Original Article

Correlation of Visual Field Parameters with Body Mass Index

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ABSTRACT

Aim: To determine the correlation between Body Mass Index (BMI) and visual field parameters.

Study Design: Cross-sectional study.

Duration and Settings of the Study: College of Ophthalmology and Allied Vision Sciences (COAVS) Mayo Hospital; Conducted from March 2023 to October 2023.

Methods: Data was collected after approval of the Ethical Review Board of COAVS. Informed written consent was obtained from all participants. The participants were included in the groups based on their Body Mass Index (BMI) which was low, normal or high. A non-probability convenient sampling technique was used. The software used for data analysis was SPSS (version 27.00), in which BMI and visual field parameters were correlated using Pearson correlation.

Results: A total of 117 participants (234 eyes) were enrolled, with 39 participants in each BMI group (low, normal, or high). The mean retinal sensitivity was similar across all groups (28.7 ± 1.5 dB in low BMI, 28.5 ± 1.6 dB in normal BMI, and 28.3 ± 1.7 dB in high BMI), showing no significant correlation with BMI (r = 0.11, $p = 0.21$). Mean Deviation (MD) in the right eye did not correlate significantly with BMI (r = 0.09, $p = 0.28$). However, a very weak but statistically significant negative correlation was observed between BMI and MD in the left eye (r = 0.18, $p = 0.03$). Pattern Standard Deviation (PSD) was also similar across groups (1.6 ± 0.5, 1.7 ± 0.4, and 1.8 ± 0.6 dB, respectively), with no significant correlation with BMI (r = 0.08, $p = 0.34$).

Conclusion: There is no significant correlation between BMI and visual field parameters, including retinal sensitivity, mean deviation, and pattern standard deviation. A very weak correlation was observed for mean deviation in the left eye only, suggesting no clinically meaningful association.

Keywords: Retinal Sensitivity; Visual Field; Perimeter; Body Mass Index.

INTRODUCTION

Perimetry is a defined and widely used technique for determining the visual field. It is crucial in the diagnosis of numerous neurological, retinal, and ocular conditions. The computer that goes with it has virtual software that is connected to the perimeter. Using a grid with six-degree intervals, the computer evaluates the middle 30 degrees of the visual field.[1] According to three indices, Fixation Loss (FL), False Positive (FP), and False Negative (FN), the reliability of VF results is determined. This is what we call "reliability parameters" determining the reliability and usefulness of the test. According to reliability requirements, FL should be less than 33% , FP should be fewer than 15%, and FN should be less than 15%.[2] One of the diagnostic procedures for conditions like glaucoma, macular degeneration, optic gliomas, brain tumors, strokes, disorders of the central nervous system, and pituitary gland disorders is perimetry.[3] A threshold perimetry test that assesses 20- and 30-degree central vision to determine retinal sensitivity is useful in identifying numerous disorders, including glaucoma and other optic neuropathies.[4]

The "gold standard" weight measurement is the Body

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Mass Index (BMI), which is calculated as weight divided by height in meters squared. As a result, it is frequently employed in clinical decision-making and research.[5] Using a simple formula, one can determine their BMI and get a basic idea of their weight as underweight, normal, overweight, or obese. Underweight, normal body weight, overweight, and obesity are all classified according to the WHO's BMI classification system as having a BMI of 18.5 kg/m2 or less; 18.5-22.9 kg/m2; 23-29.9 kg/m2, and 30 kg/m2 or more, respectively.[6] A strong association between obesity and age-related ocular diseases is observed.[7] We know that histological research indicates that as we age, the retina's overall thickness decreases. The retina and brain undergo a range of structural changes because of healthy aging. Diseases of the brain and the eye should be similar because both organs are made of neurons and originate from the neural tube.[8] Lutein and zeaxanthin are lipid-soluble antioxidants found in the macular region of the retina.[9] Carotenoids such as lutein and zeaxanthin are present in many bodily tissues, including the brain and eyes. They are well-known for having antioxidant qualities, which are thought to promote eye health and possibly even improve cognitive function.[10] People with low BMI may be more susceptible to vitamin deficiencies, which are crucial for eye health maintenance and include deficiencies in vitamin A and omega-3 fatty acids. The retina and other ocular structures are among the parts of the eyes that may be negatively affected by inadequate nutrition.[11]

METHODS

This cross-sectional study was conducted at the College of Ophthalmology and Allied Vision Sciences (COAVS), Mayo Hospital, Lahore, from March 2023 to October 2023. Ethical approval was obtained from the Institutional Review Board of COAVS (Ref#1459/23), and written informed consent was secured from all participants prior to enrollment.

A total of 117 healthy individuals (234 eyes) were included in the study. Participants were divided equally into three BMI-based groups: low, normal, or high (n = 39 per group). The sample size was calculated using the following formula:

The sampling formulae used $\frac{\sigma^2 \, (Z_{1-\frac{\alpha}{2}}+Z_{1-\beta})^2}{(\mu_O-\mu_a)^2}$ were as follow:

n= 39 (for each group) total=117 subjects.

Z=standard variate for the level of significance=5%

Power of test= 90%

Standard population deviation= 6.24.[12]

A non-probability convenient sampling technique was employed. Participants of both genders, aged 18 years or older, with good fixation and clear ocular media were included. Individuals with any ocular pathology, poor fixation, or media opacity were excluded. The equipment used for clinical evaluation included a LogMAR visual acuity chart, pen torch, occluder, slit lamp biomicroscope, and a FREY AP-50 automated perimeter. The independent variables were age, gender, and BMI, while the dependent variables included visual field parameters: retinal sensitivity, Mean Deviation (MD), and Pattern Standard Deviation (PSD).

Data were analyzed using SPSS software (version 27.0). The correlation between BMI and visual field parameters was assessed using the Pearson correlation coefficient. A p-value of < 0.05 was considered statistically significant.

RESULTS

A total of 117 participants (234 eyes) were enrolled in the study, with 39 participants (78 eyes) in each of the low, normal, and high BMI groups. The mean age of participants was 32.5 ± 8.7 years, and 54 were female (46.2%). The mean retinal sensitivity was similar across BMI categories. As shown in table 1, the low BMI group had a mean retinal sensitivity of 28.7 ± 1.5 dB, the normal BMI group 28.5 ± 1.6 dB, and the high BMI group 28.3 ± 1.7 dB. Pearson correlation analysis demonstrated no statistically significant correlation between BMI and retinal sensitivity ($r = 0.11$, $p = 0.21$).

Table 1: Retinal sensitivity across BMI groups

BMI Group	Mean Retinal Sensitivity (dB)	Standard Deviation (SD)
Low BMI	28.7	±1.5
Normal BMI	28.5	±1.6
High BMI	28.3	±1.7
Pearson r	0.11	
p-value	0.21	

BMI=body massindex, dB=decibel,SD=standard deviation

Mean deviation values were recorded separately for the right and left eyes across the BMI groups. In the right eye, MD ranged from 1.1 to 1.4 dB with no significant correlation with BMI ($r = 0.09$, $p = 0.28$). However, a very weak but statistically significant negative correlation was observed in the left eye ($r = 0.18$, $p = 0.03$), where the high BMI group showed slightly more negative MD values compared to the low and normal BMI groups (table 2).

Table 2: Mean deviation in right and left eyes across BMI groups

BMI Group	MD Right Eye (dB)	SD	MD Left Eye (dB)	SD
Low BMI	-1.2	±1.8	-1.3	±1.6
Normal BMI	-1.1	±1.9	-1.1	±1.7
High BMI	-1.4	±1.7	-1.8	±1.5
Pearson r	-0.09		-0.18	
p-value	0.28		0.03	

BMI=body massindex,MD= meandeviation, dB=decibel,SD=standard deviation

Pattern standard deviation values were also consistent across BMI groups. The low BMI group showed a mean PSD of 1.6 ± 0.5 dB, the normal BMI group 1.7 ± 0.4 dB, and the high BMI group 1.8 ± 0.6 dB. No statistically significant correlation was found between PSD and BMI ($r = 0.08$, $p = 0.34$), as presented in table 3.

Table 3: Pattern standard deviation across BMI groups

BMI Group	Mean PSD (dB)	Standard Deviation (SD)
Low BMI	1.6	±0.5
Normal BMI	1.7	±0.4
High BMI	1.8	±0.6
Pearson r	0.08	
p-value	0.34	

BMI=body massindex,PSD=pattern standarddeviation, dB=decibel,SD=standard deviation

DISCUSSION

BMI is widely accepted as the gold standard for assessing weight categories and is commonly used in both clinical decision-making and research. Numerous studies have documented a wide range of health risks associated with being overweight and elevated BMI levels.[13] Due to its strong association with fat mass and obesity-related pathologies, BMI is considered an ideal monitoring tool.[14?15]

Globally, malnutrition and underweight remain substantial issues. In 2016, approximately 75 million girls and 117 million boys were classified as moderately or severely underweight. For example, among French girls, the likelihood of being underweight increased by 41% in 2006 compared to 1998. Despite this trend, thinness remains relatively under-researched, especially in terms of its causality, health risks, and associated ocular or systemic pathologies.[16]

As a weight-to-height ratio, BMI may indirectly influence nutrient distribution throughout the body, including antioxidants that are essential for ocular health. Baran et al. reported that obese individuals may have higher Intra Ocular Pressure (IOP) and reduced retinal nerve fiber layer thickness, suggesting a potential predisposition to glaucoma at an earlier age. This underscores the importance of routine ophthalmological evaluations in obese children.[17]

Findings from our study showed no significant correlation between BMI and any of the visual field parameters studied ($p > 0.05$). A very weak negative correlation between BMI and mean deviation in the left eye was noted but was not considered clinically meaningful.

This is consistent with other published data. Several studies have demonstrated a positive correlation between BMI and IOP.[18,19,20] On the contrary, some ocular variables, such as anterior chamber depth, have been reported to show a negative correlation with BMI.[21] In Year 2020, Muhammed et al. reported individuals with abnormal BMI (underweight, overweight, or obese) had a higher risk of visual impairment compared to those with normal BMI.[22] Similarly, Roy et al. reported hypermetropic refractive errors in obese individuals based on a study involving axial length measurements and refractive assessment in an Indian population.[23] Furthermore, Harris et al. investigated the effect of lifestyle factors on retinal layers in a Danish population. While they found aging to be significantly associated with changes in photoreceptor and Retinal Pigment Epithellum- Bruch,s Membrane layer thickness, no significant association was observed between BMI and retinal structure.[24,25]

In our study, all participants were emmetropic, and free of ocular or systemic pathology. Visual field parameters were obtained using standardized equipment (FREY AP-50), and the results confirmed that BMI does not significantly influence these parameters. While retinal sensitivity is known to be age-dependent.[26] No correlation was observed between retinal sensitivity and BMI in this cohort.

One of the strengths of this study is the use of automated perimetry in a standardized, controlled setting across a balanced sample of BMI categories. Furthermore, strict exclusion criteria helped minimize confounding from ocular or systemic comorbidities, ensuring reliability in evaluating visual field performance in relation to BMI. However, certain limitations must be acknowledged. The study used a non-probability convenience sampling method, which may limit generalizability. Additionally, the cross-sectional design precludes assessment of causality. The study did not account for potential confounders such as systemic metabolic status, blood pressure, or antioxidant intake, which could influence ocular function independently of BMI.

Future studies should consider larger, population-based samples with stratification for age, systemic health markers, and nutritional profiles. Longitudinal studies would help clarify whether BMI has a cumulative or age-modifying effect on visual function. Incorporating structural retinal imaging (e.g., OCT parameters) alongside functional tests may provide more comprehensive insight into the ocular impact of body composition.

CONCLUSION

No significant correlation between BMI and visual field parameters, including retinal sensitivity, mean deviation (right eye), and pattern standard deviation were observed. Although a very weak negative correlation was observed between BMI and mean deviation in the left eye, its clinical relevance is questionable. Overall, BMI does not appear to have a meaningful impact on visual field performance in otherwise healthy individuals.

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Ethical Approval: .

Ethical approval for this study was granted by Ethical Review Board of College of Ophthalmology and Allied Vision Sciences, Mayo Hospital, Lahore under reference number “COAVS/1459/23."

Authors' Contributions:

SN: Conceptualization and design of the study, drafting, review and final approval of the final manuscript and agrees to be accountable for all aspects of the work.

ZUR: Data acquisition, review and approval of the final manuscript and agrees to be accountable for all aspects of the work.

MS: Data analysis, review and final approval of the final manuscript and agrees to be accountable for all aspects of the work.

MM: Data analysis, review and final approval of thefinal manuscript and agrees to be accountable for all aspects of the work.

REFERENCES

1.Jones PR, Campbell P, Callaghan T, Jones L, Asfaw DS, Edgar DF, et al. Glaucoma home monitoring using a tablet-based visual field test (Eyecatcher): an assessment of accuracy and adherence over 6 months. Am J Ophthalmol 2021;223:42-52. doi:10.1016/j.ajo.2 020.08.039.

2.Heijl A, Patella VM, Flanagan JG, Iwase A, Leung CK, Tuulonen A, et al. False positive responses in standard automated perimetry. Am J Ophthalmol 2022;233:180-8. doi: 10.1016/j.ajo.2021.06.026.

3.Prager AJ, Kang JM, Tanna AP. Advances in perimetry for glaucoma. Curr Opin Ophthalmol 2021;32(2):92-7. doi: 10.1097/ICU.0000000000000735.

4.Wall M, Subramani A, Chong LX, Galindo R, Turpin A, Kardon RH, et al. Threshold static automated perimetry of the full visual field in idiopathic intracranial hypertension. Invest Ophthalmol Vis Sci 2019;60(6):1898-905. doi: 10.1167/iovs.18-26252.

5.Groothof D, Post A, Polinder-Bos HA, Hazenberg BP, Gans RO, Bakker SJ. Muscle mass versus body mass index as predictor of adverse outcome. J Cachexia Sarcopenia Muscle 2021;12(2):517-8. doi:10.1002/jcs sm.12686.

6.Weir CB, Jan A. BMI Classification Percentile And Cut Off Points. In: StatPearls. StatPearls Publishing, Treasure Island (FL); 2025.

7.Ng Yin Ling C, Lim SC, Jonas JB, Sabanayagam C. Obesity and risk of age-related eye diseases: A systematic review of prospective population-based studies. Int J Obes (Lond) 2021;45(9):1863-85. doi: 10.1038/s41366-021-00829-y.

8.Liao C, Xu J, Chen Y, Ip NY. Retinal dysfunction in Alzheimer's disease and implications for biomarkers. Biomolecules 2021;11(8):1215. doi:10.3390/biom 11081215.

9.Kamal S, Junaid M, Ejaz A, Bibi I, Bigiu N. Eye sight and carotenoids. Carotenoids: Structure and Function in the Human Body 2021:609-47.

10.Spinola MV, Díaz-Santos E. Microalgae nutraceuticals: the role of lutein in human health. Microalgae biotechnology for food, health and high value products 2020:243-63.

11.Wu Y, Wu J, Bu J, Tang L, Yang Y, Ouyang W, et al. High-fat diet induces dry eye-like ocular surface damages in murine. Ocul Surf 2020;18(2):267-76. doi: 10.1016/j.jtos.2020.02.009.

12.Panon N, Luangsawang K, Rugaber C, Tongchit T, Thongsepee N, Cheaha D, et al. Correlation between body mass index and ocular parameters. Clin Ophthalmol 2019:13:763-9 doi:10.2147/OPTH .S196622.

13. Lee DH, Giovannucci EL. The utility of predicted values in place of directly measured body composition. Am J Clin Nutr 2021;114(2):418-9. doi: 10.1093/ajcn/nqab127.

14.Napoleone J, Strotmeyer E, Miller R, Devaraj S, Rockette-Wagner B, Arena V, et al. Impact of Age on Community Diabetes Prevention Program Attendance and Weight Loss Goals. Innov Aging 2020;4(Supplement_1):904-. doi:10.1093/geroni /igaa057.3328.

15.Wang Y, Beydoun MA, Min J, Xue H, Kaminsky LA, Cheskin LJ. Has the prevalence of overweight, obesity and central obesity levelled off in the United States? Trends, patterns, disparities, and future projections for the obesity epidemic. Int J Epidemiol 2020;49(3):810-23 doi: 10.1093/ije/dyz273.

16.Nepal GB, Bhaila A, Shrestha HS, Maharjan N, Adhikari B. Estimation of body fat percentage in adult population in Nepal and assess its correlation with body mass index. J Chitwan Med Coll 2022;12(4):99-102. doi: 10.54530/jcmc.699.

17.Vanhelst J, Baudelet JB, Thivel D, Ovigneur H, Deschamps T. Trends in the prevalence of overweight, obesity and underweight in French children, aged 412 years, from 2013 to 2017. Public Health Nutr 2020;23(14):2478-84. doi:10.1017/S136898002 0000476.

18.Baran RT, Baran SO, Toraman NF, Filiz S, Demirbilek HU. Evaluation of intraocular pressure and retinal nerve fiber layer, retinal ganglion cell, central macular thickness, and choroidal thickness using optical coherence tomography in obese children and healthy controls. Niger J Clin Pract 2019;22(4):539-45. doi: 10.4103/njcp.njcp_471_18.

19.Thenmozhi P, Bhuvaneshwari T. Relationship between Body Mass Index and Intraocular Pressure: Correlational Study. Asian J Res Rep Ophthalmol 2020;3(1):158-163.

20.Sangkirthanah S, Assfi RS. Relationship between body mass index and intraocular pressure among young adults. Int J Med Toxicol Leg Med

2019;22(3and4):80-3. doi: 10. 5958/09744614.2019.-00063.9.

21.Eski MT, Teberik K, Sezer T, Arslanoðlu Ý. Comparison of Anterior Segment Parameters in Obese Children And Healthy Control Group. Konuralp Med J 2023;15(2):190-6.doi: 10.18521.1194775.

22.Muhammed BT, Kabuwaya MA, Ibrahim BM. Relationship of Body Mass Index and Head Circumference with Visual Acuity among Undergraduate Student in Kano State, Nigeria. Bayero J Biomed Sci 2020; 5(1): 574-82.

23.Bikbov MM, Kazakbaeva GM, Iakupova EM, Gilmanshin TR, Fakhretdinova AA, Tuliakova AM, et al. Anterior chamber depth and angle and associations in a pediatric and adult population in Russia. Heliyon 2023;9(11):e22394.doi:10.10116/j.heliyon.2023.e22394.

24.Rozing MP, Durhuus JA, Nielsen MK, Subhi Y, Kirkwood TB, Westendorp RG, et al. Age-related macular degeneration: A two-level model hypothesis. Prog Retin Eye Res 2020;76:100825. doi:10.1016/j.preteyeres.2019.100825.

25.Harris J, Subhi Y, Sørensen TL. Effect of aging and lifestyle on photoreceptors and retinal pigment epithelium: cross-sectional study in a healthy Danish population. Pathobiol Aging Age Relat Dis 2017;7(1):1398016. doi:10.1080/20010001.2017.1398016.

26.Mazumdar D, Meethal NSK, Panday M, Asokan R, Thepass G, George RJ, et al. Effect of age, sex, stimulus intensity, and eccentricity on saccadic reaction time in eye movement perimetry. Transl Vis Sci Technol 2019;8(4):13. doi: 10.1167/tvst.8.4.13.