

# Swimming-Based Physical Activity and Its Influence on Spinal and Mental Health

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## ABSTRACT

The aim of this work is to present how the human body behaves in water, what the general swimming technique looks like, which muscles are involved in performing the movement, and how this entire process can positively or negatively affect the human spine. By reviewing this work, one can learn about the structure of the human foundation, i.e., the spine, what postural defects occur in the spinal area, and which exercises on land and in water are useful for correction. Technological development, the way of learning, working, and living often contradict the basic activity for which humans are created, namely movement. This frequently results, especially in younger individuals, in disorders of proper functioning and spinal curvatures. Swimming is one of the safest forms of physical activity that can be used in the rehabilitation process, provided it is performed under the supervision of an experienced and knowledgeable instructor or a specialist in physiotherapy. Physical activity is often recommended by specialists in fighting against postural defects and spinal curvatures, as well as solving many other problems including those of mental health. It is recommended for both young people and adults. However, each swimming style affects a specific section of the spine differently, so before starting physical activity, it is worth consulting a specialist or physiotherapist.

To understand the impact on the spine, one should first learn the technique and phases of the performed movement, then analyze the work of the muscles performing that movement, and the movement for which these muscles are responsible. Having regard to constant, repetitive movements and repeated muscle work, swimming can shape body posture. This situation can be used to correct postural defects. However, individual swimming styles should be analyzed, and make conclusions regarding the possibility of using a particular style to correct specific postural defects.

**Keywords:** corrective-compensatory gymnastics in water, physical fitness, spinal defects, psychotherapy, muscle loads, mental health.

**Background and Aim of the Study.** The aim of the study is to examine public opinion among residents of the Starogard district (Pomeranian Voivodeship, Poland) regarding the impact and use of swimming in the case of physiotherapeutic exercises for the spine, to learn about the lifestyle of an average resident in the district, and to determine whether they have ever experienced or are currently experiencing spinal degeneration. The study includes corrective gymnastics exercises, corrective swimming exercises, as well as exercises for learning proper breathing.

**Material and Methods.** The study was conducted using the Google Forms service in the form of an original author's questionnaire. The study involved 101 people, of whom 98 actually fully completed the questionnaire (53 men and 45 women). The respondents were people of various ages (from 17 to over 60 years old) who come from the territory of the Starogard district (Pomeranian Voivodeship, Poland).

**Results.** More than half of the respondents were pupils and students, who together constituted 60%, with pupils and students each separately accounting for 30% of the studied. Next, 13% were represented by persons engaged in intellectual work, 10% were classified as private entrepreneurs, and 5% as those running their own business. Four respondents were pensioners (4%). The research group also included farmers (4%), physical labor workers (3%), and one person did not fall into any of the above-mentioned categories. Furthermore, 70% of the respondents believe that swimming positively influences the spine, while 28% think it has a rather positive effect. Among the respondents, there were also those who believe that swimming has a rather negative effect on the spine – 2%.

**Conclusions.** More than half of the respondents were pupils and students, who together constituted 60%, with pupils and students each separately accounting for 30% of those surveyed. Next, 13% were represented by persons engaged in intellectual work, 10% were classified as private entrepreneurs, and 5% as those running their own business. Four respondents were pensioners (4%). The research group also included farmers (4%) and manual workers (3%).

## INTRODUCTION

The ability to swim has accompanied humans as long as the ability to walk or run. In ancient times, when people lived or settled in areas with bodies of water, it was also natural for them to learn to swim. Moreover, 70% of the earth's surface is covered with water, and humans have a membrane between their fingers that significantly helps in swimming. Therefore, it might seem that swimming is something natural for humans. The ability to swim helped in daily life activities, such as hunting, gathering, and was useful during military maneuvers. Nowadays, swimming has become a daily, often practiced physical activity for many people, as it relaxes the body and engages a huge number of muscles. At the same time, doing physical exercises brings enjoyment, adds feelings of pleasure that positively affects cognitive state, reduces stress, enhances the experience of strong positive emotions and exciting sensations, increasing mental health benefits as well [14]. Therefore, it is used in extracurricular activities, as a break from daily routine, as rehabilitation, and in training exceptionally gifted youth. The task of corrective swimming is to improve the figure and its proper shaping, simultaneously conscious increase in physical fitness and body awareness, and improvement of swimming skills along with stress adaptation, strengthening social connections, the sense of mastery, which report reduced anxiety, reduction of mood swings and depressed mood improvement [9]. J. Kołodziej defines corrective swimming as exercises in the aquatic environment in a horizontal position, which retain the character of locomotor movements, in which a muscle group with disturbed muscle tone is subjected to corrective influence [6]. Exercises performed in water undoubtedly affect the human body differently from exercises performed on land. Swimming is the opposite of many aspects of natural existence: the body position changes to a horizontal one; movement sometimes occurs mainly due to the work of the upper limbs; the resistance of the supporting surface is not significant, whereas the resistance of the aquatic environment is the main factor influencing movement [8]. The aquatic environment is an ideal place for performing rehabilitation exercises, since the reduced body weight after immersion in water makes it possible to perform movements that are impossible or very difficult on land [10].

Therefore, it is possible to make a conclusion that the horizontal position of the body in water positively influences the human organism: it allows a person to perform movements and exercises that would be difficult or impossible on land, and it also relieves the joints. The spine is the support for the human body. In cooperation with the postural muscles, it maintains an upright posture, ensures proper human functioning, and protects the spinal cord. The spine performs the functions of body support, protection, and movement [16].

The spine not only protects the spinal cord but also performs a supporting function for the body and is an important element of the musculoskeletal system. The spine as a whole is a joint structure composed of vertebrae and intervertebral discs located between them. These discs connect the bodies of the vertebrae and prevent their

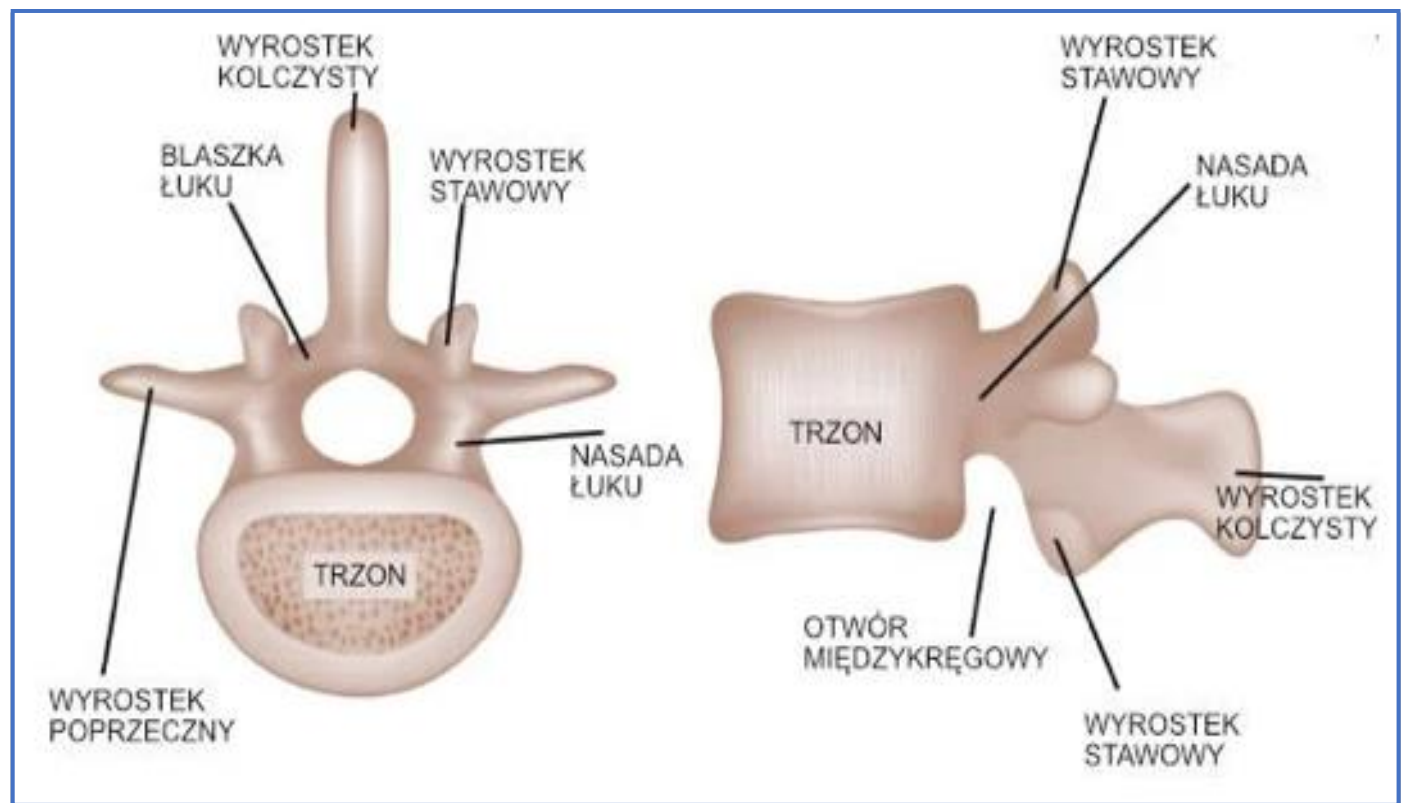
displacement. Exceptions are sacral vertebrae and coccygeal vertebrae, which are fused together. The main bones of the back are 33 vertebrae. The number and specific characteristics of the vertebrae differ depending on the part of the spine they form [2].

Although the structure and appearance of the vertebrae differ in particular sections of the spine, they have many common elements. In some parts of the spine, the structure of a vertebra varies depending on its function and purpose. A vertebra consists of a large cylindrical body and a thin, structurally diverse vertebral arch. These two parts form a canal through which the spinal cord passes. The function of the vertebral bodies is to support body weight [18].

In addition to these common elements, vertebrae also include spinous processes and transverse processes, to which muscles are attached, as well as superior articular processes and inferior articular processes, which serve to connect with the articular processes of the vertebra located above or below. Thus, the vertebrae connected to one another form a single structure called the spine, which has three natural curves: cervical lordosis, thoracic kyphosis, and lumbar lordosis. Their function is to provide shock absorption.

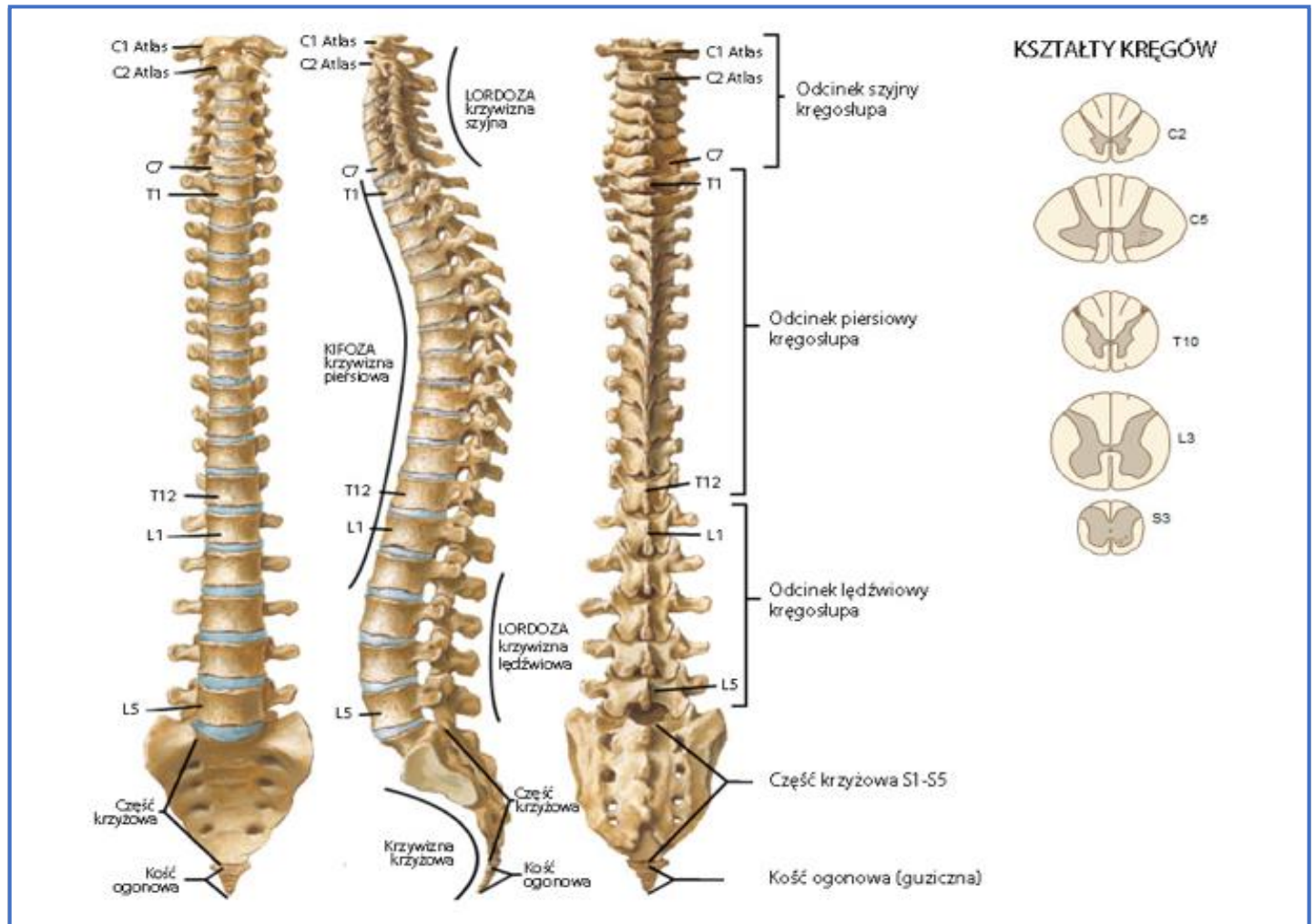
**Figure 1. Structure of a vertebra:** the body, transverse processes, spinous process, vertebral canal, and articular processes

Source: <https://www.rehab.pl/baza-wiedzy/budowa-kregoslupa/> [12]



**Figure 2. Structure of the spine as the axis of the human body** — 33 vertebrae: 7 cervical vertebrae (C), 12 thoracic vertebrae (Th), 5 lumbar vertebrae (L), 5 sacral vertebrae (S), and 4 coccygeal vertebrae (Co).

Source: <https://agakwapisiewicz.pl/kregoslup/> [1]



## Aim of the Research

The aim of the research was to examine the public opinion of residents from Starogard County, Pomeranian Voivodeship, Poland, regarding the influence and use of swimming in physiotherapeutic exercises for the spine. The study also aimed to investigate the lifestyle of an average resident of the county and to determine whether they had ever experienced, or were currently experiencing, degenerative changes in the spine.

An additional aim was to examine whether physical activity through swimming leads to visible positive changes in the human body and psychological state, whether it improves an individual's self-perception bringing enjoyment and fun as a result of losing extra weight or obtaining a better physical appearance.

## MATERIALS AND METHODS

### Participants

The study involved 101 participants, of whom 98 fully completed the questionnaire (53 men and 45 women). The participants were people of different ages, from 17 to over 60 years old, who came from the area of Starogard County, Pomeranian Voivodeship, Poland.

Among the participants, young people were the largest group. As many as 45% were aged 18 to 29, while 29% were under 17 years old. In addition, 11% of the participants were aged 30 to 39, 7% were between 40 and 49 years old, 5% were aged 50 to 59, and 3% were 60 years old or more.

Regarding education, 39% of the respondents had secondary education, 28% had higher education, 27% had basic education, 5% had vocational education, and 1% had another type of education not included in the categories mentioned above.

## Procedure

The study was conducted using an original questionnaire prepared by the authors. Its aim was to show the impact of physical activity through swimming and its positive health-related and physiotherapeutic and mental effects. The questionnaire included closed-ended, descriptive, and open-ended questions.

The survey was carried out for over several months and allowed the authors to learn the respondents' opinions on this issue. In addition, the authors analyzed available literature on physical activity through swimming, its influence on the general level of health, and physiotherapeutic exercises for the spine.

## Statistical Analysis

The conducted research aimed to collect data within the framework of the questions developed in the author's research questionnaire, used as a research instrument. Therefore, the study sought to identify trends and responses in the field of the correlation between the level of health and physical activity carried out through swimming. When presenting and justifying the obtained research results, the authors used a generally accessible method of statistical analysis, which included descriptive statistics with the use of tables and diagrams.

## RESULTS

The largest group of respondents, 42%, considered backstroke to be the healthiest swimming style. 32% of the respondents considered front crawl to be the healthiest style, 22% chose breaststroke, and only 4% of all respondents considered butterfly stroke to be the healthiest swimming style for the spine.

Regarding the frequency of swimming, 36 people, or 37.5%, reported swimming once a month. Eleven people, or 11.5%, swam twice a month, 7 people, or 7.3%, swam once every two weeks, and 23 people, or 24%, swam once a week. In addition, 19 respondents selected the answer "Other". Among them, 3 people stated that they swam every day, 2 people reported that they had never practiced swimming, while the remaining 14 respondents gave individual answers, stating that they could not define the frequency or that they swam several times a year or month.

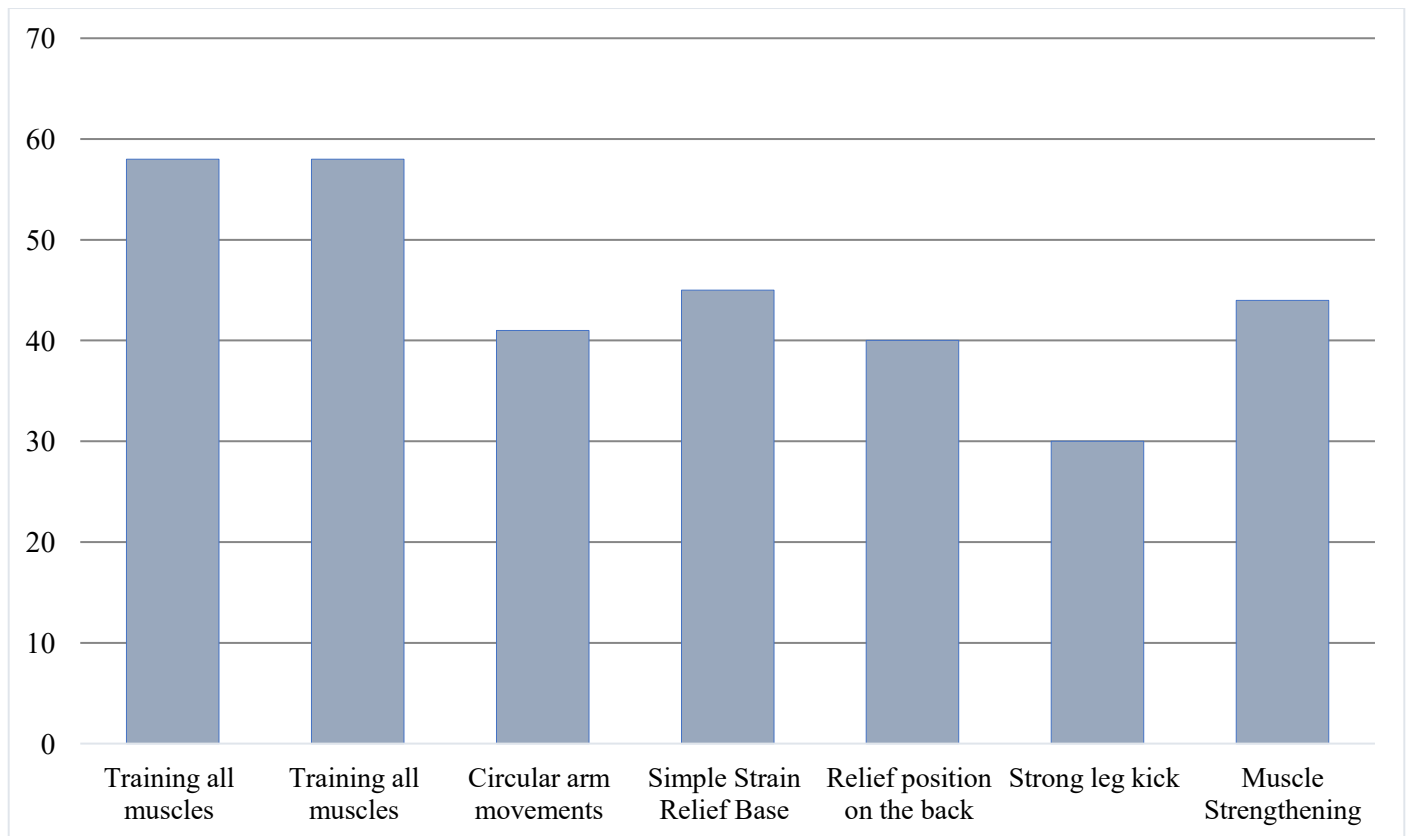
The ability to swim is very important. Among the respondents, 38 people stated that they definitely could swim, 33 respondents stated that they could swim, 19 respondents indicated that they rather could swim, 5 people stated that they rather could not swim, and 5 people stated that they could not swim.

The issue of the health-promoting effect of physical activity through backstroke swimming is also very important. Backstroke was selected by 42% of the respondents and is considered one of the most recommended styles in physiotherapeutic exercises because this style:

- trains all the muscles of the body, from the arms, through the shoulders and chest, to the legs and buttocks – 58%;
- increases the range of shoulder movement and improves back muscles' work – 58%;
- circular arm movements positively affect the lateral muscles of the trunk and shoulders, while leg movements strengthen the muscles – 41%;

- a straight and extended body position supports joint stretching – 45%;
- the supine position reduces the load on the spine – 40%;
- strong leg kicks strengthen the leg muscles – 30%;
- strengthens the shoulder and back muscles – 44% (Chart 1).

**Chart 1. Swimming style (butterfly stroke) as the healthiest for the spine**

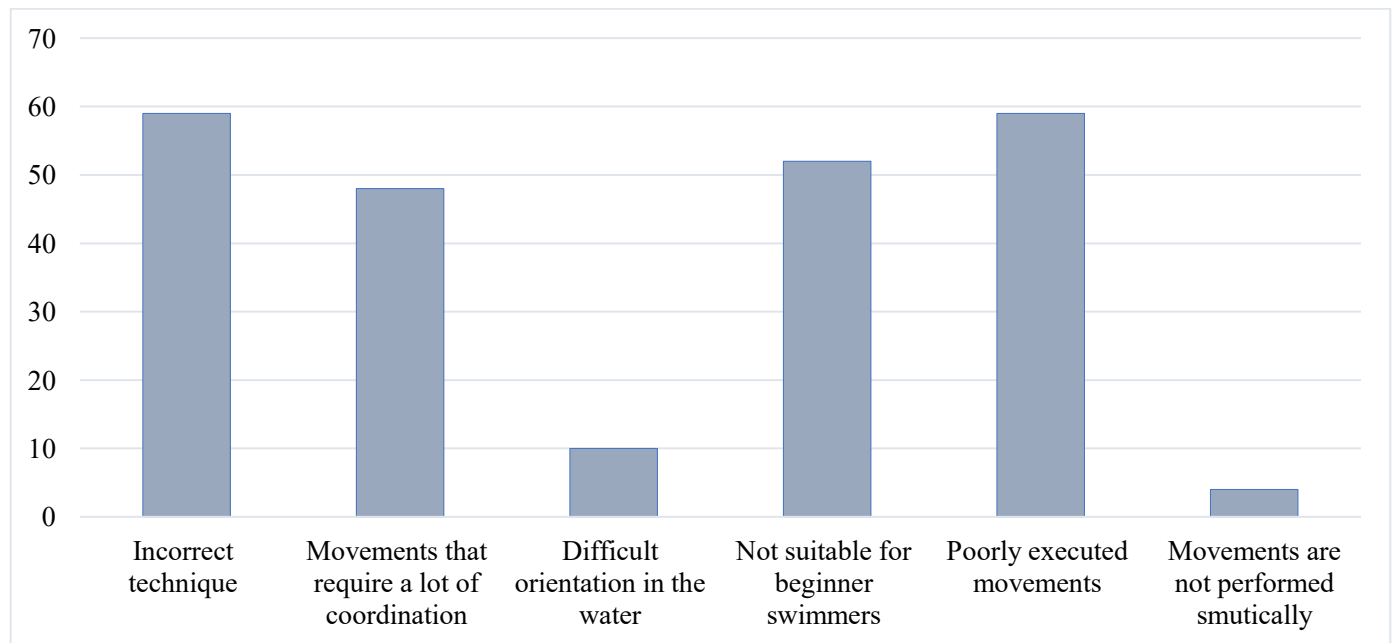


Regarding the question of which swimming style is the least healthy, 62% of the respondents identified butterfly stroke as the least healthy style for the spine. The next styles in this classification were breaststroke (21%), freestyle (9%), and backstroke (8%).

According to the respondents, butterfly stroke (62%) is the least recommended style during physiotherapeutic exercises because:

- poor technique may lead to the accumulation of tension in the neck and back of the head – 59%;
- movements require a high level of coordination and are difficult to learn – 48%;
- orientation in water is more complicated – 10%;
- due to its level of difficulty, it is not suitable for beginners – 52%;
- improperly performed movements can lead to tension and back pain – 59%;
- movements are not always performed symmetrically – 4% (Chart 2).

**Chart 2. Swimming style (butterfly stroke) as the least healthy for the spine**



Regarding the experience of pain among the respondents, one quarter of the participants reported pain in the spinal area, which represents 25% of affirmative answers. By contrast, 75% stated that they did not experience such pain. However, among the respondents, 35% had a sedentary type of work, including 17% of those who led a sedentary lifestyle. At the same time, 28% of the respondents reported sleeping on a soft mattress, 17% wore high-heeled shoes, and 26% carried heavy loads on one shoulder. In addition, 68% stated that they spent their free time actively during the day (Chart 3).

**Chart 3. Everyday activities of the study participants**



Regarding the use of cross-body, or alternating, movements in water, they are considered appropriate in the correction of spinal scoliosis. A total of 60% of the respondents considered cross-body movements useful for scoliosis correction. Among them, 16% were convinced of this, while 44% believed that this type of movement was rather useful.

According to the study, cross-body movements are recommended or not recommended in the treatment of scoliosis because:

- in case of scoliosis, the weakened side should be trained – 36%;
- in case of scoliosis, both sides should be trained at the same time – 31%;
- cross-body movements stretch the spine – 51%;
- every style, movement, or exercise performed in water has a positive effect on the spine – 9%;
- each condition requires a different selection of exercises in water – 44%

Regarding whether spinal diseases or postural defects had been diagnosed among the respondents, only 54% of the participants answered this part of the study. Among these respondents, 36% stated that they had never been diagnosed with any spinal disease or postural defect.

Among the remaining 18%, 12% reported that they had been diagnosed with scoliosis. One person had been diagnosed with a cervical spine condition, 3% of the respondents had an intervertebral disc herniation, and two people reported problems related to a flattened lumbar curve.

Regarding which part of the spine, in the respondents' opinion, is most often exposed to injuries, the largest group, 40%, indicated the lumbosacral region; 38% considered the cervical region to be the most vulnerable to injuries; and only 16% of the respondents believed that each part of the spine may be exposed to injuries to the same extent.

## DISCUSSION

Based on the analysis of available literature on the correlation between physical activity through swimming and general health and mental state level, physical activity in the aquatic environment has a positive effect on kinesthetic sense [15]. Long-term physical activity in water is one of the most effective ways to promote health-related values. Swimming supports rehabilitation, therapeutic, and preventive activities aimed at the human being as a whole [19]. The impact of swimming on cognitive and socio-emotional functions is impossible to overestimate: swimmers report less tension, depression, anger, confusion, and more vigor after exercising than before [4]. Their mood changes significantly demonstrating emotional resilience and self-regulation. This happens due to the release of endorphins, mood-enhancing neurochemicals.

Considering all forms of movement, swimming is likely to remain one of the most common forms of physical activity. Therefore, it is possible to conclude that the body's horizontal position in water positively affects human organism. It allows people to perform movements and exercises that would be difficult or impossible on land, and it reduces load on the joints. If it happens continuously and regularly, serotonin releases positively effecting mood regulation and improving cognitive functioning of an individual.

The main aim of correcting postural defects is not only to treat them, but to prevent their further progression. Five stages of postural retraining can be identified: making the person aware of the nature of the defect; restoring proper bone, joint, ligament, and muscle mobility; developing skills of local and global correction; developing postural endurance, i.e., the ability to maintain correct posture for a long time; and consolidating the achieved correction of body posture [5].

Just as when correcting defects on land, corrective swimming in the aquatic environment also includes specific stages of actions. In the process of correcting errors and postural defects in water, three main periods, or stages, of corrective swimming are distinguished:

- stage one – learning and teaching basic swimming skills;

- stage two – mastering as many corrective swimming exercises as possible, depending on the type of postural error or defect;
- stage three, that is, the stage of corrective swimming itself – mastering specialized corrective swimming exercises, conditioned by the type of postural error or defect [8].

As during physical education lessons, land-based exercises, individual sports, team games, or professional swimming, it is important in the learning process to move from technical elements that are easier to learn to those that are more difficult. The same is true for corrective swimming, where each of the above-mentioned stages has specific tasks.

The tasks of the first stage of corrective swimming include: initial adaptation of the body to the aquatic environment, especially in relation to the physical properties of water; initial functional adaptation to the aquatic environment; initial psychomotor adaptation to the aquatic environment; learning how to breathe in water; overcoming fear of water; hardening the body to new conditions, for example by becoming accustomed to different water temperatures in the shower; and mastering basic swimming skills, such as becoming familiar with the aquatic environment, moving freely in water, and performing elementary swimming activities [8].

The tasks of the second stage of corrective swimming include: strengthening the acquired swimming skills; mastering as many corrective swimming exercises as possible, depending on the existing postural error or defect; thorough preparation for the third stage of corrective swimming; developing independence, conscious individual and collective discipline, and group integration [13].

The tasks of the third stage of corrective swimming include: improving corrective swimming exercises and increasing their level of difficulty; and learning new specialized corrective exercises separately for specific types of postural errors or defects [7].

The principles of designing corrective exercises, and situations in which equipment that increases the buoyancy of the body should be used are as follows:

- each corrective swimming exercise should involve the maximum number of affected muscle groups at the given level of swimming skills;
- each corrective swimming exercise should be performed with accuracy and correctness of movement, which is the main condition for achieving the desired corrective effect;
- exercises with too high a level of difficulty should be avoided, especially when they reduce the accuracy of performance;
- in case when small swimming skills create an obstacle in the technical mastery of corrective exercise, it is recommended to turn to means that increase the ejection force of the body (appliances) [11].

## CONCLUSIONS

Based on the conducted research, the following conclusions were formulated:

- the research has shown that the participants experience back pain in the spinal area (25%);
- the participants are generally aware of the benefits of swimming, which was confirmed by 92% of the respondents; therefore, it can be stated that the vast majority of the respondents know about the benefits of swimming;
- the participants mostly stated that the lumbosacral region of the spine is the most vulnerable to injuries (40%), while the cervical region was placed second (38%);

- the participants know how to act in the case of scoliosis correction, as scoliosis is a common problem in the world of technological development and decreasing physical activity, which many people, including young people, face;
- 60% of the people who took part in the study believe that cross-body movements, which involve both the weakened and shortened sides, are appropriate when working with this defect;
- however, 40% of all respondents stated that the weakened side should be strengthened, which allows the conclusion that knowledge in this area is not well known among most of the research participants.

Based on the conducted research, review and analysis of the relevant literature, the authors of this scientific study (as specialists in corrective gymnastics in its full scope, including corrective swimming, as well as physical education, sports rehabilitation, and motor recreation) present an original basic set of five main corrective and compensatory exercises for work with scoliosis, increased kyphosis, and increased lordosis. This set includes corrective gymnastics exercises, corrective swimming exercises, and exercises for proper breathing:

1. Increased lordosis causes balance disturbance. Certain muscles are excessively shortened, including the quadriceps and hip flexors, while others are excessively stretched and weakened, such as the abdominal and gluteal muscles. The correct breathing pattern is also often disturbed and needs to be learned, especially lower-rib breathing. Basic exercises for this defect include:
  - stretching the following muscles: the iliopsoas muscles, rectus femoris muscles, lumbar back muscles, and quadratus lumborum muscles;
  - strengthening the following muscles: the gluteal muscles, calf and lower-leg muscles, abdominal muscles, and thoracic back extensors;
  - working on correct breathing by increasing the respiratory capacity of lungs and strengthening the respiratory muscles, especially the diaphragm [3].

Exercises in water for hyperlordosis include:

- leg work in backstroke, with the arms straight behind the head at the elbow joints and holding a swimming board; the legs work alternately in a pendulum-like movement;
- leg work while swimming on the front, with the arms straight at the elbow joints and holding a swimming board; the legs work alternately in a pendulum-like movement;
- support on the knees, followed by extending the left leg backwards without increasing lordosis, then returning to the starting position and repeating the same movement with the other leg;
- tucking and untucking the pelvis by activating the abdominal and gluteal muscles, with inhalation and a slight lifting of the sternum;
- lying on the back, inhaling through the nose, allowing the air to move down along the spine and expand the lower back and side ribs, followed by exhalation through the mouth.

In case of work with thoracic hyperkyphosis, it is necessary to develop awareness of one's own body and its correct position in space. It is important to learn proper movement patterns, body balance and stability awareness, restore correct physiological joint mobility, and learn a correct breathing pattern.

Kyphosis most often occurs after Scheuermann's disease in young people or in the course of osteoporosis in older adults. In such cases, care for maintaining correct posture should begin already in the initial period of these

changes. Sleeping on an even and relatively firm surface is recommended, both on the back and on the stomach. Resting, reading, or doing homework while lying on the stomach may also be beneficial [20].

### Exercises for hyperkyphosis:

- lying on the back in water, raising the arms upward in front of the body while inhaling, and lowering the arms downward in front of the body while exhaling. The exhalation should last longer than the inhalation; inhalation is through the nose and exhalation through the mouth;
- sitting cross-legged, raising the arms upward in front of the body while inhaling, and lowering them down through the sides while exhaling [3 min.];
- lying on the stomach, with the hands joined behind the head, bending the trunk backwards, moving the elbows backwards, and bringing the shoulder blades together;
- lying on the back, with the arms straight behind the head, while the legs perform a pendulum-like movement;
- lying on the back, with the arms bent and joined behind the head at the back of the head, the elbows under water, while the legs perform a pendulum-like movement [20].

Scoliosis is a serious condition, and selection of exercises cannot be made in a single, uniform way. Each case differs from another in terms of the location of the lateral curvature. Scoliosis represents a very serious therapeutic problem. Almost every case of scoliosis is different and therefore requires an individual treatment programme, depending on its type, extent, and cause.

### Exercises for scoliosis:

- sitting cross-legged, inhaling through the nose and exhaling through the mouth, with the arms extended forward and resting on the knees, palms facing upward;
- lying on the stomach, raising the arms and trunk forward and upward, holding the position for 15 seconds, and then relaxing for 3 seconds;
- lying on the back, with the legs bent and pulled toward the chest, holding the lower legs with the hands, maintaining the position for 5 seconds, and then relaxing for 4 seconds;
- backstroke swimming, with the arm on the concave side of the curvature extended along the long axis of the body, while the other arm remains along the body; the legs perform a pendulum-like movement;
- swimming on the chest, with the arm on the concave side of the curvature extended along the long axis of the body, while the other arm remains along the body; the legs perform a pendulum-like movement [17].

The value of swimming is difficult to exaggerate because, in addition to all the above-mentioned, it creates the state of absolute absorption in the process that resembles meditation lowering depressive states, anxiety and mood disorders, enhancing sustained mental health.

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