

## EDITORIAL



# The search for common causality

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There seems to be an increasing tendency amongst dental researchers to seek to find an association, and preferably a causal association, between oral and systemic disease. And that is the focus of this issue of *Evidence-Based Dentistry* – and of our latest topical collection which is now open to submissions, ‘Periodontal Disease and Systemic Health’ (<https://www.nature.com/collections/djdefchcbh>).

Looking for possible links between conditions of the mouth and conditions of the body is an admirable aim, but there does seem to be a slight desperation in some of the attempts to establish causal relationships. It’s almost as if there is a feeling that oral disease is not of sufficient importance on its own, and needs to be linked to a life-threatening condition in order to be worthy of attention. That is a stance with which I profoundly disagree. Oral disease affects more people than most diseases, and its repercussions and its enormous effect on people’s quality of life, mean it warrants our attention even if it turns out to be separate and distinct from other causes of ill health.

Which made me want to talk about the basic principles for the establishment of causal relationships, as set out by Bradford Hill<sup>1</sup>, who, like me, had concerns that statistical associations were being mistakenly assumed to imply a causal relationship between two variables. He suggested that a number of criteria had to be met before causality could be hypothesised. The first of these criteria is the strength of the relationship between the variables. If a statistical association is strong, the greater the likelihood that the relationship is causal. However, if the association is small, this does not necessarily imply that there is no causal relationship!

The second of Bradford Hill’s criteria is consistency. I think this is one of the most important of the criteria. Consistency is when the same association is seen time and again, in different places, by different people. Hence the importance of worldwide studies, and data sharing. And then there is the slightly more complex issue of specificity. That is, the proposed causal factor should lead to one, rather than several, outcomes.

Another important criteria (and this sometimes seems to be forgotten by researchers) is that events must be appropriately time-related. Hence the importance of longitudinal studies, which

allow this aspect to be studied. For causality to be implied, it must be shown that the proposed causal factor occurred earlier in time than the proposed outcome. Finally, the greater the exposure to a causal agent, the more likely the effect. This is called a “biological gradient” or “dose-response”.

Other, arguably less crucial, criteria may also be relevant. Firstly, there needs to be plausible explanation for how a causal relationship can exist i.e. a possible mechanism to link the cause and effect must exist. For example, we can explain the causation of caries by sugar because we can describe how acid is produced by the oral flora in the presence of sugar. Thus, the link between sugar consumption and caries is plausible. It is also helpful if the link can be simulated in laboratory experiments (this is called coherence) or that the association can be proven by experiment. Some people also think that reversibility (if the cause is removed, the effect disappears) is also a requirement if causality is to be established.

There has, of course, been debate about the value and validity of Bradford Hill’s criteria, but nevertheless they remain as extremely useful guidelines and are always worth keeping in mind. At the very least, they prevent us from, on observing a statistical association, leaping to the conclusion that there must be a causal relationship. With respect to the relationship between oral and systemic disease, we must also always remember that we have the difficult confounder of socio-economic status, which is related to most diseases, including those of the oral cavity, and can therefore be the reason for statistical associations which are not in any way causal. Beware then, any study purporting to demonstrate a link between two diseases, which does not control for social class.

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## REFERENCE

1. Bradford Hill A. The Environment and Disease: Association or Causation? *Proc R Soc Med.* 1965;58:295–300. <https://doi.org/10.1177/003591576505800503>.