

STUDY ON THE EFFORT CAPACITY OF MIDDLE SCHOOL STUDENTS

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ABSTRACT

The effort capacity of middle school students is crucial for their development and daily activities. This body's ability to sustain effort can be enhanced through physical activities. In physical education classes, the gradual implementation of various physical exercises is particularly important for improving the effort capacity of middle school students.

The development of effort capacity can be achieved with simple spatial materials, and the teacher must be attentive to the students' starting level to avoid overexertion. The purpose of this study was to identify the effort capacity of middle school students.

In this work, we started with the hypothesis that "the effort capacity of students can be influenced through physical education classes in middle school." The subjects of this study were fifth and sixth-grade students, 20 girls and 24 boys, from the Greek-Catholic highschool “Inochetie Micu” Cluj-Napoca.

KEYWORDS: *effort capacity, students, middle school, tests*

JEL CLASIFICATIONS: Z20, Z28, Z29

1. INTRODUCTION

"The intensity of demand represents the functional price paid by the body to exert effort and it depends on individual characteristics. Intensity of demand should not be confused with effort intensity, which represents the amount of mechanical work performed per unit of time. Efforts of the same intensity result in different functional changes from one individual to another and even within the same individual, depending on the level of training. The intensity of demand is assessed through various functional values: heart rate, respiratory rate, blood pressure. Heart rate indicates the level of oxygen consumption reached by the respective subject, from the maximum oxygen consumption they are capable of."

"The common characteristic of all actions of an individual, regardless of their nature, is energy consumption. When energy sources diminish to a certain level, fatigue ensues. Efforts specific to

physical education and sports are the most significant energy consumers because they involve somato-functional and mental overexertion (stress) of the individual. Through appropriate dosing and directing of effort, the organism is induced to improve at different levels. Directly responsible for the onset of fatigue, effort must be analyzed in correlation with it and with actions aimed at its removal, namely recovery. Through the effort-fatigue-recovery relationship, the energy consumption necessary for the activity can be assessed, an important indicator in effort dosing."

Physical education within the middle school cycle represents an essential pillar for the physical, psychological, and social development of students. Through these courses, students can improve their health status, level of physical fitness, motor skills, posture, and physical appearance.

Moreover, they have the opportunity to develop and consolidate skills for various sports and athletic games, which can bring joy and satisfaction into their lives. In parallel, physical education contributes to the formation of positive values and attitudes, such as respect, fair play, teamwork, cooperation, communication, and social integration. The middle school cycle represents a crucial stage in children's development, considering the characteristics of their age and the period of adolescence. In this perspective, physical education teachers must pay special attention to ensuring harmonious development, encouraging the correct acquisition of motor skills, especially regarding speed and dexterity, without neglecting physical strength and endurance.

The factors influencing effort and its orientation within the curriculum include volume, intensity, and complexity.

"Physical education encompasses a vast number of physical exercises. In its various forms of organization, physical education 'operates' with exercises aimed at influencing the correct and harmonious development of subjects' bodies, exercises for the development of motor qualities, exercises for motor skills (basic, utilitarian-applicative, and specific to sports), exercises from aerobic gymnastics, stretching exercises, exercises from folk or sports dances, etc. The volume, intensity, and complexity of these exercises are evidently at a much lower level compared, for example, to sports training."

"The volume represents the quantity of mechanical work and is assessed through the number of repetitions, distances covered, kilograms lifted, etc. Everything is related to time, resulting in density, a fundamental aspect of effort. Intensity represents the degree of strain on the subjects' bodies. It is expressed as percentages of maximum capabilities (60%, 70%, 80%, etc.), execution tempo (2/4, 3/4, 4/4, etc.), number of executions per unit of time, etc. Complexity represents the concrete manner of linking all elements throughout the effort. It increases when 'opponents' and even teammates appear."

2. MATERIALS AND METHODS

The subjects of this study were fifth and sixth-grade students, 20 girls and 20 boys, from the Greek-Catholic High School "Inochetie Micu" in Cluj-Napoca.

The purpose of this work is to identify the level of preparedness and the recovery capacity of the body after effort in fifth-grade students.

The research methods used were: the literature study, the testing method, the statistical-mathematical method.

"The intensity of demand represents the functional price paid by the body to exert effort, and it depends on individual characteristics. The intensity of demand should not be confused with the intensity of effort, which represents the amount of mechanical work performed per unit of time. Efforts of the same intensity lead to different functional changes from one individual to another and even within the same individual, depending on the level of training. The intensity of demand is assessed through various functional values: heart rate, respiratory rate, blood pressure. Heart rate indicates the level of oxygen consumption reached by the respective subject, from the maximum

oxygen consumption they are capable of. For example, a heart rate of 128 beats/minute in men and 138 beats/minute in women represents an oxygen consumption of 50% of the subject's maximum oxygen consumption."

"The common trait of all actions of an individual, regardless of their nature, is energy consumption. When energy sources diminish to a certain level, fatigue sets in. Efforts specific to physical education and sports are the most significant energy consumers because they involve somato-functional and psychological overexertion (stress) of the individual. Through appropriate dosing and directing of effort, the organism is induced to improve at different levels. Directly responsible for the onset of fatigue, effort must be analyzed in correlation with it and with actions aimed at its removal, namely recovery. Through the effort-fatigue-recovery relationship, the energy consumption necessary for the activity can be assessed, an important indicator in effort dosing."

3. RESEARCH PROCEDURE

For our research, we conducted the following tests:

The tests were conducted as follows:

The Ruffier Test, termed by the author as a "fitness assessment test," is a submaximal effort test based on measuring heart rate (HR) during the recovery period after exertion. It represents a screening test that applies mainly to beginners and is low-risk. Technique: The student, in a resting state, is seated and their pulse is recorded for 15 seconds, multiplied by 4 to obtain the resting pulse rate (P1). Then, the student performs 30 squats in 45 seconds, and from the initial position, the pulse is measured again for 15 seconds between seconds 0-15 post-exertion, multiplied by 4 to obtain the effort pulse rate (P2). The student remains seated for 1 minute, and in seconds 45-60 of this post-exertion minute, the pulse is measured again for 15 seconds, multiplied by 4 to obtain the recovery pulse rate (P3). The formula used is: $I.R. = (P1+P2+P3-200)/10$ Interpretation of the test: - Values less than 0 (negative) = very good result; - Values between 0-5 = good; - Values between 5-10 = average; - Values between 10-15 = satisfactory; - Values exceeding 15 = unsatisfactory result, and further investigations of the cardiovascular system are required. Based on the obtained values, the subject is directed to improve their physical condition by engaging in physical activity and sports of any kind.

The Master Test (Two-Step Test) involves climbing and descending a staircase with two steps, each 22 cm high, a certain number of times determined by the author, varying between 20 and 25, depending on age, gender, and body weight. The test lasts for 1 minute and 30 seconds, and after 2 minutes, the heart rate is determined. Normal organism recovery capacity is indicated if, 2 minutes after exertion, the heart rate is not more than 10 beats higher than the resting heart rate.

Carlson's Fatigue Curve Test This test significantly challenges the student, assuming that only such a challenge can demonstrate physical condition. It involves running in place with knees lifted for 10 seconds, with a 10-second rest interval. Ten repetitions of 10-second running intervals, with respective rest intervals, are executed, and the heart rate is recorded: - Before the exercise in a seated position; - At 10 seconds after the 10 repetitions; - At 2 minutes after the 10 repetitions; - At 4 minutes after the 10 repetitions; - At 5 minutes after the 10 repetitions. The number of touches of the right foot to the ground/floor is recorded for each 10-second interval, and then the total number of touches of the right foot is calculated. Both heart rate values and the number of right foot touches are considered in interpreting the test. If the student participates seriously in the experiment, accumulated fatigue will also result in a decrease in the number of right foot contacts with the ground. This test is considered a good training tool, yielding excellent results in this regard as well.

Table 1. Individual Results Recorded in the Ruffier Test – Initial and Final

CLASS			a V-a			
GENDER			Boys		Girls	
TEST			Ruffier		Ruffier	
Nr. crt.	Name		I.T.	F.T.	I.T.	F.T.
	B	G				
1	A.M.	A.M.	3	3	1	1
2	A.G.	A.G.	5	4	6	4
3	A.C	A.E.	2	2	4	3
4	B.G.	A.I.	7	5	7	6
5	B.A	B. M	4	3	2	2
6	C.I.	B. I.	5	5	6	5
7	C.M	C.A	3	2	3	3
8	C. A.	C.E.	5	4	4	3
9	D. D.	C.A.	2	2	0	0
10	E. S.	C. N.	8	7	1	0
11	H.D.	F.M.	0	0	2	2
12	L.D.	L.M.	4	4	5	4
13	L. A	L.I.	3	1	4	3
14	L.D.	M.M.	5	5	5	4
15	M.A.	M.E.	2	1	2	2
16	M.D.	M.R.	3	2	1	0
17	P.A.	N.A.	0	0	5	5
18	T.L.	N.M.	4	3	3	3
19	T.M.	V.I.	6	4	4	3
20	V.A.	V.A.	3	2	6	5
X_{MAX}			8	7	7	6
X_{MIN}			0	0	0	0
M.a.			3.7	3	3.5	2.9

Following the initial Ruffier test, the lowest recorded value among boys is 0, indicating very good physical condition, found in 2 out of 10 boys; among girls, the lowest recorded value is also 0, present in one girl. The highest value among boys is 8, representing average physical condition, while among girls, the highest value is 7, also representing average physical condition. No unsatisfactory values were recorded.

Table 2. Results of the initial Master test in the fifth grade.

Class			A V-a											
Test			Master											
Gender			H.R. – Boys						H.R. - Girls					
Nr. crt.	Girls name	Boys name	Rest		Post effort		Dif. HR Rep/Post		Rest		Post effor		Dif. HR Rep/Post	
			I.T.	F. T.	I.T.	F. T.	I.T.	F. T.	I.T.	F. T.	I.T.	F. T.	I.T.	F. T.
1	A.M.	A.M.	81	79	83	81	2	2	70	70	75	73	5	3
2	A.G.	A.G.	78	80	82	82	4	2	89	90	96	95	7	5
3	A.E.	A.C	78	79	81	81	3	2	75	77	80	79	4	2
4	A.I.	B.G.	78	80	82	82	4	2	89	90	96	95	6	5
5	B. M	B.A	83	80	90	87	7	7	89	89	98	96	7	7
6	B. I.	C.I.	83	80	90	87	7	7	89	89	98	96	7	7
7	C.A	C.M	82	82	88	86	6	4	91	90	100	98	9	8
8	C.E.	C. A.	77	75	78	75	1	0	76	77	85	83	7	6
9	C.A.	D. D.	83	80	90	87	7	7	89	89	98	96	7	7
10	C. N.	E. S.	77	75	78	78	1	3	76	77	85	83	7	6
11	F.M.	H.D.	89	88	96	94	7	6	93	93	101	100	8	7
12	L.M.	L.D.	82	82	88	86	6	4	91	90	100	96	7	6
13	L.I.	L. A	89	88	96	94	7	6	93	93	101	100	8	7
14	M.M	L.D.	90	90	93	92	3	2	86	87	90	89	3	2
15	M.E.	M.A.	78	79	80	80	2	1	75	77	80	79	5	2
16	M.R.	M.D.	76	76	84	83	7	7	77	79	79	79	2	0
17	N.A.	P.A.	75	78	77	79	2	1	90	88	90	90	0	2
18	N.M.	T.L.	83	80	90	87	7	7	89	89	98	96	9	7
19	V.I.	T.M.	89	88	96	94	7	6	93	93	101	100	8	7
20	V.A.	V.A.	77	75	78	78	1	3	76	77	85	83	6	6
X _{max}			90	90	96	94	7	7	93	93	101	100	9	8
X _{min}			75	75	77	75	1	0	70	70	75	73	0	0
M.a.			81.4	80.7	86	84.6	4.7	3.9	84.8	85.2	91.8	90.3	6.1	5.1

Following the initial Master test, the following values were obtained:

Both for girls and boys, the post-exertion heart rate exceeded between 0-9 beats per minute compared to the resting heart rate.

In conclusion, all fifth-grade students exhibit good cardiovascular behavior, indicating a good level of physical fitness.

Following the final Master test, the following values were obtained:

For both girls and boys, the post-exertion heart rate exceeded between 0-8 beats per minute compared to the resting heart rate.

Progress was observed in both girls and boys following the Master test, both initial and final, considering the heart rate; the number of post-exertion beats decreased by one value in the final test.

Table 3. Initial Results Carlson's Fatigue Curve Test - HR before and post-exertion

<i>Gender</i>			<i>HR – Girls</i>					<i>HR - Boys</i>				
<i>Nr. Crt</i>	<i>Name</i>		$\hat{I}$	10s	2m	4m	5m	$\hat{I}$	10s	2m	4m	5m
	<i>G</i>	<i>B</i>										
1	A.M.	A.M.	81	150	96	89	82	70	145	110	82	72
2	A.G.	A.G.	78	155	100	85	79	89	170	120	95	91
3	A.E.	A.C	85	175	110	90	86	90	176	135	110	92
4	A.I.	B.G.	87	150	125	100	93	86	160	120	100	93
5	B. M	B.A	77	148	98	90	80	77	165	130	99	79
6	B. I.	C.I.	80	164	110	92	84	81	146	120	85	78
7	C.A	C.M	79	160	99	92	80	80	175	140	115	84
8	C.E.	C. A.	85	170	100	89	87	86	165	126	110	90
9	C.A.	D. D.	86	166	112	90	88	88	174	150	115	91
10	C. N.	E. S.	78	160	110	87	80	78	160	120	87	79
11	F.M.	H.D.	86	153	109	100	87	90	166	130	115	93
12	L.M.	L.D.	78	154	100	88	80	89	150	120	98	94
13	L.I.	L. A	79	155	102	86	79	89	165	117	95	90
14	M.M.	L.D.	86	173	108	92	87	86	176	132	110	92
15	M.E.	M.A.	87	155	117	100	93	89	156	136	112	93
16	M.R.	M.D.	86	160	114	93	88	87	160	165	110	90
17	N.A.	P.A.	85	175	110	90	86	90	170	135	110	92
18	N.M.	T.L.	85	160	123	89	86	89	145	126	110	93
19	V.I.	T.M.	77	158	106	86	78	79	150	117	86	80
20	V.A.	V.A.	78	160	124	98	80	80	143	127	96	85
X _{max}			91	175	125	100	93	91	176	150	115	94
X _{min}			77	150	96	85	80	70	143	110	82	72
M.a.			82.1	160	108.6	91.3	83.7	84.6	160.8	128.8	102	87.5

Following the initial Carlson's Fatigue Curve Test, the highest recorded HR after 10 seconds of exertion was 184 for girls and 182 for boys; the lowest value was 150 for girls and 143 for boys. Post-exertion HR did not exceed by more than 5 beats per minute compared to the resting HR for both girls and boys.

Table 4. Final Results Carlson's Fatigue Curve Test - HR before and post-exertion for the fifth grade

Gender			HR – Girls					HR– Boys				
Nr: crt	Name		î	10s	2m	4m	5m	î	10s	2m	4m	5m
	G	B										
1	A.M.	A.M.	81	140	96	89	81	70	140	100	82	70
2	A.G.	A.G.	78	155	99	83	78	90	160	120	95	91
3	A.E.	A.C	83	170	110	89	86	88	162	133	107	90
4	A.I.	B.G.	91	170	119	95	92	90	168	120	100	92
5	B. M	B.A	78	160	98	88	80	74	165	130	99	75
6	B. I.	C.I.	80	164	110	88	82	78	166	120	82	78
7	C.A	C.M	74	160	99	90	77	90	165	134	102	92
8	C.E.	C. A.	87	170	100	89	88	89	165	120	99	90
9	C.A.	D. D.	85	166	112	92	88	90	162	128	98	91
10	C. N.	E. S.	77	158	100	87	80	78	160	120	87	79
11	F.M.	H.D.	80	157	125	83	82	90	166	120	95	92
12	L.M.	L.D.	80	160	108	87	82	78	162	121	82	78
13	L.I.	L. A	78	155	99	83	78	90	164	130	95	92
14	M.M.	L.D.	85	164	112	95	88	90	150	132	102	91
15	M.E.	M.A.	82	120	90	82	80	80	120	97	77	85
16	M.R.	M.D.	77	160	100	87	80	77	160	120	87	77
17	N.A.	P.A.	85	175	108	89	86	85	162	131	107	87
18	N.M.	T.L.	80	170	110	88	82	78	166	120	82	78
19	V.I.	T.M.	77	160	100	87	80	77	160	120	87	77
20	V.A.	V.A.	81	170	110	87	86	88	167	134	107	89
X _{max}			91	170	125	92	92	90	168	134	107	92
X _{min}			74	120	90	80	77	70	120	97	77	70
M.a.			80.9	160.2	105.2	87.9	82.8	83.5	159.5	122.5	93.6	84.7

Following the final Carlson's Fatigue Curve Test, the highest recorded HR after 10 seconds of exertion was 170 for both girls and boys; the lowest value was 120 for both girls and boys. Post-exertion HR did not exceed by more than 5 beats per minute compared to the resting HR for both girls and boys.

Comparing HR before and after 5 minutes of exertion, in the case of boys, a good recovery capacity of the organism is observed, as in all cases, HR was lower in the final test, highlighting progress.

4.DISCUSSIONS

"Physical activity is an important aspect of any health promotion program, and lack of it is a primary risk factor for many lifestyle-related diseases. Promoting health and physical activity is the responsibility of a number of agencies and institutions, and schools are central to most policies." (Physical Activity Levels in Middle and High School Physical Education - Stuart J Fairclough, Gareth Stratton – 2005)

"Middle school students and primary school students preferred moderate-intensity physical exercise, followed by low-intensity exercise, and the number of students choosing high-intensity exercise is less than the other two. Exercises with moderate intensity, such as running, playing badminton, and playing table tennis, and with equal load and weak antagonism and competition are popular among primary and middle school students. Such exercise programs are easy to carry out and can release students' pressure on study and life. Most students can participate in physical exercise, but the number of students who eventually form physical exercise habits is small". (Physical Exercise of Primary and Middle School Students From the Perspective of Educational Psychology and Parents' Entrepreneurship Education, Chao Song, Sha Ge, Jingjing Xue, and Wanxiang Yao – 2022)

5. CONCLUSIONS

Physical education is crucial for middle school students as it helps improve their health and fitness levels while developing motor skills and coordination.

Through physical education lessons, middle school students learn not only about the importance of physical activity, but also about values such as fair play, cooperation, and respect for others.

Physical education in middle schools plays an essential role in promoting an active and healthy lifestyle, thus contributing to shaping a generation of adults who are aware of the importance of physical activity for their physical and mental well-being.

"Physical education and sports are disciplines in the school curriculum that can help in various ways in educating and shaping children, young people, and adults, thereby contributing to their personal and professional development. Physical education represents a component of education expressed through a type of motor activity that has organizational forms and rules aimed at optimizing the child's biometric and psychic potential for improving quality of life". (Importance of Physical Education and Sports in the Current Context – Acsinte Marinela, National College "A. T. Laurian" Botoșani, 2018)

"School health education courses improve students' health awareness through the transmission of health knowledge, which is conducive to cultivating their healthy behaviors and eliminating or reducing the impact of unhealthy factors on students' physical and mental health. Physical exercise is an effective means to promote the physical and mental health of students in the context of health education". (Can school health education improve students' physical exercise time? Empirical research based on CEPS (2014-2015) survey data – Huamei Zhong, Jingjing Zhou, Dan Xu, Tianbiao Liu)

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