

ORIGINAL ARTICLE

**THE ASSESSMENT OF PHYSICAL EFFICIENCY IN PRIMARY SCHOOL STUDENTS**

**OCENA WYDOLNOŚCI FIZYCZNEJ UCZNIÓW SZKÓŁ PODSTAWOWYCH**

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**ABSTRACT**

**Introduction**

Physical efficiency determines ability to undertake various every-day activities. The greater it is, the better a person's quality of life and health becomes.

**Aim**

The aim of the study was the characterization of motor skills in primary school students from the 7th and 8th classes, and to compare individuals training volleyball with those who participated only in physical education classes.

**Material and methods**

The research material included 76 individuals, 41 of whom were from the training group and 35 from ordinary classes of the 7th and 8th classes of primary school. The method was the Physical Efficiency Index created by Zuchora, by means of which speed, jumping ability, arm strength, abdominal muscle strength, flexibility and stamina were evaluated. In addition, the students' parents completed the author's questionnaire about their own and their children's physical activity and eating habits.

**Results and conclusion**

The training group obtained 21 points on average and the group that did not train volleyball – 17. Despite this difference, both classes qualified for an average good mark – in the volleyball classes, over 50% got good or very good marks, whereas in the ordinary classes, more than 50% received good or satisfactory marks. In the individual trials, statistically significant ( $\alpha \geq 0.05$ ) differences were found in the jumping ability, arm strength and stamina.

Students of sports classes demonstrate better physical efficiency and the biggest differences are visible in the area of stamina. Regular physical activity has a positive impact on the students' efficiency and fitness.


**Keywords:** primary school pupils, physical activity, physical efficiency, motor skills

**STRESZCZENIE**

**Wstęp**

Wydolność fizyczna określa zdolność organizmu ludzkiego do podejmowania różnych aktywności dnia codziennego. Im jest większa, tym lepsza jest jakość życia oraz zdrowie człowieka.

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## Cel

Celem pracy było scharakteryzowanie motoryczności uczniów szkół podstawowych uczęszczających do klas VII oraz VIII oraz porównanie osób trenujących siatkówkę z osobami biorącymi udział jedynie w zajęciach wychowania fizycznego.

## Materiał i metoda

Badaniem objęto 76 osób (41 z grupy trenującej oraz 35 z klas zwykłych). Wykorzystano w nim Indeks Sprawności Fizycznej Zuchory, dzięki któremu oceniono szybkość, skoczność, siłę ramion, siłę mięśni brzucha, gibkość oraz wytrzymałość. Ponadto, rodzice uczniów objętych badaniem wypełnili autorski kwestionariusz ankiety dotyczący aktywności fizycznej oraz stylu odżywiania zarówno swoich, jak i dzieci.

## Wyniki i wniosek

Grupa trenująca w Indeksie Sprawności Fizycznej Zuchory uzyskała średnio 21 punktów, a grupa nietrenująca – 17. Pomimo tej różnicy obie klasy zakwalifikowały się na średnią ocenę dobrą – w klasach siatkarskich ponad połowa osób wypadła na ocenę dobrą lub bardzo dobrą, a w klasach zwykłych ponad połowa zdobyła ocenę dobrą lub dostateczną. W poszczególnych próbach istotnie statystycznie ( $\alpha \geq 0,05$ ) różnice występują w skoczności, sile ramion oraz wytrzymałości. Nie wykazano ich w testach szybkości, gibkości oraz siły mięśni brzucha. Wyniki badań wskazują, że uczniowie klas sportowych mają lepszą wydolność fizyczną niż uczniowie klas zwykłych, a największe różnice widoczne są w obrębie wytrzymałości. Ponadto, regularna aktywność fizyczna pozytywnie wpływa na wydolność i sprawność fizyczną uczniów.

**Słowa kluczowe:** uczniowie szkół podstawowych, aktywność fizyczna, wydolność fizyczna, zdolności motoryczne

## Introduction

Physical efficiency is the body's ability to undertake intense and long-term physical efforts involving large muscle groups without symptoms of gradually increasing fatigue. The period of post-exercise restitution is relatively short. The definition also includes the tolerance of disturbances in intracorporeal homeostasis caused by physical activity and the ability to quickly eliminate them after exercise. Physical capacity depends on many factors, including: age, sex, energy of effort, thermoregulation efficiency, regulation of the central nervous system, morphological features and motivation, and it determines the ability of the human body to daily work, physical activity, hobbies and recreation. Therefore, it can be concluded that physical efficiency determines the quality of life and health of a person (Silverthorn 2018, Górski 2019).

"Motorism is the entirety of manifestations, conditions, behaviors and motor needs of a human." This definition includes all processes, structures, states of the body or psyche, as well as possible effects related to human physical activity. For human organisms, there are strength, speed, endurance and coordination motor skills. Strength is the body's ability to overcome its own or external resistance. Speed abilities are the abilities to move individual parts of the body or its whole in space in the shortest possible time. Speed consists of reaction time, speed of a single move and frequency of movements. Endurance is the ability of the body to carry out sustained exercise of a given intensity without signs of fatigue. The maximum endurance in life falls on the 25–30 year of human life (Czajka 2017, Wilczewski, Chaliburda and Saczuk 2018). On the other hand, coordination abilities are the

body's ability to perform precise movements in changing external conditions.

The definition and distribution of these skills has varied greatly over the years. Currently, there are 11 motor coordination abilities: kinesthetic differentiation of movements, maintaining balance, showing a quick reaction, time-space orientation, rhythmization of movements, adjustment of movements, combining movements, symmetrization of movements, expressiveness of movements and muscle relaxation and cooperation (Kostiukow 2014).

When discussing the subject of physical fitness among children, it should be remembered that movement has a very beneficial effect on the functional, morphological and mental state of the whole organism. Systematic physical effort is associated with a slim and muscular figure, well-being, better resistance, slower fatigue at work, and improves all motor skills. Playing sports increases the efficiency of the human body, improving the quality of life and preventing the so-called civilization diseases (Adamczyk et al. 2012, Korpak and Bergier 2013, Górski 2019).

Objectivized measurement methods are necessary to assess the physical efficiency of each person. They should effectively, objectively and accurately examine the physical condition under various conditions and have a scientific justification for their use.

There are many commonly used and known tests in the literature:

- Mydlarski's physical efficiency test.
- Trzeźniowski's physical efficiency measure.
- Denisiuk's motor efficiency test.
- Chromiński's physical efficiency test.
- International Physical Efficiency Test.
- Zuchora's Physical Efficiency Index.
- European Physical Efficiency Test – Eurofit.
- Children and Youth Physical Efficiency Test.
- Cooper Test.
- Beep Test and many others (Wilczewski et al. 2018).

Although many of them were created in the first half of the 20th century and have been

modified over the years, they are still used, for example, by physical education teachers. Each of them is the basis for assessing the physical efficiency of children or adolescents. They are used in various modifications and allow you to check the state of physical efficiency and motor skills of a given person, taking into account their gender and age in the norms table.

One of the groups in the study were young volleyball players, because volleyball is one of the most popular sports in the world. Many people are fans of professional and competitive players and teams, and they practice this sport as an amateur and recreationally. Volleyball is also willingly practiced by children and teenagers of primary and secondary schools. Physical effort during a volleyball match and training is associated with high energy expenditure of the body. There is a variety of situations throughout the game that require the player to attack, block, serve, accept, defend and many others. Volleyball belongs to the group of very dynamic sports, during which short but intense actions are played. This places demands on players in terms of high physical efficiency as well as highly developed motor skills. Speed, strength, endurance or coordination as well as jumping strength, jumping ability and jumping endurance are particularly recommended (Grządziel 2012, Durkalec-Michalski 2016).

### **Aim of the study**

The aim of the study was to characterize the motor skills of 7th and 8th grade students of primary schools and to obtain answers to the questions whether children undertake regular physical activity, how it affects their physical capacity and whether these results are satisfactory. The aim was also to compare the performance of students in volleyball classes and regular classes.

### **Materials and methods**

The study covered students in 7th and 8th grade of Adam Mickiewicz Primary School in Gorzów Wielkopolski, who were divided into

a training group and a non-training group. The training group consisted of 41 students of the 7th and 8th volleyball classes. There were 20 girls and 21 boys among them. These people have 1.5-hour training sessions from Monday to Friday, and 10-day preparation camps during the summer holidays. Some people also practice other sports outside of school. However, in the untrained group there were 35 7th and 8th ordinary grade students (among them 19 girls and 16 boys). These people have 45 minutes of physical education 4 times a week. This group also includes people who practice other extracurricular sports.

The physical efficiency of primary school students was assessed on the basis of a selected fitness test and, additionally, a questionnaire for parents.

Zuchora's Physical Efficiency Index was the chosen research method. This test is a common measurement tool in many schools due to the fact that it can be performed in almost any conditions and is within the reach of most people. This index consists of 6 motor tasks assessing various aspects of motor skills (speed, jumping, arm strength, flexibility and strength of the abdominal muscles and endurance). Each exercise is scored on a scale of 1–6 points, distinguished by gender, and the sum of points from individual tasks allows to assess the state of physical efficiency in relation to age (Wilczewski, Chaliburda and Sączuk 2018).

In addition, a proprietary questionnaire for parents was used, which concerned information about the physical activity and eating habits of the child and parents. This allowed for additional characteristics of both groups, taking into account also extracurricular activities, willingness to exercise, eating habits and patterns that they take from home.

The statistical analysis was performed using the STATISTICA 13.3 software by StatSoft. The results of Zuchora's Efficiency Index are data from an interval scale. After checking the normality of the distribution with the Shapiro-Wilk test, which showed that

the distribution of the data was inconsistent with the normal one, the comparison of two groups – training and non-training – was performed in individual tests of motor skills and the final result with the non-parametric Mann-Whitney U test.

The adopted significance coefficient in the program was  $\alpha \leq 0.05$ .

## Results

The data for statistical analysis come from the interval scale. However, the Shapiro-Wilk test showed that the distribution was abnormal. For this reason, further calculations were made with the non-parametric U Mann-Whitney test to compare the two groups, i.e. training and non-training. Statistically significant differences concerning Zuchora's Efficiency Fitness Index were obtained in the case of:

- Jumpability – significance coefficient  $p = 0.0001$ , so it is statistically significant (Figure 10). The median of the training group was 3 and the median of the untrained group was 2.
- Arm strength – statistically significantly different in both groups, because the significance coefficient  $p = 0.0001$  (Figure 11). The median of the training group is 4 and the median of the non-training group is 3.
- Strengths – significance coefficient  $p = 0.000004$  (Figure 12), it is statistically significant. The medians of the training and non-training groups were 4 and 3, respectively.
- The sum of points from all samples – significance coefficient  $p = 0.000026$  (Chart 13), therefore it is statistically significant. Representatives of the training group scored on average 21 points, and the non-training group – 17 points.
- Final grade – significance coefficient  $p = 0.000004$  (Chart 14). There were also statistically significant differences here. In the training group, 49% obtained a good mark, 32% very good, 17% high and 2% minimal. On the other hand, in the non-training group, 43% of representatives obtained a good mark, 40% – satisfactory, 8% – minimal, 6% – very high and 8% minimal.

- There were no statistically significant differences in comparison between the two groups in terms of speed (median of both groups 4), flexibility (median of both groups 4) and strength of abdominal muscles (median training group 1, non-training group 2). In the trials of these motor aspects  $\alpha \leq 0.05$ , therefore, they are not statistically significant.

In the group training volleyball 5 times a week for 90 minutes, there were 41 students of both gender aged 2005 and 2006, currently in grades VII and VIII. In this group 49% were girls (20) and 51% boys (21). The average height of the whole group is 169 cm (the smallest – 153 cm, the highest – 192 cm). Body weight ranged from 44 kg to 76 kg with an average of 56 kg. After BMI analysis, 14 adolescents were underweight (BMI below 15.5) and 27 were normal (BMI 18.5 – 24.9). Nobody in the training group is overweight or obese.

In the Zuchora's Physical Fitness Efficiency study, students received the results of 6 motor tests as well as the final result and a grade for the entire test. Each attempt could earn a maximum of 6 points, and for the total of 35 points. Depending on their sum after all tests, the student obtained a grade. In the case of this age group, 6 points is a minimum mark, 12 points – a satisfactory mark, 17 points – a good mark, 22 points – a very good mark, 17 points – a high mark, and 31 points – an excellent mark. The results of the individual trials are summarized in the table (Table 1).

The most common final grade was good (49%), some people also scored very good (32%), and 17% of the group scored high. One person obtained the minimum grade (2%). On the other hand, no one received a satisfactory or outstanding grade. Moreover, an analysis of the questionnaires completed by the parents of these teenagers was performed. When assessing their child's willingness to participate in sports, 97% indicated a positive answer. As many as 59% indicated that their children undertake additional regular physical activity in addition to volleyball

training. The most common form of extra-curricular exercise was cycling. Parents also often mentioned swimming and running, and less often horse riding and football. The last part of the survey consisted of questions about the physical activity and eating style of the parents themselves. As many as 53% of caregivers do not encourage their children to be physically active. Moreover, parents assessed their physical fitness: 9% as very good, 47% – good, 31% – average, 13% – poor, and no one assessed themselves as very poor.

In the group not training, but only attending physical education classes 4 times a week for 45 minutes, there were 35 students aged 2005 and 2006 (present grades VII and VIII) of both sexes. In this group, 54% were girls (19) and 46% boys (16). The height of the students of the non-training group ranged from 143 cm to 181 cm, with an average of 165 cm. However, the average body weight is 55 kg (the least – 37 kg, the highest – 80 kg). BMI analysis showed that 13 people were underweight (BMI below 15.5), 19 students had a normal index (BMI 18.5 – 24.9), 2 were overweight (BMI 25.0 – 29.9), and 1 were obese (BMI above 30).

The non-training group also had Zuchora's Physical Efficiency Index made on the same principles as the training group. The results of the individual trials are presented in the table (Table 2).

The most common final grades are good (43%) and satisfactory (40%). The minimum mark was 8%, very good – 6%, and 3% was high. Nobody got an outstanding grade. Moreover, in the untrained group, the parents also filled in the same questionnaires as the parents of the students in the training group. When assessing the involvement in sports activities, 93% of parents confirmed the child's willingness. As many as 80% of regular class students undertake additional extra-curricular physical activity in addition to physical education. Cycling and dancing were indicated as the most common answers (23% each) and swimming (18%). Occasionally, the parents chose jogging, football, yoga,

**Table 1.** Results of the Physical Fitness Efficiency of the training group.

Selected aspect of motor skills	Average value (among all people in the training group)	Minimum Value	Maximum Value
Speed	4	3	6
Jumping	3	0	5
Shoulder strength	4	1	6
Suppleness	4	1	6
Strength of the abdominal muscles	2	0	5
Strength	4	1	6
Total sum of points	21	9	29

**Table 2.** List of Physical Fitness Efficiency results in the non-training group.

Selected aspect of motor skills	Average value (among all people in the training group)	Minimum Value	Maximum Value
Speed	4	3	6
Jumping	2	0	4
Shoulder strength	3	1	6
Suppleness	4	1	6
Strength of the abdominal muscles	2	0	3
Strength	2	1	5
Total sum of points	17	10	27

golf, tennis and archery. In the last part, the parents assessed themselves. Encouraging children to exercise was indicated by 60% of caregivers, and 40% did not show such initiative. The physical effort undertaken by parents varies in intensity. 13% of parents assessed their physical fitness as very good, 40% as good, 40% as average, 7% as poor, and no caregiver chose a very poor answer.

Comparing both groups, statistically significant differences concerning the Physical Efficiency Index of Zuchora were obtained in the case of jumping ( $p = 0.0001$ ), arm strength ( $p = 0.0001$ ), as well as endurance ( $p = 0.000004$ ) and the final assessment ( $p = 0.000004$ ). There were no statistically significant differences in the comparison of the two groups in terms of speed, flexibility and strength of the abdominal muscles. In the trials of these motor aspects  $\alpha \leq 0.05$ , therefore, they are not statistically significant.

## Discussion

Human motor skills have been studied for generations. Speaking of the aspects of motor skills today, these are strength, speed, endurance and coordination abilities, among which there are 11 elements. The first three groups

are the fitness abilities of the human body (Kuczyński 2012, Kostiukow 2014, Czajka 2017).

The benefits of regular exercise have been the subject of a large amount of research. Many of them focus on characterizing motor skills of children and adolescents and the influence of parents on this state (Korpak and Bergier 2013, Popowczak 2013, Antos and Staniak 2015, Burns *et al.* 2019). There are many studies on the style of nutrition and the influence of overweight or obesity on physical performance in childhood and adolescence (Barańska, Gajewska and Sobieska 2012, Durkulec-Michalski 2016).

At a time when professional sport plays an enormous role, not only at the senior level, there is no shortage of publications on the development of motor skills, somatic features, selection of training and preparation of the condition of young athletes of various disciplines. Many of them refer to beginner retinal adepts (Grządziel 2012).

The analysis of the results obtained after examining a total of 76 primary school students in the 7th and 8th grades of volleyball and ordinary school students shows that the physical activity of teenagers is at a sufficient,

although insufficient level, which is consistent with the observations from many scientific publications (Adamczyk i in. 2012, Korpak and Bergier 2013, Antos and Staniak 2015, Burns *et al.* 2019).

Zuchora's Physical Efficiency Index was used in the presented work. Both groups – training and non-training – completed the entire test with a final grade of good. However, regular class students obtained this result with a minimum number of points (17), and young volleyball players, scoring an average of one point more in a group (22 instead of 21), would have completed the test with a very good grade. When comparing the two groups, it is worth paying attention to the fact that among the people training 49% obtained a good mark and 32% obtained a very good mark, while among the representatives of the non-training group only 6% obtained a very good mark, 43% good, and 40% sufficient.

Looking at the tests checking individual aspects of motor skills, the training group obtained better results than the non-training group in terms of jumping ability, arm strength and endurance.

According to Zuchora's Physical Efficiency Index scores (1–6), both groups obtained a very good result (4) in the speed and flexibility tests. In the case of jumping, the training group was assessed at a good level (3), while the non-training – at a sufficient level (2). The strength of the volleyball players' arms indicates a very good result (4), and the strength of regular classes – a good result (3). Interestingly, the results of the abdominal muscle strength test are the worst in both groups, and this is the only aspect in which the non-training group achieved a better, albeit weak, result – the level of the group of young volleyball players and volleyball players at the minimum level (1), and the students attending classes physical education – at a sufficient level (2). However, the biggest difference between these groups is in endurance. The training group with a very good result (4), and the non-training group with a satisfactory result (2). None of the

groups scored high (5) or outstanding (6) in any of the six motor aspect tests. This shows that the focus should be more on developing endurance in physical education lessons, training and lessons, working on the abdominal muscles of the students of both groups, and a little more attention to exercises to improve jumping ability. However, it is worth working on all aspects of motor skills for both groups to ensure that young people have the best sports abilities and positively influence their performance, appearance and health.

Of course, some people, regardless of belonging to the group, may have been hindered or helped by individual characteristics such as height, weight, BMI or individual motor skills in achieving a given result. Already when enrolling in sports classes, coaches take these aspects into account. Young volleyball players in the examined classes VII and VIII had an average body height of 169 cm (ranging from 153 cm to 192 cm), and their colleagues from the parallel regular classes – 165 cm (the minimum was 143 cm and the most 181 cm). When comparing boys from both groups, boys from the training group measured 176 cm on average, and from the non-training group – 169 cm. In girls, these differences were not significant (163 cm in the training group and 161 cm in the non-training group).

In the training group, 66% of students had normal BMI and 34% underweight. Among the non-training group, 37% of people were underweight, 54% were within the normal BMI index, but already 9% were overweight or obese. It is confirmed that physical exercise has a positive effect on the correct body weight of a child, and that overweight reduces the level of motor skills (Barańska, Gajewska and Sobieska 2012).

Moreover, the results of a questionnaire completed by the parents of the surveyed children concerning additional physical activities, eating habits of the children and their guardians, as well as their physical fitness and willingness to sport, were analyzed. Among the positives, it should be noted that in both

groups children are willing to participate in various types of sports activities (97% in the training group and 93% in the non-training group). 80% of regular class students willingly undertake additional extracurricular physical activities on a regular basis, which may explain the high results of some of the respondents, similar at the level of students in volleyball classes. However, some people from the training group (59%), despite a lot of effort during training at school, also take part in other sports activities. However, when looking at it from the point of view of parental involvement, in the untrained group as many as 53% of caregivers believe that their attitude does not encourage their child to exercise regularly. In the training group it is 40% of parents, but it is still too much. When assessing their own physical fitness, the parents of all students most often indicated good or average level. The frequency of physical activity undertaken by adults is not satisfactory – in both groups less than half of parents do it at least once a week. Research shows that parents should set a better example of a healthy lifestyle for their children, and make them aware that incorrect body weight lowers the level of physical fitness (Adamczyk 2012, Barańska, Gajewska and Sobieska 2012, Korpak and Bergier 2013).

Reluctance to physical activity, both for children and adults, is a growing problem in developed countries, and it is essential for the proper motor development of children and adolescents. Sport has a positive effect on the entire human body and its individual systems and organs. It also gives you better mood, motivation and mental performance. The fact is that exercise is an excellent prevention of many diseases. Therefore, it is necessary to increase the promotion of health and healthy habits regarding physical activity, diet and other factors influencing the well-being of the whole organism, both among children and adults (Adamczyk 2012, Barańska, Gajewska and Sobieska 2012, Korpak and Bergier 2013, Antos and Staniak 2015).

## Conclusions

1. Primary school pupils undertake regular, though insufficient physical activity.
2. Regular physical activity has an impact on students' physical performance.
3. Body weight, height and BMI have an influence on the results of motor tests.
4. Physical fitness of students in volleyball classes is better than that of students in general classes.
5. The attitude of parents influences the behaviour of children regarding physical activity and diet.

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