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THE HEART RATE TO SOME EFFORT AT GIRL STUDENTS AGES BETWEEN 16 AND 17

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Abstract

The purpose of our research is to identify if the recovery response of teenage girl students of 16-17 years old, after performing some strength and aerobic effort.

The hypothesis: there are similar aspects in the ability of adjusting to effort and the capacity of body recovery of teenage girl students of 16-17 years old, after muscular strength and endurance effort and aerobic effort.

Methods. We have identified the phenomenon with a sample of 39 teenage girl students, ages between 16-17, divided into two groups: Group 1 evaluated after some muscular strength and endurance effort and Group 2 evaluated after aerobic effort. The effort was specific to age and gender, ordered in circle of strength and a sequence of aerobics. The length of the monitored effort was of 12 minutes each, placed at the end of the physical education lesson. The physiological post effort state was observed with the help of the Dorgo test, which identifies the degree of post effort recovery. The gathered data represented different values of the heart rate post effort minutes. The statistics-mathematics analysis was applied, through which we could characterize the two groups, from the angle of tendencies of grouping or scattering the variables., by ANOVA and Post Anova Scheffe Test.

Results. As for the results associated to Dorgo index, the recovery capacity of the two groups is average to low.

Conclusions. The physical condition and the physical and physiological abilities of the two groups do not support them similar in their capacities of coming back to the rest state.

Keywords: adolescence, muscular strength and endurance, aerobic endurance, recovery, Dorgo index

Introduction

Maintaining and consolidating health is the main objective of physical education and sport activity. Health is a good condition of a human being's biological, psychological and social status. The longitudinal and transversal studies prove the positive effects of the physical activities on physical and psychic health of the body (Dumitru, 1997, Boroş-Balint, Tache, 2007). Practicing physical exercise and sport, even with moderate intensity, improves the quality of life (Lupu, Bocu, 2005). The sportive activity which takes place in the physical education system or in practicing sports for performance uses as specific means physical exercises, specific materials and means of recovering the effort capacity (Dragnea, 2000, Farcaş, 2003, Sabau 2009). The recovery process includes a series of steps whose purpose is quickening the recovery of the biological balance of the body (Drăgan, 2002) and protecting the health of those who practise it (Mihăilescu, 2011). During the sportive training the recovery process has an important place, given the effort that is made during the sports for performance. During the physical education activity, recovery implies simple, natural steps similar to the level of the effort made. According to Farcaş, 2003, recovery has a less important role in physical education practised in schools because of the reduced values of physical effort, comparatively to the effort made at

training or competitions. As for recovery during physical education, the measures applied refer especially to the breaks between exercises which represent moments of fighting against fatigue caused by effort. Adjusting the body to physical effort takes shape through immediate cardio-respiratory effects, which offer the energetic resources to the muscular system. The adjusting reactions depend on the degree of challenge, age, gender and level of training. Practicing aerobic effort strengthens the cardio-respiratory system, fights against stress (Nina 1996, Borza, Mateescu, Mihalaş 2006, Niculescu 2008). High school students are motivated to practice physical exercises for their looks, relaxation and they notice the value of a physical education lesson in maintaining their health (Hârjan, Nistor, Lupu, 2007).

Methods

This paper represents a quick investigation among teenage girl students. This study has as purpose to establish the adjusting ability to different kinds of effort specific to age. During adolescence, one can act directly in order to strengthen motility and functional capacities of the body. According to requirements in the high school curricula, for developing motor qualities at Xth grade students, the development of strength for main muscular groups and of resistance to uniform and variable effort are established among

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others. Thus, we have studied the teenage girls' response to strength and aerobic effort. Work hypothesis: the recovery response of teenage school girls of 16-17 years old, after performing some strength and aerobic effort, is similar. The research methods used were ordered in specialized literature study, the observing type experiment, ANOVA statistics-mathematics analysis, Post Anova Scheffe Test, graphic representation of the recorded results. Comparisons between different post effort moments have been performed, obtained from applying the Dorgo recovery test. After performing some specific effort, the Dorgo test was applied, which investigates the recovery capacity of the body.

$$\text{Dorgo Index} = \frac{(P_1 + P_2 + P_3 + P_4) - 300}{10}$$

The values of the heart rate were registered, analyzed and graphically represented in four moments: pre effort (at rest P_1) and post effort at minute 2 (P_2), minute 4 (P_3), and minute 6 (P_4), post effort (Zamora, Merca, Zamora 1996). The data were compared and the degree of significance of the differences noticed between the investigated moments were analyzed. The studied sample consisted of 39 school girls of 16-17 years old, divided into two groups. Group 1 included 20 subjects and Group 2 – 19 subjects. Girls in Group 1 performed the program for the development of strength of the main muscular groups, which represented a interrupted effort circuit of muscular and strength endurance with 4 stops which challenge the muscles of the lower limbs, of the upper limbs, of the abdomen and of the back. The exercises are: from standing position bent-knee; from hanging at the fixed ladder, alternative lifting of the knees bent to

horizontal; from lying on the back, trunk extension; from sitting with both legs stretched close, arms bent leaned against the gymnastics bench, stretching and bending the arms. The continuous circuit is a methodical process which can be used in the training of high school students (Tibacu 1974, Scarlat, M., Scarlat, E., 2003). The structure of the circuit: 30 seconds work + 30 seconds rest, the whole circuit was repeated three times. The girls in Group 2 performed a short program of aerobics, which contained combinations of rhythmic elements on music. Both programs lasted 12 minutes each and they were placed at the end of the physical education lesson.

Results

Results obtained at Group 1 (Table 1.1. and Graph 1.1.)

The data recorded for heart rate at Group 1 show the pre effort moment (P_1 - at rest) an average value of the heart rate of 78 ± 7.46 b/min, with an amplitude of values of 28 units. The homogeneity of the group is high if we notice the value of the variability coefficient of 9.47%. For the first post effort moment of the heart rate (P_2), respectively after 2 minutes, the average value of the heart rate is 95.6 ± 7.33 , with a value of amplitude of 32 units. The homogeneity of the group at this moment is high ($C=7.66\%$). For the second post effort moment, after 4 minutes (P_3), the average value of heart rate is 88.4 ± 7.09 , with an amplitude of the values of 24 b/min and a great homogeneity with the value $C=8.02\%$. For the last moment of the investigation for G1, respectively after 6 minutes (P_4) the mean of values is of 82.8 ± 6.50 b/min. The homogeneity is high with $C=7.85\%$.

Table 1.1. Values of heart rate in 4 moments - Group 1

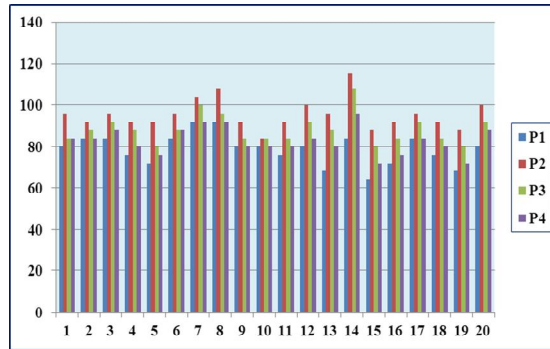
Parameters	Values	Difference
$P_1 \pm DS$	78.8 ± 7.46	
$P_2 \pm DS$	95.6 ± 7.33	16.8
$P_3 \pm DS$	88.4 ± 7.09	7.20
$P_4 \pm DS$	82.8 ± 6.50	5.60
$P_4 - P_1$		4.00
$C_v P_1$	9.47%	High omogeneity
$C_v P_2$	7.66%	High omogeneity
$C_v P_3$	8.02%	High omogeneity
$C_v P_4$	7.85%	High omogeneity

By observing the differences among the four moments, we notice that the average difference between the rest value and the one at minute 2 post effort is of 16.80 units. After four minutes, the heart rate recovers another 7.20 units and after six minutes it gains another 5.60 b/min. The average difference of the heart rate between rest and six minutes post effort is of

4 b/min. ANOVA statistics-mathematics analysis shows the existence of some differences in the recorded moments. Thus, the ratio $F=21.02$ at threshold $p > 0.01$ confirms the presence of some differences in the investigation moments. The mathematical processing, Post Anova Scheffe Test, identifies significant differences of the heart rate among the following

moments: P1 versus P2, respectively from the rest moment to the second post effort minute (7.47 at $p>0,01$) and P2 versus P3, respectively from the second minute of effort to the fourth (3.20 at $p>0,01$). Between moments P3 and P4, respectively from the

fourth minute to the sixth, significant differences (2.49 at $p>0,05$) are noticed. The gathered data show insignificant differences of the heart rate between the initial and the final moment P4 versus P1, respectively 1.78 at $p>0,05$.



Graph 1.1. Values of heart rate in 4 moments – Group 1

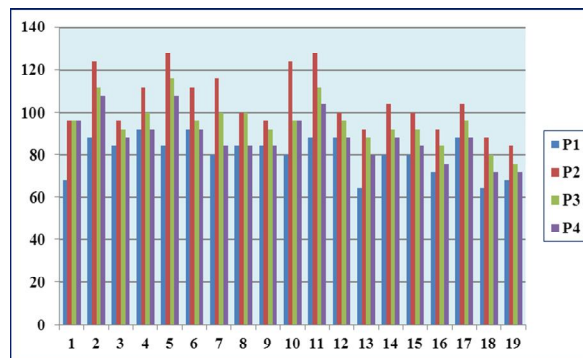
Results obtained at Group 2 (Table 1.2 and Graph 1.2.)

The data gathered at Group 2 show for the cardiac frequency, at pre effort (P1) moment, the average value of 80.42 ± 12.02 b/min. The range of values enlarges on a 28 units segment. The homogeneity of the group at this moment is high according to value $C_v=14.60\%$. On the first post effort moment (P2), respectively after 2 minutes from effort,

the heart rate recorded an average value of 105.05 ± 13.71 b/min. The amplitude of the values is of 44 units. The variability of the group at moment P2 is low, with $C_v=13.05\%$. After 4 minutes post effort (P3) the average value of the heart rate is 95.57 ± 10.23 b/min, with an amplitude of 40 units. The homogeneity of the group at 4 minutes post effort is high, respectively 11.87%.

Table 1.2. Values of heart rate in 4 moments – Group 2

Parameters	Values	Difference
P1 ± DS	80.42 ± 12.02	
P2 ± DS	105.05 ± 13.71	22.74
P3 ± DS	95.57 ± 10.23	9.48
P4 ± DS	88.63 ± 10.52	6.94
P4-P1		6.32
C_v P1	14.60%	High omogeneity
C_v P2	13.05%	High omogeneity
C_v P3	10.70%	High omogeneity
C_v P4	11.87%	High omogeneity



Graph 1.2. Values of heart rate in 4 moments – Group 2

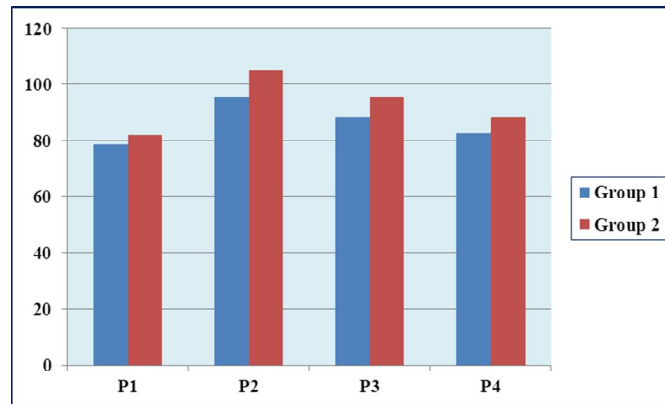
By observing the differences among the four moments of investigation, we notice that the difference between the rest moment and the one after 2 minutes post effort is of 22.47 b/min. After four minutes of effort, the heart rate recovers 9.48 units. After other six minutes of effort, the heart rate recovers another 6.94 b/min. The average difference of the heart rate from the pre effort moment to the sixth minute post effort is of 6.32 units. ANOVA statistics-mathematics analysis shows the existence of some differences among the four investigated moments, according to the ratio $F=3.17$ at $p>0.01$. The mathematical processing by Post Anova Scheffe Test indicates significant differences of the heart rate among the following moments: P1 versus P2 (5.98 at $p>0,01$) and P2 versus P3 (2.49 at $p>0.05$). For P3 versus P4 (1.82 at $p>0.01$). Between the rest moment (P1) and the final one (P4) post effort, a significant difference (2,66 at $p>0,05$) is observed.

Results between groups

The data obtained are compared between groups (Group 1 versus Group 2) for each moment of investigation. In the analysis of the mean of heart rate at the rest moments of each group ($P1_{Group 1}$ versus $P1_{Group 2}$), we notice differences, which related to t test, for non-correlated samples, show insignificant differences at threshold $p>0.01$, where $1.09<2.02$. The comparison of the heart rate for minute 2 post effort at both groups ($P2_{Group 1}$ versus $P2_{Group 2}$) indicates significant differences where $2.66>2.02$ at $p>0.01$. As for the values of the heart rate at minute four post effort, significant differences between the two groups ($P3_{Group 1}$ versus $P3_{Group 2}$) are noticed, by the values of t test for non-correlated samples, where $2.53>2.02$ at $p=0.01$. The values proper to heart rate at minute six ($P4_{Group 1}$ versus $P4_{Group 2}$) show slightly significant differences $2.07>2.02$ at $p=0.025$.

Table 1.3. Average values – comparison between groups

	Group 1 (b/min)	Group 2 (b/min)	Difference (b/min)
P1	78.8	80.42	1.62
P2	95.6	105.05	9.45
P3	88.4	95.57	7.17
P4	82.8	88.63	5.83



Graph 1.3. Average values –comparison between groups

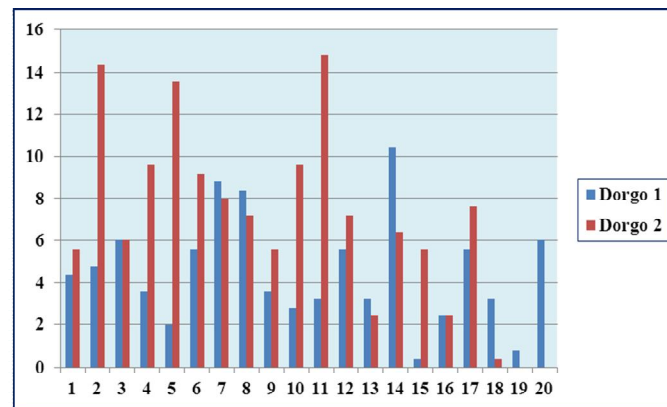
The values calculated for Dorgo index show a mean of 4.54 ± 2.59 for Group 1 and 7.13 ± 4.22 for Group 2. The amplitude of values is of 10 units for Group 1 and 14.8 for Group 2. The values of the Dorgo index are very scattered at both groups, respectively

$Cv=57.04\%$ at Group 1 and $Cv=59.14\%$ at Group 2. The difference between the two groups for the Dorgo index is significant and it is confirmed by the value of the t test for the non-correlated samples, where $t=2.30$ at $p=0.025$.

Table 1.4. Dorgo index

Parameters	Values	Diference
Dorgo G1M ± DS	4.54±2.59	
Dorgo G2 M± DS	7.13±4.22	2.59
C _v Dorgo G1	57.04%	Low omogeneity
C _v Dorgo G2	59.14%	Low omogeneity

Graph 1.4. Dorgo index



Discussions

On analyzing the data registered at Group 1, which was investigated after performing the strength program, we notice a good homogeneity of heart rate values, in all four moments, respectively at rest, after minutes 2, 4 and 6 post effort. The cardiac frequency, at two minutes after ending the strength circuit, was over 92 b/min. The effort was challenging, given the statistically significant difference between this value and the rest one. After four minutes, the heart rate diminishes and we observe a statistically significant difference, which meant a more obvious recovery of the subjects towards the rest state. After six minutes from the effort, the heart rate recorded a diminution, in comparison to the previous moment, but statistically insignificant, which indicates an incomplete recovery. On analyzing the value of the Dorgo recovery index, we see some result that indicates a mean recovery (4.54). The group is extremely heterogeneous, the speed of recovery of girls' body is completely different. The group succeeded in recovering after the strength effort, after six minutes (the difference between the post effort heart rate at minute six and the rest one is of 4 b/min). The effort induced by the challenge of main muscle group's strength, for 12 minutes, has caused fatigue which was annihilated after six minutes. For school girls, the strength of the motor system muscles can be improved. The cardiac response to the strength effort performed in the circuit, effort which has effects on the somatic level, caused an obvious degree of fatigue. The development of the muscular system is more obvious

from birth to the age of 15, with a rise of almost 90%, but until 18 years old the progress is only of 10-12 % (Fray, 1998). So, the strength challenges can continue at teenage girls, given the appropriate biological support. The experimental study made by Oprea and Lupu (2003) emphasizes a different evolution of strength capacity at high school students. If the strength of arms increased from one grade to another, the strength of lower limbs diminished at 16-17 years old; the strength involution was seen at arms, abdomen and lower limbs at 18-19 years old, respectively senior high.

By analyzing the data registered at Group 2, which was moderately subjected to aerobics, we notice high homogeneity of the group, in all moments of the investigation. The effort made required a significant part of the girls' body. The global resistance requests 2/3 from the body and organic mass and it is an important factor of the prolonged effort (Fray, 1998, Delamarche, Delamarche, 1992). Two minutes after the end of the effort, the heart rate was over 105 b/min, which statistically represents a significant difference in comparison with the rest one. After four minutes post effort, the difference between the two consecutive moments becomes insignificant, which indicates a slow recovery, with values of heart rate close to one another. On analyzing the value of heart rate at minute six post effort, we see a statistically slight insignificant difference between minute six and minute four. For the subjects in Group 2, which performed resistance continuous effort, post effort recovery is almost closed after minute six. The comparative analysis of the values



of heart rate in the four moments show close values, with slightly equal difference at rest. The two groups have the same physical condition, highlighted by rest cardiac frequency. The response of the body at the two kinds of effort is different. There are significant differences between the two groups, concerning the values of heart rate after two minutes post effort. The same situation is seen after four minutes post effort and the values of heart rate are significantly higher at Group 2 which performed some effort of continuous effort. Recovery in Group 2 was slower in comparison with Group 1, which indicates the significant difference that continues after six minutes post effort. From a study which compares the national evaluation system with Eurofit system, the aerobic capacity at girls diminishes from Xth grade until XIIth grade (Mateaș et al, 2003).

The speed of recovery of the two groups is different. At Group 1 the value of the Dorgo index shows a mean recovery and at Group 2 the recovery is slow. For both teenage girls groups, recovery appeared at the end of the six minute. As a result of the data gathered from the two groups, we notice the need of a greater number of physical education lessons or other physical activities, which can imprint favorable effects of immediate and long adjustment on teenage girls' bodies. In Romanian schools, physical education lessons are insufficient, with a great number of excused students and this does not sufficiently contribute to the development of an active lifestyle (Bogdan, Bogdan, 2009). In order to fulfill this healthy purpose, physical education and sports activity should be a rhythmic practice, with minimum three sessions of effort per week, lasting 30-90 minutes (Bocu, Tache, 2004). Unfortunately, teenagers' interest is not sufficiently stimulated to make physical effort with healthy effects. Teenagers admit that they are not enough active and included in sport activities (Baciu, Rusu, Santa, 2008). The effort made in aerobic can bring favorable effects to the cardio-vascular system of teenage girls if it is rhythmically repeated with adequate length and content. Even the medium intensity challenges can lead to a higher adjustment of teenagers' bodies (Stoica, 2010).

Conclusions

- The hypothesis initially established is partially confirmed.

- Teenage girls of 16-17 years subjected to research, during the physical education lesson, performed two categories of challenges, respectively muscular strength and endurance effort (circuit – interrupted effort) and aerobic effort (continuous effort).

- The post effort response and recovery for the two situations which the teenage girls were subjected to, were partially different. Both groups had an obvious response to the effort made, identified by the cardiac frequency, two minutes after ending the

effort. Also, at both groups the recovery of heart rate between minutes two and four was significant. The recovery was lower between minutes four and six, the difference between the compared values of heart rate was insignificant. The recovery of the group which performed strength effort was more obvious, in comparison with the group which performed resistance effort, the difference between the initial and the final moments was higher at the subjects who performed aerobic exercises.

- From the calculated values of the Dorgo recovery index, at teenage girls subjected to this study, we notice a recovery during the normal interval, medium of heart rate for girls who performed strength effort. For the girls who made resistance effort, the value of the Dorgo index shows a weak recovery.

- For teenage girls included in the study, the adjusting capacity to effort is normal and the post effort recovery is between medium and low. This can be explained by the lack of physical condition, of an effective adjustment to effort.

- Challenges during a physical education and sport lesson are not enough, given the number of classes in the curricula and teenagers' interest for physical effort.

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