RESEARCH DESIGN AND STATISTICAL ERROR OF ARTICLES SUBMITTED IN A PUBLIC SECTOR MEDICAL JOURNAL - A RETROSPECTIVE SURVEY

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ABSTRACT

Objective: The objective of this study was to identify the quality of statistical procedures used, the accuracy of study design, sampling and relevant statistical analysis

Study Design: Retrospective Survey study.

Place and Duration of Study: Army Medical College from June 2014 to Jan 2015.

Methodology: Three hundred and forty two original research articles published in Pakistan Armed Forces Medical Journal were reviewed. The selected research articles were all original articles. Case series and case reports were excluded.

Results: Among 342 articles, the major error was that the objectives, results and conclusion were not in accordance with each other in 115 (33.6%) articles. In 48 (14%) articles study design was incorrect and does not matched with the objectives. In 26 (7.6%) articles sample size was not appropriate as per the guidelines of journal. In 12 (3.5%) articles sampling technique used for sample selection was not mentioned. In 62 (18.1%) articles type of variables was incorrectly defined. In 6 (1.8%) articles descriptive statistics were not given at all. In 13 (3.8%) articles inferential statistics were not given articles. In 60 (17.5%) articles figures and tables were either not given or if given were incorrect. The pattern of statistical errors was almost similar in different years with a little bit difference but that difference could not attained any statistical significance ($p = 0.460$).

Conclusion: In order to maintain the standards of the medical writing in research with authentication the teaching of statistical methods should be enhanced.

Keywords: Biomedical research, Statistical error, Statistical methods.

INTRODUCTION

Research is concerned with critical or scientific enquiry[1]. Research methodology is a well-recognized discipline having highest importance in medical writing[2]. Types of scientific papers can be editorial, original article, review article case report, letter to editor and short communication. Organization of a scientific paper includes paper title, authors, abstract, introduction, material & methods, results, discussion, conflict of interest declaration and acknowledgment. Objectives should contain specific, measurable, achievable, realistic and time bound information. Material and methods is also called patients/subjects/participants methods and includes following place and duration of study, permission from institutional review board/medical ethics committee, written informed consent from patients/subjects, study design, sampling technique, inclusion and exclusion criteria, data collection procedure and data analysis[3].

Statistics is the study of the collection, analysis, interpretation, presentation, and organization of data. In applying statistics to a scientific problem, it is necessary to begin with a population or process to be studied. It deals with all aspects of data including the planning of data collection in terms of the design of surveys and experiments[4]. Importance of statistics and its appropriate application in every field of life are inevitable. Research conducted in all sciences, particularly in medicine stipulates the usage of statistics to make the results unswerving and authentic. Any research, can be of no worth if it fails to accomplish the tasks for which it is conducted, if statistics involved in it contains error[5]. It has been attested now, that many articles published in medical journals restrain errors in them. Particularly in Pakistan, the use of statistics is not given the suitable worth, resulting in many

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statistical flaws. Thus, it has become the need of hour to investigate these errors, highlight and consequently make an effort to eradicate them from medical research. This study has been designed to scrutinize such errors in Armed Forces Medical Journal of Pakistan (PAFMJ).

METHODOLOGY

Three hundred and forty two original research articles published in PAFMJ were reviewed through systematic sampling in retrospective survey study at Army Medical College from June 2014 to January 2015 The standards of quality for different study designs were derived from the corresponding statements, such as CONSORT, STROBE, STARD and TREND statement[6,7]. Statistical methods were categorized by a modified method used by Emerson[8]. We counted all the statistical methods used in an article, but if a method was used repeatedly in that article, it was only counted once. All the original research articles submitted for the consideration of publication were selected. All articles are reviewed by the editorial board and then forwarded for peer review as a protocol. All the articles are reviewed by the statistician and two subject experts. Case series and case reports were excluded from the study. In year 2010, 2011, 2012, 2013 and 2014 total 19,29, 26, 35, 46 original articles were received respectively. Study design, sampling size estimation, sampling technique, variable definition, descriptive statistics, inferential statistics, errors in figures and tables, objectives of the study, methodology, results and conclusion were the important parameters which were evaluated to reach conclusion.

Data was presented as percentages and frequencies using the descriptive statistical methods. Chi square were applied to calculate the *p* value. A *p* value of <0.05 was considered statistically significant.

RESULTS

Total 342 articles were assessed for statistical errors submitted to PAFMJ in the last five years from 2010 to 2014. Statistical errors, flaws and deficiencies related to the design of study and statistical analysis were assessed as mentioned in the methodology. Among 342 articles, the major error was that the objectives, results and conclusion were not in accordance one another in 115 (33.6%) articles figure-1. In 48 (14%) articles study design was incorrect and does not matched with the objectives. In 26 (7.6%) articles sample size was not appropriate as per the guidelines of journal and the statistical criteria of the sample to be representativeness. Only 316 studies mentioned the appropriate formula for sample size calculation. In 12 (3.5%) articles sampling technique used for sample selection was not mentioned. In 62 (18.1%) articles, types of variables was incorrectly defined. In 6 (1.8%) articles descriptive statistics were not given at all. In 13 (3.8%) articles inferential statistics were not given. The articles in which inferential statistics were used but did not mention whether the assumptions for statistical test used, met or not. The cut off point (for the significance) of p-value was not given, and these studies were not compared with any specific *p*-values. In 60 (17.5%) figures and tables were either not given or if given were incorrect. Wrong name of statistical test was

Table: Year-wise description of different types of errors.

Type of error	2010	2011	2012	2013	2014
Study design	6	15	7	8	12
Sample size estimation	6	3	5	5	7
Sampling technique	0	1	0	3	8
Proper variable identification	9	9	8	17	19
Descriptive statistics	2	1	1	1	1
Inferential statistics	1	4	4	3	1
Figures & Tables	8	13	11	11	17
Objective, results & Conclusion are in line	13	27	19	25	31

found in some articles with no statistical package was mentioned and overall inappropriate interpretation. Some of the authors tried to copy table of ANOVA from SPSS instead of drawing their own tables including *p*-value. Demographic description and baseline characteristics group-wise were missing from most of the studies. In main body of the article submitted , material and methods was not in the following sequence (without headings), study design, place & duration of study, inclusion & exclusion criteria, sample size & sampling technique, and data collection procedure were missing from most of the studies. In some studies the diagnostic role of a test, a validation study with all the diagnostic measures was not done. The percentages along with frequency were not given in some studies. The pattern of statistical errors was almost similar in different years with a little bit difference but that difference could not attained any statistical significance ($p = 0.460$). (Fig-2).

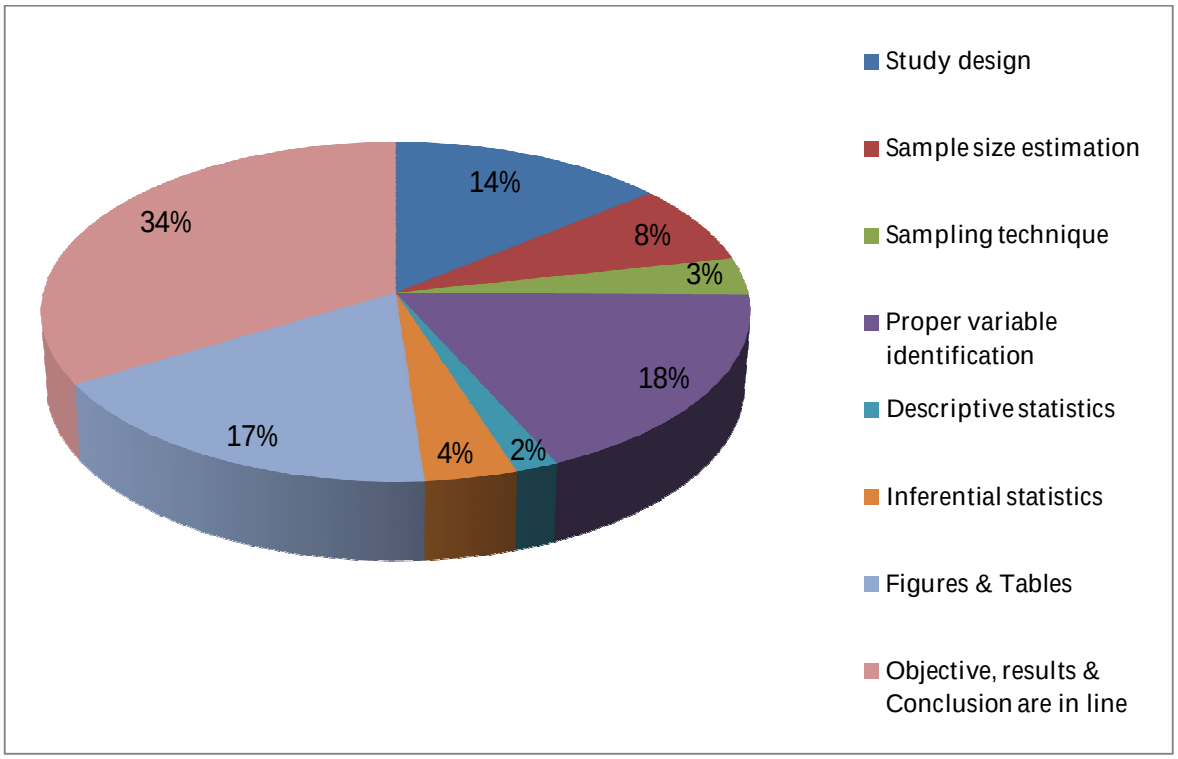

Figure-1: Description of statistical error from 2010 to 2014 (n= 42).

DISCUSSION

To write effectively has been a major concern in education for many years[9]. Problems affecting such scientific writing have included variety in terms of scientific level and requirement of the research projects as well as inadequate supervision[10]. Medical writers come across statistics when they are interpreting their research for publications. Types of medical writing include editorials, original article, review articles, short papers, case reports, letter to editor and special communication. The Basic structure of article title includes the structured abstract, introduction, what question was asked?, methods show was it studied? Results what was found?, analysis how data was analyzed?, discussion what do the findings mean?, acknowledgements and references methodology should clearly state what subjects / patients / animals / specimens techniques were used? and what were the reason for selecting the experimental design of the study. what were the statistical methods used for analysis[11,12]. Errors in statistical analysis of clinical trials are widespread, have occurred for some time and, perhaps surprisingly, concern basic and easily avoidable statistical concepts. This study was designed to identify the most common statistical errors

present in articles published in PAFMJ. The most common mistakes identified were concluding equivalence on the basis of a non-significant *p*-value, using Pearson test on ordinal data ,using paired t-tests back to baseline in treatment groups separately and using non-parametric methods unnecessarily. The statistical results of research must be communicated critically. An understanding of statistics is necessary for good medical writing. Many studies constitute incompatible and inappropriate statistical procedures that may value and test statistic are better be given at the same time. For interpretation of results, the main problem was that the authors considered that there was a trend of difference between groups when *p*> without giving a thought regarding how large the *p* value was. Simple methods like t-tests, contingency tables, and ANOVA are likely to be used incorrectly. Many results can be given in illustrative materials like tables or figures, although some data can best be written in the text[15]. The misuse of statistics has been discussed extensively and this fact has

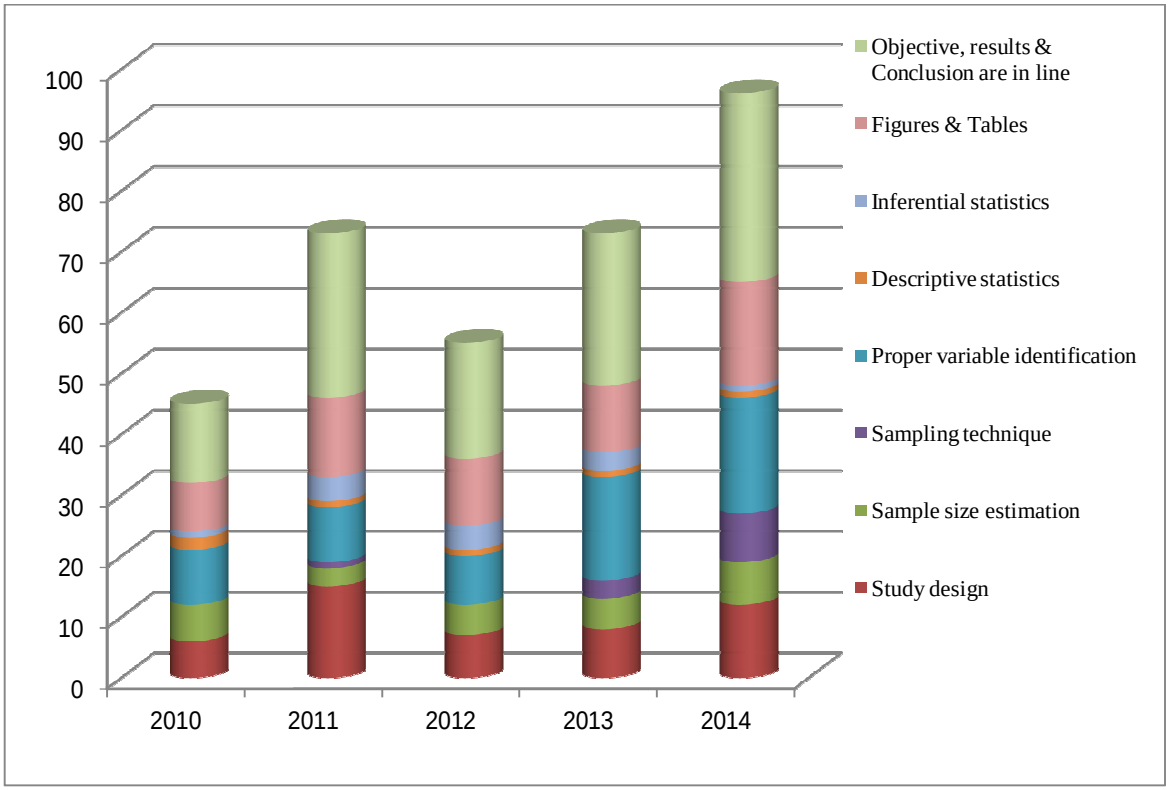

Figure-2: Year-wise description of statistical errors.

lead to deceivable and false conclusions[13]. Avoid these errors by asking your statisticians to review your manuscript before submission. Raw data refers to the results of individual replicate trials, individual observations, patient records, and other measurements that come directly from the laboratory. If there is a need to do so, include them in the appendix section[14]. Make sure that the data is accurate and consistent throughout the manuscript. When reflecting the differences in data, specify scientifically its statistical significance. Precise *p* been made clear that inappropriate usage is both unethical[16]. The topmost reason for such statistical flaws in Pakistan is deficient knowledge among professionals, and incompetent teaching of statistics in health sector[17]. Hence, the prime requirement is to point out such errors and make efforts to eradicate them as these may give incorrect conclusions and cause wastage of valuable resources. That ultimately may result in unspoken yet detrimental consequences[18]. Progress regarding statistical analyses, is there

remains ample room for improvement regarding study designs.

CONCLUSION

In order to maintain the standards of the medical writing in research with authentication the teaching of statistical methods should be enhanced and the role of biostatistician needs to be divulged.

CONFLICT OF INTEREST

Authors report no conflict of interest and they alone are responsible for all conclusions drawn from the data.

AUTHORS CONTRIBUTION

Rizwan Hashim, main idea and full editing, Khadija Qamar, collection of data, Irum Abid, data analysis, Salman Ali, supervisor

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