

FACTOR ANALYSIS OF THE MOST INFORMATIVE PARAMETERS AFFECTING THE EFFICIENCY OF TRAINING WRESTLING STUDENTS OF PHYSICAL EDUCATION

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Annotation. Comprehensively analyzed the various factors that affect the absorption of the students practical course in wrestling. The study involved 98 boys - 3rd year students of the Faculty of Physical Education, who begin the study of the course Combating and methods of teaching. Also, 32 students who are engaged in the struggle. The results of studies of anthropometric, physical, functional, ergonomics students. The input data for the factor analysis were the first 3-ranking figure, biomechanical, physical fitness and functional status, anthropometric. It is established that the content of the first most significant factors included biomechanical parameters that demonstrate the value of balance and coordination abilities of others.

Keywords: sports, fighting, factor analysis, coordination, ability.

Introduction

The problems of improvement of efficiency of different sport disciplines' teaching are worked about by many specialists: specialists in methodic, scientists-researchers, coaches-practitioners, sport doctors and other. In particular, development and perfection of wrestling methodic were dealt with by G.S. Tumanian, A.P. Kuptsov, I.G. Bogdan, M.S. Dubovys, V.F. Boyko, G.V. Danko, Yu.A. Shulika. Their experience have been generalized and elucidated in many publications. Recent years, the problem of students-wrestlers' most important qualities have been studied at physical education department of Donetsk national medical university, named after M. Gorkiy, by T.A. Neskreba, N.O. Dobrovolska. S.I. Shynshyna.

However, in opposite to the researches in the field of training of wrestlers of different qualification, in special literature concerning training of non-sport higher educational establishments' students there is insufficient scope of researches of the most important parameters, which condition good mastering of wrestling practical course by students of different specializations.

Before the beginning of subject's study, in order to increase efficiency of mastering of course "Wrestling and methodic of its teaching", and study of students' individual features, we proposed complex program, which stipulates study of anthropometric, physical, functional and bio-mechanical indicators of every student.

During researches great number of the obtained material do not give complete understanding of factors, which influence most of all on quality of students' mastering of wrestling course.

One of effective methods of determination of different parameters' influence on improvement of wrestling training methodic and their informative character can serve factor analysis, which permits to assume the most important indicators.

The authors of factor analysis concept are, mainly, American and English scientists (Ch. Spearman, L.L. Terstone, G.H. Thompson, S.L. Bart, R.B. Cattell and many others). Interest to these methods is gradually growing in countries of continental Europe.

As on to day, factor analysis is successfully used in psychology and sociology. In opinion of many known researchers, who work in the field of factor analysis, factor methods will soon become important in researches in the field of physical culture and sports. Ukrainian scientists T. Yavorska, R. Akhmetov already apply factor analysis in their researches.

The work has been fulfilled as per plan of topic work of sports department of Chernigiv national university, named after T.G. Shevchenko on subject "Urgent problems of modern bio-mechanics of physical education and sports".

Purpose, tasks of the work, material and methods

The purpose of the researches is to determine indicators, which are the most influential for mastering of sports practical discipline "Wrestling and the methodic of its training" with the help of factor analysis.

The tasks of the research: experimental study of students' individual characteristics and on the base of the obtained data establishing of the most informative parameters with the help of factor analysis.

The methods if the research: analysis, systemizing of scientific literature data, pedagogical observations of students' educational process, pedagogical experiments with application of anthropometry, physiological metering, analysis of students' physical devilmnt level by State tests and standards of evaluation of Ukrainian population's physical level, bio-mechanical methods of research, methods of mathematical statistics, factor analysis.

Organization of the research. The tested contingent consisted of 98 boys – students of the 3rd year of study (physical education faculty of ChNPU, named after T.G. Shevchenko, who only starts studying of course "Wrestling and the methodic of its training", and 32 students of the same HEE, who are trained in wrestling advanced group of sports-pedagogical perfection (SPP) and have adult sport grades and period of wrestling training not less than 5 years; in total 130 persons in the period from 2010- to 2012.

Results of the researches

We conducted research of anthropometric, functional indicators, analysis of physical preparedness and study of bio-mechanical parameters of static and dynamic stability of students.

As a result of the research it was established that comparing each anthropometric indicators of SPP group students and of the 3rd years students of PEF ChNPU, named after T.G. Shevchenko showed no confident difference ($p > 0,05$), that is reflected in table 1.

Table 1

Comparative characteristics of anthropometric indicators of 3rd year students of PEF and wrestling SPP students

Nos.	Description of parameters	Units of measurement	3 rd year	SPP	<i>p</i>
1	Height	cm	178,78±5,11	176,2±5,8	$p > 0,05$
2	Mass	kg	74,01±8,55	75,21±9,71	$p > 0,05$
3	Chest circumference (inhale)	cm	100,97±5,71	105,67±5,95	$p > 0,05$
4	Chest circumference (exhale)	cm	94,61±6,19	99±5,57	$p > 0,05$
5	Circumference	shoulder	32,6±3,31	32,6±3,31	$p > 0,05$
6		forearm	28,6±2,1	28,6±2,1	$p > 0,05$
7		thigh	53,13±6,02	53,13±6,02	$p > 0,05$
8		shin	37,93±3,24	37,93±3,24	$p > 0,05$
9		neck	39,2±2,76	39,2±2,76	$p > 0,05$
10	Length	torso	63,8±6,76	63,8±6,76	$p > 0,05$
11		arm	77,87±3,16	77,87±3,16	$p > 0,05$
12		shoulder	35,67±2,92	35,67±2,92	$p > 0,05$
13		forearm	28,29±2,05	28,29±2,05	$p > 0,05$
14		hand	19,87±1,13	19,87±1,13	$p > 0,05$
15		leg	98,47±4,19	98,47±4,19	$p > 0,05$
16		thigh	49±1,89	49±1,89	$p > 0,05$
17		shin	48±5,82	48±5,82	$p > 0,05$
18		foot	27,27±1,16	27,27±1,16	$p > 0,05$

With comparing every functional indicator of SPP students and 3rd year students, who study at physical education faculty of ChNPU, named after T.G. Shevchenko, confidential difference was found only for VCL indicators ($p < 0,05$). SPP students have much higher VCL indicators than the 3rd year students. With measuring heart beat frequency during 1 minute, systolic and diastolic blood pressure, confident difference ($p > 0,05$) was not registered that is reflected in table 2.

Table 2

Comparative characteristics of functional indicators of 3rd year students of PEF and wrestling SPP students

Nos.	Description of characteristics	Units of measurement	III kypc	CIY	<i>P</i>
1	VCL	cm ³	3710,5±192,3	4820±167,8	$< 0,05$
2	HBF	b.p.m	75,26±5,56	69±5,45	$> 0,05$
3	SBP	mm. merc. col.	120,26±8,2	127,87±6,07	$> 0,05$
4	DBP	mm. merc. col.	70,53±4,15	82,93±3,01	$> 0,05$

We also determined the level of students' physical preparedness as per State tests and standards for evaluation of Ukraine population's physical level [2]. With comparing of the results of 3rd year students, who start studying "Wrestling and the methodic of its training" and SPP students, we found confident difference of 3 tests' results ($p < 0,05$): rising from squatting position, chin ups and bending forward from sitting position. SPP students have higher indicators in the above mentioned tests. Confident difference was not registered ($p > 0,05$) with long jump from the spot, 3000 m run, 100 m run and shuttle run 4x9 m (see table 3).

Table 3

Comparative characteristics of physical preparedness of 3rd year students of PEF and wrestling SPP students

Nos	Tests	Units of measuring	3 rd year		SPP		p
			Indicator	Mark	Indicator	Mark	
1.	Rising from squatting position, during 1 min.	times	36,8±2,39	2	53,94±2,24	5	< 0,05
2.	Bending forward for flexibility	cm	13,2±1,64	3	17,39±2,25	4	< 0,05
3.	Chin ups	times	10,6±1,14	2	25,56±1,2	5	< 0,05
4.	Long jump from the spot	cm	238,8±5,54	3	249,56±11,84	4	> 0,05
5.	3000 m run	Min., sec.	12,38±1,48	4	12,11±0,88	4	> 0,05
6.	100 m run	Sec.	13,54±0,52	4	12,6±0,94	5	> 0,05
7.	4 x 9 m shuttle run	Sec.	9,02±0,19	4	8,57±0,17	5	> 0,05

Analysis of bio-mechanical parameters, obtained during tests' fulfillment with the help of stability metering methodic, resulted in establishing of the fact that mean static SPP wrestling group's indicators do not significantly differ from the same indicators of 3rd year students of physical education faculty of HEE.

Previous analysis of the obtained material does not permit to solve definitely the main question of the research: which of factors is the most influential for mastering of wrestling knowledge and skills with high quality. After factor analysis we plan to carry out complex analysis of different parameters. Factor analysis was fulfilled with the help of computer program SPSS 16.

Initial data for carrying out of factor analysis were indicators of wrestling SPP group's students:

1) first three by their rank bio-mechanical indicators (LY, OD та V), which were found by determination of correlation dependences between bio-mechanical characteristics with conducting of stability metering (see table 4).

With studying of bio-mechanical parameters, the main quantitative criteria of static postures were indicators of amplitude and frequency oscillations in sagittal and frontal planes: MO (x), mm – frontal shift; MO (y), mm – sagittal shift; Q (x), mm – frontal spread; Q (y), mm – sagittal spread; R, mm – mean spread; V_{av} , mm p. sec. – mean speed of IQT traveling; SV, sq. mm p. sec. – speed of area shift; OD – evaluation of movement; LX, mm – length of IQT frontal trajectory; LY, mm – length of IQT sagittal trajectory; КФП, % – quality of function of balance; Kriv, rad.p.mm coefficient of curvature.

Table 4

Correlation dependences of bio-mechanical indicators of students of advanced sport-pedagogic perfection wrestling group

Test for stability	1	2	3	4	5	6	7	8	9	10	11	12	
MO(x)													
MO(y)	-0,334												
Q(x)	-0,450	-0,450											
Q(y)	-0,615	0,526	-0,307										
R	-0,567	-0,372	0,653	0,865									
V	0,824	-0,464	-0,525	0,573	0,818								
SV	-0,316	-0,353	-0,461	0,628	0,663	0,933							
OD	0,928	-0,542	-0,636	0,893	-0,420	0,941	0,815						
Kriv	0,867	-0,742	0,582	-0,367	-0,509	-0,345	-0,357	-0,416					
LX	0,610	-0,483	-0,577	0,730	-0,361	0,911	0,799	0,980	-0,808				
LY	-0,600	-0,388	-0,474	0,719	0,906	0,970	0,951	0,844	-0,437	0,790			
KФP	-0,474	0,771	0,897	-0,451	-0,338	-0,902	-0,782	-0,867	-0,636	-0,853	-0,849		
Total r	6,58	5,43	6,01	6,67	6,47	8,21	7,06	8,28	6,07	7,9	7,93	7,82	84,43
%	7,79	6,43	7,12	7,90	7,66	9,72	8,36	9,81	7,19	9,36	9,39	9,26	100,00
Rank	8	12	11	7	9	2	6	1	10	4	3	5	

2) first three by their rank bio-mechanical indicators of students' physical preparedness (endurance, quickness, dexterity) were established by determination of correlation dependences between physical preparedness indicators with analysis of the students' physical preparedness (see table 5).

Table 5

Correlation dependences of physical preparedness of advanced sport-pedagogic perfection wrestling group's students

Nos.	SPP	1	2	3	4	5	6	7
1.	Rising from squatting position during 1 min.							
2.	Bending forward for flexibility	-0,659						
3.	Chin ups	0,973	0,502					
4.	Long jump from the spot	-0,123	0,729	0,821				
5.	3000 m run	0,667	-0,704	0,553	0,621			
6.	100 m jump	-0,534	0,927	-0,636	-0,813	0,767		
7.	4 x 9 m shuttle run	0,889	-0,501	-0,594	-0,566	-0,868	-0,743	
Total r		3,84	4,02	4,08	3,67	4,18	4,42	4,16
%		13,54	14,17	14,38	12,94	14,73	15,58	14,66
Rank		6	5	4	7	2	1	3

3) first three by their rank functional state indicators (VCL, SBP, DBP) were established by determination of correlation dependences between students' functional state indicators with carrying out of physiological metering (see table 6).

Таблица 6

Correlation dependences of functional state indicators of advanced sport-pedagogic perfection wrestling group's students

SPP	1	2	3	4
VCL				
HBF	0,429			
SBP	0,828	-0,783		
DBP	0,916	-0,573	0,650	
Total r	2,17	1,79	2,26	2,14
%	25,96	21,41	27,03	25,60
Rank	2	4	1	3

4) first three by their rank anthropometric indicators (body mass, circumference of neck, forearm length) were established by determination of correlation dependences between anthropometric indicators with carrying out of somatic metering (anthropometry) (see table 7).

Table 7

Correlation dependences of anthropometric indicators of advanced sport-pedagogic perfection wrestling group's students

№	СИУ	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1	Height																			
2	Mass	0,5 39																		
3	CC (inhale)	0,4 27	0,8 39																	
4	CC (exhale)	0,4 27	0,7 76	0,9 55																
5	circumference	shoul der	0,4 03	0,8 55	0,8 66	0,8 52														
6		forea rm	0,3 01	0,8 12	0,6 81	0,6 85	0,8 08													
7		thigh	0,3 35	0,8 93	0,8 37	0,7 84	0,7 83	0,7 28												
8		shin	0,3 35	0,8 77	0,7 70	0,7 44	0,7 16	0,7 11	0,8 76											
9		neck	0,7 04	0,6 66	0,6 49	0,6 10	0,5 33	0,5 83	0,4 50	0,5 05										
10	length	torso	0,4 33	0,2 67	0,0 21	- 0,0 53	0,0 47	- 0,1 42	0,2 23	0,0 32	0,1 17									
11		Arm	0,4 89	0,6 81	0,5 52	0,4 22	0,4 59	0,5 41	0,4 70	0,5 02	0,8 56	0,2 29								
12		shoul der	0,5 61	0,4 71	0,5 40	0,4 70	0,5 17	0,4 08	0,2 55	0,2 09	0,8 25	0,0 22	0,7 00							
13		forea rm	0,5 18	0,6 89	0,6 52	0,5 95	0,5 85	0,6 50	0,4 69	0,5 84	0,8 33	- 0,0 93	0,8 22	0,6 61						
14		hand	- 0,0 39	- 0,1 84	0,0 14	0,0 46	0,0 23	0,1 57	- 0,1 66	- 0,2 38	0,1 70	- 0,1 91	0,3 16	0,2 68	0,4 96					
15		leg	0,5 61	0,4 55	0,3 91	0,3 00	0,4 11	0,5 19	0,1 87	0,1 45	0,6 47	- 0,0 97	0,5 61	0,6 15	0,5 02	0,1 96				
16		thigh	0,4 69	0,1 20	0,2 61	0,3 60	0,0 80	0,2 16	0,0 31	0,1 17	0,5 07	- 0,2 12	0,2 39	0,2 59	0,4 07	0,1 34	0,4 24			
17		shin	0,1 65	- 0,2 21	- 0,2 35	- 0,1 65	- 0,1 93	0,1 11	- 0,1 94	- 0,1 52	0,1 34	- 0,2 31	- 0,1 98	0,0 04	- 0,1 49	- 0,2 40	0,3 19	0,2 86		
18	foot	0,5 43	0,6 29	0,3 34	0,3 86	0,4 38	0,5 45	0,4 54	0,5 36	0,5 61	0,3 61	0,5 55	0,3 86	0,5 07	0,0 84	0,1 34	0,1 30	- 0,1 58		
Ч	Total r	7,2 5	9,9 7	9,0 2	8,6 3	8,5 7	8,6	8,1 3	8,0 5	9,3 5	2,7 7	8,5 9	7,1 7	9,2 1	2,9 6	6,4 6	4,2 5	3,1 6	6, 74	
Ч	%	5,6 3	7,7 4	7,0 0	6,7 0	6,6 5	6,6 7	6,3 1	6,2 5	7,2 5	2,1 5	6,6 7	5,5 6	7,1 5	2,3 0	5,0 1	3,3 0	2,4 5	5, 23	
Ч	Rank	10	1	4	5	7	6	8	9	2	17	6	11	3	16	13	14	15	12	

Results of factor analysis are given in table 8

Table 8

Factor load of the tested influences on efficiency of wrestling course's mastering

Nos.	Indicators	Factors			
		I	II	III	IV
1.	V	0,832	0,313	-0,450	-0,018
2.	OD	0,873	0,196	-0,354	0,156
3.	LY	0,862	0,309	0,444	-0,096
4.	Endurance (3000 m run)	0,356	-0,690	0,310	-0,424
5.	Quickness (100 m run)	0,598	-0,087	0,372	-0,525
6.	Dexterity (4 x 9 m shuttle run)	-0,122	0,865	0,193	0,058
7.	VCL	0,270	-0,777	-0,157	0,205
8.	SBP	0,682	0,143	-0,058	0,511
9.	DBP	0,618	-0,558	-0,160	0,443
10.	Mass	0,583	0,119	0,623	-0,345
11.	Circumference of neck	0,755	0,053	-0,495	0,047
12.	Forearm length	0,322	0,248	0,571	0,411
	Contribution %	36,84	23,36	22,44	17,36

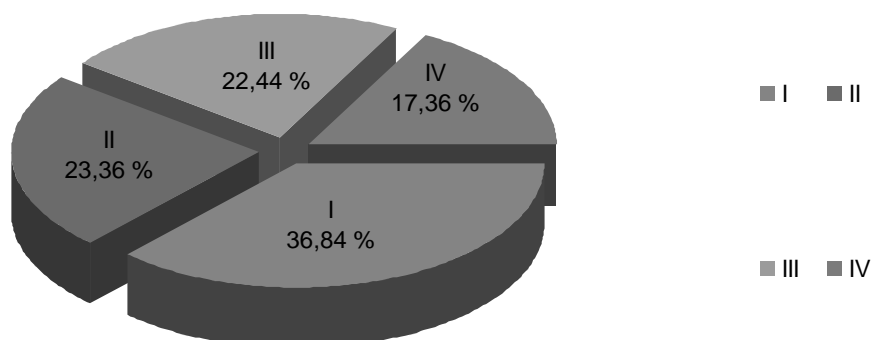
The content of the first, the most significant factor by contribution into general dispersion of the sample 36,84% with the highest coefficients includes bio-mechanical parameters of sagittal (LV) IJT trajectory length, evaluation of movement (OD) and mean speed of traveling IJT (V), which show significance of function of balance and development of other coordination abilities of the trainees for mastering of practical skills in wrestling. Thus, this factor is interpreted by us as coordination abilities, which are a complex, integral quality.

The second factor with value of sample in general dispersion of 23,36% with high indicators of coefficients, the most remarkable were indicators of endurance, VCL and dexterity. Owing to the fact that dexterity, by classification of many specialists, is one of the components of coordination abilities, we, basing on interpretation of the 1st factor, can refer it, by its significance, even to the 1st factor, speaking about wrestling training. Besides, wrestling is characterized by long term tension, which requires substantial endurance, that is why it is very important that organism would be able to carry out the work of the given intensity during long period of time [6,13]. Endurance is ensured by the whole complex of changes, which take place in organism with muscular work. Development of endurance is mainly connected with improvement of coordination of motional functional abilities of organism and is conditioned, first of all, by development of blood circulation and respiratory organs, that provide working muscles and organism's tissues with oxygen [1,14]. That is why VCL parameter, with its strong statistic connection with endurance indicator, is not an occasional one in this factor.

In the third factor with its contribution to general dispersion of 22,44%, substantial load is born by anthropometric indicators of body mass, circumference of neck and forearm length, that determine certain peculiarities of body constitution. Thus this factor can be characterized as anthropometric.

In the fourth factor with its contribution to general dispersion of 17,36 % we marked out quickness indicators and SBP and DBP indicators. Thus, this factor can be characterized as quickness-functional one.

So, percentage of different parameters' influence on efficiency of mastering of practical wrestling course can be shown in diagram (see fig.1).



- I – coordination abilities
- II – endurance
- III – anthropometric features
- IV –quickness-functional

Fig.1. Diagram of factor load on efficiency of wrestling training

Results of factor analysis concerning the most important place of coordination abilities in efficiency of mastering of wrestling knowledge and skills, which were obtained in our research, comply with ideas of many specialists in the field of wrestling.

Thus, alongside with other physical characteristics, coordination abilities are of great importance in martial arts. Teaching experience shows that successful mastering of discipline “Wrestling and methodic of its training” implies steady mastering of coordination skills on the base of reasonable usage of previously accumulated motion experience. In educational-training process, with the help of exercises, oriented on development of coordination abilities, students master special coordination knowledge and skills, which positively influence on physical development in general.

Summary

Factor analysis resulted in determination that the first, the most significant for mastering wrestling course, factor, with its contribution to general dispersion of sample 36,84%, includes bio-mechanical parameters, which demonstrate significance of static and dynamic stability, function of balance and development of other coordination abilities of students. This factor is interpreted by us as coordination abilities, which are a complex, integral quality.

The prospects of further researches. It is planned to carry out researches concerning determination of place and significance of psychological factors in wrestling training.

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