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# Importance of Sample Size Calculation and Power Analysis in Scientific Studies: An Example from the Balkan Medical Journal

The main aim of all observational or experimental scientific studies is to reveal scientific reality. Samples have a direct effect on the results of scientific studies. All of the guidelines in the EQUATOR network developed for observational and experimental studies include items that state how the sample size of studies was calculated and selected.[1] Since type I and II errors are taken into account, the method of determining the number of samples by power analysis has become widespread. The sample size and power analysis help determine whether the hypotheses put forward about the results of the study are feasible with the available resources.[2,3]

Recently, we had to reject quite a few articles because of insufficient sample size. Thus, we wanted to inform the authors about this issue and evaluate the articles published in our journal in the last ten years from this point of view. Here 448 studies published in the Balkan Medical Journal between 2011 and 2021 were reviewed. Of these studies, 427 conducted on humans and animals (88 animal experiments, 223 cross-sectional studies, 49 case-control studies, 29 cohort studies, 15 diagnostic accuracy studies, and 25 randomized controlled studies [RCTs]) were evaluated. Twenty-one studies in other categories were excluded. The included studies were evaluated in terms of study design, total sample size, group number, and sample size method.

Table 1 shows the reporting rates of the sample size or power analysis by study design. In animal experimentation studies, the median total number of samples is 31.5 and the median number of groups is 4. How the sample size was calculated was reported in only 8% of animal experiment studies. The median total number of samples in observational studies is 108, and the median number of groups is 2. How the sample size was calculated was reported in 9.5% of the observational studies. Among observational studies, how the sample size was calculated is reported in the highest rate in cohort studies (13.8%), followed by diagnostic accuracy studies (13.3%), case-control studies (12.2%), and cross-sectional studies (8.1%) In experimental RCTs, this rate was 16% (Table 1). We also wanted to see the change in sample size or power analysis reporting rates over the years. Figure 1 shows the reporting rates of the sample size or power analysis by year. As shown in Figure 1a, sample size or power analysis reporting rates have increased significantly across all article types after 2017. This significant improvement in RCTs is observed after 2016 (Figure 1b).

Sample size and power analysis aims to determine the number of participants required to test a predetermined hypothesis (a priori power analysis) or determine the power to detect a particular relationship with a given sample size (a post-hoc power analysis).

**TABLE 1.** Sample Size or Power Analysis Reporting Rates by Study Design in Articles Published in the Balkan Medical Journal between 2011-2021

| Study design | Total sample size | Group number | Reported sample size or power analysis |
|---|---|---|---|
| Animal experimentation (n = 88) | 31.5 (10-96) | 4 (1-12) | 8.0% |
| Observational studies (n = 314) | 108 (5-955369) | 2 (2-12) | 9.5% |
| Cross-sectional studies (n = 221) | 136 (12-30824) | 2 (2-12) | 8.1% |
| Case-control studies (n = 49) | 98 (12-14856) | 2 (2-4) | 12.2% |
| Cohort studies (n = 29) | 74 (13-955369) | 2 (2-4) | 13.8% |
| Diagnostic accuracy studies (n = 15) | 76 (42-646) | 2 (2-5) | 13.3% |
| Experimental studies (randomized controlled study) (n = 25) | 59 (22-168) | 2 (2-3) | 16.0% |

Median (minimum-maximum)

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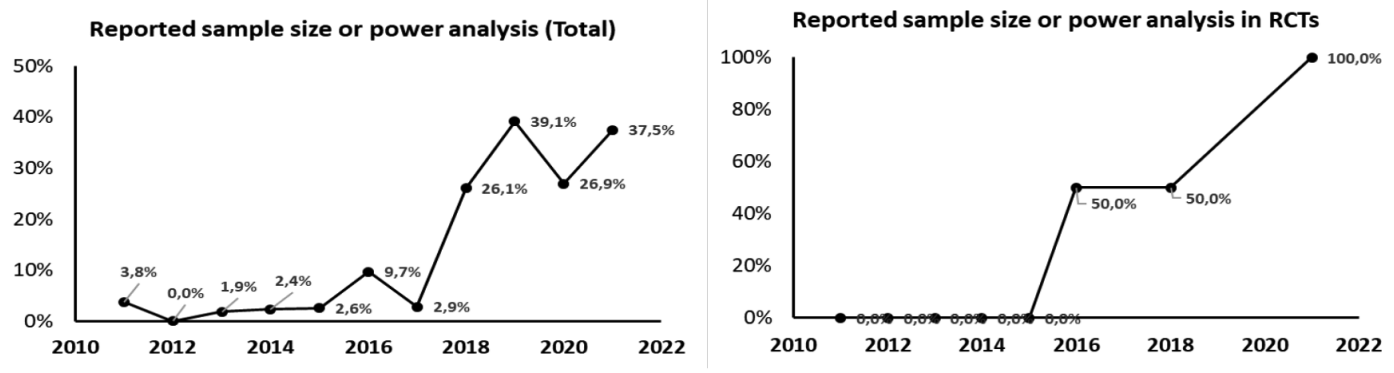


FIG. 1. Sample size or power analysis reporting rates by years in all articles and randomized controlled trials (RCTs) published in the Balkan Medical Journal between 2011-2021. The significant improvement in 2016 and beyond is remarkable

Regardless of the type of the scientific study, determining the number of samples in a scientific framework and conducting the study accordingly are important in conserving resources, time, and effort.[2]

Although reporting of sample size calculations has increased greatly over the past two decades, only about one-third (34%) of sample size calculations are adequately described even in high-impact general medical journals.[4] In the analysis done for Gait and Posture, the authors explored the frequency and ways of sample size justification. They stated that the sample size in most of the articles were not justified and that the inclusion of the guide in the instruction to authors did not make a significant change in the percentage of articles that provided a justification (from 16.6% to 28.1%).[5] For our journal, of course, these rates, as an average of 10 years, are below the desired level; however, the significant increase in recent years is an indication that we are on the right track (Figure 1).

In RCTs, it is very important to accurately report the sample size and comply with the CONSORT criteria. In the literature, compliance with the CONSORT criteria in RCTs varies between 6% and 76%.[6-8] We recently evaluated abstracts of RCTs published between 2012 and 2018 in five general medical journals in the Balkan region to determine the level of compliance of abstracts with the CONSORT abstract checklist. Consequently, the overall level of compliance with the CONSORT checklist was 44.5% (95% confidence interval 41.9%-47.1%).[9]

In conclusion, studies having a sufficient number of samples and representing the society as a structure are of great importance; thus, how the sample number is determined should be stated in scientific articles. Moreover, the use of EQUATOR network guides when planning and writing a study is vital for researchers. Manuscripts written in accordance with these guidelines positively change the first impressions of the editors and reviewers. It is also a solid indication of the rigor of the author and the research. We, the editors, should be sensitive and take an active role in training researchers and authors on this subject.

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