Chapter 14
Forensic Statistics in Health Sciences

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ABSTRACT

This chapter reviews the application of forensic statistical methods related issues such as: methods of deciphering evidence, DNA profile matching, searching a database of DNA profiles, scientific reliability, discrimination in presentation of statistical evidence in legal settings, assumptions in underlying statistical analysis when evidence is presented, precision & accuracy, role of using extreme values in evidence, and decision analysis in forensic science. The emphasis of the chapter is on concepts from statistical application, nature, and use of evidences in everyday clinical practice and in the court of law. Another goal of the chapter is to serve as a central reference to access of information about resources related to this topic.

INTRODUCTION

Forensic statistics may be defined as the application of statistics to forensic science and the law to seek the truth in a way that truth is identified with high degree of confidence from among a variety of possible solutions to the problem at hand. Forensic statisticians help to quantify evidence in criminal cases (The Royal Statistical Society, 2005). Statistics is a scientific system that analyzes data collected from a pool of observations by collection, and interprets the data to provide explanation(s) for the observed event or phenomenon. Usually, an appropriate evaluation of evidence and a comparison of probabilities of the evidence under two different propositions are required while making a decision. This evidence generated by forensic statistics may be used subsequently to either implicate or exonerate a person suspected of committing that crime, or just

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to gain further insight into the incident. Over the years, with increasing technological advancement, forensic science has become a key part of criminal investigations worldwide (The Royal Statistical Society, 2005).

The Logical Basis of Forensic Statistics

Statistics, like all scientific systems runs on logical reasoning, especially when investigating causation. Logical reasoning involves an argument consists of one or more premises (statement that is either true or false that is offered in support of a claim) and one conclusion (a sentence that is true or false). The conclusion should follow from the premises based on the claims (Chattopadhyay, 2010). Errors in logical reasoning leading to fallacious conclusions occur in health research, and are a major threat to concluding causal association. Logic may be defined as the science of those principles, laws, and methods that guides correct and proper reasoning.

Critical thinking involves knowledge of the science of logic; including the skills of logical analysis, correct reasoning, and understanding statistical methods. Critical thinking, however, involves more than just an understanding of logical procedures. A good critical thinker must also understand the sources of knowledge, the nature of knowledge, and the nature of truth. Logic is not intended merely to inform or instruct. It is also a directive and aims at assisting us in the proper use of our power of reasoning (Dolhenty, 2010). An argument is simply a set of statements, one of which is designated as a conclusion and the remaining statements, called premises, are asserted as being true and are offered as evidence that supports or implies the conclusion. The first step in recognizing an argument for the purposes of understanding and evaluating the argument is to identify the premises and the conclusion which make up the argument.

Scientific methodology uses synthesis and analysis to determine evidence in factor of truth about a question employing the two parts of logic: inductive reasoning and deductive reasoning. Fallacies arise from a discontinuity in logical chain of reasoning. Although there are several important errors in logical arguments that occur, important ones in science are: inductive argument fallacy, deductive fallacy, inductive fallacy, and factual error.

DECIPHERING EVIDENCE

Evidence is the information that supports a certain conclusion. In the courts, usually, the existence of means, motive and opportunity drives the conclusions towards commitment of crime, and loads the dice towards potentially biasing a decision against the suspect, whether the crime was committed on not. Technicalities towards admission of evidence may also play a role. Thus there always exists the possibility that the weight of evidence in court may at times deviate from the truth. Therefore Types I and II error rates may indicate efficiency of the justice process.

Scientific Reliability

It is common in courts to see most associations be interpreted as causal associations. Even if no such direct claims are made, several studies interpret the associations as causal in the discussion of the articles. However, inferring causal association is a tedious and rigorous proposition and requires quality insight, sound judgment and careful assessment of evidence. In making such inferences, design of the study must be considered as the limiting framework within which conclusions may be drawn. Errors in study designs may lead to incorrect conclusions and may color expert opinion about evidence in question in courts.

The Duhem-Quine thesis (or the Duhem-Quine problem) states that it is impossible to test a sci-