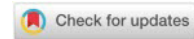


PROBLEMS OF STATISTICS APPLICATION IN SPORTS SCIENCE

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Abstract: Statistics as a scientific method has its application in a large number of scientific disciplines, including sports. The application of statistics in sports science is crucial for understanding and analyzing sports performance, as well as for making decisions regarding training, tactics, player recruitment, and other aspects of sports management. There are certain problems that may arise when applying statistical methods in the field of sports, which are directly dependent on: data quality, complexity of the sports, problems with non/adequate sample, lack of control over variables, issues of bias in the collection, analysis and interpretation of data and ethical questions. In order to overcome these problems, careful data collection, the use of appropriate statistical methods, transparency in the analysis and interpretation of results, as well as cooperation between sports experts and statisticians are crucial. Also, it is important to be aware of the limitations of statistical analyzes and interpretations in the context of specific sports disciplines and situations. However, as each scientific discipline strives to discover new/modern principles, wanting to contribute to the development of scientific knowledge, there are several research questions of empirical nature that many researchers ignore under the direct/indirect influence of factors such as possible research project funding, academic advancement or existential reasons. In this way, we consciously or unconsciously develop space for new research directions – agnotology, a multidisciplinary field that deals with the study of the production and maintenance of ignorance or misinformation. Hyperproduction, that is, the rapid increase in the number of published scientific papers leads to patterns that can be considered unwritten rules, so that in addition to the existence of ethics commissions at academic institutions and conditional compliance with the code of ethics, we have the practice that papers containing the statistical method are directly considered original scientific papers. This can have a wide range of consequences for the scientific community, researchers, but also for the quality of scientific research in general. Also, the question arises to what extent the data obtained by applying this method find their place in practice, i.e. whether to contribute to the development of science and scientific truth. The subject of this research is related to the application of statistics in the science of sports. The aim of the research is to determine the negative patterns of application of statistics in the science of sports in order to correct the scientific approach in future research. The results of the research confirmed the presence of negative patterns, that is, they indicate the appearance of giving priority to papers in which statistics were applied in relation to papers of a qualitative type, when the selection of papers for publication is made.

Keywords: science, sports, statistics, manipulation, ethics

Field: Social sciences (Sports science)

1. INTRODUCTION

Statistics as a scientific method has its application in a large number of scientific disciplines, including sports. Although many researchers consider statistics exclusively as a scientific method by which research results will be obtained quantitatively, the fact cannot be ignored, especially in the scientific establishment, that statistics relies on statistical theory, thus defining it simultaneously as a scientific method and as a scientific discipline.

Statistics represents a symbiosis of two components - theoretical and applied statistics (Macura and Kovačević, 2018). The mentioned authors indicate that theoretical statistics includes four basic areas, namely: theory of distributions, theory of statistical evaluations, theory of tests and theory of connections, while applied statistics includes two areas - descriptive and inferential statistics (Ibid). In most cases, statistics investigates phenomena that are variable in nature, that is, those phenomena that have a mass character and whose behaviour in the mass is not predetermined by exact cause-and-effect laws.

Among the many definitions of statistics, the one that defines statistics as a branch of applied mathematics and whose principles derive from probability calculus is the most commonly used. Also, depending on the goal of highlighting the importance of statistics, we find definitions that statistics is a social science that compares facts expressed in numbers and draws general conclusions, determines causes and consequences. From all of the above, it follows that the term statistics in a broader sense includes statistical theory and methodology, as well as statistical research of mass variable phenomena.

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Statistical theory definitely provides the basis for the scientific procedure of quantitative research of mass phenomena.

The application of statistics in sports science is crucial for understanding and analyzing sports performance, as well as for making decisions regarding training, tactics, player recruitment, and other aspects of sports management. There are certain problems that may arise when applying statistical methods in the field of sports, which are directly dependent on: data quality, complexity of the sports, problems with non/adequate sample, lack of control over variables, issues of bias in the collection, analysis and interpretation of data and ethical questions. In order to overcome these problems, careful data collection, the use of appropriate statistical methods, transparency in the analysis and interpretation of results, as well as cooperation between sports experts and statisticians are crucial. Also, it is important to be aware of the limitations of statistical analyzes and interpretations in the context of specific sports disciplines and situations.

However, since every work, as well as scientific work, depends on the factor called Man, statistics, in addition to its basic function, are also used for manipulative purposes, which a large number of researchers have dealt with. Particularly significant is the research that points to the collective manipulation of data derived from scientific research (Chaurasia, 2019). The aforementioned researcher covered a wide range of engineering, medical, legal, social and political fields with her research and the results she reached indicate that medical examinations of patients can influence government policy, that reports on electricity use can lead to companies taking steps to manage its tariffs, etc. She points out that there is a grey area of illegal research and asks where are the boundaries that must be set in order to avoid scientific misconduct. The paper discusses various methods of manipulation of research data in the form of fabrication and falsification, deliberate non-disclosure of results, biased methodology, misleading reporting, plagiarism, etc. (Ibid).

2. THE PROBLEM AND THE OBJECTIVE OF THE RESEARCH

The significance of the application of statistics in science is immeasurable, and its contribution to the pursuit of discoveries and realization of new laws is also very significant. However, just as it is important for a person that when he uses a medicine, he uses the exact prescribed dose because otherwise, due to an insufficiently prescribed dose of the medicine, its action and healing effect cannot occur, so in the case of an excessively prescribed dose of the medicine, poisoning or other unwanted effects can occur, which reminds us of a similar situation we have with the application of statistics. It is very important that we use it correctly during research. It is necessary to make a proper choice of the so-called statistical package and it is necessary to stick to the truth, or in other words, scientific ethics in the presentation of data. In addition to these general problems of using statistics in science, it has been observed that the hyperproduction of scientific papers leads to patterns that can be considered as unwritten rules, so that in addition to the existence of ethics committees at academic institutions and conditional compliance with the code of ethics, we have the practice that papers in the field of sports that contain the application statistical method, are directly considered original scientific works, regardless of the subject of research. This is exactly what leads us to the subject of this research, which is related to the problem of the application of statistics in sports science. The aim of the research was to determine the negative patterns of the application of statistics in the science of sports in order to correct the scientific approach in future research.

Based on the subject and aim of the research, research questions were asked:

- Does the present hyperproduction of scientific papers open up space for accidental/deliberate misinterpretation of the assessment of the originality of scientific papers?
- To what extent do the data obtained by applying statistical methods find their place in practice, actually, do they contribute to the development of science and scientific truth?
- Do ethics commissions at educational institutions fully and validly carry out their task?

3. METHOD

In this research, the method of theoretical analysis was applied based on the study and critical analysis of relevant sources from the region that were the subject of the research. The research included the last published number of scientific journals from the region until May 2022, namely: *Facta Universitatis: series physical education and sport*, *Fizička kultura*, *Sport Science*, *SportLogia* and *SportMont*. In addition to the above, the empirical approach was used in the research, which refers both to the decades-long presence of the author in the research work, as well as personally lived experiences which are never recommended to be written or spoken about because of the so-called scientific loyalty to colleagues, the

institution where we work, etc. and which a large number of researchers experienced, and were forced to change the approach to their research in accordance with current trends or the policy of science/higher education institution.

4. RESULTS

Reasons for using the so-called manipulative statistics are numerous, from the possible funding of a research project, academic advancement or for existential reasons. This indicates unethicity in the academic space, both of the researchers themselves, as well as of the editors of scientific journals, and even of the institutions that fund the research. The outcomes of such research results can lead to wrong decisions, lowering the quality of research and many other problems, which indicates that it is necessary to encourage a systematic, objective, transparent evaluation of the results as well as research ethics.

In the field of scientific research, innovation and accurate presentation of information are of critical importance to society, and society implicitly trusts scientists and researchers to be ethical and honest in their work (Doemeny and Knerr, 2017). The need for data reliability has become greater with the advancement of technology. Also, thanks to statistical applications, modern tools have made it easier to detect unethical behaviour. If an individual is once associated with such behaviour, it is quite enough that the trust in his scientific integrity is considered damaged and it becomes almost impossible to recover the previous reputation. Undoubtedly, this integrity is critical to finding employment, obtaining research grants, disseminating important research results, and generally being a successful and respected scientific professional (Ibid).

Numerous examples of scientific misconduct should not discourage the scientific community, but on the contrary, empower it to learn from others' mistakes, to continue to advocate for the integrity on which scientific progress is built. The scientific community has established a regulation related to professional behaviour that implies and binds researchers to the responsibility towards: the public, science (their scientific field), the profession, the institution, collaborators, students, colleagues, clients and the environment.

Also, the established Committees for Ethics in Science and Intellectual Property are bodies that control scientific research in their educational institutions. In their documents, they remind that the researcher should adhere to the following values and principles during his research work:

- presenting true facts and results,
- freedom in scientific research,
- responsibilities,
- integrity,
- cooperation and
- professionalism.

When it comes to science, not so long ago, this word was pronounced with great respect. However, today we are witnessing that the science that strives to discover new/modern laws is losing importance in relation to its derivative - the so-called academic science. The Bologna system of higher education may be well conceived, but not implemented. Among the many problems faced by higher education due to the application and harmonization of regulations according to the Bologna system, the positioning of the teaching staff is imposed, which is closely related to the publication of scientific works, the citation of authors, etc. The categorization of scientific journals is directly related to the publication of scientific papers, which should primarily be of importance to science in itself, and only then to the author. However, the standards for the promotion of teachers, that is, elections for scientific titles, lead us to the very obvious fact that we live in a time of hyperproduction of scientific papers.

If we know that every professor at a higher education institution has to publish five scientific papers per year, the question arises, how many professors do we have at higher education institutions in our city, state, region, world? If you multiply that number by 5 published papers, you will arrive at a fantastic figure that leads to a new question - are there really so many scientific discoveries in the world?

The appearance of patterns and unwritten rules that are present in academic practice can be observed both in the overview of the topics of published doctoral dissertations, and in the overview of the topics (subjects of research) of scientific papers published in relevant categorized journals.

As this paper focuses on science in the field of sports, it is important to note that all faculties in the field of sports belong to the social-humanistic field of sciences, which is ignored when it comes to the mentioned research topics. In a period of five years (2014-2018) at the Faculty of Sports and Physical Education in Belgrade, 40 doctoral dissertations (+/- 1) were defended, where 36 dissertations were written and defended from the scientific field of medicine (statistical method), while only 4 PhDs were

defended in social sciences. There arises the question of valorisation and insufficient knowledge of the methodology when using a qualitative and quantitative scientific approach where the quantitative scientific approach won.

The situation is similar with the scientific articles published in the aforementioned categorized and listed scientific journals. Some journal editors have elaborated journal development strategy where it is very important to point out that the ranking of the journal is directly dependent on the citation of papers from the journal itself. Directed citation of authors and journals is unfortunately also present in the region, which was discussed in several newspaper articles from Montenegro. Prof. Dr Duško Bjelica, according to data from the Google Scholar citation index, ranks first in research in the field of sports training in the world (Vijesti, 2021). Dr Aleksandar Stević, a professor at Lignan University from Hong Kong who dealt with misuse of citations in science, gave a statement to Vijesti that “the case of Duško Bjelica looks like the worst case of citation cartel that I have ever seen” (Ibid).

The attitude of the editors of almost all journals regarding references obliges the authors that they must be “new”, i.e. that the author refers to papers published in the last 5-10 years. This leads to the conclusion that the results of all research in a period older than 10 years are not valid, that is, the hyperproduction of papers is indirectly imposed in order to have a large number of references from such a short period of time.

The analysis of the works published in the five mentioned journals from the region in the field of sports science determined that although they are not of the same scientific rank, they belong to the category that is evaluated for the election of the professor’s title. Journals do not have the same publication period, and for this reason it may be unclear to the general public how the last issue of one magazine is from 2020, most from 2021, and one magazine from 2022.

When it comes to the pattern that in most cases only quantitative researches are considered original scientific works, the situation is as follows:

In the journal *Facta universitatis* series physical education and sport, out of 8 papers that were published in the analysed number, a total of 6 papers applied statistics; in the magazine *Fizička kultura*, out of 9 published papers, 7 are original scientific papers for which statistics were used for research purposes; in *SportLogia* journal, out of 8 published articles, there are a total of 6 original scientific papers, all of which had the application of statistics; in *SportScience* journal, out of 18 published original scientific papers, statistics are present in 15, and in *SportMont* journal, out of 20 published papers (19 original scientific papers and one short article), all 20 papers had the application of statistics. Out of a total of 63 scientific papers, only 9 papers were published that had a qualitative approach to research, which indicates the neglect of qualitative research during publication (selection).

This fact is supported by the frequent selection of research subjects related to:

1. Attitudes of male and female students, students, etc.,
2. Morphological characteristics of a certain population,
3. Physical activity and sedentary behaviour of a certain population,
4. Analysis of the percentage of body fat in a certain population.

The question arises as to what happens to the results of the mentioned papers and whether they find their application in practice. Do these types of papers make an objective contribution to theory and practice? Have adaptations of existing systemic policies in the fields of education, health, and science been carried out anywhere? What is the point of conducting research on someone’s views if they are not taken into account? What is the purpose of articles on the morphological indicators of a population when its results are not used for health or selection purposes. Even in the richest countries, the selection of athletes on the basis of morphological structure is carried out only on the already selected population, which is only one of the prerequisites for the selection.

A paper published in *SportMont* entitled “High Load few Repetitions Exercise is better for the Cardiovascular System than low Load Many Repetitions Exercise” by Mor, Weissblueth and Shlomo, published as an original scientific paper, calls into question what defines a paper as an original scientific paper, i.e. whether the editors were guided by the postulates that define the originality of the research, bearing in mind that the title has been treated multiple times both in the field of sports and in the field of medicine and takes its place in lectures at the basic academic studies of sports-related faculties.

The personal example of one of the authors also contributes to the understanding and seriousness of the present problem that this research dealt with. The scientific article entitled “Development of sports management in Serbia and Montenegro through the history of the Olympic committees of their countries”, which was first rejected by only one reviewer of the journal *Physical Culture*, was later (2018) published in the journal *SportLogia*. In order to clarify the value and validity of the published paper, the mentioned

paper was included in the Olympic World Library, which is known for its demanding selection.

Ethics committees at educational institutions deal only with ethical codes when it comes to doctoral dissertations and do not deal with publishing. This all leads to double standards, and the question of real ethics. The research of doctoral candidates are controlled, but the papers published by those who control them are not controlled.

In this way, we consciously or unconsciously develop a space for a new research direction - agnotology (expansion of ignorance).

5. CONCLUSION

In this research, the negative patterns of the application of statistics in sports science were confirmed, which do not directly relate to the application of statistics per se, but to the appearance of priority of papers in which statistics are applied in relation to papers of a qualitative type, when papers are selected for publication. In the absence of real research topics and imposed academic norms, papers are written and published that should, but do not have their application in practice. Also, it is necessary to find a way to apply the results of the papers in practice in accordance with the subject of the research. It is desirable to change the approach to the selection of scientific research topics in the field of sports, as well as to change the attitudes of editors, and more broadly, the bodies that prescribe and apply laws and norms in higher education. Maybe it is necessary to establish a new scientific and educational strategy?

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