

# Optical coherence tomography characteristics of the optic nerve in Ecuadorian glaucoma patients

Características do nervo óptico por tomografia de coerência óptica em pacientes com glaucoma no Equador

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## ABSTRACT

**Objective:** To characterize structural optic nerve changes in Ecuadorian glaucoma patients using optical coherence tomography data from 2015 to 2022.

**Methods:** This retrospective study analyzed anonymized optical coherence tomography data from 301 eyes of 162 patients diagnosed with primary open-angle glaucoma. Data were acquired using the Nidek RS-330 and analyzed with Statistical Package for the Social Sciences, version 21. We assessed peripapillary retinal nerve fiber layer thickness (global, quadrants, and clock-hour sectors) and cup-to-disc ratios.

**Results:** The mean global retinal nerve fiber layer thickness was  $72.97 \pm 16.48 \mu\text{m}$  (range 34 to 116  $\mu\text{m}$ ). The most affected retinal nerve fiber layer quadrants, in descending order of deterioration, were superior, inferior, nasal, and temporal. Pathological changes were most prevalent in clock-hour sectors 1, 5, 7, 11, and 12. Pathological horizontal cup-to-disc ratios were found in over 90% of patients.

**Conclusion:** Ecuadorian glaucoma patients showed significantly reduced retinal nerve fiber layer thickness and high rates of pathological optical coherence tomography parameters, particularly in superior/inferior quadrants and horizontal cup-to-disc ratios, suggesting a distinct neuropathy pattern in this population. This data is crucial for future studies on a distinct glaucomatous neuropathy pattern within the Ecuadorian population.

## RESUMO

**Objetivo:** Caracterizar as alterações estruturais do nervo óptico em pacientes equatorianos com glaucoma, utilizando dados de tomografia de coerência óptica coletados entre 2015 e 2022.

**Métodos:** Este estudo retrospectivo analisou dados anonimizados de tomografia de coerência óptica de 301 olhos de 162 pacientes diagnosticados com glaucoma primário de ângulo aberto. Os dados foram adquiridos utilizando o Nidek RS-330 e analisados com o *Statistical Package for the Social Sciences*, versão 21. Avaliamos a espessura da camada de fibras nervosas da retina peripapilar (global, quadrantes e setores de hora do relógio) e os parâmetros do disco óptico (razões escavação-disco).

**Resultados:** A espessura média global da fibra nervosa da retina peripapilar foi de  $72,97 \pm 16,48 \mu\text{m}$  (intervalo 34 a 116  $\mu\text{m}$ ). Os quadrantes da fibra nervosa da retina peripapilar mais afetados, em ordem decrescente de deterioração, foram superior, inferior, nasal e temporal. As alterações patológicas foram mais prevalentes nos setores de hora do relógio 1, 5, 7, 11 e 12. Razões escavação-disco horizontais patológicas foram encontradas em mais de 90% dos pacientes.

**Conclusão:** Pacientes equatorianos com glaucoma apresentaram espessura da fibra nervosa da retina peripapilar significativamente reduzida e altas taxas de parâmetros de tomografia de coerência óptica patológicas, particularmente nos quadrantes superior/inferior e razões escavação-disco horizontais, sugerindo um padrão de neuropatia distinto nessa população. Estes dados são cruciais para futuros estudos sobre um padrão de neuropatia glaucomatosa distinto na população equatoriana.

## INTRODUCTION

Glaucoma is a neuropathy characterized by progressive degeneration of the optic nerve caused by the loss of ganglion cells in the retina. It is the leading cause of irreversible blindness worldwide.<sup>(1,2)</sup> Early detection and intervention are crucial for preventing progressive vision loss. Currently, assessment of the retinal nerve fiber layer (RNFL) using optical coherence tomography (OCT) plays a central role in glaucoma diagnosis and management. The main alterations are the thinning of the RNFL and the progressive increase in the cupping of the optic disc.<sup>(3)</sup> While studies have established typical RNFL thicknesses in glaucoma patients internationally, current data specific to South America, and Ecuador in particular, are lacking. Glaucoma diagnosis and monitoring in Ecuador currently relies on OCT device parameters derived from studies conducted primarily on European and North American populations. This raises concerns about the applicability of these norms to the Ecuadorian population due to potential ethnic variations. Therefore, characterizing the primary RNFL changes in this region is crucial for identifying any variations or patterns that could improve glaucoma diagnosis and management.

Currently, only one national study has investigated RNFL thickness in glaucoma patients. Carrión et al. found the average RNFL thickness to be 87.58  $\mu\text{m}$  in the right eye and 87.51  $\mu\text{m}$  in the left eye.<sup>(4)</sup>

Despite global advances in glaucoma imaging, there remains a significant gap in region-specific data from Latin America, particularly regarding RNFL thickness in glaucomatous eyes. Very few studies have evaluated RNFL thickness in Latin American populations, and the existing ones are primarily focused on healthy individuals. For example, a cross-sectional study conducted in Brazil by Zangalli et al.<sup>(5)</sup> assessed peripapillary RNFL thickness in healthy participants of different ethnic backgrounds. They reported a mean global RNFL thickness of 99.59  $\mu\text{m}$  (standard deviation [SD]  $\pm$  9.57) in individuals of European descent, 103.53  $\mu\text{m}$  (SD  $\pm$  11.59) in African descent, and 103.52  $\mu\text{m}$  (SD  $\pm$  9.64) in individuals of mixed ancestry. These findings demonstrate considerable interethnic variability and highlight how structural differences may influence baseline OCT measurements. Furthermore, these values differ from those observed in the United States and European cohorts, emphasizing the potential limitations of extrapolating normative data across diverse populations.

Given Ecuador's multiethnic composition and the scarcity of local research on glaucomatous RNFL changes,

there is an urgent need to generate population-specific data. This study aims to characterize structural optic nerve changes in Ecuadorian glaucoma patients using optical coherence tomography data from 2015 to 2022. In doing so, it seeks to enhance diagnostic precision and inform more tailored clinical management strategies within this demographic context.

## METHODS

This retrospective, quantitative, descriptive, and observational study analyzed anonymized data from patients diagnosed with glaucoma who underwent OCT at the Ophthalmic Center Exilaser in Cuenca, Ecuador, between January 2, 2015, and July 31, 2022. Exilaser is a leading ophthalmological referral center in Cuenca, one of the few in the city equipped with OCT technology. Due to the limited availability of OCT in public Ecuadorian medical facilities and the surrounding region, this center serves a broad population from southern Ecuador.

The study population comprised patients aged 18 years or older who had a pre-existing diagnosis of primary open-angle glaucoma (POAG) meticulously documented in their medical records by the center's ophthalmology specialists. These diagnoses were established based on a comprehensive clinical evaluation, considering the presence of at least two of the following cardinal signs:

- Elevated intraocular pressure (IOP), defined as IOP readings exceeding 21 mmHg on applanation tonometry.
- Characteristic glaucomatous optic neuropathy, identified during dilated fundus examination, indicated by one or more of the following features:
  - Vertical cup-to-disc ratio greater than 0.3.
  - Asymmetry in cup-to-disc ratio (CDR) of more than 0.2 between the two eyes.
  - Nasalization of blood vessels.
  - Deep cupping of the optic disc.
  - Localized or diffuse thinning of the neuroretinal rim.
  - Presence of RNFL defects with a glaucomatous pattern (e.g., arcuate, wedge, or diffuse loss).
- Corresponding visual field defects: detected by perimetry study, demonstrating characteristic glaucomatous patterns such as arcuate scotomas, nasal steps, paracentral scotomas, or generalized constriction.

A gonioscopic study was routinely performed to classify the iridocorneal angle and definitively rule out angle-closure mechanisms, ensuring an accurate diagnosis of POAG. Records were excluded if they presented:

insufficient data; an average nerve fiber count of fewer than 10 in any quadrant (indicating recording error); a signal strength  $\leq 5$ ; retinal diseases other than glaucoma; ametropia  $\geq 4$  D; or if the patient was not from South America.

The following variables were analyzed:

- Sociodemographic: age, sex, and place of origin.
- Comorbidities: presence of any of the following chronic non-ocular diseases associated with increased glaucoma frequency: hypertension, diabetes mellitus, migraine, hypercholesterolemia, hypotension, and Raynaud's syndrome. These comorbidities were investigated to provide a comprehensive characterization of the study population and to acknowledge the established systemic associations of these conditions with glaucoma prevalence and progression, although a detailed analysis of their impact was beyond the scope of this descriptive study.
- IOP: measured IOP values.
- OCT parameters: signal strength, peripapillary RNFL parameters (global RNFL thickness, quadrant thicknesses, and clock-hour sector thicknesses), and optic disc parameters (horizontal and vertical cup-to-disc ratios).

## Statistical analysis

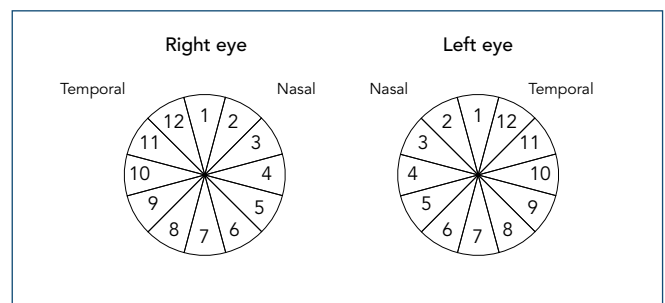
Descriptive statistics were used. Categorical variables are presented as absolute frequencies and percentages. Continuous variables are presented as means, SD, and ranges. Data were analyzed using IBM Statistical Package for the Social Sciences, version 21.

The variables were treated as follows:

- Age: age was analyzed as a continuous variable (mean, SD, range) and categorized into nominal groups: young adult ( $\leq 35$  years), adult (36-64 years), and older adult ( $\geq 65$  years).
- Comorbidities: the presence of any of the specified comorbidities was coded as a dichotomous variable (yes/no).
- Origin: based on institutional data regarding patient influx, the most frequent provinces of origin were identified. Patients from other Latin American countries were grouped as "Latin American", and those from less frequent Ecuadorian provinces were grouped as "Other Ecuadorian Provinces". Frequencies were calculated for this nominal variable.
- IOP: was analyzed as a continuous variable (mean, SD, range) and categorized into nominal groups: low teens ( $\leq 12$  mmHg), mid-teens (13 to 15 mmHg),

high-teens (16 to 18 mmHg), 19 to 21 mmHg and  $> 21$  mmHg.

- RNFL parameters: RNFL thickness (global, quadrants, and clock-hour sectors) was analyzed as a continuous variable (mean, SD, range) and categorized as normal or pathological based on the software's normative database.
- RNFL clock-hour sector definition: peripapillary RNFL thickness was analyzed in 12 clock-hour sectors, as automatically segmented by the Nidek RS 330 Retina Scan Duo software. Orientation was standardized across eyes, where sector 12 corresponds to the same anatomical region in both eyes (i.e. superotemporal). Their anatomical mapping is represented in figure 1, which illustrates the 12 clock-hour sectors for the right and left eyes. Note that a consistent topographic orientation was used, where sector 12 uniformly represents the superior-temporal region in both eyes.



**Figure 1.** Clock-hour sectors and their specific anatomical mapping.

- Cup-to-disc ratio: horizontal and vertical cup-to-disc ratios were analyzed as continuous variables (mean, SD, range) and categorized as normal ( $< 0.3$ ), suspicious (0.3 to 0.6), or pathological ( $> 0.6$ ).

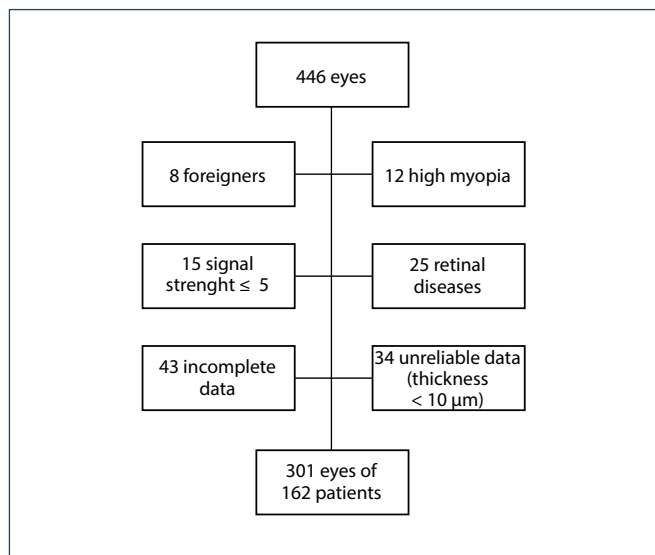
## Ethical considerations

This study was approved by the Human Research Ethics Committee of the University of Cuenca (code: CEISH-UC-2023-013EO-M). The study adhered to the principles outlined in the Declaration of Helsinki, the Belmont Report, the Council for International Organizations of Medical Sciences (CIOMS) guidelines, and Ecuadorian health legislation. An anonymized database, lacking personally identifiable information (names, ID numbers, telephone numbers, addresses, and attending physician information), was obtained from Exilaser Ophthalmological Center. The study protocol, including all amendments and findings, was reviewed by the University of Cuenca's

Ethics Committee. Data confidentiality was ensured through anonymization. The authors declare no conflicts of interest with Exilaser Ophthalmic Center or Nidek. The data were used exclusively for this research.

## RESULTS

A total of 446 eyes were initially identified. After applying the exclusion criteria (figure 2), 301 eyes from 162 patients with POAG were included in the analysis.



**Figure 2.** Flowchart of exclusion criteria application.

### Patient demographics and clinical characteristics

The study population (Table 1) consisted primarily of older adults, with a mean age of  $64 \pm 14.76$  years (range 25 to 93). The majority of participants were female and originated from the province of Azuay. Comorbidities associated with glaucoma were infrequent. The mean IOP was  $17.43 \pm 6.72$  mmHg.

### Retinal nerve fiber layer and cup-to-disc ratio analysis

As shown in Table 2, the mean global RNFL thickness was  $72.97 \mu\text{m}$  (SD:  $16.48 \mu\text{m}$ ), with 77.07% (232 eyes) classified as pathological. This indicates that over 75% of the glaucoma population exhibited a marked reduction in global peripapillary RNFL thickness.

Regarding the RNFL quadrants, the superior and inferior quadrants revealed the highest mean RNFL thicknesses, at  $88.12 \mu\text{m}$  and  $89.57 \mu\text{m}$ , respectively. Pathological findings were also most prevalent in these quadrants, with 70.09% of superior and 62.12% of inferior quadrants being classified as abnormal. The nasal and

**Table 1.** Distribution of sociodemographic and clinical variables of the study population

Variables	n (%)
Age, years	
18-35	7 (2.32)
36-64	141 (46.84)
≥ 65	153 (50.83)
Sex	
Male	137 (45.51)
Female	164 (54.48)
Origin	
Azuay	16 (54.05)
Loja	53 (17.15)
Cañar	27 (8.97)
Other Ecuadorian Province	42 (13.95)
Latin America	12 (3.98)
Comorbidities	
Yes	103 (34.22)
No	198 (65.78)
IOP	
Low teens ( $\leq 12$ mmHg)	68 (20)
Mid-teens (13-15 mmHg)	65 (19.1)
High teens (16-18 mmHg)	61 (17.9)
19-21 mmHg	26 (7.6)
>21 mmHg	81 (23.8)

IOP: intraocular pressure

**Table 2.** Retinal nerve fiber layer thickness and cup-to-disc ratio measurements in 301 eyes with glaucoma

Variables	Mean ( $\pm$ SD; range)	Pathological cases n (%)
Global RNFL	72.97 (16.48; 34-116)	232 (77.07)
RNFL quadrants		
Inferior	89.57 (29.49; 16-197)	187 (62.12)
Superior	88.12 (24.82; 35-160)	211 (70.09)
Nasal	54.32 (15.29; 22-110)	128 (42.52)
Temporal	60.57 (16.26; 24-175)	72 (23.92)
RNFL clock-hour sectors		
CS 1	83.87 (29.45; 28-183)	173 (57.47)
CS 2	65.33 (21.84; 18-144)	110 (36.54)
CS 3	50.10 (15.34; 16-110)	52 (17.27)
CS 4	55.72 (16.50; 22-126)	66 (21.92)
CS 5	81.67 (32.12; 11-176)	156 (51.82)
CS 6	101.58 (37.21; 30-191)	116 (38.53)
CS 7	84.71 (33.76; 27-230)	137 (45.51)
CS 8	57.48 (19.37; 22-152)	74 (24.58)
CS 9	49.77 (16.07; 10-150)	51 (16.94)
CS 10	65.39 (21.85; 24-148)	111 (36.87)
CS 11	87.87 (31.59; 25-186)	140 (46.51)
CS 12	92.57 (31.92; 12-200)	131 (43.52)
Cup-to-disc ratio		
Horizontal	0.79 (0.14; 0.26-0.99)	280 (93.02)
Vertical	0.75 (0.13; 0.25-0.99)	268 (89.03)

SD: standard deviation; RNFL: retinal nerve fiber layer; CS: clock-hour sector.

temporal quadrants showed lower mean RNFL thicknesses, with  $54.32 \mu\text{m}$  and  $60.57 \mu\text{m}$ , respectively, and lower percentages of pathological cases. Thus, in descending order of deterioration, the following pattern emerged: superior, inferior, nasal, and temporal.

Analysis of the 12 clock-hour sectors revealed a wide range of mean RNFL thicknesses. Sector 6 (CS 6) showed the highest mean thickness ( $101.58 \mu\text{m}$ ), while sector 9

showed the lowest (49.77  $\mu\text{m}$ ). The percentage of pathological cases varied across sectors, with the highest in CS 1 (57.47%) and the lowest in CS 9 (16.94%).

The mean horizontal and vertical cup-to-disc ratios demonstrated a high percentage of pathological ratios (over 90% for the horizontal measurements). The mean horizontal cup-to-disc ratio (0.79  $\pm$  0.14) was slightly elevated compared to the mean vertical cup-to-disc ratio (0.75  $\pm$  0.13), suggesting a potential pattern of glaucomatous damage.

### Relationship between retinal nerve fiber layer thickness and clinical variables

Associations between RNFL thickness and sociodemographic and clinical variables are presented in table 3. Lower global RNFL thickness was observed in male patients; patients with comorbidities associated with glaucoma (hypertension, diabetes mellitus, migraine, hypercholesterolemia, hypotension, and/or Raynaud's syndrome); older patients; patients with elevated IOP; patients originating from provinces other than Azuay and Loja (patients from Azuay and Loja presented greater RNFL thickness).

**Table 3.** Mean Global retinal nerve fiber layer thickness across sociodemographic and clinical variables

Variables	RNFL mean ( $\pm$ SD; range)
Age, years	
18-34	76.43 (19.23; 46-95)
35-64	77.22 (15.91; 42-116)
$\geq$ 65	69.17 (16.02; 34-105)
Sex	
Male	71 (16.8; 34-107)
Female	74.7 (16.1; 40-116)
Origin	
Azuay	73.6 (17; 40-115)
Loja	73.4 (16.3; 41-116)
Cañar	71.7 (15.4; 44-97)
Other Ecuadorian Province	71.2 (16.1; 39-97)
Latin America	72.8 (16.3; 34-100)
Comorbidities	
Yes	72.8 (18.1; 39-116)
No	73.2 (15.6; 34-110)
IOP	
Low teens ( $\leq$ 12 mmHg)	77.54 (15.09; 42-110)
Mid-teens (13-15 mmHg)	74.74 (16.21; 34-116)
High teens (16-18 mmHg)	74.44 (15.67; 42-115)
19-21 mmHg	74.31 (16.35; 43-101)
> 21 mmHg	72.43 (18.79; 41-113)

RNFL: retinal nerve fiber layer; SD: standard deviation; IOP: intraocular pressure.

## DISCUSSION

This retrospective study examined peripapillary RNFL and optic disc changes in glaucoma patients, aiming to identify the most vulnerable areas and establish local

reference ranges for glaucoma-related OCT parameters using the Nidek 330, thus informing future research. Our key findings include: a mean global peripapillary RNFL thickness of 72.97  $\mu\text{m}$   $\pm$  16.48 (range 34-116), with the superior, inferior, nasal, and temporal sectors affected in descending order; and clock-hour sectors 1, 5, 7, 11, and 12 as the most frequently altered. These results are significant as they highlight potential initial areas of glaucomatous damage in Ecuadorian patients, even prior to symptom onset.

The study population had a mean age of 64  $\pm$  14.76 years, was predominantly female, and presented with a mean IOP of 17.43  $\pm$  6.72 mmHg. These demographics align with previous research. Daneshvar et al. reported a mean age of 68 years and a female majority (53:42) in their glaucoma progression study.<sup>(6)</sup> Similarly, Trenkić-Božinović et al.<sup>(7)</sup> and Wong et al.<sup>(8)</sup> reported mean ages of 65.49  $\pm$  9.36 and 65.6  $\pm$  12.2 years, respectively, in their studies of POAG. Wong et al. also reported a mean IOP of 14.38  $\pm$  2.75 mmHg. The similarity in age and the controlled IOP in our study likely reflects the use of ocular antihypertensive medications. The higher proportion of women in our study is consistent with other research indicating a greater female prevalence of glaucoma.<sup>(6,8,9)</sup> Our finding of the highest prevalence in the  $\geq$  65 age group (50.83%) echoes Kreft et al.<sup>(9)</sup> German study, which identified the 70 to 74 age range (21.1%) as most affected, further supporting the link between advanced age and glaucoma.

Forty percent of our open-angle glaucoma patients presented with comorbidities. This aligns with Torabi et al.<sup>(10)</sup> findings on glaucoma risk factors, in which 31% of hypertensive patients and 4.4% of diabetic patients also had glaucoma. Kreft et al.<sup>(9)</sup> identified hypertension (28.83%), diabetes mellitus (23.69%), and other conditions as risk factors for glaucoma. Similarly, Sun et al.<sup>(11)</sup> found significant associations between glaucoma and hypertension (OR 1.36), diabetes (OR 2.5), and dyslipidemia (OR 1.75).

The mean global RNFL thickness in our study (72.97  $\mu\text{m}$ ) was derived from 301 eyes using spectral-domain OCT (Nidek 330) with strict image quality criteria and refractive error limits. A previous local study reported a mean global RNFL thickness of 87.54  $\mu\text{m}$  in suspected glaucoma patients in 2016.<sup>(4)</sup> No other similar studies from Cuenca, Ecuador, were found.

It is well-established that OCT studies worldwide consistently demonstrate a reduced RNFL thickness in individuals with glaucoma compared to those without the disease.<sup>(12,13)</sup> Research has further indicated that the

earliest and most sensitive indicators of glaucomatous damage are typically observed in the global average, inferior, and temporal sectors of the RNFL.<sup>(14)</sup> A systematic review supports the high diagnostic accuracy of OCT, reporting ≥90% sensitivity and specificity in identifying glaucoma.<sup>(15)</sup>

While international studies have evaluated global RNFL thickness (Table 4), our mean RNFL thickness differs notably from some reported values. Indeed, studies worldwide have explored normal RNFL thickness, revealing variations potentially linked to ethnicity, location, and measurement methods. For instance, Jammal et al. found a mean RNFL thickness of 82.4 ± 17.0 μm in a US population, suggesting potentially thicker RNFLs compared to other groups.<sup>(16)</sup> This difference could be due to genetics, environment, or how the measurements were taken. Conversely, studies in China (Hou et al.)<sup>(17)</sup> and Germany (Heindl et al.)<sup>(13)</sup> reported lower average RNFL thicknesses, 70.5 ± 11.8 μm and 70.03 ± 18.2 μm respectively, possibly attributable to anatomical differences between ethnic groups or variations in imaging techniques. These findings underscore the critical need for population-specific RNFL data for accurate diagnoses, which our study aims to address for the Ecuadorian context. These variations could also be attributed to differences in technology, equipment, and population characteristics. RNFL thickness is recognized as a highly sensitive parameter, with Arnould et al.<sup>(18)</sup> reporting 80.9% sensitivity and 87.14% specificity.

**Table 4.** Worldwide studies of global retinal nerve fiber layer thickness in glaucoma using optical coherence tomography

Author	Mean global RNFL (μm)	Sample	OCT modality	Country
Daneshvar et al. <sup>(6)</sup>	71.7 ± 7	171	Cirrus, SD	USA
Trenkić-Božinović et al. <sup>(7)</sup>	65.49 ± 9.36	88	Stratus, TD	Serbia
Wong et al. <sup>(8)</sup>	74.02 ± 9.56	119	Cirrus, SD	Singapore
Heindl et al. <sup>(13)</sup>	70.03 ± 18.2	620	Spectralis, SD	Germany
Jammal et al. <sup>(16)</sup>	82.4 ± 17.0	14 739	Spectralis, SD	USA
Hou et al. <sup>(17)</sup>	70.5 ± 11.8	231	Cirrus, SD	China
Arnould et al. <sup>(18)</sup>	64.0 ± 14.9	178	Spectralis, SD	France
Kim et al. <sup>(19)</sup>	79.45 ± 12.05	114	Cirrus, SD	South Korea
Colombo et al. <sup>(20)</sup>	91.6 ± 10.3	136	Stratus, TD	Italy
Maupin et al. <sup>(21)</sup>	79.6 ± 19.0	136	Spectralis, SD	France
Safwat et al. <sup>(22)</sup>	98.63 ± 12.22	43	Nidek RS-3000, SD	Egypt
Our study	72.97 ± 16.48	301	Nidek 330, SD	Ecuador

RNFL: retinal nerve fiber layer; OCT: optical coherence tomography; SD: spectral domain, TD: temporal domain.

Regarding RNFL quadrants and clock-hour sectors, our findings partially align with previous research. Kim et al.<sup>(19)</sup>, using Cirrus OCT, found the thinnest nasal and temporal quadrants in glaucoma, similar to our results. However, we found the inferior and superior sectors to be

most frequently classified as pathological, despite having higher average thicknesses. This highlights the importance of considering both thickness and regional vulnerability in glaucoma, as different areas may have varying susceptibility to damage.<sup>(23)</sup> Our study confirmed the ISNT rule (inferior, superior, nasal, temporal) in healthy eyes<sup>(18)</sup>, but observed a deviation in the nasal and temporal sectors in our glaucoma patients, likely due to glaucomatous damage.

Our clock-hour sector analysis revealed sectors 1, 5, 7, 11, and 12 as most frequently pathological, while sectors 3, 4, 8, and 9 showed the lowest thicknesses. This partially aligns with Kim et al.,<sup>(19)</sup> who also identified these sectors as thinned, although the specific sectors varied slightly. Trenkić-Božinović et al.<sup>(7)</sup> also reported reduced thickness in similar clock-hour sectors. These variations likely reflect methodological differences and disease severity. Our findings are consistent with Hood<sup>(24)</sup> description of vulnerable areas in the optic disc, corresponding to similar clock-hour sectors.

Our optic disc findings included horizontal cup-to-disc ratio of 0.79 ± 0.14, and vertical cup/disc ratio of 0.75 ± 0.13. These are similar to those reported by Wong et al.<sup>(8)</sup> and Anton et al.,<sup>(25)</sup> who found increased cup-to-disc ratios in glaucoma. These findings emphasize the importance of optic disc parameters in glaucoma assessment.<sup>(26)</sup>

### Limitations

This study, while being the first to describe optic nerve alterations using spectral-domain OCT in Cuenca, has several limitations that warrant consideration. The predominantly advanced stage of glaucoma in our patients may reflect delayed presentation in this population, limiting insights into early disease stages. Furthermore, IOP measurements likely reflect treated rather than true baseline pressures. A significant limitation is the inherent difficulty in directly comparing RNFL thickness measurements across different OCT platforms, as variations exist in acquisition modules, segmentation algorithms, instrument errors, and software. Consequently, our findings are specific to the Nidek 330 used in this study. Additionally, the absence of a healthy control group from the Ecuadorian population within this study limits direct comparison of our findings to a non-diseased local cohort and underscores the need for future normative data studies in this population. Finally, the small and selective sample size may not be fully representative of the broader Cuenca population.

## CONCLUSION

This study characterized optic nerve parameters with optical coherence tomography in glaucoma patients from Cuenca, Ecuador, revealing a mean global retinal nerve fiber layer thickness of 72.97  $\mu\text{m}$ , with over 75% classified as pathological. Clock-hour sectors 1, 5, 7, 11, and 12 were most frequently affected. The horizontal cup-to-disc ratio represented a higher percentage of damage. These findings provide valuable insights into glaucoma characteristics in this Ecuadorian - Latin American population.

## AUTHORS' CONTRIBUTION

This collaborative study was conceived and designed by Eduardo R., a glaucoma specialist, who identified the need for this research. Diego C. and Paula A. led the initial planning, development, data analysis, and interpretation, and were instrumental in drafting and revising the manuscript. Working closely with the other authors, Giuseppe M. and Francisco F. made substantial contributions to the data analysis and interpretation and actively participated in the review process. All authors reviewed and approved the final manuscript and are accountable for its accuracy and integrity.

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