

## CHANGES IN MOTOR SKILLS OF CHILDREN WHO TRAIN SPORTS SWIMMING AT THE INITIAL STAGE OF SCHOOL EDUCATION (IN ANNUAL TRAINING CYCLE)

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**Abstract.** *Introduction:* This is an empirical article aiming at defining the changes of motor fitness in children practicing swimming at early stage of training in year-long training cycle. Proper selection of candidates to practice certain sports is a very complex process. One needs to select from the very large population of children, girls and boys, characterized by certain features, including somatic and motor features, which developed in a longstanding process of training, will lead them to become champions. *The purpose of the research:* The purpose of the research was to define the changes of motor fitness in girls' practicing swimming at early stage of training in year-long training cycle. *Material and Methods:* The subjects to the research were 85 girls aged 7 (1st year of primary school), including 36 girls in swimming group and 49 girls in control group. 36 of them belonged to swimmers' group- all girls were members of the Municipal Swimming Club in Szczecin. Control group consisted of 49 girls, who attended the same elementary schools. The examinations were carried out twice in the 2009-2010 academic year. The most reliable and accurate indirect test- EUROFIT Test Battery- was used. *Results:* The research revealed changes in both groups (Sw, C) in terms of all eight tests. Examination II proved statistically significant improvement of results in both groups (Sw, C) in comparison to Examination I. The dynamics of changes in general balance, flexibility, static force, functional force, running agility, was bigger in the girls who practiced swimming. As the speed of movement of upper limb, explosive force and thorax force are concerned; the differences of results in both examinations were similar in both groups (swimming group and control group). Progressive changes in motor fitness of the examined groups are a positive phenomenon in the development of child's young organism. *Conclusions:* Swimming training significantly affected the dynamics of changes in motor fitness of girls at early stage of training, compared with control group (non-swimmers). Regular participation in sports activities (including swimming) positively affects the development of child's motor (physical) fitness.

**Keywords:** selection, motor fitness, swimming, girls.

### Introduction

Current world-class athletes' bodies display specific characteristics, which result from the sports discipline they train. They are of certain age and have certain parameters: somatic, motor and functional. Their size and quality result in the so-called 'champion model' [Kosmol 1997, Karpiński, Opyrchal 2008, Socha 2008, Kolbowicz 2012]. Continuous observation over the years and analysis of characteristics of the best athletes, Olympic Games medalists, help trainers make changes in their training programs in order to achieve the model champion qualities in their trainees [Karpiński Opyrchal 2008].

Knowledge of model parameters (qualities) of world's best athletes is used by trainers during selection of prospective athletes for a given sports discipline, and subsequently at various stages of sports selection. It is advisable to seek future champions based on their specific qualities (including motor skills), which being developed over the years of trainings could lead to championship in sports [Chomiak, Migasiewicz 1998, Ciężczyk 2005, 2008, Opyrchal et al. 2005]. Effects of trainers' work depend largely on a correct selection process for sports swimming, and on professional, multi-step selection at a later stage [Eider 2014].

The purpose of this study was to determine what changes in motor skills occurred in girls who trained sports swimming during a 1-year training cycle.

### Material and research methods

Subject group consisted of 85 girls aged 7 (1<sup>st</sup> grade of elementary school) who attended four elementary schools in Szczecin, Poland. 36 of them belonged to Swimmers group. All girls were members of the Municipal Swimming Club (MKP) in Szczecin. Before they were selected for swimming classes, the girls did not participate in any systematic swimming training. Control group consisted of 49 girls who attended the same elementary schools. Control group members were selected, based on the age of Swimmers group members, with 3 months' precision; all subjects attended the same grade (1<sup>st</sup> grade of elementary school). Children from Control group did not participate in any sports/recreation classes. All subjects took part in two examinations (Table 1), carried out in 2009/2010 academic year among 1<sup>st</sup> graders of Elementary School no. 51, 55, 56 and 62 in Szczecin (five swimming groups and four control groups) 1<sup>st</sup> examination was conducted in September 2009, immediately after selection of Swimmers and Control groups (1<sup>st</sup> graders), while 2<sup>nd</sup> examination took place in June 2010, i.e. at the end of the 1<sup>st</sup> grade. The analysis included only those children who participated in both examinations.

**Table 1.** Number of girls in Swimmers and Control groups during examinations

School	Group	Class number	Study	
			I	II
El. Sch. 51	Sw	1a	9	9
	Sw	1b	8	8
	C	1c	12	12
	C	1d	11	11
El. Sch. 51	Sw	1a	10	10
El. Sch.56	Sw	1a	5	5
	C	1b	11	11
El. Sch. 62	Sw	1a	4	4
El. Sch. 56	C	1c	15	15
Total			85	85

El. Sch.- Elementary School, Sw – Swimmers, C – Control

Physical ability tests were conducted in gyms and preceded by standard warm-up for all children (7-8 minutes). The tests were as simple as possible and required minimal equipment. The most reliable and accurate indirect tests were used [Szopa et al.1998]. Motor skills were assessed with eight tests of the EUROFIT Test Battery [Grabowski, Szopa 1991]:

1. Flamingo Balance Test – general balance – keeping balance while standing on one leg on a beam of certain dimensions.
2. Plate Tapping Test – speed of upper limb movements – touching quickly two purposefully placed plates with the preferred (stronger) hand.
3. Sit-and-Reach Test – flexibility – sitting and reaching forward as far as possible.
4. Standing Broad Jump Test – explosive leg power – broad jump from a standing position.
5. Handgrip Strength Test – static strength – gripping forcefully a dynamometer.
6. Sit-Up Test – torso strength – lying on the back and doing max. number of sit-up within 30 seconds
7. Bent Arm Hang Test – functional strength – total time of maintaining the hang position with bent arms on a bar.
8. 10 x 5m Shuttle Run Test – agility run – running with max. speed and changes of direction.

### Research results

Flamingo Balance Test – general balance

In the analyzed groups of girls (Sw, C), average results of the Flamingo Balance Test during Examination I were identical. Examination II, however, revealed statistically better results of girls from the Swimmers group. Examination II proved statistically significant improvement of results in both groups (Sw, C) in comparison to Examination I (Table 2). In the Swimmers group, it was on average 3.4 attempts, while in the control group: 1.9 ( $p < 0.0001$ ) (Fig. 1).

Plate Tapping Test – speed of upper limb movements

Swimmers group demonstrated statistically insignificantly better results in Examinations I and II in terms of speed of upper limbs than Control group. Examination II proved statistically significant improvement of results in both groups (Sw, C) in comparison with Examination I (Table 3). In Swimmers group, it was on average 1.3s, while in Control group it was 1.9s ( $p < 0.018$ ) (Fig. 2).

**Table 2.** Descriptive characteristics of Flamingo Balance Test (general balance) in the Swimmers and Control groups.

	Distributio n type	Examination I		Examination II		Examination I vs. Examination II	
		Sw	C	Sw	C	Sw	C
Girls	n	36	49	36	49		
	min - max	5.0-10.0	6.0-9.0	2.0-7.0	3.0-9.0		

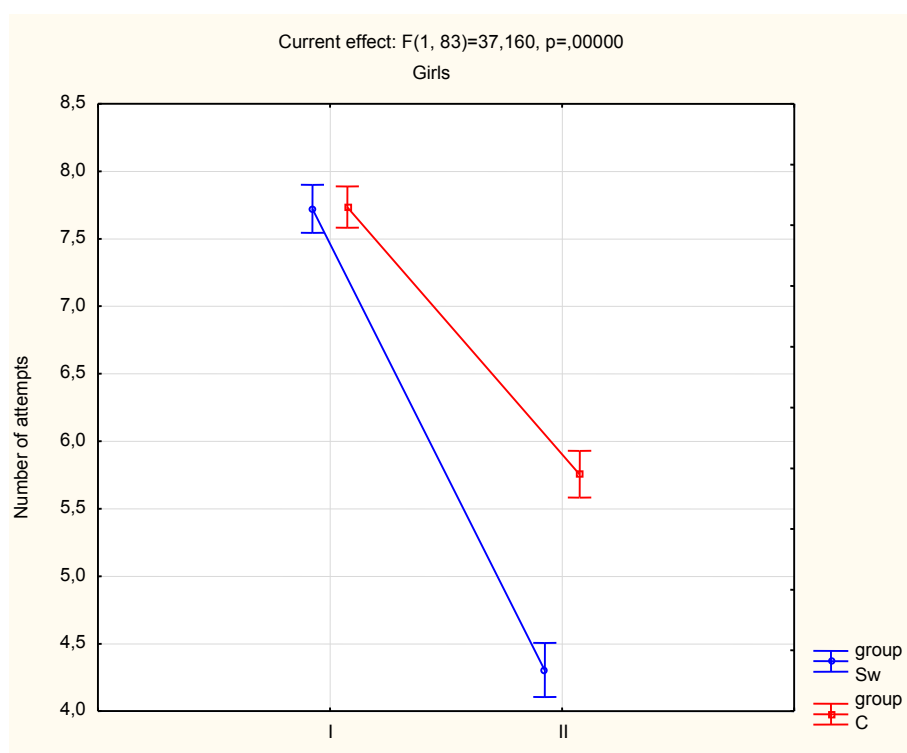
Distributio n type	Examination I		Examination II		Examination I vs. Examination II	
	Sw	C	Sw	C	Sw	C
mean	8.0	8.0	4.0	6.0		
$\bar{X}$ (SD)	7.7 (1.1)	7.7 (1.1)	4.3 (1.2)	5.8 (1.2)		
ss	0.960		<0.0001		<0.0001	<0.0001

Sw – Swimmers, C – Control, min – minimum value, max – maximum value,  $\bar{X}$  – arithmetic mean, SD – standard deviation, ss – statistical significance

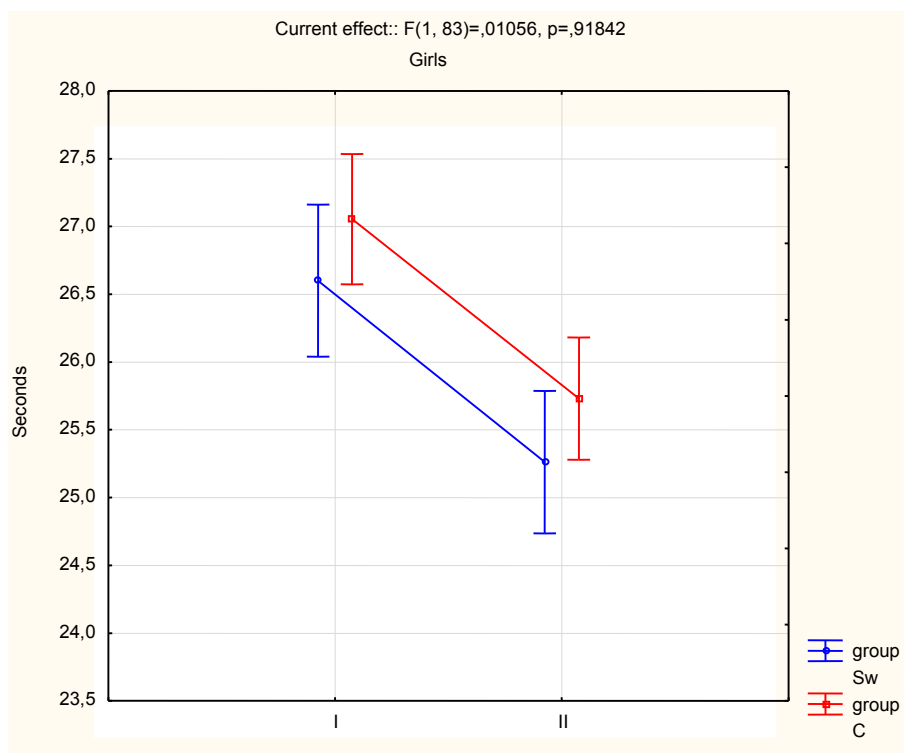
**Table 3.** Descriptive characteristics of Plate Tapping Test (speed of upper limb movements) results in the Swimmers Group (Sw) and Control group (C).

Distribution type	Examination I		Examination II		Examination I vs. Examination II	
	Sw	C	Sw	C	Sw	C
n	36	49	36	49		
min - max	15.0-31.1	21.6-34.3	14.8-29.5	20.3-32.6		
mean	27.6	26.9	25.8	25.7		
$\bar{X}$ (SD)	26.6 (3.7)	27.1 (3.1)	25.3 (3.4)	25.7 (3.0)		
ss	0.527		0.514		<0.0001	<0.0001

Sw – Swimmers, C – Control, min – minimum value, max – maximum value,  $\bar{X}$  – arithmetic mean, SD – standard deviation, ss – statistical significance



**Fig 1.** Changes of Flamingo Balance Test (general balance) results in Swimmers (Sw) and Control groups (C)



**Fig 2.** Changes of Plate Tapping Test (speed of upper limb movements) results in the Swimmers group (Sw) and Control group (C)

**Table 4.** Descriptive characteristics of Sit-and-Reach Test (flexibility) results in Swimmers (Sw) group and Control (C) group

	Distribution type	Examination I		Examination II		Examination I vs. Examination II	
		Sw	C	Sw	C	Sw	C
Girls	n	36	49	36	49		
	min - max	-6.0-14.0	-12.0-13.0	-1.0-17.0	-6.0-16.0		
	mean	3.0	1.0	8.0	4.0		
	$\bar{X}$ (SD)	3.9 (4.7)	-0.5 (5.6)	8.7 (4.0)	3.4 (5.4)		
	ss	0.0002		<0.0001		<0.0001	<0.0001

Sw – Swimmers, C – Control, min – minimum value, max – maximum value,  $\bar{X}$  – arithmetic mean, SD – standard deviation, ss – statistical significance

**Table 5.** Descriptive characteristics of Standing Broad Jump Test (explosive leg power) results in the Swimmers (Sw) group and Control (C) group

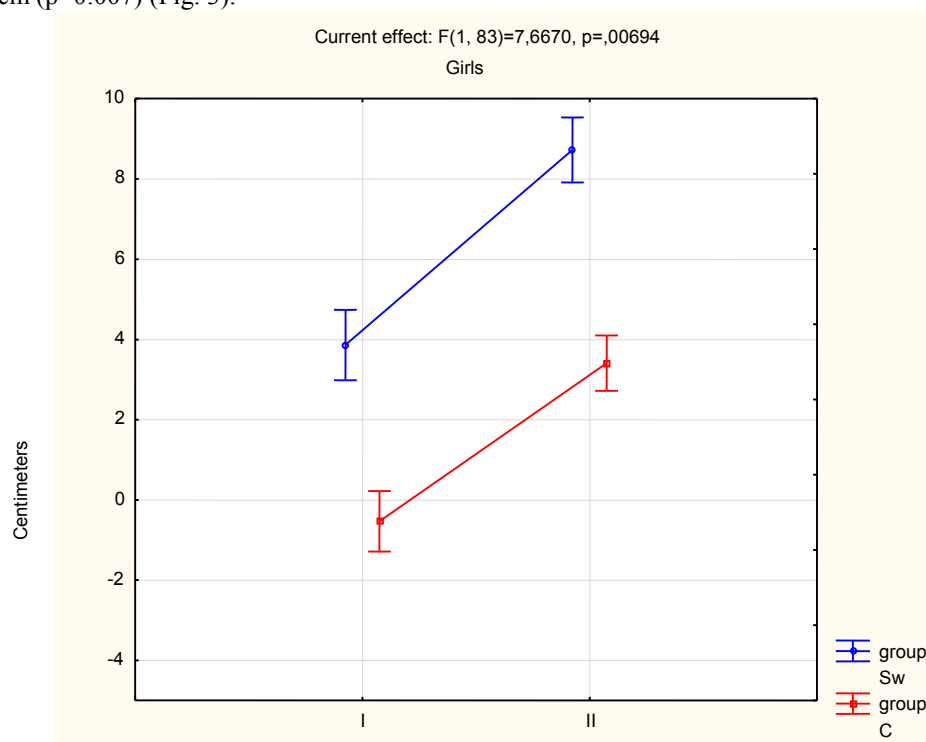
	Distribution type	Examination I		Examination II		Examination I vs. Examination II	
		Sw	C	Sw	C	Sw	C
Girls	n	36	49	36			
	min - max	55.0-132.0	52.0-129.5	64.5-146.0	65.5-141.0		
	mean	105.8	94.0	117.5	108.0		

Distribution type	Examination I		Examination II		Examination I vs. Examination II	
	Sw	C	Sw	C	Sw	C
$\bar{X}$ (SD)	105.4 (14.8)	91.4 (16.9)	117.8 (15.7)	106.4 (16.5)		
ss	0.0002		0.002		<0.0001	<0.0001

Sw – Swimmers, C – Control, min – minimum value, max – maximum value,  $\bar{X}$  – arithmetic mean, SD – standard deviation, ss – statistical significance

#### Sit-and-Reach Test – flexibility

Swimmers group displayed statistically significantly better results in Examination I and II in terms of torso flexibility. Examination II proved statistically significant improvement of results in both groups (Sw, C) in comparison with Examination I (Table 4). In the Swimming Group, it was on average 4.8cm, while in the Control group it was 3.9 cm ( $p=0.007$ ) (Fig. 3).



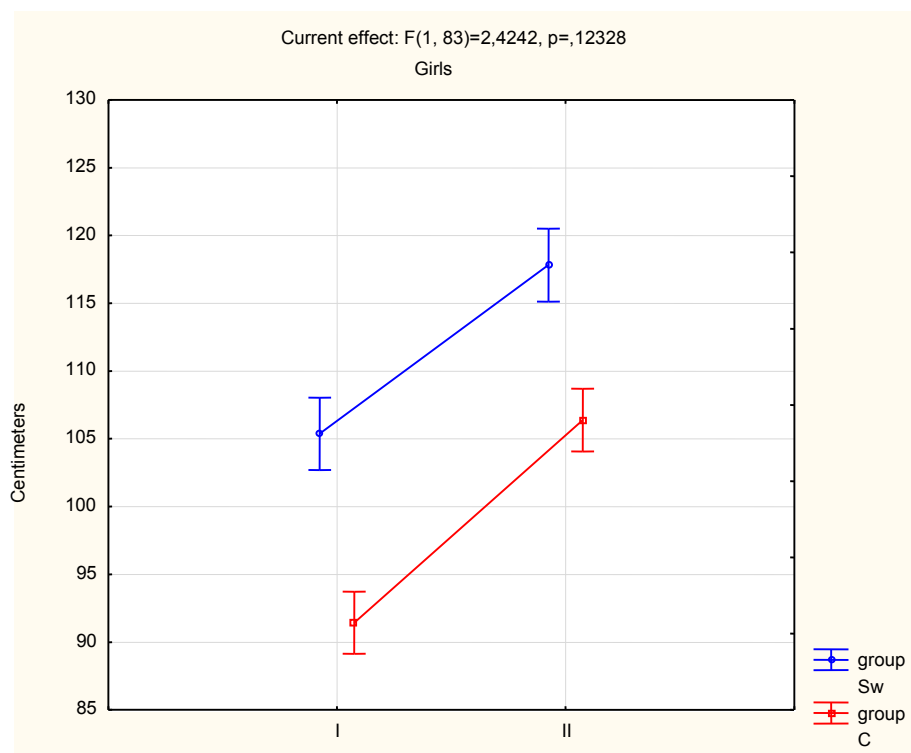
**Fig 3.** Changes of the Sit-and-Reach Test (flexibility) results in Swimmers (Sw) group and Control (C) group

#### Standing Broad Jump Test – explosive leg power

Swimmers group displayed statistically significantly better results in Examination I and II in terms of standing broad jumps. Examination II proved statistically significant improvement of results in both groups (Sw, C) in comparison with Examination I (Table 5). In the Swimmers group, it was on average 12.4cm, while in the control group it was 15cm ( $p=0.123$ ) (Fig. 4).

#### Handgrip Strength Test – static strength

Swimmers (Sw) group displayed statistically insignificantly worse results in Examination I in terms of handgrip strength, in comparison with Control (C) group. In Examination II, Swimmers group obtained statistically insignificantly better results than their peers from Control group. Examination II proved statistically significant improvement of results in both groups (Sw, C) in comparison with Examination I (Table 6). In Swimmers group it was 1.2 (psi)\*, and in Control group it was 0.7 (psi) ( $p<0.0001$ ) (Fig. 5).



**Fig 4.** Changes of Standing Broad Jump Test (explosive leg power) results in the Swimmers (Sw) group and Control (C) group

#### Sit-Up Test – torso strength

Swimmers (Sw) group displayed statistically insignificantly higher results in Examination I in terms of sit-ups, in comparison with Control (C) group. Examination II revealed statistically better results of girls from Swimmers group. Examination II proved statistically significant improvement of results in both groups (Sw, C) in comparison with Examination I (Table 7). In Swimmers group, it was in average 6.5(n), while in Control group it was 5.6(n) ( $p=0.083$ ) (Fig. 6).

**Table 6.** Descriptive characteristics of Handgrip Strength Test (static strength) results in the Swimmers (Sw) and Control (C) groups

	Distribution type	Examination I		Examination II		Examination I vs. Examination II	
		Sw	C	Sw	C	Sw	C
Girls	n	36	49	36	49		
	min - max	1.0-4.0	0.5-5.0	2.5-5.0	1.0-5.5		
	mean	2.0	2.5	3.5	3.0		
	$\bar{X}$ (SD)	2.3 (0.9)	2.5 (0.9)	3.5 (0.8)	3.2 (1.0)		
	ss	0.309		0.220		<0.0001	<0.0001

Sw – Swimmers, C – Control, min – minimum value, max – maximum value,  $\bar{X}$  – arithmetic mean, SD – standard deviation, ss – statistical significance

#### Bent Arm Hang Test – functional strength

Swimmers group displayed statistically significantly better results in Examination I and II in terms of bent arm hang. Examination II proved statistically significant improvement of results in both groups (Sw, C) in comparison with Examination I (Table 8). In Swimming Group, it was in average 3.6s, while in control group: 1.9s ( $p=0.0001$ ) (Fig. 7).

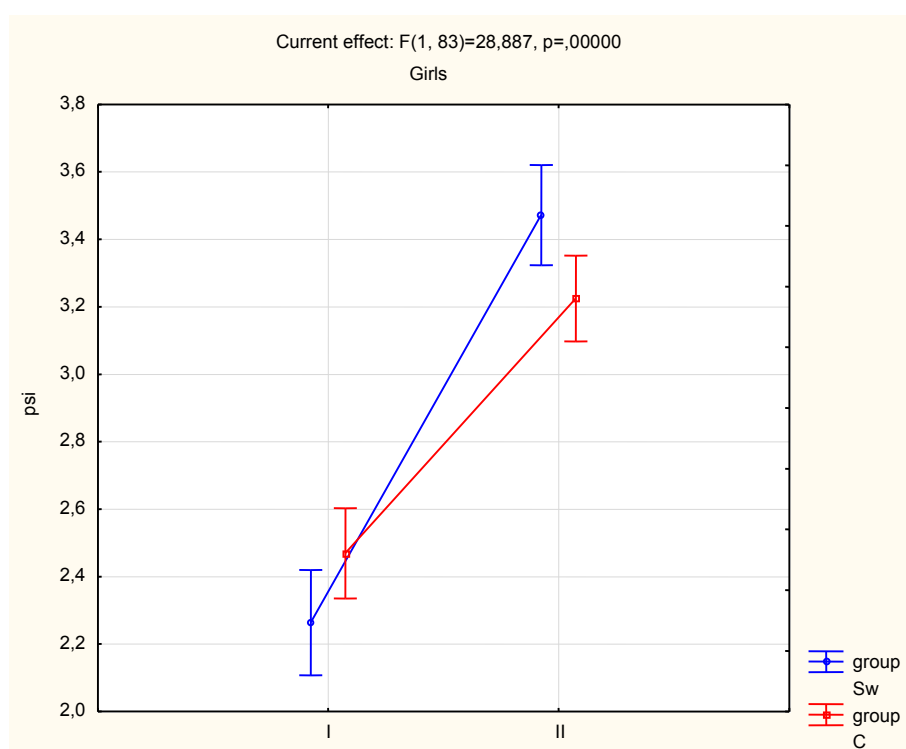
**Table 7.** Descriptive characteristics of Sit-Up Test (torso strength) results in the Swimmers (Sw) and Control (C) groups

	Distribution type	Examination I		Examination II		Examination I vs. Examination II	
		Sw	C	Sw	C	Sw	C
Girls	n	36	49	36	49		
	min - max	6.0-19.0	1.0-21.0	12.0-28.0	7.0-26.0		
	mean	12.5	11.0	18.5	17.0		
	$\bar{X}$ (SD)	12.3 (3.6)	10.7 (4.6)	18.8 (3.7)	16.3 (4.2)		
	ss	0.078		0.006		<0.0001	<0.0001

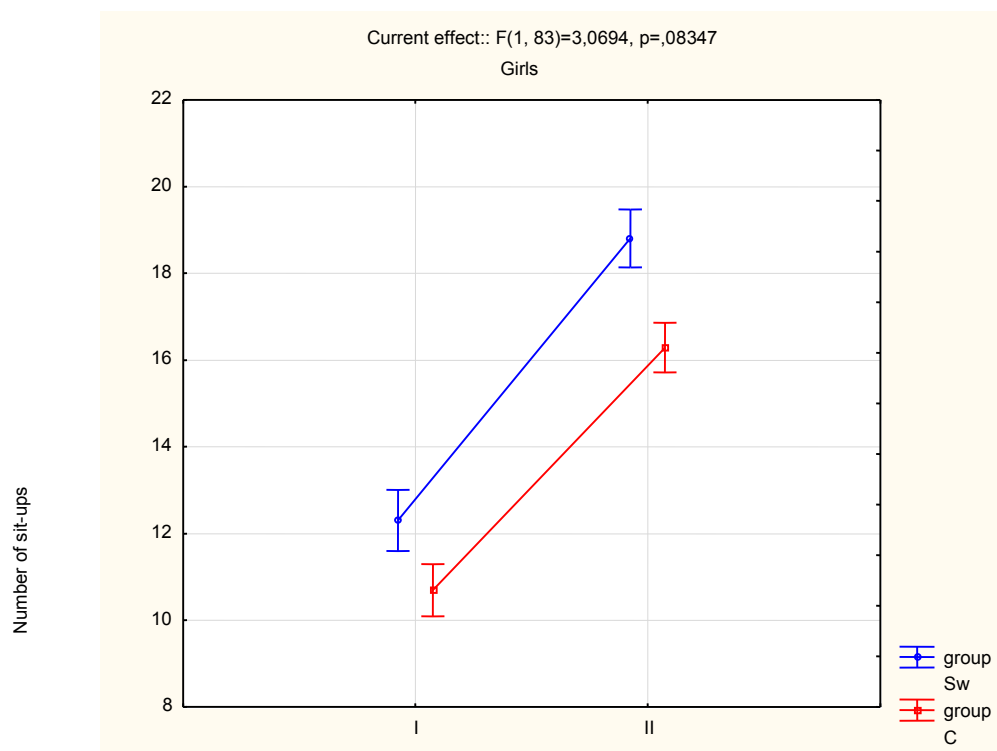
Sw – Swimmers, C – Control, min – minimum value, max – maximum value,  $\bar{X}$  – arithmetic mean, SD – standard deviation, ss – statistical significance

#### 10 x 5m Shuttle Run Test – agility run

In Examination I, average results of Shuttle Run were statistically insignificantly better in Swimmers group, while in Examination II statistical difference was significant. Examination II proved statistically significant improvement of results in both groups (Sw, C) in comparison with Examination I (Table 9). In Swimmers group, it was in average 2.7s, while in Control group it was 2.0s ( $p=0.036$ ) (Fig. 8).



**Fig 5.** Changes of Handgrip Strength Test (static strength) results in the Swimmers (Sw) and Control (C) groups



**Fig 6.** Changes of Sit-Up Test (torso strength) results in the Swimmers (Sw) and Control (C) groups

**Table 8.** Descriptive characteristics of Bent Arm Hang Test (functional strength) results in the Swimmers (Sw) group and Control (C) group

Distribution type	Examination I		Examination II		Examination I vs. Examination II	
	Sw (seconds)	C (seconds)	Sw (seconds)	C (seconds)	Sw	C
n	36	49	36	49		
min - max	1.4-21.1	0.9-20.0	4.9-23.1	3.6-22.2		
mean	9.2	6.4	13.4	7.7		
$\bar{X}$ (SD)	9.2 (4.2)	6.6 (4.1)	12.8 (3.8)	8.5 (3.7)		
ss	0.004		<0.0001		<0.0001	<0.0001

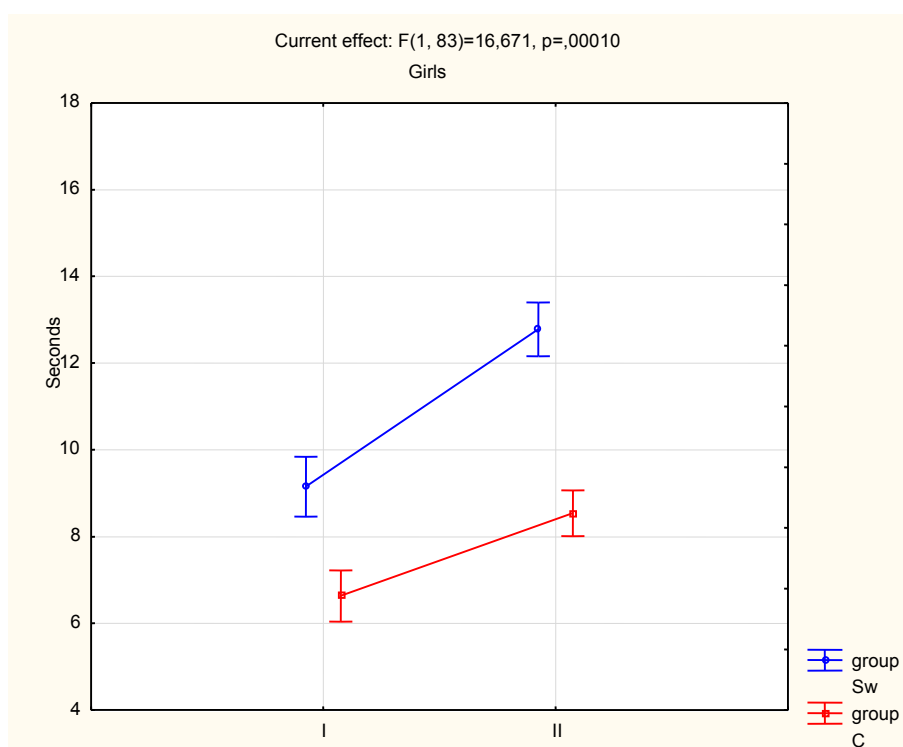
Sw – Swimmers, C – Control, min – minimum value, max – maximum value,  $\bar{X}$  – arithmetic mean, SD – standard deviation, ss – statistical significance

**Table 9.** Descriptive characteristics of 10 x 5m Shuttle Run Test (agility run) results in the Swimmers (Sw) group and Control (C) group

Distribution type	Examination I		Examination II		Examination I vs. Examination II	
	Sw (seconds)	C (seconds)	Sw (seconds)	C (seconds)	Sw	C
n	36	49	36	49		
min - max	20.7-37.4	23.0-34.6	19.2-35.9	21.2-32.5		
mean	26.1	27.2	23.5	25.1		

Distribution type	Examination I		Examination II		Examination I vs. Examination II	
	Sw (seconds)	C (seconds)	Sw (seconds)	C (seconds)	Sw	C
$\bar{X}$ (SD)	26.7 (3.4)	27.8 (3.0)	24.0 (3.0)	25.8 (2.7)		
ss	0.097		0.006		<0.0001	<0.0001

Sw – Swimmers, C – Control, min – minimum value, max – maximum value,  $\bar{X}$  – arithmetic mean, SD – standard deviation, ss – statistical significance



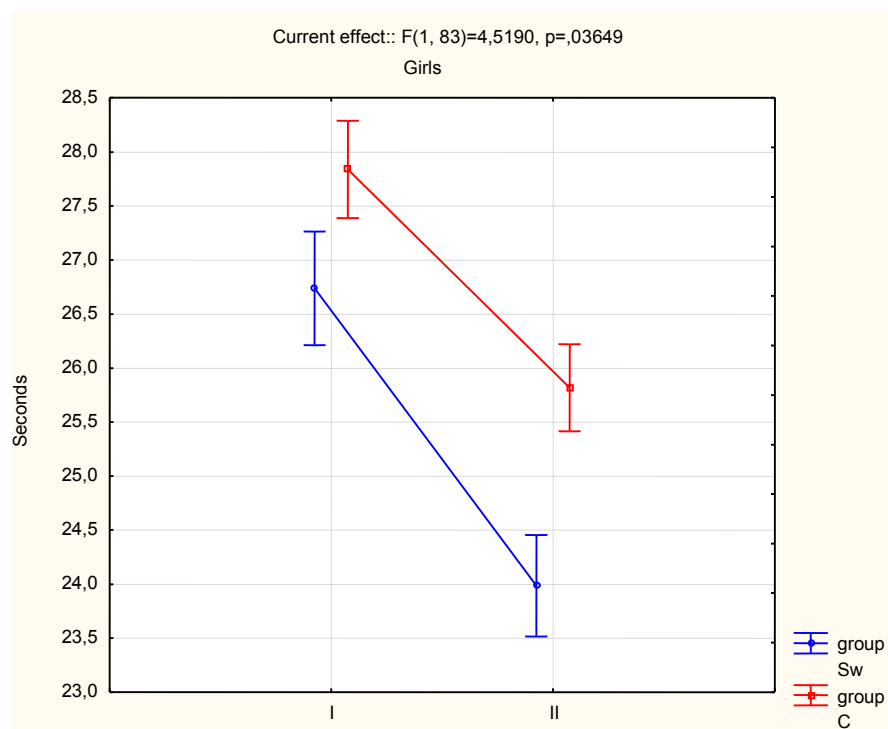
**Fig 7.** Changes of Bent Arm Hang Test (functional strength) results in the Swimmers (Sw) group and Control (C) group

## Discussion

The research revealed changes in both groups (Sw, C) in terms of all eight tests. Examination II proved statistically significant improvement of results in both groups (Sw, C) in comparison with Examination I. Changes between Examination I and Examination II results were most visible in Swimmers groups in terms of balance, agility, static strength, functional strength and agility run. Changes between Examination I and Examination II were similar in both groups (Sw, C) in terms of speed of limb movement, explosive strength and torso strength.

The analysis of statistical data from the EUROFIT Test Battery conducted by the author of this paper proved that increased number of training hours resulted in enhanced motor skills of girls who started their swimming trainings. Other authors' research [Pietrusik 1981, Dziedziczak, Witkowski 1998] also indicated positive correlation between increased number of sports hours/trainings and motor skills of children who trained swimming.

Pietrusik's research [1981] confirmed that girls in swimming groups displayed significant improvements of final results of all physical ability tests (ICSPFT). There were no significant improvements of the examined motor skills (motor qualities) of subjects in control groups. It should be noted that initial stage of school education is the period of significant development of all motor skills [Osiński 2011], and it was confirmed by Denisiuk, Milcerowa's [1969] research, conducted in the 1960s.



**Fig 8.** Changes of 10 x 5m Shuttle Run Test (agility run) results in the Swimmers (Sw) group and Control (C) group

As for this study, Swimmers group did not attain better dynamics of changes in all tests than the peers from Control group (i.e. speed of upper limb movement, agility, explosive strength, torso strength, agility run). It may be explained by specificity of swimming trainings: it was conducted at swimming pool, not at the gym, where strength of young swimmers could be increased more noticeably.

Progressive changes of subjects' motor skills are positive phenomenon in the physical development of a child. During both Examinations (I and II) subjects attended elementary school 1<sup>st</sup> grade, i.e. the first grade of junior school age [Osiński 2011]. School authorities, Physical Education teachers and Integrated Education teachers at Elementary Schools no. 51, 55, 56 and 62 in Szczecin (attended by the subjects from both groups: Sw and C) facilitated development of motor skills by their didactic, sports and recreational activities. Diversified motor and recreational activities provided during PE classes might have significantly influenced the EUROFIT Test results.

During both Examinations (I and II) subjects were 1<sup>st</sup>-graders, therefore their physical condition was at junior school age level, which lasts until puberty (age of 10-12) [Osiński 2011]. During this period, especially when children begin their school education, they must conform to certain requirements, school duties and new environment [Osiński 2011]. According to Przewęda [1981, p. 164] children demonstrate great 'need to blow off steam by physical activity, to satisfy their great «hunger for activity».' Schools (their sports and recreational infrastructure), Physical Education teachers, Integrated (junior age) education teachers influence the quality of motor skills' training. Therefore, Physical Education teacher plays significant role in the process of rising generation's physical development. Participation in organized, regular sports classes results in development of children's motor (physical) skills [Torrance et al. 2007, Chalcarz et al. 2008 Wilk, Eider 2014].

### Conclusions

1. Examination II proved statistically significant improvement of results in both groups (Swimmers, Control) in comparison with Examination I.
2. Comparative analysis of both groups' motor skills confirmed that the dynamic of changes between Examinations I and II was greater in swimming subjects in five tests (general balance, agility, static strength, functional strength, agility run) (Fig. 1, 3, 5, 7, 8).
3. In the remaining motor skill tests (speed of upper limb movement, explosive strength, torso strength) differences in results between Examination I and Examination II were similar in both groups (Swimmers and Control group) (Fig. 2, 4, 6).
4. Progressive changes of subjects' motor skills are positive phenomenon in physical development of a child.
5. Swimming training resulted significantly in positive changes in terms of motor skills of subject who were at initial stage of swimming trainings, compared with their non-training peers.

6. Participation in organized, regular sports classes results in development of children's motor (physical) skills.

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