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THE EFFECTS OF FOUR-MONTH EXERCISE PROGRAM IN IMPROVING THE GROSS MOTOR SKILLS OF STUDENTS WITH VISUAL IMPAIRMENT

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Abstract
Visual impairment affects all areas of child' development including gross motor skills. Children with visual impairment have a higher risk of motor difficulties in comparison with children without visual impairment. The goal of the present study was to examine the effects of a four-month exercise program in improving the gross motor skills of children with visual impairment. The sample for this study comprised of 24 children with visual impairment (mean age- 14.1 years, SD- 1.5 years). The results of this study showed the positive effects of exercise program on flexibility and balance of children with visual impairment, but no statistically significant improvement in the strength. Given the promising results of the exercise programs, we propose a wider use of supplementary exercise programs for children with visual impairment.

Key words: **visual impairment, gross motor skills, exercise program**

Introduction

Visual impairment can be defined as a broad term describing a wide continuum of loss in visual function (Lewis & Norwich, 2004). In the educational realm, visual impairment is defined as impairment in vision that has an adverse effect on child's educational performance (Turnbull, Turnbull, Wehmeyer, & Shank, 2004). Visual impairment affects all areas of child's development and has a strong impact on child's education and motor development (Warren, 1994). In addition to this, visual impairment has a strong impact on future employment and social prospects (Rahi et al., 2003). The prevalence rate of visual impairment in children aged 0-15 varies from 0.1/1000 children in wealthy countries to 1.1/1000 children in poor countries (Gilbert, Anderton, Dandona, & Foster, 1999). Unfortunately there are still no reliable data on the prevalence of children with visual impairment in Bosnia and Herzegovina, although these data would be very useful for planning appropriate supports.
Many etiological factors have been established in children with visual impairment. However, data on the most common etiology factors varies depending whether visual impairment in accompanied with some other disability. Some of the most commonly identified etiological factors in visual impaired group only are retinochoroiditis, retinal dystrophies, retinopathy of prematurity, ocular malformation, congenital glaucoma, optic atrophy, and congenital cataracts. On the other hand, the most common etiologic factors in multiple disability group are optic atrophy, cortical visual impairment, and toxoplasmic macular retinochoroiditis (Haddad, Sei, Sampaio, & Kara-Jose, 2007). Visual impairments can be classified in many ways, but most educators classify it in three categories (Turnbull et al., 2004):
Low vision- People with low vision are able, to some extent, to use their visual sense for learning;
Functionally blind- People in this category may use functional vision for moving in their environment and their limited vision supplements the other methods of learning such as tactual and auditory method;
Totally blind- People in this category do not receive meaningful input through visual sense.
Children with visual impairment are less active than children without disabilities and they are usually at a higher

risk to have motor difficulties in comparison with children without visual impairment (Haegele & Porretta, 2015). The performance of children with visual impairment on motor tasks is related to the degree of visual impairment and on environmental conditions (Houwen, Visscher, Hartman, & Lemmink, 2007). In addition to this, children with visual impairment have fewer opportunities to participate and interact with their environment which in turn can lead to limited movement experiences. Given the importance of physical activity for the overall physical, social, and mental well-being of children, it is of crucial importance to increase the level of participation in physical activities and sport of people with visual impairment. One potential reason for the lack of participation might be the sense of lack of abilities in motor skills for engagement in sports. Motor abilities including muscular endurance, flexibility, and balance are significantly lower in people with visual impairment are lower than in nonimpaired individuals (Skaggs & Hopper, 1996). The improvement in these motor abilities might consequentially lead to higher participation of children with visual impairment in sport activities.
Thus, the goal of the present study was to examine the effects of four-month exercise program on the improvement of flexibility, strength and balance in children with visual impairment.

Method

Participants

The sample for this study consisted of 24 children with visual impairment aged 12-17 (mean age- 14.1, SD- 1.5 years). There were 6 girls (25%) and 18 boys (75%). According to the level of visual impairment there were 20 children with low vision and 4 blind children. The participants were recruited from the School for Visually Impaired Students in Sarajevo, BiH.

Procedure

Children were initially tested on 3 motor tests, one tapping flexibility, one tapping motor strength, and one tapping balance. After the exercise program was implemented, children were tested again on the same measures.

Description of exercise program protocol

The protocol consists of two parts. The first part consisted of exercises in the gym and lasted approximately two months. Children were involved in exercise program two times per week for 45 minutes. These exercises were not part of the physical education program that is incorporated in children's regular curriculum. The exercises involved various age-appropriate games aimed at improving motor abilities of children (Vranesic-Hadzimehmedovic, Bajramovic, Likic, Tabakovic, & Imamovic, 2018). The second part of the protocol involved exercises in the swimming pool consisting of two times per week meetings, each lasting approximately 45 minutes. The benefits of swimming exercises on motor abilities have been widely documented (Vranesic-Hadzimehmedovic, Mahmutovic, Bajramovic, & Jeleskovic, 2012). Duration of the second part of the protocol was also two months. Vranesic-Hadzimehmedovic et al. (2018) provided a more detailed description of the exercises in the swimming pool.
The study protocol was approved by the Faculty for Sport and Physical Education and only children with written parental consents were included in the study.

Instruments

The pre-training and post-training tests included:
Test of flexibility
Motor flexibility can be defined as a continuous adjustment of movement to complete an action (Slaats-Willemse, de Sonneville, Swaab-Barneveld, & Buitelaar, 2005). It represent the ability of muscles to move a part of the body through its range of motion (Segal, Hein, & Basford, 2004). For the assessment of flexibility we measured the range of an overhead movement of both hands with a stick.

Motor strength

Motor strength depends on the ability to recruit motor units. So, in order to increase the strength of muscle contractions, more motor units must be activated (Waugh & Grant, 2014). For the assessment of strength we used a number of push-ups child can independently perform.

Balance

Balance can be defined as an ability to control body's position in space for the purposes of stability and orientation (Dewey & Tupper, 2004). For the assessment of balance we used the one-leg standing test measuring the ability to stand on one leg unsupported. This test is a good predictor of functional status and physical health (Vellas et al., 1997).

Statistical analysis

We calculated Pearson correlation coefficients for all measures in order to see the strength of the relationship between variables. The effects of training was evaluated by using a paired t test (pre-test vs. post-test measurement). An alpha level of .05 was used as a cut off level for determining statistical significance.

Results

We first present the correlation coefficients between flexibility, motor strength and balance for both initial and final measurement. These results are shown in tables 1.

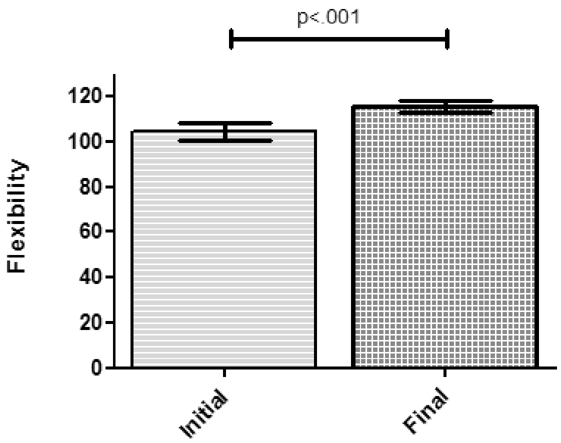
Table 1. Correlation between flexibility, motor strength and balance

	Flexibility	Strength	Balance
Flexibility	-----------	0.34	0.31
Strength	0.32	-------------	0.32
Balance	0.35	0.37	-----------------

Note. Correlations above the diagonal are for the initial assessment and correlations below the diagonal are for the final assessment. All correlations were statistically nonsignificant ($p>.05$).

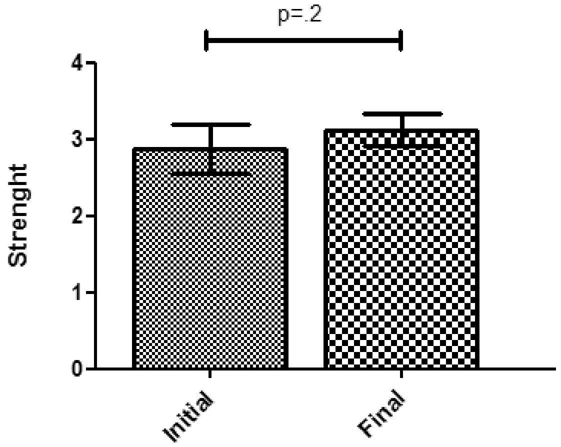
Although the correlations between motor abilities were in the moderate range, due to small sample size, they were nonsignificant. Lack of large and significant correlation is also an evidence that these three motor tests are tapping different motor abilities in children with visual impairment.
We next present initial and final assessment of flexibility in children with visual impairment. The mean initial score on flexibility test was 104 (SD- 19) and the mean final score was 115 (SD- 13). According to the paired t-test results the difference in mean scores between initial scores and final scores was statistically significant $t(23)=5$, $p<.001$. As a measure of an effect size we calculated Cohen's d (Cohen's $d= 0.67$), which represents medium to large effect size. These results are shown in Figure 1.

Figure 1. The mean results on initial and final assessment of flexibility in children with visual impairment



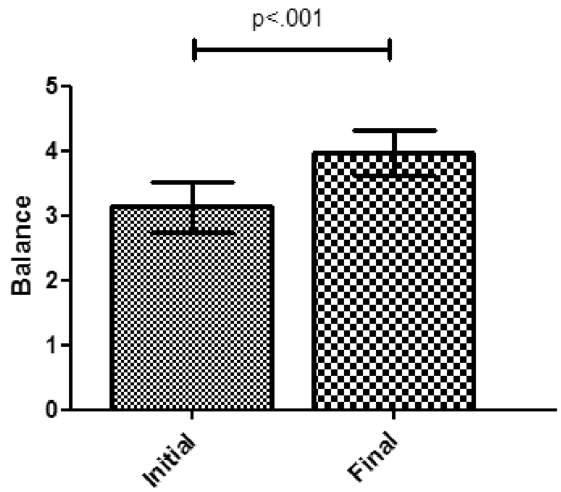
We next present the results of initial and final assessment on strength test in children with visual impairment. The mean initial score was 2.9 (SD- 1.5) and the mean final score was 3.1 (SD- 1.0). According to the paired t-test results, the difference in mean scores between initial scores and final scores on strength test was not statistically significant $t(23)=1.3$, $p<.2$. The effect size Cohen's $d=0.15$, which represents small effect. These results are shown in Figure 2.

Figure 2. The mean results on initial and final assessment of strength in children with visual impairment



Finally, we present initial and final results for the balance abilities in children with visual impairment. The mean initial score for balance was 3.1 (SD-1.9) and mean final score was 4.0 (SD-1.7). According to the paired t-test results, the difference in mean scores between initial scores and final scores on balance test was statistically significant $t(23)=4.96$, $p<.001$. The effect size was moderate in size according to Cohen's d coefficient (Cohen's $d= 0.5$). These results are shown in Figure 3.

Figure 3. The mean results on initial and final assessment of strength in children with visual impairment



Discussion

The goal of the present study was to examine the effects of a 4-month, low intensive, exercise program in improving the motor abilities of children with visual impairment. The results of this study demonstrated the effectiveness of the program in the area of motor flexibility and balance. No significant effects were observed in the area of motor strength. The strongest effect of exercises was observed for the measure of flexibility. Flexibility is related to overall physical performance and reduced likelihood of injuries during physical activities (Segal, Hein, & Basford, 2004). There are many factors that might have contributed to this large effect. We believe that the stretching exercises mainly contributed to this large, positive effect in improving flexibility. This finding is in line with previous studies aiming at improving motor flexibility in healthy students (Issurin, Liebermann, & Tenenbaum, 1994).
Statistically significant, medium in size, positive effect of exercises was observed in the area of balance improvement. Balance is an important skill necessary for numerous daily activities including housework, shopping, to reach for items, bend etc. (Judge, 2003). Balance can be defined as an ability to stay upright and steady when stationary and during different movements (Howe, Rochester, Neil, Skelton, & Ballinger, 2011). Studies, to date, have mostly focused on improving the balance of older people with visual impairment (Chen, Fu, Chan, & Tsang, 2011; Hackney, Hall, Echt, &

Wolf, 2013). However, children with visual impairment have higher risk of falling due to deficits in balance (Jazi, Purrajabi, Movahedi, & Jalali, 2012). In addition to this, children with visual impairment have large deficits in static balance in compariosom with their typically developing peers (Houwen, Visscher, Lemmink, & Hartman, 2008). Thus, the importance of the training exercises for better balance control. Our exercise protocol proved to be beneficial in significantly improving the balance in children with visual impairment.

Lastly, our training protocol did not significantly (statistically and clinically) improve the motor strength in participating children. Although the children did improve from pre-test to post-test measurement, this improvement was negligible. Although, this finding was unexpected, there are several possible explanations. One of the first explanations is from the American Association of Pediatrics, which points to limited capability of children to increase their muscular strength (APA, 1983). However, subsequent research pointed that adequate training can have positive effects in improving the muscular strength and muscular endurance in children (Faigenbaum, Westcott, Loud, & Long, 1999). As the focus of our exercise protocol was not on muscular strength per se, it might be the case that the exercises we employed were not tapping, to the large extent, the area of muscular strength. Lastly, it is possible that due to small sample size, the significant effects were not discovered. All these potential explanations seem equally likely.

Given the fact that motor abilities are susceptible to training and can be improved significantly, the importance of greater involvement in sports and physical activities seem warranted. People with disabilities in general are not involved in the sport and physical activities as much as their peers without disabilities. Next we offer some suggestions on how to increase the participation in sports of people with visual impairments. First, there need to be more awareness campaigns on the benefits of sport. These campaigns need to be directed to both, adolescents with visual impairment and to their parents. Early participation in sports is a good predictor of life-long pursuit of sport activities. Lastly, we will mention the importance of physical pre-service teacher education as an important activity in improving the attitudes of future professionals who will work with children with disabilities. This education needs to be a part of their curricula through the subject of *Special education*. It should cover basic information on different disability categories and the specific, evidence-based methods, of implementing physical education classes with these exceptional children.

As already mentioned, motor abilities are related to many everyday activities and to the general quality of life. People with disabilities tend to have a lower quality of life compared to general population. However, self-reported quality of life of people with visual impairment tends to be higher than that in other disability categories (Memisevic, Hadzic, Ibralic-Biscevic, & Mujkanovic, 2017). This is probably moderated by the factors such as employment status, as more people with sensory impairments are employed in comparison with people with other forms of disability.

Let us lastly point to some limitations of the present study. First, the sample size was relatively small, so some effects might be sample-specific and perhaps some effects were not discovered such as in the case of muscular strength. Secondly, it would be beneficial if we made several measurements during the implementation of the exercise protocol (not just pre – post measurements). Lastly, we future studies need to incorporate many more measures of the abilities tapping flexibility, strength and balance, as well as other measures such as endurance and fine motor abilities.

References

American Academy of Pediatrics. (1983). Weight training and weight lifting: Information for the pediatrician. *The Physician and Sports Medicine*, 11(3), 157–161.

Chen, E. W., Fu, A. S., Chan, K. M., & Tsang, W. W. (2011). The effects of Tai Chi on the balance control of elderly persons with visual impairment: a randomised clinical trial. *Age and ageing*, *41*(2), 254-259.

Dewey, D., & Tupper, D. E. (Eds.). (2004). *Developmental motor disorders: A neuropsychological perspective*. Guilford Press.

Faigenbaum, A. D., Westcott, W. L., Loud, R. L., & Long, C. (1999). The effects of different resistance training protocols on muscular strength and endurance development in children.*Pediatrics*, *104*(1), e5-e5.

Gilbert, C. E., Anderton, L., Dandona, L., & Foster, A. (1999). Prevalence of visual impairment in children: a review of available data. *Ophthalmic epidemiology*, *6*(1), 73-82.

Hackney, M. E., Hall, C. D., Echt, K. V., & Wolf, S. L. (2013). Dancing for balance: feasibility and efficacy in oldest-old adults with visual impairment. *Nursing research*, *62*(2), 138-143.

Haddad, M. A. O., Sei, M., Sampaio, M. W., & Kara-José, N. (2007). Causes of visual impairment in children: a study of 3,210 cases. *Journal of pediatric ophthalmology and strabismus*, *44*(4), 232-240.

Haegele, J. A., & Porretta, D. L. (2015). Physical activity and school-age individuals with visual impairments: A literature review. Adapted Physical Activity Quarterly, 32, 68–82.

Houwen, S., Visscher, C., Hartman, E., & Lemmink, K. A. (2007). Gross motor skills and sports participation of children with visual impairments. *Research Quarterly for Exercise and Sport*, *78*(2), 16-23.

Houwen, S., Visscher, C., Lemmink, K. A. P. M., & Hartman, E. (2008). Motor skill performance of school-age children with visual impairments. *Developmental Medicine & Child Neurology*, *50*(2), 139-145.

Howe, T. E., Rochester, L., Neil, F., Skelton, D. A., & Ballinger, C. (2011). Exercise for improving balance in older people. *Cochrane database of systematic reviews*, (11).

Issurin, V. B., Liebermann, D. G., & Tenenbaum, G. (1994). Effect of vibratory stimulation training on maximal force and flexibility. *Journal of sports sciences*, *12*(6), 561-566.

Jazi, S. D., Purrajabi, F., Movahedi, A., & Jalali, S. (2012). Effect of selected balance exercises on the dynamic balance of children with visual impairments. *Journal of Visual Impairment & Blindness*, *106*(8), 466-474.

Judge, J. O. (2003). Balance training to maintain mobility and prevent disability. *American journal of preventive medicine*,*25*(3), 150-156.

Lewis, A., & Norwich, B. (2004). *Special teaching for special children? Pedagogies for inclusion*. McGraw-Hill Education (UK).

Memisevic, H., Hadzic, S., Ibralic Biscevic, I., & Mujkanovic, E. (2017). Quality of life of people with disabilities in Bosnia and Herzegovina–is there a moderating effect of the health status? *Scandinavian Journal of Disability Research*, *19*(4), 375-382.

Rahi, J. S., Cable, N., & British Childhood Visual Impairment Study Group. (2003). Severe visual impairment and blindness in children in the UK. *The Lancet*, *362*(9393), 1359-1365.

Segal, N. A., Hein, J., & Basford, J. R. (2004). The effects of pilates training on flexibility and body composition: An observational study. *Archives of physical medicine and rehabilitation*, *85*(12), 1977-1981.

Skaggs, S., & Hopper, C. (1996). Individuals with visual impairments: A review of psychomotor behavior. Adapted Physical Activity Quarterly, 13, 16–26.

Slaats-Willemse, D., de Sonneville, L., Swaab-Barneveld, H., & Buitelaar, J. (2005). Motor flexibility problems as a marker for genetic susceptibility to attention-deficit/hyperactivity disorder. *Biological Psychiatry*, *58*(3), 233-238.

Turnbull, H. R., Turnbull, A. P., Wehmeyer, M. L., & Shank, M. (2004). Exceptional lives . Columbus, OH: Merrill.

Vellas, B. J., Rubenstein, L. Z., Ousset, P. J., Faisant, C., Kostek, V., Nourhashemi, F., ... & Albarede, J. L. (1997). One-leg standing balance and functional status in a population of 512 community-living elderly persons. *Aging Clinical and Experimental Research*, *9*(1-2), 95-98.

Vranešić-Hadžimehmedović, D., Mahmutović, I., Bajramović, I., & Jelešković, E. (2012). The Partial Quantitative Changes in Swimming Preformance and Basic Motor Abilities of Young Girls Under the Influence of the Experimental Program. *Homo Sporticus*, *14*(2), 41-52.

Vranešić-Hadžimehmedović, D., Bajramović, I., Likić, S., Tabaković, M., & Imamović, D. (2018). Effects of Four-Month Exercise Program on Correction of Body Posture of Persons with Different Visual Impairment. *Journal of Antropology of Sport and Physical Education,* 2(2), 15-18.

Warren, D. H. (1994). Blindness and children: An individual differences approach. Cambridge, UK: Cambridge University Press.

Waugh, A., & Grant, A. (2014). *Ross & Wilson Anatomy and physiology in health and illness E-book*. Elsevier Health Sciences.

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