ASSESSING COMPETITIVE AND POTENTIAL SUCCESSFULNESS OF ADVANCED YOUNG VOLLEYBALL PLAYERS

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OCENJEVANJE TEKMOVALNE IN POTENCIALNE USPEŠNOSTI KAKOVOSTNIH MLADIH ODBOJKAŠEV

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Abstract

The potential successfulness of a sample of twenty-four male volleyball players, between fifteen and sixteen years of age from four selected teams, in morphological-motor space was assessed with the expert system NDN. On the basis of the marks for playing successfulness given by volleyball experts to the individual players we also formed marks for competitive successfulness. Their congruence was assessed by different correlation coefficients.

The results show a high and statistically significant correlation of the marks for potential successfulness (generated by the expert-system method) and competitive successfulness. This means that we used suitable variables from the morphologic-motor space to assess potential successfulness and also an appropriate method. We can therefore successfully assess the potential successfulness of volleyball players in a simple and intelligible way and predict their competitive successfulness as well. The obtained information is also useful in the process of orientation and selection of children into volleyball and in planning and managing the training process.

Keywords: volleyball, youth, potential successfulness, competitive successfulness, expert system

Izvleček

Na vzorcu 24 odbojkarjev starih 15 in 16 let, iz štirih izbranih ekip, smo z ekspertnim sistemom NDN ugotavljali njihovo potencialno uspešnost v morfološko-motoričnem prostoru. Na osnovi ocen odbojkarskih ekspertov o uspešnosti igranja posameznega igralca smo oblikovali tudi ocene tekmovalne uspešnosti. Skladnost obeh ocen smo ugotavljali z različnimi koeficienti korelacije.

Rezultati kažejo visoko in statistično značilno povezanost ocen potencialne (izračunane z ekspertno metodo) ter tekmovalne uspešnosti. To pomeni, da smo za oceno potencialne uspešnosti v morfološko-motoričnem prostoru uporabili ustrezne spremenljivke in tudi primerno metodo. Na tak pregleden in enostaven način lahko torej uspešno ocenimo potencialno uspešnost odbojkarjev in na osnovi te ocene tudi napovemo njihovo uspešnost na tekmovanju. Dobljene informacije so uporabne tudi v procesu usmerjanja otrok v odbojko, selekcioniranja odbojkarjev ter pri načrtovanju in vodenja procesa treniranja.

Ključne besede: odbojka - mladi igralci - potencialna uspešnost - tekmovalna uspešnost - ekspertni sistem

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Introduction

Volleyball belongs, according to its motor structure, to polystructural acyclic sports and by the number of players to team sports (games). The successfulness of a player or a team is, because of the complexity of the game, dependent on a multitude of factors and interactions between them.

Important advances have been made in studying such problems with the introduction of modern scientific approaches (cybernetics, system theory) and use of computer technology. Because of the large number of factors influencing success, which need to be taken into account, various expert system methods are asserting themselves (Leskošek, 1996).

The idea is to join humans and computers in order to solve certain problems. The methods are useful also for research in sport. Some researchers are still studying the possibilities of their use in sport (Blahus, 1990), others already use them for solving practical problems in recreation (Yie, Tang and Wang, 1998), controlling a match (Vickers and Kingston, 1987), planning training-loads of athletes (Lee and Kim, 1992), track and field (Barac, Situcek and Kodejs, 1992), cross-country skiing (Sprigings, Dorotich and McGibney, 1992), swimming (Persny, Willems, Van Tilbourgh, Daly and Vervaecke 1987) etc. Such methods have found their place also in researching problems in sports games: basketball (Nissan, Simhon and Zigdon, 1992), rugby (Singer and Villepreux, 1995) etc.

In Slovenia researchers use them for assessing potential successfulness of players in different sports (Bon, 1998; Čoh, Čuk and Borštnik, 1993; Dolenc, 1996; Erčulj, 1996; Filipčič, 1996; Lešnik, 1996; Pustovrh, 1994; Šibila, 1995; Zadražnik, 1998). Two expert methods are mainly used: NDN and NDP (Leskošek, 1996). Findings are quite unanimous:

- the correlation between marks of potential and competitive successfulness is high,
- the knowledge database should be enhanced further with new findings on playing successfulness,
- this method is efficient, informative and cheap.

The sphere of evaluating successfulness of a player is one of the important areas for scientific and research work also in volleyball. The successfulness of a player can be assessed in two ways. First by assessing (computing) his/her potential, or second, by assessing (measuring) the manifestation of this potential in competition. In the first case we talk about potential successfulness - ie. potential - (PS) in the second about competitive successfulness (CS). Competitive successfulness, on the other hand, is obtained on the basis of marks of successfulness at matches in a certain period. The individual game is weighed according to its competitive level.

The foundation of a player's successfulness is his/her PS, which must be suitably developed with numerous factors, representing training conditions, competitive circumstances, etc. These depend a lot on the functioning of the factors of the wider milieu (role of parents, tradition of volleyball,…).

PS of a player is composed of his/her basic, realisational and motivational factors, as well as experience. Authors researching successfulness in volleyball stress the importance of morphologic characteristics and motor abilities. Their affect on successfulness in volleyball is also researched the most. We have therefore decided to base the computation of PS on several indicators of these two sub-spaces. The variables, with which we measured the factors important for success in volleyball, were chosen on the basis of findings of numerous Slovene and foreign authors. The reasons and sources for this selection are described in more detail in the dissertation »Tekmovalna uspešnost in psihosomatični potencial kakovostnih mladih odbojkarjev« [Competitive successfulness and psychosomatic potential of advanced young volleyball players] (Zadražnik, 1998).

PS was computed with the NDN expert method (method of weighted usefulness) and the obtained marks compared with actual competitive successfulness (CS) at the finals of the 1995 National Cadet Championship of Slovenia. In the case that the PS and the CS marks show adequate congruence, we would have at our disposal a useful system for assessing the level of potential successfulness of young volleyball players and a source of additional information for analysing the efficiency of the training process.

METHODS

Subject sample

The sample comprised of twenty-four male players (from fifteen to sixteen years of age) from four teams that competed at the finals of the Slovene cadet championship in 1995. Six players were selected from each team according to their playing time. Each player took part in two games of the finals. The chosen players trained 3-4 times/week and were involved in approximately the same number of training and official games up to the finals. The team members were therefore sufficiently used to playing with each other. All above shows that the conditions allowed the players to demonstrate their full potential. The measurements of the morphologic and motor dimensions of the players of the chosen teams were made at the Faculty of Sport in Ljubljana, a week prior to the finals.

Variable sample

Three anthropometric measures and two morphologic indices were chosen to represent the morphologic space (see Table 1). Conditional capabilities were assessed on the basis of the results of eight tests and specific motorics without the ball with six. The

Model of potential successfulness in volleyball, after Zadražnik (1998):

SUCCESSFULNESS OF A VOLLEYBALL PLAYER

- POTENTIAL OF WIDER MILIEAU
- POTENTIAL OF TRAINING CONDITIONS, COMPETITION, QUALITY OF OPPONENT
- potenTial OF PLAYER
- Basic dimensions
  - morphologic characteristics
  - functional capabilities
  - motor abilities and technical skills (special motorics with the ball)
    - basic motor abilities
      - informational component of movement
      - energy component of movement
    - special motorics without the ball
      - informational component of movement
      - energy component of movement
    - special motorics with the ball
- Realisational and motivational dimensions
  - personality characteristics
    - socio-psychologic characteristics
    - structural characteristics
    - competitive characteristics
  - abilities
    - psychomotor abilities
    - perceptive abilities
      - mental abilities
      - tactical skills
  - motivation and ambition
    - strength
    - incentive motivation
    - competitive motivation
    - professional ambitions
    - sports ambitions
- Experience
  - general
  - in current competition

end result of the player in a certain variable was the average of three repetitions. Specific motorics with the ball was assessed by precision and stability of target hitting with the spike and overhand pass. Precision of hitting the target is an average of three repetitions, while we computed stability with the following formula:

NAPS (PODS) = $\sqrt{\sum(X - \bar{X})^2/(N-1)}$ where $\bar{X}$ represents the average score of three repetitions and X the sum of all hits in the individual repetition.

The criterion variable CS is represented by the average mark of successfulness of the individual player at two final matches of the cadet championship. The players were assessed by three volleyball experts according to set criteria with marks from 1 to 5, precise to one decimal (Zadražnik, 1998).

Data analysis methods

The programme PETA was used to test for linearity of correlation between the predictor variables and the criterion. Blackman's test of linearity (Ferguson, 1966) was used. All variables where the relation was found to be non-linear were linearised by a logarithmic transformation.

The results in the chosen morphologic and motor variables were treated with the computer programme KISS 1.2 (Dežman and Leskošek, 1990). The base of this programme is a knowledge database for a decision system for potential successfulness. The shell consists of a decision mechanism and a communication interface. A morphologic-motor decision tree for PU was constructed (see the first column of Table 1). Then we defined the weights on all the levels of the decision tree. A greater weight was given to those factors that have a greater influence on competitive successfulness in volleyball (see second column of Table 1). We also constructed normalisers in centile values, which the

Table 1: Decision tree with weights and examples

	WEIGHT	PLAYER20	PLAYER2	CHARACTERISTIC, ABILITY, SKILL
CS		4.8	2.5	assessment of competitive successfulness
PS	**100.0**	**4.1**	**2.2**	**assessment of potential successfulness**
– MORPHOLOGY	35.0	4.6	1.8	**morphologic characteristics**
– LONGITUDINAL	26.6	5.4	1.3	**longitudinal dimensionality**
– AV	13.3	5.3	1.3	**body height**
– ADL	13.3	5.5	1.4	**length of palm**
– VOLUMINOSITY	5.6	0.7	2.8	**body volume**
– ITV	4.2	0.7	2.8	**ratio (weight/height) x 100**
– AMAP	1.4	0.9	2.7	**percent of body fat according to Matiegka**
– SPECIAL MORPHOLOGY	2.8	4.4	4.6	**special anthropometry**
– AKOM	2.8	4.4	4.6	**distance between the elbows**
– MOTORICS	65.0	3.9	2.4	**motorics**
– CONDITION	13.0	3.6	3.2	**conditional abilities**
– ENERGY	6.5	4.3	2.2	**energy component of movement**
– STRENGTH	5.2	4.6	2.0	**strength**
– EKS	3.1	4.7	2.5	**explosive power**
– ENOG	1.7	4.4	2.0	**explosive power of legs**
– SER	0.9	3.9	2.5	**height of take-off after Sargent**
– SP5	0.9	4.9	1.4	**sprint 5 m**
– EROK	1.4	5.1	3.1	**explosive power of arms**
– MED	1.4	5.1	3.1	**throwing the medicine ball while sitting**
– ELAST	2.1	4.5	1.2	**elastic power**
– SP20	2.1	4.5	1.2	**sprint 20 m**
– ENDURANCE	1.3	3.1	3.3	**endurance**
– T2KM	1.3	3.1	3.3	**2 km run**
– INFORMATION	6.5	2.8	4.1	**informational component of movement**
– FLEXIBILITY	0.6	4.3	3.5	**flexibility**
– PRK	0.6	4.3	3.5	**forward bend and touch on a bench**
– COORDINATION	4.2	1.6	4.6	**co-ordination**
– POL	4.2	1.6	4.6	**polygon backwards**
– HITALTGIB	1.6	5.3	3.2	**speed of alternate movements**
– TAPR	1.6	5.3	3.2	**arm plate-tapping**
– SPECBRZOGA	19.5	3.1	1.2	**special motorics without a ball**
– SMOC	7.8	5.4	0.7	**special power**
– BLOK	3.9	5.4	0.7	**achieved blocking height**
– VOZ	3.9	5.3	0.7	**achieved height from a rush**
– SPEC. ENDURANCE	3.1	3.1	2.3	**special endurance**
– SVZDREKSM	2.2	2.6	1.8	**special endurance in explosive power**
– VEM	2.2	2.6	1.8	**endurance in jumps**
– SVZDRHITR	0.9	4.3	3.4	**special endurance in speed**
– JEL	0.9	4.3	3.4	**»fir tree test« (from Russian)**
– SCOORD	8.6	1.0	1.2	**special co-ordination**
– PIR	5.6	0.6	1.2	**pirouette**
– AGILITY	3.0	1.8	1.1	**agility**
– TPI	3.0	1.8	1.1	**running from line to line**
– SPECZZOGA	32.5	4.5	2.8	**special motorics with the ball**
– ATTACK	16.2	4.6	2.9	**spike**
– NAPX	8.9	5.4	1.8	**average result in hitting target with spike**
– NAPS	7.3	3.6	4.4	**stability of hitting target with spike**
– ZGORNJIODB	16.2	4.5	2.7	**overhand pass**
– PODX	8.9	5.5	1.5	**average result in hitting target with overhand pass**
– PODS	7.3	3.2	4.1	**stability of hitting target with overhand pass**

computer uses to transform the results of the players in the chosen tests into marks between one and five. The normalisers are shown in Table 2.

Table 2: Marks in centile and z values

MARK	1	2	3	4	5
CENTILE	< 16	>= 16	>= 31	>= 69	>=86
z – value	< –1.0 z	>= –1.0 z	<= –0.5 z	<= 0.5 z	<= 1.0 z

The reliability of the judges (experts) was assessed by the coefficient of concordance. The congruence of the marks was found on the basis of the percent of common variance of measurement (first principal component). The level of association between potential successfulness (PS) and the competitive successfulness (CS) was measured by the Pearson correlation coefficient and Spearman's rank correlation.

Results

The tests of linearity of the association between the predictors and the criterion showed that only the variables MED (throwing the medicine ball) and NAPX (hitting the target with the spike) have a non-linear relation with the criterion. The relation was linearised by transforming the results into logarithms. A statistically significant correlation with the criterion was obtained for the following variables: AV, ADL, SP5, MED, PIR, VOZ, BLOK, NAPX, PODX.

The basic statistical parameters of the criterion variable (CS) are presented in Table 3. The marks of the judges were sufficiently reliable. The coefficient of concordance (W) is statistically significant (p = 0.000). The accord of the judges was also satisfactory, the common variance of the given marks was 77.4% (see Table 3). The marks of the players at the competition are therefore suitable to form the criterion variable CS.

Table 3: Reliability of the criterion variable

	Common variance	W	p (W)	Hi^2
CS	77.4 %	0.810	0.000	55.87

The marks of potential successfulness in the morphological-motor space and the marks of competitive successfulness of all the players are presented in Graph 1.

Graph 1: Players' marks of competitive and potential successfulness

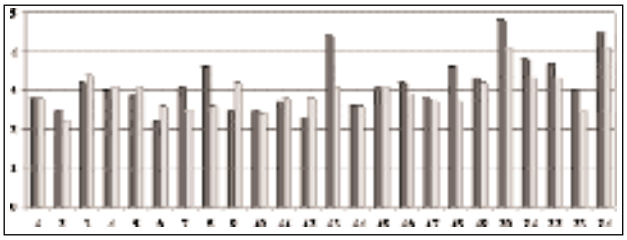

Table 4 shows the basic statistical parameters of the marks of potential successfulness computed on the basis of the variables of the morphologic-motor space and the marks of competitive successfulness.

Table 4: Basic statistical parameters of potential and competitive successfulness

	$\bar{X}$	ó	MIN.	MAX.
PS (morphological-motor space – NDN)	2.96	0.47	2.2	4.1
CS	3.17	0.69	2.2	4.8

In Table 1 we give as an example the results and marks of two players, who were judged at the competition with the highest (PLAYER20) and the lowest (PLAYER2) mark. It is at the same time a coincidence and also a manifestation of reality that they obtained the highest and the lowest computed mark of potential successfulness as well. The congruence between the PS marks in the morphologic-motor space (computed with the NDN expert method) and the CS marks is high. Both correlation coefficients are statistically significant already at the 1% error level (Table 5). We were able to explain 52% of the variance of the criterion with such a system of variables of the morphologic-motor space.

Table 5: Correlation between the marks of potential and competitive successfulness

Pearson correlation coefficient	r = 0.72	r2 = 0.52	p = 0.000
Spearman correlation coefficient	rho = 0.58		p = 0.003

Discussion

This study had several goals. We verified the method and adequacy of assessing CS (competitive successfulness at a match), that was used for the first time in this study. At the same time, we also verified the usefulness of artificial intelligence software (in our case the expert method NDN) in computing the PS (potential successfulness). The main goal of the study was the construction of the knowledge database on the basis of expert knowledge.

The results of the study show that we used an appropriate method in forming the criterion variable (CS). We can also say that the selection of variables used to compute the PS marks in the morphologic-motor space was adequate.

The good and the bad points of a players potential can be quickly determined from the results and the computed marks on the different levels of the decision tree (see the two examples in Table 1). We can also find out in the same way how the player compensates his characteristics and abilities (Dežman, 1996).

Information presented in such a way allows the coach a clinical evaluation of each player. Further study is needed to be able to use such a system in praxis, to see if similar results can be reached with less variables. It must be stressed that the knowledge database used in this case is suitable only for assessing PS of 15-16 year old players. For other age categories the knowledge database should be suitably modified and supplemented. The influence and contribution of some variables (body height, endurance in strength, endurance in speed...) to successfulness in volleyball can be, in our opinion, quite different in other age groups than the one we analysed.

The marks of competitive successfulness in the morphologic-motor space show that the players mostly played the finals of the championship in accordance with their potential. The marks of potential successfulness confirm the findings of other authors (Dežman, 1996; Erčulj, 1996; Filipčič, 1996; Pustovrh, 1994; Zadražnik, 1998). These authors used the described method to compute the players' PS in other sports and found that the best players achieve a high congruence of both marks. Such a tendency is also evident for players with a lower manifestation of their potential. The players which are placed between the two extreme groups according to their PS oscillate much more in their CS marks.

The results of the study showed that we managed to construct an informative and simple system for monitoring the morphological, motor and playing status of a young volleyball player, which can be an additional information source to the coach, while monitoring and analysing the efficiency of the training process. And from the viewpoint of praxis, the most important finding is that such an expert system is able to differentiate between better volleyball players and worse ones. This shows that the findings of this study can be useful also in some other areas (ex.: orientation of children in volleyball, selection of players, etc).

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