

Causality: A Word Used In Vain.

Associations and cause-effect relationships: Rethinking this dilemma. It is disconcerting how many authors and textbooks make references to causality in vain. There is a need to emphasize the definition of causality and reshape the way it is used. This will serve future scholars in general and Epidemiologist specifically. You have come across the word "causality" in your readings, whether reviewing some literature or in some textbooks. I supervise many dissertations in my capacity as a Public Health doctoral mentor. Students often follow what they read in textbooks and state that a disadvantage of using a case-control study or a cross-sectional study is their inability to provide causality. Are we able, however, to provide a proof of causality when using other types of study designs like a cohort study? Sounds like a rhetoric question! There should be an increased awareness of the difference between and regarding the use of words like "association" and "cause-effect" in epidemiological research. It is of utmost importance to grasp the two concepts and make a keen differentiation between the two terms. The best scenario in observational studies whether cohort, case-control, cross-sectional or ecological studies, can only provide an association between a risk factor also known as a predictor or an independent variable and an outcome also known as a disease or endpoint. Controlled clinical trials do offer the best evidence of causal relationships and they are considered the gold standard in epidemiology. The true point of contention here is that controlled clinical trials are not considered observational epidemiological studies. The latter is true because no manipulation of exposure in human populations should occur or can occur in observational studies. The focus of this editorial piece remains whether an observational study can offer any proof of causation.

Observational epidemiological studies can only provide associations whether positive or negative but never a proof of causation. A cause-effect relationship can never be inferred from one or few observational studies. For a causal relationship to be established in epidemiology other criteria remain to be satisfied. These criteria are known as Sir Bradford Hill Criteria of causation. Once an association is established from different observational epidemiological studies using different study designs showing different strength of associations accompanied by other causation criteria, then we can say with confidence that a cause-effect relationship may exist between the risk factor in question and the outcome under investigation. The emphasis is on the word "may" because researchers cannot say that a causal relationship exists for certain. Discussions regarding casualty may occur when a general scientific consensus from the scientific community arises. They can agree on a causal relationship at this point. This is the only foundation that can be used to discuss, claim, or prove causality.

Causal relationships can be inferred from observational studies in epidemiology like in the case of Smoking and Lung Cancer or exposure to Asbestos and Mesothelioma. These causal relationships had been contemplated after many observational studies with different strength of associations and supported data from different study designs reported in the literature. One must conform to the Sir Bradford Hill criteria of causality as a whole and each study should respond to one or more of the causality criteria. No one observational study can conform or provide all causality criteria known as Bradford Hill criteria of causality. A discussion on whether an association exists or whether it can be considered causal should not occur or be claimed in vain nor reported from one observational study. All should be careful with the use of association and a causal relationship terms between an exposure and an outcome. Very few epidemiological studies provide associations and never causal relationships. Some studies have shown positive associations while others negate earlier findings and

provide a negative association. This should help clarify the differences and set a standard for definition moving forward.

There are countless examples found in the literature that would be of no additional value to mention in this editorial. An association is when we have a relationship which is not yet causal between an exposure and an outcome. This can be further explained by the association between Phenylpropanolamine (PPA) and Stroke. One could say that exposure of veterans to chemicals during the gulf war is associated with the gulf war syndrome but we cannot say with certainty that this association is causal. One would need to establish more evidence to form a concrete argument to substantiate this statement. One way to form this evidence would be to use the Hill criteria of causation. More conclusive work and data would be needed to prove causation than a simple association. An association can be proven in one study whereas cause-effect relationship needs more than one and preferably many observational studies. One observational study would never be able to prove any causation and therefore any discussion relating to causality from any one study would be invalid regardless of the study design.

The lack of understanding between association and cause-effect had led the public to become skeptical about epidemiological research in its inability to prove scientific evidence. This issue and had been debated for centuries. One could compare Koch's contribution in 1877 to Henle-Koch's postulates in 1882 establishing a causative relationship between a microbe and a disease. The fundamentals of causation have been outlined in detail from Greenland to Susser. The issue has been argued, presented, and verified. The use of association and causation remains blurred today in many peer reviewed journals and textbooks. The best example to date would be the causal relationship of cigarette smoking and the development of lung cancer. This causal relationship had been reported back in 1965 following the publication of Smoking and Health, Report of the Advisory

Committee to the Surgeon General of Public Health Service in 1950 by Sir Austin Bradford Hill. He was then a professor Emeritus of the Medical Statistics at the University of London. It is my intention, through this editorial piece, to raise awareness regarding the differences between "Associations" and "Causal Relationships or Cause-Effect Relationships". I would also like to disseminate and share this editorial piece to other researchers and educators with hopes to assist a new generation of scholars who will now be aware of the distinctions.

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