

THE VALUE OF SWIMMING AND AQUATICAL EXERCISES IN THE DEVELOPMENT OF DOWN SYNDROME CHILDREN'S BODY SCHEMA

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Abstract: *This study sought to show how swimming and aquatic activities might help people with Down syndrome with their coordination and balance (knowledge of one's own body and its parts, awareness of one's own image, and laterality). The target group consisted of 15 Down syndrome diagnosed children (n = 15), children who did not practice swimming lessons or any activity that involved physical movement in water, but only had engaged in structured physical activities outside of the physical education classes that were part of the school curriculum. We can reject the null hypothesis that swimming and aquatic activities do not create the body schema, a component of psychomotricity, because each participant significantly improved their final score on each of the 10 items, and the overall p-value was less than 0.05. applying a swimming program that incorporates challenging and diverse aquatic activities might help people with Down syndrome build their body schema, a crucial aspect of human psychomotricity.*

Key words: *Down syndrome, swimming, aquatic exercises, psychomotricity, body schema.*

1. Introduction

The most prevalent genetic condition causing intellectual disability is Down syndrome (DS). The cause of this syndrome is considered as the third copy of Homo Sapiens chromosome 21 (HSA21). The 200 – 300 genes on

chromosome 21 as well as epigenetic factors are thought to be contributing factors to the clinical features of the syndrome [4]. The variance in clinical symptoms is influenced by a number of genes, both on chromosome 21 and elsewhere in the genome, including the DS

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cell adhesion molecule and the amyloid precursor protein gene polymorphisms.

Children with DS usually present difficulties in the sphere of motor and psychomotor qualities, respectively, reduced strength, resistance, balance and coordination level associated with a low cardio-respiratory capacity and neuromuscular control [19]. Psychosocially, their potential for development and socialization has seen more and more success, thanks to the widely implemented early support offered to affected children and their families, although there are still inequalities in access to medical care and other support resources [2].

Some specialists characterize people who present disorders in the sphere of psychomotricity, thus "...those who constitute the large category of uncoordinated, clumsy, slow, unstable, impulsive, inhibited, emotional, i.e. individuals whose self-control is disturbed". (Mazo cited by Moţet, 2001).

According to the aforementioned author, our study focuses on the body schema, a part of human psychomotricity. Body schema disturbances may result from cerebellar lesions, like kinesthetic illusions, or brain lesions, like the inability to name, distinguish, and show segments of one's own body or a partner's body. Simultaneously, the specific symptomatology of this type of disorder can also be characterized by the impossibility of knowing the parts of one's own body or that of one's partner, the correct establishment of spatial relationships between one's own body and surrounding objects or between objects. The author continues to mention the lack of concentration, imitation, as well as the lack of knowledge of the

spatial parameters of one's own body, which causes mistakes in the execution of movements through the incorrect use of the limbs. It is noted the delay in making movements due to a slow thought process, lack of coordination, lack of intention in the lively execution of movements, non-completion of actions caused by the appearance of disturbing factors.

Swimming, as a form of physical exercise, is considered an important element in the theory of learning motor actions, as it involves performing movements in the aquatic environment, different from those performed on land, such as, for example, learning to move in the water. The specificity of the aquatic environment leaves a significant imprint on children with Down syndrome in the learning process, which can explain the development of the child's ability to form an image of his own body and that of others (body schema).

Currently, if we discuss swimming, we are referring to a sport whose effects in terms of morpho-functional, motor and psychomotor development are not at all negligible. For individuals with musculoskeletal problems, such as low muscle tone and excess adiposity, as seen in adults with DS, water training may be a desirable option to land-based physical activity regimens [1].

However, when we compare to their contemporaries, those with DS have lower levels of physical activity [17], which is why a higher level of physical activity is recommended for this category of people.

Over time, experts attempted to determine how physical activity and training affected the health state and functional ability of those with DS, but the studies' findings were inconclusive [13].

The same authors claim that the aquatic environment is generally enjoyed by young people, and they participate in this type of physical activity willingly. Training in children with DS increased maximal ventilation, muscle strength, and aerobic work capacity as well as cardiac and cardiorespiratory efficiency [14].

There is a need for more research on the effectiveness of aquatic exercises for enhancing the body schema of people with DS. Many authors investigated the impact of various water programs on fitness and health status in people with DS. However, the results were not statistically significant.

Training in children with DS increased maximal ventilation, muscle strength, and aerobic work capacity as well as cardiac and cardiorespiratory efficiency [8], [15], [18].

Numerous research have concentrated on physiological adaptations, such as enhancements in cardiovascular activity, muscle strength, and changes in body composition seen after an exercise program, to increase physical fitness in patients with DS [5].

However, 80% of teenagers worldwide are thought to be insufficiently active [6].

The long-term well-being of individuals with DS and their families depends on paying close attention to significant periods or life events, such as work, access to health care, and community involvement, as well as legal issues and financial support.

Clinical research and the creation of evidence-based adult care recommendations are required as people with DS live longer and have a higher quality of life.

2. Materials and Methods

2.1. Study Design and Participants

15 children diagnosed with Down syndrome (7 boys and 8 girls) participated in the study. These kids only engaged in organized physical activities outside of the physical education classes that are part of the school curriculum; they did not practice swimming lessons or participate in previous aquatic activities as a form of physical activity. To enable them to participate in the study, partnership agreements were signed with the specialized staff from three institutions whose main objective is „Down syndrome” in Constanța - the Arena Sports Club, the Down East Association and the School Center for Inclusive Education „Delfinul”.

2.2. Study design

By creating and putting into practice a therapeutic program in which we will stimulate and capitalize, using a playful behavior, the need for movement and competition in the aquatic environment, our study aimed to demonstrate the effectiveness of swimming and aquatic exercises to improve the coordination and balance capacity (knowledge of one’s own body and its segments, awareness of self-image, laterality) of people with Down syndrome.

2.3. Intervention program

The group carried on with their regular daily activities during the intervention period, although systematic physical activity was not part of the schedule. For each pair of swimmers and one trio, practice sessions were held twice a week,

from Monday to Saturday, respectively, between 14:00 and 16:00, for 12 weeks, with duration of 60 min. At the beginning of the program, the ability to adapt to the aquatic environment of each subject was followed by the ability to coordinate body's segments in water.

The program was designed in such a way as to stimulate through swimming; skills and abilities that constitute the basis of psychomotor ability, with the aim of recording substantial improvements in the final results, compared to the initial testing.

We observe the physical and mental evolution of children, as they improve their coordination, as well as the body plan. Visual, auditory memory and kinesthetic sense are the main components on which the whole process is based, which can contribute to the development of children's qualities and capabilities.

The variety of swimming movements and procedures can contribute to the development of psychomotor function and, in the same time, can be a way to keep children's interest active throughout the study.

In this study, the swimming program for children with Down syndrome was structured into three stages and adapted according to the capabilities of each participant and included:

- a. The first stage, namely, the first four weeks, consisted in familiarizing the participants and adapting the body to the aquatic environment. The individuals could now open their eyes underwater and dunk their heads beneath water, get in and out of the water without help and move in the water with the help of their arms and legs (alternately and simultaneously).

What we could observe after completing the first stage, was the enthusiasm of the children when they made contact with the water, the smiles and the desire to play in the water.

- b. The second stage, i.e. the following four weeks, focused on the development of water games by involving different segments of the body, laterality, the use of "left", „right” commands. By the end of this stage, the subjects began to distinguish left from right and vice versa, developed the ability to work in a group, and could perform jumps from the edge of the pool.
- c. Like the other stages, the third occurred during the last four weeks and followed the development of the body schema by introducing and using materials such as balls, floats, tubes and circles of different colors. During these training sessions, we worked segmentally and globally, also using the previously mentioned materials.

Each training session was conducted according to the following structure:

- 5 minutes for a dry warm-up;
- 10 minutes for a warm-up in the water;
- 20 minutes for the main portion of the training session, 30 minutes for the second stage, and 40 minutes for the final stage;
- the recovery or closing part, consisted of water games lasting 25 min in the first four weeks, 15 min in the following four weeks and 5 min in the following weeks.

Table 1

Results of the t-test used to evaluate children with Down syndrome's body schema

ITEMI	N	TEST STATISTIC	STD. ERROR	STD. TEST STATISTIC	SIG. ^{A,B} (2-SIDED TEST)	DECISION
ESC-1-T0 ESC-1-T1	15	21.000	4.287	2.449	.014	Reject de null hypothesis
ESC-2-T0 ESC-2-T1	15	21.000	4.287	2.449	.014	Reject de null hypothesis
ESC-3-T0 ESC-3-T1	15	28.000	5.292	2.646	.008	Reject de null hypothesis
ESC-4-T0 ESC-4-T1	15	78.000	11.258	3.464	<.001	Reject de null hypothesis
ESC-5-T0 ESC-5-T1	15	91.000	12.619	3.606	<.001	Reject de null hypothesis
ESC-6-T0 ESC-6-T1	15	28.000	5.292	2.646	.008	Reject de null hypothesis
ESC-7-T0 ESC-7-T1	15	78.000	11.258	3.464	<.001	Reject de null hypothesis
ESC-8-T0 ESC-8-T1	15	66.000	9.950	3.317	<.001	Reject de null hypothesis
ESC-9-T0 ESC-9-T1	15	45.000	7.500	3.000	.003	Reject de null hypothesis
ESC-10-T0 ESC-10-T1	15	78.000	11.258	3.464	<.001	Reject de null hypothesis
ESC-TOT-T0 ESC-TOT-T1	15	120.000	17.450	3.438	<.001	Reject de null hypothesis

3. Statistical Analyze

To analyze the effect of swimming and aquatic exercises to improve body schema in children with Down Syndrome, we used the non-parametric Wilcoxon test for paired-samples matched data. Many statistical tests have been developed based on the assumption that the data have a normal distribution. To the extent that this is not true, the results of analysis using these tests may introduce some degree of error. In non-parametric tests, such as the Wilcoxon test, the condition that the scores are normally distributed (Quinn & Keough, 2002, Moore, 2009) or that the

measurement is on a scale with equal intervals (Markham, 2015) does not need to be satisfied.

4. Results

The participants were tested at the beginning and end of the program by using the body schema investigation test, from the Oseretsky-Guilmain battery (Moțet, 2001). The test consists of the correct answer to 10 commands. 1 point is awarded for each correct command, so the maximum score is 10 points.

The test validates balance, spatial orientation, and awareness of one's own and the partner's body plans.

The non-parametric Wilcoxon Signed-Rank Test was utilized to determine whether the applied swimming program documented gains in the development of the body schema in children with Down syndrome.

With the aid of the computer program SPSS Version 27, the data were systematized and processed.

Each participant significantly increased their overall score for each of the 10 items. Swimming and aquatic activities reject the null hypothesis, as shown by the values recorded in the sig. column (2-sided test), which is less than $p < 0.05$. This means that the difference between the two variables (Esc at T0 and T1) is statistically significant at the 5% level. We therefore accept the alternative theory that impressive gains in the area of psychomotricity can be attained by implementing an organized swimming program based on workouts intended to develop the body schema.

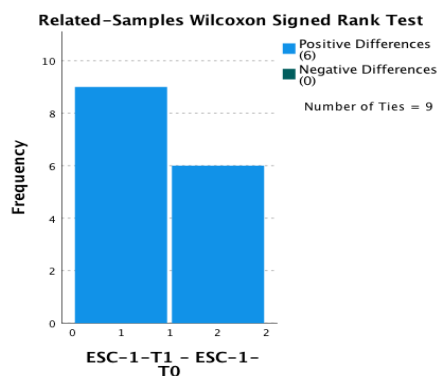


Fig. 1. *Item 1*

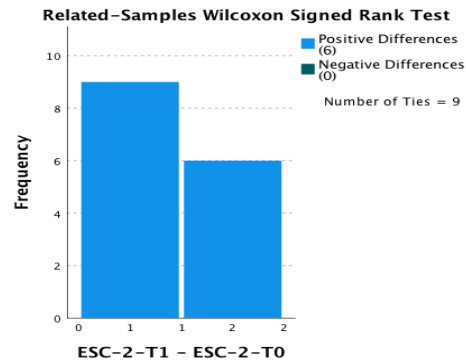


Fig. 2. *Item 2*

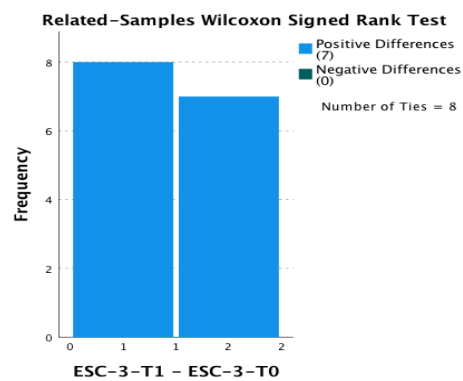


Fig. 3. *Item 3*

If we turn our attention to items 1, 2 and 3, we may notice an increase in the level of awareness of certain parts of the body, such as the eyelids, the elbow or the right thigh. All three graphs of the final tests in the three samples show improvements compared to the results obtained in the first test, where $p = 0.014$ in the case of the first and second items, respectively, $p = 0.008$ for the third (figures 1, 2, 3).

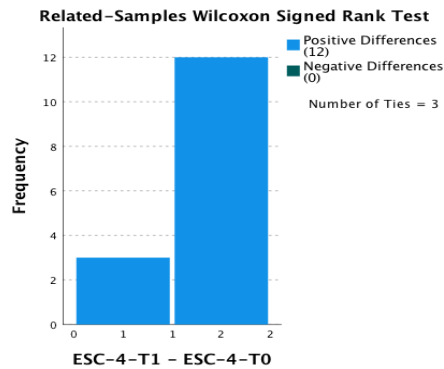


Fig. 4. Item 4

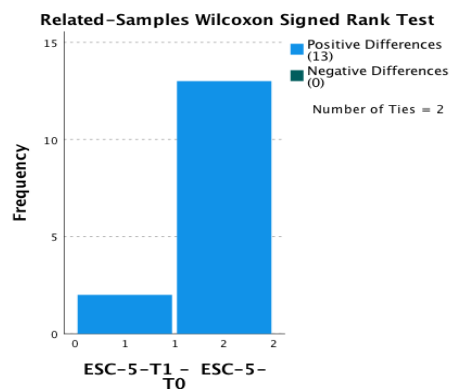


Fig. 5. Item 5

In figures 5 and 6, it is observed that in the initial testing the recorded values are lower than those of the final testing, in both items aimed at the intersegment coordination (Raise the right arm and the left leg! Take the right leg behind and catch it with the left hand!), the significance threshold registering values of $p < 0.001$, which means that the intervention program based on physical exercises carried out in the aquatic environment was effective.

5. Discussion

The specialized literature highlights the fact that people with intellectual disabilities present significant disorders at the level of body schema, general, segmental and intersegmental coordination, as well as at the level of static and dynamic balance, which has a negative impact on learning/performing fundamental locomotion skills, stability and handling [20].

Our research also supports this theory by showing that the application of a rigorous swimming program based on exercises aimed at improving fundamental movement patterns and fitness components improves the level of development of psychomotor components. Each participant achieved a significant improvement in the final score in each of the 10 items, and the total p value was less than $p < 0,05$, which supports the hypothesis that the application of a rigorous swimming program can develop the body schema of children and young people with Down syndrome.

The programs for educating posture and balance, used for eight weeks, determined statistically significant changes in the improvement of static balance ($p=0.02$), flexibility ($p=0.001$), and muscle resistance ($p=0.006$), according to research on the effects of motor interventions in children and young people with Down syndrome [7].

According to experts, when stimulation programs were used for at least six weeks to a year and a half, three to five sessions lasting between 45 and 60 minutes, and following both keeping children's physical condition safe as well as their mental and

emotional states, significant changes occurred [21].

6. Conclusions

Twelve weeks of systematic group training in two 60-minute training sessions per week and the implementation of the swimming program led to improvements in the subjects' body schema. During the study, there were improvements in the awareness of one's own and others' body segments, in differentiating left-right parts and in knowing body positions.

Simultaneously, we noticed improvements in self-confidence, the desire to improve in the execution of movements, as well as aquatic skills that began to shape/transform/change into natural movements.

The body schema side, a crucial aspect of human psychomotricity, can be developed by employing a swimming program that incorporates a variety of challenging aquatic workouts.

7. Acknowledgements

The work of Andra-Ioana Singuran was supported by the project "PROINVENT", Contract no. 62487/03.06.2022 - POCU/993/6/13 - Code 153299, financed by The Human Capital Operational Programme 2014–2020 (POCU), Romania.

Author's Contributions

This study's authors all contributed equally.

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