

Association of Pulse Wave Velocity with Intraocular Pressure in a General Adult Population: Opportunistic Screening in the “Hunting the Silent Killer” Program

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This article was submitted to RAD
CASA - Medical Sciences
as the original article

Conflict of Interest Statement:

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received: 5 November 2025

Accepted: 15 December 2025

Published: 28 December 2025

Citation:

Barisic K, Jelakovic A, Simunovic L, Perkovic D, Josipovic J, Prkacin I, Zivko M, Zeljkovic Vrkic T, Domislovic M, Gellineo L, Kos J, Vukovic Brinar I, Ivandic E, Lovric M, Pecin I, Jelakovic B. Renal denervation improves metabolic disturbances and inflammation with positive impact on kidney function in patients with resistant and difficult-to-control hypertension in long-term follow up. *Medical Sciences* 72-73 (2025): 26-29. DOI: 10.21857/mjrl3ur8k9

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ABSTRACT

INTRODUCTION: Intraocular pressure (IOP) is a key risk factor for glaucoma, while pulse wave velocity (PWV) is an established marker of cardio-reno-neuro-metabolic health. Emerging evidence suggests that elevated PWV may impair ocular perfusion, thereby contributing to optic nerve damage and glaucoma. Our aim was to analyze the association of PWV with IOP in the general adult population through an opportunistic screening study.

METHODS: This cross-sectional study was conducted in August 2025 on the island of Dugi Otok, Croatia, as a part of the public health action “Hunting the Silent Killer”. A total of 247 adult participants were recruited through voluntary, opportunistic sampling. PWV was measured in a supine position using a pOpmètre and IOP was measured using the Icare® IC200 tonometer. Subjects were divided into diagnosed glaucoma group A (N = 20) and non-glaucoma group B (N = 227).

RESULTS: The mean age of participants was 65 years, with 57% women. Median PWV and IOP were similar between participants with and without glaucoma (PWV: 9.0 vs. 8.8 m/s; IOP right eye: 17.5 vs. 17.0 mmHg; left eye: 18 vs. 17 mmHg). Spearman’s correlation showed no significant relationship between PWV and IOP (right eye $\rho = -0.08$; left eye $\rho = -0.05$). Logistic regression and ROC analyses indicated no significant association or discriminative ability of PWV for elevated IOP (right eye AUC = 0.61; left eye AUC = 0.57) or glaucoma (AUC = 0.49).

CONCLUSION: In our study, IOP was not associated with PWV which is not in line with previous studies reporting an association between arterial stiffness and glaucoma. In addition to the small sample size, the methods used to measure PWV and IOP could explain this discrepancy. Further studies with larger cohorts and gold standard techniques are needed to clarify the relationship between vascular stiffness and ocular hypertension.

KEYWORDS: arterial stiffness, general population, intraocular pressure, pulse wave velocity

SAŽETAK:

POVEZANOST BRZINE PULSNOG VALA S INTRAOKULARNIM TLAKOM U OPĆOJ POPULACIJI ODRASLIH: OPORTUNISTIČKI PROBIR U PROGRAMU „LOV NA TIHOG UBOJICU“

UVOD: Intraokularni tlak (IOP) ključni je faktor rizika za glaukom, dok je brzina pulsno vala (PWV) utvrđeni marker kardio-reno-neuro-metaboličkog zdravlja. Novi dokazi upućuju na to da

povišeni PWV može oštetiti očnu perfuziju, čime doprinosi oštećenju vidnog živca i glaukomu. Naš je cilj bio analizirati povezanost PWV-a s intraokularnim tlakom u općoj populaciji odraslih putem oportunističke studije probira.

METODE: Ova presječna studija provedena je u kolovozu 2025. na Dugom otoku u Hrvatskoj, kao dio javnozdravstvene akcije „Lov na tihog ubojicu“. Ukupno 247 odraslih sudionika regrutirano je dobrovoljnim, oportunističkim uzorkovanjem. PWV je mjereno u ležećem položaju pomoću pOpmètre-a, a IOP pomoću Icare® IC200 tonometra. Ispitanici su podijeljeni u skupinu A s dijagnosticiranim glaukomom (N = 20) i skupinu B bez glaukoma (N = 227).

REZULTATI: Prosječna dob sudionika bila je 65 godina, s 57% žena. Medijan PWV-a i očnog tlaka (OOP) bili su slični kod sudionika s glaukomom i bez njega (PWV: 9,0 vs. 8,8 m/s; OOP desnog oka: 17,5 vs. 17,0 mmHg; lijevog oka: 18 vs. 17 mmHg). Spearmanova korelacija nije pokazala značajnu povezanost između PWV-a i OOP-a (desno oko $\rho = -0,08$; lijevo oko $\rho = -0,05$). Logistička regresija i ROC analize nisu pokazale značajnu povezanost ili diskriminativnu sposobnost PWV-a za povišeni OOP (AUC desnog oka = 0,61; AUC lijevog oka = 0,57) ili glaukom (AUC = 0,49).

ZAKLJUČAK: U našoj studiji, očni tlak (IOP) nije bio povezan s postotkom krutosti arterija (PWV), što nije u skladu s prethodnim studijama koje su izvjestile o povezanosti između krutosti arterija i glaukoma. Osim malog uzorka, metode korištene za mjerenje PWV-a i IOP-a mogle bi objasniti ovu razliku. Potrebna su daljnja istraživanja s većim kohortama i tehnikama zlatnog standarda kako bi se razjasnio odnos između krutosti krvnih žila i očne hipertenzije.

KLJUČNE RIJEČI: brzina pulsna vala, intraokularni tlak, krutost arterija, opća populacija

INTRODUCTION

Intraocular pressure (IOP) is a major modifiable risk factor for glaucoma, a leading cause of irreversible blindness worldwide. Elevated IOP contributes to optic nerve damage through both mechanical and vascular mechanisms, impairing retinal and optic nerve head perfusion. Pulse wave velocity (PWV) is a well-established marker of arterial stiffness and an independent predictor of cardiovascular, renal, and cerebrovascular outcomes. Increased arterial stiffness may compromise microvascular autoregulation and tissue perfusion, potentially affecting ocular blood flow and contributing to glaucomatous optic neuropathy.

Several studies have suggested a potential association between arterial stiffness, as measured by PWV, and glaucoma or IOP (1,2).

Some clinic-based studies reported higher PWV in glaucoma patients and links to structural progression of optic nerve damage, whereas other studies found no significant relationship, emphasizing the multifactorial nature of glaucoma and the influence of age, vascular risk factors, and methodological differences (2, 3). Despite these indications, evidence remains heterogeneous and largely derived from selected or high-risk populations. The present study aimed to evaluate the association between peripheral PWV and IOP in a general adult population through an opportunistic community-based screening campaign titled “Hunting the Silent Killer,” conducted on the island of Dugi Otok, Croatia.

MATERIALS AND METHODS

This cross-sectional study was conducted in August 2025 as part of the public health initiative “Hunting the Silent Killer”, organ-

ized on the island of Dugi Otok, Croatia. A total of 247 adult participants (≥ 18 years) were recruited through voluntary, opportunistic sampling. All participants underwent a standardized screening protocol including pulse wave velocity and intraocular pressure measurement. Based on self-reported history and medical documentation, participants were divided into two groups:

- Group A – participants with previously diagnosed glaucoma (N = 20), and
- Group B – participants without glaucoma (N = 227).

Exclusion criteria included age under 18 years, terminal-stage malignant disease, dementia, paresis, amputation or immobilization of one limb, current acute illness, and absence of signed informed consent.

Ethical approval was obtained from the Ethics Committee of the Faculty of Medicine, J. J. Strossmayer University of Osijek (Class: 602-04/25-08/07; Reg. No.: 2158-61-46-25-178). All participants provided written informed consent prior to participation.

Measurement of pulse wave velocity (PWV)

PWV was measured using a portable pOpmètre® device (Axelife SAS, France) in a quiet environment, with participants in a supine position. The device estimates carotid–radial PWV based on photoplethysmographic signals recorded from the upper extremities. PWV values were expressed in meters per second (m/s).

Measurement of intraocular pressure (IOP)

Intraocular pressure was measured using a tonometer Icare®

IC200 (Icare Finland Oy, Helsinki, Finland), which allows contact-free measurement without topical anesthesia. Measurements were performed by trained medical staff according to manufacturer's guidelines, with six readings automatically averaged per eye. Both right and left eye values were recorded for each participant. The device has been previously validated, although minor deviations may occur in eyes with abnormal corneal parameters. Descriptive statistics were used to summarize participant characteristics. Data normality was assessed using the Shapiro–Wilk test. Group differences in continuous variables were analyzed with the Mann–Whitney U test, and categorical variables with the chi-square test. Associations between PWV and IOP were evaluated using Spearman's rank correlation. Logistic regression was performed to assess univariate and age-adjusted multivariable associations between PWV and elevated IOP or glaucoma, with

results reported as odds ratios (OR) and 95% confidence intervals (CI). ROC analyses were performed using predicted probabilities from logistic regression models to evaluate the discriminative ability of PWV. All statistical analyses were conducted using Jamovi, version 2.6.44 (jamovi project, Sydney, Australia), and a two-tailed p value <0.05 was considered statistically significant.

RESULTS

A total of 247 participants were included in the analysis, with a mean age of 65 years (range 24–94 years); 57% were women. Twenty participants had previously diagnosed glaucoma (Group A), while 227 participants did not (Group B). Descriptive statistics for age, sex, PWV, and IOP are presented in Table 1. Median PWV and intraocular pressure did not differ significantly between participants with and without glaucoma for either eye.

Table 1. Baseline characteristics of participants with and without glaucoma

Characteristic	Group A – Glaucoma (n=20)	Group B – No glaucoma (n=227)	p-value
Age, mean ± SD (years)	74 ± 10	64 ± 14	0.002
Female, n (%)	11 (55%)	129 (57%)	0.84
PWV (m/s), median (IQR)	9.0 (6.4–11.2)	8.8 (7.3–11.9)	0.86
IOP – right eye (mmHg), median (IQR)	17.5 (15–19)	17.0 (16–19)	0.33
IOP – left eye (mmHg), median (IQR)	18 (14–18)	17.0 (15–19)	0.59

Abbreviations: PWV = pulse wave velocity; IOP = intraocular pressure; SD = standard deviation; IQR = interquartile range.

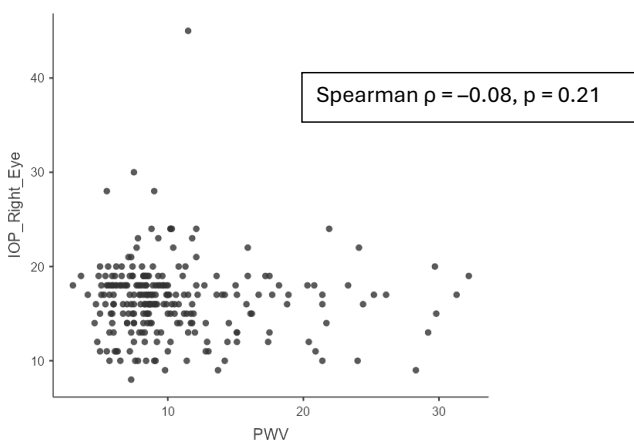


Figure 1. Scatter plot of pulse wave velocity (PWV) versus intraocular pressure (IOP) in the right eye

Each point represents an individual participant. Spearman's correlation coefficient shows no significant association between PWV and IOP in the right eye.

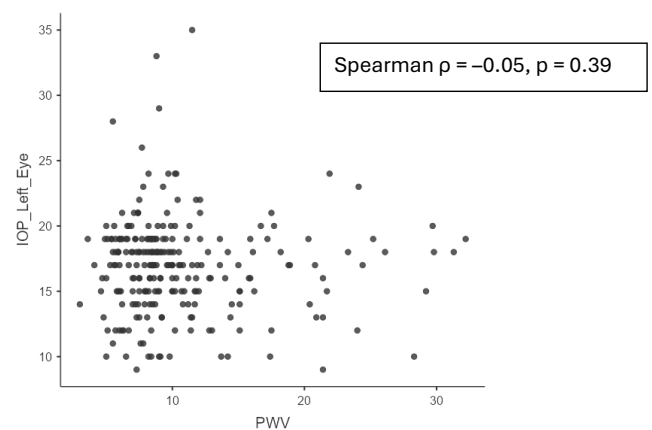


Figure 2. Scatter plot of pulse wave velocity (PWV) versus intraocular pressure (IOP) in the left eye.

Each point represents an individual participant. Spearman's correlation coefficient shows no significant association between PWV and IOP in the left eye.

Logistic regression analyses showed no significant association between PWV and elevated IOP in either eye (univariate: right eye OR = 1.02, $p = 0.63$; left eye OR = 1.01, $p = 0.89$; age-adjusted multivariable: right eye OR = 1.01, $p = 0.80$; left eye OR = 1.00, $p = 0.98$). Age was also not significantly associated with high IOP. ROC analysis indicated limited discriminative ability of PWV for elevated IOP (AUC right eye = 0.61, left eye = 0.57) and glaucoma (AUC = 0.49).

DISCUSSION

In this opportunistic screening study of a general adult population, we found no significant association between peripheral PWV and IOP or diagnosed glaucoma. Median PWV and IOP were similar in participants with and without glaucoma, and correlation analyses confirmed the absence of a meaningful relationship between arterial stiffness and IOP in either eye. Logistic regression models, including age-adjusted multivariable analyses, further indicated that PWV was not a significant predictor of elevated IOP, and age did not significantly influence IOP. ROC analysis supported these findings, showing limited discriminative ability of PWV for elevated IOP or glaucoma.

Our findings differ from several clinic-based studies reporting higher PWV in glaucoma patients and associations with optic nerve changes. For example, Božić et al. (2025) analyzed multiple glaucoma subtypes and found significantly higher estimated PWV (ePWV) in individuals with primary open-angle, normal-tension, and pseudoexfoliation glaucoma compared with non-glaucomatous controls (3). Similarly, a systematic review and meta-analysis by Beros et al. (2025) suggested higher PWV in glaucoma patients but emphasized that evidence was of low certainty due to heterogeneity in study designs, glaucoma subtypes, and PWV measurement methods (4). In both cases, the studies were mostly clinic-based and included patients with more advanced disease or vascular compromise, which may explain the observed associations. Vallée et al. (2025), using a large, middle-aged cohort and central vascular measures, reported modest

associations between arterial stiffness and IOP, highlighting how sample size, population characteristics, and measurement techniques can influence results (5).

A likely explanation for our null findings is the nature of the screened population: most participants had IOP values within the normal range, and only a small number had diagnosed glaucoma, limiting statistical power to detect subtle vascular differences. Furthermore, PWV and IOP were measured using peripheral and non-gold-standard devices, which may reduce measurement accuracy and limit comparability with other studies. Differences in population characteristics, glaucoma severity, cohort size, and measurement methodology likely contributed to discrepancies with clinic-based studies reporting positive associations.

Despite these limitations, the study has notable strengths, including community-based recruitment and consistent on-site measurements performed by trained personnel. Our results suggest that in general populations, peripheral PWV may have limited predictive value for ocular hypertension or glaucoma risk. These findings underscore the importance of future studies using gold-standard arterial stiffness measurements, standardized tonometry, and larger sample sizes to clarify potential relationships between systemic vascular stiffness and ocular hypertension.

CONCLUSION

In this opportunistic community-based screening study, no significant association was found between pulse wave velocity and intraocular pressure in a general adult population. These results suggest that arterial stiffness, as measured by portable peripheral devices, may not directly influence intraocular pressure levels. However, given the methodological limitations, the small number of participants with glaucoma, and the use of non-gold-standard measurements, further research with larger cohorts and standardized techniques is warranted to clarify the potential relationship between systemic vascular stiffness and ocular hypertension.

REFERENCES

1. Lee JS, Bae HW, Park S, Kim CY, Lee SY. Systemic Arterial Stiffness Is Associated With Structural Progression in Early Open-Angle Glaucoma. *Invest Ophthalmol Vis Sci*. 2022;63(3):28. doi:10.1167/iovs.63.3.28
2. Beros AL, Sluyter JD, Hughes AD, Hametner B, Waserthreurer S, Scragg RKR. Arterial Stiffness and Incident Glaucoma: A Large Population-Based Cohort Study. *Am J Ophthalmol*. 2024;266:68-76. doi:10.1016/j.ajo.2024.05.015
3. Božić M, Maric V, Milutinovic V, Lucic M, Vasilijevic J. Estimated Pulse Wave Velocity (ePWV) in Different Glaucoma Types. *Biomedicines*. 2025;13(8):2033. Published 2025 Aug 21. doi:10.3390/biomedicines13082033
4. Beros AL, Sluyter JD, Scragg R. Association of arterial stiffness and eye disease: a systematic review and meta-analysis. *BMJ Open Ophthalmol*. 2025;10(1):e001980. Published 2025 Jan 23. doi:10.1136/bmjophth-2024-001980
5. Vallée A, Labbé A, Arutkin M, Baudouin C, Vallée JN. The arterial stiffness and pulse pressure are predictors of intraocular pressure in a middle-aged population. *Sci Rep*. 2025;15(1):22092. Published 2025 Jul 1. doi:10.1038/s41598-025-05639-0