Genetic influence of optic disc structure: The Minnesota Twins Reared Apart Study (MISTRA)

Elena Bitran¹, Karen Armbrust¹, Martha Wright¹, Alana Grajewski², Joseph Caprioli³, Nancy Segal⁴, Thomas Bouchard⁵

¹Department of Ophthalmology, University of Minnesota, Minneapolis - USA
²Bascom Palmer Eye Institute, University of Miami, Miami - USA
³Jules Stein Eye Institute, University of California, Los Angeles - USA
⁴California State University, Fullerton - USA
⁵Department of Psychology, University of Minnesota, Minneapolis - USA

Purpose: To assess the influence of genetic and environmental factors on optic disc size and cup to disc ratio, comparing correlations between monozygotic (MZA) and dizygotic (DZA) twins separated at birth.

Methods: Retrospective review of twin pairs from the Minnesota Study of Twins Reared Apart (MISTRA). Medical records and optic disc stereo photographs from twins separated at birth were reviewed. Vertical disc diameter (VD), vertical cup (VC), vertical cup to disc ratio (VCDR), superior rim (SR), inferior rim (IR), horizontal diameter (HD), horizontal cup (HC), nasal rim (NR), temporal rim (TR) and horizontal cup to disc ratio (HCDR) were measured with computer software by the same masked experienced ophthalmologist and values were correlated in MZA and DZA.

Results: 280 eyes from 70 twin pairs (44 MZA and 26 DZA) were included. Mean MZA age was 38.45 ± 12.93 and mean DZA age was 42.38 ± 12.78 years (p = 0.014). Visual acuity was 1.08 ± 0.24 in MZA and 1.13 ± 0.21 in DZA (p = 0.147) and cup to disc ratio was 0.26 ± 0.16 mm in MZA and 0.23 ± 0.18 in DZA pairs (p = 0.129). There were no statistically significant differences between digital optic nerve measurements in the MZA and DZA twins. The measures for MZA and DZA twin pairs, respectively, were 1.82 ± 0.21 mm and 1.80 ± 0.17 mm (p = 0.364), VC 0.49 ± 0.31 and 0.45 ± 0.32 (p = 0.363), VCDR 0.26 ± 0.18 and 0.25 ± 0.16 (p = 0.542), SR 0.64 ± 0.12 and 0.64 ± 0.14 (p = 0.753), IR 0.71 ± 0.12 and 0.72 ± 0.13 (p = 0.472), HD 1.60 ± 0.2 and 1.59 ± 0.21 (p = 0.730), HC 0.42 ± 0.29 and 0.42 ± 0.31 (p = 0.813), NR 0.58 ± 0.11 and 0.57 ± 0.08 (p = 0.241), TR 0.52 ± 0.13 and 0.55 ± 0.17 (p = 0.069) and HCDR 0.25 ± 0.17 and 0.25 ± 0.17 (p = 0.845). MZA twin pairs had statistically significant correlations for all measured disc parameters: VD 0.844, VC 0.790, VCDR 0.750, SR 0.639, IR 0.599, HD 0.746, HC 0.824, NR 0.511, TR 0.647, HCDR 0.733. In contrast, DZA twins had statistically significant correlations for the following measures VD, HD and TR (correlation coefficients: VD 0.673, VC 0.222, VCDR 0.227, SR 0.164, IR 0.366, HD 0.570, HC 0.315, NR 0.153, TR 0.683, HCDR 0.337).

Conclusion: There is a high correlation between optic disc structural parameters in twins reared apart that is stronger in MZA than DZA twin pairs.