CHANGES IN THE LEVEL OF FITNESS AND PHYSICAL DEVELOPMENT IN CHILDREN FROM FIRST-GRADE SWIMMING CLASSES COMPARED TO PEERS

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Key words: sports class, swimming, physical fitness, International Physical Fitness Test, physical development, training children, non-training children

Abstract

Aim. Determining the values of changes in fitness and physical development of children from first-grade "swimming classes"¹ compared to general classes.

Material and methods. The study included two groups of children attending the first grade – the first were children “training swimming”² (including 26 boys and 23 girls), the second – non-training children (including 26 boys and 23 girls). Children admitted to the first swimming class underwent the program of “classes with an extended physical education program for children gifted with motor abilities”, in which apart from the physical education classes resulting from core curriculum, they also attended systematic swimming lessons – four hours a week. In both groups, selected International physical fitness test trials were conducted in September and June. The results were focused on the following aspects: results obtained by boys and girls which constitute sexual dimorphism, determination of differences and their direction between groups and gender in the first and second test.

Results. In the group of children “training” swimming, there were no statistically significant differences in physical development. In the “non-training”³ group, statistically significant differences in body height were found – only in the first test (b-120.30, g-117.86) and body mass both in the first (b-24.57; g-21.22) and second test (b-26.80, vs. g-22.83). In the assessment of physical fitness in the group of children subjected to systematic swimming classes, differences between boys and girls were found in the following: standing long-jump (only in the first test; b-151.65, g-134.96); hand strength measurement (only in the first test; b-23.5 test, g-19.36); bent arm hang both in the first (b-13.40, g-7.70) and second test (b-14.46, g-6.31); forward bend only in the first test (b-5, g-1,34); 4x10m run both in the first (b-14.54, g-15.23) and second test (b-13.66, g-15.11). However, in the control group: standing long-jump (also only in the first test; b-107.78; g-95.88); hand strength measurement in both the first (b -12.09, g-12.77); bent arm hang (only in the first test; b-8.21, g-3,02); forward bend (b-2.43, g-1.30), as well as in the second test (b-3.30, g-2.19).

¹ The authors used the term “swimming class” – resulting from the functioning of such terminology at school, taking into consideration that these are classes with extended programmes of Physical Education for children gifted in motor abilities.

² In the work, the term children “training swimming” was used in order to more easily distinguish those who were selected (as a result of selection) for the first grade swimming class from those accepted to general classes. However, the authors consider the fact that this group of children, going to the first swimming class, undergo systematic swimming education (pre-selection).

³ The term “non-training” children was used in the work to identify children from general classes.
**Conclusions.** In both groups, for both boys and girls, statistically significant changes in physical development were observed, which is a normal sign of growth, but only in the group of girls was there a statistically significant increase in the BMI index. When assessing the impact of increased physical activity of children attending swimming-profiled classes, it can be concluded that in the boys’ group, this positively influenced the results obtained in such attempts as: bent arm hang and sit ups from supine position. On the other hand, among girls: this was positively affected only in sit ups from supine position trial. In the group of girls, it was also noticed that although the “training” individuals obtained a significantly better result in the bent arm hang in the first test, in the second one, they achieved a weaker result, while the non-training girls achieved statistically significantly better results in the second rather than the first test. Conducting a proper pre-selection for swimming should be based on existing scientific premises. Achieving “sports championship” is not only the result of proper work during practice, but to a large extent, properly conducted pre-selection and selection at all stages of swimming training so that candidates and swimmers can fully utilize their psychological-physical abilities and swimming training.

**Introduction**

Planning training for children and youth in competitive sport requires taking all actions (including recruitment to sport, ‘stageization’, skilful adjustment of training to the laws of biological development), which should be subordinated to the general premises resulting from “uniform treatment of the whole process” [1, p. 24]. Achieving sports championship requires “meeting certain conditions in the field of: somatic build, energy and regulatory functions of the system, properties of the psyche, profile and level of physical fitness, technical and tactical skills (…). Some of these factors are to a large extent genetically determined (…)” [1, p.51]. Therefore, the search for candidates concerning relevant sports disciplines that meet the above expectations becomes an important aspect. The selection of candidates as future champions and the selection for swimming, alike any discipline, can be natural, intuitive or directed [1, 2, 3]. Thus, what should the guiding principle be and on the basis of which features should future swimming champions among the many willing candidates be determined? According to Bulagowa and Woroncowa, the basis for forecasting swimming skills is the stability of those traits that “do not succumb to the influence of training and are largely determined by hereditary factors (…)” [4, p. 39]. On the basis of many years and long-term research, the authors have identified the following factors characterized by greatest stability: skeletal dimensions, mobility index in the ankle joint and the results of swimming medium and long distances [4]. Sozański (1999) also states that at the beginning, healthy children and those interested in sport should be distinguished, and only then is it time to recognize “specific talents and properties desirable in a given discipline” [1, p. 50]. These are such elements as: health condition, consent of a parent or guardian and willingness to participate in classes or great commitment - these were the most frequently used and often the only forms of selection and choice in swimming at various stages of training [5]. Children admitted to “first-grade swimming classes” should start their adventure with sport from general (versatile) training. The task of the first stage is: to arouse interest in the sport of swimming, to recognize the abilities specific for sport in water, to equip with as many skills needed in water, to increase aerobic capacity of the body, and to increase the mobility of the articular-ligament apparatus [6].

On the basis of a literature review, the authors undertook analysis of the recruitment procedure for swimming classes in Bydgoszcz and assessed whether the admitted candidates differed significantly from children at the same age from general classes, and whether the basic tasks of the comprehensive stage (increased number of physical activities) had impact on increasing the fitness level of candidates for future swimming champions after one year of classes.

**Research questions**

1. What kind of selection for swimming classes is implemented in Bydgoszcz?
2. Are there differences in the level of somatic development and physical fitness between children admitted to swimming and general classes resulting from the selection process?
3. Does increased physical activity, realization of tasks at the comprehensive stage, favourably affect the physical fitness of swimmer candidates?

**Hypotheses**

1. Children are accepted to swimming classes on the basis of their state of health, the consent of their parents (guardians) and fitness tests.
2. Children admitted to swimming classes subjected to the selection process (fitness tests) are characterized by better physical fitness during the first test.
3. After a year of comprehensive training (including an increased number of hours of systematic swimming lessons), these children will achieve better results in the assessment of physical fitness than those from general classes.
Material and Methods

Document analysis was used to assess the type of selection for swimming classes in Bydgoszcz. Requirements regarding the recruitment process available to candidates were analysed.

The study involved two groups of children from first-grade classes – the first: children training swimming (including 26 boys and 23 girls), the second: non-training children (including 26 boys and 23 girls). Physical development, based on height, body mass and BMI, was assessed in both groups. Somatic development of the children was determined on the basis of anthropometric measurements in accordance with the applicable rules. The following were examined: body height (basis – vertex) – measurement using anthropometer, and body mass. For the measurements, subjects stood in so-called anthropometric position (standing position, free upright, upper limbs hanging freely along the trunk, hands straightened, lower limbs straightened and joined, slightly stride position). Body mass was assessed by weighing the participants on a medical scale in a standing position [7, 8]. The obtained results of height and body mass measurements were used to determine the Quetelet II i.e. relative body mass – BMI (Body Mass Index) [7].

The BMI was calculated according to the formula: 

\[
BMI = \frac{\text{body mass (kg)}}{\text{body height (m)}}
\]

In order to assess physical fitness, selected International Physical Fitness Test tests were carried out:

- standing long jump,
- hand strength measurement,
- relative strength measurement – bent arm hang,
- shuttle run 4 x 10-m,
- sit ups from supine position in 30 s,
- forward bend.

The study was carried out at two dates, at the beginning of the 2016/2017 school year (September) and at the end of the 2016/2017 school year (June). All tests were carried out in accordance with the applicable procedure [9].

The examined children attended schools with similar sports infrastructure (swimming pool, large and small gymnasiums, outside pitch). The swimming-class children attended compulsory sports classes at the swimming pool 4 x 45 minutes per week.

The obtained BMI score was compared to the results achieved by Woynarowska [10] and contained in the table below, which defines the norm of body mass, its deficiency, overweightness or obesity.

In order to present the obtained results, figures were made, and statistically significant differences were marked with an arrow (✓).

While analysing the results, focus was placed on three aspects – the assessment of sexual dimorphism among training and not training children in the first and second test. Furthermore, are there any statistically significant differences, and what is the direction in the assessment of physical fitness in the group of training and non-training children in the first and second tests? And are there statistically significant differences and what is the direction between training and non-training boys and girls in the first and second tests? The collected material was subjected to statistical analysis using STATISTICA PL by StatSoft [11]. The Mann-Whitney U test was used to assess the significance of differences (the variances between boys and girls in the first and second tests in the group of children attending the swimming class and control group), and to assess the differences between the first and second tests in the group of boys and girls attending the swimming class and mass class, using the Wilcoxon signed-rank Z- and T-tests (the differences between the first and second tests in boys and girls in the group of children attending the swimming class and control group).

Results

In the area of Bydgoszcz, children are accepted to swimming classes on the basis of their state of health, consent of their parents/guardians, swimming skills tests (degree of acquaintance with water), and in the case of some, physical fitness tests are additionally carried out.

The results of our own research regarding the level of physical development and fitness are presented below in the form of figures (1-14), and the arrow (✓) indicates statistically significant differences between studied the groups. Figures 1-4 present the results of the assessment of differences between boys and girls in physical development and fitness resulting from sexual dimorphism regarding the first and second study in the

<table>
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<th>age years</th>
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(source: Woynarowska [19])
group of children training and non-training swimming; in the next two (5-6), body mass norm, deficiency, overweightness or obesity with regard to sex in both groups are shown; Figures 7-10 – comparison of the results of somatic development assessments and physical fitness of training boys and girls, as well as boys and girls not training during the first (September) and second (June) test; in the last four figures (11-14) – differences in somatic development and physical fitness between the training and non-training children were presented.

On the basis of statistical analysis concerning the difference in sex distributions in the groups of children from the...
swimming and control classes, no differences were found. Statistically significant correlations are marked on the graph using arrows (✓).

In comparable groups of training and non-training children, no differences in gender distribution were found. In the group of children training swimming, there were no statistically significant differences in physical development (body height, body mass, BMI) between boys and girls both during the first (body height: boys - 122.79, girls - 124.70, body mass: boys - 23.51, girls - 24.56, BMI: boys - 15.57, girls - 15.76), as in the second test (body height: boys - 125.35, girls - 127.28, body mass: boys - 25.21, girls - 26.66, BMI: boys - 15.78, girls - 16.72) (Fig. 1).

In the non-training group, there were statistically significant differences between boys and girls in body height - only in the first study were the boys much taller than the girls (boys - 120.30, girls - 117.86) and body mass both in the first (boys - 24.57, girls - 21.22) and second test (boys - 26.80, girls - 22.83), the boys turned out to be heavier (Fig. 2).

In the assessment of physical fitness among the group of training children, sexual dimorphism was found in: standing long jump (only in the first test: boys - 151.65, girls - 134.96); hand strength measurements (only in the first test: boys - 23.5, girls - 19.36); Bent arm hang in the first (boys - 13.40, girls - 7.70) and second test (boys - 14.46, girls - 6.31); forward bend (only in the first test: boys - 5, girls - 1.34); 4x10 m shuttle run (both the first: boys - 14.54, girls - 15.23 and second test: boys - 13.66, girls - 15.11) (Fig. 3). While in the control group: standing long jump (also only in the first test: boys - 104.78, girls - 95.88); measurement of hand strength (both in the first: boys - 18, girls - 12.26 and in the second test: boys - 12.09, girls - 12.77); bent arm hang (only in the first test: boys - 8.21, girls - 3.02); forward bend (both in the first: boys - 2.43, girls - 1.30 and second test: boys - 3.30, girls - 2.19) (Fig. 4).

Based on the standards for the BMI index according to Woynarowska [10], it was found that both boys and girls from both groups were characterized by normal body fatness. In the assessment of obesity, among the group of children training swimming, the majority of children admitted to the swimming class had normal body mass (92% boys and 83% girls), no one was overweight or obese, and at the end of the school year (June), 85% boys and only 57% of girls displayed normal body mass. In the second test, the percentage of overweight children increased - 8% boys and 26% girls (Fig. 5). Among non-training children, in the first test, 87% of boys and 85% of girls were of normal mass, 13% of boys were obese and 15% of the girls were overweight. During the second test (June), the percentage of children with normal body mass decreased among boys and girls, the percentage of overweight boys increased by 9%, and in girls, the number of overweight girls increased by 19% (Fig. 6).

Comparing the results, the physical development (body height and mass, BMI) scores obtained by the subjects in the first (September) and second (June) test, we found statistically significant changes in physical development among both groups for boys and girls (increase in height and body mass) (Fig. 7 and 8). Only in both training and non-training girls was there a statistically significant increase in BMI found during the second test (training girls - 15.76; 16.72, non-training girls - 15.08; 15.26) (Fig. 7 and 8).

When assessing the level of motor skills between the first and the second test, the positive effect of swimming training on the majority of the assessed trials was noticed. Both boys and girls training swimming improved their performance in five out of six trials, and in three, statistically significant differences were noted. Boys and girls significantly improved their results in the following tests - hand strength measurement (boys: test I - 23.5, test II - 28.88, girls: test I - 19.36, test II - 27.17), sit up from supine position in 30 s (boys: test I - 14.04, test II - 19.81, girls: test I - 11.26, test II - 19.95), boys - 4x10 m shuttle run (test I - 14.54, test II - 13.66), girls - forward bend (test I - 1.35, test II - 3.26). A statistically significant reduction was observed for both groups in the explosive strength of the lower limbs (standing long jump) (boys: test I - 151.65, test II - 127.54; girls: test I - 134.96, test II - 119.35) (Fig. 8). The non-training boys improved their results in three trials, including one which was statistically significant - hand strength measurement (test I - 18.96, test II - 27.09), girls - in five, including two significant ones - standing long jump (test I - 95.88, test II - 107.5) and bent arm hang (test I - 3.02, test II - 4.96).

Among those non-training, the children obtained weaker results in the second test: boys in two attempts assessing muscle strength - bent arm hang (test I - 8.21, test II - 4.66) and sit ups from supine position in 30 s (test I - 12.26, test II - 10.09), in the assessment of agility (test I: - 2.43, test II: - 3.3) they achieved weaker results, but the difference was not statistically significant; girls in the assessment of abdominal muscle strength (test I - 1.77, test II - 10.31), however, this difference was not statistically significant (Fig. 10).

Figure 11 presents a comparison of the results of body height and mass, BMI and the results obtained in individual International physical fitness test trials by boys who were accepted into swimming classes and boys starting their studies in mass classes. On the basis of analysis of results, no statistically significant differences in physical development were found, while in the assessment of physical fitness, boys who started studies in the sports class obtained significantly better results in only three attempts - standing long jump (swimming class - 151.65; mass class - 107.78), forward bend (swimming class: 5, mass class: 2.43) and the 4x10 m shuttle run (swimming class - 14.54, mass class - 16.14). In the other trials, differences were not statistically significant (Fig. 11). In the second test (June), the results of the physical devel-
Figure 3. Differences in results obtained during International physical fitness test attempts for boys and girls training swimming in the first (September) and second (June) test

(statistically significant difference – p < .05; I – first test (September), II – second test (June))

Figure 4. Differences in results obtained during International physical fitness test attempts for boys and girls not training swimming in the first (September) and second (June) test

(statistically significant difference – p < .05; I – first test (September), II – second test (June))
Figure 5. Underweight, normal, overweight and obese body mass norms in children training swimming in the first and second test  
I – first test (September), II – second test (June)

Figure 6. Underweight, normal, overweight and obese body mass norms in children not training swimming in the first and second test  
I – first test (September), II – second test (June)
Figure 7. Comparison of results regarding somatic development in girls and boys training swimming in the first (September) and second (June) test
(✓) – statistically significant difference – p < .05; I – first test (September), II – second test (June)

Figure 8. Comparison of the results regarding physical fitness in boys and girls training swimming in the first (September) and second (June) test
(✓) – statistically significant difference – p < .05; I – first test (September), II – second test (June)
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**Figure 9.** Comparison of results regarding somatic development in girls and boys not training swimming in the first (September) and second (June) test

(✓) – statistically significant difference – p < .05; I – first test (September), II – second test (June)

**Figure 10.** Comparison of the results regarding physical fitness in boys and girls not training swimming in the first (September) and second (June) test

(✓) – statistically significant difference – p < .05; I – first test (September), II – second test (June)
Discussion

Swimming belongs to so-called early sports [1, 4, 12-14], which means that the initial training of swimmers starts already in first grade [12-14]. Selection for the swimming class is based on the results obtained during entrance exams. In literature on the subject, the main prospective parameters defining a child’s abilities are length features (body height, length of trunk and limbs) [1, 4, 12, 14]. In reference to the above premises, the selection of the tested "swimmers" seems to be incorrect, since the children were accepted to the "swimming class" on the basis of swimming fitness tests and physical fitness on land. However, the condition was met that healthy and the most efficient children were accepted from among the candidates, perhaps the future champion hidden among them.

In the assessment, differences between boys admitted to the "swimming class" and the control group are small, while among girls, swimmers turned out to be significantly taller than their peers. Different results were obtained by Pietrusik, the examined seven-year-olds obtained opposite values, the girls from the control group and the boys from the swimming group turned out to be taller and heavier in both tests [15]. There are only a few studies regarding the comprehensive stage, most often the assessment or comparison of body build and physical fitness between the training and non-training groups of swimming concern older children [14, 16, 17, 18, 19, 20].

In the assessment of physical fitness, between the first and the second test, statistically significant differences were found in four trials among the training boys - three positive and one negative, while only one positive and two negative were found among the non-training boys. In training girls, positive changes were also observed in three trials and one negative, as in boys, while in non-training girls, only two positive changes were found. In similar studies conducted among first-graders, the author noted a statistically significant difference in all trials evaluating physical fitness [21]. In studies conducted among older children, a similar direction of changes was also noted [15, 17, 19].

All systematic physical activity is conducive to proper development, and the universal benefits of sports for children are widely known and often emphasized in scientific research. Movement is a factor having wide-ranging impact on the body. Swimming is also included in this general trend, where based on the review of literature and the authors’ research, it was found that the positive effect of increased motor activity on motor fitness is already visible at the first-grade level.

Verifying the assumed hypotheses, not all have been completely confirmed. In the assessment of physical fitness, candidates from the swimming class obtained statistically significantly better results in the assessment of somatic development and in three attempts to assess physical fitness (standing long jump, hand strength measurement, bent arm hang). In two, they obtained better results but were not statistically significant (forward bend, 4x10 m run). In one, the results were weakest – sit ups from supine position. The boys achieved statistically significantly better results in only two trials (bent arm hang, forward bend). In the assessment of physical development, they turned out to be taller and lighter, but the differences were not statistically significant.
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Figure 11. Comparison of results regarding somatic development and physical fitness assessment in boys training and not training swimming in the first (September) test

(✓) – statistically significant difference – p < .05

Figure 12. Comparison of results regarding somatic development and physical fitness assessment in boys training and not training swimming in the second (June) test

(✓) – statistically significant difference – p < .05
Figure 13. Comparison of results regarding somatic development and physical fitness assessment in girls training and not training swimming in the first (September) test

(✔) – statistically significant difference – p < .05

Figure 14. Comparison of results regarding somatic development and physical fitness assessment in girls training and not training swimming in the second (June) test

(✔) – statistically significant difference – p < .05
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In the second study, the female swimmers turned out to be better in all trials assessing physical fitness, including three which are statistically significant (standing long-jump, hand strength measurement, and sits from supine position). In the final results, what seems interesting is the decrease in distance regarding the assessment of functional strength, between groups and among the girls training swimming, there was a decrease in this strength (statistically non-significant), while among those not training, there was a statistically significant increase in this strength. When assessing boys, a positive effect of increased physical activity was found, boys training swimming obtained better results of physical fitness assessment in all the assessed trials (standing long jump, bent arm hang, forward bend, sit ups from supine position, 4x10 m run), and five of them were statistically significant (standing long jump, bent arm hang, forward bend, sit ups from supine position, 4x10 m run).

Conclusions

- Fitness tests are not a reliable tool for selection in swimming, however, good physical fitness and lack of fear of water may be a good start to pre-selection.
- In both groups of boys and girls there were statistically significant changes in physical development (height and body mass), which is a normal sign of growth, but only in the group of training and non-training girls was there a statistically significant increase in BMI.
- In the assessment of physical fitness, between the first (September) and second (June) test, statistically significant differences were found in four trials among the training boys – three positive (hand strength measurement, sit ups from supine position in 30 s, 4x10 m run) and one negative (standing long jump), while among the non-training boys, there was only one positive difference (hand strength measurement) and two negative ones (bent arm hang and sit up from supine position in 30 s). In the training girls, positive changes were also observed in three trials; similarly to boys, in two tests (hand strength measurement, sit ups from supine position within 30 s) and in the forward trunk bend, and one negative, as in the boys, for the standing long-jump, while in the non-training girls, only two positive changes were found (standing long-jump, pull-ups with bent arms).
- Statistically significant differences in physical development between training and non-training children were only found in the group of girls – in both tests the training girls turned out to be taller and heavier than the non-training females, and in the second test, they had a higher BMI index.
- In the assessment of functional strength, there was a noticeable decrease in the distance between the assessed groups of girls. Among the females training swimming, there was a decrease in this strength (statistically insignificant), while among those non-training, there was a statistically significant increase in this strength.
- In assessing the explosive strength of the lower limbs (standing long jump), the training children achieved significantly weaker results in the second test, while the non-training children achieved better results in the second one test than in the first one; non-training girls achieved statistically better results.
- In the assessment of shoulder girdle strength (bent arm hang), the training boys obtained better results in the second measurement than in the first one, while the girls achieved weaker outcomes – these results were not statistically significant. However, in the group of non-training children, the opposite occurred. The boys in the second test achieved weaker results than in the first one, the girls were better and in both groups, the results were statistically significant.
- When assessing the increased amount of physical activity and its impact on physical fitness, it can be stated that in the boys’ group, it positively influenced the strength tests (bent arm hang and sit ups from supine position) – only in the second attempt did the boys training swimming obtain better results. In the remaining attempts, there were no statistically significant differences for both the first and the second test. However, among girls, the positive effect of increased physical activity was found only in the test evaluating abdominal muscle strength (sit ups from supine position).
- Conducting proper pre-selection for swimming should be based on existing scientific premises, however, among the children admitted on the basis of good health, willingness and good physical fitness, a future “swimming champion” candidate may be hidden.
- Achieving “sports championship” level is not only the result of proper work at practices, but to a large extent, the properly conducted pre-selection and selection at all stages of swimming training so that candidates and swimmers can fully utilize their psycho-physical abilities and swimming training.
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