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CONTRIBUTIONS REGARDING THE DEVELOPMENT OF THE MOTIONAL ABILITY ENDURANCE AND ITS CORRELATION WITH OTHER MOTIONAL ABILITIES AT THE AGE OF 15/16 – 17/18 YEARS

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Abstract
This study is a completion of some previous researches and aims to stress the importance of the development of the motional ability i.e. the endurance at the age of 15/16 – 17/18 years when the subjects attend the high-school courses. This age is characterized by numerous changes which occur not only at the psihomotric level, but also at the functional and somatic level. As it is already known, one of the main aims of the syllabi is represented by the development of the motional abilities, out of which endurance is one of the qualities which can be improved quite easily, as it does not require any special devices or equipments.
Subjects and Applied Methods. This research was carried out during the school year comprised between 2011-2012 using a sample of 80 students. It took place at Colegiul Tehnic „Lazar Edeleanu" from Ploiesti. The experiment involved 40 boys and 40 girls who were divided into experiment groups and monitored groups, the trainings of these groups being different one from another. The experiment groups were taught a superior number of lessons which regarded the development of the endurance skills. The trials which were considered were as follows: the 1000 metres endurance running (boys), the 800 metres endurance running (girls), the long jump, the 50 m sprint and the commuting.
Results. After presenting this statistical data in this paper, it can be observed a more or less significant improvement of the performance of the experiment groups regarding the motional ability i.e. the endurance together with the improvement of the values of the other variables featured by this experiment such as the running speed and the explosive force.
Conclusions. Analysing the data provided by this experiment, it can be asserted that, at this age, the improvement of the motional ability i.e. endurance is likely to be achieved to a fairly great extent too, due to its feature of being perfected until at a relatively adult age, as it does not require any special equipments. Its evolution depends on the bio-psiho-motric features of every individual and the perseverance, the continuity and the methods used by the teacher. It was also observed that the development of the endurance abilities has an indirect influence on the other motional abilities, in genere, and chiefly on the running speed and the explosive force.
Keywords: endurance, motional abilities, correlation.

Introduction

The topic of the development of the motional skill named resistance (endurance) is a topic many studies have been written about, this study being a completion of some previous researches and aims at highliting the importance of the development of the motional ability named resistance at the age 15/16 - 17/18 years , age at which subjects attend high-school courses and which is characterized by numerous changes encountered at both psychomotric, functional and somatic level.Bota (2000,) considers resistance as "the ability to endure physical and mental fatigue during a long-term physical performance." Also, Manno (1992) defines resistance as "the motional ability that enables man to deal with fatigue in long-term effort".Consulting specialised literature, it can be said that the definition varies very little according to the opinions of specialists, resistance being conceived as "psychophysical ability of the performer's body to cope with fatigue specific to the his actual performance" (Dragnea and Mate-Teodorescu, 2002, page 381).

As it is already known, one of the main objectives of the curriculum is to develop motional skills, resistance being one of these qualities that can be improved relatively easily because it requires no special equipment and installations.

Experts in the field consider that resistance is one of the motional capacities which can be easily perfected, but only being based on systematic and continuous performance of the specific means, the values obtained can be thus kept for a quite long time.Mitra and Mogoş (1977) consider that "ensuring a high level of aerobic activity of the body depends largely on the degree of preparation of the respiratory system,on the execution of correct breathing both at rest and during effort. It is well known that the respiratory system develops morphofunctionally under the influence of special exercises. Together with this development, an improvement of the neural processes which adjust

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breathing to the intensity of the physical activity takes place".Development of resistance is very important due to increased efficiency and exercise capacity of students, by delaying the occurrence of the phenomenon of fatigue (physical, mental, nervous system, etc.). Developing this capacity according to a well-established schedule which is adapted to the peculiarities of the students has positive effects on the body systems, especially the cardiovascular and respiratory systems.

Dragnea (2002) believes that the development of resistance is reflected in the increased functional capacity of the respiratory, nervous, cardiovascular system, of the metabolism, and also in the ability to coordinate the rest of the systems and apparati that are found in the human body.The main factors that condition the development of resistance are intermuscular and intramuscular coordination, energy resources, and hormonal mechanisms regulating enzyme activity, psychological factors (volitional processes, endeavour, perseverance, etc.), caplillarisation and peripheral adjustment, the muscle fibre type involved in the activity (slow fibres, "red" with increased oxidative metabolic potential compared to "white" or fast fibres), aerobic capacity, anaerobic capacity, blood components (red blood cells - which serve to transport oxygen), high stability neural processes , fundamental neural processes (excitation and inhibition) by maintaining an optimal state of cortical arousal, so by maintaining an approximately constant ratio in which excitation and pulmonary and cardiovascular capacity prevail (maxim VO2, systolic flow, cardiac output).Contrary to the belief which has persisted among specialists, until recently, according to which the development of resistance is contraindicated in children, recent data and studies in the field, based on well-documented scientific evidence shows that there is no danger of developing resistance in children if attention is paid to the process, knowing that the relative resistance in children is comparable to that of adults, significant differences may be observed in absolute values. A specific issue of developing resistance skills at school age is stimulating the development of the subjects' motivation.It is also recommended that the development of resistance skills at school age should be realised using simple means and with great efficiency, making possible the training during longer time periods, the duration of running gradually increasing.Studying specialised literature, it can be said that the development of resistance can be realised at almost any age (taking into account the somato-functional and mental peculiarities of every subject), with data showing great availability in the development of this quality even at low ages.The education of the conditional motional capacity (quality) named resistance can be carried out not only by running, but also by other specific means. Resistance can be scheduled at any time of the year, during the physical education lesson and it is recommended that it should address the last part of the lesson avoiding thus the association with the motional quality named force. It was found out that complete maturation of resistance ability is achieved during puberty.Generally speaking, the main features underlying the development of resistance skills are: a well-appropriated structure of exercises , breaks which not ensure full recovery of the body and of the exercise capacity,the volume of exercises should result in the appearance of fatigue (large volumes and average volumes), moderate tempo of execution, (2/4) and the possibility to work on sets or continuously (Dragomir andBarta, 1998, page 121).In physical and sport education, the primary means used to develop resistance skills is running, highlighting the necessity of the ability to breathe properly.

Materials and methods

This study was carried out at the Technical College "Lazar Edeleanu" in Ploiesti, in 2011-2012 school year and it was based on a total of 80 students. The experiment included 40 boys and 40 girls, divided into experimental and control groups (with 20 boys and 20 girls for each age group), the study being performed in different training conditions between the two groups. The experiment groups benefitted from a higher number of lessons which targeted the development of the resistance skills.

The tests which were targeted are as follows: the 1000 metres resistance running (boys), the 800 metres endurance running (girls), the long jump, the 50 m sprint and the commuting.

The values of the running resistance test are expressed in minutes, the values of the long jump are rendered in meters and the values of the running speed are expressed in seconds.

The commuting test consists in drawing two parallel lines on the ground at a distance of 15 m. for boys and 10 m. for girls. Behind one of the lines there are positioned 6 small cubes for boys and 4 small cubes for girls. From the top starting position, behind the starting line, at a sound signal, a full speed running is performed to the second line (behind which there are the small cubes), they pick up a small cube, run up to the starting line and place the small cube behind it, then run to the line behind which there are small cubes and bring another small cube. The test continues until all the 4 (6) small cubes are brought back. They are not allowed to throw the small cubes from great distance, the necessary time for bringing them back being rendered in seconds.

The main methods used in carrying out this study are: the method of bibliographic study, experimental method, method of measurements and records,

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statistical and mathematical method and graphical method.
Also, statistical indicators on which data processing and interpretation were performed are: arithmetic average, median, upper limit, lower limit, quartiles, range, standard deviation and coefficient of variability.

Results

The study is rendered as statistical data in tables 1-8, the interpretation of results is based on the mentioned tables in which the statistical and mathematical values of experimental and control groups obtained in the 1000 metres endurance running test (boys), the 800 metres endurance running test (girls),the long jump test, the 50 m. sprint test, and the commuting test are shown, both in the initial and final tests for both boys and girls.

Table 1. Statistical values obtained in the experimental group boys, 15-16 years

	1000 metres endurance running		50 m. sprint		Long jump		Commuting 15 m.	
	Initial	*Final*	*Initial*	*Final*	*Initial*	*Final*	*Initial*	*Final*
Average	3.58	3.41	7.92	7,21	1,85	2,04	33,22	30,90
Minimum	3.48	3.29	7.5	7,1	1,78	1,87	32,5	30,1
Maximum	4.12	3.58	8.3	7,8	2,19	2,25	33,9	32,4
Range	0.24	0.29	0.8	0,7	0,47	0,38	1,4	2,3
Median	3.57	3.39	7.7	7,2	1,86	1,99	33,4	30,6
Lawer quartile	3.52	3.36	7.7	7,1	1,81	1,95	32,8	30,2
Upper quartile	4.1	3.51	7.9	7,3	1,9	2,12	33,5	31,2
Standard deviation	10.73	12.01	0.30	0,29	0,05	0,15	0,56	0,94
Coefficient of variability	4.48	5.40	3.88	3,99	2,91	7,36	1,69	3,05

Table 2. Statistical values obtained in the control group boys, 15-16 years

	1000 metres endurance running		50 m. sprint		Long jump		Commuting 15 m.	
	Initial	*Final*	*Initial*	*Final*	*Initial*	*Final*	*Initial*	*Final*
Average	3,56	3,44	7,88	7,48	1,91	2,03	34,80	33,85
Minimum	3,4	3,25	7,6	7,1	1,79	1,84	32,9	32,6
Maximum	4,17	4	8,4	8,1	2,21	2,26	35,8	35
Range	0,37	0,35	0,8	1	0,42	0,42	2,8	2,4
Median	3,54	3,45	7,8	7,45	1,855	1,99	35,2	33,65
Lawer quartile	3,48	3,39	7,7	7,15	1,8	1,96	34,42	33,52
Upper quartile	4,06	3,49	7,97	7,6	1,94	2,07	35,37	34,45
Standard deviation	12,85	12,00	0,29	0,42	0,16	0,14	1,03	0,87
Coefficient of variability	36,93	34,88	3,71	5,57	8,47	7,02	2,96	2,58

Table 3. Statistical values obtained in the experimental group girls, 15-16 years

	800 metres endurance running		50 m. sprint		Long jump		Commuting 10 m.	
	Initial	*Final*	*Initial*	*Final*	*Initial*	*Final*	*Initial*	*Final*
Average	4,08	3,47	8,67	8,05	1,73	1,82	24,22	23,13
Minimum	3,29	3,24	7,8	7,6	1,58	1,64	22,6	21,5
Maximum	4,52	4,38	9,4	8,9	2	2,06	26	25,4
Range	1,23	1,14	1,6	1,3	0,42	0,42	3,4	3,9
Median	4,12	3,49	8,45	8,1	1,75	1,85	24,1	22,75
Lawer quartile	4,08	3,44	8,32	8,02	1,63	1,75	23,27	21,92
Upper quartile	4,16	3,53	9,02	8,1	1,79	1,89	25,15	24,25
Standard	20,72	19,37	0,50	0,14	0,11	0,11	1,34	1,59

deviation								
Coefficient of variability	8,35	8,47	5,82	1,71	6,61	6,18	5,52	6,87

Table 4. Statistical values obtained in the control group girls, 15-16 years

	800 metres endurance running		50 m. sprint		Long jump		Commuting 10 m.	
	Initial	*Final*	*Initial*	*Final*	*Initial*	*Final*	*Initial*	*Final*
Average	4,14	4,03	8,93	8,82	1,62	1,67	25,52	25,07
Minimum	3,44	3,31	7,9	7,7	1,31	1,33	23,8	23,6
Maximum	5,15	4,45	10,5	10,1	1,96	2,02	27,6	27,1
Range	1,31	1,14	2,6	2,4	0,65	0,70	3,80	3,5
Median	4,04	3,57	8,7	8,55	1,635	1,69	25,45	25,1
Lawer quartile	3,57	3,43	8,05	8,1	1,405	1,48	25,02	24,6
Upper quartile	4,25	4,18	9,65	9,45	1,805	1,86	26,1	25,75
Standard deviation	23,30	24,77	1,07	0,99	0,26	0,27	1,05	0,90
Coefficient of variability	56,28	61,43	11,97	11,19	16,22	16,37	4,11	3,58

Table 5. Statistical values obtained in the experimental group boys, 17-18 years

	1000 metres endurance running		50 m. sprint		Long jump		Commuting 15 m.	
	Initial	*Final*	*Initial*	*Final*	*Initial*	*Final*	*Initial*	*Final*
Average	3,53	3,38	7,24	6,97	2,19	2,32	34,03	31,45
Minimum	3,41	3,23	6,7	6,5	1,95	2,1	32,4	30,2
Maximum	4,17	4	7,5	7,4	2,42	2,48	38,1	33,8
Range	0,36	0,37	0,8	0,9	0,42	0,38	5,7	3,6
Median	3,49	3,31	7,3	7	2,17	2,35	32,8	30,9
Lawer quartile	3,43	3,23	7,15	6,75	2,07	2,26	32,4	30,65
Upper quartile	3,59	3,54	7,45	7,2	2,29	2,41	34,42	31,7
Standard deviation	13,91	17,70	0,28	0,33	0,18	0,16	2,74	1,60
Coefficient of variability	5,96	8,12	3,89	4,74	8,36	6,98	8,06	5,10

Table 6. Statistical values obtained in the control group boys, 17-18 years

	1000 metres endurance running		50 m. sprint		Long jump		Commuting 15 m.	
	Initial	*Final*	*Initial*	*Final*	*Initial*	*Final*	*Initial*	*Final*
Average	3,56	3,46	7,34	7,28	2,16	2,21	34,19	33,09
Minimum	3,4	3,29	7	6,6	1,89	2	32,2	30,5
Maximum	4,15	4,08	7,7	7,7	2,33	2,40	36,9	34,9
Range	0,35	0,34	0,7	1,1	0,44	0,45	4,7	4,4
Median	3,58	3,45	7,4	7,3	2,2	2,22	33,5	33,4
Lawer quartile	3,49	3,36	7,2	7,1	2,02	2,07	32,7	32
Upper quartile	4,03	3,58	7,4	7,7	2,32	2,28	35,65	34,27
Standard deviation	12,17	13,46	0,26	0,46	0,19	0,17	1,85	1,54
Coefficient of variability	5,14	5,94	3,55	6,32	8,78	7,68	5,42	4,66

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Table 7. Statistical values obtained in the experimental group girls, 17-18 years

	800 metres endurance running		50 m. sprint		Long jump		Commuting 10 m.	
	Initial	*Final*	*Initial*	*Final*	*Initial*	*Final*	*Initial*	*Final*
Average	4,05	3,54	8,43	7,98	1,76	1,81	24,53	23,78
Minimum	3,36	3,26	7,8	7,7	1,61	1,59	22,9	22,4
Maximum	4,28	4,21	9,2	8,9	2,1	2,2	25,4	25,2
Range	0,52	0,49	1,4	1,2	0,49	0,61	2,5	2,8
Median	4,08	3,52	8,4	7,85	1,7	1,76	24,9	23,85
Lawer quartile	3,56	3,45	8,05	7,7	1,68	1,65	24,35	23,3
Upper quartile	4,15	4	8,75	8,02	1,82	1,92	25,12	24,27
Standard deviation	17,72	16,33	0,50	0,40	0,16	0,21	0,99	1,00
Coefficient of variability	7,23	6,96	5,94	5,05	9,20	11,84	4,05	4,21

Table 8. Statistical values obtained in the control group girls, 17-18 years

	800 metres endurance running		50 m. sprint		Long jump		Commuting 10 m.	
	Initial	*Final*	*Initial*	*Final*	*Initial*	*Final*	*Initial*	*Final*
Average	4,09	4,02	8,24	8,14	1,74	1,77	24,60	24,31
Minimum	3,35	3,31	7,6	7,6	1,55	1,62	23,2	23
Maximum	4,35	4,33	9	8,9	2	2,12	25,1	25,1
Range	1	1,02	1,4	1,3	0,45	0,5	1,9	2,1
Median	4,15	3,57	8,35	8,1	1,71	1,71	24,75	24,4
Lawer quartile	3,48	3,47	7,85	7,8	1,63	1,68	24,57	24,05
Upper quartile	4,28	4,20	8,5	8,3	1,85	1,79	24,92	24,7
Standard deviation	23,35	21,57	0,47	0,43	0,15	0,17	0,60	0,67
Coefficient of variability	9,38	8,91	5,73	5,33	8,85	9,53	2,44	2,76

Discussions

Analysing the results recorded in 15-16 year-old boys in the 1000 m. test (tables 1 and 2), the experimental group shows values of 3.58 min. in the initial testing and 3.41 min. in the final testing, the difference is 17 seconds compared to the control group whose average is 3.56 min. in the first test and 3.44 min. in the second, a difference of only 12 seconds. The 50 m. speed run test of the experimental group of boys evinces an initial average value of 7.92 sec. and a final average value of 7.21 sec., the increase being 0.71 sec., comparatively with the achievement of the control group which was only 0.40 sec., its values being 7.88 sec. in the former test and 7.48 sec. in the latter. Although the values of the initial long jump test are superior within the control group (as well as the values of the resistance running test and the values of the 50 m. speed running test), this test is characterized by a higher progress of the experiment group (19 cm.) compared to the control group (12 cm.) The values of the experimental group were 1.85 m. in the initial test and 2.04 m. in the final test, which can be compared with the control group who obtained 1.91 m. in the initial test and 2.03 m. in the final test. In the commuting test on a distance of 15 m., superior results can be observed both in the initial testing and in the final testing of the experimental group. The values are 33.22 sec. in the initial testing and 30.90 sec. in the final testing, which can be compared with the control group whose values are 34.8 sec. in the first testing and respectively 33.85 sec. in the second testing, a progress of 2.32 sec. within the experimental group and 0.95 sec. within the control group, as can be seen in table 1 and table 2.These results correspond with Monea et al.(2006) and Vaida, Finichiu (2003) results.

The results obtained by 15-16 year old girls (tables 3 and 4) in the 800 m. running resistance test emphasize the obvious progress of the experimental group compared with the control group, the improvement of the former being 21 sec. (4.08 min. in the initial testing and 3.47 min. the final testing) and 11 sec. of the latter (4.14 min. in the initial testing and 4.03 min. in the final testing). Also, in the 50 m. speed running test, it can be observed the same trend of high progress

within the experimental group (0.62 sec.),which can be compared with the control group (0.11 sec.), their values being 8.67 sec. in the first test and 8.05 sec. in the second test within the experimental group and 8.93 sec. in the initial testing and 8.82 sec. in the final testing within the control group. Regarding the long jump, one can see a relative improvement in both groups, the difference is not very large, the progress of the experimental group being 9 cm. (1.73 m. in the initial testing and 1.82 m. in the final testing), while the control group had an improvement of 5 cm. (1.62 m. in the initial testing and 1.67 m. in the final testing). Both initial and final values are significantly higher within the experimental group. Superior results can be observed in the commuting test on a distance of 10 m. both in the initial testing and in the final testing within the experimental group whose progress was 1.08 sec., the values were 24.22 sec. in the initial testing and 23.13 sec. in the final testing, which can be compared with the control group who had an average of 25.52 sec. in the first testing and 25.07 in the second, the progress being of only 0.45 sec, as can be seen in tables 3 and 4.

Analysing the data from 17-18 year old boys reflected in the statistical values which are presented above (tables 5 and 6), one can find higher values of the experimental group both in initial tests and in final tests, the 1000 m. resistance running being characterized by an improvement of 15 sec. within the experimental group compared to 10 sec. within the control group, the average values of the experimental group were 3.53 min. in the initial testing and 3.38 min. in the final testing , while those of the control group were 3.56 minutes. in the initial testing and 3.46 min. the final testing.

The 50m speed running evinces better values within the experimental group - 7.24 sec. in the initial testing and 6.97 sec.in the second testing, with a progress of 0.27 sec. in comparison with the results of the control group who had average value of 7.34 sec. in the initial testing and 7.28 sec. in the final testing, the progress is just 0.06 sec.

At the same time, it can be observed that the initial values are relatively similar in both groups in the long jump test, the average values being 2.19 m. within the experimental group and 2.16 m. within the control group, the difference appeared in the final testings where the values are different, the experimental group with an average of 2.32 m. in comparison with the control group whose average was 2.21 m., the progress is 13 cm within the first group and only 5 cm. within the control group.

Also, the commuting test on a distance of 15 m. reflects the tendency of other tests, the progress being 2.58 sec. within the experimental group (34.03 sec.in the initial testing and 31.45 sec. in the final testing) which can be compared with the control group had an improvement of 1.1 sec. (34.19 sec.in the initial testing and 33.09 sec.in the final testing). By increasing the number of exercises specific to the resistance development also an increase of speed and the strength at the level of inferior limbs was noticed by Christou, et. al. (2006), Finichiu (2005), fact that confirms the study realized by me.

Analysis of the results obtained in 17-18 year old girls highlights a higher progress of the experimental group in all the tests (tables 7 and 8), even if the control group had a better average in the 50 m. speed running initial testing. The 800 m. running resistance test has a progress of 11 sec. within the experimental group (4.05 min. in the initial testing and 3.54 min. the final testing) and 7 sec. within the control group (4.09 min.in the initial testing and 4.02 min. the final testing).

Regarding the 50 m. speed running test, is can be noticed initial values of 8.43 sec. and final values of 7.98 sec. within the experimental group, the progress being 0.45 sec. which can be compared with the control group whose progress is only 0.10 sec., its values being 8.24 sec. in the former test and 8.14 sec. in the latter. Regarding the long jump, one can see a small improvement in both groups, the progress of the experimental group being 5 cm. (1.76 m. in the initial testing and 1.81 m. in the final testing) while the control group had an improvement of 3 cm. (1.74 m. in the initial testing and 1.77 m. in the final testing),as can be seen in tables 7 and 8.

Also, the commuting test on a distance of 10 m. is defined by an upper evolution of the experimental group, its progress being 0.75 sec. in comparison with the control group who had an improvement of 0.29 sec. The values of the experimental group are 24.53 sec.in the initial testing and 23.78 sec. the final testing, while those of the control group are 24.6 sec. in the initial testing and 24.31 sec. in the final testing.These results correspond with Finichiu (2003, 2005) results.

It should also be mentioned that there were cases in which both girls and boys abandoned the resistance running test, there were 4 girls and one boy.

After presenting statistical calculations in this study, an improvement more or less significant of the experimental groups can be observed regarding the motional named endurance together with the improvement of the values of other variables included in the experiment, i.e. the speed and explosive power.

Conclusions

The data presented above shows that, by increasing the number of hours that have as objective the development of resistance skills, a steady improvement of the 15-16 and 17-18 year old students's performance is achieved, this development also influencing other motional capabilities. A superior evolution can be observed at 15-16 year old students in

comparison with 16-17 year old students in the majority of the analysed items.

Also, by continuing the process of preparation of students in terms of the motional capacity named resistance, based on the continuous growth of distance or duration of the activity and on the variation of volume of the effort, one can achieve superior results, knowing that at this age, the capacity of adapting and performing this type of physical activity is very high.

By increasing the endurance capacity of the students, an improvement of other motional skills is also achieved, all these leading to the amelioration of their cardiovascular system.

Contrary to some opinions that say it is not advisable to use means of developing resistance skills for long periods, I believe that it should be paid a special attention to the development of resistance skills, its development not only improving the quality of life, but also other motional capabilities such as strength, moving speed, coordination and so on.

Analyzing the results obtained in this experiment we can say that at this age it is possible to improve the capacity of resistance in a quite considerable extent due to the characteristic of this capability of being perfected to a relatively mature age, its evolution depending, in addition to bio-psycho-motor features of each individual, on the perseverance, continuity and the types of methods used by the teacher.

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