Letter to the Editor: “Directed Acyclic Graphs for Oral Disease Research”

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We congratulate the authors on their splendid paper about the role of directed acyclic graphs (DAGs) in the design and analysis of observational studies. We wish to highlight some details while being aware of the big picture. The big picture comprises not only the “causal structure thought to underlie a given exposure and outcome” (Akinkugbe et al. 2016) but also causal conditions on exposure and outcome. About outcome, “if case inclusion in any epidemiologic evaluation takes into account information on exposure, it is apt to lead to biases. Instead, disease should be defined on the basis of criteria that have nothing to do with exposure” (Rothman 2012). Diseases per the RDC/TMD (Research Diagnostic Criteria for Temporomandibular Disorders) and DC/TMD (Diagnostic Criteria for Temporomandibular Disorders), such as “headache attributed to TMD,” however, are defined in terms of an exposure. About exposure, the validity of causal inferences also requires well-defined interventions (Hernán and Robins 2016). In relation to cardiovascular outcomes, for example, the exposure of missing, unreplaced teeth is closer to a the criteria for well-defined intervention than tooth loss is (Schwahn et al. 2013). Besides well-defined interventions, valid measurements are required for causal inference (Hernán and Robins 2016), whereas complex TMD definitions are prone to misclassification.

To solve detailed problems related to exposure or outcome, our experience is that augmented DAGs (Hernán and Robins 2016) may be helpful, especially in conjunction with testable implications (Textor et al. 2011). Augmented DAGs are designed for identifying different types of bias, including self-selection bias due to symptoms. For TMD, differentiating symptoms and signs should be a good starting point for augmenting the DAG.

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