



FACTORAL STRUCTURE OF MORPHO-FUNCTIONAL INDICATORS AND MOTOR QUALITIES OF MUSCULAR STRENGTH AND ENDURANCE IN STUDENTS

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ABSTRACT

The purpose of the present study is to establish the factor relationships between morpho-functional parameters and physical qualities, muscle strength and endurance due to the application of a specialized fitness model. To achieve this goal the following tasks are set: research of literature resources; development and testing of a specialized fitness model; development of a test battery; processing and analyzing the data from the conducted testing. Research methods - pedagogical experiment, testing, factor analysis, graphical analysis. The contingent of the study are 34 students from the Trakia University. The students are on average 20.04 years old. The results and their analysis show that in the applied fitness model there is a decrease in the number of the main factors in the factor structure of the morpho-functional indicators and the observed motor functions; the increase in the influence of the first main factor in the second study explains the higher percentage of the cumulative variance. This leads to structural changes in the content of the main factors; changes the influence of factors, which after the experiment increases the influence of endurance due to the composition of body weight; the force factors retain approximately the same weight in the second study.

Key words: experiment, university, circle activities

INTRODUCTION

Discovering the correlation structure of morpho-functional indicators and motor qualities of muscle strength and endurance in students allows us to trace the relationships between individual indicators and motor qualities.

A natural continuation of the correlation analysis is the factor analysis. Factor analysis is designed to convert a set of correlated data into a new set with non-correlated artificial variables or factors that explain as much of the overall variation of the original data as possible. This technique reduces the number of initial variables by grouping those that correlate with each other in a common factor and dividing the non-correlations into different factors. The main task in factor analysis is to

determine the number of factors k , which depends significantly on the strength of the correlations between the data (1).

The performed factor analysis is applied to establish the factor structure of the morpho-functional indicators and the motor qualities observed by us in the experimental group.

The smaller number of latent signs (factors) can explain the variance of a large set of tests. The factors are formed as a result of similar general characteristics of the studied indicators. The factor analysis of the morpho-functional indicators and the motor qualities of the experimental group is based on the method of the main components.

At the beginning and the end of the experimental period, the correlation matrices determined their own meanings, which are arranged in descending order. Eigenvectors larger than one correspond to eigenvectors, which form the main factors (2).

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METHODS

The aim of the study is to establish the factor relationships between morpho-functional parameters and physical qualities, muscle strength and endurance due to the application of a specialized fitness model.

To achieve this goal the following tasks are set:

1. Study of literature sources.
2. Development and testing of a specialized fitness model.
3. Development of a test battery.
4. Processing and analysis of the data from the conducted testing.

Research methods:

Pedagogical experiment

Testing

Factor analysis

Graphic analysis

The testing was conducted during the winter semester of the 2016/2017 school year. The contingent of the study are 34 students from the Faculty of Agriculture, Faculty of Veterinary Medicine and Faculty of Economics at the Trakia University of Stara Zagora. The subjects are on average 20.04 years old.

RESULTS

The analysis of the incoming test results shows that there are seven factors. The first weighs 3,570, the second 2,098, the third 1,980, the fourth 1,623, the fifth 1,454, the sixth 1,420 and the seventh 1,183. In total, all seven factors explain 74.05% of the total variance. The data are shown in **Table 1**.

Table 1. Analysis of the main factors at the beginning of the experiment

Test	Factors (components)						
	1	2	3	4	5	6	7
FAT%	,935	,020	-,026	,025	-,083	,035	,077
Muscle mass	,911	-,045	-,061	,011	-,050	-,042	-,056
TBW%	-,894	-,006	,026	-,037	,088	-,025	-,072
Height	,660	,014	,188	,003	-,014	-,180	-,409
Height to failure	-,528	-,064	,138	,135	,499	,409	-,164
Kuper's Test	,155	,885	,146	-,070	,026	-,010	,159
Beep test	-,208	,732	,138	-,032	-,020	-,040	-,029
Chest circuit - difference	-,065	-,553	,457	-,168	-,254	,046	,098
Plank	-,094	,037	,833	,243	,031	-,005	-,017
Shuttle 10x10m	,000	-,178	-,686	,186	-,109	-,009	,009
Step test – heart rate beginning – 3 rd minute of the recovery	,014	-,190	-,180	,816	,060	-,052	,063
Abdominal presses until failure	-,076	,075	,198	,643	,061	-,527	-,032
Dumbbell retention 2 kg	,149	,294	,335	,592	-,187	,182	,190
Jump length from one place	-,264	,080	,031	-,065	,859	-,046	,002
State power	,347	,100	,512	,159	,528	-,108	,213
Throwing a medical ball forward	,105	,447	,217	-,039	,165	,697	-,154
FVC	-,207	-,298	-,098	-,063	-,154	,630	,074
Push-ups with knee supports until failure	-,007	,045	,055	,105	,011	-,048	,907
Total	3,570	2,098	1,980	1,623	1,454	1,420	1,183
% of Variance	19,835	11,658	11,001	9,018	8,081	7,890	6,570
Cumulative %	19,835	31,493	42,494	51,512	59,592	67,482	74,053

The first factor explains 19.84% of the total variance. Here the following indicators significantly correlate - FAT% (0.935), muscle

mass (0.911), TBW% (-0.894), height (0.660), height to failure (-0.528) (**Figure 1**).

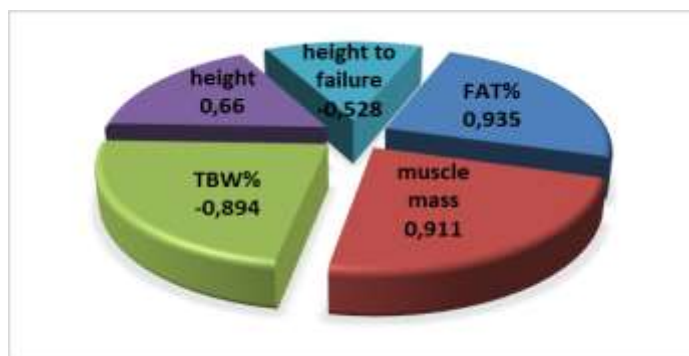


Figure 1. Invoice structure of the first factor of the incoming testing

Tests TBW% and higher to failure have negative signs, which means that have an inverse correlation. Due to the availability of sufficient indicators characterizing body mass composition, the first factor can be identified as "body mass composition".

The second factor explains 11.66% of the total variance. The following tests significantly correlate in this factor - Cooper's test (0.885), beep test (0.732), chest circumference - difference (-0.553) (**Figure 2**).

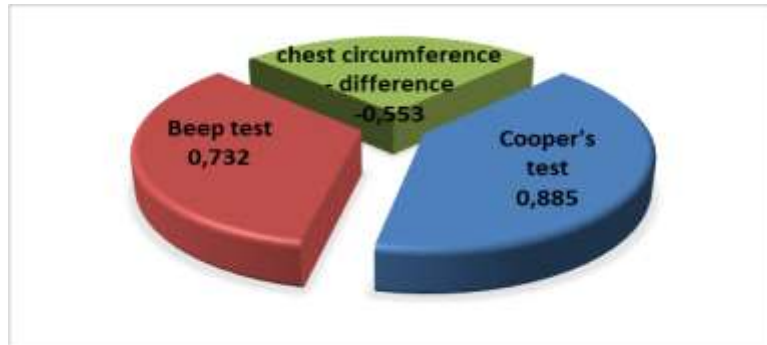


Figure 2. Factoral structure of the second factor of the incoming testing

Chest circuit test - the difference is negative. Both factors have a cumulative percentage of 31.49%. This factor can be characterized as "general endurance".

The third factor explains 11% of the total variance. The following tests significantly correlate in this factor - plank (0.883), shuttle 10x10m (-0.989) (**Figure 3**).

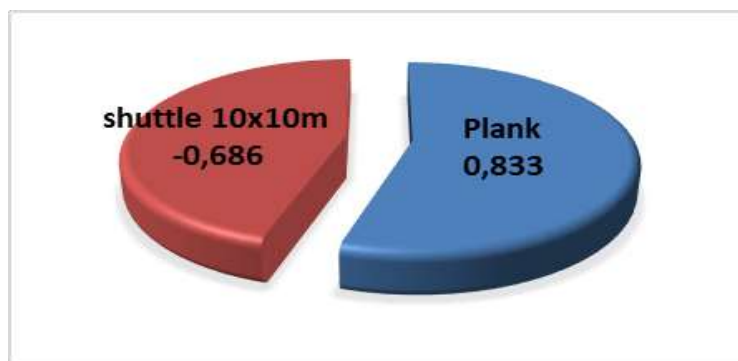


Figure 3. Factoral structure of the third factor of the incoming testing

The 10x10m shuttle test has a negative sign. The cumulative percentage of the three factors is 42.49%. This factor can be defined as characterizing "special endurance".

The fourth factor explains 9.02% of the total variance. The following tests significantly correlate in this factor - step test - pulse onset - 3 min from recovery (0.816), abdominal presses to failure (0.643), weight retention 2 kg (0.592) (**Figure 4**).



Figure 4. Invoice structure of the fourth factor of the incoming testing

The cumulative percentage of the first four factors is 51.51%. This factor can be defined as characterizing "strength endurance".

The fifth factor explains 8.08% of the total variance. In this factor the following tests

significantly correlate - jump in length from place (0.859) and state force (0.528) (**Figure 5**).

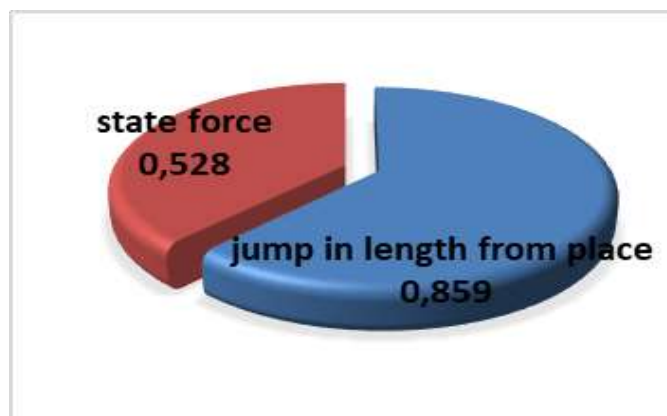


Figure 5. Invoice structure of the fifth factor of the incoming testing

The cumulative percentage of the first five factors is 59.59%. This factor can be defined as characterizing the "explosive force of the lower extremities".

The sixth factor explains 7.89% of the total variance. The following tests significantly correlate in this factor - throwing a medical ball (3 kg) forward (0.697) and FVC (0.630) (**Figure 6**).

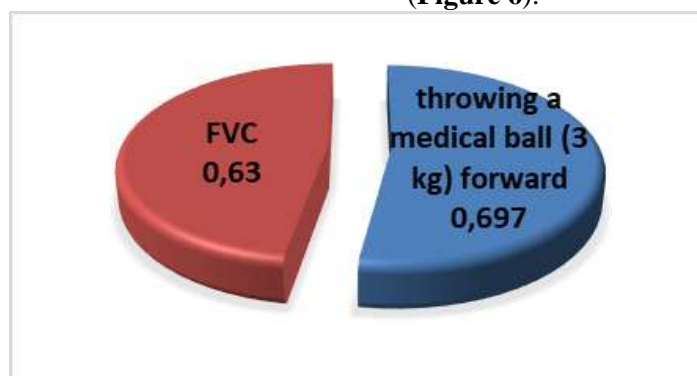


Figure 6. Factorial structure of six factors of incoming testing

The cumulative percentage of the first six factors is 67.48%. This factor can be defined as characterizing the "explosive force of the upper extremities".

4,188, the second 3,301, the third 2,088, the fourth 1,922. In total, all four factors explain 63.88% of the total variance. The data are shown in **Table 2**.

The seventh factor explains 6.57% of the total variance. There is only one test in this factor - push-ups to knee failure (0.630).

The first factor explains 23.27% of the total variance. Here the following indicators significantly correlate - plank (0.851), state force (0.798), abdominal presses to failure (0.714), beep test (0.660), shuttle 10x10m (-0.629), Kuper's test (0.611), Step test - pulse onset - 3rd minute from the recovery (-0.557), Height to failure (0.485) (**Figure 7**).

All seven factors have a cumulative percentage of 74.05%. This factor can be defined as "characterizing the strength endurance of the upper extremities".

The analysis of the results of the tests shows that there are four factors. The first weighs

Table 2. Analysis of the main factors at the end of the experiment

Test	Factors (components)			
	1	2	3	4
Plank	,851	-,055	-,250	,024
State force	,798	,144	,129	,133
Abdominal presses until failure	,714	-,064	-,062	,313
Beep test	,660	-,112	,257	,469
Running 10x10m	-,629	-,044	-,407	,057
Kuper's test	,611	-,024	,393	,503
Step test - pulse onset - 3rd minute from the recovery	-,557	,214	-,187	-,357
Height to failure	,485	-,462	,281	-,158
FAT%	,025	,891	-,204	,153
Muscle mass	-,050	,870	,229	,050
TBW%	-,010	-,814	,280	-,057
Height	,074	,715	,233	-,299
Jump length from one place	,452	-,456	,185	,130
Chest circuit - difference	,074	-,142	,738	-,047
FVC	-,087	-,053	,647	,425
Throwing a medical ball (3kg) forward	,389	,101	,525	,082
Push-ups with knee supports until failure	,193	,014	,016	,807
Dumbbell retention 2kg	,393	,181	,067	,449
Total	4,188	3,301	2,088	1,922
% of Variance	23,269	18,339	11,599	10,676
Cumulative %	23,269	41,607	53,206	63,882

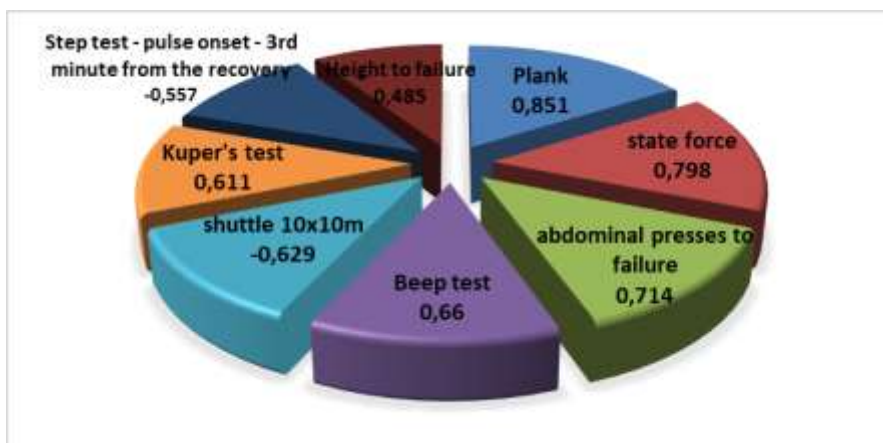


Figure 7. Factoral structure of the first factor of the outgoing testing

Step tests - pulse onset - the 3rd minute of recovery and the shuttle 10x10m are negative, i.e. have an inverse correlation. Due to the presence of sufficient indicators characterizing the first factor can be identified as "endurance".

The second factor explains 18.34% of the total variance. Here the following indicators significantly correlate - height to failure (-0.462), FAT% (0.891), muscle mass (0.870), TBW% (-0.814), height (0.715), jump in length from place (-0.456) (**Figure 8**).

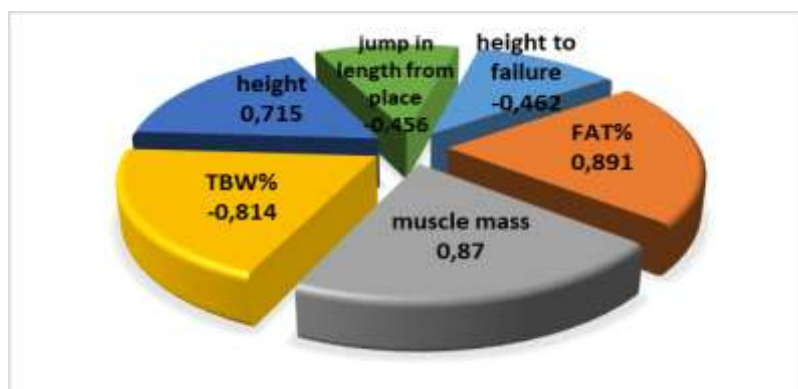


Figure 8. Factoral structure of the second factor of the outgoing testing

Tests jump length from one place to height to failure and TBW% are negative. This factor can be defined as characterizing the "composition of body mass". This factor in the first study has the greatest intrinsic weight, and after conducting the experiment it is no longer of the greatest intrinsic importance. The failure test has enough weight to be in the first and second factor. This shows that the test correlates simultaneously with the tests of the

two factors, but the correlation in the second factor is negative. The cumulative percentage of the first and second factors is 41.61%.

The third factor explains 18.34% of the total variance. Here the following indicators significantly correlate - chest circumference - difference (0.738), FVC (0.647), throwing a medical ball (3kg) forward (0.525) (**Figure 9**).

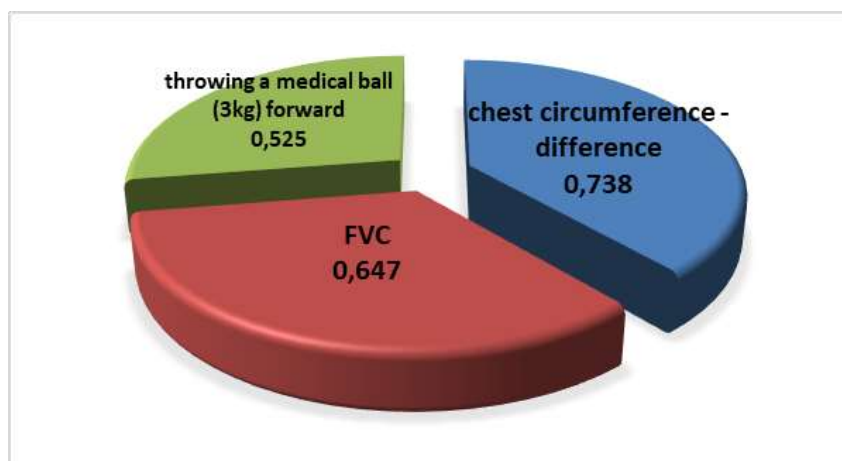


Figure 9. Factoral structure of the third factor of the outgoing testing

This factor can be defined as a characteristic "vital capacity". The cumulative percentage of the first three factors is 53.21%.

The fourth factor explains 10.68% of the total variance. Here, the following indicators are significantly correlated - push-ups to knee failure (0.807), dumbbell retention 2 kg (0.449) (**Figure 10**).

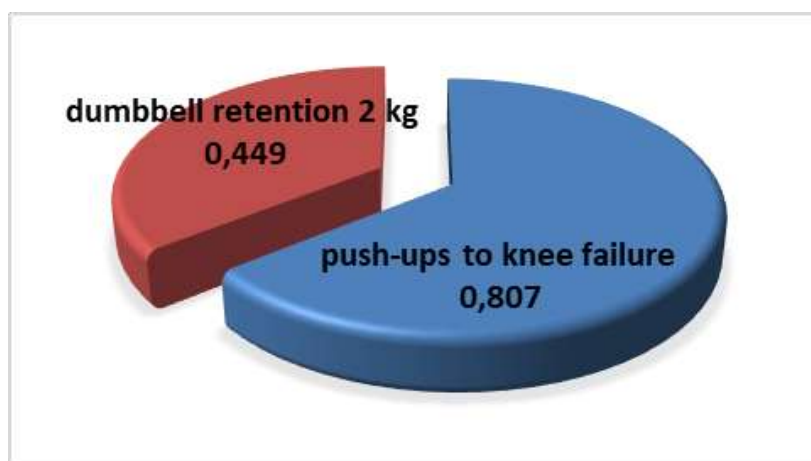


Figure 10. Factoral structure of the fourth factor of the outgoing testing

This factor can be defined as characterizing "strength endurance of the upper extremities". The cumulative percentage of the four factors is 69.88%.

in the factor structure of the morpho-functional indicators and the observed motor qualities was observed in the experimental group.

After the factor analysis the following conclusions can be summarized:

- The increase in the influence of the first main factor in the second study explains the higher percentage of the cumulative variance. This in turn leads to

- In the applied fitness model, a decrease in the number of the main factors

structural changes in the content of the main factors.

- The influence of factors changes, which after the experiment increases the influence of endurance at the expense of body composition.
- The force factors retain approximately the same weight in the second study.

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