

Lowest limit measures of reliability of tests with a particle covariance matrix in determination of the structure of conative dimensions of selected volleyball players

PhD Zoran Savić¹, doc., PhD Evagelia Boli¹, full prof.,

PhD Danijela Dasheva², full prof., PhD Dragan Popovic¹, full prof.

¹Faculty of Sport and Physical Education of the University of Pristina
temporarily seated in Leposavic, Serbia

²National Sports Academy "Vassil Levski", Bulgaria

e-mail: zoran.savic@pr.ac.rs

Abstract

Hypothesis 2

Coefficients β_{π} vary in the range of (0,1), but they cannot reach value 1.

Proof:

If $\mathbf{P} = \mathbf{I}$, then also $\mathbf{Y}^2 = \mathbf{I}$, so that all coefficients β_{π} equal zero. However, as $\mathbf{Y}^2 = \mathbf{0}$ is not possible if matrix \mathbf{P} is regular, all coefficients β_{π} are necessarily less than 1 and tend towards 1 when unique variance of variables from which latent dimensions are deduced inclines towards zero.

By means of the same technique it is easy to determine measures of absolute low limit of reliability of latent dimensions defined by this procedure the same way Guttman determined his measure λ_1 . For that purpose, we will assume that $\mathbf{E}^2 = \mathbf{I}$. In that case

$$\alpha_p = 1 - (\mathbf{q}_p^t \mathbf{R} \mathbf{q}_p)^{-1}$$

will be measures of absolute low limit of reliability of latent dimensions, as, obviously, $\mathbf{\Theta}^t \mathbf{\Theta} = \mathbf{I}$.

Key words: /variance/ matrix/ variable /universe /latent/ dimension

1. Introduction

The fact is that human organism is very complex, dynamic and hierarchically organized system, the abilities and characteristics of which depend, at first on the process of reception, retention and processing of information. This further conditions the necessity to explore the problems of structure, functioning and conducting of certain segments of anthropological status in an integral and interactive way.

Applied to sport i.e. sport activities, this knowledge conditions the assessment of specific demands in order to continue the process of transformation or to influence the improvement of exactly those characteristics of students and players in specific conditions of competitions on which the highest level of sport success depends. Before mentioned demands come from the fact that each sport game, apart from the general and common characteristics, contains its specific characteristics.

Anthropological status of a person is determined by the following characteristics: morphological characteristics, functional capabilities, motor abilities, cognitive abilities, conative characteristics and social characteristics.

Thus, it is necessary to establish methods of determining inheritance factors as the most influential ones for developing human abilities and, based on this, first set the rules for selection in certain sports and then foresee success in certain sports' disciplines. It is necessary to determine their morphological, functional, motor, cognitive, conative and social structure which, as a general anthropological status, benefits sports' results (Petković, 2008).

Considering that in each sport and sport games there are certain exclusive characteristics and differences in their competition structure, there emerges the need to continually and practically explore and confirm these exclusive characteristics, and especially certain anthropological abilities and characteristics which are genetically conditioned, then their hierarchical values in sport games as well as their structure

and development under the influence of particular training processes, methods and loads.

Recently, and especially in the last twenty years, very serious efforts to reduce disarray in volleyball training have been made and it has been attempted to transform it into an organized system which could be more successfully included in contemporary sport practice.

2. Methods

2.1. Sample of subjects

Sample of subjects depended on organizational and financial resources required for the research. Sufficient number of qualified and trained personnel performing measurements, defined instruments and standardized conditions of the research planned were provided. Measurements were performed on the sample which is representative for the whole Republic of Serbia.

- subjects were male

- age was defined on the basis of chronological age, so that the research was performed on subjects from 18 to 27 years of age plus-minus 0.5 years

- subjects were registered players of the national competition rank (two highest levels of competition)

- subjects had regular trainings, which was confirmed by evidence kept by coaches

- we chose a sample of 100 subjects based on statistical-mathematical model and program, aims set by hypotheses.

No other exclusion criteria or stratification variables were used in defining of the population from which the sample of subjects was taken apart from the listed ones.

2.2 Sample of the variables

SAMPLE OF THE VARIABLES FOR EVALUATION OF CONATIVE CHARACTERISTICS

For the assessment of conative characteristics, the measuring instrument CON6 was chosen which assesses the following conative regulators:

- activity regulator (EPSILON),

- regulator of organ functions (HI),
- regulator of defense reactions (ALFA),
- regulator of attack reactions (SIGMA),
- system for coordinating regulatory functions (DELTA) and
- system for integration of regulatory functions (ETA).

2. 3. Methods of processing of the results

Value of a research does not depend only on the sample of subjects and the sample of variables, that is on value of basic information, but also on the applied procedures for transformation and condensation of those information. Some scientific problems can be solved by multiple different and sometimes equally trustworthy methods. However, with the same basic data and based on results of different methods, different conclusions can be drawn. Therefore the problem of selection of particular methods for data processing is rather complex.

In order to reach satisfactory scientific solutions, the research was based on, primarily acceptable, adequate, unbiased and comparable procedures, which were appropriate to the nature of the problem posed and which enabled extraction and transformation of appropriate dimensions, hypotheses testing of those dimensions, defining differences, relations, prognosis and diagnosis, as well as definition of principles within the research field.

Taking all this into account, for the purpose of this research we chose procedures which are considered to be appropriate to the nature of the problem which do not impose too severe restrictions on the basic information.

If ξ^2 is variance of any defined total result, if τ^2 is variance of thus defined accurate result, and if ε^2 is variance of measurement deviation of some composite measurement instrument.

As

$$\mathbf{G}^1\mathbf{E} = \mathbf{U}^2 - \mathbf{U}^2\mathbf{R}^{-1}\mathbf{U}^2$$

Is for tests with regular, and

$$\mathbf{G}^1\mathbf{E} = \mathbf{U}^2 - \mathbf{U}^2\mathbf{R}\mathbf{U}^2$$

For tests with singular matrices of particle covariance, two theoretical definitions of reliability,

and
$$\alpha_1 = \tau^2 \sigma^{-2}$$

$$\alpha_2 = 1 - \varepsilon^2 \sigma^{-2}$$

are not equivalent when it comes to the measurement model based on Guttman image theory.

Let us first consider λ_{α} measurements (Guttman, 1945) defined by functions α_1 i α_2 . For the result defined by function \mathbf{h} , those measures will be

$$\lambda_{61} = \eta^2 \sigma^{-2},$$

and

$$\lambda_{62} = 1 - \theta^2 \sigma^{-2}.$$

β_{α} measure types (Momirović, 1996) defined by functions α_1 i α_2 for the result defined by function \mathbf{h} will be

$$\beta_{61} = \gamma^2 \lambda^{-2}$$

and

$$\beta_{62} = 1 - \delta^2 \lambda^{-2}.$$

It is not hard to prove that for regular particle clusters α_1 measure types of the estimated low limit of reliability of λ_{α} i β_{α} measure types, and that α_2 measure types are estimates of high level of reliability of λ_{α} i β_{α} measure types.

Hypothesis 1

Coefficients γ_{π} vary in the range (0,1) and can reach value 1 only if $\mathbf{P} = \mathbf{I}$, if all the variables are measured correctly, and value 0 only if both $\mathbf{P} = \mathbf{0}$ and $\mathbf{P} = \mathbf{I}$, that is if the entire variance of all variables consists only of variance of measurement deviation, and variables from \mathbf{V} have spherical normal distribution.

Proof:

If the whole variance of each variable from some variable cluster consists only of variance of measurement deviation, then $\mathbf{E}^2 = \mathbf{I}$ and $\mathbf{P} = \mathbf{I}$, so all coefficients γ_{π} equal zero. The first part of hypothesis is obvious from the definition of coefficient γ_{π} ; this means that reliability of each latent dimension, regardless of how that latent

dimension was determined, equals 1 if all variables from which the dimension was deduced were measured correctly.

However, reliability coefficient matrix $P = (\rho_j)$ is frequently unknown, so that matrix of measurement deviation variance E^2 is also unknown. But, if variables from V are selected to represent some range of U variables with the same array of importance, high limit of measurement deviation variances is defined by elements of U^2 matrix (Guttman, 1945, 1953), that is by unique variances of those variables. This is why, in that case, low limit of reliability of latent dimensions can be estimated by coefficient

$$\beta_p = 1 - (\mathbf{q}_p^t \mathbf{U}^2 \mathbf{q}_p)(\mathbf{q}_p^t \mathbf{R} \mathbf{q}_p)^{-1} \quad p = 1, \dots, k$$

which were reached by the procedure identical to the one used for reaching coefficients γ_π with definition of $E^2 = Y^2$, that is the same way Guttman reached his measure λ_6 .

Hypothesis 2

Coefficients β_π vary in the range of (0,1), but they cannot reach value 1.

Proof:

If $P = I$, then also $Y^2 = I$, so that all coefficients β_π equal zero. However, as $Y^2 = 0$ is not possible if matrix P is regular, all coefficients β_π are necessarily less than 1 and tend towards 1 when unique variance of variables from which latent dimensions are deduced inclines towards zero.

By means of the same technique it is easy to determine measures of absolute low limit of reliability of latent dimensions defined by this procedure the same way Guttman determined his measure λ_1 . For that purpose, we will assume that $E^2 = I$. In that case

$$\alpha_p = 1 - (\mathbf{q}_p^t \mathbf{R} \mathbf{q}_p)^{-1}$$

will be measures of absolute low limit of reliability of latent dimensions, as, obviously, $\Theta^t \Theta = I$.

Hypothesis 3

All the coefficients α_π are always less than 1.

Proof:

It is obvious that all the coefficients must α_π be less than 1, and that they all incline towards 1 when m, number of variables in V cluster, inclines towards infinity, since in that case square form of matrix P inclines towards infinity. If $\mathbf{P} = \mathbf{I}$, then, obviously, all the coefficients α_π equal zero. However, low limit of coefficient α_π needs not to be zero, since it is possible, but not for all α_π coefficients, that variance σ_π^2 of some latent dimension is less than 1. Certainly, latent dimension which provides less information than any variable from which it was derived makes no sense, and the best way to show that is by coefficient α_π .

Measure types β_6 defined by α_1 i α_2 functions (Momirović, 1996) will be, for the result defined by function η ,

$$\begin{aligned} \alpha\nu\delta \quad \beta_{61} &= \gamma^2\lambda^{-2} \\ \beta_{62} &= 1 - \delta^2\lambda^{-2}. \end{aligned}$$

It is not hard to prove that, for regular particle clusters, measure types α_1 are estimated low limits of reliability of measures type λ_6 i β_6 , while α_2 measure types are estimated high limits of measure types λ_6 i β_6 .

Hypothesis 4

If $m \geq 2$, $|\mathbf{R}| \neq 0$ and $\mathbf{T} \subset \alpha$, where α is cluster of all vectors which are in the positive hyperquadrant \mathfrak{R}^m of the space, so that $r_{jk} \geq 0 \forall \mathbf{t}_j, \mathbf{t}_k; j,k = 1, \dots, m$, then, for $\mathbf{x}: \mathbf{x}^t\mathbf{x} = 1$ is such that $\mathbf{x}^t\mathbf{R}\mathbf{x} = \lambda^2 = \text{maximum}$,

$$0 \leq \lambda_{61} \leq \beta_{61} < 1.$$

Proof:

Obviously, $0 = \lambda_{61} = \beta_{61}$ only when $\mathbf{C} = \mathbf{0}$, i.e. $\mathbf{R} = \mathbf{I}$. Ako $\mathbf{x} \neq \mathbf{e}$, $\lambda^2 \geq \sigma^2$, which is why it is crucial to determine what is the difference between functions $(\mathbf{x}^t\mathbf{C}\mathbf{x})(\mathbf{x}^t\mathbf{R}\mathbf{x})^{-1}$ and $(\mathbf{e}^t\mathbf{C}\mathbf{e})(\mathbf{e}^t\mathbf{R}\mathbf{e})^{-1}$. As

$$(\mathbf{x}^t\mathbf{C}\mathbf{x})(\mathbf{x}^t\mathbf{R}\mathbf{x})^{-1} - (\mathbf{e}^t\mathbf{C}\mathbf{e})(\mathbf{e}^t\mathbf{R}\mathbf{e})^{-1} = (\mathbf{x}^t\mathbf{U}^2\mathbf{R}^{-1}\mathbf{U}^2\mathbf{x})\lambda^{-2} - 2(\mathbf{x}^t\mathbf{U}^2\mathbf{x})\lambda^{-2} - (\mathbf{e}^t\mathbf{U}^2\mathbf{R}^{-1}\mathbf{U}^2\mathbf{e})\sigma^{-2} + 2(\mathbf{e}^t\mathbf{U}^2\mathbf{e})\sigma^{-2}$$

and as

$$(2(\mathbf{e}^t\mathbf{U}^2\mathbf{e})\sigma^{-2} - 2(\mathbf{x}^t\mathbf{U}^2\mathbf{x})\lambda^{-2}) > ((\mathbf{e}^t\mathbf{U}^2\mathbf{R}^{-1}\mathbf{U}^2\mathbf{e})\sigma^{-2} - (\mathbf{x}^t\mathbf{U}^2\mathbf{R}^{-1}\mathbf{U}^2\mathbf{x})\lambda^{-2}),$$

since matrix elements outside diagonal $\mathbf{U}^2\mathbf{R}^{-1}\mathbf{U}^2$ are negative if $\mathbf{T} \subset \alpha$ and \mathbf{x} vector elements in the negative correlation with matrix elements \mathbf{U}^2 , then $\lambda_{\beta_1} \leq \beta_{\beta_1}$, which is exactly what needed to be proved.

In a similar manner we can demonstrate that relations defined by hypotheses 1, 2, 3 i 4 stand in case if $|\mathbf{R}| = 0$ and $\mathbf{U}^2 = (\text{diag } \mathbf{R}^{-1})^{-1}$, taking into account that $\mathbf{R}\mathbf{R}^{-1} = \mathbf{X}\mathbf{X}^t$, where $\mathbf{X}: \mathbf{X}^t\mathbf{X} = \mathbf{I}$ and matrices typical of vectors of matrix \mathbf{R} coupled with typical values of that matrix other than zero. However, in that case, due to inflation of uniqueness in the zone of singularity, there will almost always occur reduction of all measures of reliability which are based on estimation of unique particle variance (Momirović, 1999).

3. Results

It is of utter importance to apply the results of scientific researches to training process in order to reach high sport results in every kinesiological activity and consequently volleyball too. As the success in sport depends on a range of factors, it is very important to have reliable indicators about which dimensions and to what extent influence reaching maximum results. Conative space presents the part of personality responsible for modalities of one's behavior. As there are normal and pathological modalities of behavior, there are also normal and pathological conative factors.

The characteristic of normal conative factors is that they are mostly independent and normally distributed within the population. The attempts to research normal modalities of behavior and normal conative factors are rare and that is why this sub-space of personality is not clearly defined.

Pathological conative factors are better defined in than normal factors in conducted researches and in most cases there are certain theoretical explanations.

It is considered that pathological conative factors are responsible for those behaviors which reduce adaptive level of a human being regarding his or her potential abilities. The influence of conative factors on all the activities which are not very sensitive to the influence of conative factors is not the same, but also there are the ones for which this influence is of crucial importance. That influence can be either positive or negative, depending on the factors and activities. To conclude, there is no activity which is completely resistant to the influence of conative factors, which makes determination of the structure of conative regulatory mechanisms very important in volleyball too.

All this makes assessment of latent dimensions on the basis of simple, confirmative algorithms possible in such researches. These algorithms are proper not

only for their great efficacy and economy, but also because they enable very simple interpretation of the results.

Algorithm applied in this research and the program associated to it is used to explain the structure of the spaces treated in the simplest way.

In attempt to determine characteristics of the basic space of conative variables, the transformation and condensation of the data into the matrix of correlations were performed and thus the characteristics of the measuring instruments were explained.

MAIN COMPONENTS OF CONATIVE VARIABLES OF VOLLEYBALL PLAYERS

Table 1

	FAC 1	FAC 2	FAC 3	h2
EPSILON	,03	,59	-,66	,76
HI	-,69	-,03	,26	,52
ALFA	,09	-,83	-,03	,67
SIGMA	,34	,46	,72	,84
DELTA	,65	-,17	-,18	,47
ETA	,87	-,01	,08	,74
Characteristic root	1,89	1,44	,99	
% Variance	29,88	22,31	18,11	
Cumulative %	29,88	52,19	70,30	

MATRIX OF THE CONATIVE VARIABLES' CLUSTER OF THE VOLLEYBALL PLAYERS

Table 2

	OBL 1	OBL 2	OBL 3
EPSILON	,13	,87	-,19
HI	-,73	-,16	,0
ALFA	,18	-,64	-,43
SIGMA	,10	-,06	,92
DELTA	,69	-,04	-,08
ETA	,81	-,09	,27

MATRIX OF THE STRUCTURE OF CONATIVE VARIABLES OF VOLLEYBALL PLAYERS

Table 3

	OBL 1	OBL 2	OBL 3
EPSILON	,10	,85	-,13
HI	-,73	-,13	,00
ALFA	,20	-,68	-,47
SIGMA	,12	-,00	,91
DELTA	,69	-,07	-,07
ETA	,83	-,10	,28

OBLIMIN FACTORS INTERCORRELATIONS

Table 4

	OBL 1	OBL 2	OBL 3
OBL 1	1,00		
OBL 2	-,05	1,00	
OBL 3	,02	,09	1,00

Based on the Guttman criterion λ_6 , three principal components which explained 70.30% of the total variance of variables were obtained (Table 1). Thereby, already the first characteristic root extracted 29.88% of the common variance of variables. Most variables have large positive projections on the first principal component: ETA.87, HI.69, DELTA.65. This principal component, undoubtedly, acts as a general conative factor, (Popovic et al. 1995 et 1996).

The second principal component explains 22.31% of the variance and the variable for regulation of defense reactions ALFA.83 has the largest projection on it.

The third principal component explains 17:16% of the variance and the variable for regulation of attack reactions SIGMA .72. and variable EPSILON .66. have the largest projection on it.

Communalities of all the variables are satisfactory. Although other main components cannot be given special relevance as it is the case with the first main variance, those generators of variabilities which are, according to the position of their importance, responsible for the variability of the analyzed space can be discovered by examination of these components.

To obtain a parsimonious structure, the entire initial coordinate system is rotated in one of the oblique rotations. On this occasion, the direct oblimin criterion of Jennrich and Sampson was used and the same number of factors was kept while obtaining three matrices: pattern matrix (Table 2), structure matrix (Table 3) and factor inter-correlation matrix (Table 4). In order to obtain an interpretable structure, both the factor matrix and the structure matrix will be interpreted at the same time.

The first oblimin factor of the largest parallel and orthogonal projections is with the test vectors whose intentional subjects of measurements were the regulator of organ functions HI, coordination of regulatory functions DELTA and system for integration of regulatory functions ETA.

Another oblimin factor is represented by the activity regulator EPSILON and factor of regulation of defense reactions ALFA.

The third oblimin factor is represented by the factor of regulation of attack reactions (SIGMA).

Matrix of the intercorrelation factors (table 4) shows that the first latent dimension does not have any statistically relevant relation with the other one, which means that the isolated latent dimensions are clean in factorial sense. Cybernetic model of

the conative regulators, which is in fact integrated into the model of cognitive functions, functions through biologically and socially most important and most complicated system for regulation and control of the regulatory functions and is related with all other systems. The efficacy of conative regulatory mechanisms partly depends on physiological components which determine the range and stability of the regulation, and partly on the programs formed under the influence of exogenous factors as well as on the interaction of social factors and physiological basis of regulatory mechanisms. Considering that a player does not have the inner drive to perform aggressive movements during the volleyball match, except in extreme situations when the concentration and self-control because of the sense of responsibility in a stressful situation are low, this pathological personality trait should be studied with all available measuring instruments in future researches.

4. Conclusion

The study was conducted in order to determine a structure of conative characteristics in athletes involved in volleyball. To determine the structure of conative dimensions, 100 volleyball players were examined.

For the assessment of conative characteristics, the measuring instrument CON6 was chosen which assesses the following conative regulators:

- activity regulator (EPSILON),
- regulator of organ functions (HI),
- regulator of defense reactions (ALFA),
- regulator of attack reactions (SIGMA),
- system for coordinating regulatory functions (DELTA) and
- system for integration of regulatory functions (ETA).

All the data in this study were processed at the Multidisciplinary Research Center, Faculty of Sport and Physical Education, University of Pristina with the help of the software system for data processing developed by Popovic, D. (1980), (1993), and Momirović, K. and Popovic, D. (2003).

Based on the Guttman criterion λ_6 , three principal components which explained 70.30% of the total variance of variables were obtained (Table 1). Thereby, already the first characteristic root extracted 29.88% of the common variance of variables. Most variables have large positive projections on the first principal component: ETA.87, HI.69, DELTA.65. This principal component, undoubtedly, acts as a general conative factor, (Popovic et al. 1995 et 1996).

The second principal component explains 22.31% of the variance and the variable for regulation of defense reactions ALFA.83 has the largest projection on it.

The third principal component explains 17.16% of the variance and the variable for regulation of attack reactions SIGMA .72. and variable EPSILON .66. have the largest projection on it.

To obtain a parsimonious structure, the entire initial coordinate system is rotated in one of the oblique rotations. On this occasion, the direct oblimin criterion of Jennrich and Sampson was used and the same number of factors was kept while obtaining three matrices: pattern matrix (Table 2), structure matrix (Table 3) and factor inter-correlation matrix (Table 4). In order to obtain an interpretable structure, both the factor matrix and the structure matrix will be interpreted at the same time.

The first oblimin factor of the largest parallel and orthogonal projections is with the test vectors whose intentional subjects of measurements were the regulator of organ functions HI, coordination of regulatory functions DELTA and system for integration of regulatory functions ETA.

Another oblimin factor is represented by the activity regulator EPSILON and factor of regulation of defense reactions ALFA.

The third oblimin factor is represented by the factor of regulation of attack reactions (SIGMA).

5. Literature

- [1.] Boli, E.: (1996) The structure of intellectual and musical abilities and personal traits of girls involved in standard and Latin American dance, Master thesis, University in Priština, Faculty of Physical Education.
- [2.] Boli, E., Popović, D., A. Hošek.: (2009) Sort and crime, University in Priština, Center for multidisciplinary research of the Faculty of Sport and Physical Education, Leposavić.
- [3.] Boli, E.: (2011) The structure of anthropological dimensions of male and female dancers and procedures processing for their evaluation and monitoring. (Monograph) University in Priština, Center for multidisciplinary research of the Faculty of Sport and Physical Education, Leposavić.
- [4.] Gredelj, M., D. Metikoš, A. Hošek, K. Momirovic (1975): A model of hierarchical structure of motor abilities. *Kinesiology*, 5 (1-2), 7-81.

- [5.] Guttman, L. (1945): A basis for analysis test-retest reliability. *Psychometrics*, 10:255-282.
- [6.] Knežević, G.; Momirović, K. (1996): Algorithm and program for orthoblique transformation of the main components of which the importance is based on PB criterion. Technical report, Institute of criminological and sociological research, Belgrade
- [7.] Momirović, K. (1996): About the reliability measures of latent dimensions determined by semiorthogonal transformations of the main components in S. Bogosavljević and M. Kovačević, *Grouping Analyses*, 2. Belgrade: National Institute for Statistics
- [8.] Momirović, D, Wolf, B. and Popović, D: (1999) The introduction to the theory of measurement and internal metric properties of composite measuring instruments (textbook), University in Priština, Faculty of physical education, Priština.
- [9.] Momirović, K. (1999): Two measures of low and high reliability levels of the tests with regular and singular matrix of particles' covariance
- [10.] Momirović, K.; Erjavec, N.; Radaković, J. (1988): Method, algorithm and program for concurrent validation of measuring instruments under confirmative and explorative model of component analysis, *Applied Psychology*, 9: 157-162
- [11.] Momirovic, K and Popović, D. (2003): Construction and applied taxonomy of neural webs, Leposavić, University in Priština, Center for multidisciplinary researches of the Faculty of Physical Education.
- [12.] Mulaik, S. A. (1972): The foundations of factor analysis. New York: McGraw-Hill.
- [13.] Popović, D.: (1980) Research methodology in Physical Education, University in Niš, Scientific Youth, Niš.
- [14.] Popović, D., Antić, K., Stanković, V., Petković, V. & Stanković, S.: (1989) The procedures for objectification of estimating the effectiveness in performing the judo techniques. *Scientific Youth*, 21(1-2), 83-89.
- [15.] Popović, D., Kocić, J., Boli, E. & Stanković, V.: (1995) Conative characteristics of female dancers. *International Congress "Images of Sport in the World"*, 75th Anniversary of the German Sport University, Abstract Volume, (pp. 96), Open Forum, Cologne, Germany.
- [16.] Popović, D., Petrović, J., Boli, E. & Stanković, V.: (1995) The structure of the personality of female dancers. *3rd International Congress on Physical Education and Sport*, Exercise & society supplement issue No. 11 (pp. 196), Komotini, Greece.
- [17.] Popović, D., Stanković, V., Kulić, R. & Grigoropoulos, P.: (1996) The structure of personality of handball players. *4th International Congress on*

- Physical Education and Sport*, Exercise & society supplement issue No. 15 (pp. 164), Komotini, Greece.
- [18.] Popović, D. (2005): GUTTMAN, Programs for the analyses of metrical characteristics of composite measuring instruments, in Savić, Z.: The influence of situational training on the transformation of some anthropological elements of selected football players (doctorial thesis), Leposavić, Faculty of Physical Education.
- [19.] Popović, D.: (1988) Application methods of factorial analysis for determining morphological types. *4rd international symposium on the methodology of mathematical modeling*, Varna, Bulgarija.
- [20.] Popović, D.: (1991) Research methodology in Physical education (textbook), University in Niš, Scientific Youth, Niš.
- [21.] Popović, D.: (1992) Methodology of research in physical education, Athens, Greece.
- [22.] Popović, D.: (1993) Programs and subprograms for the analysis of quantitative modifications (textbook), University in Priština, Faculty of physical education, Center for multidisciplinary research, Priština.
- [23.] Popović, D.: (1993) Determination of the structure of psychosomatic dimensions in combats and procedures processing for their evaluation and monitoring (monograph), University in Priština, Faculty of physical education, Priština.
- [24.] Kaiser, H. F. (1958): The varimax criterion for analytic rotation in factor analysis. *Psychometrics*, 23:187-200.
- [25.] Kurolić, N., et. al. (1975): Structure and development of motor and morphological dimensions of the youth. Belgrade: Institute for scientific research, Faculty of Physical Education, University in Belgrade.
- [26.] Harris, C. W.; Kaiser, H. F. (1964): Oblique factor analytic solutions by orthogonal transformations. *Psychometric*, 29:347-362.
- [27.] Stanković, V. & Popović, D. (2009). The results of various factor procedures for establishing the cognitive abilities of handball players. I International scientific congress “Anthropological aspects of sport, physical education and recreation”, pp. 209-213, Banja Luka, BiH.
- [28.] Štalec, J.; Momirović, K. (1971): The total amount of acceptable variance as the basis of the criterion for determining the number of important main components.

Kinesiology, 1, 1:83-90.

Received on 20th March 2013

Accepted on 18th November 2013

Lowest limit measures of reliability of tests with a particle covariance matrix in determination of the structure of conative dimensions of selected volleyball players

PhD Zoran Savić¹, doc., PhD Evagelia Boli¹, full prof.,

PhD Danijela Dasheva², full prof., PhD Dragan Popovic¹, full prof.

*¹Faculty of Sport and Physical Education of the University of Pristina
temporarily seated in Leposavic, Serbia*

²National Sports Academy "Vassil Levski", Bulgaria

e-mail: zoran.savic@pr.ac.rs

Summary

The study was conducted in order to determine a structure of conative characteristics in athletes involved in volleyball. To determine the structure of conative dimensions, 100 volleyball players were examined.

For the assessment of conative characteristics, there was chosen the measuring instrument CON6 which assesses the following conative regulators: activity regulator (EPSILON), regulator of organ functions (HI), regulator of defense reactions (ALFA), regulator of attack reactions (SIGMA), system for coordinating regulatory functions (DELTA) and system for integration of regulatory functions (ETA).

All the data in this study were processed at the Multidisciplinary Research

Center, Faculty of Sport and Physical Education, University of Pristina with the help of the software system for data processing developed by Popovic, D. (1980), (1993), and Momirović, K. and Popovic, D. (2003).

Based on the Guttman criterion λ_6 , three principal components which explained 70.30% of the total variance of variables were obtained (Table 1). Thereby, already the first characteristic root extracted 29.88% of the common variance of variables. Most variables have large positive projections on the first principal component: ETA.87, HI.69, DELTA.65. This principal component, undoubtedly, acts as a general conative factor, (Popovic et al. 1995 et 1996).

The second principal component explains 22.31% of the variance and the variable for regulation of defense reactions ALFA.83 has the largest projection on it.

The third principal component explains 17:16% of the variance and the variable for regulation of attack reactions SIGMA .72. and variable EPSILON .66. have the largest projection on it.

To obtain a parsimonic structure, the entire initial coordinate system is rotated in one of the oblique rotations. On this occasion, the direct oblimin criterion of Jenrich and Sampson was used and the same number of factors was kept while obtaining three matrices: pattern matrix (Table 2), structure matrix (Table 3) and factor intercorrelation matrix (Table 4). In order to obtain an interpretable structure, both the factor matrix and the structure matrix will be interpreted at the same time.

The first oblimin factor of the largest parallel and orthogonal projections is with the test vectors whose intentional subjects of measurements were the regulator of organ functions HI, coordination of regulatory functions DELTA and system for integration of regulatory functions ETA.

Another oblimin factor is represented by the activity regulator EPSILON and factor of regulation of defense reactions ALFA.

The third oblimin factor is represented by the factor of regulation of attack reactions (SIGMA).