Analysis of the Health-Related Quality of Life through PROreg R package: a case study of patients with eating disorders

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Patient-reported outcomes (PROs) are becoming important indicators of the health status of patients in observational and experimental studies. PROs are measured through questionnaires leading to several dimensions that constitute the PRO. The dimensions are constructed as a sum of ordinal responses to several items and, hence, they are defined as bounded and discrete scores, which, due to patients' perception variability, usually show U, J, or inverse J shapes. Consequently, PRO dimensions tend to have excess variability beyond the binomial distribution, a property called overdispersion.

In this context, beta-binomial distribution has been proposed in the literature to fit PRO dimensions, and beta-binomial regression as a good alternative for modelling purposes. However, the fact that the beta-binomial does not belong to the exponential distribution family limits its applicability in both distributional and regression framework.

In this work, we present the PROreg R-package, an innovative R package which offers a wide variety of functions that implement models based on the beta-binomial distribution. These functions can be can very useful when analysing overdispersed binomial data in regression framework, especially PROs such as Health-Related Quality of Life (HRQoL). With the aim of showing the contribution of the package to clinical application, we have developed two different model approaches to analyse the HRQoL of patients diagnosed with eating disorders who were followed up for two years at Galdakao-Usansolo Hospital in Biscay. The objective was to check the influence of clinical and sociodemographic variables on the HRQoL of the patients. In the first approach, we selected a specific HRQoL dimension and we aimed to analyse the effect of some covariates on the evolution of the dimension over time. Therefore, we applyed a longitudinal beta-binomial regression model, where specific matrices that define the temporal correlation within patients were defined. For the second approach, it is worth mentioning that in real practise, as it was done in the first approach, each of the dimensions that constitute the PRO is analysed separately. This approach can have a loss of information as PRO dimensions given by the same questionnaire tend to be correlated. Therefore, in this case, we applyed a multidimensional beta-binomial model to analyse the influence of clinical and sociodemographic variables in the dimensions of the HRQoL all together. Clinical interpretations of the results, such as the matrices that must be constructed before applying the functions that implement the models are explicitly shown.

Keywords: PROreg, Patient Reported Outcomes, Beta-binomial regression