Epidemiology series

Descriptive studies: what they can and cannot do

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Descriptive studies often represent the first scientific toe in the water in new areas of inquiry. A fundamental element of descriptive reporting is a clear, specific, and measurable definition of the disease or condition in question. Like newspapers, good descriptive reporting answers the five basic W questions: who, what, why, when, where . . . and a sixth: so what? Case reports, case-series reports, cross-sectional studies, and surveillance studies deal with individuals, whereas ecological correlational studies examine populations. The case report is the least-publishable unit in medical literature. Case-series reports aggregate individual cases in one publication. Clustering of unusual cases in a short period often heralds a new epidemic, as happened with AIDS. Cross-sectional (prevalence) studies describe the health of populations. Surveillance can be thought of as watchfulness over a community; feedback to those who need to know is an integral component of surveillance. Ecological correlational studies look for associations between exposures and outcomes in populations—eg, per capita cigarette sales and rates of coronary artery disease—rather than in individuals. Three important uses of descriptive studies include trend analysis, health-care planning, and hypothesis generation. A frequent error in reports of descriptive studies is overstepping the data: studies without a comparison group allow no inferences to be drawn about associations, causal or otherwise. Hypotheses about causation from descriptive studies are often tested in rigorous analytical studies.

Descriptive studies have several important roles in medical research. They are often the first foray into a new disease or area of inquiry—the first scientific “toe in the water”. They document the health of populations and often prompt more rigorous studies. Since descriptive studies are often reported, clinicians need to know their uses, strengths, and weaknesses.

A descriptive study is “concerned with and designed only to describe the existing distribution of variables, without regard to causal or other hypotheses.” The key qualifier about causal hypotheses is sometimes forgotten by investigators, resulting in erroneous conclusions. Here, we provide an overview of the advantages and disadvantages of descriptive studies, provide examples of several types of descriptive study, examine their clinical uses, and show how they can be misinterpreted.

The descriptive triad—or pentad?

Five “W” questions

Traditional descriptive epidemiology has focused on three key features: person, place, and time, or agent, host, and environment. An alternative approach is that of newspaper coverage. Good descriptive research, like good newspaper reporting, should answer five basic “W” questions—who, what, why, when, and where—and an implicit sixth question, so what?

Who has the disease in question? Age and sex are universally described, but other characteristics might be important too, including race, occupation, or recreational activities. The risk of venous thromboembolism, for example, increases exponentially with age. Only 1% of breast cancers arise in men, but Klinefelter’s syndrome or a family history of breast cancer increase their risk. Race affects the risk of leiomyomas of the uterus. Commercial fishing remains a risky business, and having fun with an all-terrain vehicle or snowmobile, especially when drunk, can be lethal.

What is the condition or disease being studied? Development of a clear, specific, and measurable case definition is an essential step in descriptive epidemiology. Without such a description, the reader cannot interpret the report. Some conditions, such as fractures, can be overt. Other diagnoses might be challenging: multiple sclerosis, systemic lupus erythematosus, and pelvic inflammatory disease (salpingitis), for example. By use of the consensus or Delphi panel approach rather than evidence, some organisations have promulgated case definitions that have subsequently been shown to be invalid. For instance, evidence indicates that vaginal discharge and a raised erythrocyte sedimentation rate predict salpingitis, yet these predictors are not included in widely-used diagnostic criteria.

Generally, stringent criteria for case definitions are desirable. Admittedly, if only the more severe cases of disease are targeted, milder or earlier cases will be missed. Although this approach inevitably leads to some loss of information, the trade-off is better specificity; severe cases of a disease are less likely to be confused with other conditions than are mild cases. An example would be the stringent case definition used for toxic shock syndrome, which requires involvement of multiple organ systems. More recently, expanding the case definition of AIDS has yielded a sudden surge in “new” cases.

Why did the condition or disease arise? Descriptive studies often provide clues about cause that can be pursued with more sophisticated research designs (panel).

When is the condition common or rare? Time provides important clues about health events. The prototype might be the outbreak of gastroenteritis soon after ingestion of staphylococcal toxin. Some temporal relations can be long—eg, vaginal adenosis and clear cell carcinoma of the vagina appeared years after intrauterine exposure to diethylstilboestrol. Furthermore, cervical and other epithelial cancers develop decades after infection with human papillomavirus, and births and deaths from pneumonia and influenza have regular seasonal patterns, as might sperm counts.
Where does or does not the disease or condition arise? Geography has had a huge effect on health. Living close to rodents and insects (and thus their parasites) has shaped both medical and political history.29 Living where drinking water has high fluoride protects against dental caries,21 whereas residing downwind from a lead smelter is less salutary.20 Latitude plays a part in both multiple sclerosis23 and vitamin D deficiency;41 sunlight might decrease25 or increase29 cancer risk.

So What? The implicit “W” relates to the public health effect. In view of the proliferation of descriptive reports,1 what is their import? Is the condition a current and timely one? Is it serious? Are large numbers involved? Are its societal implications broad? Has it been studied before?26 Although many descriptive reports herald new illnesses or monitor health, the net effect of others might be only thicker curricula vitae at the expense of thinner forests.

### Examples of early leads from descriptive studies

<table>
<thead>
<tr>
<th>Clinical observation</th>
<th>Underlying association</th>
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<tr>
<td>Hepatocellular adenoma in young women</td>
<td>Exposure to high-dose oral contraceptives</td>
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<tr>
<td>Blindness in newborn infants</td>
<td>High ambient oxygen concentrations in incubators</td>
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<td>Kaposi’s sarcoma in young men</td>
<td>Infection with HIV-1</td>
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<td>Angiosarcoma of the liver in employees</td>
<td>Industrial exposure to vinyl chloride</td>
</tr>
<tr>
<td>Cataracts, heart defects, and deafness in newborns</td>
<td>Maternal infection with rubella during pregnancy</td>
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### Types of descriptive studies

Descriptive studies consist of two major groups: those that deal with individuals and those that relate to populations. Studies that involve individuals are the case report, the case-series report, cross-sectional studies, and surveillance, whereas ecological correlational studies examine populations.4

**Case report**

The case report is the least publishable unit in the medical literature. Often, an observant clinician reports an unusual disease or association, which prompts further investigations with more rigorous study designs (panel). For example, a clinician, among others, reported benign hepatocellular adenomas, a rare tumour, in women who had taken oral contraceptives.28 A large case-control study pursued this lead and confirmed a strong association between long-term use of high-dose pills and this rare, but sometimes deadly, tumour.29 Not all case reports deal with serious health threats; however, some simply enliven the generally drab medical literature.30–31

**Case-series report**

A case-series aggregates individual cases in one report. Sometimes, the appearance of several similar cases in a short period heralds an epidemic. For example, a cluster of homosexual men in Los Angeles with a similar clinical syndrome alerted the medical community to the AIDS epidemic in North America.32 Whereas a report of a single unusual case might not trigger further investigation, a case-series of several unusual cases (in excess of what might be expected) adds to the concern. A convenient feature of case-series reports is that they can constitute the case group for a case-control study, which can then explore hunches about causes of disease.

### Cross-sectional (prevalence) studies

Prevalence studies describe the health of populations. For example, in the USA, periodic surveys of the health status of the population are done by the federal government—eg, the Health Interview Survey and the Health and Nutrition Examination Survey. Analogous to the decennial census, these studies provide a snapshot of the population at a particular time.

Prevalence studies can be done in smaller populations as well. For example, the results of a survey done in a Puerto Rican pharmaceutical factory indicated an exceptionally high prevalence of gynaecomastia among employees (figure). This finding led to the hypothesis that exposure to ambient oestrogen dust in the plant might be the cause; serum concentrations of oestrogen lent support to the hypothesis. After improvements in dust control in the factory, the epidemic disappeared.33 Similar prevalence studies have linked gynaecomastia with feeding of refugees34 and tainted food.35

Although generally distinguished from cohort and case-control studies, the cross-sectional study can be thought of as the case-control analogue of a population cohort study.36 Since both exposure and outcome are ascertained at the same time (the defining feature of a cross-sectional study), costs are small and loss to follow-up is not a problem. However, because exposure and outcome are identified at one time point, the temporal sequence is often impossible to work out. An exception would be long-standing exposures, such as sex or blood type, which unquestionably preceded the outcome. For exposures that vary, information of aetiological relevance from the past might be more useful than current information.37

### Surveillance

Surveillance is another important type of descriptive study. Surveillance can be thought of as watchfulness over a community. A more formal definition is “the ongoing systematic collection, analysis, and interpretation of health data essential to the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of these data to those who need to know.”38 The key feature here is feedback, as in a servomechanism. Prevention and control of the problem are fundamental parts of the feedback loop.

Surveillance can be either active or passive. Passive surveillance relies on data generally gathered through traditional channels, such as death certificates. By contrast, active surveillance searches for cases. The reporting of abortion-related deaths provides an example. Since 1972, the US Centers for Disease Control and Prevention has been doing active surveillance of these deaths in the USA, using multiple overlapping sources—ie, state maternal mortality study committees, professional organisations, newspapers, and colleagues in the specialty. By comparison with official statistics, active surveillance identifies about twice as many deaths.39 Similarly, underreporting of maternal deaths remains an international problem.40–43

Epidemiological surveillance has made important contributions to health, but none more impressive than smallpox eradication. Surveillance and containment were responsible for the elimination of smallpox from the world, an extraordinary public-health achievement.44 Whereas mass immunisation of the world’s population had failed, the approach of identification of cases through surveillance and then immunisation of susceptible persons in the surrounding communities stopped transmission. Without a non-human vector, the virus died out.

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Preventive Services Task Force have given routine electronic fetal monitoring a D recommendation (fair evidence against its routine use). Despite this advice, about three-fourths of all births in the USA include electronic fetal monitoring. Failure to appreciate the limitations of descriptive studies has caused lasting harm and squandered billions of dollars.

Conclusion

Descriptive studies are often the first, tentative approach to a new event or condition. These studies generally emphasise features of a new disease or assess the health status of communities. Health administrators use descriptive studies to monitor trends and plan for resources. By contrast, epidemiologists and clinicians generally use descriptive reports to search for clues of cause of disease—ie, generation of hypotheses. In this role, descriptive studies are often a springboard into more rigorous studies with comparison groups. Common pitfalls of descriptive reports include an absence of a clear, specific, and reproducible case definition, and interpretations that overstep the data. Studies without a comparison group do not allow conclusions about cause of disease.

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6. Anderson FA Jr, Wheeler HB, Goldberg RJ, et al. A population-based comparison group do not allow conclusions about cause of disease—ie, generation of hypotheses. In this role, descriptive studies are often a springboard into more rigorous studies with comparison groups. Common pitfalls of descriptive reports include an absence of a clear, specific, and reproducible case definition, and interpretations that overstep the data. Studies without a comparison group do not allow conclusions about cause of disease.

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