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FENCING TRAINING EFFECT ON MUSCULOSKELETAL FITNESS IN CHILDREN DIAGNOSED WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER

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Abstract: The present research intends to examine the effect of a fencing training program on Musculoskeletal fitness of youth population diagnosed with Attention Deficit Hyperactivity Disorder. *Musculoskeletal fitness* (Mf) is a multidimensional design comprising the integrated function of muscle strength, muscle endurance, and flexibility constructed to enable the performance of work against one's own body weight or external resistance. One of the suggested tests for Mf evaluation is the Eurofit Test Battery. The study population (N=40) children, mean age of 10 at the beginning of the study diagnosed with ADHD divided into two groups: one is the experimental fencing training group (N=20, 10 boys and 10 girls) applying fencing training program combined with general physical activity program and specifically fencing physical activity program; compared to the second group, the Physical Activity (PA) control group (N=20, 10 boys and 10 girls) about the same age and characteristics undergoing only a Physical Education (PE) training program. The duration of the research was 9 months, twice a week, 90 minute each time. The end results as reflected from the Eurofit Physical Fitness Test Battery indicate superiority of the fencing program over the PA program. The control group undergoing PA program achieved definitive higher results only for the Flamingo Balance test and for the muscular upper body development as reflected by the Arm Bent while all other test where in favor of Fencing Training program. Fencing Training program was found to yield higher impact on Physical Fitness than the control group undergoing PA training program as reflected from the Eurofit Physical Fitness Test Battery, supporting the presumption of Fencing Training program superiority on improving the Mf of ADHD diagnosed children over plain PA program.

Key words: Muscuoskeletal fitness, Eurofit Test Battery, ADHD, fencing, physical education

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INTRODUCTION

This study shows the effect of a fencing training program and PA program on Musculoskeletal of youth Attention Deficit Hyperactivity Disorder (ADHD) diagnosed population as reflected by Eurofit Test Battery results.

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Musculoskeletal fitness (Mf) is a multidimensional design comprising the integrated function of muscle endurance, muscle strength, and flexibility constructed to enable the performance of work against the own body weight and or an external resistance. *Muscle strength* is the ability of the skeletal muscle to exert great force, stress, pressure twisting force, moment of joints during a single or few maximal voluntary contractions, performed within a defined set of controlled conditions, including specificity of movement pattern like muscle tension type (concentric, isometric, or eccentric), and contraction speed. *Muscle endurance* as defined by Kell et al., (2001) is "*the ability of a muscle or muscle group to perform repeated contractions against resistance an extended period of time*".

The physical fitness can be either an absolute external resistance, which provides measure of absolute endurance, or a relative effort based on an individual's maximal strength, which provides measure of relative endurance. Flexibility has two components; dynamic and static, static - the range of motion of a joint, dynamic – the resistance of a joint to movement namely the forces opposing movement rather the range itself.

Over the past 55 years the fitness test batteries have been used to assess Mf in youth – Artero EG. et al., (2011) reviewed 32 relevant studies between 1990 to 2009, Ruiz R. J. et al. (2011) suggested the ALPHA Test Battery, and a more recent and comprehensive work by Ortega F.B. et al. (2014) came up with the proposal of the Pre-fit Battery. The tests vary in their specific protocols; some intend to assess the muscle fitness of specific body regions like skeleton, lower back, abdomen and some measuring isolated muscular function like muscle strength, endurance, and power and or combined strength and endurance function.

At 1988 the Council of Europe has devised the Eurofit Physical Fitness Test Battery for children of school age. It includes nine physical fitness tests covering flexibility, speed, endurance and strength. The tests designed so that they can be performed within 35 to 40 minutes and can use very simple measurement equipment. According to Skowronsky W. et al. (2009) the Eurofit Special was able to distinguish performance levels by gender, age and level of intellectual disability and Polish researchers confirmed that individuals with intellectual disabilities had significantly lower levels of physical and motor functioning than individuals without intellectual disabilities, while the classification of intellectual disability is based on IQ level.

Diagnostic and Statistical Manual of Mental Disorders (DSM 5) most widely used in USA determined that "*ADHD is a neurodevelopmental disorder defined by impairing levels of inattention, disorganization, and/or hyperactivity-impulsivity".* The term used by the International Classification of Mental and Behavioral Disorders 10th revision (ICD10) widely used in Europe is hyper-kinetic disorder (HKD) and population surveys, affirmed that ADHD occurs in most cultures in about 5% of children and about 2.5% of adults, being about 3 times more common in boys than in girls.

The impact of PA on ADHD was investigated very deeply during the last years from various aspects – Verret (2012) concluded that functional adaptation of children with ADHD may be clinical relevant with structured PA program; Matthew B. P. (2013) concluded that positive implications on children with ADHD may be caused by single bouts of 20 minutes mildly aerobic exercise; Hoza (2015) found reduced impairment associated with ADHD following PA intervention; Wigal (2012) and Smith (2013) aimed to help manage symptoms of ADHD by advance habitual PA through organized sports; Egmond-Frohlich (2012), Berger (2014) reported on reducing the risk for ADHD symptoms through PA, similar to Gapin J. (2011); Kiluk (2009) concluded that practicing PA promote emotional functioning. Fencing is a combat type PA utilizing skills advantageous to a warrior such as speed, strength, accuracy and courage. Fencing was found to improve physical conditioning, and emotional balance Johnson R. C. (2000).

This article is based on the results of Eurofit Physical Fitness Test Battery conducted as part of thesis research regarding "The influence of a fencing training program on youth population diagnosed with ADHD" which made use of the Test Battery as a tool to evaluate the subject's Physical Fitness before and after the intervention program.

OBJECTIVES

The objectives of this study were to determine the effects of fencing training program on musculoskeletal fitness of children diagnosed with ADHD, compared with the effect of physical activity in physical education lessons.

MATERIALS AND METHODS

The research subjects were 40 elementary 4th grade students divided into two groups: 20 Fencing Training Group (FTG) – 10 girls and 10 boys) and 20 Control Physical Activity Group (CPAG) – 10 girls and 10 boys – all diagnosed as ADHD. After the preliminary tests we found no differences between the groups, confirming that the groups are homogeneous. The research period was thru whole academic year (9 months). All research population was divided randomly and had no previous expertise in fencing, similar to research conducted by Kang K.D (2011) with 13 diagnosed ADHD children undergoing sport activity compared to a control group of 15 diagnosed ADHD children, performing education on behavior control sessions during a 6-week, 90-min twice a week. The intervention program consisted of fencing training program or physical education lessons of 90 minutes, twice a week.

The Fencing group undergoing fencing training program comprised three steps annual program:

- Step A – November 2014 – January 2015; basic fencing skills and improvement of physical condition like on-guard, back and forth movement, crouch, basic attacks and composite attacks involving balestra and forward leap.
- Step B – February 2015 – May 2015; tactical fencing skills and improvement of particular fencing physical condition like enhanced attack combinations, enhanced defense combinations, enhanced fencing dexterity – double, parry, coupe, flash
- Step C – June 2015 – October 2015; competitive fencing skills like competitive training including 4 hit and 8 hit matches, internal club competitions with and without rewards, regional competitions.

The control group received physical education lessons by the same amount of time and sessions as the study group but emphasized on general physical fitness.

The study was performed after-school activity program with population chosen among Misgav elementary school and fencing clubs in Akko city and Kiryat Ata city and Maalot city.

First step in the study was to conclude the research population among school children. For statistical homogeneity all children were ADHD diagnosed using the familiar social performance evaluation test ADHD RS (Rating Scale) IV: Home Version questionnaire – as explored by Goodman D. (2010).

The Eurofit Test Battery was applied for both fencing and control groups at the early first stage of the research and once again at the termination according the rules implied by the test. The Eurofit Physical Fitness Test Battery is a set of nine physical fitness tests covering speed, flexibility, endurance and strength. The standardized test battery was devised by the Council of Europe, for children of school age and has been used in many European schools since 1988. The series of tests are designed so that they can be performed within 35 to 40 minutes, using very simple equipment

The data obtained were statistically analyzed using the SPSS program, by performing the descriptive analysis and comparing the means.

RESULTS

As standard procedure, the Eurofit Test Battery includes also anthropometric measurements of height, weight, BMI and % body fat from skinfold thickness. After the measurement was carried out descriptive analysis thereof, resulting from this point of view the two groups are homogeneous (Table 1).

Table 1. The mean and standard deviations values of anthropometric measurements (N=40)

Group	Age		Weight		Height		BMI	
	Mean	STDEV	Mean	STDEV	Mean	STDEV	Mean	STDEV
FTG (N=20)	9,60	±0,35	35,62	±6,10	1,4	±0,1	18,05	±
CPAG (N=20)	9,64	±0,75	34,50	±4,30	1,4	±0,3	16,45	±

Before applying the intervention program in the two groups, preliminary testing of physical fitness of subjects with Eurofit Tests Battery was performed. The results were interpreted statistically, the descriptive analysis to these data is shown in Table 2.

Table 2. The assessment of subjects (N = 40) using the Eurofit Test Battery

Group Statistics					
Test	Group	N	Mean	Std. Deviation	Std. Error Mean
Flamingo	Fencing group	20	9,75	8,24	1,84
	CG Physical Activity	20	8,45	7,98	1,79
Plate Tapping	Fencing group	20	13,20	1,83	0,41
	CG Physical Activity	20	13,58	1,61	0,36
Sit and Reach	Fencing group	20	0,25	2,02	0,45
	CG Physical Activity	20	-1,45	3,93	0,88
Standing Broad Jump 1	Fencing group	20	1,33	0,16	0,04
	CG Physical Activity	20	1,30	0,19	0,04
Standing Broad Jump 2	Fencing group	20	1,37	0,15	0,03
	CG Physical Activity	20	1,37	0,24	0,05
HGTL	Fencing group	20	13,90	3,09	0,69
	CG Physical Activity	20	13,90	2,90	0,65
HGTR	Fencing group	20	14,44	3,32	0,74
	CG Physical Activity	20	14,26	2,51	0,56
Sit-Up	Fencing group	20	21,45	4,50	1,01
	CG Physical Activity	20	20,65	4,30	0,96
Bent Arm Hang	Fencing group	20	11,50	11,58	2,59
	CG Physical Activity	20	5,91	7,03	1,57
Shuttle Run	Fencing group	20	23,52	2,80	0,63
	CG Physical Activity	20	21,56	5,41	1,21
Endurance	Fencing group	20	3,36	1,58	0,35
	CG Physical Activity	20	3,43	1,68	0,38

After the preliminary tests we found no differences between the groups, confirming that the groups are homogeneous

Table 3. Testing the distribution of subjects' results to Eurofit tests

Tests of Normality						
Tests	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Flamingo Balance	,296	40	,000	,732	40	,000
Plate Tapping	,079	40	,200*	,981	40	,714
Sit and Reach	,199	40	,000	,935	40	,023
Standing Broad Jump 1	,083	40	,200*	,968	40	,316
Standing Broad Jump 2	,138	40	,054	,955	40	,115
Hand Grip Left	,092	40	,200*	,980	40	,704
Hand Grip Right	,121	40	,146	,957	40	,131
Sit-Up	,148	40	,028	,945	40	,050
Bent Arm Hang	,195	40	,001	,805	40	,000
Shuttle Run	,206	40	,000	,674	40	,000
Endurance	,137	40	,056	,919	40	,007

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

As shown in Table 3, the distribution test shows that Flamingo, Sit and Reach, Sit-up, Bent Arm and Shuttle Run results are normally distributed, meaning that for testing the significance of differences in the mean scores of the subjects in the two groups we will use a parametric test, that is, Independent Sample t-Test. In Table 4 we can see that in any of these tests the difference between the means of the two groups is not significant, it can be said that they are equal in terms of statistics.

Table 4. Independent Sample t-Test for Flamingo, Sit and Reach, Sit-up, Bent Arm and Shuttle Run tests

Tests		Levene's Test for Equality of Variances		*t-test for Equality of Means*		
		F	Sig.	t	df	Sig. (2-tailed)
Flamingo Balance	Equal variances assumed	,114	,738	,507	38	,615
Sit and Reach	Equal variances not assumed	7,208	,011	1,721	28,42	,096
Sit-Up	Equal variances assumed	,183	,671	,575	38	,569
Bent Arm	Equal variances not assumed	13,046	,001	1,844	31,32	,075
Shuttle Run	Equal variances assumed	,232	,633	1,438	38	,158

Because the results of Plate Taping, Standing Broad Jump, Left Hand Grip, Hand Grip Right and Endurance tests are not normally distributed, were compared the means using the nonparametric Mann-Whitney U test. No significant differences were found (Table 5).

Table 5. Nonparametric tests for Plate Taping, Standing Broad Jump, Left Hand Grip, Hand Grip Right and Endurance

Test Statistics[a]

	Mann-Whitney U	Wilcoxon W	Z	Sig. (2-tailed)
Plate Taping	155,00	365,00	-1,218	,223
Standing Broad Jump	188,50	398,50	-,311	,755

Hand Grip Left	183,50	393,50	-,447	,655
Hand Grip Right	186,00	396,00	-,379	,705
Endurance	197,00	407,00	-,081	,935

a. Grouping Variable: Group

After carrying out of the intervention programs (1 academic year) were repeated Eurofit Tests Battery, mean and standard deviation of the measurements are shown in Table 6.

Table 6. Descriptive statistics of final measurements (N=40)

	N	Minimum	Maximum	Mean	Std. Deviation
Flamingo Balance Test 2	40	11,00	26,00	16,65	4,14
Plate Tapping 2	40	9,22	15,45	12,25	1,79
Sit and Reach 2	40	-9,00	25,00	1,54	5,72
Standing Broad Jump 21	40	1,15	1,98	1,56	0,20
Standing Broad Jump 22	40	1,38	2,20	1,63	0,21
Hand Grip Left 2	40	10,10	24,80	17,10	3,57
Hand Grip Right 2	40	10,20	25,10	17,49	3,12
Sit-up 2	40	15,00	30,00	24,08	4,28
Bent Arm Hang 2	40	,98	36,01	12,34	10,35
Shuttle Run 2	40	17,08	26,38	21,32	2,10
Endurance 2	40	2,03	6,57	3,95	1,55

In order to see the effect of the intervention programs on the physical fitness of the subjects, we need to check whether there are differences between the means of the measurements made at the beginning and at the end of the interventions program and, if they exist, to test whether they are significant or not. For this, we need to compare the means using the appropriate tests. In our case the t-test for pairwise samples was used, and we can see in Table 7 that the differences are highly significant, with the exception of 5x10 Shuttle Run Test ($t = 1.68$, $df = 39$, p 2 -tailed = 0.100).

Table 7. Paired Samples t-Test for Eurofit Tests Battery

		t	df	Sig. (2-tailed)
Pair 1	Flamingo Balance Test 1 - Flamingo Balance Test 2	-4,21	39	,000
Pair 2	Plate Tapping 1 - Plate Tapping 2	8,73	39	,000
Pair 3	Sit and Reach 1 - Sit and Reach 2	-3,36	39	,002
Pair 4	Standing Broad Jump 2 - Standing Broad Jump 22	-11,69	39	,000
Pair 5	Hand Grip Left 1 - Hand Grip Left 2	-15,30	39	,000
Pair 6	Hand Grip Right 1 - Hand Grip Right 2	-14,62	39	,000
Pair 7	Sit-up 1 - Sit-up 2	-7,57	39	,000
Pair 8	Bent Arm Hang 1 - Bent Arm Hang 2	-7,25	39	,000
Pair 9	Shuttle Run 1 - Shuttle Run 2	1,68	39	,100
Pair 10	Endurance 1 - Endurance 2	-11,75	39	,000

DISCUSSION

In the following we will analyze the results from the point of view of the effect of the intervention programs. For the analysis of the effect to be well reflected, measurement is made by comparing the amounts of each subject, depending on the group to which it belongs and the time the measurements were made (initial or final).

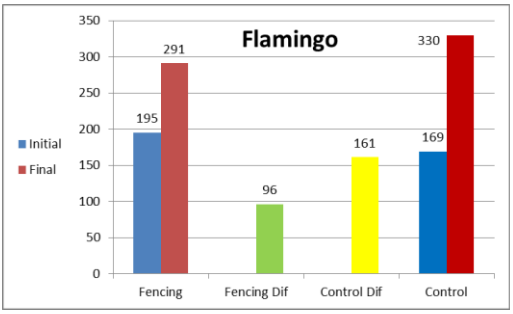


Figure 1. Training Effect: Flamingo Balance Test

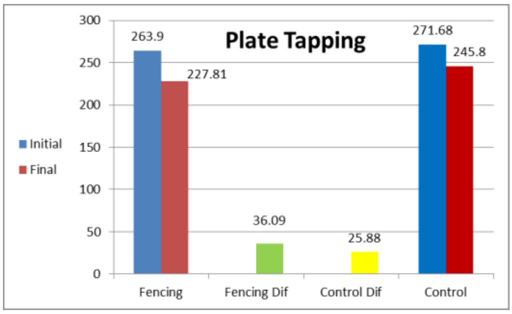


Figure 2. Training Effect: Plate Tapping Test

The score achieved by Flamingo Balance test trying to assess the ability to balance successfully on a single leg is displayed in Figure 3. This particular test is quite misleading since a null score can be achieved in two opposite ways: either by achieving the best score given for not falling at all, and remaining on the board for 60 seconds or by achieving the worst score given after falling from the board 15 times during the first 30 seconds. Therefore, the data of this test cannot be processed by a straightforward quantitative analysis.

Figure 2 shows the scores recorded on the Tapping Plate test. The initial scores are higher than the final scores indicating the time taken to complete 25 full cycles (50 taps) decreased, therefore the speed increased, (inverse correlation between data to value) following training and it is seen that fencing program (36.09) contributed to this dexterity more than the control group (25.88) – not surprisingly, because of the stabbing and defences using hand movements in fencing.

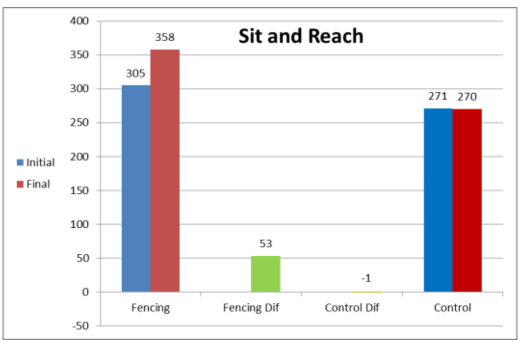


Figure 3. Training Effect: Sit and Reach Test

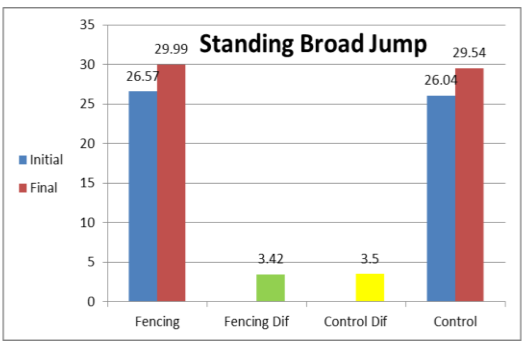
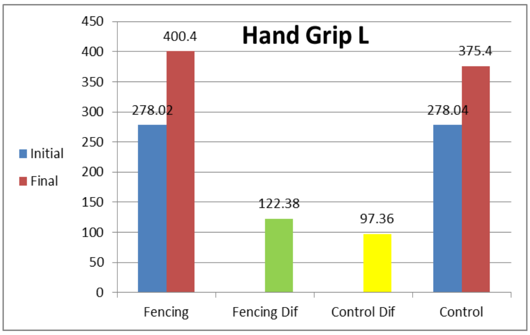


Figure 4. Training Effect: Standing Broad Jump Test

In the Sit and Reach test, the initial scores are lower than the final scores, meaning the flexibility translated into the ability to reach further distance increased (direct correlation) following training and it displays that fencing program (53) contributed to this dexterity more than the control group (-1) that actually caused a decrease (Figure 3). The contribution of fencing is of no surprise, because of the lunge and Jumps used in fencing. The decrease of the control group is also explainable since flexibility is an ability that is lost with time if not worked hard.

Figure 4 shows the score achieved by Standing Broad Jump test. The initial scores are lower than the final scores, meaning the muscular leg power translated by the ability to reach further distance, increased (direct correlation) following training and it is seen that fencing program (3.42) contributed to this dexterity just a little less than the control group (3.5). The reason could be because fencing requires a diversity of capabilities that have to be implemented into a certain time limit and have to disperse the focal points.



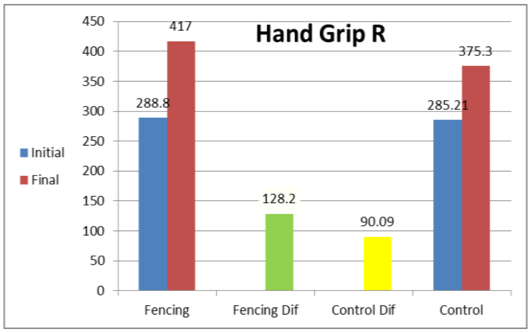
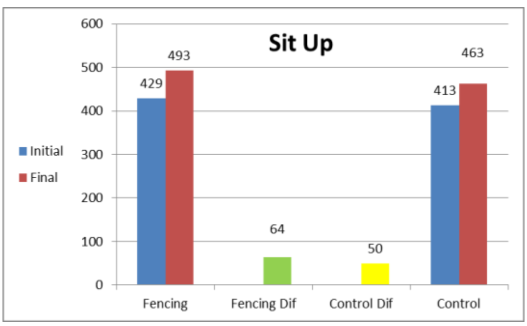


Figure 5. Training Effect: Hand Grip Left **Figure 6.** Training Effect: Hand Grip Right

Referring to Hand Grip Test for two hands (Figures 5 and 6), the analysis will be done separately for each hand. The initial scores for left hand (Figure 5) are lower than the final scores, meaning the muscular arm power translated into the ability to grip harder increased (direct correlation) following training, and it is seen that the fencing program (122.38) contributed to this dexterity more than the control group (97.36). The predominance of the fencing program effect is explained by the use of the hand to manipulate the sword.

The initial scores for the right hand are lower than the final scores (Figure 6), meaning the muscular arm power translated into the ability to grip harder increased (direct correlation) following training, and it is seen that the fencing program (128.2) contributed to this dexterity more than the control group (90.09). The superiority of the fencing program is explained by the manipulation of sword in the hand. It is also interesting to compare the relative progress of the left hand (25.02) to the relative progress of the right hand (38.11) and to assume there are more right handed than left handed fencers. It is also interesting to expose the results in light of the research done by Deforche B. (2003) who found that obese children achieve better strength on handgrip than non-obese children.



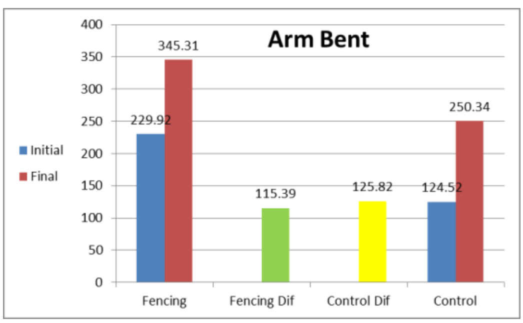


Figure 7. Training Effect: Sit-Up Test **Figure 8.** Training Effect: Arm Bent Test

Figure 7 is shown the score achieved by Sit Up test. The initial scores are lower than the final scores, meaning the muscular abdomen increased (direct correlation) following training and it is seen that fencing program (64) contributed to this skill more than the control group (50) The supremacy of the fencing program is explained by the body movements including leaning forward and backward used in fencing.

The initial scores for Arm Bent test (Figure 8) are lower than the final scores, meaning the muscular upper body increased (direct correlation) following training and it is seen that fencing program (115.39) contributed to this dexterity less than the control group (125.82). The inferiority of fencing is explained by the lack of needed and use of Isometric exercise in upper body power.

The score achieved by 10x5 Shuttle test we can see in Figure 9. The initial scores are higher than the final scores, meaning the agility translated into less time required for completing the 50 meters run increased (inverse correlation) following training, and it is seen that fencing program (40.87) contributed to this skill more than the control group (13.56). The result of the fencing program is explained by the needed of a sudden back and forth movements thru changing direction and speed required in fencing for the attacks, defends and retreats.

Figure 10 presents the score achieved by 20m Endurance test also known as the "Beep Test". The initial scores are lower than the final scores meaning the VO_{2max} (the ability to consume more oxygen in less time) increased (direct correlation) following training and it is seen that fencing program (100.9) contributed to this ability much more than the control group (31.75). The superiority of the fencing program is explained by the intensity of the activity required in fencing to constantly keep up with the opponent from the other side and with the necessity of fighting many combats during a training lesson.

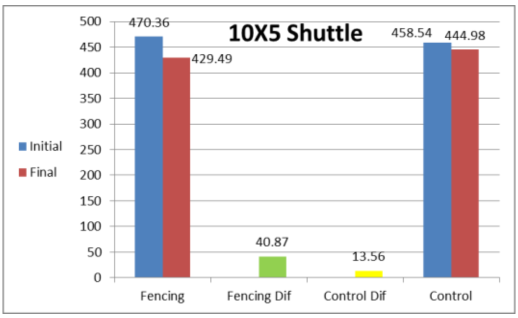


Figure 9. Training Effect: 10x5 Shuttle Test

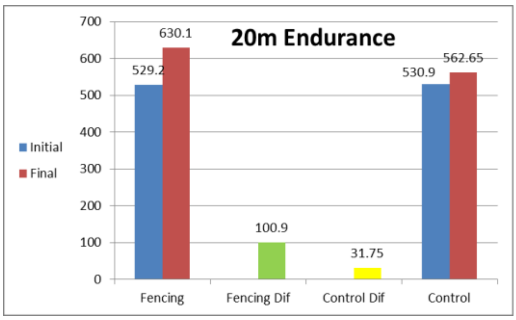


Figure 10. Training Effect:20m Endurance Test

Figure 11 indicates the fencing training effect comparative to the control group effect. The outcome is stand alone for each test the tests can-not be compared one to other because the different scale used for each test. The visualization provides an overall knowledge about the quality of the data: all values above the null line indicate superiority of the fencing program over the PA program. There are only three tests upon which the values are under the null line indicating inferiority of the fencing training program over the PA program:

- Flamingo Balance test- As explained earlier can-not be quantitatively analyzed because the scoring system by giving the null score both to the best and worst performances therefore qualitative analyze is required.
- Standing broad jump – this parameter determines the muscular leg power translated by the ability to reach to a greater distance. Nevertheless, the differences between the change in performances of both fencing and control groups, are nearly identical and it seems that the attempt invested in fencing footwork yield similar results as the attempt invested in general

PA as running, playing field games and alike.

- Arm bent - this parameter determines the muscular upper body development which is definitely not one of the necessary fencing requirements therefore the inferiority of fencing training program is quite explainable.

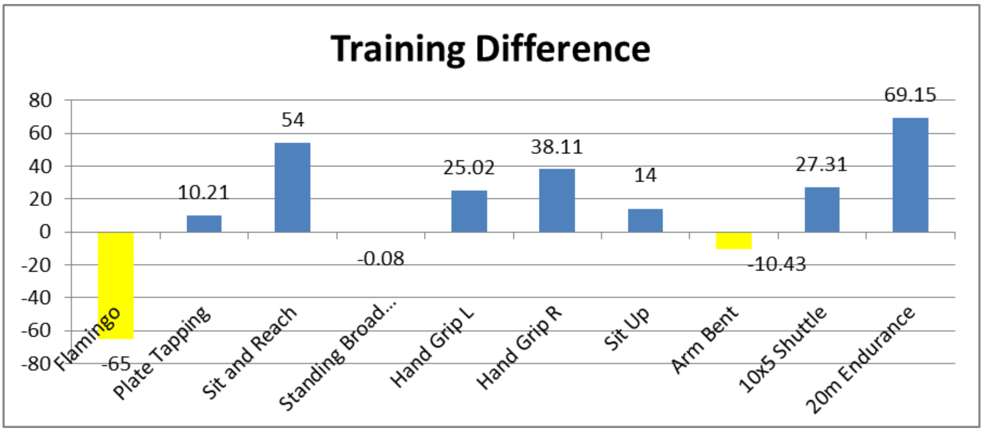


Figure 11. Differences between the effects of intervention programs in the Fencing group and control physical activity group

Considering that the study was conducted during a school year, taking into account that somatic changes occur during this period due to the growth and development of children, BMI undergoes changes. Table 9. emphasizes the BMI approximate percentile values according to the CDC (Centres for Disease Control and Prevention) chart, although other similar charts are also available, for instance WHO (World Health Organization). The values indicate better stability of the anthropometry factor on the fencing group (about 3 scales for the girls and 15 scales for the boys), compared with the control group (about 25 scales for the girls and 28 scales for the boys), the meaning is that the fencing program seems to be more effective in fighting obesity, which has major implications for all aspects of life. One of the aspects found to be influenced by BMI, is ADHD as investigated by P.A. Graziano et. al (2012) who explored the link between pediatric obesity to ADHD.

Table 9. BMI Percentile Values

Assessment	Fencing Group		Control Group	
	Girls	Boys	Girls	Boys
Initial	75	63	45	50
Final	78	78	70	78

CONCLUSION

Fencing training program yield higher impact on Physical Fitness than the control group undergoing PA training program as reflected from the Eurofit Physical Fitness Test Battery.

The research examined the effect of a fencing training program on Mf youth population diagnosed Attention Deficit Hyperactivity Disorder (ADHD), as reflected by Eurofit Test Battery results. The study population (N=40) children diagnosed with ADHD was divided into two groups (N=20, 10 boys and 10 girls): one is the experimental fencing training group applying fencing training program combined with general physical activity program the second, the Physical

Activity (PA) control group undergoing only a Physical Education (PE) training program - all groups, applied research program duration of 9 months, twice a week 90 minute each time.

The aim of the research was to explore the existence of extra value in fencing training program over General PA program, and the presumption was proven in both physical parameters as reflected from the Eurofit Physical Fitness Test Battery.

The outcome consequences of the Eurofit Test Battery results at the end of the research compared to the initial results, support superiority in improving the physical fitness of the Fencing Training Program of ADHD diagnosed children over the control group on most tests. Noticeable the difference overtime of: Sit and Reach (FG 53 vs. CG -1), Hand Grip Right (FG 128.2 vs. CG 90.09), Hand Grip Left (FG 122.38 vs. CG 97.36) and 20m Endurance (FG 100.9 vs. CG 31.75) tests. On the other hands, the control group undergoing PA Program achieved slightly higher results in the Arm Bent (CG 125.82 vs. FG 115.39) and in Flamingo Balance tests (CG 161 vs. FG 96). One of the explanations for the results of the Arm Bent is that fencing training doesn't include exercise for developing static fitness skills because it is not needed for fencing. The flamingo test as we indicated before can-not be measurable analyzed because the null scoring is giving both to the best and worst performances.

Excluding the controversial balance performance assessed by the Flamingo Balance test and the muscular leg power which seems to yield identical results for both fencing and control group as assessed by the Standing Broad Jump test (CG 3.42 vs. FG3.5), only the upper body power development is neglected by fencing training program from the same reason mentioned before while all other fitness components are well taken care as the fencing controlled skills are necessity. In addition, the anthropometry factor as evaluated by BMI indicates evidently more stability for the fencing training program that may be not only as a result of the physical training but also a behavioral side effect of fencing as a competitive sport demanding high devotion and self-discipline.

Further research in the field for evaluation of the extended benefits yielding from fencing training program is recommended by accomplish similar research with same population for a shorter period of time and increasing the number of training lessons per week and the number of samples. Other alternative could be similar research with different types of population, for instance normal children and other behavioral disorders for instance Obsessive Compulsive Disorder (OCD), Oppositional Defiant disorder (ODD).

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