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Factor structure of physical and technical-tactic preparedness with highly-qualified female basketball players

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Abstract

The objective of the study is to optimize the training process of teams taking part in the National Basketball League (women) through disclosing the factor structure separately of physical and technical-tactical features with elite female basketball players and tracking the changes incurred in this structure under the affection of the applies specialized methodic. The factor analysis is based on the method of main components with Varimax orthogonal rotation. Our methodic is applied in the training process of highly-qualified female basketball players of “Dunav 8806” – Ruse, long-time champions of the country. At the end some conclusions are drawn.

Keywords: Basketball, physical, technical-tactical features, factor analysis, optimization

1. Introduction

Pursuant to the national representative study of public opinion, basketball is one of the most popular sports (I. Tsenov, V. Pavlov, 2013) ^[15] and falls in Top 10 of the priority sports in Bulgaria (V. Pavlov, I. Tsenov, 2013) ^[11]. According to the experts this requires respective national policy for development of basketball on all levels with pupil, student, mass and competitive character as well as with special needs people.

On the other hand, the worldwide practice also shows that without reached high results in the professional sports and creating the model of the so-called elite team, in a certain type of sport it is unthinkable to attract funding (through attracting funding from the target groups of those doing sports, spectators, media, sponsors and advertisers).

The Polish expert T. Hutsinskiy (2004a) ^[13], in his study, held within a 19-year old period (1985-2003) makes the following characteristics of elite female basketball players: they have brightly expressed peculiarities of the personal profile; they have more expressed intellect, emotional balance, positive attitude toward themselves and their partners, self-criticism and brightly expressed strive to self-organization; they do not have acute psychological problems; they are opened and benevolent to other people. Those features allow them to successfully deal in various everyday situations (T. Hutsinskiy, 2004b) ^[14].

The contemporary sport for high achievements has exceptionally high requirements to competitors having chosen the path of professionalism. The achievements bar is so high that only the athlete with complex and unusual capabilities can overcome it.

Basketball cannot be compared to the game from the first periods of its development. The contemporary, modern basketball characterizes with rich technical arsenal, high speed of movement on the field, in defense as well as in attack, master handling of the ball, large variety and thunderbolt execution of tactical interactions among which priority have the quick attacks and active forms of defense. All of this is preconditioned on a high level of development of the so-called basketball athleticism and sustainable psychic.

Physical training of competitors (K. Aladzhev, 2007 ^[1], 2011 ^[2]; P. Blagush, 1982 ^[5]; B. McKenzie, 201 ^[10]; M. Tomov, A. Georgieva, 2007 ^[12] and others) combined with the technique, tactics, physical and functional features (M. Aleksieva, 2011 ^[3]; L. Petrov, 2011 ^[22]; Atsevski, A., M. Naumovski, L. Petrov, 2005 ^[4] and others) are in the basis of the successful presentation in a competitive cycle.

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2. Materials and methods

The objective of the study is to optimize the training process of the teams taking part in the National Basketball League (women) through developing the factor structure separately of physical and technical-tactical features of elite female basketball players and tracking the changes incurred in this structure under the effect of the applied specialized methodic.

Experimental methodic is set in the training activities for a period of eight months. Preliminary we prepared a plan-program, related to the dynamics of the sports results depending on the division of the annual cycle into periods. The separate units contain training activities, weekly micro-cycles, monthly mezzo-cycles, annual macro-cycles which are interrelated and subordinate to set high goals of the team and peculiarities of the sports calendar - participation in the National Basketball League - women (October-May), European Tournaments – FIBA EURO CUP (October – December), Bulgaria Cup (March) (G. Boshkov, 2016) [7].

2.1 Participants

The research is held with representative female team “Dunav 8806” – Ruse upon its participation in the National Basketball League, 2013/14. Examined were 12 competitors with average age of 24, 5 years and average height 181,35 cm (G. Boshkov, 2015) [8].

2.2 Research's methodic

Observed are 19 indicators of which eleven for physical features marked with X1, X2,..., X11 and eight for technical-tactical features, marked with X12, X13,..., X19 (table 1).

During the selection of those indicators taken into consideration are the following requirements: they shall bear information about the development of various physical features and technical skills; they shall have proven reliability, validity, accessibility, objectivity and standards; they shall be applicable at field conditions (G Boshkov, V Pavlov, 2015) [6].

Part of the indicators is often used in sports and pedagogical practice and the others are presented in our previous publications (G. Boshkov *et al.*, 2013) [9]. (Insert Table 1 here) From the theory of factor analysis it is known that the dispersion (variability) of an array of indicators can be explained with a smaller number of latent indicators called factors. Their number is much smaller than the number of the first selection of indicators. This facilitates the contemplation and interpretation of the diversity of correlation dependencies. Factors are extracted based on general similar characteristics which objectively exist between the examined indicators and allow an ability (property) of the studied object to be discovered.

For the needs of the study, the results of the testing of the female basketball team of “Dunav 8806” – Ruse are processed through a factor analysis, based on the method of main components.

For the correlation matrices in the beginning and end of the examined period defined are the so-called eigenvalues of their respective own vectors. The eigenvalues are aligned in descending order where every eigenvalue has its respective own vector. The own vectors, corresponding to the eigenvalues greater than one (Kaiser's criteria) form the so-called main factors (components).

3. Results

For the needs of the study held are three official tests – in the beginning (September 2013), interim (December 2013) and in the end of the sports season (April 2014). In this paper an

analysis of results is performed, based on the initial and end testing.

In our analysis the following designations are used: $XJ^{(0)}$ and $XJ^{(8)}$ - values of the indicator XJ in the beginning and in the end of the period (after 8 months), for the respective number of the indicator J=1, 2, 19.

In the group of indicators for the physical features in the beginning of the experimental period formed are two main factors (table 2). The first complies with eigenvalue 5,763 and the second with 2,533. Those two factors explain 75,419% of the total dispersion. (Insert Table 2 here)

Determining the contents of the two factors is made through the following Varimax orthogonal rotation (Wainer/Braun, 1988) [23] with the assistance of the so-called R-technique where a number of units of the observation – n (in our case n=12) is estimated as per specific number of indicators – m (in our case m=11), when required is n>m. This way the indicators which materially correlate (*- the ration of Pierson on the absolute value is larger than 0,5) with a given factor, define its contents (table 3).

The first factor explains highest percentage of the total dispersion – 52,395% (table 2). With this factor materially correlate the indicators (table 3): X5 – standing triple jump with two feet; X6 – vertical standing two-feet jump; X7 – lifting rod from occipital laying down position; X8 – throwing thick ball above head; X9 – standing up from occipital laying down position to sitting position; X11 – moving within a square; X12 – shuttle run; X13 – moving in defense with change in the movement direction.

Therefore the exploding power of the lower limbs, the strength and durability of the arms, the shoulder girdle and abdominal muscles; the specific basketball movements determine the first major factor in the group of indicators for physical properties in the beginning of the experimental period.

(Insert Table 3 here)

The second factor explains lower percentage 23,024% of the total dispersion compared to the first one (table 2). With this factor materially correlate the indicators (table 3): X4 – high start 20 m running; X10 - tilt in depth with straight knees and X14 – 1600 m running. This way speed, speed durability and flexibility are the second main factor in the group of indicators for the physical features in the beginning of the period.

In the end of the experimental period, under the effect of the applied specialized methodic formed is another main factor (table 4) and there are some changes in the components structure of main factors (table 5). This way the main factors become three and explain 81,654% of the total dispersion.

(Insert Table 4 here)

The first factor (48,276%) has changed component structure. It is determined by the explosive power of lower limbs and specific basketball movements (table 5).

The second factor (21,374%) is new and proves the growing significance of power and power durability of arms, shoulder girdle and abdominal muscles, as specialized individual factor in the group of the physical feature indicators (table 5).

The third factor (12,00%) is identical to the second one, extracted in the beginning of the experimental period and underlines the significance of the speed, speed durability and flexibility as a main factor in the group of indicators for physical features (table 5). (Insert Table 5 here)

In the group of indicators for technical-tactical features as result of the applied specialized methodic observed are reverse changes.

In the beginning of the experimental period formed are three main factors (table 6). The first factor complies with

eigenvalue 2,763 and explains highest percentage of the total dispersion - 34,534 %. With this factor materially correlate the indicators (table 7): X16 - shoot with sliding after dribble; X17 – shuttle run with dribble; X21 - Moving in a defense position between three poles. This way some specific basketball movements, dribble with the ball and shooting with serving define the first main factor in the group of indicators of the technical-tactical features in the beginning of the experimental period.

With the second factor (24,948%) materially correlate two indicators (table 7): X20 – shooting from a line for 3 points with mastering and dribble the ball for 2 minutes and X22 - 50 shots from the 3-point line with two ball passers for 2 min. 45 sec. This way the shooting from 3-point line defines itself to be the second main factor in the group of indicators for technical – tactical features in the beginning of the period. (Insert Table 6 here)

With the third factor (17,979%) materially correlate two indicators (table 7): X18 – shooting from a line for penalty shots in two baskets for 2 minutes and X19 – shooting from two ends of the line for penalty shots with mastering of the ball for 1 minute. (Insert Table 7 here)

This way shooting from the line for penalty shots defines the third main factor in the group of indicators for technical-tactical features in the beginning of period.

As we marked in the end of the experimental period, under the effect of the applied specialized methodic the main factors from three become two (table 8), which causes changes in the component structure of the main factors (table 9).

(Insert Table 8 here)

It is important to mark that the weight of the two new factors is equal to the previous three, as an explanation of the total dispersion. (Insert Table 9 here)

The first factor (52,395%) is defined entirely by the shot from the line for penalty shots and 3-point line (table 9).

The second factor (23,024%) is entirely defined by the agility, specific basketball movements, dribble with the ball and shooting with serving (table 9).

3.1 Discussion

In literature mainly met are studies for young or amateur basketball players as examined are various sides of their training, for example analysis of their anthropometric characteristics and their impact on the technical skills (Apostolidis, N., E. Zacharakis, 2015) ^[16]; comparative analysis between the abilities of the two genders at basketball players with average age of 15 years old (Mendes, P., D. Marinho J Petrica, 2015 ^[20]); students-basketball players (Bolotin AV Bakayev, 2016 ^[17]; Galazoulas Ch, 2016 ^[18]) and others. In literature sporadically met are papers for perfecting the training process through the training method as there are no such for highly-qualified basketball players. Mostly examined is the impact of training programs for improvement of physical features at basketball players (Keerthi Kumar M, Sundar Raj URS, 2016 ^[19]; N Sivasankar, Dr. M Govindaraj, 2016 ^[21]).

3.2 Tables

Table 1: A test battery

№	Indicator	Symbol	Measure	Measurements accuracy
1.	Running 20m standing start	X1	sec	0,01
2.	Standing triple jump with 2 feet	X2	cm	1
3.	Standing high jump with 2 feet	X3	cm	1
4.	Weight lifting lying down	X4	kg	1
5.	Overhead throw of 3kg medicine ball	X5	cm	10
6.	Crunches	X6	number	1
7.	Tilt in depth with straight knees	X7	cm	1
8.	Moving within a square (NBA test)	X8	sec	0,01
9.	Shuttle run (Poland test)	X9	sec	0,01
10.	Defense with change of moving direction	X10	sec	0,01
11.	Running 1600m standing start	X11	sec	1
12.	Illinois Agility run test	X12	sec	0,01
13.	Shoot with sliding after dribble (Lay-up test)	X13	cm	0,01
14.	Shuttle run with dribble (Poland test with dribble)	X14	sec	0,01
15.	Free throw shooting for 2 min. 2 x (3+3+2+2+1+1)	X15	number	1
16.	Shooting from the end of the free-throw line and mastering the ball for 1 min.	X16	number	1
17.	Shooting from the 3-point line for 2 min.	X17	number	1
18.	Moving in a defense position between three poles (T-test)	X18	sec	0,01
19.	50 shots from the 3-point line with two ball passers for 2 min. 45 sec.	X19	number	1

Table 2: Main factors in the group of indicators for the physical features in the beginning of the period

Factors (components)	Eigenvalue	Dispersion percentage	Cumulative percentage
1	5,763	52,395	52,395
2	2,533	23,024	75,419
3	0,851	7,737	83,156
4	0,694	6,306	89,462
5	0,609	5,537	95,000
6	0,346	3,148	98,148
7	0,121	1,096	99,243
8	0,056	0,510	99,753
9	0,020	0,182	99,935
10	0,007	0,065	99,999
11	6,509E-005	0,001	100,000

Table 3: Component matrix of main factors in the group of indicators for physical features in the beginning of period

Indicators	Main factors (components)	
	First	Second
X1 ₍₀₎	- 0,124	0,932*
X2 ₍₀₎	0,789*	- 0,272
X3 ₍₀₎	0,793*	- 0,287
X4 ₍₀₎	0,868*	0,362
X5 ₍₀₎	0,846*	0,046
X6 ₍₀₎	0,737*	- 0,113
X7 ₍₀₎	- 0,038	- 0,874*
X8 ₍₀₎	- 0,649*	0,465
X9 ₍₀₎	- 0,766*	0,450
X10 ₍₀₎	- 0,737*	0,499
X11 ₍₀₎	- 0,124	0,799*

Table 4: Other main factors in the group of indicators for the physical features in the end of the period

Factors (components)	Eigenvalue	Dispersion percentage	Cumulative percentage
1	5,310	48,276	48,276
2	2,351	21,374	69,650
3	1,320	12,004	81,654
4	0,833	7,570	89,223
5	0,620	5,641	94,864
6	0,204	1,855	96,720
7	0,195	1,771	98,490
8	0,112	1,020	99,510
9	0,032	0,287	99,798
10	0,020	0,178	99,975
11	0,003	0,025	100,000

Table 5: Component matrix of main factors in the group of indicators for physical features in the end of the period

Indicators	Factors		
	First	Second	Third
X1 ₍₈₎	- 0,406	- 0,368	0,730*
X2 ₍₈₎	0,798*	0,419	- 0,202
X3 ₍₈₎	0,846*	0,338	- 0,198
X4 ₍₈₎	0,345	0,835*	0,360
X5 ₍₈₎	0,463	0,723*	0,196
X6 ₍₈₎	0,335	0,763*	0,008
X7 ₍₈₎	0,101	- 0,041	- 0,923*
X8 ₍₈₎	- 0,752*	- 0,126	0,469
X9 ₍₈₎	- 0,878*	0,029	0,286
X10 ₍₈₎	- 0,828*	- 0,227	0,319
X11 ₍₈₎	- 0,209	0,059	0,759*

Table 6: Main factors in the group of indicators for technical-tactical features in the beginning of period

Factors (components)	Eigenvalue	Dispersion percentage	Cumulative percentage
1	2,763	34,534	34,534
2	1,996	24,948	59,482
3	1,438	17,979	77,461
4	0,931	11,638	89,099
5	0,476	5,954	95,053
6	0,325	4,056	99,109
7	0,047	0,591	99,700
8	0,024	0,3000	100,000

Table 7: Component matrix of main factors in the group of indicators for technical-tactical features in the beginning of the period

Indicators	Factors		
	First	Second	Third
X12 ₍₀₎	0,478	- 0,009	0,439
X13 ₍₀₎	0,911*	0,141	- 0,289
X14 ₍₀₎	0,831*	- 0,432	0,244
X15 ₍₀₎	- 0,216	0,485	0,733*
X16 ₍₀₎	- 0,160	0,270	0,815*
X17 ₍₀₎	- 0,094	0,896*	0,010
X18 ₍₀₎	0,836*	0,083	0,074
X19 ₍₀₎	0,158	0,867*	0,056

Table 8: Main factors in the group of indicators for technical-tactical features in the end of period

Factors (components)	Eigenvalue	Dispersion percentage	Cumulative percentage
1	5,763	52,395	52,395
2	2,533	23,024	75,419
3	0,851	7,737	83,156
4	0,694	6,306	89,462
5	0,609	5,537	95,000
6	0,346	3,148	98,148
7	0,121	1,096	99,243
8	0,056	0,510	99,753

Table 9: Component matrix of the main factors in the group of indicators for technical-tactical features in the end of the period

Indicators	Main factors (components)	
	First	Second
X12 ₍₈₎	- 0,116	0,775*
X13 ₍₈₎	- 0,186	0,796*
X14 ₍₈₎	- 0,484	0,768*
X15 ₍₈₎	0,943*	- 0,140
X16 ₍₈₎	0,714*	- 0,306
X17 ₍₈₎	0,866*	- 0,206
X18 ₍₈₎	0,055	0,901*
X19 ₍₈₎	0,923*	0,068

4. Conclusions

The applied specialized methodic of work with female basketball team of "DUNAV 8806" – Ruse leads to: emerging of new main factor in the group of indicators for physical features and changes in the component structure of the first main factor; decrease of the main factors from three to two in the group of indicators for technical-tactical features where clearly defined is one main factor related to the shooting abilities from the penalty shots line and the 3-point line and second main factor, related to the agility, specific basketball movements, dribble and shooting with serving.

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