

Study designs: Part 2 – Descriptive studies

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Abstract

One of the first steps in planning a research study is the choice of study design. The available study designs are divided broadly into two types – observational and interventional. Of the various observational study designs, the descriptive design is the simplest. It allows the researcher to study and describe the distribution of one or more variables, without regard to any causal or other hypotheses. This article discusses the subtypes of descriptive study design, and their strengths and limitations.

Keywords: Epidemiologic methods, observational studies, research design

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INTRODUCTION

In our previous article in this series,^[1] we introduced the concept of “study designs”– as “the set of methods and procedures used to collect and analyze data on variables specified in a particular research question.” Study designs are primarily of two types – observational and interventional, with the former being loosely divided into “descriptive” and “analytical.” In this article, we discuss the descriptive study designs.

WHAT IS A DESCRIPTIVE STUDY?

A descriptive study is one that is designed to describe the distribution of one or more variables, without regard to any causal or other hypothesis.

TYPES OF DESCRIPTIVE STUDIES

Descriptive studies can be of several types, namely, case reports, case series, cross-sectional studies, and ecological studies. In the first three of these, data are collected on

individuals, whereas the last one uses aggregated data for groups.

Case reports and case series

A case report refers to the description of a patient with an unusual disease or with simultaneous occurrence of more than one condition. A case series is similar, except that it is an aggregation of multiple (often only a few) similar cases. Many case reports and case series are anecdotal and of limited value. However, some of these bring to the fore a hitherto unrecognized disease and play an important role in advancing medical science. For instance, HIV/AIDS was first recognized through a case report of disseminated Kaposi’s sarcoma in a young homosexual man,^[2] and a case series of such men with *Pneumocystis carinii* pneumonia.^[3]

In other cases, description of a chance observation may open an entirely new line of investigation. Some examples include: fatal disseminated *Bacillus Calmette–Guérin* infection in a baby born to a mother taking infliximab for Crohn’s disease suggesting that administration of

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infliximab may bring about reactivation of tuberculosis,^[4] progressive multifocal leukoencephalopathy following natalizumab treatment – describing a new adverse effect of drugs that target cell adhesion molecule $\alpha 4$ -integrin,^[5] and demonstration of a tumor caused by invasive transformed cancer cells from a colonizing tapeworm in an HIV-infected person.^[6]

Cross-sectional studies

Studies with a cross-sectional study design involve the collection of information on the presence or level of one or more variables of interest (health-related characteristic), whether exposure (e.g., a risk factor) or outcome (e.g., a disease) as they exist in a defined population at one particular time. If these data are analyzed only to determine the distribution of one or more variables, these are “descriptive.” However, often, in a cross-sectional study, the investigator also assesses the relationship between the presence of an exposure and that of an outcome. Such cross-sectional studies are referred to as “analytical” and will be discussed in the next article in this series.

Cross-sectional studies can be thought of as providing a “snapshot” of the frequency and characteristics of a disease in a population at a particular point in time. These are very good for measuring the prevalence of a disease or of a risk factor in a population. Thus, these are very helpful in assessing the disease burden and healthcare needs.

Let us look at a study that was aimed to assess the prevalence of myopia among Indian children.^[7] In this study, trained health workers visited schools in Delhi and tested visual acuity in all children studying in classes 1–9. Of the 9884 children screened, 1297 (13.1%) had myopia (defined as spherical refractive error of -0.50 diopters (D) or worse in either or both eyes), and the mean myopic error was -1.86 ± 1.4 D. Furthermore, overall, 322 (3.3%), 247 (2.5%) and 3 children had mild, moderate, and severe visual impairment, respectively. These parts of the study looked at the prevalence and degree of myopia or of visual impairment, and did not assess the relationship of one variable with another or test a causative hypothesis – these qualify as a descriptive cross-sectional study. These data would be helpful to a health planner to assess the need for a school eye health program, and to know the proportion of children in her jurisdiction who would need corrective glasses.

The authors did, subsequently in the paper, look at the relationship of myopia (an outcome) with children’s age, gender, socioeconomic status, type of school, mother’s education, etc. (each of which qualifies as an exposure). Those parts of the paper look at the relationship between

different variables and thus qualify as having “analytical” cross-sectional design.

Sometimes, cross-sectional studies are repeated after a time interval in the same population (using the same subjects as were included in the initial study, or a fresh sample) to identify temporal trends in the occurrence of one or more variables, and to determine the incidence of a disease (i.e., number of new cases) or its natural history. Indeed, the investigators in the myopia study above visited the same children and reassessed them a year later. This separate follow-up study^[8] showed that “new” myopia had developed in 3.4% of children (incidence rate), with a mean change of -1.09 ± 0.55 D. Among those with myopia at the time of the initial survey, 49.2% showed progression of myopia with a mean change of -0.27 ± 0.42 D.

Cross-sectional studies are usually simple to do and inexpensive. Furthermore, these usually do not pose much of a challenge from an ethics viewpoint.

However, this design does carry a risk of bias, i.e., the results of the study may not represent the true situation in the population. This could arise from either selection bias or measurement bias. The former relates to differences between the population and the sample studied. The myopia study included only those children who attended school, and the prevalence of myopia could have been different in those did not attend school (e.g., those with severe myopia may not be able to see the blackboard and hence may have been more likely to drop out of school). The measurement bias in this study would relate to the accuracy of measurement and the cutoff used. If the investigators had used a cutoff of -0.25 D (instead of -0.50 D) to define myopia, the prevalence would have been higher. Furthermore, if the measurements were not done accurately, some cases with myopia could have been missed, or vice versa, affecting the study results.

Ecological studies

Ecological (also sometimes called as correlational) study design involves looking for association between an exposure and an outcome across populations rather than in individuals. For instance, a study in the United States found a relation between household firearm ownership in various states and the firearm death rates during the period 2007–2010.^[9] Thus, in this study, the unit of assessment was a state and not an individual.

These studies are convenient to do since the data have often already been collected and are available from a reliable source. This design is particularly useful when the differences in exposure between individuals within a group are much smaller than the differences in exposure between groups. For instance,

the intake of particular food items is likely to vary less between people in a particular group but can vary widely across groups, for example, people living in different countries.

However, the ecological study design has some important limitations. First, an association between exposure and outcome at the group level may not be true at the individual level (a phenomenon also referred to as “ecological fallacy”).^[10] Second, the association may be related to a third factor which in turn is related to both the exposure and the outcome, the so-called “confounding”. For instance, an ecological association between higher income level and greater cardiovascular mortality across countries may be related to a higher prevalence of obesity. Third, migration of people between regions with different exposure levels may also introduce an error. A fourth consideration may be the use of differing definitions for exposure, outcome or both in different populations.

ADVANTAGES

Descriptive studies, irrespective of the subtype, are often very easy to conduct. For case reports, case series, and ecological studies, the data are already available. For cross-sectional studies, these can be easily collected (usually in one encounter). Thus, these study designs are often inexpensive, quick and do not need too much effort. Furthermore, these studies often do not face serious ethics scrutiny, except if the information sought to be collected is of confidential nature (e.g., sexual practices, substance use, etc.).

Descriptive studies are useful for estimating the burden of disease (e.g., prevalence or incidence) in a population. This information is useful for resource planning. For instance, information on prevalence of cataract in a city may help the government decide on the appropriate number of ophthalmologic facilities. Data from descriptive studies done in different populations or done at different times in the same population may help identify geographic variation and temporal change in the frequency of disease. This may help generate hypotheses regarding the cause of the disease, which can then be verified using another, more complex design.

DISADVANTAGES

As with other study designs, descriptive studies have their own pitfalls. Case reports and case-series refer to a

solitary patient or to only a few cases, who may represent a chance occurrence. Hence, conclusions based on these run the risk of being non-representative, and hence unreliable. In cross-sectional studies, the validity of results is highly dependent on whether the study sample is well representative of the population proposed to be studied, and whether all the individual measurements were made using an accurate and identical tool, or not. If the information on a variable cannot be obtained accurately, for instance in a study where the participants are asked about socially unacceptable (e.g., promiscuity) or illegal (e.g., substance use) behavior, the results are unlikely to be reliable.

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Conflicts of interest

There are no conflicts of interest.

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