Making Sense of Statistics for Family Practitioners: "Case-control studies"

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Keywords: case-control studies, family practitioners, statistics

(SA Fam Pract 2004;46(8): 31)

Introduction

A case-control study is an epidemiologic study that compares those with the disease (**cases**) with those without the disease (**controls**) in order to determine their frequency of past exposure to possible risk factors. In other words, this study design initially identifies the cases and controls and then collects information on exposure later. In case-control studies, the researcher can only investigate one disease at a time although many exposures to risk factors are simultaneously possible.

When to use case-control studies?

Ideally case-control studies are useful for studying rare diseases due to the ease of identification and low prevalence. But a number of challenges occur using this study design namely:

- Uniformity of data collection among cases and between cases and controls, which if not structured may influence the responses and results obtained,
- The selection of control and case groups which should be from the same study base or population to avoid selection bias,
- Information on exposure being a retrospective process may be inaccurate or biased resulting in recall and/or measurement bias,
- The study design does not give information about prevalence or incidence of the disease, and
- It does not address sequence of events resulting in a weaker proof of causality

Despite these challenges, case-control studies are relatively inexpensive, small to conduct, of short duration and the control groups are readily available for comparison within the same study base. Doll R et al compared mortality in relation to cigarette smoking among smokers and non-smokers in the UK over a fifty year period.[1] Although the study spanned a period of fifty years, it was relatively easy to collect data on causes of death in 98.9% of cases (cigarette smokers), controls (non-cigarette smokers), and correlated exposure to cigarette smoking. The most significant finding was that men from the same cohort born in 1900 – 1930 who smoked only cigarettes and continued smoking (cases) died on average about 10 years younger than life long non-smokers (controls). In terms of overall mortality during the 50-year period, non-smokers (controls) accounted for only 2917 of the 25 346 deaths, while the rest occurred in smokers, that is, 22 429 deaths (Table I). Hence the odds of dying because of cigarette smoking were 7.69 higher in smokers than in non-smokers. It is important to note that case-control studies are used to measure exposure-disease associations and that the controls represent the probability of exposure in the population at risk of becoming cases. Hence a 7.69 mortality ratio in smokers highlights the strong association of cigarette smoking as a risk factor in the cases when compared with the controls.

In addition, case-control designs are appropriate when it is impossible to define or study all persons at risk of becoming cases. The crucial task is to seek evidence on the magnitude of the association between exposure and disease state (cases), and express the association as using the odds ratio.[2] In instances where the number of cases is too small to detect statistically significant associations, if the magnitude of the exposure-disease association is large in relation to other exposures, inference can still be made that the exposure is causally linked to the disease status (cases). Case-control studies are also useful only when enough is known about the outcome to help identify and classify cases and controls. Remember that with this study design, you have to retrospectively determine the risk factors after the cases and controls have been matched to seek evidence on associations and their magnitude.

References

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