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# Sex-specific differences in ophthalmic and central retinal artery velocity: A cardiovascular and retinal analysis

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## Abstract

**Purpose** : The study aims to investigate sex-based differences in ocular and systemic vascular biomarkers in early-stage open-angle glaucoma (OAG) patients from the Indianapolis Glaucoma Progression Study (IGPS).

Additionally, it seeks to compare clinical and theoretical values of blood pressure (BP) and the peak-systolic velocity (PSV) in the ophthalmic artery (OA) and central retinal artery (CRA) as predicted by the novel EYE2HEART model.

**Methods :** The EYE2HEART closed-loop mathematical model of systemic and retinal circulation is used to characterize the hemodynamic impact of known structural and functional differences in men and women. On average, women are considered to have higher heart rate (HR; by 5%), left ventricular (LV) systolic elastance (ELS; by 15%), LV diastolic elastance (ELD; by 30%), right ventricular (RV) systolic elastance (ERS; by 15%) and retinal capillary density (by 5%). However, women also have smaller arterial diameter and length (by 10%), and smaller OA and CRA (by 5%). These differences are used as model inputs to study sex-related differences in the circulation. Markers of systemic and retinal circulation - systolic BP (BP SYS), mean arterial BP (MAP), PSV in the OA, and CRA - simulated by the model are compared to those measured clinically within IGPS and within the

literature. Early-stage OAG eyes are selected when the visual field Humphrey's mean deviation (MD) is  $>-6$  dB (n=804). Differences in markers are analyzed using a Kruskal-Wallis test.

**Results :** Markers simulated by the model align consistently with the mean clinically obtained values (Table). Notably, women exhibit a statistically significant lower BP SYS (127.0 vs 121.4 mmHg) and MAP (90.6 vs 85.9 mmHg). This reduction results in a significantly lower OA PSV (26.2 vs 24.1 cm/s). Smaller CRA diameter compensates for the lower velocity in the OA, where there is no significant difference in the CRA PSV (9.4 vs 9.6 cm/s).

**Conclusions :** Model findings emphasize the importance of accounting for sex-specific differences in cardiovascular function when assessing ocular hemodynamics. Results highlight the potential of the EYE2HEART model for predicting and understanding these relationships in the context of diseases.

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