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# Greater physical activity is associated with neuroretinal thinning in glaucomatous and normative cohorts

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## Abstract

**Purpose :** A multicohort investigation of the association between physical activity and longitudinal structural thinning in a cohort of early manifest primary open-angle glaucoma and between self-reported physical activity and total macular thickness in a population-based cohort.

**Methods :** In the discovery phase, 402 participants from the Progression Risk of Glaucoma: RElevant SNPs with Significant Association study wore a tri-axis accelerometer for a continuous seven-day period. Participants were split into tertiles based on the mean number of daily steps. The retrospective rate of Spectral-Domain Optical Coherence Tomography (SD-OCT) macular ganglion cell-inner plexiform layer (mGCIPL) was compared between tertiles. For the replication phase, self-reported exercise data from 29,708 individuals from the UK Biobank were cross-sectionally correlated with total macular thickness using SD-OCT imaging.

**Results :** Following adjustment for ocular and demographic covariates, the most active tertile was associated with a thicker cross-sectional mGCIPL (multivariate  $P=0.013$ ) and demonstrated a  $0.23\mu\text{m}/\text{year}$  slower rate of mGCIPL thinning (beta:  $0.07\mu\text{m}/\text{year}/\text{SD}$  95% CI 0.02-0.12  $P=0.004$ ). The most active tertile also exhibited a 2-fold lower risk of Guided Progression Analysis detected event based mGCIPL progression compared to the least active tertile (hazard ratio: 2.01 95% CI: 1.06-3.34;  $P=0.027$ ). The magnitude of this

association strengthened after adjusting for relevant cardiovascular and systemic comorbidities (0.08 $\mu$ m/year/SD 95% CI 0.03-0.13 P=0.003). A secondary analysis of cross-sectional visual fields demonstrated a higher daily step count was also associated with a higher mean deviation (less visual field damage) at time of accelerometer acquisition (beta: 0.24dB/SD 95% CI: 0.05-0.43 P=0.013). Assessment of the UK Biobank cohort revealed a positive correlation between self-reported days per week of exercise and total macular thickness (0.01SD/day 95% CI: 0.005-0.13 P<0.001).

**Conclusions :** Greater physical activity was associated with both a thicker cross-sectional mGCIPL and slower rate of mGCIPL thinning in primary open-angle glaucoma. Furthermore, greater physical exercise was associated with a thicker total macular thickness in the UK Biobank. These results implicate physical activity as a relevant covariate for neuroretinal degeneration, which may be relevant to glaucoma disease progression.

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