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Focus on: Contemporary Methods in Biostatistics

New Statistical Methods in Cardiovascular Research

Nuevos métodos estadísticos en la investigación cardiovascular

Juan Sanchis,[a,*] Pablo Avanzas,[a] Antoni Bayes-Genis,[a] Leopoldo Pérez de Isla,[a] and Magda Heras[b]

[a] *Associate editor, Revista Española de Cardiología*
[b] *Editor-in-Chief, Revista Española de Cardiología*

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As part of its on-going training and updating efforts, *Revista Española de Cardiología* is beginning a new miniseries on advances in statistical methods.[1] Statistics is an increasingly important part of our activity, both in research and clinical practice. Being able to interpret the findings presented in articles or at scientific conferences, and being able to appreciate their relevance, often depends on having an adequate understanding of statistics. Clinicians, when presented with a series of patient-related data, need to know how those data relate to the patient's current situation (diagnosis) or future (prognosis). For a new diagnostic examination or treatment to be recommended, it must have shown its statistically significant superiority to existing alternatives.

Statistical techniques are continuously evolving, with new methods being increasingly adopted in clinical research. The objective of this miniseries is to familiarize cardiologists with new statistical methods that are replacing or complementing traditional methodology. The topics addressed in the miniseries are summarized below.

NEW PREDICTIVE MODELS AND THEIR ASSESSMENT

In many areas of medical research, the attribute of interest is binary and information is expressed as a probabilistic predictive model for that attribute. Predictive models are most commonly assessed based on their discriminative ability and their goodness-of-fit.[2] Discriminative ability refers to whether the model successfully discriminates between patients with and without the attribute of interest and can be measured using the C statistic, which corresponds to the area under the ROC (receiver operating characteristic) curve. Calibration refers to the degree of correspondence between the frequency of events predicted by the model and the frequency of events observed in the population and is evaluated using the Hosmer-Lemeshow test.

New methods have recently been introduced to assess this type of model.[3] They include risk reclassification techniques, which estimate the number of patients whose risk would be reclassified when a particular marker is added to the model. This approach can thereby provide an overview of the marker's clinical utility. Risk reclassification indicators include the NRI (Net Reclassification Improvement) and IDI (Integrated Discrimination Improvement).[4] Decision curves have also been proposed as a means of evaluating prediction models. They attempt to illustrate the clinical usefulness of a model by showing the net benefit achieved when taking decisions based on the model.[5]

PROPENSITY SCORE

One of the limitations of observational studies is the existence of baseline differences between groups of patients treated in different ways. These differences may influence any divergence in outcomes when comparing the treatments. However, this potential bias can be minimized using the propensity score, which measures the likelihood that a patient will be in a given treatment group based on his or her pre-treatment characteristics.[6] Although this adjustment can be made by introducing covariates in a multivariate model, such models support only a limited number of covariates. The main contribution of the propensity score is that it behaves as a single variable that includes all possible covariates contributing to the bias.[7]

COMPETITIVE EVENTS ANALYSIS

Biomedical studies often evaluate the effect of a variable (eg, an intervention or risk factor) on the occurrence of an event in time. When the event considered is total mortality, traditional statistical techniques such as Cox models and Kaplan-Meier curves are adequate. However, for other events (eg, cardiac death or myocardial infarction), the presence of competitive events (eg, non-cardiac deaths) may prevent the event of interest appearing, thereby altering the risk estimate. In such situations, competitive event analysis should be used instead of the traditional statistical models.[8,9]

METAANALYSIS

Interest in metaanalysis has been growing. The possibility of combining data from several studies allows for an overall analysis with greater statistical power. Indeed, conclusions from metaanalyses provide a high level of evidence in clinical practice guidelines. However, interpreting the results of metaanalyses can be problematic due to the presence of several sources of bias.[10,11] The quality of metaanalyses also varies substantially and several flaws have been highlighted both in the methodological aspects of

* Corresponding author: *Revista Española de Cardiología,* Sociedad Española de Cardiología, Nuestra Señora de Guadalupe 5-7, 28028 Madrid, Spain.
E-mail address: rec@revespcardiol.org (J. Sanchis).

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the metaanalyses and in the individual articles contributing to them. It is therefore essential to understand metaanalytical techniques in order to be able to critically evaluate them.

CONCLUDING REMARKS

We hope that this miniseries will be well received by readers of *Revista Española de Cardiología*. We are aware that the articles are aimed at an audience that is not expert in statistical methodology. For that reason, the topics addressed will be presented in an understandable and practical way. The final goal is to increase our awareness and understanding of new statistical methods in the hope that this will improve our capacity for critical analysis of scientific articles as well as enhancing our work as clinical investigators.

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