Dear Editor:

Statistical analysis is an important aspect of clinical research. It helps researchers to make accurate inferences based on information gathered from various groups of participants. These inferences later help them to develop a better understanding of an association for a particular research question. Not many people are aware that there are two schools of thought regarding the approach to statistical analysis. The two approaches, the frequentist method and the Bayesian method, have different philosophies.

In the frequentist approach, the probability of a hypothesis is not computed. The Bayesian approach requires computation of the probabilities of both the data and the hypothesis. For frequentist methods, the probabilities of both observed and unobserved data are required. On the contrary, Bayesian methods require a prior probability and the probability of the observed data. The Bayesian approach is based on Bayes’ theorem that the posterior probability is in proportion to the product of the likelihood and the prior probability. In other words, the probability of an event occurrence is derived from previous information related to the event. The characteristic feature of a frequentist approach is a fixed population value of unvarying quantity without a probability distribution. Then, either a confidence interval (CI) is calculated for this quantity or significance tests of hypotheses are performed. In the Bayesian approach, the population means and proportions are unknown quantities that have probability distributions. As the ideology of the Bayesian approach differs from that of the frequentist method, the derived conclusions are different, especially when the observed effect sizes are relatively large but the statistical power is relatively small [1].

Unlike the frequentist approach, which uses null and alternate hypotheses, the Bayesian approach uses a prior probability also known as a prior and a posterior probability. The terminology “prior” means the probability of an event occurring before collection of any new information or data. The term “posterior probability” is the revised probability of an event that occurs after gathering the new information. The problem with a prior is that there is no uniform or standard method for choosing. With different priors, there will be different posterior probabilities and, thus, different conclusions. In frequentist statistics, the p-value or probability is the likelihood of rejecting the null hypothesis that an intervention or modality has no effect. An isolated P-value should be interpreted with caution as it is very prone to false positives. Many researchers have shown that the P-value provides limited information about the data and can result in misinterpretation. A CI provides a range of values within which the true value is certain with a given level of confidence. A narrow CI is significant, and a wide CI suggests that the P-value should be interpreted with extreme caution.
Many researchers have recently challenged the results of multicentric trials and questioned the conclusions of the frequentist approach. Zampieri et al. [2] reanalyzed the results from the study by Hernández et al. [3], also known as the ANDROMEDA-SHOCK trial. The initial study compared peripheral perfusion-targeted resuscitation during early septic shock in adults with a lactate level-targeted resuscitation for reducing mortality using the frequentist approach. The authors concluded that the resuscitation approach leading to normalization of capillary refill time did not reduce the 28-day mortality compared to that improving serum lactate level. However, when the Bayesian approach was utilized to analyze the data, the authors concluded that capillary refill-targeted resuscitation could result in lower mortality and early resolution of organ dysfunction compared to the results of lactate-guided resuscitation.

Combes et al. [4] investigated mortality at 60 days with the use of extra-corporeal membrane oxygenation (ECMO) compared to that of the conventional mechanical ventilation strategy (ECMO to Rescue Lung Injury in Severe ARDS trial) in patients with very severe acute respiratory distress syndrome (ARDS). Upon analysis, the authors concluded that the 60-day mortality was not significantly reduced when ECMO was used in ARDS compared to when using traditional mechanical ventilation that included ECMO as a salvage therapy. Combes et al.’s study [4] used the frequentist approach. Later, Goligher et al. [5] performed post hoc Bayesian analysis of data from the EOLIA trial by Combes et al. [4]. The analysis based on mortality data revealed that ECMO might have some benefits over conventional ventilation. This uncertain conclusion was due to heterogeneous patient recruitment from different centers, and the fact that the Bayesian analysis was conducted post hoc and was not planned initially.

In conclusion, the Bayesian approach should be considered for larger and multicentric clinical trials instead of the frequentist approach due to its flexibility and allowance for better interpretation of the results due to probabilities being assigned to the events. Researchers should involve statisticians in the decisions regarding the best approach for a particular study from the planning stages of the research.

CONFLICT OF INTEREST

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REFERENCES