

## More erroneous statements about the use of frequentist statistical methods in medical research

Sir,

I read the response (1) to Dr. Yazici's letter commenting on a recent publication (2). Dr. Livneh *et al.* reply contains statements on the application of common frequentist statistical techniques. I quote: "Dr. H. Yazici criticised some of our secondary outcomes as being incorrect, by using a more sophisticated phrasing - type 1 and type 2 errors. This terminology refers to false negative and false positive results, with respect to a certain null hypothesis. However, in the absence of such hypothesis, the use of these terms is incorrect, and typing errors as 1 or 2 is inappropriate. Also, as calculated and discussed in our paper, despite the small sample size, the study is statistically powered; this precludes the occurrence of type 1 and type 2 errors based on sample size."

Now, one cannot analyse differences in secondary outcomes between groups, as Livneh *et al.* did, by applying frequentist statistical tests and calculating  $p$ -values, without a null hypothesis. The  $p$ -value is defined by the null hypothesis. As recent-

ly reiterated and discussed in a position paper of the American Statistical Association (3), the  $p$ -value is: "the probability for a given statistical model that, when the null hypothesis is true, the statistical summary (such as the sample mean difference between two compared groups) would be the same as or more extreme than the actual observed results."

So, when performing statistical tests one cannot get away from a null hypothesis (even if kept implicit) nor from type 1 and 2 errors. In addition, power calculations help to limit type 1 and type 2 errors given certain assumptions, but can never preclude their occurrence.

M. BOERS, *MSC, MD, PHD*

*Department of Epidemiology and Biostatistics, VU University Medical Centre, Amsterdam, the Netherlands.*

*Please address correspondence to:*

*Dr. Maarten Boers,*

*Department of Epidemiology and Biostatistics, VU University Medical Center, PO Box 7057,*

*1007 MB Amsterdam, the Netherlands.*

*E-mail: m.boers@vumc.nl*

*© Copyright CLINICAL AND*

*EXPERIMENTAL RHEUMATOLOGY 2017.*

*Competing interests: none declared.*

## References

1. LIVNEH A, BEN-ZVI I, LIVNEH A: Anakinra for colchicine resistant familial Mediterranean fever - Reply to the comment by H. Yazici. *Arthritis Rheumatol* 2017; accepted article.
2. YAZICI H: Important issues with the double blind study of Anakinra in FMF. *Arthritis Rheumatol* 2017; accepted article.
3. WASSERSTEIN RL, LAZAR NA: The ASA's statement on  $p$ -values: context, process, and purpose. *The American Statistician* 2016; 70: 129-33.