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ASSESSMENT OF VISUAL FUNCTIONING IN PREMATURE AND FULL-TERM INFANTS UNDER 24 MONTHS USING PREVIAS

PROCJENA VIZUALNOG FUNKCIONIRANJA PRIJEVREMENO ROĐENE I TERMINSKE DJECE MLAĐE OD 24 MJESECA PRIMJENOM PREVIAS

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ABSTRACT

The Preverbal Visual Assessment (PreViAs) questionnaire is designed to assess visual functions both in the general pediatric population and in children at high risk for visual cognitive abilities, through parent responses. The aim of the research is to evaluate visual attention (VA), visual communication (VC), visual-motor coordination (VMC), and visual processing (VP) in age subgroups ranging from 0 to 24 months. These subgroups, which were examined, fall under visual cognitive integrative functions, and to assess them, it is necessary to evaluate the child's behavior, which requires an experienced evaluator. The PreViAs questionnaire was designed to assess these functions both in the general pediatric population and in children at high risk for visual cognitive issues, through responses from parents or primary caregivers. Method. A total of 60 infants (<24 months) were divided into two groups based on gestational age. The first group consisted of preterm infants (n=30), while the second group consisted of term-born children (n=30). Their parents or primary caregivers completed the PreViAs questionnaire, which consists of 30 questions related to one or more visual domains: visual attention, visual communication, visual-motor coordination, and visual processing. The responses from the first group of respondents were compared with the results of visual behavior assessments of the second group by ophthalmologists and defectologists-typhlologists. Results. For visual attention, the results ranged from 0 to 11, for visual communication from 0 to 5, for visual-motor coordination from 0 to 13, and for visual processing from 0 to 20. The total score ranged from 0 to 30. The obtained results show that the mean score for visual attention was 6.05±4.15, with a standard error of 0.93, a median and mode of 5.50 and 11, respectively, and the minimum and maximum results ranged from 0

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to 11. Conclusion. The PreViAs questionnaire has proven useful for detecting abnormal visual maturation in infants aged 0 to 24 months. It facilitates the process of collecting anamnestic data from infants at risk of visual dysfunctions.

Keywords: PreViAs, assessment scales, visual functioning.

SAŽETAK

Upitnik Preverbal Visual Assessment (PreViAs) osmišljen je za procjenu vidnih funkcija, kako u opštoj pedijatrijskoj populaciji, tako i kod djece s visokim rizikom vizualnih kognitivnih sposobnosti, kroz odgovore roditelja. Cilj istraživanja je evaluirati vidnu pažnju (VP), vidnu komunikaciju (VK), vidno-motoričku koordinaciju (VMK) i vidnu obradu (VO) u dobnim podskupinama u rasponu od 0 –24 mjeseca. Navedene podgrupe koje su ispitivane spadaju u vizualne kognitivne integrativne funkcije, a kako bi se one procijenile potrebno je evaluirati ponašanje djeteta, što zahtijeva iskusnog evaluatora. Upitnik Preverbal Visual Assessment (PreViAs) osmišljen je za procjenu ovih funkcija, kako u opštoj pedijatrijskoj populaciji tako i kod djece s visokim rizikom od vizualnih kognitivnih problema, putem odgovora roditelja ili primarnih skrbnika. Metod. Ukupno 60 dojenčadi (<24 mjeseca) podijeljeno je u dvije skupine prema gestacionoj dobi. Prvu grupu činila su prijevremeno rođena djeca (n=30), dok su drugu grupu činila djeca rođena u terminu (n=30). Njihovi roditelji ili primarni skrbnici ispunili su PreViAs upitnik koji se sastoji od 30 pitanja koja se odnose na jednu ili više vizualnih domena: vizualna pažnja, vizualna komunikacija, vizualno-motorička koordinacija i vizualna obrada. Odgovori na upitnik prve grupe ispitanika uspoređeni su s rezultatima procjena vizualnog ponašanja druge grupe od strane oftalmologa i defektologa-tiflologa. Rezultati. Kod vidne pažnje rezultati se kreće od 0 do 11, vidne komunikacije 0 do 5, vidno-motorne koordinacije 0 do 13 i vidne obrade 0 do 20. Ukupan rezultat se kreće u rasponu od 0 do 30. Dobijeni rezultati pokazuju da aritmetička sredina kod vidne pažnje iznosi 6,05±4,15, standardna greška 0,93, medijana i modus 5,50 i 11, te se minimalni i maksimalni rezultati kreću u rasponu od 0 do 11. Zaključak. Upitnik PreViAs pokazao se korisnim za otkrivanje abnormalnog vizualnog sazrijevanja kod dojenčadi od 0 do 24 mjeseca života. Olakšava istraživačima proces prikupljanja anamnestičkih podataka kod dojenčadi koja imaju rizik od vidnih disfunkcija.

Ključne riječi*:* PreViAs, skale procjene, vizualno funkcioniranje.

INTRODUCTION

Since visual perception develops rapidly after birth, early detection of developmental maturity is necessary. Healthy infants do not have many opportunities for assessing visual perception, therefore, a reliable assessment method is essential (Kim et al., 2022).

The level of visual functioning in infants from 0 to 24 months of age, that is, the way in which vision integrates with other higher-order cognitive functions, cannot be assessed through a standard ophthalmological examination or clinical history. Early diagnosis of abnormal visual maturation, which can occur for various reasons, allows us to establish timely monitoring and, accordingly, the initiation of a visual stimulation strategy. To optimally enhance the integrative functions dependent on the ventral and dorsal afferent

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streams, early diagnosis, detection, and monitoring of delayed visual maturation must begin before 24 months of the child's age (García-Ormaechea I, 2014).

Current clinical protocols for young children include electrophysiological and neuroradiological tests. However, these tests do not clarify the integrity of the ventral and dorsal pathways (Braddick O, 2011).

Clinical signs and symptoms can be confusing for pediatricians and ophthalmologists who lack experience in assessing preverbal neonates with neurological risk, as the abnormality is not present in the eye structures but in visual behavior. Therefore, a structured clinical history, including a visual behavior assessment, facilitates the diagnostic process (Lheman SS, 2012).

Assessing the visual functions of children through a simple and evidence-based method during the preverbal period will enable early diagnosis and intervention for visual impairments (Kim et al., 2022). Since the 1980s, several questionnaires have been available for parents or primary caregivers to fill out regarding the activities of their preverbal child. The questionnaires mostly consisted of simple questions about daily life activities that required quick and spontaneous answers. After reviewing the existing questionnaires, the Preverbal Visual Assessment (PreViAs) questionnaire for infants under 24 months was developed (Pueyo V, 2014). Infants develop many complex visual abilities within the first 12 months of life. Preterm infants are at high risk for abnormal visual and neurological development. Clinical history or neurological assessment does not provide enough information about visual maturation in infants under 12 months of age (Lee et al., 2021). Therefore, as the first 24 months of life are crucial for timely treatment and rehabilitation, the PreViAs questionnaire was designed to assess how the infant integrates vision with other neurological functions, evaluating four visual domains: visual attention, visual communication, visual-motor coordination, and visual processing.

Assessing the visual functions of children using a simple, evidence-based method during the preverbal period will enable early diagnosis and intervention for visual impairments by applying the Preverbal Visual Assessment (PreViAs) questionnaire, which was developed to assess the visual functioning of preverbal infants (Erol et al., 2024).

This study included 30 healthy term (born on time) infants under 24 months of age and 30 preterm infants under 24 months of age, using the Preverbal Visual Assessment (PreViAs) questionnaire, which measures the results of age-divided groups for overall results and 4 domains: visual attention (VA), visual communication (VC), visual-motor coordination (VMC), and visual processing (VP).

The aim of the research is to examine visual functions using the PreViAs questionnaire, specifically the differences in visual functions between preterm and term infants during the preverbal period, which will allow for timely and appropriate intervention, treatment, and rehabilitation. Since the PreViAs questionnaire has proven to be a useful scale that is easy for parents to complete, another goal was to confirm that the PreViAs questionnaire is suitable and acceptable in clinical practice.

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MATERIAL AND METHODS

The PreViAs questionnaire consists of 30 simple yes/no questions about the child's visual development. Each question relates to one or more of the following four visual-cognitive domains: visual attention (VA), visual communication (VC), visual-motor coordination (VMC), and visual processing (VP). The results are calculated as 1 point for each positive answer and 0 for a negative answer. The score for each domain is the sum of all positive responses. Some items belong to multiple domains. The maximum total result a respondent can achieve on the questionnaire is 30 points.

The mother, father, grandmother, or other primary caregivers of the child completed the questionnaire at the beginning of the examination, before the clinical evaluation. In 15% of cases, the questionnaire was re-administered within 7 days for test-retest analysis. Although parents received information about the visual function of their infant, they were not aware of the specific details of their performance on each evaluated item. Visual acuity was assessed using LEA symbols in cases where cooperation with the child allowed it.

The visual assessment included ocular motility (bulbomotor function), cycloplegic refraction (skiascopy), fundoscopy (retinal examination), and visual behavior assessment.

Since there is no standard behavioral protocol for visual assessment in infants (<24 months of age), a measurement instrument was designed based on the VAP-CAP assessment (Blanksby DC, 1993). This is a visual assessment procedure (VAP) that evaluates capacity, attention, and processing (CAP) in infants. It was designed to assess visual impairment in children.

Our measurement instrument was the Preverbal Visual Assessment questionnaire (PreViAs), an effective tool for evaluating visual functioning and for the early detection of deviations in visual behavior in infants under 24 months. The questionnaire has proven reliable and provides normative data on specific areas of visual-cognitive behavior in age subgroups ranging from 0 to 24 months.

The PreViAs questionnaire consists of 30 simple yes/no questions about the child's visual development. Each question relates to one or more of the following four visual-cognitive domains: visual attention (VA), visual communication (VC), visual-motor coordination (VMC), and visual processing (VP). The results are calculated as 1 point for each positive answer and 0 for a negative answer. The score for each domain is the sum of all positive responses. Some items belong to multiple domains. The maximum total result a respondent can achieve on the questionnaire is 30 points.

A result equal to or below the threshold on the total test, as well as in each domain, indicates difficulties in visual functioning, that is, limited visual-cognitive skills compared to age. The threshold values for the total test and each domain are defined for each age subgroup. The PreViAs questionnaire is not a screening tool, nor is it a substitute for a comprehensive ophthalmological assessment. It should primarily be viewed as an assessment tool that can complement and guide the process of gathering information about visual behavior in infants in clinical practice and identify infants with limited visual-cognitive skills (Eunhee et al., 2022).

Infants under 24 months who came for examination at the Amblyopia and Strabismus Treatment Cabinet at the Tuzla Clinic for Eye Diseases, with a referral diagnosis of: strabismus (crossed eyes), retinopathy of prematurity, refractive error, amblyopia (low

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vision), between January and March 2024, were included in the study. The neonates (n=60) were divided into two groups: preterm infants (n=30) and term infants (n=30). The age of the preterm infants was corrected based on their gestational age at birth.

Considering that the prevalence of visual integrative disorders in the pediatric population is low, and assuming a 95% confidence level, the sample size consisted of 60 subjects under 24 months of age. The results of all four domains of the questionnaire for term-born children were compared with the results of the assessment for the same four domains in preterm-born children. Threshold points with the best balance between sensitivity and specificity for both groups of subjects were selected.

The research data were processed using descriptive and inferential statistical methods. Basic statistical indicators were calculated, and to verify the research objective, the t-test for independent samples was applied.

RESULTS

A total of 60 infants were included in the study, divided into two groups: 30 preterm-born infants and 30 term-born infants. Table 1 shows the results of measures of central tendency and dispersion for the visual-cognitive domains in preterm-born children. According to the authors of the visual functioning assessment instrument, results in the domains are obtained by summing the positive responses to individual statements. The results for visual attention range from 0 to 11, for visual communication from 0 to 5, for visual-motor coordination from 0 to 13, and for visual processing from 0 to 20. The total score ranges from 0 to 30. The results shown in Table 1 indicate that the arithmetic mean for visual attention is 6.05±4.15, the standard error is 0.93, the median and mode are 5.50 and 11, respectively, with minimum and maximum results ranging from 0 to 11. The arithmetic mean for visual communication is 1.90±1.97, with the median and mode being 1, and the minimum and maximum results ranging from 0 to 5. The results for visual-motor coordination show an arithmetic mean of 6.30±4.85, and for visual processing, 8.70±7.47. The arithmetic mean for the total score is 14.35±11.02, the standard error is 2.46, and the minimum and maximum results range from 0 to 30.

Table 1. Descriptive Statistics for the Visual-Cognitive Domains in Preterm Infants

Domain	AS	SD	SG	MED	MOD	MIN	MAX
Total visual attention	6.05	4.15	0.93	5.50	11.00	0.00	11.00
Total visual communication	1.90	1.97	0.44	1.00	1.00	0.00	5.00
Total visual-motor coordination	6.30	4.85	1.08	6.00	0.00	0.00	13.00
Total visual processing	8.70	7.47	1.67	7.00	0.00	0.00	20.00
Total result	14.35	11.02	2.46	12.50	.00[a]	0.00	30.00

In Table 2, the results of measures of central tendency and dispersion for the visual-cognitive domains in term-born children are shown. The results obtained in Table 1 indicate that the

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arithmetic mean for visual attention is 10.35±1.87, the standard error is 0.42, the median and mode are 11, with the minimum and maximum results ranging from 4 to 11. The arithmetic mean for visual communication is 4.65±0.99, with the median and mode being 5, and the minimum and maximum results ranging from 1 to 5. The results for visual-motor coordination show an arithmetic mean of 11.95±2.50, and for visual processing, 17.85±4.85. The arithmetic mean for the total score is 27.25±6.55, the standard error is 1.47, and the minimum and maximum results range from 6 to 30.

Table 2. Descriptive Statistics for the Visual-Cognitive Domains in Term Infants

Domain	AS	SD	SG	MED	MOD	MIN	MAX
Total visual attention	10.35	1.87	0.42	11.00	11.00	4.00	11.00
Total visual communication	4.65	0.99	0.22	5.00	5.00	1.00	5.00
Total visual-motor coordination	11.95	2.50	0.56	13.00	13.00	4.00	13.00
Total visual processing	17.85	4.85	1.08	20.00	20.00	3.00	20.00
Total result	27.25	6.55	1.47	30.00	30.00	6.00	30.00

To determine significant differences between preterm and term-born children regarding visual functioning domains, an independent sample t-test was applied, and the results are presented in Table 3. Based on the t-test results, it can be concluded that term-born children achieve significantly better results ($p < 0.01$) in the domains of visual attention, visual communication, visual-motor coordination, and visual processing. Based on the overall results, it can also be concluded that term-born children, with a significance level of 0.01, perform better in visual functioning compared to preterm children.

Table 3. Results of the t-test

Domain.	Group	AS	SD	SG	t	p
Total visual attention	Preterm children	6.05	4.15	0.93	-4.22	**.000**
	Term-born children	10.35	1.87	0.42		
Total visual communication	Preterm children	1.90	1.97	0.44	-5.57	**.000**
	Term-born children	4.65	0.99	0.22		
Total visual-motor coordination	Preterm children	6.30	4.85	1.08	-4.63	**.000**
	Term-born children	11.95	2.50	0.56		
Total visual processing	Preterm children	8.70	7.47	1.67	-4.59	**.000**
	Term-born children	17.85	4.85	1.08		
Total results	Preterm children	14.35	11.02	2.46	-4.49	**.000**
	Term-born children	27.25	6.55	1.47		

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DISCUSSION

Early or congenital visual dysfunctions negatively affect neurocognitive development in infants and interfere with related functions such as attention, sequential memory, motor development, communication, and learning (Ahmed & Dutton, 1996). In children with neuro-ophthalmological disorders, the questionnaire focuses on visual behavior, thus improving the process of taking the medical history, while parents or other primary caregivers serve as important sources of information regarding the acquisition of certain visual behaviors (Diamond & Squires, 1993). Unrecognized visual dysfunctions can mimic intellectual or social disorders (Dale & Sonksen, 2002), which is why a transdisciplinary or multidisciplinary approach is required in the assessment to validly and accurately identify existing deficits. Physicians, pediatricians, defectologists, neurologists, and therapists working with infants need to obtain accurate information from parents regarding visual functioning and cognitive visual abilities. The PreViAs questionnaire was designed to aid in the process of taking medical histories and in discriminating infants who require further cognitive visual assessments. Desirable characteristics of the questionnaire for developmental screening include standardization, reliability, validity, and criterion-related reliability (that is, sensitivity, specificity, and positive and negative predictive value). Preterm infants are at a higher risk of abnormal visual and neurological development compared to term-born infants (Boot, 2010). As previous studies have shown that early intervention can improve outcomes, early diagnosis is imperative.

CONCLUSION

Specific limitations of the study are a result of the young age (for example, prematurity) of the infants and accompanying challenges (such as multiple impairments). Motor or hearing issues can hinder the assessment of visual cognitive functions in young infants and therefore interfere with the process of obtaining the desired behaviors. To minimize this impact, parents were informed and instructed to answer the questions with a focus only on the visual function of their child. Abnormal results found in infants younger than 2 months should be approached with caution, as predictive values are low in this age group. Based on the overall results, it can be concluded that term-born children, with a statistical significance level of 0.01, achieve better results in visual functioning compared to preterm children.

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