# The language of research (part 4): research methodologies — case-control studies

KEY WORDS

- Case control
- Method
- Methodology
- Quantitative
- Research
- Retrospective

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In the first and second papers in this series, we introduced research paradigms and the idea of research methodologies and methods. In this, the second of the methodology papers (the last one covered cross-sectional study design), case-control studies will be explored; it should be considered that methodology refers to the overall approach/blueprint that is guiding the design and execution of the study. In future papers in the series, we will examine more research methodologies, as well as some of the terminology associated with undertaking health and social care research.

Case-control studies are used to identify potential (as yet unproven) associations between exposures and disease — between potential causes and a real effect. Case-control studies are retrospective (backward-looking) in design and study individuals who already have a disease (an outcome/effect) of interest while attempting to determine past exposures (potential causes) that may have been involved in producing the disease under investigation (Gordis, 2012).

This may seem naive at first glance. The best way to understand why case-control studies are helpful is to remember that the causes of ill health are not always known and, therefore, a disease or health phenomenon must be investigated often in order to ascertain its cause. For example, we did not know smoking (exposure) caused lung cancer (outcome) until it was noted that smokers develop more lung cancer than non-smokers; this observation may then be tested in other types of studies — as was the case for smoking and various cancers.

Case-control studies cannot (usually) be used to prove the causality of disease, primarily because they do not collect data in a prospective (forward-looking) manner. Case-control studies are cheap and easy to undertake when compared with other epidemiological research methodologies because they can be undertaken quickly and often use pre-existing data.

Due to case-control studies being retrospective, they are prone to confounding and bias, which affect the data they produce. For example, people with the disease under investigation might recall past exposure to a potential cause better than people without the disease. This is because people with a disease (for instance, lung cancer) might think more about what caused their disease than people without the disease. This bias (known as recall bias) is quite systematic in the type of error it produces — people in the disease group recall their exposure with much more clarity than people in the non-diseased group in almost every instance. This impacts on the quality of the exposure data collected with affected individuals (say, with lung cancer) perhaps presenting a history of exposure (say, smoking) that is greater than that of people who are not affected (but among who, some at least, have the same degree of exposure to that in the affected group).

In order to undertake a case-control study, the researcher must start with a hypothesis, or hypotheses. Starting with a hypothesis makes the design of the study easier and focuses the data collection strategies.

People are selected for a case-control study because they have an outcome of interest — in the case of the study discussed below, postoperative wound infections following colorectal surgery. These cases are then matched to controls who are similar in many respects, but who do not have the outcome that is being investigated; in this example, the cases developed postoperative wound infections and the controls did not, but in other respects they are similar, especially in the fact that they have undergone colorectal surgery.

Power et al (2014) investigated the association between patient- and operation-related factors (exposures/causes) and postoperative wound infections (outcomes/effects) in patients undergoing colorectal surgery. They identified patients in whom wound infection

or dehiscence had been documented from a database containing data on colorectal surgery. Patients with wound infections (cases) were matched by type of operation to a group of colorectal surgery patients in whom no infection was documented (controls). Data on patient-specific and operative factors were analysed, comparing cases and controls.

From the results of the statistical comparisons, Power et al (2014) were able to show that the incidence of postoperative wound infection is higher in patients who are obese and/or who had open — as opposed to laparoscopic — surgery. Incidence refers to the number of new cases of a disease or other variables during a defined period of time (Last, 1995).

Choosing the controls for a case-control study is perhaps as much a matter of scientific judgment as it is a science. Because case-control studies aim to compare like with like, then the controls chosen need to reflect as many characteristics of the cases as is possible. In some instances, the controls may have the same outcome of interest as the cases, but their outcome (e.g. wound infection) may not be as bad as that of those termed 'cases'.

The data collected for case-control studies are usually taken from medical, nursing and other documentary records. Sometimes, the study includes interviews that will certainly include all of the cases and the controls and possibly even family members. Other studies, as is the case in the Power et al (2014) study, require the use of biological samples to establish at the very least the existence of disease (in this instance, the infection) and often potential causes, or contributory factors to the causes of, disease. This observation leads us to another criteria for successful design of case-control studies: the need to define exactly what a case is — for example, wound infection may need to be verified by the microscopy and culture, with 'general redness' around the wound site not being acceptable.

Case-control studies are often used to generate hypotheses that are subjected to further testing in subsequent studies. The findings from Power et al (2014) will need to be subjected to further scientific study in order to establish if the associations they have identified are indeed causal. That is to say, if obesity and open surgery are indeed causal factors for wound infection or whether they are markers of something else, which might in fact be causing the infection — or indeed whether the obesity is causing the need for open surgery and, therefore, it is the open surgery that is actually the risk factor for infection, with obesity lying on the causal pathway.

## A CAUTIONARY NOTE

The term 'case-control study' is frequently misunderstood and misrepresented in study designs. Not all studies that use 'cases' and 'controls' are case-control studies (Lewallen and Courtright, 1998).

A study can begin with two groups of people: one group with a known exposure and a comparison group ('control group') without the exposure. These two groups may be followed through time to see what outcomes result, but this is not a case-control study — it is more like a form of cohort study. Randomised controlled trials also contain a group that is known as 'cases' and one which is known as a 'control', but again this is not a case-control study, not least of which is because its design is prospective.

## CONCLUSION

Case-control studies are quick and easy to conduct; they are useful in generating hypotheses about the causes of disease and other outcomes of interest. Case-control studies cannot show cause and effect and their findings need to be interpreted with a degree of caution.

Case-control studies are useful in the study of rare diseases or outcomes as, unlike cohort studies that run until enough cases develop, case-control studies start with the cases and work backwards towards identifying causality. WUK

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