4–7] Thomas Sydenham (1624–1689), an English physician, described and distinguished different diseases, including some psychological maladies. He also promoted useful treatments and remedies, including exercise, fresh air, and a healthy diet, which physicians rejected at the time.[7] James Lind (1716–1794), an English physician, pioneered naval hygiene in the Royal Navy and advanced the idea that citrus fruit was protective against scurvy, on the basis of experimental investigation.[8] Finally, John Snow (1813–1858) became known as the father of epidemiology because of his observational investigative studies of cholera. He used both descriptive and analytic epidemiologic methods to identify contaminated water as the source of cholera outbreaks in London in the mid-1800s.[9]

The word epidemiology is based on the Greek words *epi*, a prefix meaning "on, upon, or befall"; *demos*, a root meaning "the people"; and *logos*, a suffix meaning "the study of." In medical terminology, the suffix is read first, and the prefix is followed by the root. Hence, epidemiology literally means the study of

that which befalls the people. The modern definition of **epidemiology** is the study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to control for health problems.[10] Thus, epidemiology is the process of defining, classifying, or categorizing health-related states or events and their connections with potential causes, identifying causal associations and providing a basis for predicting the effects of certain exposures, and using this information to improve the health and social conditions of people.

To better understand the definition of epidemiology, consider the word **study**, which implies the use of sound methods of scientific investigation, where **methods** are rules or procedures employed in order to accomplish a task. A number of study designs and statistical methods are used to this end. The word **distribution** refers to the frequency and pattern of health-related states or events. **Frequency** refers to the number of cases or events. This number is often divided by the population at risk of becoming a case in order to obtain a rate, which is a more appropriate measure of risk. **Pattern** is a description of the reproductive health-related states or events by *who* is experiencing the problem (person), *where* the problem occurs most or least (place), and *when* the problem occurs most or least (time). The term **health-related state or event** refers to the fact that epidemiology involves more than just the study of disease states (e.g., influenza, human immunodeficiency syndrome, and cancer), but also includes the study of events (e.g., injury, homicide, drug abuse), behaviors, and conditions associated with health (e.g., diet, contraceptive use, nutrition, physical activity). Finally, **application** refers to the fact that the information obtained through epidemiology is then applied to better prevent and control health problems in human populations.

Like public health, epidemiology has a population focus. Epidemiologic investigations are directed toward populations, not individuals. For example, is there an excess of infant deaths above what is expected in Zambia (epidemic)? Or is the frequency of infant death what is normally expected (endemic)? If an epidemic in infant deaths is established, the epidemiologic investigation then seeks to characterize the problem according to person, place, and time factors, which may provide important clues as to the cause of the public health problem.

Like the word epidemic, **outbreak** also means an excess of the health-related state or event above what is expected; however, the word outbreak is typically used when a more limited geographic area is involved. In addition, the word outbreak may be less alarming to the public than epidemic.

What Is the Scientific Method?

Epidemiology uses the scientific method to describe and analyze reproductive health-related states or events. The **scientific method** refers to the techniques used for investigating an observable occurrence and acquiring new knowledge. It involves collecting data through observation or experiment, identifying a problem, formulating hypotheses that attempt to characterize some phenomena, and testing the hypotheses. Study designs and statistical methods are selected and employed to test research hypotheses. In hypothesis testing, information is used in a sample of observations, and the results either support or fail to support the research hypothesis.

The presence of a reproductive health problem is established through descriptive epidemiologic methods, which involve observation, definitions, measurements, interpretations, and dissemination. Once the research problem is established, hypotheses are then formulated to explain observed and measured associations with the population of interest. Hypotheses are tested using appropriate analytic epidemiologic study designs and statistical methods. Statistical analyses are then followed by interpretation and dissemination of the health findings.

What Is Reproductive Epidemiology?

Reproductive epidemiology is simply the area of epidemiology concerned with reproduction. **Reproduction**, which is fundamental to all known life, is the biological process by which organisms produce offspring.[11] Thus, **reproductive epidemiology** is the study of the distribution and determinants of health-related states or events in human populations and the application of this study to promote complete physical, mental, and social well-being as they relate to the reproductive system and to its functions and processes.

Reproductive Epidemiology in Public Health

Providing epidemiologic information useful for improving reproductive health may be considered a basic human right that is essential for empowering women. Such information plays a vital role in reducing poverty, increasing economic growth and female productivity, lowering infertility, and improving maternal health and child survival. Both public health and individual decision making rely

on epidemiologic information for making informed choices. Information useful for public health and individual decision making is obtained by:

- Identifying risk factors for reproductive health-related states or events.
- Identifying individuals and populations at greatest risk for reproductive health-related states or events.
- Providing an understanding of the critical window of vulnerability.
- Identifying where the public health problem is greatest.
- Monitoring the extent of the reproductive health-related states or events over time.
- Identifying the urgency with which the reproductive health-related states or events need to be addressed.
- Evaluating the efficacy and effectiveness of prevention and treatment programs.
- Providing information useful for improving reproductive health.
  - Family planning to reduce unintended pregnancies
  - Contraceptive safety and efficacy
  - Maternal morbidity and mortality
  - Perinatal and infant health
  - Sexually transmitted diseases
  - Resource allocation

The means by which this information is obtained is through application of an epidemiologic study design. An epidemiologic study design is a plan or detailed approach for obtaining information. Epidemiologic study designs are classified as descriptive and analytic. The descriptive epidemiologic study design is used to describe the public health problem according to person, place, and time. In reproductive epidemiology, for example, it is the means by which we identify individuals and populations at greatest risk for unwanted fertility, high maternal morbidity and mortality, poor sexual health, and inadequate access to and utilization of prenatal care and birth-planning methods. It is also a means for identifying where the health problem is greatest and whether the problem is changing over time. In contrast, the analytic epidemiologic study design provides the tools for determining risk factors and the efficacy and effectiveness of prevention and

treatment programs. Specific types of descriptive and analytic study designs used in reproductive epidemiology are presented in Chapter 6, "Study Designs in Reproductive Epidemiology."

Selected examples of what we know about reproductive health because of epidemiology are as follows:

- Approximately 250 million years of productive life are lost each year because of reproductive health problems.
- Over 500,000 women die annually from pregnancy-related causes, whereas millions suffer related disabilities.[12]
- Maternal mortality is the leading cause of death for women ages 15–44 years.
- For every one of these women who die, 15 to 30 experience debilitating injury.
- About 75 million unplanned pregnancies occur each year, with roughly a third resulting in an unsafe abortion.
- All women, both rich and poor, face about a 15% risk of complications at delivery.[13]
- Babies born to adolescent girls compared with older women are 50% more likely to die within a year from birth. Adolescent girls have a greater risk of premature delivery and obstructed labor, which are both primary causes of infant death.[14]
- Women in developing countries bear a disproportionately greater burden of reproductive health problems (see **Table 1-1**). For example, in the developed world, there are approximately 14 maternal deaths per 100,000 live births compared with 472 in Cambodia, 130 in Vietnam, and 44 in Thailand.[15,16] Approximately 99% of all maternal deaths occur in developing countries.[17,18]
- The comparatively high maternal mortality rates in developing countries are primarily the result of poor access to family planning to reduce unintended pregnancies, unskilled attendance at delivery, and a lack of timely emergency obstetric care when complications arise.[16,19]
- Poor access to family planning is a primary reason for about 76 million unintended pregnancies each year in developing countries.[20]

TABLE 1-1 Maternal Mortality Ratio and Lifetime Risk of Maternal Death, 2000

Region	*Maternal Deaths Per 100,000 Live Births*	*Lifetime Risk of Maternal Death, 1 in*
World	400	74
Developed regions	14	3,800
Commonwealth of independent states	68	820
Developing regions	450	60
Northern Africa	130	210
Sub-Saharan Africa	920	16
Latin America and the Caribbean	190	160
Eastern Asia	55	840
Southern Asia	540	44
Southeastern Asia	210	140
Western Asia	190	110
Oceania	240	83

Source: World Health Organization/United Nations Children's Fund, Maternal Mortality in 2000: Estimates developed by WHO, UNICEF, UNFPA. Available at http://www.unfpa.org/publications/detail.cfm?ID=160&filterLisType=4. Accessed December 29, 2008.

- Roughly 19 to 20 million unsafe abortions are performed annually, causing 68,000 deaths each year.[21]
- Approximately one in 10 pregnancies will result in an unsafe abortion, with the highest numbers in Asia, Africa, and Latin America.[21]
- Because up to 15% of all births are complicated by problems that can be fatal, availability of skilled attendance at all births is a critical intervention in order to recognize problems early, and to control, manage, or stabilize problems.[22]
- A mother's death can be devastating for a surviving child who faces a greater chance of poor health, poverty, and exploitation without the mother's protection and love. If the mother survives but is disabled, her contribution to the family and economy diminishes, and the struggle against poverty is weakened. For every woman who dies in childbirth, roughly 20 women suffer from serious injury or disability because of complications related to pregnancy and childbirth.[13]

- Some success has been observed in lowering maternal mortality in developing countries over past decades. For example, in Matlab, Bangladesh, improved access to surgical obstetric care and other maternal health services led to a significant decline from 600 maternal deaths per 100,000 live births in 1976 to 200 in 2001.[12] Bangladesh and Thailand also stand as examples of developing countries that have met and even exceeded the Millennium Development Goal to reduce maternal mortality by 75% between 1990 and 2015.[12]

Conclusion

The area of epidemiology that involves reproduction is called reproductive epidemiology. Reproductive epidemiology provides useful information about the distribution and determinants of reproductive-related health states or events in human populations. The application of this study is intended to promote complete physical, mental, social, spiritual, emotional, and environmental health as they relate to the reproductive health system and to its functions and processes.

Key Issues

1. This chapter provides a foundation for exploring how reproductive epidemiology contributes to public health.
2. Reproductive epidemiology is the study of the distribution and determinants of health-related states or events in human populations and the application of this study to promote complete physical, mental, and social well-being as they relate to the reproductive system and to its functions and processes.
3. Reproductive epidemiologic studies contribute to public health by (1) identifying risk factors, (2) identifying individuals and populations at greatest risk, (3) providing an understanding of the critical window of vulnerability, (4) identifying where the public health problem is greatest, (5) monitoring the extent of the public health problem, (6) identifying the urgency with which the problem needs to be addressed, (7) evaluating the efficacy and effectiveness of prevention and treatment programs, and (8) providing information useful in family planning and healthcare management.

Exercises

Key Terms

Define the following terms.

Application
Distribution
Epidemiology
Endemic
Epidemic
Frequency
Health
Health-related state or event
Methods
Outbreak
Pattern
Public health
Reproduction
Reproductive epidemiology
Reproductive health
Scientific method
Study

Study Questions

1.1 How does epidemiology enable the fulfillment of the three core public health functions presented in the outset of this chapter?
1.2 Describe the primary purpose of reproductive epidemiology.
1.3 In this chapter, we noted that epidemiology uses the scientific method. Explain.
1.4 How does reproductive epidemiology contribute to public health?

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