Instruments for evaluation of functionality in children with low vision: a literature review

Instrumentos para avaliação da funcionalidade da criança com baixa visão: uma revisão da literatura

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ABSTRACT

We conducted a literature review of tools used to evaluate functionality in children with low vision with the aim of analyzing the applicability, advantages, and disadvantages for children <6 years of age, an age at which visual development is mostly complete. Publications in Portuguese, English and, Spanish describing functional evaluation tools for children aged 0-18 years with low vision in the following databases were included: Web of Science, Virtual Health Library, Cochrane, Scielo, and PubMed. A total of 181 articles were collected, 15 of which were included in this review. Thirteen tools were identified, nine of which evaluated overall functionality and quality of life through questionnaires. The other 4 instruments, using a observational test model, evaluated functionality and they were elected. Observational tests chosen for their accuracy and lower selection bias were used to evaluate visual functionality. Of these, the Functional Vision Assessment up to 6 years seems to be promising. In conclusion, we observed a lack of tools for evaluating functionality in children with low vision. This type of evaluation is necessary for planning visual rehabilitation to improve quality of life in children with low vision.

Keywords: Vision, low/rehabilitation; Disability evaluation; Vision disorders; Quality of life

RESUMO

Realizada revisão bibliográfica dos instrumentos de avaliação da funcionalidade da criança com baixa visão analisando sua aplicabilidade, vantagens e desvantagens, principalmente entre crianças abaixo de 6 anos de idade, período de grande importância para a reabilitação visual. Publicações descrevendo instrumentos para avaliação funcional nas bases de dados Web of Science, *Biblioteca Virtual em Saúde,* Cochrane, Scielo *e* Pubmed*; em crianças (0-18 anos) com baixa visão, nos idiomas português, inglês e espanhol. Recuperaram-se 181 artigos, sendo 15 incluídos na revisão. Foram identificados 13 instrumentos, sendo nove para avaliar funcionalidade global e qualidade de vida, em modelo de questionário. Os demais, (4 instrumentos), em modelo de testes observacionais, avaliavam funcionalidade visual e foram eleitos. Para avaliar funcionalidade visual foram utilizados testes observacionais, eleitos por serem precisos e com menos viés de seleção. Destes, o AVIF-2 a 6 anos mostrou-se um instrumento promissor. Concluindo, observou-se escassez de instrumentos para avaliar funcionalidade em crianças com baixa visão. Essa avaliação é necessária para planejamento da reabilitação visual e melhora na qualidade de vida de crianças com baixa visão.*

Descritores: *Baixa visão/reabilitação; Avaliação da deficiência; Transtornos da visão; Qualidade de vida*

INTRODUCTION

During the development of vision in children, which is typically complete approximately by 6-7 years of age, health professionals seek to identify possible problems in visual functions to plan appropriate treatment and rehabilitation. Pediatric ophthalmologists routinely assess visual acuity, pupils, ocular motility, refraction, fundoscopy, visual field, color vision, and brightness adaptation. This evaluation is often insufficient to learn how a child performs activities by using their residual vision, which has been defined by Colenbrander[1] as functional vision. Some authors[2,3] consider this to be the best definition for functional vision assessment because it makes clear the difference between the evaluations performed by therapists (functional vision) and by ophthalmologists (visual functions).

Functional vision generally reflects changes in visual functions, but this correlation is not absolute because children with the same visual acuity may present differences in functional vision that can be explained by the interference of environmental factors (e.g., domiciles, schools, and social organizations) and personal (individual particularities and lifestyles), as cited in the International Classification of Functioning, Disability and Health (ICF)[4].

Some authors[5] have been dedicated to the study of functional vision assessments in various age groups, including infants, and have sought to recognize patterns of normality and identify methods to detect changes in these patterns. The functional evaluation of infants is a challenge because of the non-standardization of methods, rapid evolution of abilities due to growth/development, and difficulty in correlating test results with visual acuity[6]. With respect to pre-school children (2-6 years) and school children (7-10 years), standardized assessments for adequate intervention planning are known to be important, especially for visual functionality because of the difficulties that the disability may cause in the learning process. Nobre[7] studied school children and observed that, in most children, vision problems were detected by teachers.

In general, impairment of various visual functions can lead to poor visual acuity[8]. A person with low vision is defined by the World Health Organization[9] (WHO) as having "impairment of visual functioning, even after treatment and/or correction of common refractive errors, and has a visual acuity of <20/60 (6/18, 0.3) to perceived light or a visual field of <10° from its fixation point but uses or is potentially capable of using vision for planning and performing a task".

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For children with this condition, assessment of visual and overall functionality is the first step in visual habilitation/rehabilitation planning. Children, especially those with moderate to profound visual loss, may become dependent or have disabilities that may interfere with their quality of life if they cannot fully use their remaining vision. Functional evaluation allows individualized intervention according to the potential of each child because visual behavior is a representation of neurological development[5]. Early visual intervention, performed between 0 and 6 years of age, is called visual rehabilitation and occurs in the period of the greatest and most significant changes in the child's development when visual, motor, and cognitive acquisitions occur over short time intervals[10]. Visual habilitation aims to avoid or minimize delays in child development and provide a better quality of life.

Evaluation of the functionality of a child can be performed by direct methods, through performance observation, or by indirect methods (self-administered questionnaires or interviews). It should be emphasized that, in general, the concept of functionality described in the CIF encompasses all body functions, activities, and individual participation[11,12]. Thus, for evaluation, the therapist must be well acquainted with the instrument that will be used, which must be appropriate to the age group and stage of development of the child.

Global functionality can be assessed, including activities of basic daily life, instrumental activities (such as using a telephone), and social and leisure activities[13]. The quality of life, in a generic concept, is defined as "the individual's perception of his position in life in the context of the culture and value system in which he lives and in relation to his goals, expectations, standards, and concerns"[14] . In the evaluation of visual functionality, a child uses vision to interact with the environment and people, usually in the form of contextual tasks, in a structured observational process (basic visual, oculomotor, and visuoperceptive functions)[15].

There are several instruments available focused on motor functions, such as the Coordination and Motor Dexterity Assessment[16] and Gross Motor Function Measure[17], and some focused on learning areas, such as the Visual Motor Integration (VMI), which assesses VMI and learning problems[18].

Considering the scarcity of specific instruments validated for functional evaluation in children with low vision, we decided to review the scientific literature on the instruments available to evaluate the functionality in children with low vision and discuss the advantages and disadvantages of the instruments to contribute to decision making on the choice of instrument to be used by professionals for a given purpose.

METHODS

To achieve the proposed objectives, a bibliographic survey of the scientific publications on instruments to evaluate the functionality in children with low vision in the main databases in the health area was performed. Relevant information on the subject was searched in the Web of Science, Virtual Health Library, Cochrane, Scielo, and Pubmed databases, which index national and international peer-reviewed journals. The formulation of the search strategies was based on the terms in Medical Subject Headings: low vision, rehabilitation, disability evaluation, vision disorders, and quality of life. The bibliographic review was performed through September 6, 2016.

Selection of the documents was based on reading of the title and summary of each article. We used the filters present in the databases with the terms "children", "questionnaires", "occupational therapy", and "ophthalmology" and selected only original articles. The term "baby" was not used because the authors did not aim to retrieve instruments that evaluated this audience.

To be included in the study, the articles had to contain the following: a description of the instruments (questionnaires, interviews, or observational and/or assisted tests) used to evaluate the functionality in children with low vision as understood in its generic concept or as related to some disease that commonly occurs associated with low visual acuity; evaluations of some function of the body that would impair the functionality of children with low vision; and assessments of the quality of life/impact of low vision on a day-to-day basis or on children's activities. We included all articles that met the previous criteria and whose casuistry consisted of children. To delimit this age group, we opted for the broader definition proposed by WHO[9] that considers a child as a human being <18 years old.

We excluded studies with instruments that did not evaluate the functionality of children with low vision or disease leading to this condition; functional evaluations or evaluations of the quality of life of adults with low vision; studies in which the instrument used were not described or were not present in the process of validation for the evaluation of the series. The following variables were considered: country, year of publication, age of the study population, sample size, disease associated with low vision, type of instrument used, and assessed functions (visual, overall, and quality of life). Correlations between functional evaluation results and visual acuity were also reviewed. Excel was used for the presenting of the database and descriptive statistical analysis. The study was approved by COEP-UFMG CAAE, 0540.0.203.000.11.

RESULTS

A total of 181 articles were retrieved on the basis of the descriptors and 57 were selected after reading the titles and abstracts. These articles were fully read and classified according to the inclusion and exclusion criteria. From this reading, the articles quoted in the selected papers that were not included in the initial bibliographic review were also included in the final review.

Articles were excluded for the following reasons: two articles for not mentioning any instrument for assessing the functionality of children with low vision, 35 because the instruments were used to evaluate adults/elderly, three because they did not describe the instrument used in the study, two because they evaluated structures of the eye, and one because the instrument was not a questionnaire, test, or interview but rather a focus group work with discussion and comment collection.

Data from the 15 studies surveyed are shown in table 1. They were published between 1993 and 2016, most in the last 15 years after the year 2000. Seven of the 15 studies selected were developed in Brazil. The sizes of the samples studied were quite heterogeneous and ranged from 12 to 773 children, and studies that evaluated a larger number of children[21,23-25] performed more robust statistical analyses, with application of, for example, the Rasch Model of the Response to the Item in addition to analyses of variance, covariance, and multiple comparisons. Only Katsumi et al.[23] evaluated global and visual functionality, whereas the other studies evaluated visual functionality and quality of life. Regarding the age group studied in the 15 articles selected, seven evaluated preschoolers and schoolchildren, five evaluated only preschoolers (2-6 years), and three evaluated only schoolchildren (>6 years and 11 months).

It was not possible to describe the most recurrent baseline disease among the studies because almost all of them grouped more than one disease associated with low visual acuity or adopted the generic description of low vision following WHO criteria. Lopes et al.[21] studied a cohort of children with low vision caused only by congenital cataracts and published results of the instrument Visual Functional Infant Questionnaire (QFVI) to evaluate functionality in this population.

Regarding the instruments, among a total of 12 used or reapplied in the 15 studies, half were the Children Visual Function Questionnaire (CVFQ) or Portuguese version of the Visual Child Function Questionnaire (QFVI). All questionnaires required objective responses. They were addressed to parents or caregivers in the case of the LV-FVV, Functional Vision Questionnaire for Children and Young Peo-

Table 1. Data on 15 studies that evaluated functionality in children with low vision[1]

Author (year of publication)	Location	Instrument name	Instrument (type)			n	Age group in years		Evaluated functions			Correlation with visual acuity	
			Questionnaire	Interview	Observational test		Case group	Control group	Quality of life	Visual functionality	Global functionality	Accomplished	Unrealized
Blanksby e Langford (1993)[27]	Australia	VAP-CAP			X	193	0.25 to 4			X			X
Katsumi et al. (1998)[23]	USA	VAS	X			600	1.3 to 14			X	X	X	
Gothwal et al., (2003)[29]	Índia	LV P-FQV	X			78	8 to 18			X	X		X
Felius et al., (2004)[24]	USA	CVFQ	X			773	0 to 7		X		X	X	
Malta et al., (2006)[19]	Brazil	PEDI		X		27	4.8 to 8	5.8 to 7.5			X		X
Birch et al., (2007)[30]	USA	CVFQ	X			193	0 to 7		X		X		X
Lopes et al., (2009)[21]	Brazil	QFVI	X			69	0 to 7	0 to 7	X		X	X	
Mancini et al., (2010)[20]	Brazil	PEDI		X		30	2 to 6	2 to 6			X		X
El Byoumi e Mousa. (2010)[31]	Egypt	LVP-FVQ	X			50	5 to 18			X	X		X
Rossi et al., (2011)[22]	Brazil	AVIF 2-6 years			X	40	2 to 6	2 to 6		X			X
Cunha et al., (2011)[26]	Brazil	CATM EMMC PBFG-DV			X	12	5 to 9				X		X
Messa et al., (2012)[32]	Brazil	QFVI	X			24	6 mo to 6 yo		X		X		X
Tadić V1, et al., (2013)[25]	United Kingdom	FVQ_CYP	X			101	12 yo to 17 yo		X		X	X	
Zimmerman et al. (2015)[28]	Brazil	Functional vision assessment			X	143	0 to 5.92			X			X
Tunay et al. (2016)[33]	Turkey	CVAQC	X			150	6 to 18		X		X		X

X= present.

ple (FVQ-CYP) and Cardiff Visual Ability Questionnaire for Children (CVAQC). The most used questionnaire among the analyzed studies was the CVFQ, which evaluated global functionality and quality of life, with results published in the year 2000 in the USA. Rossi et al.[3] reported the results of the first three studies with FVCF, indicating that this is one of the few instruments that suitably evaluate the pre-school age group. Another relevant aspect of the test is the subdivision into two age groups: <3 years and ≥3 years. This is because the period <3 years is considered to be the gold standard for evaluation of visual habilitation when development is in the process of accelerated acquisitions. Finally, during validation of the CVFQ for use in Brazil, the authors chose to apply the questionnaire to children who presented only congenital cataracts as a cause of the visual deficit, which provided information about the functional profile of this group specifically and enabled determination of a correlation between the test results and the visual acuity variable[21]. The QFVI was also used in 2012 with children undergoing visual stimulation, but in this study, the series consisted of children with low vision due to different diseases.

The LVP-QFV, FVQ-CYP, CVFQ, CVAQC, and Visual Ability Scores (VAS) questionnaires were applied in patients with a more extended age range, usually ≤18 years of age; patients with various diagnoses; and patients in Australia, India, the United Kingdom, Turkey, and Egypt and they enabled evaluation of the quality of life and daily activities in children with low vision. Table 1 shows which questionnaires were applied to evaluate global functionality, visual functionality, and quality of life. The results obtained from application of the VAS, FVQ-CYP, and FVCF questionnaires were highly correlated with visual acuity according to the studies' authors. Although these questionnaires were affected by bias caused by the respondent's understanding, they are the best way available to evaluate the quality of life. They were applied in studies with a size >100 individuals, analyzed by using recognized strategies for the construction and validation of psychometric instruments, and developed with a focus on the visually impaired public. The CVFQ evaluates not only the quality of life but also global functionality and was the most applied because it encompasses many tasks.

Two studies[19,20] used an interview model as an instrument to evaluate global functionality. It was observed that this instrument may be affected by comprehension bias, which can be minimized by how well the examiners made themselves understood, and suffers interference from the same factors related to the questionnaires, which were the veracity of the answers that could have been affected by the influence and values of the parents or guardians.

The Pediatric Evaluation of Disability Inventory (PEDI) was the most widely used instrument to evaluate global functionality. It is the Brazilian version for assessment of the functional abilities of children, but not those specifically with low vision, and is applied to parents or caregivers. It was applied to children with low vision in studies with a small number of participants (<30 individuals) with several diseases causing the dysfunction or without specification, but with the inclusion of a control group, which improves interpretation of the results. Malta et al.[19] applied PEDI and observed a significant result for the mobility scale. In 2010, Mancini et al.[20] showed significant results for the self-care scale applied to the test in children aged 2 to 6 years. These two studies did not consider the classification of children according to visual acuity and did not correlate the test results with this variable or with any other specific test for children with low vision. Because the test was translated and adapted for children with developmental impairment in general, it would also need to be adapted for visually impaired children with or without developmental delay concomitantly. Its adaptation and validation for children with low visual acuity would place it as an extremely useful tool for measuring performance on tasks related to global functionality.

Observational tests were most commonly used to assess visual functionality. Direct observation generally provides more reliable and accurate results, although it requires more time to perform and depends on a qualified professional. These tests demonstrated evolu-

tion over the 2 decades with a better understanding of their results and the presence of more objective scores and qualifications. The achievement of the task by the child itself is considered. The examiner can score the child's performance in a neutral way and check other information that can be extracted from the observation during the tasks. This process involves observation of overall behavior, communication ability, mood, current health status, and interaction. All those items are taken in consideration.

The VAP-CAP, published in Australia in 1993, is not scored by the tasks performed but instead involves quantification of a group of visual abilities that enables classification of the degree of functional vision in different age groups. According to the authors, this tool reflects the agreement between the visual performance of the child and the accepted vision for a child in a certain age group[27]. The advantage of this test is that it shows if a particular child has the vision functionality expected for their age group. The test requires experienced professionals to observe and analyze the achievement of the tasks by the child according to the classification parameters proposed by the author and should take into account the updating of the same according to new research. The failure of subjects to meet the criteria of this test in many publications probably reflects the difficulty in its reproducibility.

The Functional Vision Assessment (AVIF-2) test was developed by the professionals of the Universidade Federal de Minas Gerais, Brazil and is based on an observational model that aims to evaluate the degree of functional vision by taking into account several visual functions, with activities performed by the child or by visualization of objects. The AVIF-2 uses materials aimed at infants and is the only validated observational test that has as a goal evaluation of children ≤6 years of age.

Another observational test, the Functional Vision Assessment, was developed at the Visual Stimulation Outpatient Clinic of the State University of Campinas, São Paulo, Brazil with the goal of evaluating children between 0 and 5 years 11 months, including assessment for intervention in infants.

The authors of the AVIF-2 (to 6 years) and the Functional Vision Evaluation emphasized that their information on the performance of the child for each visual function evaluated may be complementary to the ophthalmologic evaluation and vice versa and is more useful for visual rehabilitation, especially in terms of visual functionality. The tests have the advantage of not suffering from information bias provided by parents or caregivers. A control group was used in the AVIF study, and it was possible to demonstrate that the test discriminated between children with normal vision and those with low vision.

Assisted testing, such as the Columbia Mental Maturity Scale (CMMS), the Search Questions Game for Children with Visual Impairment, and the Children's Anaerobic Thinking Modifiability are focused on assessing cognitive functions and have been included. It should be considered that cognitive function is a prerequisite for global functionality because it is essential for the execution of daily instrumental tasks. The instruments have been studied[26] and proven to be innovative and adaptable to visually impaired children. The materials as described allow good visualization, and the execution of the tasks is assisted. The fact that the CMMS classifies children according to the mental maturity index enables demonstration of whether cognitive performance is sufficient or deficient in a certain age group and can contribute much to the work of visual rehabilitation. This is especially relevant at the time of visual habilitation (early intervention) so that the activities proposed to evaluate the vision are in agreement with cognitive ability.

The authors of the present review believe that observational tests are the most appropriate model for evaluation of visual functionality. The interview model may be interesting for assessments of quality of life and overall functionality because it can reduce the bias caused by differences in understanding of the questions and facilitates better responses. However, no standardized interview has been found for this assessment that is specifically aimed at children with low vision.

The present broad review of the literature without delimiting the time intervals used identified instruments used to evaluate the functionality of children with low vision in several countries. Differences were observed in the evaluations according to the studied populations, items evaluated, and the design and analysis of the studies. These differences underscored the paucity of research in pre-school age children with low vision.

The limitations of the present revision were the non-inclusion of other languages, except Portuguese e and English in the bibliographic search, non-inclusion of the instruments of subjective evaluations, and non-search for materials not indexed in these bases as books and theses. However, the authors suspect that at the present revision, the most used instruments for functional vision assessment have been included in this review. The approach used to evaluate the types of functions by a specific test (global, visual, or quality of life) can facilitate the choice of a suitable instrument. A gap is observed with regard to standardized functional tests for children with low vision, although studies using the AVIF 2 to 6 years and Functional Vision Assessment have been shown to be promising. It should be highlighted that the lack of instruments for evaluation of visual functionality and its correlation to the visual acuity is a very important aspect of a functional evaluation method that should be added to the ophthalmologic examinations. The presented instruments were not addressed to groups with specific ocular diseases. Such attention would enable detection of differences in the behaviors or functional profiles of subjects by grouping them according to the causative diseases (retinopathy, toxoplasmosis, congenital cataracts, and glaucoma), in addition to other peculiarities related to the diagnosis and functional activities of children.

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