

Invited article

**TWENTY YEARS OF THE FACTA UNIVERSITATIS, SERIES
PHYSICAL EDUCATION AND SPORT:
THE HISTORICAL ASPECTS OF RESEARCH METHODOLOGY
IN SPORT AND PHYSICAL EDUCATION**

UDC 001.8:93/94

**Nenad Stojiljković, Zvezdan Savić, Milovan Bratić, Dragana Berić,
Zoran Milanović**

The Faculty of Sport and Physical Education, University of Niš

Abstract. *The aim of this paper was to use the analysis of all the articles published in the journal Facta Universitatis – series: Physical Education and Sport since it was first published in 1994, up to 2013 to gain insight into the research methodology used in sport and physical education. For the purpose of this analysis, the authors classified the articles based on various criteria which are considered good methodological indicators (type of article, research design, field of study, characteristics of the sample of participants, measuring instruments, data processing methods). By monitoring the individual methodological characteristics of the research done in sport and physical education, we were able to explain the development of research methodology in this field, as well as the trends of research methodology both in theory and practice, including whether there is a possible imbalance between the number of published articles in various fields of study, what the relationship between the longitudinal and transversal studies is and so on. By gaining insight into the improvements made in the applied testing procedures, study design, choice of participants and methods of statistical data processing in the articles published in the journal Facta Universitatis - series: Physical Education and Sport, we can conclude that our science over the past twenty years has achieved a significant improvement in terms of research methodology.*

Key words: *history, measuring instruments, scientific journal, research design, methodology.*

Received January 03, 2015 / Accepted January 05, 2015

Corresponding author: Nenad Stojiljković

Faculty of Sport and Physical Education, University of Niš, St. Čarnojevića 10a, 18000 Niš, Serbia

Phone: +381 18 510900, +381 (0) 63 8084961 • E-mail: snesadif@yahoo.com

1. INTRODUCTION

Starting a scientific-research periodical is a key point in the process of academic professionalization. The existence of a scientific journal is a necessary precondition for the existence of a field of scientific study. This led experts in the field of sport and physical education try their best to maintain the continuity of the publication of journals devoted to studies in this particular field, while constantly attempting to improve their standing. The journal *Facta Universitatis – series: Physical Education and Sport* celebrated a milestone in u 2014, its first twenty years of existence. During this twenty-year period, the journal was primarily characterized by the high quality of the published articles, which allowed it to obtain the highest ranking in the field of research in social studies and humanities in Serbia today.

The first volume of the journal *Facta Universitatis – series: Physical Education and Sport* came out in 1994, as a publication of the University of Niš. In its first few years, it was entitled *Facta Universitatis – series: Physical Education* only to be renamed in 2000 into *Facta Universitatis – series: Physical Education and Sport*, a name which it carries to this day. This journal came into being as a new publication from the university edition of *Facta Universitatis*, which was first published in 1986, when the first volume of the journal *Series: Mathematics and Informatics* came out. When in 1994 the series *Physical Education and Sport* first started coming out, the edition of *Facta Universitatis* already consisted of six series (1. *Mathematics and Informatics – 1986*, 2. *Electronics and Energetics – 1987*, 3. *Mechanics, Automatic Control and Robotics – 1991*, 4. *Economics and Organization – 1993*, 5. *Mechanical Engineering – 1994*, 6. *Physics, Chemistry and Technology – 1994*). Today the edition of *Facta Universitatis* numbers 13 series, but no longer includes the series *Mechanics, Automatic Control and Robotics*, which was discontinued in 2007 (www.facta.junis.ni.ac.rs/).

The focus of the journal *Facta Universitatis – series: Physical Education* was described in the impressum of the journal, where it is clearly stated that this is a scientific journal of the University of Niš, whose aim is to publish journals related to educational practices in the field of theoretical and experimental knowledge which is fundamental in physical education, sport and recreation. When the journal changed its name in 2000 to *Facta Universitatis – series: Physical Education and Sport*, its goals also changed, and so in the impressum of the journal we can now find out that it is: “A scientific journal which publishes original scientific and research articles related to the fields of: physical education, recreation, sports games, sports medicine, physiology of sports, sociology of sport, philosophy of sport, sports history, kinesitherapy, dance, health and exercise.”

The journal *Facta Universitatis – series: Physical Education and Sport*, according to the categorization of the Ministry of Education, Science and Technological Development is classified as being a journal ranked as category M24. In other words, it belongs to the group of journals of international importance verified by a special order of the Advisory Committee of the Ministry (the rule book for the evaluation and quantitative expressions of scientific and research results, 2008). Based on the categorization of the advisory committee for social sciences and humanities, this journal has the highest category in the field of sport, as do journals such as the *Serbian Journal of Sport Sciences* (category M51), *Physical Education* (category M52), *TIMS Acta: Journal of sport sciences, tourism and wellness* (category M52), *Exercise and Quality of Life* (category M53), *Godišnjak Fakulteta sporta i fizičkog vaspitanja* (category M53), *Sport - nauka i praksa* (category M53).

The aim of this paper was to represent the historical aspects of research methodology in sport and physical education on the example of articles published in the journal *Facta Universitatis* – series: Physical Education and Sport.

2. THE METHOD

In studying the historical aspects of scientific research in sport and physical education, we relied on the historical method. This is the basic method of research in historical methodology, which is primarily used in historical sciences. However, today this method can be applied in both social and natural sciences, as thus can be used as one of the basic methods in the history of physical education (Savić, 2008).

For the purpose of a quantitative overview of the work published over a period of twenty years of the journal's history, we designed an instrument which was used to classify and profile the research published in *Facta Universitatis* – series: Physical Education and Sport. Based on this instrument, all the published articles were classified into certain categories, where the following parameters were observed: type of paper, research design (longitudinal or transversal), field of study, the characteristics of the sample of participants, method of data processing (statistical analysis), the sample of the measuring instruments (methods of data collection).

All of the articles published in the journal *Facta Universitatis* - series: Physical Education and Sport, based on the type of study, were classified into the following categories: theoretical papers; descriptive papers; review papers; case studies; comparative studies; correlation studies; historical papers; normative studies; reports and discussions. The aforementioned classification was described in the book "Research Methods in Physical Activity" (Thomas, Nelson & Silverman, 2005).

Based on the research design, all of the studied articles were published in the journal *Facta Universitatis* - series: Physical Education and Sport are classified into two categories: longitudinal studies; transversal studies. Longitudinal studies represent a particular type of research design which will include the same group of participants during an extended period of time, where a certain selected variable or set of variables will be studied (Thomas, Nelson & Silverman, 2005). Longitudinal studies include at least two measurements of the variables (the initial and final), but it is also possible to realize a series of transit measurements which are carried out in the time period between the initial and final measuring, that is, between the beginning and end of the research or the application of some specific treatment (training program, supplementation, and so on). Longitudinal studies can last for several days and even several decades. Longitudinal studies usually require a lot of time, and even money. A special problem that arises in longitudinal studies represents the dissipation in the sample of participants so that in the end the overall number of participants included in the study significantly diminishes. A small number of participants leads to problems in generalizing the obtained results, that is, the inability to transfer results to a wider population. The second group consists of transversal studies which last for a much shorter period of time than the longitudinal ones. They include the analysis of data accumulated from the entire population or a representative sample of participants in a particular moment. In the case of transversal studies, we can determine the causality of certain occurrences based on the intercorrelation of two or more variables (Thomas, Nelson & Silverman, 2005).

Based on the field of study, all of the analyzed articles published in the journal *Facta Universitatis - series: Physical Education and Sport* were classified into the following categories: sport; physical education; recreation; physical culture; corrective physical exercise; sports medicine; sports psychology; motor skills; sociology of sport; sports management and marketing. The obtained results are shown in table 3.

An overview of the publications in the journal *Facta Universitatis - series: Physical Education and Sport* had, among other things, the aim to determine the characteristics of the sample of participants who were included in the published studies. An author of a study is responsible for representing the characteristics of the sample of participants. At this point, he is responsible for presenting data on the number of participants, method of sample extraction, who the participants were and how they were selected, the age of the participants. A detailed description of the sample of participants was necessary because the final outcome of the research could significantly differ depending on the sample of participants. This means that the conclusions of a scientific study in most cases are valid only for those individuals who are similar to the individuals in the sample included in the study. In the structure of a research paper which is current today, the description of the sample of participants is usually found at the beginning of the section in which the research method is being described. This modern type of article structuring, where the introduction, method, result and discussion section are clearly separated (IMRAD) has been adhered to by the journal *Facta Universitatis - series: Physical Education and Sport* from the very start. The IMRAD structures offers the possibility of the so-called modular reading of research papers, where the readers are not forced to follow the text in a linear fashion, and can instead focus only on some of its individual segments which are the focus of their research. This standard form consists of parts whose content is known beforehand (Meadows, 1985). In the articles published in the journal *Facta Universitatis - series: Physical Education and Sport*, the following characteristics of the sample of participants were studied gender, the number of participants, the age and status of the participants. In the case of the status of the participants, for easier analysis of the published articles, all of the participants were classified in the following categories: children and adolescents; athletes; students; athletes and non-athletes; healthy adults and individuals involved in recreation; the elderly; experts in the field of sport (physical education teachers, pedagogues, coaches, instructors); special groups (police officers, soldiers, search and rescue workers, firemen and so on); individuals with some kind of health problems or disability (obese individuals, diabetics, invalids and so on); animals; scientific publication (research papers, monographs and the like); and other (clubs, matches, broadcasts of sports techniques, matches, clubs, schools, goals, basketball hoops and so on). This division also includes the age classification of the participants into children and adults, adults and the elderly, which was made based on the classification of the American College of Sports Medicine (2005). Based on this classification into the group of children and adolescents, we classify participants aged from 1 to 20, a group of adults aged 20 to 64, and the group of the elderly aged 64 and over (American College of Sports Medicine, 2005).

Another parameter analyzed in the research articles published in the journal *Facta Universitatis - series: Physical Education and Sport* is the data processing method or the method of statistical processing. The method of statistical data processing can be applied in various scientific disciplines which include some sort of numerical data. Each quantitative study contains within it some kind of statistical data processing. One of the

goals of this paper was to determine the frequency of use of various statistical procedures in the articles published in the journal *Facta Universitatis* - series: Physical Education and Sport. All sciences are based on precise and detailed information, and for that reason researchers strive to use statistical methods so as to more easily organize the obtained data and derive conclusions from them. Statistical analysis is not sufficiently connected to the design of scientific research. In order for the statistical methods used in the articles published in the journal *Facta Universitatis*: Series Physical Education and Sport to be analyzed, all of the methods were classified into the following categories: descriptive statistics; the T-test; non-parametric statistics; a univariate analysis of variance (ANOVA); univariate analysis of covariance (ANCOVA); multivariate analysis of variance (MANOVA); multivariate analysis of covariance (MANCOVA); correlation; canonical discriminant analysis; canonical correlation analysis; regression analysis; factor analysis; taxonomic analysis; the method of mathematical modelling; neuron networks; and cluster analysis.

The sample of measuring instruments used in the articles published in the journal *Facta Universitatis* - series: Physical Education and Sport should answer the question of how the science of sport and physical education in our country has advanced, since the applied testing procedures and measuring of anthropological characteristics are good indicators of the exactness of our science and the attempts to quantify human physical abilities. In the science of sport and physical education, the measuring of anthropological characteristics takes a central position in scientific research, but also in professional practice. Physical education teachers, coaches, recreational participants, and instructors apply tests which can be used to diagnose the state of their trainees, which will allow them to plan and program the training process, and then monitor the improvement which occurs under the influence of a certain load training program. In scientific-research practice, the tests were applied on a particular sample of participants so as to test the set research hypotheses, or to describe the current status of the participants in by monitoring certain variables.

All of the collected data will be described using the parameters of descriptive statistics which include frequency, percentage, and valid percentage (this parameter is an especially important indicator in the results which had missing variables) and cumulative percentage. The obtained data were processed using the statistical package IBM SPSS Statistics, Version 21

3. THE RESULTS AND DISCUSSION

Table 1 shows the overall number of articles published in the journal *Facta Universitatis* - series: Physical Education and Sport in the period between 1994 and 2013. Based on the data in the table we can see that in this period a total of 287 articles were published, which were, based on the type of the article, classified into eight categories. Most of them were descriptive (25,4%) and experimental (25,1%) articles. Next are the comparative and correlational studies with 18,1% and 12,9% respectively. The number of review articles was very small, only 7%. Ever since the journal was first published, only 3 case studies were published, which makes up only 1%. The obtained results indicate a clear scientific-empirical orientation of the journal, which focuses on original scientific research.

Table 1 The descriptive statistical parameters for the journal *Facta Universitatis - series: Physical Education and Sport* for the period between 1994 and 2013: Type of published article

	Frequency	Percentage	Valid percentage	Cumulative percentage
Theoretical	27	9.4	9.4	9.4
Descriptive	73	25.4	25.4	34.8
Overview	20	7.0	7.0	41.8
Case study	3	1.0	1.0	42.9
Experimental	72	25.1	25.1	67.9
Comparative	52	18.1	18.1	86.1
Correlational	37	12.9	12.9	99.0
Historical	3	1.0	1.0	100.0
Overall	287	100.0	100.0	

Table 2 shows the relationship between the longitudinal and transversal studies in the journal *Facta Universitatis - series: Physical Education and Sport*. We should point out that 56 articles could not be classified in any of the cited categories since they were either theoretical or review articles which could be classified under either of the two categories. Based on the results presented in the table, we can conclude that the number of transversal studies was far greater. This result could be expected since transversal studies are cheaper and simpler to realize in terms of time and material-technical support.

Table 2 The parameters of descriptive statistics in the journal *Facta Universitatis - series: Physical Education and Sport* for the period between 1994 and 2013: Study design

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid		56	19.5	19.5	19.5
	Longitudinal	48	16.7	16.7	36.2
	Transversal	183	63.8	63.8	100.0
	Overall	287	100.0	100.0	

Based on the results shown in table 3, we can conclude that the greatest number of articles published in the journal *Facta Universitatis - series: Physical Education and Sport* is from the field of sport. Then come the articles published in the field of motor skills, followed by sports medicine. We should point out that the number of articles in the field of physical education is small and makes up only 5,2% of the overall number of articles. What is also interesting is the fact that there were more articles in the field of recreation (7%) than physical education, even though it is a much younger field of study.

Of the overall number of articles published in the journal *Facta Universitatis - series: Physical Education and Sport* the largest number of studies included participants who were male. The number of participants who were female was twice as small, while 29,3% of the studies were carried out with participants of both genders. The obtained results indicate that the number of articles including participants who were male is much greater. This could be explained by the fact that sport has always been a social activity meant for men. That this is true is supported by the data that the greatest sports event, the modern Olympic Games, was first reserved only for male participants. Over time, women fought for their right for equality and the right to participate in the Games (Savić, 2008).

Table 3 Descriptive statistical parameters for the journal Facta Universitatis - series: Physical Education and Sport in the period between 1994 and 2013: Field of study

	Frequency	Percentage	Valid percentage	Cumulative percentage
Sport	124	43.2	43.2	43.2
Physical education	15	5.2	5.2	48.4
Recreation	20	7.0	7.0	55.4
Physical culture	17	5.9	5.9	61.3
Valid Corrective physical exercise	12	4.2	4.2	65.5
Sports medicine	38	13.2	13.2	78.7
Psychology of sport	13	4.5	4.5	83.3
Motor skills	48	16.7	16.7	100.0
Overall	287	100.0	100.0	

Table 4 Descriptive statistical parameters for the journal Facta Universitatis - series: Physical Education and Sport from the period between 1994 and 2013: The gender of the participants

	Frequency	Percentage	Valid percentage	Cumulative percentage
Valid Men	101	35.2	44.1	44.1
Women	44	15.3	19.2	63.3
Both genders	84	29.3	36.7	100.0
Overall	229	79.8	100.0	
Missing System	58	20.2		
Overall	287	100.0		

Table 5 shows that the descriptive statistical parameters which refer to the number of participants included in the articles published in the journal Facta Universitatis - series: Physical Education and Sport. The smallest number of participants was 1 and it was found in case studies, while the largest number of participants was 6414.

Table 5 Descriptive statistical parameters for the number of participants in the journal Facta Universitatis - series: Physical Education and Sport

	N	Minimum	Maximum	Mean	Median	SD
Number of participants	214	1	6414	236.06	71	650.96

Table 6 also shows the represented characteristics of the size of the samples of participants in the articles published in the journal Facta Universitatis - series: Physical Education and Sport. Here the number of participants was divided into quartiles and represented for five-year period of publication over the past twenty years. Based on the results shown in table 6, we can conclude that the number of participants in the articles did not change significantly.

Table 6 The number of participants in the journal *Facta Universitatis - series: Physical Education and Sport*

Number of participants per five-year periods	1994-1998	1999-2003	2004-2009	2009-2013
Percentiles	25	25.25	25.50	28.75
(number of participants)	50	61.00	73.00	81.50
	75	199.00	184.50	183.00
				202.50

By analyzing the results in table 7 which refer to the status of participants in the articles published in the journal *Facta Universitatis - series: Physical Education and Sport*, we can conclude that the greatest number of published articles included participants who were athletes (32,6%). This finding is in accordance with the results which refer to the field of study and which indicate that most of the articles were from the field of sport. Then come children and adolescents who made up 19,1% of the articles. It is quite understandable that researchers usually extracted their samples from the population of elementary and high school students, as well as preschool aged children. Along with children and adolescents, the student population was also widely present in the articles. This is also a category of participants who are readily available to researchers and for this reason they often decide to realize their studies on the population of students. It is also interesting that one article (0,4% of the articles published in the journal *Facta Universitatis - series: Physical Education and Sport*) was carried out on animals, namely rats (Ghanbari-Niaki, Desy & Lavoie, 2005). This article belongs to the group of fundamental studies which were used to evaluate the reactions of the body to physical activity and inactivity by following the biomechanical parameters of rats. We could say that articles of this type today are exclusive in the science of sport and physical education, and that they are very rare. With the development of recreation as a special field of physical education, the number of articles with participants from the category of healthy individuals increased, but this increase was negligible. In the case of adults with certain health problems such as obesity, diabetes, individuals with a disability and other chronic illnesses, as well as their inclusion in studies, we can conclude that such studies were infrequent (2,1%). Studies involving participants who suffered from some kind of disability were rare as a result of the fact that it is difficult to carry out research into physical exercise on this sample of participants. In addition to a greater amount on evidence based on scientific research that physical activity can be used not only for prevention, but also therapeutically for individuals with health issues, on the territory of Serbia hardly any of these individuals are included any form of physical exercise, which is not the case with developed countries in Europe and the US.

Articles in which the participants belonged to the category of physical education teachers, pedagogues, coaches or in a word professionals responsible for the organization and realization of activities in the field of sport and physical education made up 7,6% of the published articles.

The category of participants marked as special groups included participants of military or police formations, but also firemen, rescue workers and other similar special graduations. This category of participants made up only 0,9%.

Table 7 Descriptive statistical parameters for the journal Facta Universitatis - series: Physical Education and Sport in the period between 1994 and 2013: The status of the participants

	Frequency	Percentage	Valid percentage	Cumulative percentage
Children and adolescents	45	15.7	19.1	19.1
Athletes	77	26.8	32.6	51.7
Students	45	15.7	19.1	70.8
Athletes and non-athletes	9	3.1	3.8	74.6
Healthy adults and recreational athletes	17	5.9	7.2	81.8
Teachers, coaches, pedagogues	18	6.3	7.6	89.4
Valid Special groups	2	.7	.9	90.3
The disabled/patients	5	1.7	2.1	92.4
The elderly	3	1.0	1.3	93.7
Animals	1	.4	.4	94.1
Scientific publications	1	.3	.4	94.5
Other	14	4.5	5.5	100.0
Overall	236	82.2	100.0	
Missing System	51	17.8		
Overall	287	100.0		

We should point out that in a significant number of these articles, the category of participants was very specific, and did not include people as participants, but material-financial indicators in sport and physical education, such as the number and type of characteristics of sports facilities, the number of schools and physical education props for physical education, and the average income of physical education teachers, coaches and athletes. In addition, this category also included articles whose sample of participants represented a parameter of success in sport such as the number of scored points, the number of mistakes, number of (un)successfully performed techniques, but also kinematic parameters of a specific sports technique obtained by analyzing the recordings of games and performances on sports fields. This category of participants was classified as Other, and it made up 5,5%.

Articles in which the sample of participants was the number of articles or journals was classified as a special category. These articles are similar to the review article, in which some bibliographic parameters of scientific production were monitored, including scientific-metric parameters of local and foreign publications in the field of sport and physical education. These articles made up 0,4%.

Table 8 represents the results of the distribution of individual statistical procedures in the journal Facta Universitatis - series: Physical Education and Sport. As expected, descriptive statistics were the most frequent, but if we were to exclude the basic statistics which are indispensable in studies of a quantitative type, the t-test and ANOVA were the most widely distributed tests, with 24,1% and 23,0%, respectively. Third place goes to the regression analysis with 10,5%, followed by the method for the calculation of the correlation with 9,5%. Non-parametric statistics made up 4,9%, while the least frequent were the taxonomic analyses applied in only one article.

Table 8 Descriptive statistics parameters for the journal *Facta Universitatis - series: Physical Education and Sport* in the period between 1994 and 2013: Statistical procedure

	Frequency	Percentage	Valid percentage	Cumulative percentage
T-test	84	14.5	24.1	24.1
Non-parametric	17	2.9	4.9	29.0
ANOVA	80	13.8	23.0	52.0
ANCOVA	14	2.4	4.0	56.0
MANOVA	24	4.2	6.9	62.9
MANCOVA	12	2.1	3.4	66.4
Correlation	33	5.7	9.5	75.9
Canonical discriminant	13	2.2	3.7	79.6
Canonical correlational	19	3.3	5.5	85.1
Regression	37	6.4	10.6	95.7
Factor	14	2.4	4.0	99.7
Taxonomic	1	.2	.3	100.0
Overall number of articles excluding descriptive statistics	348	60.2	100.0	
Descriptive statistics	230	39.8		
Overall	578	100.0		

In the case of measuring instruments used for data collection, that is, tests for the evaluation of various characteristics of anthropological status used in the journal *Facta Universitatis - series: Physical Education and Sport*, it was not possible to count them all and determine the frequencies of their application, since we were dealing with very different methods which cannot be classified in the same category. For these reasons, the characteristics of the measuring instruments will be analyzed in the form of a qualitative study with a short description of the most representative testing procedures. In its first few years, this journal contained a very small number of experimental studies in which the physical abilities of individuals were measured. The editorial policy of the journal in the first years following the start of the journal was focused primarily on theoretical work which viewed the physical activity of individuals from a theoretical, sociological and philosophical standpoint.

The first articles published in the journal *Facta Universitatis: Series Physical Education and Sport* in which the testing procedures for motor skills were used contained the standard field tests for the evaluation of coordination (Kostić, 1994), flexibility (Dopsaj, 1994), but also motor control and motor learning (Ilić, 1995). Soon the journal *Facta Universitatis - series: Physical Education* started publishing articles in which the entire field of motor skills was tested: strength, coordination in rhythm, whole body coordination, flexibility, explosive strength, balance, movement frequency (Bala & Franceško, 1997). In 1998, the journal published an article in which a method for the evaluation of physical composition was used, which was different from the calculations of the body composition as previously used, which were based on the thickness of skin folds and the volume of individual body segments. The applied method has been known as Drinkwater Ross since 1980 (Mészáros, Soliman, Othman, & Mohácsi, 1998). The journal *Facta Universitatis - series: Physical Education* very early recognized a good perspective and the possibility of rapid improvement in the journal by publishing articles which would use methods based more on biomedicine than on sport and physical

education. Perhaps that was one of the reasons for the high ranking of this journal. Such an article presented a study carried out by a group of authors in which an ultrasound technique was used to measure the parameters of treadmill walking. Following the recording, the kinematics of the knee and the time differences in the measured parameters of walking were analyzed (Kocsis, Kiss, Knoll & Jurák, 1999). Over the next ten years, the technique of the ultrasound measuring of parameters would be used on numerous occasions in articles published in this journal. In articles published in the first decade of the journal *Facta Universitatis* - series: Physical Education, the muscle strength of the lower extremities was mostly evaluated based on field testing of the high jump or depth jump (Bala & Franceško, 1997), and maximum oxygen uptake was still mostly being measured indirectly, while heart-rate frequency was measured using telemetric devices which were considered sophisticated at the time, and were known as pulsometers (Ostojić, 2000). Body composition was still evaluated using one of the traditional formulas which required skin folds from certain points of the body as input, and even the volume of certain body segments (Ostojić, 2000). The clinical and somatic methods for the determination of the state of the spinal cord used till then were replaced with more modern methods of ultrasound recordings (Zsidai & Kocsis, 2001). We could note that after 2001, in the journal *Facta Universitatis* - series: Physical Education and Sport we find article which analyze the state of the locomotor apparatus among individuals suffering from some kind of health problems, deformities or illnesses (Horváth, Tihanyi & Tihanyi, 2001; Illyés & Kiss, 2005; Horváth, Fazekas, Tihanyi & Tihanyi, 2005). In the previous period, these articles could not be found. In addition, the methods used to gather data over the last decade are not specific to the field of sport and physical education, and instead mostly require medical or electronic equipment such as the ultrasound, x ray, EMG, gas analyzer, echocardiography, bioelectrical impedance (Horváth, Tihanyi & Tihanyi, 2001; Kiss & Knoll, 2002; Hreljac et al., 2002; Petridis, Kubátová & Petridou, 2003). By using the cited methods, it was possible to directly measure anthropological characteristics. Up until the end of the 1990s, testing mostly included the use of batteries of tests which evaluated the manifested abilities so as to determine the structure of some latent motor dimensions. For that purpose we used field tests for strength evaluation (various kinds of push-ups, torso lifts, hanging pull-ups and so on), speed evaluation (the 20 meter sprint with a flying start, the 30 meter sprint, the 50 meter sprint, the frequency of individual movements), to evaluate endurance (the Cooper test, Astrand test, the 800 meter run, the 1500 meter run). With the improvement in technique and technology, measuring instruments in sport and physical education became more precise, directly measuring the quality of the human locomotor apparatus and the functions of the most important systems. Thanks to this progress over the past ten years, an increasingly greater number of articles which attempted to implement measuring techniques from other scientific disciplines in the field of sport and physical education could be found. One such method is the application of the tensiometric platform used to measure the reaction force of the surface during take-off which represents a much more precise means of measuring explosive leg strength. Tensiometric platforms in the articles published in the journal *Facta Universitatis* began to occur only after 2000 (Rajić, Dopsaj & Abella, 2004; Ivanović, Dopsaj, Čopić & Nešić, 2011; Čoh, Berić & Bratić, 2013). Another similar method was the method of measuring propulsion force during swimming, represented in the work of Dopsaj et al. (Dopsaj, Matković, Thanopoulos, & Okičić, 2003). The participants swam in place with maximum intensity.

The testing was realized by measuring the force generated from the tensiometric probe with the appropriate hardware-software support. In addition to measuring the force generated by the swimmers, the authors also monitored the kinematic parameters of the stroke. In 2010, in the articles published in *Facta Universitatis - series: Physical Education and Sport* with the goal to evaluate jump height, that is, explosive leg strength, authors began using the Myotest (Bubanj et al., 2010a, Bubanj et al., 2010b). This is a valid instrument with proven reliability which functions based on an accelerometer, and which with its very small dimensions enables quick and easy use in the field (Casartelli, Müller & Maffiuletti, 2010). Another innovation which occurred in 2010 in the journal *Facta Universitatis - series: Physical Education and Sport* is the application of the Spinal Mouse for the evaluation of the spinal cord status (Bubanj et al., 2010b). The beginning of the application of this device significantly changed the practice of determining postural status by applying some less valid and reliable methods.

4. CONCLUSION

The chronological overview of the articles published in the journal *Facta Universitatis - series: Physical Education and Sport* over the past twenty years enabled us to determine the trend of the constant increase in the number of published articles, which over time become methodologically more precise, and relied on valid and tested measuring instruments which directly measure the various characteristics of anthropological status. The editors of the journals quickly understood the significance of quantitative studies, so that by the end of the 1990s the journal was full of experimental articles, as well as descriptive articles in which various characteristics of the participants were studied based on reliable procedures of data collection. Following 2000, there was an increased technical-technological development which was also included the scientific and research activities in the field of sport and physical education. By gaining insight into the applied testing procedures, study design and choice of participants and methods of statistical data processing in the articles published in the journal *Facta Universitatis - series: Physical Education and Sport*, we can conclude that sports science in Serbia over the past twenty years made significant improvements in research methodology. Basing the analysis of the research methodology in sport and physical education used in articles published in the journal *Facta Universitatis - series: Physical Education and Sport*, we can conclude that sports science progressed from theoretical studies of a small scientific impact, such as those published in the first volumes of the journal, all the way to quantitative studies based on precisely executed experiments and measurements of anthropological characteristics, such as those that were published following 2000, when the rating of the journal began to increase.

REFERENCES

- ACSM (2005). *ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription*. Lippincott: Williams & Wilkins.
- Bala, G., & Salaj-Franceško, M. L. (1997). Motor and cognitive functioning of students of Faculty of Physical Education. *Facta universitatis - series: Physical Education*, 1(4), 1-6.
- Bubanj, S., Milenković, S., Stanković, R., Bubanj, R., Živković, M., Atanasković, A., & Gašić, T. (2010b). The correlation between explosive strength and sagittal postural status. *Facta universitatis - series: Physical Education and Sport*, 8(2), 173-181.
- Bubanj, S., Stanković, R., Bubanj, R., Dimić, A., Bednarik, J., & Kolar, E. (2010a). One leg vs two-legs vertical jumping performance. *Facta universitatis - series: Physical Education and Sport*, 8(1), 89-95.
- Casartelli, N., Müller, R. & Maffiuletti, N.A. (2010). Validity and reliability of the Myotest accelerometric system for the assessment of vertical jump height. *Journal of Strength & Conditioning Research*. 24(11), 3186-3193.
- Čoh, M., Berić, D., & Bratić, M. (2013). The biodynamic analysis of drop jumps in female elite athletes. *Facta universitatis - series: Physical Education and Sport*, 11(1), 1-8.
- Dopsaj, M. (1994). Extent of flexibility among athletes in different sports games: Soccer, volleyball, basketball and handball. *Facta universitatis - series: Physical Education*, 1(1), 51-60.
- Dopsaj, M., Matković, I., Thanopoulos, V., & Okičić, T. (2003). Reliability and validity of basic kinematics and mechanical characteristics of pulling force in swimmers measured by the method of tethered swimming with maximum intensity of 60 seconds. *Facta universitatis - series: Physical Education and Sport*, 1(10), 11-22.
- Ghanbari-Niaki, A., Desy, F., & Lavoie, J. (2005). Effects of acute ethionine-induced hepatic ATP deficiency at rest and during exercise in female rats. *Facta universitatis - series: Physical Education and Sport*, 3(1), 11-22.
- Horváth, M., Fazekas, M., Tihanyi, T., & Tihanyi, J. (2005). Standing stability of hemiparetic patients estimated in different ways. *Facta universitatis - series: Physical Education and Sport*, 3(1), 59-68.
- Horváth, M., Tihanyi, T., & Tihanyi, J. (2001). Kinematic and kinetic analyses of gait patterns in hemiplegic patients. *Facta universitatis - series: Physical Education and Sport*, 1(8), 25-35.
- Hreljac, A., Parker, D., Quintana, R., Abdala, E., Patterson, K., & Sison, M. (2002). Energetics and perceived exertion of low speed running and high speed walking. *Facta universitatis - series: Physical Education and Sport*, 1(9), 27-35.
- Ilić, D. B. (1995). The variables of motor programs of fast self-terminated movements a test of motor control theories. *Facta universitatis - series: Physical Education*, 1(2), 57-63.
- Illyés, Á., & Kiss, R. M. (2005). Gait analysis of patients with osteoarthritis of the hip joint. *Facta universitatis - series: Physical Education and Sport*, 3(1), 1-9.
- Ivanović, J., Dopsaj, M., Čopić, N., & Nešić, G. (2011). Is there a relation between maximal and explosive leg extensors isometric force?. *Facta universitatis - series: Physical Education and Sport*, 9(3), 239-254.
- Kiss, R. M., & Knoll, Z. (2002). A motion analysis of the lower extremity during gait with special regard to the EMG activity of m. adductor longus. *Facta universitatis - series: Physical Education and Sport*, 1(9), 1-10.
- Kocsis, L., Kiss, R. M., Knoll, Z., & Jurák, M. (1999). Bute's ultrasound-based measuring technique and model for gait analysis. *Facta universitatis - series: Physical Education*, 1(6), 1-13.
- Kostić, R. M. (1994). Correlation between coordination and basic musical abilities. *Facta universitatis - series: Physical Education*, 1(1), 45-50.
- Meadows, A.J. (1985). The scientific paper as an archaeological artifact. *J Inf Science*. 11(1):27-30.
- Mészáros, J., Soliman, Y., Othman, M., & Mohácsi, J. (1998). Body composition and peak aerobic power in international level Hungarian athletes. *Facta universitatis - series: Physical Education*, 1(5), 21-27.
- Ostojčić, S. M. (2000). Physical and physiological characteristics of elite Serbian soccer players. *Facta universitatis - series: Physical Education and Sport*, 1(7), 23-29.
- Pravilnik o postupku i načinu vrednovanja, i kvantitativnom iskazivanju naučnoistraživačkih rezultata istraživača. (Regulations on the procedure and method of evaluation and quantitative expression of scientific research results). (2008). *Službeni glasnik RS*, 38/08 (Official Gazette of RS, No. 38/08)
- Petridis, L., Kubátová, J., & Petridou, K. (2003). A swim-test and echocardiographic results on male junior water polo players. *Facta universitatis - series: Physical Education and Sport*, 1(10), 1-10.
- Rajić, B., Dopsaj, M., & Abella, P. C. (2004). The influence of the combined method on the development of explosive strength in female volleyball players and on the isometric muscle strength of different muscle groups. *Facta universitatis - series: Physical Education and Sport*, 2(1), 1-12.
- Thomas, J.R., Nelson, J.K., & Silverman, S.J. (2005). *Research Methods in Physical Activity*. Champaign, IL: Human Kinetics
- Zsidai, A., & Kocsis, L. (2001). Ultrasound-based spinal column examination systems. *Facta universitatis - series: Physical Education and Sport*, 1(8), 1-12.
- WWW (Internet): www.facta.junis.ni.ac.rs/ Retrieved October 3, 2014, from the World Wide Web: www.facta.junis.ni.ac.rs/

**DVADESET GODINA ČASOPISA FACTA UNIVERSITATIS,
SERIES PHYSICAL EDUCATION AND SPORT:
ISTORIJSKI ASPEKTI METODOLOGIJE NAUČNOG
ISTRAŽIVANJA U SPORTU I FIZIČKOM VASPITANJU**

Cilj ovog rada bio je da se kroz analizu svih radova publikovanih u časopisu Facta universitatis – series: Physical Education and Sport od njenog osnivanja 1994. godine do 2013. godine sagleda metodologija naučnog istraživanja u sportu i fizičkom vaspitanju. Za potrebe analize radova autori klasifikuju radove na osnovu različitih kriterijuma koji se smatraju dobrim metodološkim pokazateljima (vrsta rada, dizajn naučnog istraživanja, oblast istraživanja, karakteristike uzorka ispitanika, merni instrumenti, metode obrade podataka). Praćenjem pojedinačnih metodoloških karakteristika naučno-istraživačkog rada u sportu i fizičkom vaspitanju dobijena je mogućnost da se objasni kakav je bio razvojni put metodologije naučnog istraživanja u ovoj oblasti, kao i to kakvi su bili trendovi u istraživačkoj teoriji i praksi, da li postoji eventualna neravnoteža u broju publikovanih radova iz različitih oblasti istraživanja, kakav je odnos broja longitudinalnih i transverzalnih istraživanja i sl. Sagledavajući napredak u primenjenim procedurama testiranja, dizajniranju studije, izboru ispitanika i metodama statističke obrade podataka u radovima publikovanim u časopisu Facta universitatis - series: Physical Education and Sport možemo zaključiti da je naša nauka u proteklih dvadeset godina ostvarila značajan napredak u metodologiji naučnog istraživanja.

Ključne reči: istorija, merni instrumenti, naučni časopis, dizajn istraživanja, metodologija.