Normal parameters of optic nerve variables in Latin American patients: a retrospective study by optical coherence tomography

Parâmetros normais de variáveis do nervo óptico em pacientes latino-americanos: um estudo retrospectivo por tomografia de coerência óptica

Eduardo Rojas Alvarez[1], Ruth Estefania Mendoza Munzón[2], Karla Verenice Gallegos Reinoso[2], Giuseppe Miotto Montesinos[1]

[1]EXILASER Ophthalmic Clinic, Cuenca, Ecuador.
[2]Faculty of Medicine, University of Cuenca, Cuenca, Ecuador.

How to cite:
Rojas Álvarez E, Mendoza Munzón RE, Gallegos Reinoso KV, Miotto Montesinos G. Normal parameters of optic nerve variables in Latin American patients: a retrospective study by optical coherence tomography. Rev Bras Oftalmol. 2026;85:e0049.

doi:
https://doi.org/10.37039/1982.8551.20260049

Keywords:
Tomography, optical coherence; Optic nerve

Descritores:
Tomografia de coerência óptica; Disco óptico

Received on:
July 31, 2025

Accepted on:
March 21, 2026

Corresponding author:
Ruth Mendoza
Zip code: 030102 – Azogues, Cañar, Ecuador
E-mail: md.ruthmendoza@gmail.com

Institution:
EXILASER Ophthalmic Clinic, Cuenca, Ecuador

Conflict of interest:
no conflict of interest.

Financial support:
no financial support for this work.

Data availability statement:
The datasets generated and/or analyzed during the current study are included in the manuscript.

Associate editor:
Sebastião Cronemberger Sobrinho
Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brazil
https://orcid.org/0000-0003-1466-9963

ABSTRACT

Objective: The primary objective of this study was to characterize normal optic nerve parameters in Latin American patients using Optical Coherence Tomography (OCT) during the period from 2015 to 2022.

Methods: A retrospective, cross-sectional, descriptive study was conducted using data retrieved from the database of the Exilaser Clinic in Cuenca, Ecuador. The study included 290 adult patients without ocular abnormalities. Data from each eye (left and right) were analyzed using SPSS software. For quantitative variables, measures of central tendency and dispersion were calculated.

Results: Females constituted 67.6% of the sample, with 52.4% aged between 36 and 64 years, and 61.4% originating from the Azuay province. OCT-derived optic nerve parameters showed comparable values between right and left eyes but were notably higher than international reference standards. A progressive decrease in the mean retinal nerve fiber layer (RNFL) thickness, both globally and by quadrants, was observed with advancing age.

Conclusions: This study highlights the clinical relevance of establishing population-specific OCT reference values, as significant differences were identified when compared to existing foreign standards. The findings contribute to the standardization of optic nerve parameters in the Latin American population.

RESUMO

Objetivo: Descrever parâmetros normais do nervo óptico em pacientes latino-americanos por meio da tomografia de coerência óptica, no período de 2015 a 2022.

Métodos: Foi realizado um estudo retrospectivo, transversal e descritivo. A informação foi obtida do banco de dados da clínica Exilaser localizada em Cuenca. Dados de 290 pacientes adultos sem alterações foram incluídos. Os dados de cada olho (esquerdo e direito) foram processados com *Statistical Package for the Social Sciences*. Para variáveis quantitativas, foram calculadas medidas de tendência central e dispersão.

Resultados: Mulheres predominaram (67,6%), com idade entre 36 e 64 anos (52,4%) e da região de Azuay (61,4%). Os parâmetros mostraram valores bastante semelhantes entre os dois olhos, mas muito mais altos do que os padrões estrangeiros. Há uma diminuição notável no número médio de camadas de fibras nervosas na retina, tanto globalmente quanto por quadrantes com o avanço da idade.

Conclusão: O estudo demonstrou a importância de fazer essas medições por meio dessa técnica, mostrando grandes diferenças com os padrões estrangeiros estabelecidos, e contribuiu para a padronização dos parâmetros do nervo óptico em nossa população.

INTRODUCTION

Optical coherence tomography (OCT) plays a fundamental role in the diagnosis and management of optic nerve pathologies, owing to its high precision and ability to provide reliable quantitative measurements of the optic disc and optic nerve head. This technology enables clinicians to perform more accurate clinical assessments and to monitor structural changes over time. Within ophthalmology, OCT has been revolutionary, offering distinct advantages such as being non-invasive, rapid, and capable of producing high resolution images of retinal and optic nerve structures.[1] OCT is based on the principle of interferometry. The image is generated by transmitting infrared light through the pupil.[2] Moreover, OCT enables the acquisition of images with greater speed and higher quality.[3,4] The development of OCT originated from the interferometry method, which was initially designed to measure distances based on the presence or absence of a reflected light signal. The technique evolved, and in 1990, OCT was introduced as an auxiliary diagnostic tool.[5]

OCT has made it possible to detect and quantify structural changes in various ocular tissues under pathological conditions. In 1995, Schuman et al. used OCT imaging to study the retinal nerve fiber layer (RNFL) thickness and demonstrated a correlation between RNFL thinning and aging in a Boston-based cohort.[2] Conversely, Baquero et al. reported that standardized measurements of peripapillary thickness could not be established using OCT, as some authors observed greater thickness in the superior quadrant, followed by the inferior, temporal, and nasal quadrants.[7] In cases of optic neuritis, OCT reveals thinning of the retinal nerve fiber layer and may show the presence of abnormal subretinal neovascular membranes.[8] Each episode of optic neuritis results in irreversible axonal damage, which is readily detectable on OCT. In the acute phase, the RNFL thickness at the optic nerve head may appear normal or even increased in cases involving the anterior optic nerve.[9] Chronic OCT changes, however, can reveal prior optic nerve injury. Asymmetry greater than 5 μm in the peripapillary RNFL or more than 4 μm in the ganglion cell-inner plexiform layer (GCIPL) has been reported in autoimmune disorders such as multiple sclerosis (MS).[10] OCT also aids in the differential diagnosis between MS and neuromyelitis optica spectrum disorder (NMOSD), as well as other retinal diseases involving Bruch's membrane—the elastic layer beneath the retinal pigment epithelium (RPE).[11,12] In retinal evaluation, OCT provides an "*in vivo* biopsy," producing high-resolution images with axial discrimination of approximately 10 microns using color-based algorithms. Modern OCT systems now achieve near-micrometric resolution. Over the years, OCT technology has evolved from early time-domain systems to more advanced spectral-domain devices, offering superior image quality and resolution.[13] Overall, OCT plays a pivotal role in the diagnosis, monitoring, and management of ocular diseases.

The morphological characteristics of the optic nerve may vary according to geographic, ethnic, and demographic factors. Therefore, it is essential to establish population-specific normative reference values to accurately differentiate between healthy individuals and those with optic nerve pathology. A review of major scientific databases, including PubMed®, Cochrane, and UpToDate, revealed a lack of baseline normative data or previous studies describing optic nerve parameters in Latin American populations, particularly in Ecuador. Consequently, European and North American reference standards are frequently used as benchmarks, despite notable anatomical and ethnic differences that may affect OCT interpretation.

Given these disparities, the use of foreign normative values may lead to misinterpretation of OCT findings and potential diagnostic inaccuracies. Considering this knowledge gap, the present study was designed to address the following research question: What are the normative optic nerve parameters obtained through OCT in the population of Cuenca, Ecuador?

The objective of this study was to characterize normative optic nerve parameters in Latin American patients using OCT, during the period from 2015 to 2022.

METHODS

A retrospective, cross-sectional observational study was conducted using data from patients with normal optic nerve parameters obtained through OCT at the Exilaser Ophthalmological Clinic in Cuenca, Ecuador, between January 2015 and September 2022. The analysis was based on information extracted from the institution's electronic database.

The study population included patients from various regions of Ecuador who received ophthalmological care at Exilaser, a specialized center for ocular pathology located in Cuenca. The sample comprised 290 adult patients, representing the total number of eligible cases that met the inclusion and exclusion criteria during the study period.

The inclusion criteria comprised OCT reports from patients aged 18 years or older who demonstrated normal optic nerve characteristics. Specifically, OCT scans were included when the color-coded quadrant maps of the optic nerve head were entirely green or presented with only one yellow quadrant, indicating values within or near the normal range. Scans displaying white coloration in any quadrant were also included, as this denotes supernormal values relative to the general population.

The exclusion criteria encompassed OCT scans exhibiting abnormal findings in two or more quadrants of the optic nerve head map from patients evaluated at the Exilaser Clinic. In addition, patients diagnosed with glaucoma, optic neuritis, or media opacities were excluded. Scans with inadequate image quality due to motion artifacts or signal interference were also omitted from the analysis.

Ethical approval for this research was obtained from the Bioethics Committee of the University of Cuenca, and formal authorization was granted by the Director of the Exilaser Ophthalmological Center to access the institutional database. As part of routine clinical practice, all patients provided written informed consent prior to undergoing ophthalmological examinations, including OCT. This consent included explicit authorization for the use of anonymized clinical data for future academic and research purposes, in accordance with ethical research principles.

All data were de-identified to ensure confidentiality. A structured data collection form was used to record sex, age, place of origin, and OCT-derived optic nerve parameters for each eye (right and left).

The OCT examinations were performed using the Nidek Retina Scan Duo (RS-330) system, with NAVIS-EX software (version 1.5.0.20). Only scans with an Ultrafine Signal Quality Index (SSI) of 10/10 were included in the analysis to ensure optimal image quality and measurement reliability.

Data corresponding to the optic nerve variables of each eye (right and left) were collected and entered into a structured Excel database designed for this study. The dataset included both qualitative and quantitative variables of interest. Initial data organization and simple tabulation were performed using Microsoft Excel 2019. Subsequently, the data were exported to IBM SPSS Statistics, version 23, for statistical analysis.

Descriptive statistics were applied to summarize the findings. Absolute and relative frequencies were computed for qualitative variables, while means and standard deviations were calculated for quantitative variables. These statistical measures were used to establish reference values representing the range considered within normal limits for the study population.

RESULTS

Table 1 shows how female participants predominated (61.4%). Only 38.6% were men.

Table 1. Distribution of participants according to sex, age, and place of origin

Sociodemographic variables	
Sex	
Female	196 (67.6)
Male	94 (39.2)
Age, years	
19-35	53 (18.3)
36-64	152 (52.4)
65 or older	85 (29.3)
Mean/standard deviation	53.22 ±16.16 years
Place of origin	
Azuay	178 (61.4)
Cañar	45 (15.5)
Loja	20 (6.9)
El Oro	11 (3.8)
Guayas	8 (2.8)
Chimborazo	6 (2.1)
Morona Santiago	6 (2.1)
Cotopaxi	4 (1.4)
Zamora Chinchipe	4 (1.4)
Pichincha	3 (1.0)
Los Ríos	2 (0.7)
Bolívar	1 (0.3)
Napo	1 (0.3)
Tungurahua	1 (0.3)
Total	290 (100)

More than half of the participants were between 36 and 64 years old (52.4%), 29.3% were older adults and 18.3% were under 36 years old, with an average of 53.22 ± 16.16 years, a minimum of 18 years and a maximum of 87 years old.

The study group came from 14 parishes. The majority resided in Azuay (61.4%), 15.5% in Cañar and 6.8% in Loja, the rest of the parishes were represented by less than 4% each.

Table 2 shows very similar results between both eyes. Although the minimum and maximum values were somewhat lower in the right eye, the means only varied by only 0.004 at most.

Table 3 reflects quite similar results between both eyes. Although the maximum value was somewhat higher in the right eye, the means varied by just 0.003.

Table 4 indicates quite similar results between both eyes. Although the range between minimums and maximums was greater in the right eye, the means varied by only 0.005 mm^2 at most.

Table 2. Distribution of participants according to cup-disc ratio (minimum and maximum values, mean, and standard deviation)

Cup-disc relationship		Right eye	Left eye
RC-D Vertical	Minimum	0.16	0.22
	Maximum	0.89	0.94
	Mean/standard deviation	0.654 ± 0.141	0.658 ± 0.14
RC-D Horizontal	Minimum	0.12	0.24
	Maximum	0.84	0.84
	Mean / standard deviation	0.592 ± 0.126	0.588 ± 0.134
RC-D Global	Minimum	0.02	0.06
	Maximum	0.72	0.76
	Mean / standard deviation	0.402 ± 0.151	0,402 ± 0.155

RC-D:(Retina–Cup to Disc Ratio) relationship between the size of the optic nerve (cup) and the total diameter of the optic (disc).

Table 3. Distribution of participants according to retina-minimum disc ratio (minimum and maximum values, mean, and standard deviation)

Retina-minimum disc ratio	Right eye	Left eye
Minimum	0.01	0.01
Maximum	0.60	0.70
Mean/ standard deviation	0.110 ± 0.069	0.113 ± 0.073

Table 4. Distribution of participants according to average optic disc area (minimum and maximum values, mean, and standard deviation)

Average optical disc area	Right eye	Left eye
Minimum (mm^2)	0.92	1.21
Maximum (mm^2)	4.58	4.38
Mean / standard deviation	2.692 ± 0.517	2.697 ± 0.527

Table 5 indicates similar results between both eyes. Although the range between minimums and maximums was also somewhat greater in the right eye, the means varied by only 0.003 mm^2 at most.

Table 5. Distribution of participants according to excavation area (minimum and maximum values, mean, and standard deviation)

Excavation area	Right eye	Left eye
Minimum (mm^2)	0.04	0.12
Maximum (mm^2)	2.95	2.89
Mean/standard deviation	1.114 ±0.532	1.111 ±0.533

Table 6 shows that the ISNT law is followed where the largest number of nerve fibers of the optic nerve are found in the lower quadrant, followed by the upper quadrant, then the nasal quadrant and finally the temporal quadrant.

Table 7 reflects a notable decrease in both eyes in the averages of nerve fiber layers in the retina both globally and by quadrants with advancing age. Young adults present much higher values than older adults, especially the upper quadrant, the lower quadrant and at a global level, where they exceed the average fiber layers of the youngest to the oldest adults by more than ten units. In the nasal and temporal quadrants, the differences are not so evident; even in the temporal quadrant, subjects aged 36 to 64 years show a higher average number of fiber layers than those aged 18 to 35 years, for both eyes.

Table 6. Distribution of participants according to average retinal nerve fiber layers globally and by quadrants (minimum and maximum values, mean, and standard deviation)

Average of retinal nerve fiber layers		Right eye	Left eye
Global	Minimum	80	56
	Maximum	135	156
	Mean / standard deviation	106.32 ± 10.21	106.12 ± 11.96
Higher	Minimum	90	72
	Maximum	179	188
	Mean / standard deviation	131.86 ± 16.7	135.02 ± 18.83
Lower	Minimum	100	70
	Maximum	193	197
	Mean / standard deviation	139.93 ± 17.82	139.62 ± 18.36
Nasal	Minimum	50	49
	Maximum	144	146
	Mean / standard deviation	79.44 ± 14.53	76.79 ± 13.85
Temporary	Minimum	45	49
	Maximum	117	111
	Mean / standard deviation	73.53 ± 10.42	71.17 ± 9.87

Table 7. Distribution of participants by age group, according to average retinal nerve fiber layers overall and by quadrants (mean and standard deviation)

Average of retinal nerve fiber layers, years		Right eye	Left eye
Global	19-35	111.13 ± 9.42	110.42 ± 14.3
	36-64	107.64 ± 9.23	107.2 ± 10.1
	65 or older	100.95 ± 10.18	101.51 ± 12.3
Higher	19-35	142.28 ± 14.38	145.79 ± 21.71
	36-64	132.64 ± 15.35	136.14 ± 16.75
	65 or older	123.96 ± 16.58	126.29 ± 16.46
Lower	19-35	146.7 ± 16.71	144.81 ± 20.8
	36-64	142.17 ± 17.07	142.12 ± 16.44
	65 or older	131.69 ± 16.99	131.93 ± 17.84
Nasal	19-35	83.04 ± 15.7	78.17 ± 13.06
	36-64	79.92 ± 14.49	77.36 ± 14.25
	65 or older	76.35 ± 13.34	74.54 ± 14.35
Temporary	19-35	72.4 ± 11.7	70.89 ± 9.17
	36-64	74.91 ± 9.68	72.49 ± 10.24
	65 or older	71.76 ± 10.61	69.0 ± 8.8

DISCUSSION

The study population was predominantly female, with 67.6 of participants being women, primarily over 35 years of age, with a mean age of 52 years, and the majority residing in the Azuay province. Similar demographic trends were observed in other studies, such as that of Vásquez et al.,[14] who also reported a predominance of female participants, although the mean age in their cohort did not exceed 42 years. Conversely, Chua et al.[15] showed a higher mean age in their study population, with an average age of 63 years old.[16] Aging is the primary risk factor, representing the leading cause of blindness among individuals over 60 years of age.[17] When the macula is affected, central (fine) vision becomes compromised. During the aging process, both the monolayer of the RPE and Bruch's membrane undergo degenerative changes, impairing the nutritional support essential for retinal photoreceptors.[18,19] In age-related ocular diseases, it has been hypothesized that glial cell migration originating from retinal tissue at the optic disc contributes to pathological alterations such as posterior vitreous detachment and foveal hole formation.[20,21] Although no significant gender differences have been reported in the general Ecuadorian population, the predominance of women in the present sample may be explained by their greater health-seeking behavior and increased awareness of ocular health.

These findings demonstrate a negative correlation between increasing age and the thickness of the retinal nerve fiber layer. The retinal layers most affected are those comprising the nuclei of photoreceptor cells, including the cell bodies of ganglion and amacrine cells.[22]

Regarding optic nerve parameters, the vertical cup-to-disc (C/D) ratio averaged 0.65, while the horizontal C/D ratio was 0.59. The global C/D ratio was 0.4. The mean disc area measured 2.69 mm^2 (Megalopapilla), and the excavation area averaged 1.11 mm^2. The global retinal nerve fiber layer (RNFL) thickness was 106 um, values generally higher than those reported in previous studies.[23-25] In the study conducted by Vasquez Alania et al.[14] involving a mestizo population from Lima, Peru, OCT an analysis of 184 participants yielded a mean disc area of 2.21 mm^2, neuroretinal rim area of 1.37 mm^2, excavation area of 0.84 mm^2, mean C/D ratio of 0.58, and vertical C/D ratio of 0.55, with a mean RNFL thickness of 100.69 µm. The authors also identified cases of megalopapilla (disc area 2.5 mm^2), whereas in the present study, the mean disc area exceeded this threshold, and most participants exhibited similar characteristics.[14,26] In contrast, Chua et al.[15] reported smaller optic disc dimensions, with a mean disc area of 1.92 mm^2, cup area of 1.13 mm^2, axial length of 23.79 mm, and global RNFL thickness of 92.04 µm. Alasil T et al.[27] documented the thickest retinal nerve fiber layer (RNFL) measurements in accordance with the ISNT rule. A reduction in RNFL thickness was associated with increasing age and higher degrees of myopia. Additionally, Caucasian individuals tend to exhibit thinner RNFL values compared with Hispanic and Asian populations. Likewise, Quiñonez et al.[28] documented a mean C/D ratio of 0.3, RNFL thickness of 112.5 µm, and regional RNFL values of 136.9 µm (superior), 144.9 µm (inferior), 83.1 µm (nasal), and 84.7 µm (temporal), with a disc area of 2.1 μm^2[28] and ganglion cell complex (GCC) thickness of 96.3 µm.[14,29] The latter study, however, involved children and adolescents, whose OCT parameters typically differ from adult populations. Banc and Ungureanu[30] reported that normative pediatric OCT findings indicate that retinal nerve fiber layer (RNFL) thickness is largely independent of age, sex, and laterality, whereas macular thickness varies with age and tends to be greater centrally in younger children. Additionally, refractive error and axial length may influence certain measurements, and portable OCT devices represent a valuable tool for imaging in uncooperative pediatric patients.[30]

Munoz et al.[31] emphasized that OCT measurements should be interpreted with consideration of the specific device and software used, as each system employs distinct segmentation algorithms and analytical protocols, potentially leading to variability in reference values.

A progressive, age-related reduction in RNFL thickness was observed bilaterally, both globally and across all quadrants.[31] Young adults present much higher values than older adults, especially at the upper quadrant, the lower quadrant, and at a global level.[32] Younger adults demonstrated significantly higher RNFL values than older adults, particularly in the superior and inferior quadrants, where mean differences exceeded 10 µm. There are diseases that can affect this group, including schizophrenia.[33] Nieves Moreno M, Martínez J, et al. found that an inverse correlation between age and RNFL thickness reflects the age-dependent decline in retinal neuronal and glial cell density, particularly within the inner retinal layers.[34]

A high frequency of macro discs was noted during clinical evaluation, a finding corroborated by the data and likely indicative of a distinct anatomical characteristic of the local population. The age-related loss of retinal ganglion cells has been widely reported in the literature. Although both inner and outer retinal layers exhibit thinning with age, the inner retina tends to be more markedly affected, consistent with prior studies.[35]

In the work of Sanna Svensson et al., conducted in 69 children aged 5-17 years, the mean macular retinal thickness was 288.9 µm, the ganglion cell layer thickness averaged 75.3 µm, and the circumpapillary RNFL thickness was 110.0 µm. These findings align with the present study, reinforcing the notion that RNFL thickness declines with age. In our sample, the mean RNFL was 106.32 ± 10.21 µm in the right eye and 106.12 ± 11.96 µm in the left eye. It should be noted, however, that different OCT devices were used. The Retina Scan Duo (Nidek RS-330) was used with NAVIS-EX software (v1.5.0.20) in the present study, and the Topcon DRI Triton Plus was used in Sanna Svensson et al.'s work, which may account for interstudy variability.[36]

Retinal nerve fiber layer thinning has been attributed to retinal neuronal and glial cell loss associated with aging.[37,38] According to Mauschitz et al.[39], the rate of RNFL thinning accelerates after age 50, particularly in specific retinal layers. Importantly, their study excluded only subjects with overt ocular disease, potentially including individuals with early or subclinical pathologies, such as preperimetric glaucoma, that could influence retinal thickness measurements.[9] Current evidence suggests that RNFL thinning occurs globally with age but may be more easily detected in regions with higher axonal density.[39,40] The physiological loss is estimated at approximately 2,500 axons per year until the fifth decade, increasing to 7,500 axons annually thereafter.[37,41]

The development of advanced imaging modalities such as OCT underscores the importance of establishing population-specific normative databases. The current study provides valuable baseline data on optic nerve parameters and RNFL thickness in an Ecuadorian population, contributing to the regional standardization of OCT interpretation. The low prevalence of myopia (4%) in the sample suggests minimal influence on mean RNFL values of the general sample, a factor that was considered during the analysis.

It is important to consider the ethnic diversity of the Ecuadorian population, which includes Indigenous, African, and European ancestry, resulting in substantial phenotypic heterogeneity. Such variation likely contributes to differences in optic nerve morphology and OCT-derived measurements. Additionally, the specific OCT model, patient age distribution, and sex ratio may also influence these parameters. Given the limited number of comparable studies in Latin America, the establishment of a regional normative OCT database is warranted.

Finally, this study's external validity is limited by its single-center design and focus on a specific geographic region. Future multicenter investigations encompassing diverse Latin American populations are recommended to validate these findings and to develop comprehensive reference standards for the region.

CONCLUSION

The study population was predominantly female, with over half of the participants aged 36 to 64 years, and the majority originating from the Azuay province. Overall, the optic nerve parameters evaluated by optical coherence tomography showed comparable values in the right and left eyes but were significantly higher than international reference standards for all studied variables.

A progressive, age-related reduction in the retinal nerve fiber layer thickness was observed bilaterally, both globally and by quadrants. Younger adults exhibited higher retinal nerve fiber layer values than older adults, particularly in the superior and inferior quadrants, confirming an inverse correlation between age and retinal nerve fiber layer thickness.

The findings underscore the importance of conducting population-specific optical coherence tomography assessments, as substantial differences were identified compared with established foreign reference values. Consequently, this study contributes to the standardization of normative optic nerve parameters in the Ecuadorian population.

Additionally, optical coherence tomography-derived parameters in this study were consistently higher than those reported in global datasets, suggesting the need for the development of regional threshold or cutoff values to improve diagnostic accuracy and early detection of optic nerve pathology in Latin American populations.

RECOMMENDATIONS

Due to the variability in the data, future studies should delve into personal pathological history and comorbidities that may affect the value of these parameters.

This investigation should serve as a foundation for the establishment of normative optical coherence tomography reference standards applicable to the Ecuadorian population.

The promotion of studies across various ophthalmological institutions in the region are recommended to compare findings among different ethnic and demographic groups, thereby enabling the creation of a comprehensive regional database for optic nerve and retinal nerve fiber layer parameters.

AUTHORS' CONTRIBUTION

Eduardo Rojas Alvarez: Conceptualization, study design, interpretation of results, and drafting of the manuscript. Ruth Estefania Mendoza Munzón: Data collection, data curation, data analysis, statistical analysis, and drafting of the manuscript. Karla Verenice Gallegos Reinoso: Data collection, data analysis , literature review, and critical revision of the manuscript. Giuseppe Miotto Montesinos: Supervision, methodological guidance, interpretation of results, and critical revision of the manuscript.

REFERENCES

1. Watanabe T, Hiratsuka Y, Kita Y, Tamura H, Kawasaki R, Yokoyama T, et al. Combining optical coherence tomography and fundus photography to improve glaucoma screening. Diagnostics. 2022;12(5):1100.
2. Schuman JS, Hee MR, Puliafito CA, Wong C, Pedut-Kloizman T, Lin CP, et al. Quantification of nerve fiber layer thickness in normal and glaucomatous eyes using optical coherence tomography: a pilot study. Arch Ophthalmol. 1995;113(5):586-96.
3. Karrabi N, Hooshmandi S, Amirabadi A, Roshandel D, Hassanpour K, Pakravan M. The role of optical coherence tomography angiography in optic nerve head edema: A narrative review. J Ophthalmol. 2022;2022(1):5823345.
4. Boyd SA. Tomografía de coherencia óptica: atlas y texto. Jaypee – Highlights Medical Publishers; 2010.
5. Everett M, Magazzeni S, Schmoll T, Kempe M. Optical coherence tomography: From technology to applications in ophthalmology. Translational Biophotonics. 2021;3(1):e202000012.
6. Li J, Bai X, Yang Z, Wang Y, Chen X, Zhou X. Time domain ptychographic full field optical coherence tomography. Laser Physics Letters. 2023;20(4):045601.
7. Baquero Aranda I, Morillo Sánchez M, Garc´ıa Campos J. Estudio de parámetros de normalidad en relación a la edad con el tomógrafo óptico de coherencia. Arch Soc Esp Oftalmol. 2005;80(4):225-31.
8. Zangalli CS, Vianna JR, Reis AS, Miguel-Neto J, Burgoyne CF, Chauhan BC, et al. Bruch's membrane opening minimum rim width and retinal nerve fiber layer thickness in a Brazilian population of healthy subjects. PLoS One. 2018;13(12):e0206887.
9. Rodríguez-Acevedo B, Rovira A, Vidal-Jordana A, Moncho D, Pareto D, Sastre-Garriga J. [Optic neuritis: aetiopathogenesis, diagnosis, prognosis and management]. Rev Neurol. 2022;74(3):93-104. Spanish.
10. Kim NH, Kim HJ, Park CY, Jeong KS. Retinal Degeneration After First-Ever Optic Neuritis Helps Differentiate Multiple Sclerosis and Neuromyelitis Optica Spectrum Disorder. Front Neurol. 2019;10:1076.
11. Verdaguer TJ. Degeneración macular relacionada a la edad. Rev Méd Clínica Las Condes. 2010;21(6):949-55.
12. Ferrara M, Lugano G, Sandinha MT, Kearns VR, Geraghty B, Steel DH. Biomechanical properties of retina and choroid: a comprehensive review of techniques and translational relevance. Eye. 2021;35(7):1818-32.
13. Zheng F, Deng X, Zhang Q, He J, Ye P, Liu S, et al. Advances in swept-source optical coherence tomography and optical coherence tomography angiography. Adv Ophthalmol Pract Res. 2022;3(2):67-79.
14. Vasquez Alania PY, Gálvez Olórtegui T, Ayamamani Torres P, Pantoja Dávalos N, Fernandez Llerena S. Morphometric characteristics of the optical disc and thickness of retinal nerve fibre layer using Cirrus 5000 optical coherence tomography in healthy patients attending the National Institute of Ophthalmology. Arch Soc Esp Oftalmol (Engl Ed). 2019;94(12):579-84.
15. Chua J, Schwarzhans F, Wong D, Li C, Husain R, Crowston JG, et al. Multivariate Normative Comparison, a Novel Method for Improved Use of Retinal Nerve Fiber Layer Thickness to Detect Early Glaucoma. Ophthalmol Glaucoma. 2022;5(3):359-68.
16. Beltrán Saínz RI, Hernández Baguer R, Pérez Muñoz ME, Dyce Gordon BL. Utilidad de la tomografía de coherencia óptica para la caracterización y clasificación del edema macular diabético. Rev Habanera Cienc Méd. 2018;17(5):692-704.
17. Mohammadzadeh V, Fatehi N, Yarmohammadi A, Lee JW, Sharifipour F, Daneshvar R, et al. Macular imaging with optical coherence tomography in glaucoma. Surv Ophthalmol. 2020;65(6):597-638.
18. Alonso EP. Caracterización de la cicloposición ocular mediante el ángulo fóvea-disco óptico: evaluación de nuevos métodos de medida. Madrid, Spain: Universidad Complutense de Madrid; 2019.
19. Zhang J, Zhang J, Zhang C, Zhang J, Gu L, Luo D, et al. Diabetic macular edema: current understanding, molecular mechanisms and therapeutic implications. Cells. 2022;11(21):3362.
20. Wang X, Yang J, Wang C, Li X. Choroidal morphologic and vascular features in patients with unilateral idiopathic epiretinal membranes: An optical coherence tomography analysis integrated with assessment of retinal layers. Front Med (Lausanne). 2023;9:1083601.Karanfil FC, Toklu Y, Yorgun MA. Amniotic Membrane Transplantation for Macular Hole Closure. Beyoglu Eye J. 2023;8(1):55-59.
21. Jorge L, Canário N, Quental H, Bernardes R, Castelo-Branco M. Is the Retina a Mirror of the Aging Brain? Aging of Neural Retina Layers and Primary Visual Cortex Across the Lifespan. Front Aging Neurosci. 2020 Jan 8;11:360.
22. Anda Jiménez DE. Características clínico epidemiológicas y prevalencia de glaucoma crónico simple en la Fundación DONUM durante el período 2017-2019 [thesis]. Ecuador: Universidad de Cuenca; 2021.
23. von der Emde L, Vaisband M, Hasenauer J, Bourauel L, Bermond K, Saßmannshausen M, et al. Histologic Cell Shape Descriptors for the Retinal Pigment Epithelium in Age-Related Macular Degeneration: A Comparison to Unaffected Eyes. Transl Vis Sci Technol. 2022;11(8):19.
24. Hassan E, Elmougy S, Ibraheem MR, Hossain MS, AlMutib K, Ghoneim A, et al. Enhanced Deep Learning Model for Classification of Retinal Optical Coherence Tomography Images. Sensors (Basel). 2023;23(12):5393.
25. Han L, Ma Z. Multimodal imaging of a micro-anatomical structure in the vitreous base. BMC Ophthalmol. 2023;23(1):284.
26. Alasil T, Wang K, Keane PA, Lee H, Baniasadi N, de Boer JF, et al. Analysis of normal retinal nerve fiber layer thickness by age, sex, and race using spectral domain optical coherence tomography. J Glaucoma. 2013;22(7):532-41.
27. Quiñónez Quiñónez W, Chávez Gutiérrez RD, Chávez Gutiérrez KG. Espesor de la capa de fibras nerviosas y células ganglionares de la retina mediante tomografía de coherencia óptica en una población mexicana sana menor de 18 años. Rev Mex Oftalmol. 2017;91(3):109-64.
28. Passarelli F, Bonamino A, Caride GG. Tratamiento quirúrgico del agujero macular: resultados anátomo-funcionales. Oftalmol Clín Experiment. 2021;14(1):34-41.
29. Banc A, Ungureanu MI. Normative data for optical coherence tomography in children: a systematic review. Eye (Lond). 2021;35(3):714-38.
30. Muñoz Gallego AM, Tejada P. Tomografía de coherencia óptica en población pediátrica: diferencias con la población adulta y pautas a tener en cuenta a la hora de interpretar los mapas de grosor. Acta Estrabol. 2020;49(2):97-106.
31. Liu X, Hao F, Hao P, Zhang J, Wang L, You SW, et al. Regeneration and functional recovery of the completely transected optic nerve in adult rats by CNTF-chitosan. Signal Transduct Target Ther. 2023;8(1):81.
32. Tian YE, Di Biase MA, Mosley PE, Lupton MK, Xia Y, Fripp J, et al. Evaluation of Brain-Body Health in Individuals with Common Neuropsychiatric Disorders. JAMA Psychiatry. 2023;80(6):567-76.
33. Nieves-Moreno M, Martínez-de-la-Casa JM, Morales-Fernández L, Sánchez-Jean R, Sáenz-Francés F, García-Feijoó J. Impacts of age and sex on retinal layer thicknesses measured by spectral domain optical coherence tomography with Spectralis. PLoS One. 2018;13(3):e0194169.
34. Chauhan BC, Vianna JR, Sharpe GP, Demirel S, Girkin CA, Mardin CY, et al. Differential effects of aging in the macular retinal layers, neuroretinal rim, and peripapillary retinal nerve fiber layer. Ophthalmology. 2020;127(2):177-85.
35. Svensson S, Minor AS, Ohnell HMV. Normative retinal thickness values in children, measured by swept-source optical coherence tomography. Med Hypothesis Discov Innov Ophthalmol. 2025;14(2):50-59.
36. Palazon Cabanes A. Base de datos normativa del grosor de las capas retinianas maculares segmentadas usando el algoritmo de polo posterior 8x8 de la SD-OCT Spectralis. Proyecto de investigación. Universidad de Murcia; 2020 [citado 2026 Mar 23]. Disponível em: https://portalinvestigacion.um.es/documentos/60ff6f5efc2add7ccf414592?lang=en
37. Karkhur S, Chauhan K, Soni D, Sharma B, Yadav N, Banerjee Let al. Optical coherence tomography-based assessment of macular vessel density, retinal layer metrics and sub-foveal choroidal thickness in COVID-19 recovered patients. Indian J Ophthalmol. 2023;71(2):385-95.
38. Mauschitz MM, Holz FG, Finger RP, Breteler MM. Determinants of Macular Layers and Optic Disc Characteristics on SD-OCT: The Rhineland Study. Transl Vis Sci Technol. 2019;8(3):34.
39. Miller NR, Tsai RK. Optic Neuropathies: Current and Future Strategies for Optic Nerve Protection and Repair. Int J Mol Sci. 2023;24(8):6977.
40. Arzuaga Hernández E, Piloto Díaz I, Fumero González FY, Domínguez Randulfe M, Batista Peña M. Tomografía de coherencia óptica macular en el diagnóstico y seguimiento de glaucoma. Rev Cubana Oftalmol. 2020;33(4):e972.