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Morphometric Study of the Optic Nerve Head Among Northern Nigerian Adults, Using Optical Coherence Tomography

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ABSTRACT: Glaucoma is a common health problem worldwide especially in adult population. It is characterised by progressive irreversible optic nerve head (ONH) damage, due to alterations in retinal ganglion cells nutrition and viability. Early diagnosis is key to better management and prognosis. This study measures the ONH parameters among adults in northern Nigeria, using Optical coherence tomography (OCT). This would provide a reference values of ONH parameters that would help clinicians observe early abnormal optic nerve changes for early diagnosis of glaucoma among the population. Healthy 770 adult volunteers from ethnic northern Nigerians underwent complete ocular examination, including anterior and posterior segment examination. Those with normal findings proceeded to have optic nerve head examination using a Stratus OCT machine. The ONH parameters analysed were; optic disc area (DA), rim area (RA), cup area (CA), and cup-to-disc ratio (CDR). The mean DA, RA, and CDR found in the study were 2.35mm^2 SD=$\pm$0.88, 1.76mm^2 SD=$\pm$0.43, and 0.44 SD=$\pm$0.21, respectively. The DA and CDR were significantly larger with age (p=0.001) and the RA was found to significantly decline with age. A regression formula was derived to use for the estimation of ONH dimensions based on age. This study provided reference values of the ONH parameters among the northern Nigerians. We also obtained a regression model that could be used to estimate different ONH dimensions from individual's age, with a reliable accuracy. This would enable an ethnic specific screening protocol for clinicians in screening, diagnosis, and management of optic neuropathies like glaucoma.

KEYWORDS: Optic nerve head, Optical Coherence Tomography, Disc area, Cup-disc ratio, rim area, Cup area, Glaucoma.

SYNOPSIS

Glaucoma is a progressive disease affecting the optic nerve head. This study analyses the optic nerve head of healthy individuals to provide normative reference values and an age-based estimates of the nerve head dimensions important for screening and monitoring purposes.

INTRODUCTION

Optic nerve head (ONH) is also termed the optic disc, papilla or simply the disc. It is the very beginning of the optic nerve, the 2nd cranial nerve that is visible on retinal examination [1]. Axons of the retinal ganglion cells form nerve bundles that converge on the ONH in four zones (superior, inferior, medial and lateral) and exit the eye posteriorly through the lamina cribrosa of the sclera to become the optic nerve. There is a central pale depression of the disc termed the optic cup. This contains no retinal tissue and bares the central retinal vessels (artery and vein). The area between the central cup and margins of the disc is the neuro-retinal rim (NRR). It looks pinkish red ophthalmoscopically as it contains nerve fibres with fine capillary network [2].

Morphometry of the ONH parameters is used to correlate normal from pathologic conditions of the optic nerve that occur in a variety of optic nerve diseases like glaucoma, colobomas and compressive neural lesions [2]. Such parameters are disc area (DA), NRR area (RA), NRR thickness, cup area (CA), vertical cup to disc ratio (vCDR), and peri-papillary nerve fibre layer thickness.

Primary retinal lesions, neuro-ophthalmic conditions or primary optic nerve disorders present with characteristic ONH findings that enable making diagnoses and monitoring progression of these disorders [3].

In glaucoma, a disease with characteristic optic nerve neuropathy, there is irreversible death and loss of retinal ganglion cells. The pathogenesis is still not very clear but is related to elevated eye pressure. It is however proved that more than a third of glaucoma patients have normal or even low eye pressure. This brought to the knowledge of 'normal pressure glaucoma' which is linked to imbalance between neural protective mechanisms provided by various neural growth factors. Diagnosis and monitoring of glaucoma

involve detecting changes on the ONH which could initially be subtle and difficult to recognize from the normal [4]. Different studies have shown variations in the topography of the ONH among races [4-6] and gender [7-10].

Evaluation of the ONH can be done using qualitative techniques which are clinical ophthalmoscopy and stereophotography [8]. These methods are subjective, with high interobserver variability. Quantitative evaluation using imaging techniques like optical coherence tomography (OCT) gives accurate and more objective measurements. This helps in early detection of optic disc and retinal disorders, providing means of early diagnosis and objective monitoring of abnormalities like glaucoma [3].

Optical coherence tomography is a non-contact, non-invasive imagine technique which provides in vivo cross-sectional image of the various parts of the retina including the ONH that are reproducible, quantitative and objective [11]. The OCT machine is a computer assisted optical instrument that uses the principle of low coherence interferometry to measure the echo time delay and intensity of backscattered and back-reflected light form internal microstructure in biological tissues. In the eye, it provides cross sectional images of the optic nerve head and the retina with high resolution tomographic sections with <10 µm axial resolution [12].

As there is no information readily available about the normal values of the optic nerve head in northern Nigerian population, this study aimed to provide these values among adult Nigerians. Clinicians can use this information as references in making early diagnosis of glaucoma and other optic nerve diseases.

METHODOLOGY

Study settings

This cross-sectional study was carried out on volunteer adults at the eye clinic of Amina Kano Teaching hospital, northern Nigeria. Ethical approval was obtained from the institutional ethical board of the teaching hospital and Bayero university, Nigeria. All subjects provided verbal and endorsed written consent to ensure voluntary participation. The subject's information was handled with utmost confidentiality by anonymizing all data obtained that will expose an individual's identity. Such information was only made available to authorize personnel. All the examinations and investigation procedures conducted were done free of charge.

Study Location and sample selection

The study was conducted at the ophthalmic clinic of the teaching hospital, extending over a period of 8 months. The minimum sample size was determined by the formula:

$$n = \frac{Z^2 \times P \times (1-P)}{e^2}$$

Where

n = minimum sample size

Z = Z score at 95% confidence interval (1.96)

P = prevalence 50%

e = margin of error (used here as 5%)

$$n = \frac{(1.96)^2 \times 0.3 \times (1-0.5)}{(0.05)^2}$$

Minimum sample size (n) = 384

In order to obtain more robust data for analysis we conducted a systematic random sampling and selected 770 volunteers. These included relatives of patients attending the clinic and hospital staff, that fulfilled the study criteria and were enrolled as the study participants. All the selected samples had to be of Hausa descent (ensured by a grand parentage), from the northern Nigeria, aged 18 to 60 years and free of systemic medical and/or ocular complaints or abnormal findings.

Examination

Detailed medical history regarding systemic conditions, and several risk factors associated with glaucoma and retinal disease including hypertension, diabetes mellitus, heart disease, and vascular disease like sickle cell disease were obtained. All subjects underwent a complete eye examination that included measurement of Snellen best-corrected visual acuity, slitlamp biomicroscopy, gonioscopy, applanation tonometry, lens opacity estimation with version III of the Lens Opacities Classification System grading system [13]. Anterior segment of the eye was examined using the slit lamp biomicroscope (Keeler, 2000 model). Posterior segment examination was done using +78D condensing lens with the slit lamp and Keeler direct ophthalmoscope. Intraocular pressure (IOP) was measured by a Goldmann applanation tonometer, which is mounted on the slit lamp machine. Topical 0.5% proparacaine chloride was instilled in the eye as a surface anaesthetic agent. In subjects that were not cooperative, IOP was measured with the Keeler air puff non-contact applanation tonometer.

Exclusion criteria

Volunteers with history of glaucoma, previous eye trauma or surgery, those with systemic diseases like diabetes mellitus, hypertension or sickle cell disease. Other exclusion criteria were uncorrected VA of <6/12, anisocoria more than 3mm, hazy media, narrow anterior chamber angle, IOP > 21mmHg, or posterior segment pathology noticed on fundoscopy.

Optic Nerve Head OCT Measurements

Subjects that fulfilled the above criteria were scheduled for OCT procedure. The ONH measurement was performed using Time domain Stratus OCT machine (model 3000, version 4.0). The steps of the procedure were fully explained to the subjects. Both eyes were scanned, right then left. Subject would be examined sitting upright, head fitted to the head rest and eyes aligned to the beam source. The optic nerve head was scanned using the fast scan ONH protocol by clicking on the 'ONH' icon which would be highlighted, as described by Mansoori.[14] Signal strength of acceptable quality, 7 and above was accepted and printed out. Otherwise, a signal of < 6 would be discarded and the ONH re- scanned. The OCT machine has an inbuilt software that provided a measurement of the optic nerve parameters. It then analyzed these measurements and created a numeric and pictorial image of the ONH dimensions (Fig. 1: Optical Coherence Tomography image of the ONH).

Statistical analysis

Data was analysed using IBM Statistical Package for Social Sciences (SPSS, USA version 23.0;). Optic nerve head parameters analysed; disc area (DA), rim area (RA), cup area (CA) and cup to disc ratio (CDR). Continuous variables were expressed as minimum, maximum and mean $\pm$ standard deviation (SD). Comparison of the means of disc parameters between gender and between right and left eyes was examined using Student's (independent) t-test. Mean difference of the disc parameters were compared among different age groups using one-way analysis of variance (ANOVA), followed by post- hoc test for multiple comparisons. Linear regression was conducted to obtain regression models for predicting ONH dimension. Age was used as the predictor for ONH dimension which were the dependent variables. $P < 0.05$ was set as a level of statistical significance

RESULTS

After entry and cleaning, the data of 770 subjects was obtained and processed for analysis. Subjects were aged between 18 and 61 years with majority (68%) being males and the remainder were females. Male to female ratio was 2.1: 1. Subjects were grouped into three age categories <30 years, 30 – 50 years and >50 years.

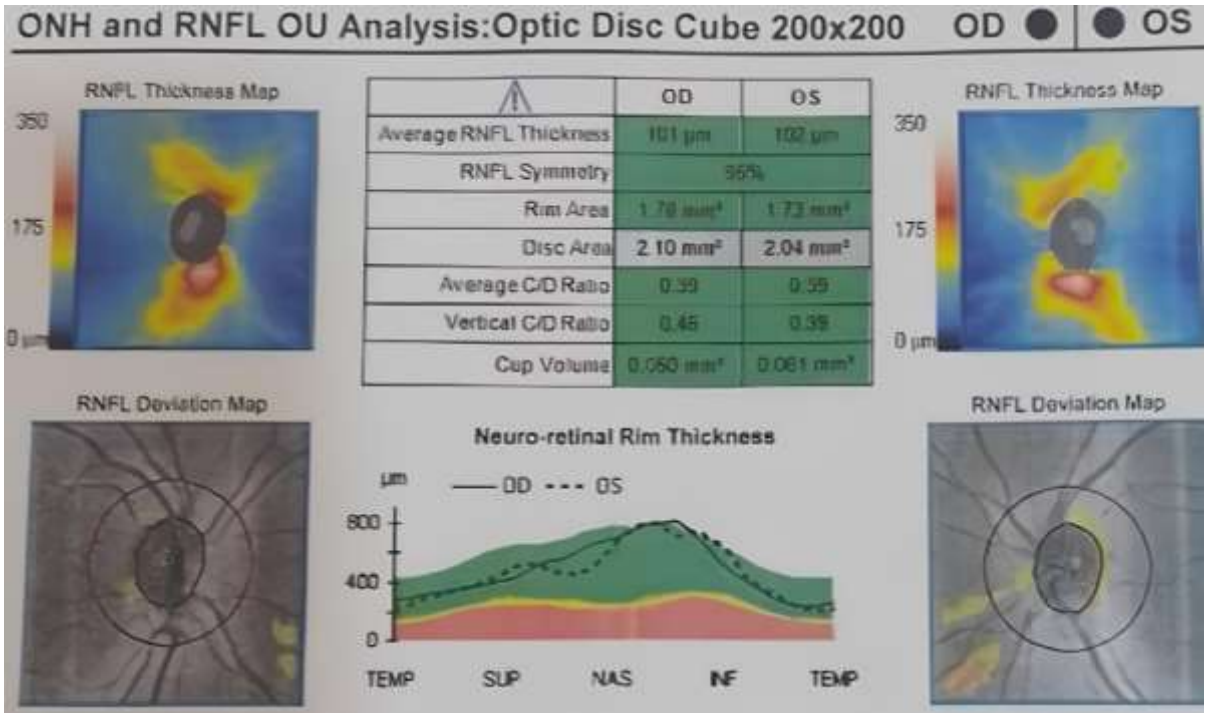

Figure 1: Optical Coherence Tomography image of the ONH

Table 1 shows the descriptive statistics of disc parameter (disc area, rim area, cup area and CDR) in all the subjects. The mean disc area was found to be 2.35mm^2 +SD 0.88. The mean rim area and cup area were 1.76mm2 +SD 0.40 and 0.59mm2 +SD0.20 respectively. The vertical cup to disc ratio (vCDR) mean value observed was 0.44 +0.19 SD with a range of 0.24 to 0.75.

Table 1: Descriptive statistics of disc parameters in all subjects

Disc parameter(mm)	Minimum	Maximum	Mean	±S. D
Disc area	1.60	3.53	2.35	0.88
Rim area	1.00	3.03	1.76	0.40
Cup area	0.21	1.50	0.59	0.20
Vertical Cup disc ratio	0.24	0.75	0.44	0.19

To compare the mean difference of the optic disc parameters between left and right eyes, an independent t-test was performed and result shown in Table 2. The means of all disc parameters, except for vCDR, were observed to be higher in the left side. The mean difference was not found to be statistically significant in all subjects. Mean vCDR was found to be similar (mean= 0.44) in both eyes (p=0.84, t= -0.21).

Table 2: Comparison of disc parameters between right and left eyes in all subjects

Variables	Right (n=770)	Left (n=770)	t	P value
Disc area	2.34	2.37	-0.61	0.54
Rim area	1.76	1.79	-0.46	0.96
Cup area	0.58	0.59	-0.56	0.61
Vertical Cup disc ratio	0.43	0.44	-0.21	0.84

Table 3 shows the comparison of mean difference of the disc parameters between males and females as tested by independent t-test. Male subjects were found to have statistically significant larger disc area, rim area and CDR than the female subjects. Mean difference of cup area between the males and the females was not statistically significant.

Table 3: Comparison of disc parameters between male and female subjects

Disc parameter	Male (n=524)			Female (n=246)			t-test	p-value
	Min	Max	Mean	Min	Max	Mean		
Disc area	1.80	3.53	2.38	1.60	3.58	2.29	2.80	.005
Rim area	1.00	3.01	1.78	1.00	3.03	1.70	2.33	.021
Cup area	0.21	1.50	0.59	0.20	1.20	0.58	0.90	.362
Vertical Cup disc ratio	0.24	0.70	0.45	0.24	0.75	0.43	2.18	.033

Figures 2 and 3 show the distribution of the ONH dimensions through the different age group categories. Comparison of the mean differences of the variables among age groups tested using the one-way ANOVA is represented in table 4.

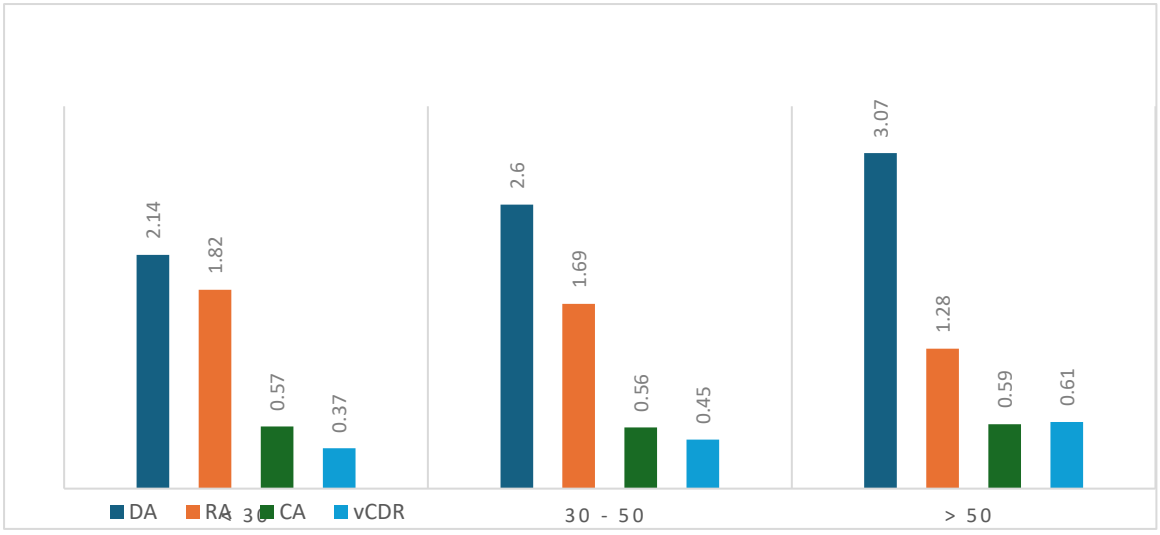

Figure 3: Distribution of ONH dimension across age groups

Mean disc area was found to be highest among the older subjects, which was found to be statistically significant difference (F=8.54, p= 0.001). The post- hoc multi-comparison test shows that deviation of the mean disc area was statistically significant (p<0.05) between the age groups of <30 years and >50 years.

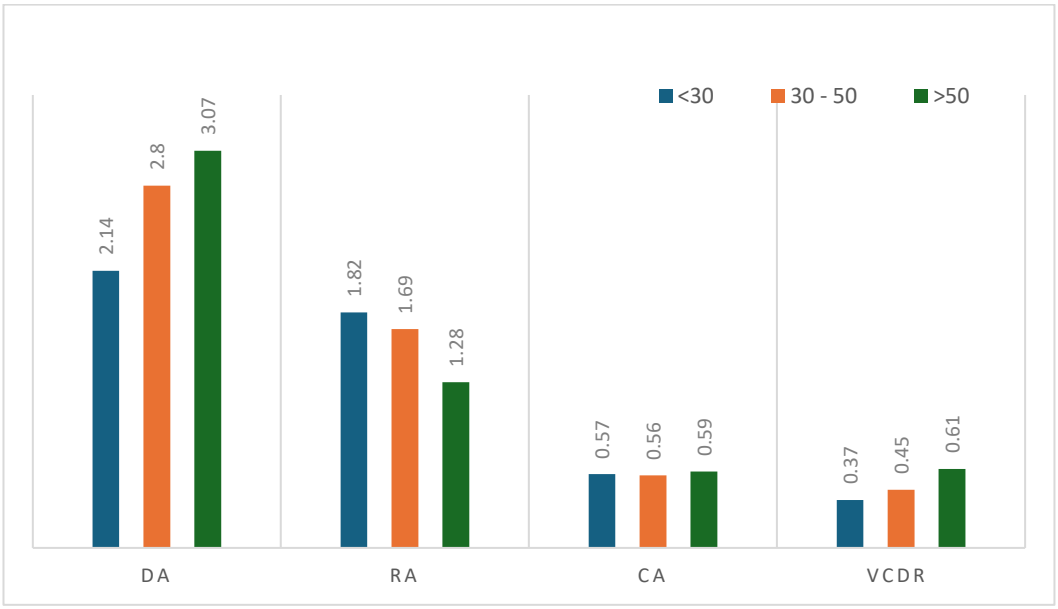

Figure 4: Age group category based on ONH dimension

No significant difference was observed in the CA across the age groups. Older subjects were found to have larger DA and vCDRs with statistically significant differences in the means shown between those in the age group <30 years, 30 – 50 years and >50 years (Table 4).

Table 4: Mean difference of disc parameters among the age groups

Variable (mm)	<30 yearsn = 378	30 – 50 yrs n = 248	>50 n = 144	*f*	P value
Disc area	2.14 (0.72)	2.60 (0.92)	3.07(0.35)	8.54	0.012*
Rim area	1.82 (0.21)	1.69(0.08)	1.09(0.61)	5.64	0.011*
Cup area	0.57 (0.05)	0.56(0.18)	0.59 (0.03)	3.42	0.612
Vertical CDR	0.37	0.45	0.61	2.56	0.001

There was a steady decline observed in the neuro-retinal rim thickness (RA) with age, the highest man obtained among the youngest subjects and lowest among the older subjects. The ANOVA test (table 4) shows a significant difference between the age groups (F=5.64, p= 0.01). The post- hoc multi-comparison test shows that the difference of the mean rim area was statistically significant between the age groups of <30 and those 50 years and above.

Table 5 shows the regression equation models derived from linear regression analysis for prediction of the ONH variables using age as the predictor. It also shows the R^2 value which is the percentage prediction accuracy, and the standard error of estimate (*SEE*) which is difference between the estimated and observed predicted values. As shown in the table, there is strong positive correlation between DA, CA and vCDR with age. It also shows a negative strong positive correlation between vCDR with age indicating thinning of the RA with increasing age. The R^2 value for DA, RA, CA and vCDR stood at 50%, 46%, 11%, and 64% respectively. This indicates that using age as predictor one can get 50%, 45% and 64% accuracy in predicting DA, RA and vCDR of an individual. The SEE observed showed low values (3.44, 3.75, 4.45) indicating good model prediction ability for DA, RA and vCDR respectively. All the regression relationships were statistically significant ($p<0.05$) except for that for CA ($p=0.52$).

Table 5: Regression equations for estimation of ONH dimension using age as predictor

ONH Variables	r	R^2	Regression Equation $y = mx + c$	SEE	P value
Disc area	0.71	0.50	DA = Age x 0.05 + 1.05	3.44	0.02*
Rim area	– 0.68	0.46	RA = Age x-0.02 + 2.5	3.75	0.01*
Cup area	0.33	0.11	CA = Agex0.66 + 1.51	7.76	0.72
Vertical CDR	0.80	0.64	vCDR= Agex0.015– 0.15	4.45	0.02*

DISCUSSION

Primary open-angle glaucoma (POAG) is considered a very common cause of progressive irreversible blindness, and therefore early diagnosis is a key factor in the management of the disease. Assessment and analysis of the optic nerve head parameters is employed as a non-invasive tool for early detection of the disease. Various studies evaluated the optic nerve head (ONH) topography using different examination methods, providing values of the ONH indices based on the ethnicity, gender, and the technique used in the analysis [2,7,15]. This study presented normative values of the ONH parameters in adult Hausa ethnics from northern Nigerians, using optical coherence tomography (OCT) scans.

The mean optic disc area found in this study (2.35 mm² $\pm$ 0.88) was higher than that reported in some studies around the world. For example, a study in the Netherlands observed a disc area of 1.89 mm² among the white studied population [8]. Similarly, some studies observed disc areas smaller than those found in this study of 1.83 mm² and 1.82 mm², respectively [16,17]. This difference may be because these studies used spectral domain OCT machine, whereas in this study we used the Stratus OCT type. In Switzerland, a study reported a mean disc area lower than that obtained in this study [18]. Their values are almost similar to that reported as part of the Sydney Adolescent Vascular Eye (SAVE) study of 1.98 mm² [19]. These two studies had much larger samples than the present study. More importantly, they used Heidelberg Retina Tomography (HRT) scanning laser ophthalmoscopy (cSLO) for optic disc evaluation, so their figures may not be entirely comparable to our findings. Similarly, a study conducted in Japan among Hispanics reported lower disc areas (2.15 mm²) than that reported in this study [20]. The racial difference may account for this difference, but a different OCT protocol (combined ONH/RNFL) was used in the above research as against stratus OCT used in this study. Adjustment for the measured refractive error of eyes was proposed to influence mean disc area as suggested by a study conducted among adults in Turkey [21]. They showed that this adjustment results in obtaining a smaller mean disc area. This adjustment was not done in this study.

Mean disc area obtained in this study is closer to what was obtained by a study among Hispanics (2.32 mm²), using a stratus fast ONH protocol [6]. Additionally, the study found larger discs in their African American subjects (2.40 mm²) than what they obtained among the white subjects (2.29 mm²). However, the difference observed between the studies could have resulted from the fact that most of the Black subjects were associated with the myopic refractive error.

The Rotterdam Eye Study [22], that used a stereo-disc analyser in evaluating the ONH rather than OCT, reported a disc area of 2.42 mm². This method may be affected by image magnification, possibly resulting in obtaining larger values than those of OCT. Mansoor [23], also in India, obtained a higher mean disc area (3.36 mm²) than our finding. As these above studies used stratus OCT machine like the one used in this study and obtained larger disc areas, ethnic diversity and genetic makeup may, therefore, be a possible explanation for the difference. Similarly, researchers in Egypt reported a larger mean disc area of 2.51 mm² using HRT in the Egyptian population [2]. In this latter study, however, the categories of subjects recruited were both those with healthy and those with 'suspicious' optic discs, and they had a much smaller sample size (100 subjects) than our study of 770 subjects.

Sample et al., in the African Descent and Glaucoma Evaluation Study (ADAGES I) reported a smaller mean neuro-retinal rim area than that obtained in this study of 1.76mm² (+0.2) [24]. They evaluated disc parameters using OCT on samples of African descent and compared them to those of European ancestries. They found a mean rim area of 1.53mm² among the healthy subjects. The rim area was also found to be statistically significantly thicker (1.58 mm²) among those of African descent than that of European descent (1.38 mm²). The finding of this study also showed a thicker rim area than that reported by a study [25] among whites (1.27 mm²) and in African Americans (1.18 mm²). They used the Rodenstock disc analyser (RODA) for optic nerve head examination, and this might have affected the acquired images, so their result may not be entirely comparable to our findings. Thicker neuro-retinal rim areas were reported by many other studies [23,24,26]. The mean neuroretinal rim area observed in this study was closer to what was reported by Shaun [15] in India (1.77 mm²). However, in this study, a wider range of the rim area was observed among the subjects (1.00 mm² to 3.03 mm²) against 0.68 mm² to 0.83 mm² reported by the Indian research. The sample size in this study (770) was much larger than that of the research (150) and might have recruited subjects with a wider range of rim area.This study obtained a mean vertical cup-disc ratio (vCDR) of 0.44 in all subjects. This value was higher than that reported in a study by Tsai et al. among whites, Hispanics, and Asians (0.27, 0.33, and 0.29, respectively) [26]. The vCDR they obtained among African Americans was still smaller (0.41) than that in this study. Our finding of mean vCDR was also higher than that reported by Girkin [24] who also used a similar OCT technique as that of this study. In their cohort of 634 participants, they made linear regression adjustments for axial length and retinal nerve fibre layer (RNFL). Uncorrected, however, they obtained just slightly higher mean value (0.46) of vCDR than that found in this study. Mean vCDR obtained in this study is in agreement with what Knight and colleagues [17] obtained using a similar OCT type and protocol on 271 participants of different ethnicities. When corrected for the race, the vCDR observed among Africans was slightly larger (0.50) than our finding. Although the Blue Mountain Eye Study [27] conducted among the white population employed subjective fundus indirect ophthalmoscopy for optic disc examination as against a more objective measurement used in this study, they observed similar (0.44) CDR findings. Similarly, studies [1,4,23,24] mostly from India, all reported larger CDRs than what was obtained in this study. All these studies examined the optic disc with a Stratus OCT and did similar ONH scan protocols like our study. The difference may, therefore, be due to variation in ethnic influence or smaller sample sizes of these studies. Some studies in Africa also reported higher CDR values than those observed in this study. For example, in Egypt, Tharwat [2] reported a mean CDR value of 0.62 among the population. The study used the HRT cSLO machine in their research and obtained a higher mean CDR. They concluded that their findings might be due to the effect of refractive error magnification, as many of their subjects were observed to have axial myopia.

This study found a statistically significant larger male disc area (2.34 mm²) than that of female subjects (2.29 mm²). Mean rim area was also found to be larger in males than in females, and the difference was statistically significant. There was also a considerable difference in the cup-disc ratio. The difference in hormonal influence might have resulted in this difference as proposed by many studies [1,7,28]. However, the axial ocular length may cause image magnification and hence, the significant difference. Bourne et al. reported similar significant gender differences in the Tanjong Pagar study in Singapore, where disc parameters were observed to be significantly higher in males than in the females [29] In India [4] and the United States of America [27], similar larger discs area among males was reported. The Indian study, however, did not find the difference to be of statistical significance.

In agreement with the gender difference findings of this study, a study [23] among the Indian population observed that disc area among males was significantly more extensive than that of females in their study. As females in their study had shorter axial length, they concluded that the gender-based difference observed was likely due to axial magnification. Our study also conforms to the findings of Gvozdenović [30], who also showed a similar gender relationship. They found that disc area and vCDR were significantly higher in males than in the female subjects. Even after correction for refractive error and axial length, statistically significant gender association was apparent. The gender differences of the disc parameters observed in this study were different from those of a study among an Asian population, as observed by Mansour [23], who did not show any significant gender difference with ONH parameters.

Neuro-retinal rim thinning with increasing age has been proposed over the years in the literature [31]. The ageing process may promote free radicals, inducing apoptotic loss of the retinal ganglion cell, which manifests as rim thinning [31]. This study observed a statistically significant ($p = 0.001$) decline in neuro-retinal rim area (RA) among the older subjects. After adjusting for sex, rim area was still statistically associated with age. Vertical cup-to-disc ratio (vCDR) was also found to be significantly larger in the older subjects. Reduction in the rim area among the older subjects observed in this study was not demonstrated in the survey by Budenz and colleagues [32] who did not find any significant RA decline in all the age groups. That could be because their subjects' ages were clustered around 40 years, and therefore, no significant difference was observed. Similarly, the Vellore eye study in India [4] did not show any critical age relationship with ONH parameters after correction for gender. The smaller sample size (70 subjects) than this study might have resulted in having no significant difference. The similar age-related difference observed in this study was demonstrated by a study in Kano, Nigeria [3], which found that peripapillary rim area declined steadily with advancing age. Similarly, our finding was also in support of what was observed in Cameroon, in a study among rural southern Cameroonians [33]

Using fundus photography, they found an average CDR of 0.15 in the youngest and 0.45 in the oldest subjects. The positive correlation they observed was not very far from the finding of this study even though they used a different examination procedure.

Strengths and Limitations

Only a few studies were conducted about ONH dimensions among Nigerian, and no such was done in the northern Nigeria where glaucoma is prevalent. The utilisation of more than 700 study sample could be a strength to some extent. Obtaining a strong statistical tool (regression analysis) to calculate empirically the ONH dimension among adult could also suggest a fairly strong clinical conclusion.

We drew our samples only from Hausa ethnic population while there are over 250 ethnic groups in Nigeria. Therefore, in order to obtain a more generalised data with a better clinical conclusion, studies need to be carried out among other ethnic groups, to determine if there are variations in the findings. Further studies should also include more ocular and systemic determinants of the ONH.

CONCLUSION

Normal reference value of the Optic Nerve Head morphometric parameters (DA, CA, RA and CDR) in normal northern Nigerian adults was presented in this study. We found that optic disc parameters are slightly larger in the left, but not statistically significant. All the parameters were found to be significantly larger in males, except for the CA. There is significant age variation, as the DA and the vCDR were larger in the older patient, and the neuro-retinal rim (RA) was thinnest in them. The regression equations obtained in the study may be useful in estimating different ONH dimensions from patient's age. This finding would serve as a reference value among adults and could be used as a screening tool in diagnosis and management of glaucoma and other optic neuropathy.

LIST OF ABBREVIATIONS

ONH – Optic Nerve head
OCT - Optical Coherence Tomography
DA – Disc area
RA – Rim area
CA – Cup area
vCDR – Vertical cup to disc ratio

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DECLARATION

The author(s) declare that they have no competing interest.

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REFERENCES

1) Wang YX, Panda-Jonas S, Jonas JB. Optic nerve head anatomy in myopia and glaucoma, including parapapillary zones alpha, beta, gamma and delta: Histology and clinical features. Prog Retin Eye Res 2021;83: 100933
2) Tharwat HM, Amal ME, Hossanti ES. Retinal Nerve Fibre Layer vs Optic Nerve Head Evaluation in Diagnosis of Glaucoma and Suspects. Journal of the Egyptian Ophthalmological Society 2013;103: 253-258.
3) Lawan A, Rabi YS, Phillips A. Macular Volume and Central Foveal Thickness Measurements in Normal Eyes of Healthy Nigerian Adults Using Optical Coherence Tomography. Annals of Afr Med 2014;13: 134- 137.
4) Jonas JB, Thomas R, George R, Berenshtein E, Muliyil J. Optic disc morphology in south India: the Vellore Eye Study. Br J Ophthalmol 2003;87(2):189-96
5) Pitkänen J, Liinamaa J, Leiviskä I, Saarela V. Morphology of the optic nerve head and factors affecting it in the Northern Finland birth cohort. Acta Ophthalmologica 2023;101:575–581

6) Barbara CM, Louis BC, Darrel W, Joni H, Jennifer L, Budenz D, et al. Optic Nerve Head Topographic Analysis in Normal Subjects: Correlation to Disc Size, Age and Ethnicity. Journal of Glaucoma 2010**;**19(5):310-318**.**
7) Li D, Rauscher FG, Choi EY, Wang M, Baniasadi N, Wirkner K, et al. Sex-Specific Differences in Circumpapillary Retinal Nerve Fiber Layer Thickness. Ophthalmology 2019;127(3):357-368.
8) Hermann MM, Theofylaktopoulos I, Bangard N, Junecu-Cuypers C, Coburgar S, Dielteshorst M. Optic Nerve Head morphometry in Healthy Adults using confocal scanning tomography. British Journal of ophthalmology 2004;88 (6): 761-5,
9) Samaravickrama C, Hong T, Jonas JB, Mithell P. Measurement of Optic Nerve Head Parameters. Survey of Ophthalmology 2012**;**57(4):317-36
10) Knight OJ, Girkin CA, Budenz DL, Durbin MK, Feuer WJ. Cirrus OCT Normative Database Study Group. Effect of race, age, and axial length on optic nerve head parameters and retinal nerve fiber layer thickness measured by Cirrus HD-OCT. Arch Ophthalmol 2012;130(3):312-8.
11) Medeiros FA, Zangwill LM, Bowd C, Vessani RM, Susanna R Jr, Weinreb RN et al. Evaluation of retinal nerve fiber layer, optic nerve head, and macular thickness measurements for glaucoma detection using optical coherence tomography. Am J Ophthalmol 2005;139(1):44-55.
12) Muna B, Sharan S, Mohana K, Ramya S. Optical coherence Tomography, A guide to interpretation of Common Macular diseases. Indian Journal of Ophthalmol 2018;66(3): 485
13) Mathis T, Rosier L, Meniai F, Baillif S, Maschi C, Herault J, et al. The Lens Opacities Classification System III Grading in Irradiated Uveal Melanomas to Characterize Proton Therapy-Induced Cataracts. Am J Ophthalmol. 2019; 201:63-71.
14) Mansoori T, Viswanath K, Balakrishna N. Optic disc topography in normal Indian eyes using spectral domain optical coherence tomography. Indian J Ophthalmol. 2011;59(1):23-7.
15) Dacosta S, Bilal S, Rajendran B, Janakiraman P. Optic disc topography of normal Indian eyes: an assessment using optical coherence tomography. Indian J Ophthalmol 2008;56:99-102.
16) Mwanza JC, Oakley JD, Budenz L, Anderson DR. Cirrus Optical Coherence Tomography Normative Database Study Group. Ability of cirrus HD-OCT optic nerve head parameters to discriminate normal from glaucomatous eyes," Ophthalmology 2011;118:241-8.
17) Knight OJ, Girkin CA, Bundenz DL, Durbin MK, Feuer WJ. Effect of age, Race and Axial Length on Optic Nerve Head Parameters and Retinal Nerve Fibre by Cirrus OCT. *Archives of Ophthalmology* 2012**;**130:312-318
18) Gherghel D, Orgul S, Prunte C, Gugleta K, Lubeck P, Gekkieva M. Intraocular Difference in Optic Disc Topography Parametres in Normal Subjects. Current eye Research 2000**;**20 (4): 276- 282
19) Tariq YM, Li H, Burlutsky G. Retinal Nerve Fibre Layer and Optic Nerve Head Measurements by Spectral OCT. Eye 2012; 26:1563-1570
20) Sawada Y, Ishikawa M, Sato N, Yoshitomi T. Optic Nerve Head Morphology Assessed by Laser Scanning Tomography in Normal Japanese Subjects. Journal of Glaucoma 2011;20: 445-451.
21) Hakan D, Iclal Y, Yusuf A, Zeki BM. Assessment of ONH Topographic Parameters with CSLO. Clinical and Experl Ophthalmol 2004;32:259-264.
22) Ramrattan RS, Wolfs RC, Jonas JB. Determinants of optic disc characteristics in a general population: The Rotterdam Study. Ophthalmology. 1999; 106:1588–96.
23) Mansoor AM. Racial variation of optic disc size." Ophthalmic Res. 1991;23(2):67-72.
24) Sample PA, Girkin A, Zangwill LM, Jain S, Racette L, Becerra M, Weinreb N, et al. African Descent and Glaucoma Evaluation Study Group. The African Descent and Glaucoma Evaluation Study (ADAGES): design and baseline data. Arch Ophthalmol. 2009;127(9):1136-45.
25) Chi T, Ritch R, Stickler D, Pitman B, Tsai C. Racial differences in ONH parameters. Arch Ophthalmol. 1989;107(6):836-9.
26) Tsai CS, Zangwill L, Gonzalez C, Irak, I, Garden V, Hoffman R. Ethnic Differences in Optic Nerve Head Topography." Journal of Glaucoma **1995;** 4:248–257.
27) Ong LS, Mitchell P, Healey, PR, Cumming RG. Asymmetry in Optic Disc Parameters: The Blue Mountains Eye Study. Investigative Ophthalmology and Vision Science **1999**; 40:849–57.
28) Kashiwagi K, Tamura M, Abe K, Kogure S. The Influence of Age, Gender, Refractive Error, and Optic Disc Size on the Optic Disc Configuration in Japanese Normal Eyes. Acta Ophthalmol Scand 2000**;**78:200 –203.
29) Bourne RR, Foster PJ, Bunce C, Peton T, Hitchings RA, Khaw PT, Garway D. The Morphology of the Optic Nerve Head in the Singaporean Chinese population – the Tanjong Pagar Study. British Jour of Ophthalmol 2008; 92(3):303-309

30) Gvozdenović R, Risović D, Marjanović I, Vuković D, Stanković B. Morphometric characteristics of optic disc in patients with myopia and primary open-angle glaucoma. Vojnosanit Pregl 2013;70(1):51-56.
31) Jonas, JB, Schmidt AM, Muller-Bergh JA, Schlotzer-Schrehardt UM Naumann GO. Human Optic Nerve Fiber Count and Optic Disc Size. Investigative Ophthalmology and Vision Science1992; 33:2012–8.
32) Budenz DL, Anderson DR, Varma R, Schuman J, Cantor L, Savell J, Greenfield DS, Patella VM, Quigley HA, Tielsch J. Determinants of normal retinal nerve fiber layer thickness measured by Stratus OCT. Ophthalmology 2008;114(6):1046-52.
33) Preussner PR, Grossmann A, Ngounou F, Kouogan G, Tamon J. Glaucoma screening in Western Cameroon. Graefes Arch Clin Exp Ophthalmol 2009;247(12):1671-5.