

Analysis of the use of sample size calculation and error of method in researches published in Brazilian and international orthodontic journals

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Abstract

Introduction: Reliable sample size and an appropriate analysis of error are important steps to validate the data obtained in a scientific study, in addition to the ethical and economic issues. **Objective:** To evaluate, quantitatively, how often the researchers of orthodontic science have used the calculation of sample size and evaluated the method error in studies published in Brazil and in the United States of America. **Methods:** Two major journals, according to CAPES (Brazilian Federal Agency for Support and Evaluation of Graduate Education), were analyzed through a hand search: *Revista Dental Press de Ortodontia e Ortopedia Facial* and the *American Journal of Orthodontics and Dentofacial Orthopedics* (AJO-DO). Only papers published between 2005 and 2008 were examined. **Results:** Most of surveys published in both journals employed some method of error analysis, when this methodology can be applied. On the other hand, only a very small number of articles published in these journals have any description of how sample size was calculated. This proportion was 21.1% for the journal published in the United States (AJO-DO), and was significantly lower ($p= 0.008$) for the journal of orthodontics published in Brazil (3.9%). **Conclusion:** Researchers and the editorial board of both journals should drive greater concern for the examination of errors inherent in the absence of such analyses in scientific research, particularly the errors related to the use of an inadequate sample size.

Keywords: Biostatistics. Sample size. Error of methods.

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Editor's summary

Science advancement depends fundamentally on methodologically well-designed studies. Recently, two methodological issues have gained prominence: Method error and sample size calculation. Method error is usually obtained by duplicating some of the measurements performed within a given time interval in order to verify that the analyzed data are reproducible, which ensures that the methodology employed in the research is indeed reliable. On the other hand, sample size must be appropriate before important clinical differences, if any, can be proven statistically significant. Given the scientific importance of these calculations, the present study sought to examine the frequency with which sample sizing and method error appear in the Brazilian and international orthodontic literature.

The two foremost scientific journals of orthodontics in Brazil and abroad — according to the Brazilian Federal Agency for Support and Evaluation of Graduate Education (CAPES) — were found to be the *Revista Dental Press de Ortodontia e Ortopedia Facial (Dental Press)* and the *American Journal of Orthodontics and Dentofacial Orthopedics (AJO-DO)*. Ninety-two original articles published in the Dental Press journal (2005-2007) and ninety-four in the AJO-DO (2007-2008) were evaluated. The results showed that within this time period sample size calculation was used in only 3.9% of articles published in the Dental Press journal compared to just over 21% in the AJO-DO, with a statistically significant difference between them.

The use of method error, however, was reported in 60.9% of the Dental Press journal articles and 76.6% of the AJO-DO articles. The authors concluded that although method error is often employed, there was a fairly limited number of articles in which sample sizing was performed in both periodicals, with a greater, statistically significant difference in the Dental Press journal. In light of this finding, greater attention should be paid by reviewers, researchers and editors to appropriate sample sizing in orthodontic studies in order to ensure more reliable scientific results.

Questions to the authors

1) What issues should be addressed in defining the size of a sample in a prospective clinical study?

Proper sample size, along with an appropriate analysis of the method error, are important steps in validating the data obtained in a particular scientific study, in addition to economic and ethical issues. Studies using a small sample may not produce useful results, exposing their subjects (sample) to unnecessary risks, while an overly large sample size consumes more resources than necessary, exposing many individuals to existing risks.

To understand the importance of sample size calculation we need to understand what “power” means in statistics. Power expresses the probability of detecting a true effect. Small samples reduce the power of a study. However, excessively large samples often provide statistical significance between study groups³ even when the difference is negligible and considered clinically unimportant. In addition to the desired level of certainty expressed by the p value and by power, other factors form part of the formula that defines the sample size.^{1,2,4} These are:

- a) The minimal clinical effect that the researcher wishes to see in the main (primary) study variable.
- b) How the data obtained in the study will be measured (continuous, ordinal or nominal scale).
- c) The type of statistical test to be used, and if it is a one-tailed or two-tailed test.
- d) The variability of the data obtained in the study.

2) How important are studies like yours?

The results of this research disclosed that only 3.9% of the articles published in the Dental Press journal in the years 2005 through 2007 presented data regarding sample size calculation. This percentage was significantly lower ($p=0.008$)

TABLE 1 - Absolute and relative frequency (%), relative difference, p-value and power for papers with statistical analysis (A) and the description of sample size calculation (B), published in the *Revista Dental Press de Ortodontia e Ortopedia Facial* and in the *American Journal of Orthodontics and Dentofacial Orthopedics*.

Description	Dental Press 2005-2007	AJO-DO 2007-2008	Difference (%)	p-value	Power
Original articles with statistical analysis (A)	51 (100%)	57 (100%)	----		
Articles with sample size calculation (B)	2 (3.9%)	12 (21.1%)	-17.2	0.008**	0.78

**p<0.01.

compared to articles published in AJO-DO, in which little more than 21% of the articles comprised a description of the methods used for sample size calculation (Table 1). These data reflect a worrying neglect on the part of researchers and reviewers regarding this important factor, responsible for errors occurring in the statistical evaluation of data obtained in articles published by these two major journals.

3) How do the authors see Brazilian scientific research in the field of orthodontics in today's international context?

Orthodontics as a science has evolved continuously, as well as the use of statistical methods. In Brazil, this growth is noticeably faster. In previous decades certain studies were published which today would probably not be accepted due to methodological issues. Among these issues are the use of sample size calculation and method error. Competitiveness imposes increasingly stringent standards, and therefore whoever shows concern about this issue will certainly receive a more favorable evaluation from reviewers and editors. In a recent interview published in the AJO-DO, the then editor-in-chief,⁵ remarked: "... I am amazed at the number of authors who conduct quite creative studies but submit a manuscript without considering the need of calculating the number of subjects required for the findings to be rated as statistically significant..."

In terms of published works, Brazilian orthodontic literature is the most active in the world. Given this fact, the researchers likely to achieve greater success are those who put in their best efforts in the planning and implementation of statistical methods. In other words, inspiration is still important, but perspiration has become the differentiator key.

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