

Katja Roj, Jurij Planinšec,
Majda Schmidt
Slovenia

Effect of Swimming Activities on the Development of Swimming Skills in Student with Physical Disability – Case Study

DOI: 10.15804/tner.2016.46.4.19

Abstract

The aim of our study was to examine the effect of swimming activities on the development of swimming skills in student with physical disability and to determine whether these activities also affect the student's general motor development. The sample consisted of one student with physical disability in the third grade of primary school. The student was involved in a ten-hour swimming course, based on the Halliwick concept of swimming for children with special needs. Data about the student's progress were obtained through structured observations at the beginning and at the end of the course, where the SWIM internationally standardized test was used. Results show that the student developed balance, coordination, power, precision, flexibility and was capable of independent 25-meter backstroke swimming at the end of the course. Results prove that swimming is a highly suitable activity for students with physical disability.

Keywords: motor development, physical fitness, swimming course, cerebral palsy, Halliwick concept

Introduction

Regular physical activity is essential for maintaining lifelong health (O'Brien *et al.*, 2015). It means better functioning of an individual in all areas of development and better life quality (Zurc, 2009). Maintaining physical activity is particularly

important for children with physical disability, because their obstacles may interfere with daily activities and participation in sports (Van Wely *et al.*, 2014b). Their movement is slower, less qualitative and perfective. Problems arise in the coordination, flexibility, precision and rhythm of movement, due to underdeveloped motor skills (Filipčič, 2009). Children with cerebral palsy (CP) are more rarely involved in various physical activities than their peers who do not have these barriers (O'Brien *et al.*, 2015), and therefore they have a lower level of physical condition and physical activity (Van Wely *et al.*, 2014b). It is worth noticing that CP is often associated with additional problems: learning disabilities, epilepsy, visual impairment, hearing impairment, dysarthria, gastrointestinal problems, respiratory problems, bladder and bowel dysfunction, and psychosocial problems (Berker and Yalcin, 2010). Among all the associated difficulties, many authors in the world warn about the presence of pain in the lives of individuals with CP (Hinchcliffe, 2007; Mejaški-Bošnjak, 2007).

Reduced physical activity among people with CP and others with physical disability can lead to permanent inactivity (Van Wely *et al.*, 2014a), which results in an increase in body fat and loss of muscle tone, which gradually reduces health, well-being and increases the risk of type 2 diabetes or cardiovascular disease (O'Brien *et al.*, 2015). With appropriately adapted sports, rehabilitation and physical-therapeutic activities we can make their qualitative integration at work and in life possible (Brown *et al.*, 2007).

Swimming is an activity that has a positive impact on maintaining and improving health. It is also one of the most suitable physical activities for people with physical disability (Vute, 1999). The heart's functioning speeds up while overcoming water pressure, which causes better blood flow throughout the body. Consequently, there is less chance for failure of the circulatory system. Swimming causes the lung capacity to increase and strengthens the respiratory muscles (Jurak and Kovač, 1998).

Swimming and different forms of movement in water present opportunities for rehabilitation and therapeutic recreation for children with physical disability. Therapeutic effects of water activities can be seen as strengthening the weakened muscles, maintaining and increasing joint mobility, reducing pain and muscle spasms, maintaining and improving balance, posture, coordination and improving blood circulation (Zupan, 2012).

Specific characteristics of water such as density, buoyancy, hydrostatic pressure, viscosity and thermodynamics affect the swimmer's activity in water (Tripp and Krakow, 2014). Children with physical disability, who move with different tools outside the swimming pool, can move independently in water and without any

tools due to the force of buoyancy (Lepore, 2005). It takes away a specific part of the body weight in relation to the proportion of the submerged body and relieves the muscular system. The results are less burdened bones and joints. On land, muscles have to work against the force of gravity. In water, the force of buoyancy helps the muscles to move. Consequently, moves can be carried out in water, which cannot happen on land. Furthermore, moves are less painful in water (Zupan, 2012). Warm water relaxes muscles and improves muscle strength and endurance, adapted activity in water improves breathing control under water (Lepore, 2005). Water has a positive effect on the senses and the nervous system. Children with physical disability have certain parts of the body (backside, thighs and back) exposed to pressure due to sitting in a wheelchair. Those parts are therefore deprived of a variety of stimuli. Movement in water gives relief to those body parts (Zupan, 2012).

In order to maintain body temperature in water a layer of insulation is required, which consists of the subcutaneous fat and the fat in the deeper layers of the body. Children with CP often have less muscle and fat mass. Consequently, they cool down faster in water. It results in the feeling of coolness that elicits discomfort, which can lead to muscle tension and spasm. An increase in muscle tension causes an increase in muscle density and consequently poor navigability of the swimmer (Groleger Sršen, 2012).

In Slovenia, the Halliwick concept of swimming for children with special needs is established. The main idea of the program is to experience pleasure, joy and relaxedness in water (Kapus *et al.*, 2011). The program focuses on the swimmer's stability achievement and on the control of the moves, which is the basis for safe and coordinated movement in and out of water (Tripp and Krakow, 2014). The goal of the program is secure, independent and relaxed movement in water (Vute, 1999). The Halliwick concept program includes the techniques of aquatic therapy, according to which specific therapeutic exercises were developed (Hastings, 2010).

In Slovenia, two studies were carried out recently, which involved children with special needs who attended a swimming course to learn to swim with the use of the Halliwick concept of swimming (Groleger Sršen *et al.*, 2010; Božič *et al.*, 2013). The first survey was conducted in 2010, in which 12 children with special needs participated, who had various problems with movement or learning. The children attended the swimming program for four years. They were evaluated at the beginning and at the end of the school year. The SWIM scale and Halliwick badges were used for the evaluation. It was found that the average value for individual skills at the retesting improved statistically significantly ($p < 0.05$) for all skills except the

entry into water. The children achieved the greatest progress in the longitudinal rotation and in the development of swimming style (Groleger Sršen *et al.*, 2010).

The second study was carried out three years later, when the progress of 10 children with disabilities was monitored. They attended the Halliwick concept of swimming for 18 hours in a school year. It was found out that the children made progress in all skills. Good progress was achieved in backward and forward transversal rotation, as these are the simplest skills. Less progress was found in combined rotation, since it is more difficult (Božič *et al.*, 2013).

In the literature, there is not much research into the development of swimming skills in children with physical disability. This finding represents the basic purpose of our study. Each child with physical disability has specific characteristics, individual adjustments and responds differently to the new environment and situation. Because of the differences in needs and degrees of disabilities children cannot benefit from the same treatment, so we decided to use a case study.

Previous research shows that children achieve the greatest progress in the development of basic swimming skills (breathing control, maintaining balance, longitudinal rotation, etc.), and the least progress in the development of advanced swimming skills (sagittal rotation, combined rotation, etc.). We assumed that our child with disability would develop basic swimming skills and that the results at the final measurement would be better than the results at the initial measurement. We predicted that our child would make progress in the development of swimming style and would be able to swim independently at least 15 meters.

Methods

The sample

The research sample was purposive and non-probable. It included one student, who attends the third grade of an elementary school near Maribor, is male and is nine years old. The student has the placement decision of special needs, where he is defined as a child with severe physical disability and with learning disabilities. The reason for that is cerebral palsy (CP), specifically diplegia and a spastic form of CP. The student's both legs are impaired, so he uses an electric wheelchair. Problems arise in sensorimotorics, fine and gross motor. The student has difficulty in fixing the eyes and eye-hand coordination. Fine motor is better developed in his right hand and it is harder for him to perform tasks with the left hand. Activities that require precise movements are harder for him. Therefore, he has the adjustments

in the use of teaching aids. The student also attends physiotherapy treatment once a week. His parents were informed of the purpose and the expiry of the research. They signed an informed consent concerning the participation of their child in the study.

Sample variable –SWIM test

The information about the student's progress at the swimming course was obtained through structured observations at the beginning and at the end of the swimming course. Internationally standardized SWIM test was used, which measured the progress in developing swimming skills. The author of the SWIM test is Peacock (Groleger Sršen *et al.*, 2010). The purpose of the test is to evaluate the basic skills of an individual in a swimming pool. The test verifies an individual's swimming skills which are necessary for independent swimming (Groleger Sršen *et al.*, 2010).

The SWIM test includes 11 swimming skills (A – entry into water, B – adjustment to water, C – breathing control, D – maintaining balance, E – backward transversal rotation, F – forward transversal rotation, G – sagittal rotation, H – longitudinal rotation, I – combined rotation, J –development of swimming style and K – exit from water). Each individual swimming skill is divided into seven levels or points (1–7), describing the extent to which the learner has mastered a particular skill. It is therefore a seven-point rating scale, where 1 means that the mentioned skills cannot be executed with help, 7 means that the skill can be executed completely independently. The student can reach a maximum of 7 points for each individual skill, which means that he can reach a total maximum of 77 points in the SWIM test.

The measurement characteristics of the SWIM test:

- **Validity:** an internationally standardized test was used, which was tested on the Slovenian population of children. Determining validity is based on content (rational) validation (Groleger Sršen *et al.*, 2012).
- **Reliability:** reliability is proven with the use of the method of internal consistency or the concordance between pairs of assessors, among whom there were no differences in the assessments (Groleger Sršen *et al.*, 2012).
- **Objectivity:** the assessor of the student's knowledge of swimming skills was suitably qualified. For evaluation, a license for a swimming instructor for the Halliwick concept of swimming for children with special needs is required. The assessor held the license.

Methods of data processing

The data were analysed with the use of qualitative content analysis. An analysis of the student's achievements was made at the beginning and at the end of the swimming course and a precise description of progress was made for each of the eleven swimming skills.

Results

The student scored 48 points at the initial testing and 59 points at the final testing.

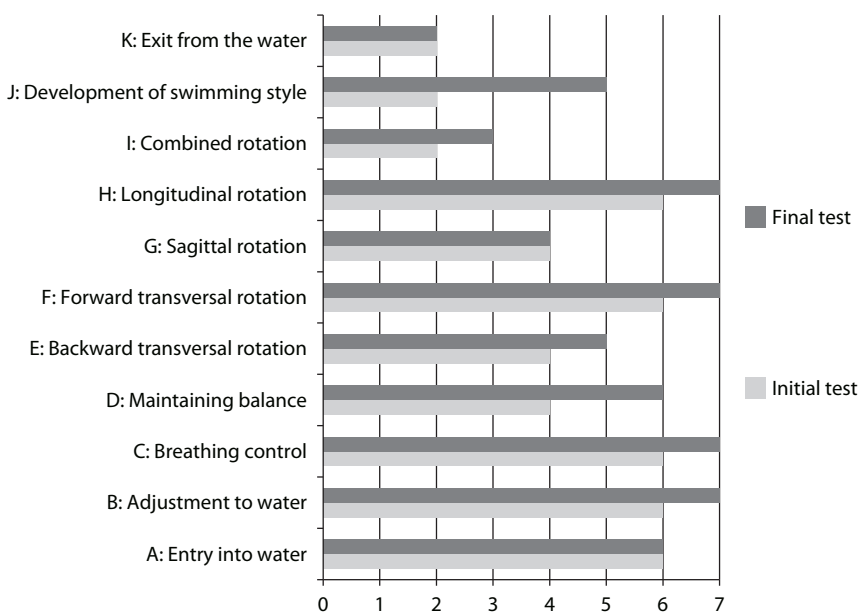


Figure 1. Comparison of points obtained on initial and final testing with the SWIM test according to individual swimming skills

From Figure 1 it is evident that the student made progress in eight of the eleven skills. He improved in the skills B – adjustment to water C – breathing control, D – maintaining balance, E – backward transversal rotation, F – forward transversal rotation, H – longitudinal rotation, I – combined rotation and J – development of swimming style. The progress is not shown in skills A – entry into water, K – exit from water and G – sagittal rotation.

Discussion

The student achieved the greatest progress in the development of swimming style, where he improved by 3 points. At the beginning of the course, he swam 5 metres with the support of his instructor, at the end of the course, he could swim independently 25 meters backstroke without support. The reason for such significant progress is the student's ability to maintain balance in water. The student had problems with balance and buoyancy at the beginning, because the lower part of his body submerged towards the bottom of the pool, which made it difficult to swim.

With the adjustment to water, breathing control, backward transversal rotation and longitudinal rotation, the student reached all points (7 points) at the end of the swimming course. We must emphasize that he reached 6 points in each of the four skills at the initial test, which represents a high initial result. Therefore, we expected him to reach the highest result (7 points) for these skills at the final test. The reason for such high initial results is the fact that the student likes water and aquatic activities. Every year during the summer holidays, he attends holiday activities for children with special needs, where he learns to swim with professionals. We believe that the student is well adapted to water and can correctly monitor his breathing. We noticed that he did not show any signs of fear of water and of the exhalation in water, as he already enjoyed the first hour of the swimming course in water, diving his head under water and picking submersible toys.

We would like to point out the student's progress in forward transversal rotation and longitudinal rotation, which he could carry out completely independently at the end of the course. We noticed that he needed some guidance for the latter two skills to rotate easily. The student was unable to plan his moves to do forward transversal rotation (from the position of lying on his back to the position of lying on his stomach along the transversal axis). He had trouble with organizing movements, because he made some unnecessary movements at the initial testing, which resulted in turning the body in the wrong direction. The instructor taught him how to carry out the rotation during the training. The same problem was also in the longitudinal rotation (from the position of lying on his back to the position of lying on his stomach along the longitudinal axis). The student rushed too much and wanted to implement the rotation as soon as possible. Consequently, incorrect movements occurred.

We noticed that the student relaxed in water on the third day of the swimming course. He became confident and gained self-esteem. On the first two days, he expressed the wish that the instructor held him repeatedly. We believe that he

experienced the fear associated with distrust in himself. His movements were tense and stiff because of tension. On the third day, the fear disappeared. He showed a desire for greater autonomy in water. The instructor did not hold him all the time, but most of the time the student moved independently. The instructor was present and offered him support when he needed it. We believe that the student became more flexible in water due relaxedness, which could cause correct and precise movements and better coordination.

The research proved that the swimming activity is important in the improvement of the health and development of a child with physical disability. Specific water characteristics have a positive and relaxing influence on an individual. Due to the feeling of lightness in water, a child with physical disability moves easily in water (Zupan, 2012). Children in wheelchairs are often deprived of a variety of sports activities. Consequently, they are less active or even inactive. Reduced sports activity or inactivity often leads to health problems (O'Brien *et al.*, 2015).

The research showed that for a positive impact and progress in swimming a high quality and appropriate approach to teaching to swim is required. Teaching of swimming skills should be individually oriented. It should satisfy the needs and take into account the disabilities of the student (Maes and Gresswell, 2010). In this study, we used the Halliwick concept of swimming, which takes into account the swimmer's performance and provides customized training intensity (Vute, 1999; Kapus *et al.*, 2011; Tripp and Krakow, 2014). The student achieved remarkable progress in ten hours, to which his relaxedness and courage in water contributed. It is an important fact that the swimming course was held during the regular school programme of physical education in elementary school. The study confirms and proves that many children with physical disability who attend the regular programs of elementary schools should participate in a swimming course, which is a mandatory part of the curriculum for physical education.

Conclusion

We can conclude that swimming is an activity which is extremely important for children with physical disability and it should be implemented as often as possible. A child can be offered individual and high-quality training, in which he can develop his physical skills, and at the same time alleviate developmental disabilities through physical activity, improve his health and reduce effects of less active life.

It may be added that swimming makes it possible for the child to achieve success and the success in learning has a positive impact on the child's self-esteem and

self-confidence. A positive experience with learning is the vital encouragement for lifelong acquisition and upgrading of knowledge and skills (Bakracevic Vukman, Funcic Masic and Schmidt, 2013).

Conflict of interest: The authors declare that no conflict of interest exists.

References

- Bakracevic Vukman, K., Funcic Masic, T., Schmidt, M. (2013). Self-regulation of Learning in Secondary School Students with Special Educational Needs and other Students of Vocational and Technical Schools. *The New Eduactional Review* 33, 297–307.
- Berker, N., Yalcin, S. (2010). *The help guide to cerebral palsy*. Washington: Global Help.
- Božič, M., Groleger Sršen, K., Vrečar, I., Vidmar, G. (2013). Izboljšanje plavalnih veščin pri otrocih z zmanjšanimi zmožnostmi v programu učenja plavanja po Halliwickovem konceptu. [Improving swimming skills in children with disabilities involved in Halliwick's swimming program.] *Rehabilitacija* 12, 32–38.
- Brown, I., Parmenter, T.R., Percy, M. (2007). Trends and issues in intellectual and developmental disabilities. In *A comprehensive guide to intellectual and developmental disabilities*. Baltimore: P.H. Brookes Publishing Co.; pp. 45–57.
- Filipčič, T. (2009). Otroci s posebnimi potrebami pri pouku športne vzgoje. [Children with special needs in physical education.] Retrieved 3/10/2014, from: <http://www.os-hpuhar.si/default.aspx>.
- Groleger Sršen, K. (2012). Učenje plavanja invalidov – specifika plavanja pri različnih vrstah invalidnosti. [Teaching disabled people to swim - the specifics of swimming in various types of disability.] In: *Plavanje invalidov: zbornik predavanj*. Ljubljana: Univerzitetni rehabilitacijski inštitut Republike Slovenije – Soča, Zveza za šport invalidov Slovenije – Paraolimpijski komite, Fakulteta za šport; pp. 14–19.
- Groleger Sršen, K., Vidmar, G., Pikel, M., Vrečar, I., Burja, C., Krušec, K. (2012). Content validity and inter-rater reliability of the Halliwick-concept-based instrument Swimming with independent measure. *Int J Rehabil Res* 35, 116–123.
- Groleger Sršen, K., Vrečar, I., Vidmar, G. (2010). Halliwickov koncept učenja plavanja in ocenjevanje plavalnih veščin. [Halliwick's concept of learning to swim and evaluation of swimming skills.] *Rehabilitacija* 9, 32–39.
- Hastings, P. (2010). The Halliwick concept: Developing the teaching of swimming to disabled people. Retrieved 27/10/2014, from: <http://halliwick.files.wordpress.com/2011/11/halliwick-jan2010.pdf>.
- Hinchcliffe, A. (2007). *Children with cerebral palsy: a manual for therapists, parents and community workers*. New Delhi: SAGE Publications India Pvt Ltd.

- Jurak, G., Kovač, M. (1998). *Morski konjiček: priročnik za učenje plavanja*. [Sea Horse: A guide to swimming.] Ljubljana: Zavod za šport Slovenije.
- Kapus, V., Štrumbelj, B., Kapus, J., Jurak, G., Šajber, D., Vute, R. et al (2011). *Plavanje: učenje: Slovenska šola plavanja za novo tisočletje. Učbenik za učence-studente, učitelje-profesorje, trenerje in starše*. [Swimming: Teaching: Slovenian swimming school for new millennium. The textbook for pupils-students, teachers-professors, coaches and parents.] Ljubljana: Fakulteta za šport, Inštitut za šport.
- Lepore, M. (2005). Aquatics. In *Adapted physical education and sport* (4th ed.). Champaign, IL: Human Kinetics; pp. 435–454.
- Maes, J.P., Gresswell, A. (2010). The Halliwick Concept for clients with cerebral palsy or similar conditions. Retrieved 25/10/2014, from: <http://www.halliwick.org.uk/downloads/TheHalliwickConceptforclientswithcerebralpalsyorsimilarconditionsBAPTNewsletter62.pdf>.
- Mejaški-Bošnjak, V. (2007). Neurološki sindromi dojenačke dobi. [Neurological syndromes of infant age and cerebral palsy.] *Paediatr Croat* 51 (Suppl1), 120–129.
- O'Brien, T.D., Noyes, J., Spencer, L.H., Kubis, H.P., Edwards, R.T., Bray, N. et al. (2014), Well-being, health and fitness of children who use wheelchairs: Feasibility study protocol to develop child-centred 'keep-fit' exercise interventions. *J Adv Nurs* 71, 430–440.
- Tripp, F., Krakow, K. (2014). Effects of an aquatic therapy approach (Halliwick-Therapy) on functional mobility in subacute stroke patients: a randomized controlled trial. *Clin Rehabil* 28, 432–439.
- Van Wely, L., Balemans, A.C.J., Becher, J.G., Dallmeijer, A.J. (2014a). The effectiveness of a physical activity stimulation programme for children with cerebral palsy on social participation, selfperception and quality of life: a randomized controlled trial. *Clin Rehabil* 28, 972–982.
- Van Wely, L., Balemans, A.C.J., Becher, J.G., Dallmeijer, A.J. (2014b). Physical activity stimulation program for children with cerebral palsy did not improve physical activity: a randomised trial. *J Physiother* 60, 40–49.
- Vute, R. (1999). *Izzivi drugačnosti v športu*. [The challenges of diversity in sport.] Ljubljana: Debora.
- Zupan, A. (2012). Pomen plavanja in ostalih oblik gibanja v vodi za invalide. [The importance of swimming and other forms of movement in water for people with disability.] In *Plavanje invalidov: zbornik predavanj*. Ljubljana: Univerzitetni rehabilitcijski inštitut Republike Slovenije – Soča, Zveza za šport invalidov Slovenije – Paraolimpijski komite, Fakulteta za šport; pp. 1–8.
- Zurc, J. (2009). Gibalna aktivnost kot sestavni del promocije zdravja. [Physical activity as an integral part of health promotion.] In *New trends in contemporary nursing - promoting research, education, and multisector partnership*. Jesenice: Visoka šola za zdravstveno nego; pp. 378–384.