EDITORIAL

Research, statistics, and causality in dentistry

The decision to treat a disease rationally depends on the type of evidence available to the clinician. With advances in knowledge from each discipline of dentistry and medicine, there are attributes that complement the decision process, whether in the diagnosis of a disease or in policy making for the health benefit of the general public. There are different ways this evidence is gathered and extrapolated to humans. This can be achieved in multiple ways, namely, basic research, clinical research, application of epidemiology and biostatistics in descriptive studies, observational studies, and meta-analysis of pre-existing studies. Basic research answers the questions pertaining to the effect of a cause or intervention on morbidity or mortality. Basic scientific research has the distinctive ability to explore the environmental and genetic factors that promote or bring about phenotypical expressions of diseases. At the same time, the basic research also has the downside of questionable relevance to humans.[1]

It is known that epidemiologists and biostatisticians collaborate with clinicians, formulate hypotheses from descriptive studies, and test those hypotheses in more elaborate analytic or observational studies. The expected result would perhaps be an answer to the question of whether there is a statistical association between an exposure and an outcome, such as morbidity or mortality. At the same time, the epidemiologic research has the weakness of being crude and inexact, since it is difficult to gather observations on humans under the controlled conditions of basic research.[1] The descriptive studies are not very high on the hierarchy of evidence. They are case reports, case series, or cross-sectional studies. The observational studies are typically either case-control studies or cohort studies. Meta-analyses of individual randomized clinical trials reduce the role of chance but may introduce bias and confounding variables. Large-scale randomized clinical trials provide the most reliable evidence concerning even very small or moderate effect sizes. Although every question cannot be addressed by a randomized clinical trial, the best available evidence should be used to formulate treatment guidelines.

Before any valid statistical association can be made using the observational studies, the clinician needs to answer some fundamental questions regarding the study, including whether it is a chance occurrence or if there is a bias in the selection of subjects. Finally, are there confounders or variables that have an adverse effect on the outcome by masking independent risk factors? A statistical correlation is not complete unless the clinician answers these questions. Conclusions about the causality cannot be drawn unless there is sufficient evidence from the studies. Several positive criteria support the causality. These include the strength of association, consistency, biologic credibility, and temporal sequence.[2] Many times, clinicians rush to judgments regarding a hypothesis based solely on a lower level of evidence and one that has not been tested by higher level randomized control clinical trials. Even though a valid statistical association can be safely made from observational studies after excluding chance, bias, and confounder influence, this association may or may not be causal. Causation is considered a concrete credence based on the totality of evidence gathered from a variety of positive factors from basic, clinical, epidemiologic, and statistical research. As clinicians, we should strive to achieve this level of excellence in the translational research.

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