Original Article

Sexual dimorphism in the level of special coordination ability of swimmers of the Sports Championships Schools

PRZEMYSŁAW STELMACH[1], ŁUKASZ RYDZIK[2] , TADEUSZ AMBROŻY[2]

[1]*Department of Sport Theory and Anthropomotorics, Faculty of Physical Education and Sport, University of Physical Education in Krakow, Poland*
[2]*Institute of Sport, Faculty of Physical Education and Sport, University of Physical Education in Krakow, Poland*

ABSTRACT

Background. Gender differences in the area of motor coordination skills have been the subject of many studies. Differences among school-age children are very often examined. However, reports describing the level of dimorphism in groups characterized by an almost identical lifestyle are less numerous. Objective. Examining the sexual dimorphism in the level of special coordination ability of swimmers of the Sports Championships Schools (SCS). Material & methods. The study was based on tests assessing the coordination motor skills of swimmers (CMS) in the same age group (14-16 years) and at a similar level of sporting performance. Tests were carried out under the same conditions and during the same preparation periods. Results. Based on the conducted research among swimming youth, both boys and girls, the obtained test results in tests measuring the level of special coordination skills clearly indicate a higher level of training these abilities among boys. The smallest differences between the examined groups occurred in the test of balance during rotation. Conclusion. The suppositions of the players' advantage in the trials requiring precision were confirmed. Also, the results showing a stronger dimorphism with a predominance of boys in the energy component are not surprising.
Keywords: Dimorphism; Coordination; Swimming; Sports schools.

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Corresponding author. *Institute of Sport, Faculty of Physical Education and Sport, University of Physical Education in Krakow, Poland. https://orcid.org/0000-0001-7956-7488*
E-mail: lukasz.gne@op.pl
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INTRODUCTION

The effectiveness of training of young swimmers depends on many factors such as: the age of starting swimming and targeted training (Coatsworth and Conory, 2006, Caspersen et al., 2010), the time to reach the best sports results (Donato et al., 2003), training methods (Wallace and Lee, 2010), load dynamics and progress in the swimming technique (Strzała and Tyka, 2009). It should be noted that the demands placed on competitors in the field of technology are increasing (Truijens and Toussaint, 2005).

Motor and technical preparation is decisive for raising the sports level. Reserve search is key at this stage. Experts in the theory of training and anthropomotorics believe that one of them is the formation of coordination motor skills (CMS), i.e. the ability to quickly, accurately, purposefully and economically perform movement (Raczek et al., 2002). Constant increase of sports results imposes the need to involve a growing number of specialists from various fields of science for training work. Theory and practice reveal new lines of action that require detailed analysis, especially in the field of theoretical foundations of sports training. Improving this process creates optimal conditions for the trainer to program and control the effects of work performed (Chatard and Steward, 2011). Swimming is a dynamically developing discipline, which puts new tasks for theoreticians and trainers. They relate to the quality and amount of work done, its impact on young organisms, stimulation and improvement of motor skills as well as the formation of volitional features etc. (Dokumaci at al., 2017). The significance of the discussed issue is reinforced by the fact that specialist training in swimming already covers children. Observation of the level of results in various age categories indicates too passive development already in 11-12-year-olds, where Polish youth begins to stand out from the world leaders. The observed differences lead to reflection on the course of training juvenile swimmers (Raglin et al., 2000). The process of teaching sports skills depends on many factors, including somatic and motor development as well as the proper selection of means and methods of influence - appropriate for age and level of advancement. Therefore, the training of a competitor should be planned and controlled very carefully from the beginning, and especially in the complex of potential body properties that determine the level of motor fitness, where a special role is played by coordination motor abilities (CMS). CMS create opportunities for fast, accurate, purposeful and economical execution of a motor task. In swimming, they determine the ability to assess and regulate dynamic parameters of space-time movements and also express the perfection of such specialized properties as: feeling and developing strength, feeling of time, pace, rhythm, water feeling. They condition every form of motor activity and decide on the effectiveness of the individual's motor activities and behaviours (Jaakkola and Timo, 2017). They determine the speed and quality of motor learning, improvement and stabilization of technical and tactical skills and their appropriate use in relation to the situation and conditions. Therefore, the more habits are mastered by the swimmer the more quickly and effectively he solves the task and his reaction is more adequate to the emerging situation. Systematic monitoring of this process allows you to get the relevant information concerning the quality of the measures and the level of training of students (Raczek et al., 2002). Many authors emphasize the importance of the above fact in sport practice and suggest to trainers that at this stage of training they should focus on shaping the correct technique and movement coordination using the favourable psycho-motor conditions of young organisms (Osiński, 2000, Raczek et al., 2002, Ryguła, 2000). Obtaining positive effects in the process of shaping and improving CMS requires long-term and continuous interactions. Therefore, it is necessary to ensure a year-round coordination improvement process at all stages of sport training (Raczek et al., 2002). The above statements incline to conduct further in-depth research in this area, taking into account the specificity of this sport discipline.

In addition to the natural need to determine the structure of CMS, there is a need to indicate the diversity of its level due to sexual dimorphism of players. The research on dimorphism regarding the coordination aspect is numerous, while its results and conclusions are ambiguous (Lyakh, 2013). It results from the varying

strength of genetic control of each CMA, different test methods for determining the level of all ages tested, and significant impact of environmental factors (including social and economic ones) on their level. It is impossible to ignore the fact that the degree of sexual dimorphism in terms of motority is also influenced by the volume, intensity and type of motor activity (Raczek, 2002). These indicators will look differently among non-training people and different among players. Analysis of the literature in the field of sexual dimorphism of the CMS area allows you to trace the observed trends in their development and severity in each sex (Lyakh, 2013).

The results of numerous works (Lyakh, 2008) analysing the level of spatial orientation capacity often provide us with conflicting data. On the basis of studies of both young people and people practicing sports, some authors write about the clear advantage of girls, while other data describe the clear dominance of boys. More explicit results relate to the level of adaptability. Research by Ladziea (Lyakh, 2008) revealed that boys are superior to girls in their ability to adjust their movements from 7-9 age. Similar trends were found in sports groups e.g. soccer players (Lyakh, 2008) or youngsters practicing handball (Diaczuk, 1994). Observations on the various aspects of balance have a very rich research history. Similarly, to the majority of CMSs, in this case the data are ambiguous.

The undertaken topic was an attempt to empirically verify the above-mentioned problem based on an experiment carried out with swimming class sports students.

MATERIAL AND METHODS

Six groups of swimmers from individual SCS were tested, a total of 112 people: 66 boys and 46 girls. The comparison of results concerned only sex, not individual groups.

Children were tested at the age of 14-16.

All competitors started training at the age of 10, assuming that the first 3 years of elementary school were swimming lessons.

In order to solve the research problem, variables were defined and research tools, techniques and indicators were selected.

The scope of research included:

Assessment of CMS level in water (8 tests)

(*References to the lines in the tables with the results - test number are included in brackets*).

Test 1. Crawl on the chest (time differentiation).
Equipment and aids: stopwatch.
Test description:
The examined person flows a 25m crawl on his chest in full style coordination. Time is measured with an accuracy of 0.01 sec.
25 meters - for 100% possibilities, (8).
25 meters - for 75% of the possibilities, (10).
Result: the result is measured time.

Test 2. Crawl on chest (ability to vary pulling force).
Equipment and aids: quantitative sheet.
Test description:
The examined person flows a 25m crawl on his chest in full style coordination.
We count the number of shoulder work cycles at different swimming speeds and time.
25 meters - for 100% possibilities, (9) (4) (5).
25 meters - for 75% of the possibilities, (11).
Result: The result is the number of cycles measured.

Test 3. Starting jump from the post to the crawl on the chest (reaction speed).
Equipment and aids: stopwatch, tape measure.
Test description:
The examined person stands in the starting position on the post, on the signal he makes a start jump to the crawl on his chest and flows 7.5m on time. Time is measured with an accuracy of 0.01 sec.
Result: The test is repeated twice, the better test time is saved, (7).

Test 4. Flip-side reversion on the breast (reaction speed, spatial orientation ability).
Equipment and aids: stopwatch, tape measure.
Test description:
The examined person stands at a distance of 7.5 m from the reversing wall, the signal arrives at maximum speed with a crawl on the breast to the reversing wall, performs a goat's return - slipping and returns with the crawl to the starting point, i.e. 7.5 m from the wall.
Result: The test is carried out twice in time with an accuracy of 0.01 sec. The time for a better sample is recorded, (6).

Test 5. An attempt to slip (the ability to maintain balance).
Equipment and aids: stopwatch, tape measure.
Test description:
The examined person stands with his back against the reversing wall, on a signal he skips to the crawl / at a distance of 7.5 m from the wall.
Result: The test is carried out twice in time with an accuracy of 0.01 sec. The time for a better sample is recorded. The result is the time obtained, (12).

Test 6. Trial of rotation (ability to maintain balance).
Equipment and aids: stopwatch.
Test description:
The tested person stands on the starting pole, on the signal he jumps into the water on his feet (we turn on the stopwatch), the hands are placed along the torso - then the tested person must as soon as possible take a position lying back on the water at the moment of achieving balance (turn off the stopwatch) - then the player on the signal (turn on the stopwatch) it goes to the supine position along the transverse axis of the body and again when the balance is reached (turn off the stopwatch). Time is measured with an accuracy of 0.01 sec.
Result: The result is the time obtained, (14).

Test 7. Swimming coordination index (ability to combine movement).
Equipment and aids: stopwatch, quantitative sheet.
Test description:

- 25 meters with a crawl on the chest on the shoulders with a small board between the legs - T 25 RR, (1).
- 25 meters with a crawl on his chest and a board, working with his feet alone - T 25 NN, (3).
- 25 meters with a crawl on the chest in full coordination - T 25 crawl, (2).

All tests are measured with a stopwatch with an accuracy of 0:01 sec.
The intervals between attempts are 5 minutes.
Result: The result is the time obtained.

Test 8. 100m result with variable style.
Equipment and aids: stopwatch.
Test description:
Time measurement for 100% possibilities with a variable style over a distance of 100 m.
Result: The result is the time obtained, (13).

Assessment of the CMS level on land (3 tests)
Test 1. Jump from the gym to the goal (The ability of aesthetic differentiation cinemas).
Equipment and aids: gymnastic box, 90 cm high, 1 mattress, measuring tape.
Test description:
The sheet is standing on the crate, on a mattress pushed against the longitudinal side of the crate, a line is drawn at a distance of 1 m parallel to its edge. The tested person first visually assesses the distance to the line and then, blindfolded, tries to jump as accurately as possible from the crate to the line (hit it with heels), the distance from the line of heels to the line on the mattress is measured. After explanation and demonstration, five attempts are made.
Result: The two extreme results are deleted and the final result is the average error in the remaining three jumps expressed in centimetres, (3).

Test 2. Marching on a bench-equivalent gait (Ability to maintain dynamic balance).
Equipment and aids: stopwatch and gym bench.
Description of the test performance:
On the inverted bench strip two lines are separated from each other by 2 m. The tested person puts any foot on the strip in front of one of the lines, after "ready" commands, "start" performs "equivalent gait" for 45s between lines each time exceeding any each of them. He tries three times.
Result: Distance covered (in meters) within 45s, or until you lose balance (touching the ground with your foot), which is the average of the two best trials. Notes: you should march at the optimal (individual) pace, (4).

Test 3. Balance, turnover - (Raczek et al. 2002)
Equipment: stopwatch, gym bench.
Test description:
Tested from the standing position "foot in front of the foot" on the inverted bench strip (width 10 cm) is to make 4 turns (left or right) and return to the starting position.
The test is performed after previous description, demonstration and one attempt. In the event of loss of balance, e.g. touching the ground with one foot, 1 second is added with a stone. If the substrate is touched more than 3 times, the test is repeated again.
The result is a turnover time of 4 expressed in seconds, (2).

Table 1. Table showing the results achieved by the competitors in motor tests.

		Boys			Girls													
	Parameters	Mean	Min	Max	Mean	Min	Max	Diff. of means	Boys' mean (%)	Girls' mean (%) time	Girls' mean (%) quantity	Diff. Of means (%)	Standard deviation (boys)	Standard deviation (girls)	Coefficient of variation (boys)	Coefficient of variation (girls)	Significance (means)	Dimorphism formula
Tests in water																		
1	Arms work (s)	13.88	13.02	14.84	15.36	14.8	16.2	-1.48	100.00	90.35		9.65	1.20	0.28	0.09	0.02	-0.10	-1.24
2	Crawl (s)	11.92	11.08	12.45	13.58	13.1	14.16	-1.65	100.00	87.83		12.17	0.51	0.37	0.04	0.03	-0.20	-3.24
3	Legs work (s)	16.14	14.20	18.14	17.98	17.2	18.4	-1.84	100.00	89.76		10.23	0.07	0.12	0.00	0.01	-0.93	-2.63
4	Number of arms cycles	18.25	18.00	19.00	19.25	18.00	22.00	-1.00	100.00		94.81	5.20	0.27	0.31	0.01	0.02	-0.18	-3.70
5	Number of arms cycles (full coordination)	16.51	16.00	17.00	18.00	17.00	20.00	-1.5	100.00		91.66	8.33	0.38	0.92	0.02	0.05	-0.10	-3.92
6	Reversal (s)	8.61	7.72	9.43	9.37	8.03	11.33	-0.76	100.00	91.89		8.11	0.15	1.27	0.14	0.14	-0.04	-5.07
7	Starting jump (s)	2.36	2.19	2.57	2.18	2.72	2.88	-0.43	100.00	84.57		15.42	0.16	0.06	0.07	0.03	0.08	1.09
8	Time differentiation (s)	11.92	11.08	12.45	13.58	13.1	14.16	-1.65	100.00	87.82		12.17	0.09	0.29	0.01	0.02	-0.37	-3.67
9	Sense of pace of arms work (s)	16.51	16.00	17.00	18.00	17.00	20.00	-1.5	100.00		91.66	8.33	0.49	0.82	0.03	0.05	-0.11	-3.04
10	75% time differentiation (s)	12.96	11.96	13.45	14.98	14.68	15.4	-2.02	100.00	86.49		13.50	0.32	0.06	0.02	0.00	-0.50	-6.32
11	75% sense of pace	15.75	15.00	16.00	17.25	16.00	19.00	-1.5	100.00		91.30	8.69	0.14	1.15	0.01	0.07	-0.09	-1.07
12	Slip (s)	3.52	3.16	3.77	3.94	3.57	4.68	-0.42	100.00	89.27		10.73	0.19	0.07	0.05	0.02	-0.17	-2.22
13	Result 100m medley (s)	60.74	55.14	63.86	68.13	65.48	70.42	-7.39	100.00	89.14		10.85	0.75	0.17	0.01	0.00	-0.77	-9.86
14	balance jump (s)	5.26	4.91	5.83	4.39	4.08	5.08	0.87	100.00	83.40		16.60	0.38	0.18	0.07	0.04	0.16	2.29
Tests in land																		
1	Balance rotation (s)	1.40	0.38	2.88	1.36	0.81	2.07	0.05	100.00	96.61		3.38	0.91	0.45	0.65	0.33	0.00	0.05
2	Kinaesthetic differentiation (cm)	6.00	4.5	7.00	8.38	7.00	11.00	-2.37	100.00		71.64	28.36	0.44	1.43	0.07	0.17	-0.11	-5.40
3	Walk on a bench (m)	63.51	58.00	72.00	44.50	41.00	48.00	19.00	100.00		70.07	29.92	2.08	1.38	0.03	0.03	0.58	9.14

RESULTS

The test results are presented in Table 1. Based on a comparative analysis of 17 CMS indicators, it was found that most swimmers gained a significant advantage over swimmers. Reliable differences in favour of swimmers were not recorded in any of the assessed indicators. The biggest differences in favour of boys were noted in two tests on land, i.e. in the jump test from the chest to the target and dynamic balance - crossing the bench. The smallest differences were recorded in tests for equivalent rotation and the number of work cycles of the arms themselves. Relatively small differences were observed in the tests: the number of arm work cycles in full style coordination, the rate of goat relapse and the sense of pace of arm work. A significant difference in the results in the remaining tests was at the level of up to 15%.

DISCUSSION

Coordination motor skills are integral elements of the motor fitness structure conditioning the efficiency of sporting activities (Marchetti 2015). The process of teaching sports skills depends on many factors, including somatic and motor development as well as the proper selection of means and methods of influence - appropriate for age and level of advancement.

Seems to be well founded, the work undertaken in the analysis of sexual dimorphism of young swimmers.

Based on the results of the above tables, it can be concluded that boys have a higher level of coordination efficiency than girls. This can be influenced by the main physiological factor, which is strength. This is not the only factor that distinguishes this group. There are also differences in the age of the respondents, as well as in the number of years of training. Many other researchers came to similar conclusions, and boys' advantage over girls can be noticed in their studies (Migasiewicz, 2006, Asienkiewicz, 2004, Napierała, 2007).

To sum up, it can be said that as a result of the methodological procedure used, several indicators were identified from various predisposition spheres, with high predictive value regarding the level of professional development of young swimmers. A good predictor of professional development is special coordination assessed on the basis of general and special fitness tests presented in the paper. Therefore, the comparison of dimorphism, verification, diagnosed by means of various trials and tests of abilities and skills should also result from systematic and multi-faceted observations of swimming techniques during sports competitions and training (Kunicki, 2002).

CONCLUSIONS

1. All trials have statistically significant differences in the level of special coordination skills in favour of boys.
2. The biggest differences in the level of efficiency exhibited a special coordination tests relying that the *fall up to the passage of the strip and benches.*
3. As expected, the level of boys 'fitness and coordination is higher than the girls' level of fitness and coordination.
4. Contrary to the assumptions in the water, the level of girls 'special fitness and coordination did not prove to be higher than the level of boys' fitness and coordination. The result was to be influenced by factors such as greater accuracy of movements and more economical work in water. The girls obtained better results only in two attempts.

AUTHOR CONTRIBUTIONS

Przemysław Stalmach: Study design, data collection, statistical analysis, manuscript preparation, funds collection. Łukasz Rydzik: Study design, statistical analysis, manuscript preparation. Tadeusz Ambroży: data collection, manuscript preparation.

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