

## **FACTOR STRUCTURE OF SPEED-STRENGTH PREPARATION OF GROWING UP FEMALE VOLLEYBALL PLAYERS**

*(Original scientific paper)*

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### **Abstracts**

*The aim of the current investigation is to improve the level of speed-strength preparation of growing up female volleyball players in the age range 17-19 years, through specialized (fitness and field) training programs, by disclosing the factor structure and identification of the basic factors of speed-strength preparation of female players. Contingent of the investigation has been 24 female volleyball players competing for the teams of UNWE (University of National and World Economy-Sofia) and Locomotive – Sofia. For the needs of the investigation, the female volleyball players have been subjected to sport-pedagogic testing by means of 12 indices, bearing information of the level of development of the special power, both of upper and lower limbs and torso. With the biggest contribution to the factor structure of speed-strength preparation in the beginning of the experiment is the explosive upper limbs power and abdominal musculature. After the experimental work carried out, the power of catch has manifested as the most important component of the speed-strength preparation of the investigated 17-19 years old female volleyball players.*

**Keywords:** *female volleyball players, experimental training programs, explosive upper limbs power and abdominal musculature, speed-strength endurance, sport-pedagogic testing, physical and technical-tactical preparation, motor abilities, training process, fitness, factor analysis.*

### **INTRODUCTION**

Disclosure of the factor structure of physical growth bears high informational value for the training process optimization. Optimizing of educational-training process has been, is and will be a subject of serious scientific investigations. The disclosure of the factor structure of investigated events, important for the volleyball game, could help sport experts at optimizing the educational-training process of each one of investigated aggregates.

To a great extent, the contribution of each one of investigated indices to the sport achievement of a certain individual or an aggregate depends on 3-4 basic factors, taking and identification which is of a decisive significance for the success in a certain competition (Giosheva, Tsarov, & Tsarova (Гъошева, Църров, & Църрова, 1990; Dimitrova (Димитрова), 2004; Tsarov (Църров), 1981).

Disclosure of the factor structure of physical growth, physical and technical-tactical preparation, as well as the specific work capacity, or competitive efficiency is a multi-plan task of high informational value, for optimizing the training process (Broglej (Брогли), 2012; Verhosanski (Верхошанский, 1970); 1979; Zheliazkov (Желязков), 1998).

Among the scientific developments in the field of

volleyball, not a few are devoted to the factors defining the physical and technical preparation of contestants (Andreev (Андреев), 1991; Bozhkova (Божкова), 2007; Gikova (Гикова), 1996; Zhechev (Жечев), 1981; Krumova, Gigov, Kiyghukov, Dimitrova, Antonov, Mikhailov, & Hristova (Крумова, Гигов, Кючуков, Димитрова, Антонов, Михайлов, & Христова, 1991).

*The aim of the current investigation is to improve the level of the speed-strength preparation of growing up female volleyball players within the age range 17-19 years, through specialized (fitness and field) training programs, by disclosing the factor structure and identification of the basic factors of speed-strength preparation of female players.*

### **METHODS**

Investigation has been carried out in the period September 2013 – May 2014.

*Subject of investigation are the basic indications of physical preparation of female volleyball players within the age range 17-19 years.*

*Contingent of the investigation has been 24 female volleyball players competing for the teams of UNWE (University of National and World Economy-Sofia) and*

Table 1. List of investigated indications of the special power preparation

No	Indication measured	Test name	Measurement unit	Measurement accuracy	Growth direction
1.	Catch power	Dynamometry – strong hand	kg	1	+
2.	Catch power	Dynamometry – weak hand	kg	1	+
3.	Upper limbs and shoulder girdle explosive power	Solid ball throw from occipital lying position (strong hand)	m	0,1	+
4.	Upper limbs and shoulder girdle explosive power	Solid ball throw from occipital lying position (weak hand)	m	0,1	+
5.	Upper limbs and shoulder girdle explosive power	Solid ball throw from occipital lying position with two hands	m	0,1	+
6.	Upper limbs and shoulder girdle explosive power	Volleyball ball from occipital lying position (striking hand)	m	0,1	+
7.	Torso power	Abdominal presses	Number	1	+
8.	Lower limbs explosive power	Standing position vertical jump	cm	1	+
9.	Lower limbs explosive power	Vertical jump after gaining strength	cm	1	+
10.	Lower limbs explosive power	Standing position long jump	cm	1	+
11.	Lower limbs explosive power	Long jump – triple	cm	1	+
12.	Lower limbs strength endurance	Squatting to give up	Number	1	+

Locomotive – Sofia.

For the needs of the investigation, the female volleyball players have been subjected to sport-pedagogic testing by means of 12 indices (Table 1), bearing information of the level of development of the special power, both of upper and lower limbs and torso.

For realization of the aim set and tasks of investigation, the following *methods of investigation* have been applied: field survey, sport-pedagogic testing, sport-pedagogic experiment.

Results from the investigation are subjected to *mathematical-statistical processing* through a factor analysis.

**RESULTS AND DISCUSSION**

For settlement of the aim and tasks of the investigation, the starting data from the carried out tests are subjected to factor analysis. It has allowed for the basic factors to be taken out and basing this to build factor structures of speed-strength preparation of 17-19-years female volleyball players, in the beginning and in the end of the experimented programs.

Analysis in Table 2 shows that the factor structure of speed-strength preparation of female volleyball players from the age group at the start of the experimental programs has been built by 5 basic factors, generally explaining a very high percentage of the starting dispersion of the investigated event (88,13 %).

In Table 2 it can be seen that at the start of the experimental programs, the first two factors have almost equal weight (23,44 % and 22,75 % respectively). It is a proof of their contribution to the factor structure of speed-strength preparation of the investigated 17-19-years Bulgarian female volleyball players.

Analysis in the table shows that at the *first factor*, the indices with numbers from 3 to 7 are distinguished

with the highest factor weights. The first 4 of them bear information of the place of upper limbs and shoulder girdle explosive power, in the factor structure. The last index 7 characterizes the power of abdominal musculature. All this gives reason for that factor to be identified as *“upper limbs and abdominal musculature explosive power”*.

Indices 8 and 9 build the *second factor* at the start of the experiment (“vertical jump – from standing position” and “vertical jump – after gaining strength” respectively). With them, the factor weights are too high (0,929 and 0,918). It allows for this factor to be defined as *“lower limbs explosive power at vertical muscle efforts (exertions)”*.

The *third factor* of the speed-strength preparation of the investigated aggregate in the beginning of the experimental period, also is defined by 2 basic indications, explaining 17,23 % of the starting dispersion of the investigated event. They define the significance of the power of the fingers and palms of hands for the volleyball game. This factor could be identified as *“catch power”*.

The *fourth factor* (15,84 %) characterizes the possibilities of female volleyball contestants from the investigated age group, to make long jumps at the horizontal plane.

Grounding the information, born by 10 and 11<sup>th</sup> indices, this factor could be defined as *“lower limbs explosive power with muscle exertions at the horizontal plane”*.

The last *fifth factor* (8,87 %) has the lowest contribution to the factor structure of speed-strength preparation at the start of the experimental programs. It could be identified as *“speed-strength endurance”*.

For the needs of the investigation, the factor structure of speed-strength preparation of 17-19 years old,

Table 2. Factor structure of speed-strength preparation at the start of the experimental programs

No	Indices / Factors	I	II	III	IV	V	h <sup>2</sup>	1-h <sup>2</sup>
1.	Dynamometry – strong hand	0,141	0,103	0,913	0,224	0,136	0,932	0,068
2.	Dynamometry – weak hand	0,151	0,095	0,938	0,142	-0,059	0,936	0,064
3.	Solid ball catch – strong hand	0,827	0,331	0,255	0,148	0,067	0,885	0,115
4.	Solid ball catch – weak hand	0,782	0,442	0,198	0,097	0,123	0,871	0,129
5.	Solid ball catch – two hands	0,542	0,542	0,186	0,377	-0,011	0,764	0,236
6.	Volleyball ball – striking hand	0,627	0,278	0,263	0,377	-0,055	0,684	0,316
7.	Abdominal presses	0,760	-0,376	-0,120	0,279	0,026	0,812	0,188
8.	Standing position vertical jump	0,133	0,929	0,056	0,179	0,065	0,921	0,079
9.	Vertical jump after gaining strength	0,173	0,918	0,122	0,195	0,101	0,935	0,065
10.	Standing position long jump	0,230	0,401	0,196	0,818	0,098	0,931	0,069
11.	Long jump (triple)	0,324	0,121	0,271	0,834	-0,178	0,920	0,080
12.	Squatting to give up	0,068	0,111	0,048	-0,055	0,982	0,986	0,014
$\Sigma a^2 = 88,13\%$		23,44 %	22,75 %	17,23 %	15,84 %	8,87 %		

Table 3. Factor structure of speed-strength preparation in the end of the experimental programs

No	Indices / Factors	I	II	III	IV	V	h <sup>2</sup>	1-h <sup>2</sup>
1.	Dynamometry – strong hand	0,887	0,178	0,259	-0,040	0,107	0,899	0,101
2.	Dynamometry – weak hand	0,896	0,183	0,207	0,029	-0,065	0,884	0,116
3.	Solid ball catch – strong hand	0,444	0,316	0,437	0,529	-0,105	0,778	0,222
4.	Solid ball catch – weak hand	0,509	0,169	0,554	0,376	-0,044	0,737	0,263
5.	Solid ball catch – two hands	0,217	0,416	0,834	0,001	0,130	0,933	0,067
6.	Volleyball ball – striking hand	0,280	-0,058	0,887	-0,025	-0,041	0,870	0,130
7.	Abdominal presses	-0,140	-0,218	-0,058	0,895	0,176	0,901	0,099
8.	Standing position vertical jump	0,198	0,953	0,074	-0,036	-0,026	0,955	0,045
9.	Vertical jump after gaining strength	0,202	0,942	0,118	-0,057	0,050	0,947	0,053
10.	Standing position long jump	0,458	0,570	0,447	-0,114	0,310	0,844	0,156
11.	Long jump (triple)	0,679	0,479	0,300	-0,173	0,068	0,815	0,185
12.	Squatting to give up	0,025	0,048	0,018	0,123	0,975	0,969	0,031
$\Sigma a^2 = 87,77\%$		24,52 %	23,07 %	20,01 %	10,72 %	9,44 %		

Bulgarian female volleyball players, in the end of the applied experimental programs has also been disclosed. Results, presented on Table 3, allow for changes occurred in the factor structure for the time of the experiment, to be followed.

Analysis in the table shows that the 5 factors taken out in the end of the carried out experimental programs, explain totally 87,77 % of the starting dispersion of the investigated event.

With the analysis of the figure, what makes impression is that the percentages of the explained by the first two factors starting dispersion are too close to the ones already commented at the starting factor structure. However, what makes impression is the sharp decline of the relative shares of the last two factors – from 20,01 % at the third factor to 10,72 % at the fourth and 9,44 % - at the fifth factor.

The comparative analysis of the factor structures (starting and end) shows that after the experimental work carried out, *the catch power* which is defining for the third factor at the start, here already, it is manifested as the most important component of the speed-strength preparation of the investigated 17-19 years old female volleyball players. It is the base of the *first factor* of the end factor structure. From the figure, it is seen that the *lower limbs explosive power at repeated horizontal muscle exertions* is building up component of this factor (index 11 – “triple jump”).

Analysis of the results also shows that in the end of the experiment, *lower limbs explosive power at vertical muscle exertions* preserves its place as defining the *second factor* in the factor structure of speed-strength preparation of the female volleyball players. However here, increasing of the significance of *lower limbs explo-*

sive power at single horizontal muscle exertions..

*Third factor* in the end of the experiment is too close to the first one in the beginning of the period. It defines the place of *upper limbs and shoulder girdle explosive power* in the factor structure of the speed-strength preparation of female volleyball contestants.

*The fourth factor* (10,72 %) could be identified as “*abdominal musculature explosive power*”. It is necessary to note that in the beginning of the experimental period this motive quality has been a part of the most important (first) factor of speed-strength preparation.

The last (*fifth*) factor explains only 9,44 % of the starting dispersion. It defines the *speed-strength endurance* as a motive quality, which has the least contribution to the speed-strength preparation of the investigated 17-19 years old, Bulgarian female volleyball players.

## CONCLUSIONS

Factor structure of the speed-strength preparation of female volleyball players from the investigated age group, both at the start and in the end of the experimental programs is built up of 5 basic factors that as a whole, explain a very high percentage of starting dispersion of the investigated event. With the biggest contribution to the factor structure of speed-strength preparation in the beginning of the experiment is *the upper limbs and abdominal musculature explosive power*. After the carried out experimental work, the *catch power* which at the start is defining for the third factor, here it is manifested as the most important component of the speed-strength preparation of the investigated 17-19-years old female volleyball players.

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