22 April, 11:40 - 12:00, Auditorium Francisco Sampaio

Statistical modelling methods applied to the diagnosis of temporomandibular disorders

Ricardo São João[1], **Henrique J. Cardoso**[2], **David F. Ângelo**[3]
[1] Polytechnic Institute of Santarém, Portugal; CEAUL, Portugal; CINDUR, Portugal; CEG-Uab, Portugal, ricardo.sjoao@esg.ipsantarem.pt
[2] Instituto Português da Face, Portugal, henrique.cardoso@ipface.pt
[3] Instituto Português da Face, Portugal; Centre for Rapid and Sustainable Product Development, Polytechnic Institute of Leiria, Portugal; Faculty of Medicine of Lisbon University, Portugal, david.angelo@ipface.pt

---

The aim of this presentation is to illustrate statistical modelling applied to temporomandibular disorders (TMD). The multifactorial aetiology and pathogenesis of TMD, its complexity and consequently its correct diagnosis are challenges in the medical field. Statistics can make an additional contribution to its better understanding. A diversified range of statistical approaches will be used based on the records present in the EUROTMJ database, considering patients diagnosed with TMD in the last three years.

Keywords: temporomandibular disorders, diagnosis, logistic regression, statistical modelling

---

Temporomandibular disorders (TMD) are a set of musculoskeletal and neuromuscular disorders that involve the temporomandibular joint, the masticatory muscles and all associated structures. Aetiologically, TMD are associated with various risk factors that, individually or together, contribute to triggering the development of the disease. Anatomical, pathophysiological, psychosocial, hormonal, traumatic and gender-related aspects are identified as risk factors. The most frequent symptom of TMD is orofacial pain that affects a large part of the population. Other symptoms are also frequently reported: sounds in the joint, limitation in opening the mouth, masticatory and cervical muscle tension, headaches, otalgia, ear fullness, tinnitus and vertigo. The origin of TMD symptoms may be related to muscular or intra-articular changes, or both.

Epidemiologically, it is not easy to estimate the prevalence of TMD due to the underdiagnosis performed by several health professionals. Due to its multifactorial aetiology and pathogenesis, it serves as motivation for the application of statistical modelling, justifying the topic of the present communication. To this extent, a 3-year prospective study was designed with patients diagnosed with TMD from 2019 to 2022 at the Instituto Português da Face. Clinical data, registered in the EUROTMJ database, was considered for its implementation.

The initial statistical approach analyzed the prevalence of clinical signs and symptoms of TMD and their association with sociodemographic characteristics, risk factors, comorbidities, most frequent complaints and parafunctional habits. Given the nature of some of these variables, measured on a nominal/ordinal scale, the contingency tables were used, namely to perform independence tests and association measures. On the other hand, when variables measured on an interval/ratio scale are considered, Pearson's parametric correlation coefficient was used or, alternatively, Spearman's non-parametric coefficient. Another relevant aspect concerns the distribution of different variables according to their TMD classification, which requires the use of the parametric ANOVA test or the non-parametric Kruskal Wallis test and, if necessary, the *post hoc* tests.

Subsequently, a relevant question for clinical practice and statistics will be to what extent the adoption of self-report questionnaires (e.g. Fonseca Anamnestic Index-FAI and Visual Analog Scale-VAS) can contribute to a correct classification of the TMD diagnosis. Definitive TMD diagnosis is made through clinical and imaging analysis, namely through computed tomography, magnetic resonance imaging or minimally invasive methods. We know that these procedures are expensive and time-consuming when compared to self-report questionnaires that are easy to answer, quick and inexpensive. However, it is not known to what extent the identification of certain patterns in these questionnaires together with other characteristics of the patients can contribute to a correct diagnosis of TMD. Therefore, we used Generalized Linear Models with logit link function, specifically the Multinomial and Ordinal Logistic Regression models, given the nature of the TMD response variable. The subdivision of the sample to determine the training model (adjustment) and the test model (validation and prediction), the use of discriminant measures and measures of quality of adjustment, as well as the selection of the covariates (manual vs. automatic choice) to be included in the final model, are important when combined with the remaining assumptions (absence of complete separation, absence of multicollinearity, proportional hazards, independence of irrelevant alternatives, etc.). The methodology now implemented is very well portrayed in the Frank Harrell's book [1]. The level of accuracy of the previous model(s) dictates the pertinence of using this type of scales obtained through self-report questionnaires or by seeking other alternatives.

Acknowledgements This work was supported by Research Grant SORG 2019-project: "EUROTMJ –recording TMJ outcomes in a central database". This work was co-financed by Fundação para a Ciência e Tecnologia (FCT), project UIDB/00006/2020

References

[1] F. E. Jr. Harrell. *Regression Modeling Strategies With Applications to Linear Models, Logistic and Ordinal Regression, and Survival Analysis.* Springer Series in Statistics, Switzerland, 2016.