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### Reading performances of low vision children after using low vision aid

Брзина читања код слабовиде деце након коришћења помагала за  
слабовиде

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## Reading performances of low vision children after using low vision aid

Брзина читања код слабовиде деце након коришћења помагала за слабовиде

### SUMMARY

**Introduction/Objective** Objectives are to assess the causes of LV in pediatric population in Montenegro and to evaluate the influence of using low vision aid in reading performances regarding to speed of reading and understanding of reading text.

**Methods** A prospective study was conducted on 40 “treatable” LV children what represent all registered LV children in Montenegro. All participants read the same text before and after using LVA. Reading rate was calculated as a number of reading words in a minute. Functional speed of reading was calculated as a rate of speeding/understanding of reading text x 100.

**Results** Fourty LV children with mean age of 12.60±4,06 years (20 boys and 20 girls). The most common cause of LV in children were premature retinopathy ( 10/40 or 25%), retinitis pigmentosa ( 8/40 or 20%), optic nerve anomaly ( 5/40 or 13%), degenerative myopia ( 4/40 or 10%), macular dysgenesis ( 4/40 or 10%) , Stargardt disease ( 3/40 or 7%), optic nerve atrophy ( 2/40 or 5%), albinism ( 2/40 or 5%). Nystagmus was found in 11 LV children or 28% of all. To all of them LV aids ( LVA) were prescribed. Reading speed before vs.after LVA using was 36.58± 35.60 vs. 73.83± 27.05 words/min (  $p<0.001$ ) while functional reading was 26.00±30.43 vs. 59.41±29.34 (  $p<0.001$ )

**Conclusion** LV children has a significant improvement in reading performances by using LVA.

**Keywords:** low vision aid; low vision children; reading performances

### САЖЕТАК

**Увод/Циљ** Циљ овог рада је био да се утврде разлози слабовидости код деце у Црној Гори као и да се утврди утицај специјалних помагала на брзину и на функционално читање код ове деце.

**Метод** Проспективна студија спроведена на 40 слабовиде деце која су користила специјална помагала. Сва деца су добила исти текст да прочитају пре и после коришћења помагала. Брзина читања је исказана као број прочитаних речи у минути, а функционално читање као однос брзине читања и разумевања прочитаног x 100.

**Резултати** Средњи узраст слабовиде деце је био 12.60±4,06 година (20 дечака и 20 девојчица). Најчешћи разлози слабовидости су били: прематурна ретинопатија (10/40; 25%), пигментни ретинитис (8/40; 20%), анормалије оптичког нерва (5/40; 13%), дегенеративна миопија (4/40; 10%), макуларне дизгенезије (4/40), Старгард дистрофија (3/40; 7%), атрофија оптичког нерва (2/40; 5%), албинизам (2/40; 5%). Нистагмус је дијагностикован код 11 деце (28%). Свој слабовидој деци су прописана помагала. Брзина читања пре у односу на брзину читања после коришћења помагала је била 36.58±35.60 тј. 73.83±27.05 речи/мин ( $p<0.001$ ) док је функционално читање било 26.00±30.43 тј. 59.41±29.34 ( $p<0.001$ )

**Закључак** Слабовида деца показују значајно побољшање читања после коришћења специјалних помагала.

**Кључне речи:** помагала за слабовиде; слабовида деца; брзина читања

### INTRODUCTION

According to the International Classification of Diseases -10, there are four levels of visual function: normal vision, moderate visual impairment (VI) , severe VI and blindness [1]. Moderate and severe VI is grouped under the term “low vision” (LV). “Functional” LV is defined as presenting best-corrected visual acuity (BCVA) in the better-seeing eye of less than 0.3 and more than 0,05 according to World Health Organization (WHO) criteria,  $VA < 0.3$  and  $VA \geq 0.05$ ; or United States (US) criteria,  $VA < 0.5$  and  $VA \geq 0.1$ ) and blindness (WHO criteria,  $VA < 0.05$ ; US criteria,  $VA < 0.1$ ) [1]. LV cannot be improved or corrected with medical treatment, surgery neither with conventional glasses or contact lenses. Unlike total blindness, most individuals with LV have some degree of useful, residual sight even when vision loss is significant. WHO estimated that 19 million children in the world are visually impaired. Of these, 1.4 million are irreversibly blind [2]. The

International Classification of Functioning, Disability and Health (ICF) adopted by the WHO can be used as a framework to comprehensively describe the problems of persons with visual impairment and the Environmental factors which influence their lives [3]. Surely, LV significantly interferes with the functioning of a person. Common subjective complains of LV persons includes loss of central and/or peripheral vision, constricted visual field, abnormal color perception, generalized haze, blurred vision, extreme light sensitivity and night blindness. LV patients represent unique challenge in ophthalmic and optometric care.

Very few low vision clinics are available even in the most developing countries. The Low Vision Service for pediatric patient has been established in 2013 in Clinical center in Podgorica, Montenegro (which is a referral tertiary health care center in Montenegro). Mentioned Service is the pioneer LV service in region, covering all needs of LV children including education, training and sight rehabilitation. A team of trained specialists with comprehensive, multi-disciplinary approach to LV children has the purpose to help them to maximize remaining functional vision and maintain independence in daily living. Podgorica pediatric LV service meets WHO recommendation for establishment LV centers to fight avoidable childhood blindness. Namely, since 2004, WHO in partnership with Lions Clubs International has established a global network of 45 childhood blindness centers in 35 countries for the preservation, restoration or rehabilitation of sight in children [2]. LV center in Podgorica is specific since all registered LV children are covered with LV aids (LVA) for free.

According to the available data, average 1000 blind and visually impaired persons of all ages are registered in Montenegro. The exact number of blind LV children is unknown. There are no precise national register on the prevalence of childhood VI but, regarding to available sources (referral associations, primary health care registers etc.) it has been estimated that in Montenegro are 200 VI children and 50-60 LV children in this moment. Assessment of the causes of VI is important to develop preventive and therapeutic strategies. The standardized protocol for reporting causes of blindness in children with coding instructions and database for statistical analysis which was developed by the International Centre for Eye Health (ICEH), a WHO Collaborating Centre for Blindness Prevention, and WHO serves as a mechanism to monitor changing pattern of childhood blindness, too [4]

Objectives of this paper is to assess the causes of LV in pediatric population in Montenegro and to evaluate the influence of using low vision aid in reading performances regarding to speed of reading and understanding of reading text.

## **METHODS**

A prospective study was conducted on 40 “treatable” LV children what represent all registered LV children in Montenegro. Including criteria were the following: best correcting visual acuity (BCVA) ranging from 0.05 to 0.3 in the better-seeing eye and aged less than 17 years. Term

“treatable” LV person represents a person who has improving in reading or distance vision using LVA. Children were recruited from registers of Association of blind and LV persons (one association with 8 local branches), followed by two schools for special education of blind and LV children (in Podgorica and Bijela) and primary eye care registers from all over countries. All amblyopic children (215 of them) underwent complete ophthalmological examination. In total, 40 children meet criteria of „treatable“ LV person. The study was performed in accordance with the tenets of the Declaration of Helsinki and approved by Institutional Review Board (decision number 03/01-12238/2). Written informed consent was obtained from all parents.

All participants read the same text before and after using LVA. The words were printed in seven lines with 1.5 line spacing (0.8 cm), with black letters on white background to enhance contrast, fonts were in Times New Roman, N12 letter size. Reading rate was calculated as a number of reading words in a minute. Understanding of text was measured by a multiple choice test with 20 questions related to reading text. Scores were rated from 0 up to 20, in total and presented as a percentage (for example, if LV child has 12 correct answer, it means that the score of understanding is 60%). Functional speed of reading was calculated as a rate of speeding/understanding of reading text x 100.

Statistical analysis: All parameters were expressed as mean  $\pm$  standard deviation (SD). Differences between pre and post LVA using were evaluated by means of Wilcoxon Signed Ranks test. The level of statistical significance was set at 0,05. All statistical analyses were performed with the Statistical Program for Social Sciences (SPSS) version 20.0 for Windows software package (SPSS, Inc., Chicago, IL, USA).

## RESULTS

Forty LV children with mean age of  $12.60 \pm 4.06$  years (20 boys and 20 girls) underwent complete ophthalmological examination and socio-epidemiological assessment. Mean age of girls was  $10.95 \pm 4.16$  years while at boys it was  $14.25 \pm 3.28$  years. All LV children lived in families with both biological parents.

Educational profile of fathers of the LV children completed primary school in 20 cases (50.0%), 19 had secondary degree (47.5%) and one (2,5% of all) had a higher education. Among mothers, none has finished higher education, secondary school finished 19 mothers 8 47.5% of all) and 21 completed primary school.

In the group of children with retinal dystrophy, eight children (20%) had retinopathy pigmentosa, in 3 cases (7%) was diagnosed Stargardt macular dystrophy. Development anomalies of optic nerve had 4 children with optic hypoplasia and one with congenital coloboma of optic disc. Associated macular and optic nerve anomalies were found in two cases while 4 children had isolated macular hypoplasia. Causes of LV were presented in table 1.

**Table 1. Causes of low vision in children.**

Clinical finding	Number of patients	%
Retinal dystrophy	11	27
Premature retinopathy	10	25
Macular dysgenesis	4	10
Optic nerve anomaly	5	13
Associated macular and optic nerve anomalies	2	5
Central nervous tumor	2	5
Degenerative myopia	4	10
Albinism	2	5
<b>Total</b>	<b>40</b>	<b>100</b>

hand moving at 8 children ( 20% of all); in 12 children ( 30% of all) was 0,1 while 20 children ( 50% of all) had 0,2 up to 0,4. At 3 children, fellow eye was blind, 16 children ( 40% of all) had BCVA described as hand movement only, while 21 children had less than 0,2 according to Sneleln chart.

**Table 2. List of low vision aids for reading which were prescribed to low vision children.**

Low vision aid	Number of children	%
Electronic magnifier	17	42
Ready fit prism	21	53
Telescope	2	5
<b>Total</b>	<b>40</b>	<b>100</b>

**Table 3. Speed of reading and functional reading results in low vision children before and after using of low vision aids.**

		Before	After	p
		$\bar{x} \pm SD$ med (min-max)	$\bar{x} \pm SD$ med (min-max)	
Reading	Speed	36.58±35.60 21.5 (0-120)	73.83±27.05 81 (31-121)	<0.001 <sup>a</sup>
	Functional reading	26.00±30.43 13.72 (0-108)	59.41±29.34 62.65 (14.40-114.95)	<0.001 <sup>a</sup>

<sup>a</sup>Wilcoxon Signed Ranks test

## DISCUSSION

Visual impairments results in different degree of difficulty functioning in performing daily activities and tasks. Great progress has been made in the development and deployment of intraocular LVA such as implantable monocular telescope, afterward in the global positioning system-based navigation system etc. location-aware LVA... LV children has specific and additionally tasks concerning education so reading is one of the core activities of their study. As it is well-known, LV and VI affects their sensorial development, physical, psychological and social well-being. Socio-epidemiological or so called external factors (i.e. education/employment and parental influence) can either facilitate or hinder participation [3]. In our study, all parents completed primary and average

Optic atrophy in 2 cases was a consequence of intracranial tumor, but it was found in two premature children and one with albinism, too. Nystagmus was found in 11 cases ( 9 with horizontal, 1 rotatory and 1 vertical). Macular scars were diagnosed at two high myopic cases and three children with retinitis pigmentosa. Four children had esotropia while two had exotropia.

BCVA concerning better seeing eye , was

Regarding to refractive error, 27/40 children had myopia, 3/40 ( 7,5% of all) had hyperopia, 2/40 ( 5% of all) had astigmatism while 8 children had no possibility to be optically corrected.

All children accepted LVA for reading distance. In the table 2. are listed devices which they had used.

Speed of reading and understanding of content was measured before and one month after using of LVA for reading. Results were presented in table 3. As it has been shown, speed and functional speed of reading has been significantly improved.

half of them completed secondary school. Finishing at least primary school is a legislative obligation what can explain a relatively huge percent of parents who had completed at least primary education level.

The commonest cause of LV among children and adolescent in Montenegro was retinal dystrophy, on the first- retinitis pigmentosa ( 20% of all) followed by Stargardt disease ( 7% of all). Afterward, premature retinopathy ( 25%) , macular dysgenesis ( 10%) , myopic degenerative changes (10% of all), . The etiology of childhood VI in the Montenegro includes 13% of those who had VI with coexisting neurological disability, too. In opposite, in Brazil, the most frequent finding was congenital glaucoma ( 21,1%) [4] while in Sao Paulo study was found that higher prevalence of congenital glaucoma (30.6%), followed by macular retinochoroiditis due to congenital toxoplasmosis (16.7%), congenital cataract (12.8%), retinal and macular inherited disorders (11.7%), and optic atrophy (9.8%) [5]. Further, Haddad et al. reported that only 2% of children with congenital glaucoma had normal visual acuity levels, while 29% had mild visual impairment, 28% had moderate visual impairment, 15% severe visual impairment, 11% profound visual impairment and 15% near blindness<sup>8</sup>. Principal causes of blindness among VI children in New Zealand were cerebral visual impairment in 61 children (42.4%), optic nerve atrophy in 18 children (12.5%), and retinal dystrophy in 13 children (9.0%). The main avoidable causes of blindness in 27 children (19%) were neonatal trauma, asphyxia in 9 children (33%), and nonaccidental injury 6 children (22%)[6].

Causes of LV in childhood and adolescent in Africa and Asia differs from those from other part of the world. In Nigeria, the most common causes were cataract (21%) followed by glaucoma (12.9%) but in even 43.6% LV children was found treatable causes of blindness [7] while Olusanya et al. reported that the most common cause of LV in children was while albinism (24.4%) and optic atrophy (24.4%) [8] . In Ekiti State Special Education School, Nigeria was conducted in May-June 2008 was reported that the most commonly cause of VI coming from cataract (26.7%), glaucoma (20%) retinitis pigmentosa (16.7%) and posttraumatic phthisis bulbi (6.7%). Blindness was avoidable even 61% of cases.[9] In Ethiopia, the most common causes of childhood VI were corneal disease /phthisis (62.4%), followed by optic nerve lesions (9.8%), cataract/aphakia (9.2%), and lesions of the uvea (8.8%). The etiology was unknown in 45.1% of cases while 68% of cases were considered to be potentially avoidable [10]. Cataract and corneal damage are the leading cause among LV children in India, too. Even the time difference between studies is almost 20 years, the conclusions of both studies were that in prevention of avoidable blindness, very important is to provide measles and rubella immunization and nutrition care [11].

Among LV children in Nepal, refractive error and amblyopia (20.1 per cent), retinitis pigmentosa (14.9 per cent) and macular dystrophy (13.4 per cent) were the most common causes of pediatric visual impairment. Nystagmus (50.0 per cent) was the most common cause of low vision in the one to five years age group, whereas refractive error and amblyopia were the major causes in the six to 10 and 11 to 16 years age group (17.6 and 22.9 per cent, respectively) [12].

It is a widely accepted belief in clinical practice that children with a visual impairment can profit from the use of a low vision aid (LVA) [13]. To LV patients at Instituto Brasileiro de Oftalmologia e Prevencao da Cegueira (IBOPC) telescopic system was the only optical aid indicated for distance (44%) and glasses were the most indicated for near (54.5%) [14] which were prescribed. In India, only 18% of LV children with coloboma, microcornea and microphthalmus has been used telescope, while in 6% children stand magnifier was prescribed [15]. LV children from Montenegro has an specific possibility to be treated with the most diverse specter of LVA for distance, intermediate distance and near, respectively.

## CONCLUSION

According to the published data, this is the first study targeted to the influence of using LVA in LV children on reading performances as well as the first report about demographic data and causes of low vision among LV children in Montenegro. Our results indicate that LV for reading or near distance significantly improves reading performances in LV children and should be applied in everyday practice.

## NOTE

This paper is a part of a doctoral thesis of Zorica Tončić entitled “The influence of visual rehabilitation on quality of life using low vision aids in low vision children”.

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