

Benchmarking of Anthropometric Indicators Based on Swimming Activities

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Abstract: The study aimed to evaluate the level of motor development, based on the monitoring of anthropometric indicators: height, weight, and chest circumference by organizing systematic swimming lessons for children in the initial stage of the basic educational level. The benchmarking analysis of the learning results was carried out within one academic year. The subject of the analysis is the influence of primary swimming training on children's health condition and motor development in the initial stage of the basic educational level. The object of research is the dynamics of anthropometric indicators in the process of swimming training, as well as the tracking of specific indicators measured with objective instruments, their systematization, and analysis. Scientifically based conclusions will allow us to establish the influence of motor training of students on the dynamics of their anthropometric indicators: height, weight, and chest circumference through systematic swimming activities. An analysis of the dynamics through mathematical-statistical processing was applied to derive the interrelationship between the indicators.

Keywords: motor development, benchmarking analysis, anthropometric indicators, training swimming activities

Ключови думи: двигателно развитие, бенчмаркинг-анализ, антропометрични показатели, учебно-тренировъчни плувни занимания



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INTRODUCTION

The question of the morphological and functional features of the growing organism has excited scientists since ancient times. The growth and development of the human organism is a process in which quantitative accumulation (increase in the number of cells, body mass, and body proportions) leads to new structural and functional changes^{1, 2, 3}. Changes occur in the biological composition and structure of muscle tissue. The properties of the neuromuscular apparatus in the process of growth are constantly being improved. The rate of growth and development of the body as a whole and of its organs and systems is different. Certain dynamics in the rates of growth and development of the organism are observed, expressed in periods of increased

¹ Angelova 2023: 420-424.

² Angelova 2021: 29-32.

³ Angelova 2021a: 654-658.

and periods of slow growth^{4, 5, 6}. In the periods of delayed growth, qualitative changes are made at the structural level in the composition and functions of the organism, and changes are being prepared, ensuring a new quantitative increase of the structural elements^{7, 8, 9}. This general biological law of gradual and uneven development is the result of inherited prerequisites the influence of the environment and the influence of endocrine glands^{10, 11, 12}.

The sports-pedagogical practice is based on anatomical, physiological, and psychological features in childhood and school age, conditionally divided into the following periods:

- o preschool age (3-6 years);
- o primary school age (7-11 years);
- o secondary school age (12-16 years);
- o upper school age (17-19 years).

The subject of the present study is primary school age (7-11 years).

METHODOLOGY

The study aimed to determine the level of motor development, based on monitoring the dynamics of anthropometric indicators: height, weight, and chest circumference by organizing systematic swimming lessons for students in the initial stage of the basic educational level. A benchmarking analysis was carried out in the conditions of the educational and training process in the level of motor development from the end of the school year. The subject of the analysis is the dynamics in the indicators and the influence of initial swimming training, on the health condition and motor development of 7-8-year-old students, between the collected empirical data from the beginning of the research period and their comparison with empirical data from the end of the research period. Scientifically based conclusions will allow us to establish the influence of motor training of students on the dynamics of anthropometric

indicators, through systematic swimming activities. From 01.09.2023 to 01.05.2024, the motor potential was measured at the initial stage of a basic educational degree swimming training activities. Organized swimming sessions were held three times a week. The program includes the study of preparatory exercises preceding swimming training in the swimming styles of crawl, back crawl, and breaststroke in elements and coordination. Basic, auxiliary, and additional exercises are provided. If mistakes are made when learning basic, auxiliary, and additional exercises, the program includes corresponding exercises for their elimination and correct learning. Each workout lasts forty-five minutes. Venue – covered swimming pool *V-Gym Fitness & SPA* – Sofia. The studied contingent was divided into two target groups:

- ⊗ Control group – who are not subjected to systematic swimming activities;
- ⊗ Experimental group – who will be engaged in systematic swimming activities based on initial swimming training.

RESULTS

A study was conducted with thirty children from the first grade of a metropolitan school aged 7-8 years, who were divided into two groups Control and Experimental for the study. The experimental group was trained according to a standard methodology approved and developed for the study, applicable to the requirements of initial swimming training. The control group of students did not participate in swimming activities. The motor load for them takes place only in the hours provided for the subject of physical education and sports and established by the curriculum. The study aimed to trace the dynamics of their anthropometric parameters by establishing and comparing the changes that occurred in the growth of the

⁴ Dimitrova 2020: 143-149.

⁵ Dimitrova 2019: 143-149.

⁶ Dimitrova 2019a: 36-39.

⁷ Ignatova & Iliev 2023: 08-14.

⁸ Ignatova 2018: 207-212.

⁹ Ignatova 2021: 867-873.

¹⁰ Nesheva 2023: 560-572.

¹¹ Nesheva 2023a: 231-235.

¹² Nesheva 2022: 22-27.

results of the motor tests conducted to establish changes in the motor capacity of the students. The main method for realizing the goal and achieving the tasks in the present study is the use of specialized, scientific-methodological literature. From a large number of morphological and functional signs for evaluating the motor

development of adolescents, different criteria are applied for each age. In the current study, the emphasis falls on one main group of indicators for establishing changes in motor capacity, namely tracking the dynamics of anthropometric indicators, in particular – height, weight, and chest circumference.

Table 1. Anthropometric indicators

| № | Indicators | Units of measurement | Accuracy of measurement | Direction of increase |
|----|-------------|----------------------|-------------------------|-----------------------|
| 1. | Height | Centimeters | 0,5 | + |
| 2. | Body mass | Kilograms | 0,1 | +/- |
| 3. | Chest girth | Centimeters | 0,5 | + |

Quantitative and qualitative analysis of anthropometric indicators

For the study, anthropometric measurements were carried out to establish the current state of motor development of the tracked research contingent, and to establish

dynamics in the data of the studied indicators, as a consequence of the applied swimming training methodology. The results of the applied variation analysis for anthropometric indicators of the two target groups are presented in Tables 2 and 3.

Table 2. Anthropometric indicators CG – beginning

| № | Height/cm | Body mass/kg | Chest girth/cm |
|-----|-----------|--------------|----------------|
| 1. | 134 | 25 | 61 |
| 2. | 125 | 35 | 74 |
| 3. | 124 | 24 | 58 |
| 4. | 118 | 20 | 59 |
| 5. | 124 | 20 | 56 |
| 6. | 128 | 24 | 59 |
| 7. | 126 | 30 | 64 |
| 8. | 142 | 47 | 78 |
| 9. | 120 | 20 | 59 |
| 10. | 137 | 38 | 71 |
| 11. | 116 | 18 | 57 |
| 12. | 129 | 25 | 60 |
| 13. | 144 | 50 | 81 |
| 14. | 128 | 29 | 63 |
| 15. | 128 | 23 | 56 |

Table 3. Anthropometric indicators EG – beginning

| № | Height/cm | Body mass/kg | Chest girth/cm |
|-----|-----------|--------------|----------------|
| 1. | 132 | 25 | 61 |
| 2. | 125 | 36 | 75 |
| 3. | 127 | 24 | 58 |
| 4. | 120 | 22 | 58 |
| 5. | 124 | 21 | 55 |
| 6. | 127 | 23 | 55 |
| 7. | 126 | 30 | 64 |
| 8. | 137 | 47 | 78 |
| 9. | 120 | 20 | 59 |
| 10. | 137 | 38 | 71 |
| 11. | 116 | 18 | 57 |
| 12. | 128 | 24 | 59 |
| 13. | 143 | 50 | 80 |
| 14. | 127 | 29 | 63 |
| 15. | 128 | 25 | 57 |

It can be seen from Chart 1 and Chart 2 that the indicators of height, weight, and chest circumference define the control and experimental groups as homogeneous. No difference was observed beyond the standard

deviations. The following diagrams give us a clear idea that the research contingent of the experimental group started systematic swimming lessons with similar values of anthropometric indicators to the contingent of the control group.

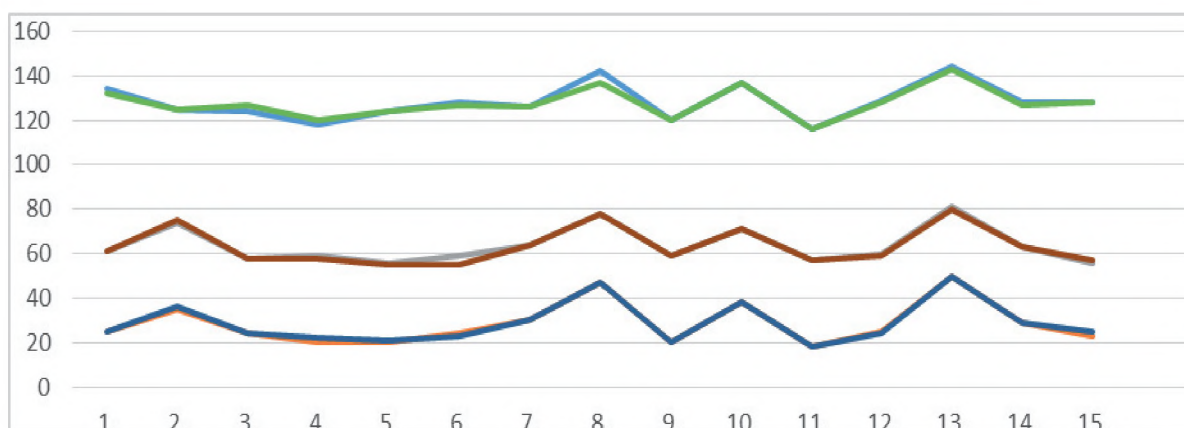


Chart 1. Anthropometric indicators – differences.

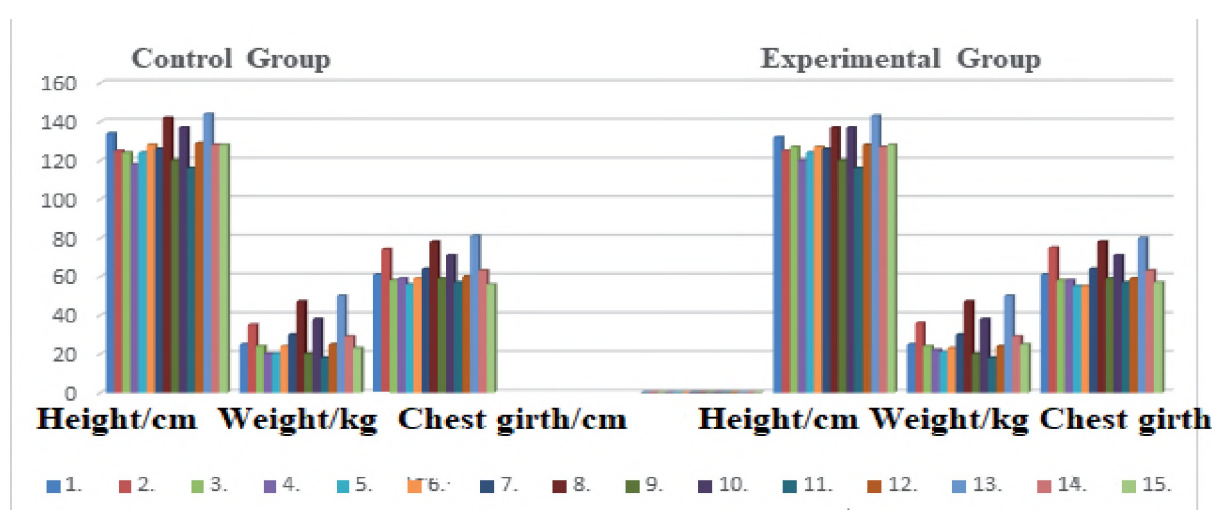


Chart 2. Indicators of height, weight, and chest circumference.

In the initial testing, after the end of the pedagogical experiment on 01.05.2024, we again collect data regarding the current state of the anthropometric indicators of the two target groups.

Table 4. Anthropometric indicators CG – end

| № | Height/cm | Weight/kg | Chest girth/cm |
|-----|-----------|-----------|----------------|
| 1. | 135 | 24 | 62 |
| 2. | 125 | 36 | 74 |
| 3. | 125 | 26 | 58 |
| 4. | 118 | 21 | 59 |
| 5. | 126 | 24 | 57 |
| 6. | 128 | 26 | 59 |
| 7. | 127 | 31 | 64 |
| 8. | 142 | 49 | 78 |
| 9. | 121 | 22 | 59 |
| 10. | 137 | 39 | 71 |
| 11. | 117 | 18 | 57 |
| 12. | 129 | 25 | 60 |
| 13. | 145 | 50 | 81 |
| 14. | 128 | 30 | 63 |
| 15. | 129 | 24 | 57 |

Table 5. Anthropometric indicators EG – end

| № | Height/cm | Body mass/kg | Chest girth/cm |
|-----|-----------|--------------|----------------|
| 1. | 134 | 25 | 62 |
| 2. | 125 | 33 | 77 |
| 3. | 130 | 26 | 60 |
| 4. | 124 | 24 | 62 |
| 5. | 125 | 22 | 58 |
| 6. | 127 | 22 | 56 |
| 7. | 128 | 32 | 68 |
| 8. | 145 | 47 | 81 |
| 9. | 121 | 21 | 60 |
| 10. | 139 | 37 | 74 |
| 11. | 119 | 20 | 58 |
| 12. | 132 | 25 | 60 |
| 13. | 147 | 50 | 84 |
| 14. | 131 | 31 | 67 |
| 15. | 134 | 27 | 61 |

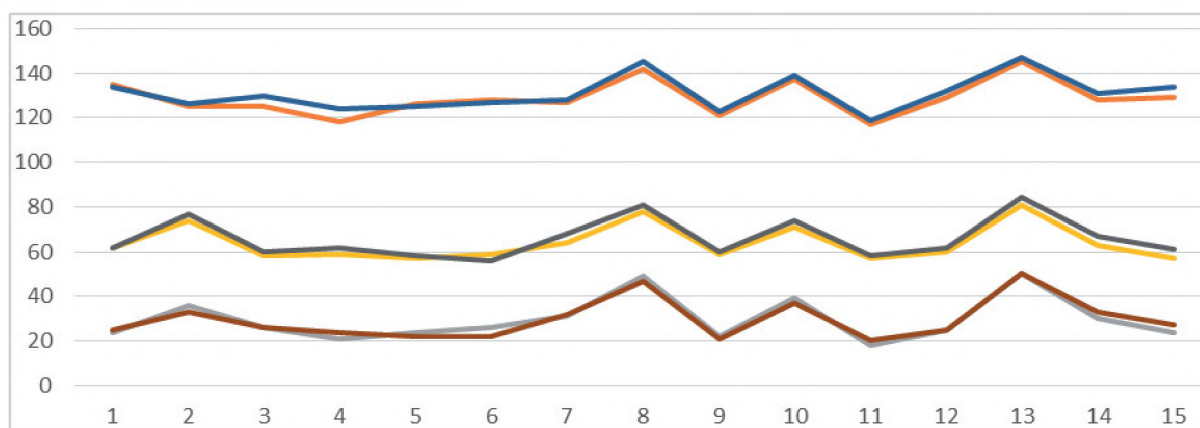


Chart 3. Benchmarking analysis of CG and EG results – end.

DISCUSSION

To prove the research hypothesis, namely whether systematic swimming activities could improve health and motor development at this age, we will benchmark the obtained results of the anthropometric indicators in the experimental group. According to data from Chart 3, it is clear that the lines showing the dynamics in anthropometric indicators are quite close. A small difference is noticeable in the growth indicator. The values growth index shows a minimal increase compared to the control group. In the next measure of weight, the values showed an even rise in both groups. There were no significant weight changes in the two target groups. Inspiratory chest girth results also showed a small increase in the experimental group. However, a trend towards a massive rise in chest girth is not noticeable.

The biggest difference between the growth indicators was found in the experimental group. These results show that swimming from an early age has the greatest impact on height development and a minimal increase in chest girth, resulting in improvement in breathing, lung, and heart function. A positive effect was also found in the rise of muscle mass in the experimental group. In the benchmarking analysis between the two target groups, a statistically significant difference was observed for each period studied.

From the obtained results, it can be concluded that swimming activities have a beneficial effect on the children's body, developing muscle mass. In the following Chart 4, we apply a benchmarking analysis of empirical data to the control group.

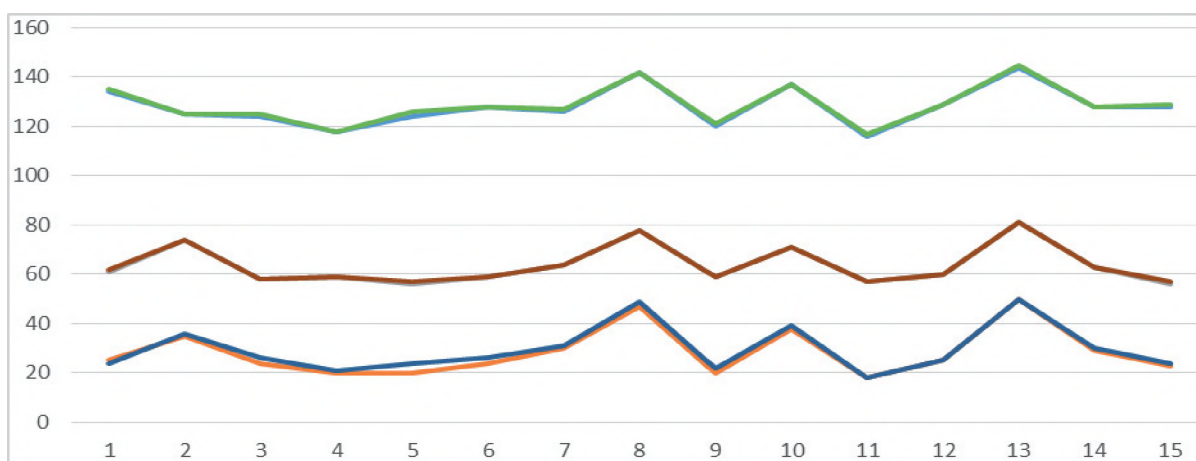


Chart 4. Anthropometric data – start/end – CG.

Height and chest girth values for the control group remained unchanged over the eight months of the experiment. A minimal difference was observed in the body mass values. At the end of the experiment, an increase in body mass was found compared to the results at the beginning of the experiment. The minimum deviations vary in small values, therefore they should not be leading and subject to in-depth analysis. Based on the benchmarking analysis of the results of the anthropometric indicators for the motor development of the experimental group, graph 4 shows a statistically significant difference in the dynamics of the three tracked indicators. The first and most important indicator is height. It shows an increase with

a tendency to accelerated growth, expressed in the lengthening of the limbs. Pronounced pectoral musculature is noted, reflected in chest girth indicators, reflected in growth, compared to the initial data of the study. In the monitored contingent, increased values of chest girth during inhalation are noted. Body mass is the most dynamic indicator in the experimental group. In the two stages of the study, certain dynamics were observed, expressed in an increase and a slight decrease in weight. Based on the benchmarking analysis of the empirical data so far, it can be argued that the other two indicators have increased values, with the weight maintaining standard values.

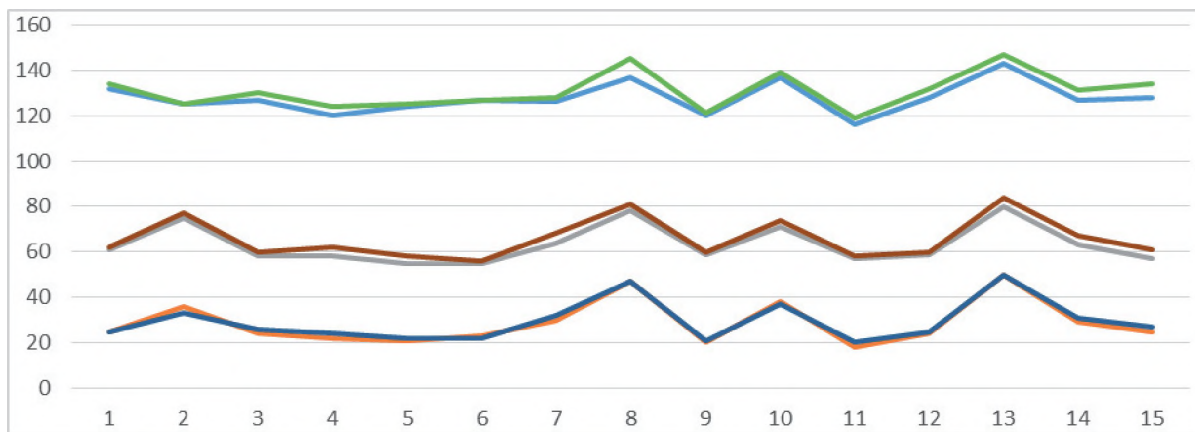


Chart 5. Anthropometric data – start/end – EG.

Table 6 shows average anthropology values according to World Health Organization.

Table 6. Average values and standard deviation of anthropometric indicators

| | Group I norm - average value | | Group II - extended norm | | Group III - over the norm | | | |
|---------|------------------------------|-----------|---------------------------|-----------|---------------------------|---------|---------------------------|---------|
| | Boys | Girls | Boys | Girls | Boys | Girls | Boys | Girls |
| 7 years | Height | | Height | | Height | | Height | |
| | 119-131 | 120-131 | 131-137 | 131-136 | below ↓ | below ↓ | above ↑ | above ↑ |
| | | | 113-119 | 113-119 | 113 | 114 | 137 | 135 |
| | Body mass | | Body mass | | Body mass | | Body mass | |
| | 21-30 | 21-29 | 30-34 | 29-33 | below ↓ | below ↓ | above ↑ | above ↑ |
| 8 years | | | 17-21 | 17-21 | 17 | 17 | 34 | 33 |
| | Chest girth on inhalation | | Chest girth on inhalation | | Chest girth on inhalation | | Chest girth on inhalation | |
| | 60,8-69,6 | 59-68 | 69,6-74 | 68-72,4 | below ↓ | below ↓ | above ↑ | above ↑ |
| | | | 56,4-60,8 | 54,6-59 | 56,4 | 54,6 | 74 | 72,4 |
| | Height | | Height | | Height | | Height | |
| 8 years | 123-138 | 123-136 | 116-123 | 116-123 | below ↓ | below ↓ | above ↑ | above ↑ |
| | | | 138-145 | 136-142 | 116 | 117 | 145 | 142 |
| | Body mass | | Body mass | | Body mass | | Body mass | |
| | 23-33 | 22-33 | 18-23 | 17-22 | below ↓ | below ↓ | above ↑ | above ↑ |
| | | | 33-38 | 33-38 | 18 | 17 | 38 | 38 |
| 8 years | Chest girth on inhalation | | Chest girth on inhalation | | Chest girth on inhalation | | Chest girth on inhalation | |
| | 61,9-72,7 | 60,5-70,9 | 72,7-78,1 | 70,9-76,1 | below ↓ | below ↓ | above ↑ | above ↑ |
| | | | 56,5-61,9 | 55,3-60,5 | 56,5 | 55,3 | 78,1 | 76,1 |

The evaluation of the anthropometric indicators was made based on the average values (\bar{x}) and the standard deviation (s) of the same by age and sex, forming the following groups:

- Group I norm ($\bar{x} \pm 1s$) – includes children whose indicators are within the limits of the average value
- Group II extended norm – children whose anthropometric indicators are between ($\bar{x} \pm 1s$) and ($\bar{x} \pm 2s$)
- Group III outside the norm – children whose anthropometric measurements are below ($\bar{x} - 2s$) and above ($\bar{x} + 2s$)

After the results made at the end of the study of the experimental group and considering the average values of the anthropometric indicators according to the World Health Organization (WHO). Two eight-year-old children fall into the second group – extended norm with height and weight indicators. And an eight-year-old child who, according to the indicators of height and weight, falls into the third group – outside the norm. All other seven- and eight-year-old children who participated in the experimental study according to the three indicators: height, weight, and chest girth fall into the Group I norm.

CONCLUSIONS

The analysis of literary sources, a questionnaire survey with specialists in the

field of swimming, and the conducted research experiment give us the basis to make the following findings:

❖ It is necessary to organize and plan swimming training for this age group following the age characteristics, and the selection of methods and means should be by motor capabilities and level of mastered motor skills.

❖ Findings from the survey conducted with swimming specialists' show that they would engage with children of this age group to build skills and habits. And their improvement at club level.

❖ According to pediatricians, swimming is a suitable motor activity that improves: the state of health; acts as a health booster; and prevents the most common problems in the development of the child's body.

❖ The conducted research experiment proved that regular activities with a structured swimming training organization: reduce fat accumulation and develop height and chest, which leads to improved functions of the lung, heart, and respiratory system; and provides a favorable development of the body, harmoniously developing it, motor strengthening and improving the functions of the organs; increases the quality of life by improving the motor, functional and mental state and has a practically life-saving effect.

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Бенчмаркинг на антропометрични показатели, базиран на плувни занимания

Даринка Игнатова

Цел на проучването бе установяване и оценка нивото на двигателно развитие, базирайки се на проследяване на антропометрични показатели: ръст, тегло и гръдна обиколка чрез организиране на системни занимания по плуване на деца в начален етап на основната образователна степен. Бенчмаркинг-анализът на резултатите от обучението е осъществен в рамките на една учебна година. Предмет на анализа е влиянието на началното обучение по плуване, върху здравословното състояние и двигателно развитие при 7 – 8-годишни деца. Обект на изследване е динамиката в антропометричните показатели в процеса на обучение по плуване, както проследяване на специфични индикатори, измерени чрез обективни инструменти, систематизирането и анализа им. Изследователски контингент са 30 деца, на 7 – 8-годишна възраст, редовно посещаващи занимания по плуване на басейн „V-Gym Fitness & SPA“ в гр. София. Научно обосноваването изводи позволяват да бъде установено влиянието на двигателната подготовка на учениците върху динамиката на антропометричните им показатели: ръст, тегло и гръдна обиколка посредством системни плувни занимания. В периода от 01.09.2023 до 01.05.2024 г. бе проведено измерване на двигателния потенциал на ученици от начален етап на основната образователна степен в условията на учебно-тренировъчни плувни занимания. За извеждане взаимовръзката между индикаторите е приложен анализ на динамиката чрез математико-статистическа обработка.