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THE SWIMMING PROGRAM EFFECTS ON THE GROSS MOTOR FUNCTION, MENTAL ADJUSTMENT TO THE AQUATIC ENVIRONMENT, AND SWIMMING SKILLS IN CHILDREN WITH CEREBRAL PALSY: A PILOT STUDY

The aim of this research was to determine the swimming program effects on the gross motor function, mental adjustment to the aquatic environment and the ability to move in the water and swim in children with cerebral palsy. The sample consisted of seven children (4 boys and 3 girls) with spastic cerebral palsy and an average age of 9y 5mo ± 1y 3 mo. The swimming program lasted 6 weeks, with two swimming sessions per week. Each session lasted 45 minutes. The swimming program included the application of the Halliwick Method and swimming exercises which are used in a healthy population. The GMFM test was used for the assessment of gross motor functions. The WOTA2 test was applied to assess mental adjustment and swimming skills. The Wilcoxon matched pairs test was used to determine the statistically significant differences between the initial and final measuring. The results have indicated that there was statistically significant differences in the E dimension (p=0.04) and the total score T (p=0.03) of the GMFM test, then for mental adjustment to the aquatic environment WMA (p=0.02), ability to move in water and

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swimming skills WSW (p=0.03) and the overall result WTO (p=0.02) of the WOTA2 test.

The applied swimming program had a statistically significant effect on the improvement in walking, running and jumping as well as the overall gross motor functions of children with cerebral palsy. The applied program also contributed to a statistically significant influence on the increase in mental adjustment to the aquatic environment and the ability to move in water and swim.

Key words: *Hallwick Method, swimming program, cerebral palsy, gross motor function.*

INTRODUCTION

Cerebral palsy is characterized by the limited ability of movement and balance due to the damage to the parts of the brain which control muscle tonus and spinal reflexes (Laskin, 2003). The majority number of children with cerebral palsy suffer from spastic cerebral palsy, which usually affects the lower extremities more than the upper ones (Dimitrijević et al., 2007). Based on the Surveillance of Cerebral Palsy in Europe (2002), the prevalence of cerebral palsy in the period between 1980 and 1990 was 2.08 out of every 1000 newborns. Despite the development of medicine in general, as well as in terms of neonatology and perinatology, the prevalence of cerebral palsy has not diminished, and 2 out of 1000 newborns are still affected by it (Cock, 2009). Cerebral palsy falls into the category of dynamic disabilities. This means that the physical conditions of individuals with cerebral palsy can be altered under the influence of physical activities and exercise (Lockette & Keyes, 1994). Early diagnosis and early therapy are of the utmost importance for the rehabilitation process of children with cerebral palsy (Dimitrijević & Jakubi, 2005).

Aquatic interventions are some of the most popular forms of alternative therapy used for children with cerebral palsy and similar neuromotor damage (Hurvitz et al., 2003). Some of the aquatic therapy programs in use among the patients with cerebral palsy include the Halliwick Method, Bad Ragaz Ring Method and Watsu (Hanlon & Hines, 2007). The Halliwick Method is a swimming program aimed to enable individuals with disability to learn how to swim and

independently move in the aquatic environment (Lambeck & Gamper, 2009). The basis of the Halliwick Method is a program containing ten points which are focused on postural control during the process of learning how to swim (Lambeck & Stanat, 2000). The 10 item program consists of three levels of learning: mental adjustment, control of balance and movement (Lambeck & Gamper, 2009). It could be said that, by means of the process of motor learning in the Halliwick Program, an individual with disability first learns how to maintain his/her balance in a stable floating position on their back, and then learns how to move about in the aquatic environment, or in other words, swim. Today the Halliwick Method is also successfully being used as a swimming program for individuals with disability as well as the aquatic therapy program (Grosse & Lambeck, 2004). Getz et al. (2007), Hiromi et al. (2005), Mackinnon (1997), have all applied the Halliwick Method in their research involving children with cerebral palsy.

The history of aquatic programs for individuals with disabilities has followed a progress from aquatic therapy to adapted aquatics. Adapted aquatics program was created as a consequence of the raised awareness that all individuals should have the ability to learn basic swimming skills. Individuals with disability can now take part in a variety of aquatic activities such as swimming, diving, water polo, synchronized swimming, aqua aerobic (Sherrill & Dummer, 2004). The physical and psycho-social benefits of aquatic activities are more significant and more pronounced among individuals with disability than other individuals (Lepore, 2005). Unrestrained movement and the ability to use muscles which have trouble overcoming gravitational constraints are the primary reasons why swimming and any related aquatic activities are suitable for individuals with a wide range of physically disabling conditions that include amputation, cerebral palsy and even paraplegia (Prins, 2009). The potential benefits of the adaptive aquatic programs include the increase in cardio-respiratory endurance, strength, coordination and swimming skills improvement (Fragala-Pinkham et al., 2010). Aquatic exercise can especially be used for the fitness level enhancement among children with cerebral palsy (Kelly & Darah, 2005). Water actually represents a medium in which

everyone can take part in recreational and therapeutic activities, irrespective of their age (Daly & Lambeck, 2007).

The objective of this research was to determine the swimming program effects which included the Halliwick Method and swimming exercises for healthy population on the gross motor function, mental adjustment to the aquatic environment and the ability to move in water and swim in children with cerebral palsy.

METHOD

Participants

The sample consisted of seven children (4 boys and 3 girls) with spastic cerebral palsy. All children from the city of Niš are included in rehabilitation process at the Department of Physical Medicine, Clinical Center in Niš. The average age of the participants was 9 year 5 months ± 1y 3mo (Mean±SD). The inclusion criteria were: (1) aged 7 to 11 years, (2) able to walk independently with or without an assistive device, (3) able to follow simple verbal instructions, (4) any level of swimming ability and (5) written consent from their parents and doctor in charge of their rehabilitation. Four children had level I, two children had level II and one child had level III of the Gross Motor Function Classification System (GMFCS). Level I - means walking without restriction, the limitations are in the more advanced gross motor skills. Level II - means walking without assistive devices, walking limitations outdoors and in the community. Level III - means walking with assistive mobility devices, walking limitations outdoors and in the community (Palisano, Rosenbaum, Walter, Russell, Wood et al., 1997). GMFCS is a 5 level classification system that describes the gross motor function of children with cerebral palsy on the basis of their self-initiated movement with particular emphasis on sitting (truncal control), walking, and wheeled mobility. Distinctions between levels are based on functional abilities, the need for assistive technology and to a much lesser extent, movement quality (Palisano, et al., 1997). Their parents Written consent for the participation in this research and the research itself were carried out in accordance

with the standards of the Helsinki Declaration from 1975 (WMA, 2008). The characteristics of the participants are shown in Table 1.

Table 1 – The basic characteristics of the participants

The number of participants		7
The participant's age (year and months)	Mean±SD	9y 5mo±1y 3mo
	age range	7-11
The participant's gender	Male	4
	Female	3
GMFCS levels	I	4
	II	2
	III	1
The type of cerebral paralysis	Quadriplegia	1
	Diplegia	2
	Hemiplegia	4

Measurements

Gross Motor Function Measure–88 (GMFM-88)

The Gross Motor Function Measurement Test (GMFM) with 88 items was used for the purpose of the assessment of the gross motor function (Russell, Rosenbaum, Avery, & Lane, 2002). Each item was assessed by using the ordinary scale ranging from 0 to 3 points. The research was executed in all five dimensions: A (lying and rolling), B (sitting), C (crawling and kneeling), D (standing) and E (walking, running and jumping). After that, the results were calculated for each dimension individually and for the overall result (T) for all five dimensions combined. The results of this test are expressed in percentages (%). Measuring the gross motor function by means of the GMFM test was performed at the Department of Physical Medicine, Clinical Center in Niš. The testing was conducted by two physiotherapists with years of experience. The GMFM is a standardized test for the motor function assessment of children with cerebral palsy and enables the monitoring of changes in motor functions over the time (Russell et al., 2002). The test validity was confirmed in the research (Russell, Rosenbaum, Cadman, Gowland, Hardy et al., 1989).

Water Orientation Test Alyn 2 (WOTA 2)

The Water Orientation Test Alyn 2 (WOTA2) was used for the assessment of the psychological adjustment to the aquatic environment and the swimming skills of children with cerebral palsy. This test is used to assess the degree of the psychological adjustment of an individual to the aquatic environment and one's level of functioning in the pool, that is, one's swimming skills. The results of the (WOTA2) test led to three variables: WTO - the overall test scores, WMA - water mental adjustment and WSW - the ability to move in the water and swim.

This test is used for children with disabilities who can understand and carry out simple instructions. It was designed and developed by Ruti Tirosh, the Head of the Hydrotherapy Department, in 1999 in the Alin Hospital. The test consisted of 27 items or tasks. The each task performance was assessed on the ordinary scale of 0 to 3 points. This test results are expressed in percentages (%). The WOTA2 test was measured in the pool located within the Department of Physical Medicine, Clinical Center in Niš. Based on the Halliwick Concept (Tirosh, 2011). Tirosh, Katz-Leurer & Getz, (2008), the test has confirmed its reliability and validity.

Procedure

The study employed a non-randomized A–B group design consisting of two measurement sessions. Outcomes were measured twice: firstly, at the initial measuring (A) during the baseline before the intervention was initiated and secondly, at the final measuring (B) at the end of the 6-week aquatic intervention.

Intervention

The swimming program lasted 6 weeks with training sessions twice per week. Each session lasted 45 minutes. The swimming program included the use of the Halliwick Method and swimming exercises which are used on a healthy population. The program was conducted in the pool which is located within the Department of Physical Medicine, Clinical Center in Niš.

The Halliwick Method (McMillan, 1978) included the use of the Ten Point Swimming Program. According to Lambeck et al. (2009) this encompassed: 1. mental adjustment, 2. sagittal rotation control, 3. transversal rotation control, 4. longitudinal rotation control, 5. combined rotation control, 6. upthrust, 7. balance in stillness, 8. turbulence gliding, 9. simple progression and 10. basic Halliwick movement. During the realization of these program points, exercises and games were used for every point of the program (Kapus, Štrumbelj, Kapus, Jurak, Pincolič et al., 2002; Vute, 1999). The manner in which the exercises were performed was learned during the Halliwick Course in Budapest in 2010. The realization of the cited program points enables participants to move independently in the water and to swim using a technique which requires doing the back stroke with both hands (basic Halliwick movement).

Exercises used to teach swimming in a healthy population (Madić, Okičić & Aleksandrović, 2007) were used so that the participants could learn the freestyle, backstroke and breaststroke techniques. Every child is practiced by an instructor. Depending on the participants' individual progress during the swimming program, increasingly more exercises were used for the realization of the basic Halliwick movement, freestyle, breaststroke and backstroke technique.

Statistical Analysis

The Wilcoxon matched pairs test for nonparametric statistics was used in order to determine the differences between the initial and final measuring of the GMFM and WOTA2 test. Statistically notable differences were determined at the 0.05 ($p \leq 0.05$) significance level.

RESULTS

Table 2 shows the differences between the initial (I) and final (F) individual dimensions measuring as well as for the overall result (T) of the GMFM test by using the Wilcoxon matched pairs test. The obtained results indicate that a statistically significant difference

between the initial and final measuring exists in the (E) dimension as well as for the overall result (T).

In the (E) domain, which is used to assess the ability to walk, run and jump, statistically significant changes were noted at the final measuring compared to the initial one, at the p= 0.04 significance level. The increase in the results in percentages went from 75.36% to 80.35%.

As for the overall result (T), which refers to the overall results at all the domains, statistically significant changes were determined at the final measuring, in comparison to the initial one, at the p= 0.03 level. The results increase in percentages went from 89.47% to 91.11%.

The difference between the initial and final measuring was also determined in the (D) domain, which refers to the ability to stand, but it was not statistically significant p= 0.07. In the case of the remaining dimensions (A, B and C), no differences were determined between the initial and final measuring. The high values in the A, B and C dimensions at the initial measuring are the reasons for these results.

Table 2 – The results of the Wilcoxon matched pairs test for the GMFM test

GMFM test	Initial measuring		Final measuring		Wilcoxon matched pairs test		
	Mean	SD	Mean	SD	T	Z	p
A(%)	99.44	1.485	100		0.00		
B(%)	99.29	1.89	99.29	1.89	0.00		
C(%)	90.81	17.03	93.87	14.14	0.00		
D(%)	81.01	21.35	83.21	22.29	0.00	1.83	0.07
E(%)	75.36	29.69	80.35	24.75	0.00	2.02	0.04
T(%)	89.47	12.53	91.11	10.66	0.00	2.20	0.03

A, B, C, D, E - dimensions of the GMFM test, T – the total score of the GMFM test

Table 3 shows the differences between the initial (I) and final (F) measuring in the overall result WTO of the WOTA 2 test, in the mental adjustment to aquatic environment WMA and the ability to move and swim in the water WSW. The obtained results indicate that in the case of all three variables, statistically significant changes took place in the final measuring (F) in comparison to the initial one (I). Changes in the WTO variable were statistically significant at the p= 0.02 level, where the results increase in percentages went from 35.62% to 60.85%. The changes in the variables of mental adjustment to the aquatic environment WMA are statistically significant at the

p= 0.02 level. The results increase for this variable in percentages went from 61.91% to 88.64%. In the case of the WSW variable, statistically significant changes also took place at the p= 0.03 level. As for this variable, the greatest changes between the initial and final measuring expressed in percentages went from 1.02% to 35.03%.

Table 3 – The results of the Wilcoxon matched pairs test for the WOTA2 test

WOTA 2 test	Initial measuring		Final measuring		Wilcoxon matched pairs test		
	Mean	SD	Mean	SD	T	Z	p
WTO(%)	35.62	22.44	60.85	25.38	0.00	2.37	0.02
WMA(%)	61.91	22.57	88.64	12.81	0.00	2.37	0.02
WSW(%)	1.02	2.70	35.03	42.36	0.00	2.20	0.03

(WTO - total score, WMA - mental adjustment, WSW - the ability to move about in the water and swimming) of the WOTA2

DISCUSSION

The results indicate the applied swimming program positive effects on the E dimension that represents the ability to walk, run and jump and on the overall result (T) of the GMFM test. The improvement in the results of the E dimension was 4.99% and in the overall result 1.64%. The obtained results indicate that a positive influence of the applied swimming program was determined according to the ability of children with cerebral palsy to walk, run and jump. Furthermore, a significant improvement was determined in the overall gross motor function of these participants. In the case of the A, B and C dimensions, no differences were determined between the initial and final measuring. The reason for this are the high results obtained for these dimensions at the initial measuring. In the case of the A and B dimensions, the results obtained at the initial measuring were 99.44% and 99.29%. As for the C dimension, the result was somewhat lower, 90.81%.

In the case of the GMFM test, the obtained results are in accordance to the results obtained by Thorpe et al. (2005), Fragala-Pinkham et al. (2009), Retarekar et al. (2009), Mackinon (1997). On the sample of seven children with cerebral palsy Thorpe et al. (2005) established an increase in the results of the GMFM test for the E dimension by 7% at the p=

0.01 significance level. The exercise program lasted 10 weeks, and each training session lasted 45 minutes, three times per week. The program encompassed the lower extremities strength exercises, stretching exercises and walking and running in the water aerobic exercises.

In their single-subject design study of one child with spastic diplegic cerebral palsy, Fragala-Pinkham et al. (2009) determined a statistically significant improvement in the overall result of the GMFM-66 test of 7.53% following the applied exercise program for a period of 6 weeks. Each session was 60 minutes long, eight of them being in the water and four on the land. The pool exercises included swimming among other activities.

Retarekar et al. (2009) in addition to other outcomes, determined a significant improvement in the overall result of the GMFM test by 0.41% in their single-subject design study of one child with spastic cerebral palsy. The exercise programs which were meant to be conducted in the aquatic environment lasted 12 weeks, while each training session lasted 30 to 40 minutes. The training sessions were held three times a week. The following activities were practiced as the part of the exercise program: swimming, running in the pool, crawling, deep water running etc.

Mackinon (1997) also established an improvement in the results of the GMFM test from 91% to 96% in the single-subject design study of a boy with spastic cerebral palsy. The aquatic program was scheduled once a week for 6 weeks. The swimming and aquatic exercise program included the use of the Halliwick Method just like in this research.

Based on the results of their study, Chrysagis et al. (2009) determined an improvement in the abilities of walking, running, and jumping among the members of the experimental group, following the applied swimming program which contained instruction exercises how to learn the backstroke and freestyle swimming. The abilities to walk, run and jump were measured using the GMFM test. The improvement in the E dimension was 6.02%. The experimental group encompassed 6 participants, and the aquatic program lasted 10 weeks.

The results obtained in this research and the analysis of the previous studies indicate that the aquatic programs which lasted from 6 to 12 weeks with 2 to 3 training sessions weekly and on average of 45 min period have a positive influence on the improvement in

the gross motor functions, especially walking, running and jumping among children with cerebral palsy. This indicates a positive transfer of the movement in the water to the ability to move and balance on the land as the result of the aquatic exercise and swimming.

The results shown in Table 3 indicate that the applied swimming program had a significant influence on the improvement in mental adjustment to the aquatic environment, the ability to move in the water and the swimming skills of children with cerebral palsy. An increase in all three variables of the WOTA2 test was statistically significant. The greatest increase in the results expressed in percentages was found for the WSW variable with the value of 34.01%, then for the WMA variable, 26.73% and finally for the WTO variable, 25.23%. The greatest results improvement concerning the swimming ability was determined for the application program results itself, which contained swimming exercises.

Declerck (2010) also used a WOTA2 test to assess swimming abilities among children with cerebral palsy in her research. In accordance with the results of this research, Declerck (2010) determined a statistically significant increase in the results of the WOTA2 test for all three variables. In her research, the improvement of the results in percentages was smaller than the one determined in this study, and had a value of 17.15% for WTO, 16.85% for WMA and 17.35% for WSW.

In their studies, where diverse tests were used, Sršen et al. (2010), Fragala-Pinkham et al. (2010), Hutzler et al. (1998) also determined a statistically significant improvement in the swimming abilities of children with cerebral palsy following their participation in the swimming and exercise program in the water. Sršen et al. (2010) used the Swim Test, Fragala-Pinkham et al. (2010) by applying the Swimming Classification Scale, while Hutzler et al. (1998) performed an adapted version of the Water Orientation Checklist. The results of this and the cited studies indicate that, irrespective of the tests which were used to measure swimming skills, the aquatic programs enable children with cerebral palsy to learn how to swim and move in the water without the help of others. In this manner, the aquatic activities enable chlidren 7 to 11 years old with cerebral palsy to improve their basic motor abilities and to put their free time to good use.

CONCLUSION

The following conclusions can be drawn based on the analysis of this research results. The applied swimming program which included the Halliwick Method and swimming exercises for the healthy population led to the statistically significant improvement in walking, running and jumping as well as in the overall gross motor functions of children with cerebral palsy. The applied program also led to the statistically significant influence on the increase in mental adjustment to the aquatic environment and the ability to move in the water and swim. Considering the fact that this was a pilot study, in order for the results to be usable in practice, it is necessary to repeat the study more than once and on the greater number of participants.

REFERENCES

1. Chrysagis, N., Douka, A., Nikopoulos, M., Apostolopoulou, F., & Koutsouki, D. (2009). Effects of an aquatic program on gross motor function of children with spastic cerebral palsy. *Biology of exercise, 5* (2), 13-25.
2. Cock, P. (2009). The cerebral palsies: a changing panorama-the Luven experience. In A. Mikov (Ed.) *Proceedings of the international symposium: Current aspects of cerebral palsy therapy* (pp. 1-9). Novi Sad: Pokrajinski institut za nauku i tehnološki razvoj Vojvodine.
3. Daly, D. & Lambeck, J. (2007). New trends in adapted swimming. In Colomina R., Molina J., Valdivieso F., Ortiz E., Contreras G. (Eds.), *Swimming science I* (pp. 19-30). Granada, Spain:. Editorial Universidad de Granada.
4. Declerck, M. (2010). Effect of aquatic intervention on the gross motor function and quality of life of children with cerebral palsy. *Master thesis*. Leuven: Faculty kinesiology and rehabilitation sciences.
5. Dimitrijević, L., Stanković, I., Živković, V., Mikov, A., Čolović, H., & Janković, I. (2007). Botulinum toxin type A for the

treatment of spasticity in children with cerebral palsy, *Vojno sanitetski pregled, 64* (8), 513-518.

6. Dimitrijević, L. & Jakubi, J.B. (2005). The importance of early diagnosis and early physical treatment of cerebral palsy. *Facta Universitatis, Series: Medicine and Biology, 12* (3), 119-122.
7. Fragala-Pinkham, M., O'Neil, M.E., & Haley, S.M. (2010) Summative evaluation of a pilot aquatic exercise program for children with disabilities. *Disability and Health Journal, 3* (3), 162-170.
8. Fragala-Pinkham, M., Dumas, H., Barlow, C., & Pasternak, A. (2009). An aquatic physical therapy program at a pediatric rehabilitation hospital: a case series. *Pediatric Physical Therapy, 21* (1), 68–78.
9. Getz, M., Hutzler, Y., & Vermeer, A. (2007). The effects of aquatic intervention on perceived physical competence and social acceptance in children with cerebral palsy. *European Journal of Special Needs Education, 22* (2), 217 - 228.
10. Getz, M., Hutzler, Y., & Vermeer, A. (2006). Effects of aquatic interventions in children with neuromotor impairments: a systematic review of the literature. *Clinical Rehabilitation, 20*, 927-936.
11. Grosse, J.S., & Lambeck, J. (2004). The Halliwick method: A comparison of Applications to swim instruction and aquatic therapy. *Journal of ICHPER-SD, 40* (4), 31-36.
12. Hanlon, J., & Hines, M. (2007). Aquatic therapy. In F. Miller (Ed.), *Physical therapy of cerebral palsy* (pp. 351-358). Springer science: New York.
13. Hiromi, T., Takako, I. & Junko, S. (2005). The effect of swimming by Halliwick Method for a girl with cerebral palsy-Through the process of learning to float on her back without any help. *Nihon Joshi Taiiku Daigaku Kiyo, 35*, 65-73.
14. Hurvitz, E.A., Leonard, C., Ayyangar, R., & Nelson V.S. (2003). Complementary and alternative medicine use in families of children with cerebral palsy. *Developmental Medicine and Child Neurology, 45* (6), 364-370.

15. Hutzler, Y., Chacham, A., Bergman, U., & Szeinberg A. (1998). Effects of movement and swimming program on vital capacity and water orientation skills of children with cerebral palsy. *Developmental Medicine and Child Neurology, 40* (3), 176-181.
16. Kapus, V., Štrumbelj, B., Kapus, J., Jurak, G., Pincolič Šajber, D., Vute, R., Kapus, M., & Čermak, V. (2002). *Plavanje, učenje*. Ljubljana: Fakulteta za šport, Inštitut za šport.
17. Kelly, M., & Darah, J. (2005). Aquatic exercise for children with cerebral palsy. *Developmental Medicine & Child Neurology, 47*, 838–842.
18. Lambeck, J., & Gamper, N. (2009). The Halliwick Concept. In: L. Brody, & P. Geigle, *Aquatic Exercise for Rehabilitation and Training* (pp. 45-71). Champaign: Human Kinetics.
19. Lambeck, J., & Stanat, F. C. (2000). The Halliwick Concept, part I. *The Journal of Aquatic Physical Therapy, 8* (2), 6-11.
20. Laskin, J.J. (2003). Cerebral palsy. In *ACSM's Exercise management for persons with chronic diseases and disabilities* (pp.288-294). Champaign: Human Kinetics.
21. Lepore, M. (2005). Aquatics. In: J.P. Winnick (Ed.), *Adapted Physical education and Sport* (pp.435-454). Champaign: Human Kinetics.
22. Lockette, K.F., & Keyes, A.M. (1994). *Conditioning with physical disabilities*. Champaign: Human Kinetics.
23. Mackinnon, K. (1997). An evaluation of the benefits of Halliwick swimming on a child with mild spastic diplegia. *Association for Pediatric chartered Physiotherapy Journal,* 30-39.
24. Madić, D., Okičić, T., & Aleksandrović, M. (2007). *Plivanje*. Niš: FSFV u Nišu.
25. McMillan, J. (1978). The role of wather in rehabilitation. *Fysioterapeuten, 45*, 87-90.
26. Palisano, R., Rosenbaum, P., Walter, S., Russell, D., Wood, E., & Galuppi, B. (1997). Development and reliability of a system to classify gross motor function in children with cerebral palsy. *Developmental Medicine and Child Neurology*, *39* (4), 214-223.

27. Prins, J. H. (2009). Aquatic rehabilitation. *Serbian Journal of Sports Sciences, 3* (1-4), 45-51.
28. Retarekar, R., Fragala-Pinkham, M., & Townsend, E. (2009). Effects of aquatic aerobic exercise for a child with cerebral palsy: single-subject design. *Pediatric Physical Therapy, 21* (4), 336–344.
29. Russell D.J., Rosenbaum P.L., Avery, L.M., & Lane, M. (2002). *Gross motor function measure (GMFM-66 & GMFM-88) user's manual*. London: Mac Keith Press.
30. Russell, D.J., Rosenbaum, P.L., Cadman, D.T., Gowland, C., Hardy, S., & Jarvis, S. (1989). The gross motor function measure: a means to evaluate the effects of physical therapy. *Developmental Medicine and Child Neurology*, *31* (3), 341-352.
31. Sherrill, C., & Dummer, G.M. (2004). Adapted Aquatics. In: C. Sherrill (Ed.), *Conditioning with physical disabilities* (pp. 454-484). New York: McGraw-Hill.
32. Sršen, K.G., Vrečar, I., & Vidmar, G. (2010). The Halliwick concept of teaching of swimming and assessment of swimming skills. *Rehabilitacija, 9* (1), 32-39.
33. Surveilance of cerebral palsy in Europe. (2002). Prevalence and characteristics of children with cerebral palsy in Europe. *Developmental Medicine & Child Neurology, 44* (9), 633-640.
34. Thorpe D.E., Reilly M, & Case L. (2005). The effects of an aquatic resistive exercise program on ambulatory children with cerebral palsy. *Journal of Aquatic Physical Therapy. 13*, 21-34.
35. Tirosh, R. (2011). *Water Orientation Test Alyn, 2nd. edition*. Jerusalem: Alyn Family Hospital.
36. Tirosh, R., Katz-Leurer, M,. & Getz, MD. (2008). Halliwick-Based Aquatic Assessments: Reliability and Validity. *IJARE, 2* (3), 224-236.
37. Vute, R. (1999). *Izziv drugačnosti v športu*. Ljubljana: Debora.
38. WMA (2008). World Medical Association Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects. Retrieved January 15, 2012. from http://www.wma.net/en/30publications/10policies/b3/index.html

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EFEKTI PROGRAMA PLIVANJA NA GRUBU MOTORIČKU FUNKCIJU, PSIHIČKU PRILAGODLJIVOST NA VODENU SREDINU I PLIVAČKE VEŠTINE KOD DECE SA CEREBRALNOM PARALIZOM - PILOT STUDIJA

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Sažetak

Cilj ovog istraživanja je utvrđivanje efekata programa plivanja na grubu motoričku funkciju, prilagodljivost na vodenu sredinu i sposobnost kretanja u vodi i plivanja kod dece sa cerebralnom paralizom. Uzorak ispitanika je činilo sedmoro dece (4 dečaka i 3 devojčice) sa spastičnim oblikom cerebralne paralize, prosečne starosti od 9 god. i 5 meseci ± 1god. i 3 meseca (Mean±SD). Progam plivanja je trajao 6 nedelja sa učestalošću od dva puta nedeljno. Svaki čas vežbanja je trajao 45 minuta. Program plivanja je podrazumevao primenu Halliwick metode i vežbi plivanja koje se primenjuju kod zdrave populacije. Za procenu grube motoričke funkcije korišćen je GMFM test. Za procenu psihičke prilagodljivosti na vodenu sredinu i plivačkih veština korišćen je WOTA2 test. Za utvrđivanje statistički značajnih razlika između inicijalnog i finalnog merenja u primenjenim testovima korišćen je Wilcoxon matched pairs test. Rezultati su pokazali da je došlo do statistički značajnih razlika u dimenziji E (p=0.04) i u totalnom rezultatu T (p=0.03) GMFM testa, zatim u mentalnoj prilagodljivost na vodenu sredinu WMA (p=0.02), sposobnosti kretanja u vodi i plivanja WSW (p=0.03) i u ukupnom rezultatu WTO (p=0.02) WOTA2 testa.

Primenjeni program plivanja je imao značajne pozitivne efekte na poboljšanje sposobnosti hodanja, trčanja, skakanja i ukupne grube motoričke funkcije kod dece sa cerebralnom paralizom. Doprineo je i značajnom povećanju psihičke prilagodljivosti na vodenu sredinu i poboljšanju sposobnosti kretanja u vodi i plivanja.

Ključne reči: Halliwick metoda, plivački program, cerebralna paraliza, gruba motorička funkcija

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