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Evaluation of the Effect of Blood Glucose Level and Body Mass Index on Optic Nerve Sheath Diameter and Visual Acuity of Apparently Normal Subjects in Nnewi Metropolis

Blessing Chiemerie Obi[1], E. E. Ezugwu[2], Nwamaka Chizube Ikegwuonu[3], Adaobi Chiazor Emegoakor[4] Fanny Okeghene Igbinedion[5] Enoch Ikechukwu Ugwuagbor[6]

[1,3,4,6]Department of Radiology, Nnamdi Azikiwe University Teaching Hospital, Nnewi
[2]Department of Radiography and Radiological Sciences, Nnamdi Azikiwe University, Nnewi Campus
[5]Department of Radiography, School of Basic Medical Sciences, University of Benin, Benin-City

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***Corresponding author:** Blessing Chiemerie Obi

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Abstract

Original Research Article

Background and Aim: The optic nerve sheath diameter (ONSD) serves as a non-invasive sonographic surrogate marker for monitoring intracranial pressure (ICP) dynamics, while visual acuity (VA) reflects the spatial resolving power of the visual pathway. Systemic metabolic indicators such as Body Mass Index (BMI) and fasting blood Glucose (FBG) influence microvascular and neurological health, yet their baseline effects on ocular microstructures in healthy African populations require local reference characterization. This study evaluated the effect of blood glucose levels and BMI on the ONSD and visual acuity of apparently normal adults in Nnewi metropolis, Anambra State, Nigeria.

Materials and Methods: A prospective, cross-sectional, community-based study was conducted among 400 apparently healthy adults aged 18–60 years recruited via quota sampling across the four communities of Nnewi (Otolo, Uruagu, Umudim, and Nnewichi). Anthropometric parameters were measured to compute BMI, venous/capillary fasting blood samples were analyzed for FBG, and distance visual acuity was assessed at 6 meters using a Snellen chart and converted to LogMAR values. Transorbital B-mode ultrasonography using a 7–12 MHz linear array transducer measured ONSD 3 mm posterior to the retina–optic nerve junction in transverse and longitudinal planes. Data were analyzed using MedCalc statistical software 23.2.5 via descriptive statistics, Kendall's tau correlation and Kruskal-Wallis H test at $p < 0.05$.

Results: The cohort comprised 278 females (69.5%) and 122 males (30.5%). Composite ONSD demonstrated high bilateral symmetry with a mean of 4.7 ± 0.7 mm (median: 4.8 mm; 75th percentile: 5.0 mm) and showed no statistically significant variation across underweight (4.6 ± 0.6 mm), normal weight (4.7 ± 0.7 mm), and overweight/obese (4.7 ± 0.7 mm) categories ($p = 0.606$) or between genders ($p > 0.05$). Median LogMAR values were -0.02 (right) and -0.04 (left), with no significant differences across BMI groups ($p > 0.05$). Conversely, mean FBG increased progressively with BMI from 90.4 ± 24.7 mg/dL in underweight subjects to 91.6 ± 27.8 mg/dL in normal-weight subjects and 101.2 ± 37.4 mg/dL in overweight/obese subjects ($p = 0.007$; Kruskal-Wallis $p = 0.000011$), correlating positively with BMI ($\tau = 0.198$, $p < 0.0001$). Negligible correlations were observed between FBG and composite ONSD ($\tau = 0.0511$, $p = 0.1273$), right LogMAR ($\tau = 0.0507$, $p = 0.1298$), and left LogMAR ($\tau = 0.00823$, $p = 0.8062$).

Conclusion: Baseline normative ONSD values for healthy adults in Nnewi metropolis were established at 4.7 ± 0.7 mm. Although elevated BMI significantly drives higher fasting blood glucose levels, neither BMI nor baseline FBG exerts a statistically significant structural impact on ONSD or immediate functional impact on visual acuity in apparently healthy adults, confirming ONSD as an anthropometrically stable diagnostic biomarker.

Keywords: Body Mass Index, Fasting Blood Glucose, Intracranial Pressure, Ocular Ultrasonography, Optic Nerve Sheath Diameter, Visual Acuity.

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INTRODUCTION

Blood glucose serves as the primary metabolic fuel for mammalian tissues, particularly the central nervous system (CNS), where its concentration is tightly regulated by pancreatic hormones such as insulin and glucagon [1]. Within the human eye, glucose is distributed across the tear film, aqueous humor, and vitreous body, providing essential nourishment to avascular ocular structures including the cornea and crystalline lens while maintaining structural integrity [2,3]. However, sustained hyperglycemia induces oxidative stress, vascular permeability, ischemia, and neurodegeneration, ultimately predisposing individuals to diabetic retinopathy, retinal nerve fiber layer loss, and optic atrophy [4].

The optic nerve (cranial nerve II) is a direct white-matter extension of the central nervous system enveloped by the three cranial meninges—dura, arachnoid, and pia mater—and bathed in cerebrospinal fluid (CSF) within the retrobulbar subarachnoid space [5,6]. Because the orbital subarachnoid space communicates freely with the intracranial CSF compartment, fluctuations in intracranial pressure (ICP) are transmitted directly along the optic nerve sheath, causing measurable distension most pronounced 3 mm posterior to the globe [7–9]. Transorbital B-mode ultrasonography (USG) has emerged as a rapid, non-invasive, radiation-free, and cost-effective bedside modality for quantifying optic nerve sheath diameter (ONSD) with high diagnostic sensitivity and low intra- and inter-observer variability [10–13].

Visual acuity (VA) measures the spatial resolving power of the visual system and relies on both intact optical refraction and healthy neural transmission along the retinocortical pathway [14,15]. Both acute glycemic fluctuations and chronic dysglycemia can impair visual function [2,4]. Similarly, Body Mass Index (BMI)—an established anthropometric index classifying adults into underweight (<18.5 kg/m²), normal weight (18.5–24.9 kg/m²), overweight (25.0–29.9 kg/m²), and obese (≥30.0 kg/m²) categories [16]—has been linked to systemic metabolic dysregulation, altered CSF dynamics, elevated central venous pressure, and microvascular ocular remodeling [17–19].

Despite growing clinical adoption of transorbital ultrasonography, normative ONSD thresholds vary across ethnic and geographic populations [20,21], and existing literature presents conflicting evidence regarding whether anthropometric factors such as BMI and baseline glycemic status confound ONSD and visual acuity measurements [17,22–24]. Establishing population-specific baseline reference values and clarifying the influence of systemic metabolic variables are essential for accurate neuro-ophthalmic interpretation in clinical settings such as Nnamdi Azikiwe University Teaching Hospital (NAUTH). Therefore, this study evaluated the effect of fasting blood glucose levels and BMI on ONSD and visual acuity among apparently normal adults in Nnewi metropolis, Anambra State, Nigeria.

MATERIALS AND METHODS

Study Design and Setting

A prospective, cross-sectional, community-based study was conducted over a four-month period across the four indigenous communities (quarters) that constitute Nnewi metropolis—Otolo, Uruagu, Umudim, and Nnewichi—in Anambra State, Southeast Nigeria. Nnewi was selected due to its relatively homogeneous indigenous Igbo population sharing comparable dietary and environmental exposures alongside a broad distribution across all BMI categories.

Target Population, Sample Size, and Sampling Technique

Nnewi comprises four major indigenous communities: Otolo, Uruagu, Umudim, and Nnewichi. The study targeted healthy adult residents aged 18 to 60 years. The target population was calculated using the 2006 Nigerian National Population Census baseline for Nnewi North (155,443) projected to 2026 using an annual exponential growth rate model (r = 2.3% - 2.5%), yielding an estimated population (P_{2026}) of ≈ 254,709.

Sample size (n) was determined using Taro Yamane's formula for finite populations [25]:

$$n = \frac{N}{1 + N(e)^2}$$

Where N = 254,709 and e = 0.05 (margin of error).

The calculated minimum sample size of 399.37 was rounded to 400 participants

A quota sampling technique was employed to recruit 400 eligible participants with balanced representation across the four communities of Nnewi and across the three World Health Organization (WHO) BMI strata: underweight (<18.5 kg/m²), normal weight (18.5–24.9 kg/m²), and overweight/obese (≥25.0 kg/m²).

Selection Criteria

Apparently healthy adults aged 18–60 years who resided within Nnewi metropolis and provided written informed consent were included. Exclusion criteria comprised individuals outside the 18–60-year age bracket; unwillingness to provide consent; known neurological or ophthalmic pathologies (such as glaucoma, optic neuritis, intracranial tumors, or previous stroke); history of head trauma, ocular surgery, or cranial surgery; and current use of medications known to alter blood glucose levels or intracranial pressure.

Ethical Considerations

Ethical approval was obtained from the Health Research Ethics Committee of Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi and traditional ruler of Nnewi Community. Written informed consent was secured from every participant following a detailed explanation of the non-invasive study procedures. Participant anonymity and data confidentiality were strictly maintained using coded identifiers.

Data Collection Procedures

Participants completed a structured proforma capturing sociodemographic characteristics (age, gender, community of residence, and occupation) prior to undergoing four standardized clinical assessments:

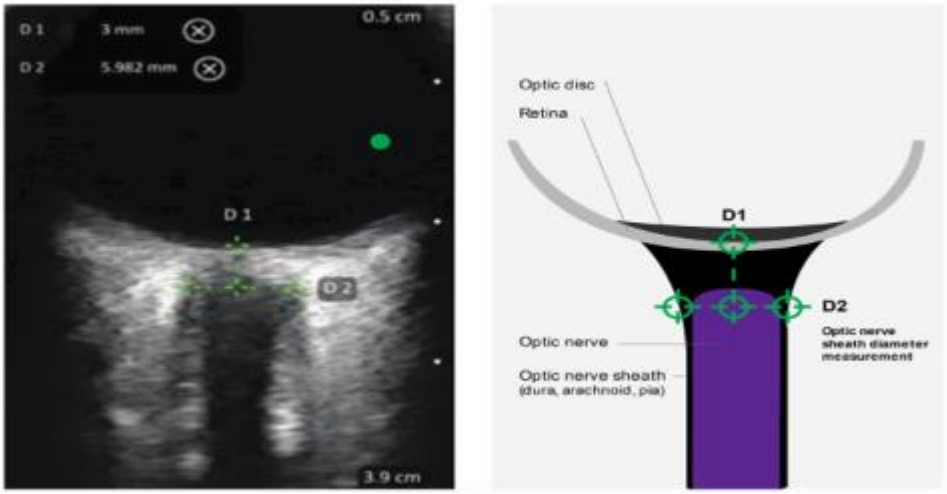
1. Anthropometric Assessment: Body weight (in kilograms) and standing height (in meters) were measured using a calibrated weighing scale and stadiometer, respectively. BMI was calculated as weight (kg) divided by height squared (m²) and classified into underweight (<18.5 kg/m²), normal weight (18.5–24.9 kg/m²), and overweight/obese (≥25.0 kg/m²) [16].

2. Fasting Blood Glucose Analysis: Following an overnight fast of at least 8 hours, blood samples were obtained and analyzed for fasting blood glucose (FBG, in mg/dL) by a certified medical laboratory scientist using an automated glucometer/analyzer (ACUANSWER system) [26].

3. Visual Acuity Assessment: Distance visual acuity was evaluated independently for the right eye (OD) and left eye (OS) by a qualified optometrist at a standard testing distance of 6 meters (20 feet) under uniform ambient illumination using a Snellen chart [15]. Snellen fractions were subsequently converted to Logarithm of the Minimum Angle of Resolution (LogMAR) units for quantitative statistical analysis.

4. Sonographic ONSD Measurement: Transorbital B-mode ultrasonography was performed by a trained sonographer using a high-frequency linear array transducer (7–12 MHz) in accordance with the ALARA (As Low As Reasonably Achievable) acoustic safety principle [12]. With the participant in the supine position and eyes gently closed, a generous layer of sterile coupling gel was applied over the closed upper eyelid to prevent mechanical globe compression. The optic nerve was visualized as a homogeneous hypoechoic linear band extending posteriorly from the globe, bordered by hyperechoic meningeal sheaths. Using electronic calipers, ONSD was measured from outer sheath edge to outer sheath edge at a standardized depth of 3.0 mm posterior to the retina–optic nerve junction in both transverse and longitudinal planes (Figure 1) [8,12]. Three readings were acquired per eye and averaged to

yield right ONSD, left ONSD, and composite bilateral ONSD. Measurements were repeated after 5 minutes to ensure intra-operator reproducibility.



[Figure 1: Transorbital B-mode sonogram and schematic illustration demonstrating standardized outer-to-outer optic nerve sheath diameter (ONSD) caliper placement 3.0 mm posterior to the optic disc/retina junction. Adapted from Geeraerts et al. [8].]

Statistical Analysis

Data were analyzed using MedCalc Statistical Software. Normality of continuous variables was evaluated using the Shapiro-Wilk test, which indicated non-normal distributions across all continuous parameters ($p < 0.0001$). Consequently, both parametric (mean ± standard deviation, one-way ANOVA) and non-parametric (median, interquartile range [25th–75th centiles], Kruskal-Wallis H test, and Kendall's tau [τ] rank correlation) tests were utilized. Categorical distributions were compared using the Chi-square (χ^2) test. Statistical significance was set at $p < 0.05$.

RESULTS

Sociodemographic and BMI Distribution of Participants

A total of 400 apparently healthy adults participated in the study, comprising 278 females (69.5%) and 122 males (30.5%). Participants were nearly equally distributed across the four communities of Nnewi: Nnewichi (101; 25.25%), Umudim (101; 25.25%), Uruagu (99; 24.75%), and Otolo (99; 24.75%). Across age groups, the 56–60-year bracket constituted the largest proportion (30.5%), whereas the 18–25-year bracket was the smallest (9.8%), with no significant gender disparity across age strata ($\chi^2 = 2.104$, df = 4, $p = 0.7166$; Table 1).

Table 1: Distribution of Study Participants According to Gender and Age Group (n = 400)

Gender	18–25 yrs	26–35 yrs	36–45 yrs	46–55 yrs	56–60 yrs	Total
Male	10 (2.5%)	23 (5.8%)	28 (7.0%)	26 (6.5%)	35 (8.75%)	122 (30.5%)
Female	29 (7.3%)	52 (13.0%)	48 (12.0%)	62 (15.5%)	87 (21.75%)	278 (69.5%)
Total	**39 (9.8%)**	**75 (18.8%)**	**76 (19.0%)**	**88 (22.0%)**	**122 (30.5%)**	**400 (100.0%)**

Regarding BMI classification, 80 participants (20.0%) were underweight, 139 (34.75%) had normal weight, and 181 (45.25%) were overweight or obese. A statistically significant difference was observed in gender distribution across BMI categories, with females predominating in all strata, particularly the overweight/obese group ($\chi^2 = 14.584$, df = 2, p = 0.0007; Table 2).

Table 2: Distribution of Study Participants According to Gender and BMI Category (n = 400)

Gender	Underweight (<18.5 kg/m²)	Normal Weight (18.5–24.9 kg/m²)	Overweight/Obese (≥25.0 kg/m²)	Total
Male	21 (5.25%)	59 (14.75%)	42 (10.50%)	122 (30.50%)
Female	59 (14.75%)	80 (20.00%)	139 (34.75%)	278 (69.50%)
Total	**80 (20.00%)**	**139 (34.75%)**	**181 (45.25%)**	**400 (100.00%)**

Composite Anthropometric, Glycemic, ONSD, and Visual Acuity Profiles

Across the entire sample, the mean BMI was 25.1 ± 6.5 kg/m² (median: 24.4 kg/m²), and the mean FBS was 95.7 ± 32.3 mg/dL (median: 89.0 mg/dL; Table 3). Bilateral ONSD measurements exhibited strong symmetry, with identical mean values of 4.7 ± 0.8 mm for the right eye, 4.7 ± 0.7 mm for the left eye, and 4.7 ± 0.7 mm for the composite bilateral ONSD (median: 4.8 mm; 75th centile: 5.0 mm). Median LogMAR visual acuity values were -0.02 (right eye) and -0.04 (left eye), indicating that over half of the cohort possessed visual acuity equal to or sharper than 6/6 (20/20) vision (Table 3).

Table 3: Summary Statistics for Anthropometric, Glycemic, ONSD, and LogMAR Variables (n = 400)

Variable	Min	Max	Mean ± SD	25th Centile	Median	75th Centile
Weight (kg)	35.0	129.0	68.6 ± 16.2	55.0	66.0	79.0
Height (m)	1.42	1.84	1.66 ± 0.10	1.59	1.66	1.75
BMI (kg/m²)	11.9	43.6	25.1 ± 6.5	19.8	24.4	29.4
FBG (mg/dL)	56.0	367.0	95.7 ± 32.3	83.0	89.0	100.0
Right ONSD (mm)	0.42	6.90	4.7 ± 0.8	4.3	4.6	5.0
Left ONSD (mm)	0.42	6.40	4.7 ± 0.7	4.5	4.7	5.1
Composite ONSD (mm)	0.42	6.40	4.7 ± 0.7	4.4	4.8	5.0
Right LogMAR	-0.08	1.00	0.13 ± 0.28	-0.08	-0.02	0.30
Left LogMAR	-0.08	1.00	0.16 ± 0.33	-0.08	-0.04	0.30

Comparison of ONSD, Visual Acuity, and FBG Across BMI Categories and Gender

Comparison across BMI strata revealed no statistically significant differences in right ONSD (Kruskal-Wallis p = 0.2217), left ONSD (Kruskal-Wallis p = 0.5331), or composite ONSD (Kruskal-Wallis p = 0.2533), with composite means remaining virtually invariant across underweight (4.64 ± 0.55 mm), normal-weight (4.72 ± 0.70 mm), and overweight/obese (4.72 ± 0.71 mm) groups (Table 4). Similarly, right and left LogMAR scores showed no significant differences across BMI categories (p > 0.05), although median LogMAR values shifted slightly upward (0.00 bilaterally) in overweight/obese participants compared to underweight participants (-0.06 right; -0.07 left).

In contrast, fasting blood glucose varied significantly across BMI groups (Kruskal-Wallis p = 0.000011), rising progressively from 90.4 ± 24.7 mg/dL (median: 86.5 mg/dL) in underweight participants to 91.6 ± 27.8 mg/dL (median: 87.0 mg/dL) in normal-weight participants and 101.2 ± 37.4 mg/dL (median: 94.0 mg/dL) in overweight/obese participants (Table 4).

Table 4: Comparison of ONSD, LogMAR Visual Acuity, and FBG Across BMI Categories

Parameter	Underweight (n=80) Mean±SD | Med	Normal (n=139) Mean±SD | Med	Overweight/Obese (n=181) Mean±SD | Med	Kruskal-Wallis p-value
Right ONSD (mm)	4.57±0.54 | 4.60	4.72±0.81 | 4.60	4.70±0.85 | 4.70	0.2217
Left ONSD (mm)	4.71±0.67 | 4.70	4.74±0.68 | 4.70	4.72±0.75 | 4.70	0.5331
Composite ONSD (mm)	4.64±0.55 | 4.65	4.72±0.70 | 4.75	4.72±0.71 | 4.80	0.2533
Right LogMAR	0.09±0.26 | -0.06	0.14±0.28 | -0.02	0.14±0.29 | 0.00	0.3099
Left LogMAR	0.11±0.30 | -0.07	0.16±0.33 | -0.04	0.18±0.34 | 0.00	0.2854
FBG (mg/dL)	90.4±24.7 | 86.5	91.6±27.8 | 87.0	101.2±37.4 | 94.0	**0.000011***

When stratified by gender (Table 5), males (n = 122) and females (n = 278) exhibited identical mean composite ONSD values of 4.7 ± 0.7 mm. Females demonstrated a slightly higher mean FBG (96.7 ± 37.5 mg/dL; range: 56.0–367.0 mg/dL) than males (93.4 ± 14.6 mg/dL; range: 75.0–154.0 mg/dL), as well as higher 75th centile LogMAR scores (0.48 bilaterally vs. 0.18 in males).

Table 5: Summary Statistics for ONSD, LogMAR Visual Acuity, and FBG Stratified by Gender

Variable	Min	Max	Mean ± SD	25th Centile	Median	75th Centile
Males (n = 122)						
Right ONSD (mm)	0.42	6.10	4.7 ± 0.8	4.4	4.7	5.1
Left ONSD (mm)	0.42	6.20	4.7 ± 0.8	4.5	4.8	5.1
Composite ONSD (mm)	0.42	6.05	4.7 ± 0.7	4.5	4.8	5.1

Variable	Min	Max	Mean ± SD	25th Centile	Median	75th Centile
Right LogMAR	-0.08	1.00	0.07 ± 0.23	-0.08	-0.02	0.18
Left LogMAR	-0.08	1.00	0.08 ± 0.25	-0.08	-0.04	0.18
FBG (mg/dL)	75.0	154.0	93.4 ± 14.6	85.0	89.5	99.0
Females (n = 278)						
Right ONSD (mm)	0.46	6.90	4.7 ± 0.8	4.3	4.6	5.0
Left ONSD (mm)	0.53	6.40	4.7 ± 0.7	4.5	4.7	5.1
Composite ONSD (mm)	0.50	6.40	4.7 ± 0.7	4.4	4.7	5.0
Right LogMAR	-0.08	1.00	0.15 ± 0.30	-0.08	-0.02	0.48
Left LogMAR	-0.08	1.00	0.19 ± 0.35	-0.08	0.00	0.48
FBG (mg/dL)	56.0	367.0	96.7 ± 37.5	81.0	89.0	100.0

Correlation Analysis

Kendall's tau rank correlation analysis (Table 6) demonstrated a statistically significant positive correlation between FBG and BMI ($\tau = 0.198$, $p < 0.0001$). Conversely, correlations between FBG and right ONSD ($\tau = 0.0370$, $p = 0.2697$), left ONSD ($\tau = 0.0512$, $p = 0.1265$), composite ONSD ($\tau = 0.0511$, $p = 0.1273$), right LogMAR ($\tau = 0.0507$, $p = 0.1298$), and left LogMAR ($\tau = 0.00823$, $p = 0.8062$) were all negligible and statistically non-significant.

Table 6: Kendall's Tau (τ) Correlation Between Fasting Blood glucose and Ocular/Anthropometric Parameters (n = 400)

Correlated Parameter with FBG	Kendall's Tau (τ)	Strength of Association	p-value
Right ONSD (mm)	0.0370	Negligible	0.2697
Left ONSD (mm)	0.0512	Negligible	0.1265
Composite ONSD (mm)	0.0511	Negligible	0.1273
Right LogMAR value	0.0507	Negligible	0.1298

Correlated Parameter with FBG	Kendall's Tau (τ)	Strength of Association	p-value
Left LogMAR value	0.00823	Negligible	0.8062
BMI (kg/m²)	0.1980	Moderate Positive	**<0.0001***

DISCUSSION

Establishing population-specific baseline reference ranges is essential for optimizing the diagnostic accuracy of transorbital ultrasonography. In this community-based cohort of 400 apparently normal Nigerian adults, the mean composite ONSD was 4.7 ± 0.7 mm (median: 4.8 mm; 75th centile: 5.0 mm), with complete bilateral symmetry between the right and left eyes (4.7 mm each). This finding aligns closely with the widely accepted adult upper normal threshold of 5.0 mm [8,11] and sits within the spectrum of normative values reported across Sub-Saharan African populations, including 4.20 ± 0.28 mm in Beninese adults [20] and 5.1 ± 0.33 mm in Black South African adults [21], while remaining lower than the 6.3 ± 0.42 mm reported in Southern Iranian adults [22]. Such inter-population variations underscore the value of local reference data for clinicians in Nnewi.

A key finding of this investigation is that ONSD did not vary significantly across underweight (4.64 mm), normal-weight (4.72 mm), and overweight/obese (4.72 mm) categories ($p = 0.606$), nor between male and female participants (4.7 ± 0.7 mm in both sexes). These results corroborate previous reports by Mohammadi et al. [22] and Savi de Tové et al. [20], who observed no statistically significant correlation between ONSD and BMI, weight, height, or sex in healthy adults. Similarly, Olatunji and Bodunde [23] found no correlation between ONSD and BMI in Nigerian children, although they noted minor sex-related right-eye differences not observed in our adult cohort. In contrast, Cardim et al. [24] reported slightly larger ONSD values in healthy males than females in a European cohort, whereas Hyerim et al. [19] noted elevated baseline ONSD in obese subjects with chronically raised ICP. Our findings demonstrate that among apparently healthy adults without intracranial pathology, physiological variations in body habitus and sex do not distort retrobulbar optic nerve sheath dimensions, validating sonographic ONSD as an anthropometrically stable biomarker that does not require BMI- or gender-adjusted cutoff modifications.

Conversely, fasting blood glucose levels exhibited a highly significant progressive elevation across BMI categories ($p = 0.007$; Kruskal-Wallis $p = 0.000011$) and a significant positive correlation with BMI ($\tau = 0.198$, $p < 0.0001$), rising from 90.4 ± 24.7 mg/dL in underweight subjects to 101.2 ± 37.4 mg/dL in overweight/obese individuals. This finding agrees with Adesh et al. [27], who documented significantly higher fasting blood glucose and HbA1c levels among overweight and obese individuals compared to normal-weight controls, reflecting insulin resistance driven by increased adiposity. Notably, female participants in our study exhibited a higher prevalence of overweight/obesity ($p = 0.0007$) alongside wider glycemic excursions (up to 367.0 mg/dL) and higher 75th centile LogMAR scores (0.48 vs. 0.18 in males), pointing toward undiagnosed dysglycemia and subclinical visual impairment within a subset of the community.

Despite the strong link between BMI and FBG, neither parameter showed a statistically significant correlation with ONSD or LogMAR visual acuity across the overall cohort ($p > 0.05$). This agrees with MRI-based findings by Sahar et al. [28], who reported no significant difference in ONSD between diabetic patients and healthy controls, and with Erol et al. [29], who observed

no baseline ONSD enlargement during acute hyperglycemia prior to fluid therapy. While Gupta and Thakur [18] reported higher rates of accommodative and vergence anomalies among obese and underweight university students, static distance visual acuity (LogMAR) in our community cohort remained largely preserved across BMI groups, with only a subtle upward shift in median LogMAR among overweight/obese participants (0.00 vs. -0.06 to -0.07 in underweight subjects). This suggests that early metabolic elevations in apparently normal adults precede overt structural distension of the optic nerve sheath or gross distance acuity loss, though longitudinal microvascular damage remains a risk if dysglycemia persists [4].

LIMITATIONS OF THE STUDY

Three limitations merit consideration. First, the sample exhibited a female predominance (69.5% female vs. 30.5% male), which may limit the generalizability of gender-stratified glycemic and visual variance findings. Second, glycemic assessment relied on a single fasting blood glucose measurement rather than long-term markers such as glycated hemoglobin (HbA1c), which better reflect chronic glycemic exposure. Third, the cross-sectional design precludes causal inference regarding whether sustained weight gain and hyperglycemia progressively alter ocular structures over time.

CONCLUSION

This study established a baseline normative composite ONSD of 4.7 ± 0.7 mm (median: 4.8 mm) for apparently healthy adults in Nnewi metropolis. While higher BMI significantly elevates fasting blood glucose levels, neither BMI nor baseline fasting glucose exerts a statistically significant structural effect on optic nerve sheath diameter or immediate functional effect on distance visual acuity in healthy adults. Consequently, transorbital sonographic ONSD measurement serves as a reliable, anthropometrically resilient diagnostic tool for neuro-ophthalmic evaluation across diverse body mass profiles. Routine integrated metabolic and ophthalmic screenings—particularly targeting overweight individuals and women with elevated glycemic profiles—are recommended to detect early microvascular changes before irreversible visual impairment develops.

DECLARATIONS

Ethics Approval and Consent to Participate: Ethical approval for this study was obtained from the Health Research Ethics Committee of Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi, Anambra State Nigeria and traditional ruler of Nnewi Community. Written informed consent was obtained from all participants prior to enrollment.

Data Availability Statement: The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

Conflict of Interest: The authors declare that they have no competing financial or non-financial interests.

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AUTHOR CONTRIBUTIONS

Blessing Chiemerie Obi collected and analysed the data and drafted the manuscript.

E.E.Ezugwu conceived the study, supervised the study design.

Adaobi Chiazor Emegakor, Nwamaka Chizube Ikegwuonu assisted in Data collection,

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