



External Validity: A Forgotten Issue?

The Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD)¹ have fostered better research on TMD since they have provided well-defined inclusion criteria allowing for the classification of comparable TMD diagnostic subgroups across different studies. In addition, the RDC/TMD have made the dental community aware of the importance that the patient's psychosocial status plays in the etiology, prognosis, and therapy of TMD. As a consequence, researchers began investigating the patient's psychosocial condition. This Editorial was prompted by a case-control study that compared the TMD and psychological status of adults seeking orthodontic treatment for a deep bite with that of an age- and gender-matched control group of patients having a neutral occlusion and not seeking treatment.² The study concluded that deep bite patients had significantly more TMD signs and symptoms and higher somatization scores than the controls.

This conclusion obviously raises several questions. For instance, why should individuals with a deep bite have higher somatization scores than individuals with a normal occlusion, not to say why should they have more TMD signs and symptoms? What is the biological plausibility? Can the results alternatively be ascribed to a selection bias,³ which means that they should not be generalized?

Generalization, eg, the study's external validity, is the extrapolation of the research findings and conclusions from a specific study sample to the population at large, and although case-control studies are good instruments to study associations, they can also lead to biased conclusions if not interpreted properly, in particular if they do not warrant generalizability.

The representativeness of a sample to its disease/disorder target population is important when the sample is being used to draw generalized conclusions or to estimate the strength of possible risk factors. Thus, a major question for each study protocol is whether the characteristics of the cases investigated limit the generalizability of the results from that specific patient sample to the entire target population having the disease. For instance, in case-control studies aiming to test possible associations between occlusal features and TMD, the patient sample is often selected from private offices, clinics, and tertiary care centers. Due to their care-seeking behavior, these patients are probably not representative of their

source population that has the same condition without seeking treatment. Indeed, patients having both malocclusion and TMD are more likely to be referred or to make a self-referral to a specialized dental clinic than patients having similar malocclusions without any masticatory functional disorder. The former patients may also suffer from various somatic and psychological problems. For instance, propensity to somatization might confound any relation between occlusion and TMD, and can represent a threat to both external and internal validity of the findings. There are several examples of studies pointing to this problem, although they do not address the occlusion-TMD relationship. Subjects seeking care for dental cosmetic treatment, including orthodontics and orthognathic surgery, showed increased levels of psychosocial dysfunction and an increased frequency of body dysmorphic disorders,^{4,5} a condition that is strongly associated with somatization.⁶ Self-referred patients complaining of multiple somatic and mental symptoms attributed to amalgam fillings showed increased levels of anxiety, somatization, and depression in comparison to patients with dental fillings seen in ordinary dental practices.⁷ Moreover, subjects requesting prosthodontic treatment had a poorer oral health-related quality of life than individuals in the general population with the same prosthodontic status but not seeking therapy.⁸

Generalization problems can also occur for control groups if they are not randomly selected from the same population from which the cases are selected, as the controls may have several characteristics diverging from the target population of interest. While discussing the major principles underlying control selection in case-control studies, Wacholder and colleagues wrote: "Perhaps the key concept is that of the study base. If the study base is identified correctly and if controls are chosen from it properly, the exposure experience of the controls should be representative of the individuals who compose the base."⁹ Unfortunately, this is seldom the case for studies addressing a possible association between occlusion and TMD, in which controls are selected among dental students or staff members of the institution to which the patients are referred. Dental students and/or staff members can be, for instance, more aware of the risk of parafunction and therefore avoid it, and parafunction is just one of the well-known TMD risk factors.



Studies on risk factors for TMD should have a good internal validity but also a strong external validity. There is a tendency to favor the former, by randomizing the individuals and including a number of inclusion and exclusion criteria to strategically select homogeneous and matched samples for several established risk factors (eg, age and gender). Unfortunately, they are seldom matched for the other risk factors such as the degree of stress and other psychological factors (eg, somatization, anxiety, depression, parafunctional oral habits, and genetic factors). In addition, less emphasis is set on selection of samples best representing the population at large.

Conducting a study with low external validity provides information limited to the selected sample and prevents generalizability. This is often the case with the vast majority of studies on the etiology of TMD and is the main cause for the still present confusion that is apparent over the role of occlusion in TMD. One way to increase representativeness of groups investigated and generalizability of the findings is to use community-based samples, which are not selected according to patient referral. Noteworthy, three studies conducted on large, randomly selected community-based samples showed that overbite, overjet, and cross-bite are not risk factors for TMD.¹⁰⁻¹²

Lack of external validity carries the inherent risk that non-critical readers erroneously generalize the results and conclude, for instance, that TMD can be caused and therefore can be treated by correcting a nonideal occlusion. Lack of understanding for the generalizability principle is basically also the reason why many clinicians believe in a causal relationship between occlusion and TMD, and consider the conclusions emerging from well-designed rigorous investigations invalid or at best irrelevant to the patients they treat. This happens not because clinicians are poor observers, but because the patients encountered in their day-to-day clinical experience represent a specific clinical subgroup, whose characteristics often strongly diverge from the entire population having that disease.¹³

Only enhancement of external validity will increase our knowledge of TMD risk factors and, hopefully, concur in eliminating some of the prejudices still in vogue on TMD etiology. Editors and reviewers need to give preference to research on risk factors for TMD that warrant generalizability of the findings. Lastly, clinicians should understand that the patients treated in their offices do not represent the population at large and should therefore be most careful in generalizing their observations.

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