Clinical characteristics and etiology of low vision and blindness in an adult population with visual impairment

Caracterización clínica y etiología de baja visión y ceguera en una población adulta con discapacidad visual

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Abstract

Introduction: low vision and blindness make up the visual disability, one of the types of disability with the highest worldwide prevalence, and apparently the most frequent at a Colombian level. The conventional etiology of permanent and transitory deficiencies responsible for visual impairment such as glaucoma, cataract, infectious blindness and uncorrected ametropias, may be changing due to the presence of other entities and results of public health programs, and it is necessary to extend the etiological spectrum to both Ophthalmological causes as not ophthalmological. **Objectives:** to identify the etiology and the most relevant clinical characteristics in an adult population with visual impairment. **Materials and methods:** descriptive cross-sectional study in 96 adults with confirmed visual impairment. **Results:** 61% with low vision; in 55% the etiology of the visual deficiency was in the posterior segment, 21% in the anterior segment and 10% in the pathway and/or visual cortex. The most frequent individual pathologies: pathological myopia, non-glaucomatous optic neuropathy, glaucoma and macular degeneration related to age. **Conclusions:** in this study, pathologies with posterior segment involvement occupied the most frequent etiologies related to visual disability, and the neuro ophthalmological and ocular trauma entities were identified as a potential source of visual deficiencies. It is necessary to continue carrying out studies that clarify whether the spectrum of conventional etiologies causing visual disability has changed, with the aim of redirecting programs of promotion, prevention, diagnosis, treatment and rehabilitation in low vision and blindness.

Key words: Etiology. Low vision. Blindness. Visually impaired persons. Statistics on sequelae and disability.

Resumen

Introducción: Baja visión y ceguera conforman la discapacidad visual, uno de los tipos de discapacidad con mayor prevalencia mundial y, al parecer, el de mayor frecuencia en Colombia. La etiología convencional de las deficiencias permanentes y transitorias responsables de discapacidad visual como el glaucoma, la catarata, la ceguera infecciosa y las ametropías no corregidas puede estar cambiando por la presencia de otras entidades y los resultados de los programas de salud pública, y es necesario extender el espectro etiológico tanto a causas oftalmológicas como a no oftalmológicas. **Objetivos:** Identificar la etiología y las características clínicas más relevantes en una población adulta con discapacidad visual. **Materiales y métodos:** Estudio transversal descriptivo realizado en 96 adultos con discapacidad visual confirmada. **Resultados:** El 61%

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de los pacientes presentaban baja visión. En el 55% de los casos la etiología de la deficiencia visual se ubicaba en el segmento posterior; en el 21%, en el segmento anterior, y en el 10%, en la vía y/o corteza visual. Las enfermedades individuales más frecuentes fueron: miopía patológica (MP), neuropatía óptica (NO) no glaucomatosa, glaucoma y degeneración macular relacionada con la edad (DMRE). **Conclusiones:** En este estudio las enfermedades con compromiso del segmento posterior ocuparon las etiologías más frecuentes relacionadas con discapacidad visual, y las entidades neurooftalmológicas y el trauma ocular se identificaron como una potencial fuente de deficiencias visuales. Es necesario continuar realizando estudios que esclarezcan si el espectro de etiologías convencionales causantes de discapacidad visual ha cambiado, con el objetivo de redireccionar los programas de promoción, prevención, diagnóstico, tratamiento y rehabilitación en baja visión y ceguera.

Palabras clave: Etiología. Baja visión. Ceguera. Personas con daño visual. Estadísticas de secuelas y discapacidad.

Introduction

The concepts and definitions of disability change over time¹ and adapt more and more to an inter-sectoral context, beyond the mere health sector. From the perspective of human performance of the World Health Organization (WHO), disability is universal; it is part of the human condition and is not a purely biological or exclusively social phenomenon². Disability is a condition that induces a communication and continuous interaction between the body (deficits), the individual (limitations in activity and personal factors) and social factors (restrictions on participation and environmental factors)^{3,4}. In this context, it is recommended to understand visual disability, classified as low vision or blindness. People can have a wide range of activity limitations, restrictions on participation, barriers, personal and environmental facilitators.

Since 2011, the WHO has reported a global prevalence of disability of 15% (near one billion people with some kind of disability)³. In 2011, a systematic review with 20-year data (1990-2010) reported a prevalence of about 223 million people with visual impairment, distributed among 32.4 million blind people and 191 million people with low vision⁵. Current WHO figures indicate a worldwide prevalence of visual impairment of 253 million⁶, of which 217 million have low vision and 36 million are blind. Low vision is more frequent than blindness. Visual impairment as a form of disability due to sensory impairment constitutes about 28% of all disabilities, and this is one of the deficiencies with more prevalent limitations in activity and restrictions on participation (disability).

In Colombia, according to official data from the 2005 national census, the general prevalence of visual impairment (from a perspective of permanent visual limitations, despite wearing contact lenses or eyeglasses) is of 2.72% (about 1,121,129 people)^{7,8}, which represents 43.4% of the Colombian population with some

disability⁸. In other words, the most frequent impairment in the population with disabilities in Colombia is the visual one (until the Colombian population census data for 2018 are published).

The most frequent etiologies of visual impairment that lead to a condition of low vision or blindness are, in general, of ophthalmological nature. The WHO points out that in the world, uncorrected refractive errors (myopia, hyperopia and astigmatism) produce visual impairment in 43% of cases; cataracts in 33%, and glaucoma in 2%⁶. In Latin America, based on the official report of the Vision 2020 program on 2013, the main causes of low vision in people over 50 years were cataracts (40-76%), refractive errors (18-50%) and causes related to the posterior segment (2-23%)⁹. This shows data with great variability because they include multiple studies, some carried out either with urban or rural populations and others with both types (Argentina, Chile, Peru, Guatemala, and Paraguay). This report did not include Colombia due to lack of information⁹.

However, multiple ophthalmological and non-ophthalmological medical etiologies (neurological and systemic, for example) can induce permanent visual deficiencies that also cause visual disability. It is possible that the conventional etiology (purely ophthalmological) of visual disability is changing due to an epidemiological transition phenomena, the increase in the prevalence of chronic non-communicable diseases, the establishment and completion of promotion and prevention plans established by the WHO and the Pan American Health Organization (PAHO) (programs for the control of infectious blindness, for example), plus the current dynamics of basic health care plans and coverage in health systems. Studies that explore the clinical and etiological characteristics at the local, regional and national levels are useful. In the case of Colombia, there are few studies regarding the etiology and clinical characteristics of people with

visual impairment, but they are required to redirect the promotion, prevention and assistance programs in low vision and blindness.

Objective

To identify and classify the most relevant etiologic and clinical characteristics in an adult population with visual disability in the city of Medellin (Colombia). Local and national data are scarce and based on projections of studies carried out in other countries and contexts. Other etiologies, different from conventional ophthalmological ones, may be invigorating the panorama of visual disability.

Methods

Descriptive cross-sectional study conducted in 96 individuals over 18 years of age with visual impairment identified by the Visual Disability Group of the School of Health Sciences (ECS) of the Universidad Pontificia Bolivariana (UPB) at the city of Medellin (Antioquia, Colombia). This is a sample based on convenience due to difficulties in the identification of persons with confirmed visual disability within the health system and in professional practice, secondary to obstacles such as little awareness and technical training in the subject, difficulties regarding the CIE-10R diagnostic coding and little visibility of people with visual disabilities within the health system. The Public Health Research Group ECS-UPB, in the framework of a clinical study about research on disability conducted in the second semester of 2015, examined participants in 16 research days at the facilities of the ECS-UPB. Sociodemographic data, clinical information on etiology and comorbidities, visual acuity (VA) assessment with the ETDRS chart and the application of a format adapted from the International Classification of Functioning, Disability and Health (CIF-2001) were collected.

Visual deficit in patients with visual impairment was categorized by the severity classification of the visual impairment *WHO consultation CIE-10*¹⁰. The criteria used for moderate-severe visual impairment (to classify low vision or blindness) by VA using the ETDRS chart were the following:

- Low vision: Corrected VA less or equal than 6/18 (0.3 in decimal values or $\leq 20/60$ in US notation) and/or visual field less than 20° from the fixation point in the best eye, after the best treatment, common refraction or both, but with a visual

remainder potentially useful for planning and executing tasks this definition includes functional VA).

- Blindness: VA less than 3/60 (0.05 in decimal values or $< 20/400$ in US notation) in the best eye with the best possible correction and/or visual field less than 10° from the central fixation point^{5,10,11}.

The clinical characteristics considered in the study were age, sex, educational level and literacy, category of visual disability, ophthalmological and/or neuro-ophthalmological etiological diagnosis, age of onset of visual symptoms and use of non-optical and optical devices to compensate the visual deficit. The etiology of the visual deficit responsible for the visual disability was grouped by anatomical location in the anterior segment, posterior segment, pathway and visual cortex, and mixed location.

In this study, the *Rapid Assessment of Avoidable Blindness* (RAAB) survey was not used because it is restricted to people over 50 years of age, and its objective is to estimate the prevalence of blindness and low vision in a population by evaluating the coverage and quality of cataract surgeries.

Qualitative variables were reported by frequencies and percentage; regarding quantitative variables, they were evaluated if they followed a normal distribution, by means of the Kolmogorov-Smirnov test (KS test). According to this, means or medians were obtained with their respective standard deviation (SD) or interquartile ranges. The Ethics and Research Committees of the ECS-UPB approved the study. The procedures used in patients were performed after an explanation and obtaining the informed consent. This was a project funded by the Integrated Center for the Development of Research (CIDI) of the UPB, based in Medellin.

Results

There were 96 patients with visual impairment confirmed by VA criteria in the best eye with the best correction and/or campimetry. The average age was 50.5 years (SD: 19.5), following a normal distribution (KS test: $p = 0.806$). Fifty-seven percent (55/96) were women. Thirty-three percent (32/96) had elementary school education level (incomplete: 16.7%; complete elementary school: 14.6%, and currently in elementary school: 2.1%); 30% (29/96) with secondary school education level (incomplete secondary school: 13.5%; complete secondary school: 12.5%, and currently in secondary school: 4.2%). The prevalence of illiteracy was 15% (14/96).

Table 1. Frequency of visual impairment stages in patients

Visual stage	n	%
Moderate visual impairment (< 20/60-20/200)*	42	44
Severe visual impairment (< 20/200-20/400)*	17	18
Blindness (< 20/400)*	37	39

*VA measurement

Table 2. Frequency of use of optical and non-optical devices

Device	n (%)
Optical type:	
– Augmentation lens	32 (33)
– Augmentation telescope	9 (9)
Non-optical type:	
– Orientation and mobility cane	37 (39)
– Braille	24 (25)
– Guide dog	3 (3)

There were 61% (59/96) patients with low vision and 39% (37/96) patients with blindness. Table 1 details the frequency of the visual stages of the deficit in patients, according to the severity classification of the visual impairment *WHO consultation CIE-10*¹⁰.

The most frequent individual diagnoses of the patients, at the ophthalmological and neuro-ophthalmological level, were PM (16% [15/96]), NO (10% [10/96]), glaucoma (9% [9/96]), AMD (9% [9/96]), retinitis pigmentosa (RP) (7% [7/96]), ocular trauma (7% [7/96]), cataract (6% [6/96]), uncorrected refractive errors (4% [4/96]), ocular albinism (2% [2/96]) and choroide-remia (2% [2/96]). Figure 1 shows the distribution of diagnoses grouped by anatomical location.

The posterior segment of the globe, comprising the retina, the choroid and the vitreous chamber, was the anatomical site most affected by the individual diagnoses identified in all the patients.

The onset of visual symptoms in 76% (73/96) of the cases was after birth, at 28.8 years (SD: 22.7) on average, and follows a normal distribution according to the KS test ($p = 0.095$). In 24% (23/96) of the patients, the onset of symptoms occurred at birth, that is, the visual disorder was congenital.

Sixty-seven percent (64/96) and 43% (41/96) of the patients used non-optical and optical devices, respectively, to compensate for their visual deficit. Table 2 shows in detail the frequency of use of optical (telescopes and magnifying glasses) and non-optical devices (cane, Braille and guide dog) by patients.

Discussion

Visual disability produces changes and adaptations in various aspects of people's performance¹², since it is a subject with different inter-sectoral challenges that transcend health care¹³⁻¹⁵.

In this study there were more patients with low vision than with blindness (61 vs. 39%; and the reason is because for each blind person there are about two patients with low vision), and among those with low vision, the most frequent impairment category was moderate visual impairment (VA between 20/60 and 20/200). In Latin America and the Caribbean, it is estimated that for every million inhabitants, about 20,000 have low vision and 5,000 are visually impaired¹⁶, and worldwide, the estimated ratio between blindness and low vision is of 1: 6⁶.

The results on the etiology of visual impairment causing visual disability in this study show a wide spectrum of diseases capable of permanently affecting visual functioning. Individual diseases with a frequency greater than 5% were PM, non-glaucomatous optic neuropathy, glaucoma, AMD, RP, ocular trauma and cataract. No cases of visual disability (especially blindness) of infectious origin were found, and the causes for the highest prevalence of visual impairment reported worldwide, such as cataract and glaucoma, did not occupy the first positions in this study population⁶.

By anatomical location, diseases of the posterior segment were the most relevant with a frequency of 55%. In high-income countries, the main cause of visual impairment are uncorrected refractive errors, AMD, glaucoma and diabetic retinopathy,¹⁷ and in low-income countries (like Colombia), cataracts dominate as the main cause of blindness (51%), followed by glaucoma (8%) and AMD (5%)¹⁸. The Vision 2020 program on 2013 reported that the main causes of low vision in people over 50 years of age were cataracts (40-76%), refractive errors (18-50%) and causes related to the posterior segment (2-23%)⁹. The authors of this work did not find other publications on the impact of PM and ON in low vision or blindness in Colombia.

In 2015, our group reported a similar finding (low relative frequency of glaucoma and cataract) in terms of causes of visual disability identified through the review and analysis of 107 medical records of patients examined in two referral centers in the city of Medellin between the years 2011 to 2013; cataracts accounted for 4.5% and advanced chronic glaucoma only for 2.2% of the causes of visual disability¹⁹.

Although in this study cataracts were not the main cause of visual disability, it is clear that in Latin America

Figure 1. Diagnoses grouped by anatomical location.

they represent around 38-74% of avoidable causes of blindness²⁰.

In this study, the presence of PM as an etiology of visual disability is striking. PM has several definitions in the ophthalmological literature. Some authors consider it as a refractive error greater than -6.00 diopters²¹. Yasuo Tano defined it as all myopia cases associated with degenerative changes of the posterior segment²², and the American Academy of Ophthalmology defines it as a refractive error greater than -6.00 diopters with an axial length greater than 26.5 mm²³. A meta-analysis from 2015 defined it as eyes with chorioretinal atrophy equal to or more severe than a diffuse atrophy²⁴. In clinical terms, PM is a refractive and degenerative entity. It is reported as a major cause of visual impairment in eastern Asia (12-27%)^{24,25} and one of the leading causes of visual impairment in the European population (reported prevalence of 7%)²⁶. In Colombia, there are no reports or data regarding the epidemiology and implications of PM as a cause of visual disability.

AMD as a chronic degenerative entity of the macula is a cause of visual disability that has been increasing in recent decades and that affects mainly the central visual field. It is the leading cause of blindness in the adult population of western industrialized countries^{27,28} and the third leading cause of visual impairment currently worldwide²⁸. The worldwide prevalence of AMD is close to 170 million people²⁸. The WHO estimates that the population with AMD will double by the year 2020 (mainly in industrialized countries)¹⁰. Wong, et al.

estimate a global prevalence of AMD of 288 million individuals by 2040²⁹. If cataracts and infectious blindness (trachoma and onchocerciasis) continue to be the main visual health challenges in several non-industrialized countries, AMD constitutes today the greatest challenge regarding visual health and well-being in the industrialized countries. In Latin America, there are different reports on the magnitude and importance of AMD. In a Brazilian study with three million people with visual deficit, AMD was responsible for 5.46% of the cases³⁰. In Ecuador, in a study with 802 patients, AMD caused blindness in 3% of cases³¹. In Colombia, there are no official data on the epidemiological and clinical magnitude of AMD and visual disability; however, in this study AMD was the fourth most frequent disease in the patients.

In England, hereditary diseases of the retina are the main cause of blindness in the population between the ages of 16 and 64³². The worldwide prevalence of RP reported is of 1:4,000³³, about 1.5 million people. In this context, RP is the most frequent hereditary degeneration of the retina, the first cause of genetic blindness in adults, characterized by nictalopia, progressive loss of peripheral visual fields, photoreceptor involvement and retinal atrophy^{32,33}. RP is transmitted in an autosomal recessive pattern in 50 to 60% of cases, in an autosomal dominant pattern in 30-40% and with an X-linked pattern in 5-15%^{33,34}. RP was the fifth individual disease in the patients with visual impairment evaluated in this study. In Colombia, there are no studies with sufficient statistical power to understand the importance of

RP and other retinal hereditary diseases on visual disability.

In Colombia, some studies about the causes of visual disability have been carried out. In the department of Caquetá (year 2004), in a random sample of 10,111 people, cataracts contributed to more than half of the causes of blindness (54.7%), uncorrected refractive errors contributed in 11.9% and glaucoma accounted for 4.76% of the cases³⁵. In the department of Santander, in a study published in 2009, glaucoma accounted for 2.8%³⁶. In 213 people with visual limitations in the city of Bogotá, a prevalence of diabetic retinopathy of 18.3% was reported³⁷. In the city of Cali, a characterization of 124 children with visual impairment reported as the most frequent causes of childhood blindness (potentially preventable) retinopathy of prematurity (33.8%), visual pathway anomalies (20.9%) and ocular toxoplasmosis (15.3%)³⁸. However, the absence of an adequate etiological and clinical systematization of the population with visual impairment in Colombia (with more clinical and specific information compared to the information about the location and characterization of the disabled population of the Ministry of Health) hinders a true academic and practical understanding on the subject. This conclusion is similar to that made by Cañón Cárdenas in 2011³⁹, when he reviewed data about the population with low vision in Colombia.

It is striking that in our study other diseases and entities outside the posterior and anterior segment of the globe, such as ocular trauma and diseases of the visual pathway and visual cortex, may cause permanent visual deficiencies ranging from low vision to blindness. The WHO reports at least 1,000 million people with a neurological disorder⁴⁰, and the magnitude or repercussion of visual deficiencies of neurological origin such as non-glaucomatous ON, as well as vascular, neurodegenerative or demyelinating involvement of visual brain areas, are current study challenges in the field of visual disability.

Age is an increasingly documented variable to understand the etiology and epidemiology of sensory (visual and auditory) and mental disability³. The world disability report for 2011³ indicates that one out of seven people over 15 years of age have some type of disability. This relationship with age has also been evidenced in the population with visual impairment, since one out of three people over 65 years of age may have low vision. This is a common cause of chronic performance deterioration in people older than 70 years,⁴¹ and about 65% of the entire world population with visual impairment is 50 years of age or older⁴². In this

study, the average age of patients with visual impairment was 50.5 years.

Since 2011, the WHO reports³ a greater tendency in the figures of disability towards the female gender. In the study population, female gender showed a slightly higher frequency (57%). Several descriptive studies on visual impairment have reported a higher prevalence in women^{17,43}, and this disparity accentuates in high-income countries when it comes to blindness-type visual impairment⁴². Stevens, et al. report that 60% of blind people and 57% of people with low vision are female¹⁴. Although this data are still limited to explain this trend, they are partly related to women's longer life expectancy⁴⁴. In Colombia, the population census figures from 2005 describe that visual impairment affects the male gender more in ages ranging from birth to 14 years, while women are more affected in adulthood and old age, and this difference is more pronounced after the age of 34⁷.

In our study, we found an illiteracy rate of 15%, and some patients were enrolled in primary and secondary studies as adults. The *Latino Eye Study*⁴⁵, a cross-sectional descriptive study conducted in 2004 in a population of 6,357 patients, reported that having 12 or more years of schooling, compared to 0-6 years, positively influences the visual quality of patients. Other authors have observed that the prevalence of visual disability increases in some sectors with populations characterized by low cultural and educational levels⁴⁶.

A facilitator in visual disability consists of assistance to rehabilitation services, use of optical and non-optical aids, accessibility, educational and job opportunities. In our study population, the use of magnifying glasses and/or an orientation and mobility cane were the most used optical and non-optical aids, respectively. The lack of supply of optical devices continues to be one of the main causes that contributes to the increase and maintenance of visual disability figures, since it generates limitations in activity and restrictions in participation². In Colombia, optical and non-optical aids have a complex administrative dynamic, considered either technical devices versus educational measures, and some health promoting entities hinder their actual delivery to patients. This reality contradicts part of the legal framework on disability in Colombia (for more information, see Statutory Law 1618 of 2013 and Decree 1328 of 2016). The 2011 disability report³ states clearly that in the world, people with disabilities are three times more likely to be denied health care (mainly in the area of rehabilitation). It is reported that the main reasons that contribute to the increase of visual

disability are the lack of social coverage, the lack of participation of insurers in health and the little knowledge and awareness about the timely referral of patients with visual disabilities to rehabilitation services by health professionals⁴⁷.

This work has methodological limitations that restrict the extrapolation or external validity of the results; however, as a non-analytical observational study, it suggests the need for studies with a larger population and of analytical type to support that the conventional etiology of low vision and blindness may be currently changing. Therefore, it would be reasonable to adjust the promotion and prevention programs of visual impairment to alterations in the visual pathway and the posterior segment, in order to control and treat them with the same importance as cataract plans, glaucoma screening and control of infectious blindness and uncorrected refractive errors.

Conclusions

Visual disability is a current subject in ophthalmology, both in the clinical-practical aspect and in the academic-research aspect. Depending on the degree of disability, it is classified as low vision or blindness, and its conventional etiology (mainly cataracts, glaucoma and infectious blindness) may be changing because of promotion and prevention campaigns, due to epidemiological transition phenomena and to an increased prevalence of chronic non-communicable diseases. Currently, the spectrum of visual disability seems to lean towards other entities that are located anatomically in the posterior ocular segment, without discarding, of course, the importance of diseases of the anterior segment and the presence of neuro-ophthalmological disorders (increasingly more frequently). Therefore, it may be necessary to redirect the programs of promotion, prevention and clinical assistance in low vision and blindness.

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Ethical disclosures

Protection of human and animal subjects. The authors declare that the procedures followed were in

accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the written informed consent of the patients or subjects mentioned in the article. The corresponding author is in possession of this document.

Conflicts of interest

The authors have no commercial interests or other conflicts of interest to disclose.

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