Supplementary Table S4. Characteristics of studies included in the qualitative synthesis.

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Cui et al., Association of Physical Activity with Retinal Thickness and Vascular Structure in Elderly Chinese Population, 2023	Chinese retirees ≥50 years, community-dwelling older adults, China	220	Cross-sectional study	Physical activity assessed by International Physical Activity Questionnaire (IPAQ), MET-min/week; total PA, recreational PA, non-leisure PA	Habitual physical activity (no intervention)	OCT angiography (OCTA)	Foveal avascular zone (FAZ area, circumference), vessel density (VD), perfusion density (PD), macular thickness, retinal nerve fiber layer (RNFL) thickness	Higher physical activity was associated with a smaller foveal avascular zone (FAZ), greater central retinal vessel density (VD), greater central perfusion density (PD), increased retinal nerve fiber layer (RNFL) thickness, and greater foveal thickness.	Cross-sectional association with smaller FAZ, greater central VD/PD, and increased retinal thickness measures.

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Goeder et al., VascuFit: Aerobic exercise improves endothelial function independent of cardiovascular risk: A randomized-controlled trial, 2024	Sedentary adults aged 40–60 years with elevated cardiovascular risk, Switzerland / Germany (multicenter)	44 randomized (30 intervention, 14 control)	Randomized controlled trial	Non-linear periodized aerobic exercise (NLPE), ergometer-based training	8 weeks	Static retinal vessel analysis (SVA)	CRAE, CRVE, AVR (SVA parameters)	Brachial FMD increased by 2.38% (95% CI 0.70–4.06; p = 0.007), whereas retinal vessel parameters (CRAE, CRVE, AVR) showed no significant changes.	No significant change

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Xiang et al., The effects of physical activity on diabetic retinopathy in type 2 diabetes using automated vascular analysis: a cohort study, 2025	Adults with type 2 diabetes mellitus, China	42,992 (cross-sectional analysis); 3,669 (3-year longitudinal cohort)	Cross-sectional and prospective cohort study with Mendelian randomization analysis	Physical activity assessed using the International Physical Activity Questionnaire (IPAQ); categorized into low, moderate, and high PA levels	Median follow-up 3 years	Automated retinal vascular analysis from fundus photographs	CRAE, CRVE, AVR, PRAE, PRVE, PAVR, diabetic retinopathy incidence	Physical activity was associated with increased peripheral retinal artery equivalent (PRAE) and peripheral arteriovenous ratio (PAVR), whereas no significant associations were observed for central retinal vessel parameters (CRAE, CRVE, AVR) or PRVE. Cross-sectionally, higher physical activity was also associated with lower odds of diabetic retinopathy; in the 3-year longitudinal cohort, it was associated with a lower risk of incident diabetic retinopathy.	Association with favorable peripheral retinal vascular parameters and a lower risk of diabetic retinopathy

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Simms et al., Decreased retinal capillary density as a beneficial response to 24-week high-speed circuit resistant training in healthy older adults, 2024	Healthy older adults (≈65 - 85 years), United States (USA)	30 (intervention + control)	Clinical trial / exercise intervention study	High-speed circuit resistance training (HSCRT)	24 weeks	Optical coherence tomography angiography (OCTA)	Superficial capillary density (SCP), deep capillary density (DCP)	Significant within-group reductions in OCTA-derived retinal vessel density (RVN, SVP, and DVP) were observed after 24 weeks of HSCT in the training group (all $p < 0.05$). However, the changes were not significantly different between the intervention and control groups ($p > 0.05$); therefore, a statistically significant intervention effect was not demonstrated.	Within-group decrease; no significant between-group intervention effect

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Müller et al., Effects of high-intensity interval training on retinal vessel diameters and oxygen saturation in patients with hypertension: A cross-sectional and randomized controlled trial, 2024	HyperVasc cohort[1]; Normotensive healthy adults and patients with arterial hypertension, Switzerland (with one author affiliation in Germany, study conducted in Basel)	60 (19 normotensive controls and 41 with hypertension; cross-sectional analysis); 41 randomized and 38 analyzed (19 HIIT and 19 control; RCT)	Cross-sectional study with a subsequent randomized controlled trial	Supervised walking-based high-intensity interval training (HIIT), 3 sessions/week	8 weeks	Static retinal vessel analysis (SVA) and retinal oximetry	CRAE, CRVE, AVR, arterial oxygen saturation (aO_2), venous oxygen saturation (vO_2)	In the cross-sectional analysis, normotensive participants had significantly wider CRAE and higher AVR than patients with hypertension, whereas CRVE, aO_2, and vO_2 did not differ significantly between groups. In the RCT, eight weeks of HIIT significantly reduced CRVE and increased AVR compared with the control condition, whereas CRAE, aO_2, and vO_2 did not change significantly.	Reduced CRVE and increased AVR after HIIT; no significant changes in CRAE, arteriolar oxygen saturation, or venular oxygen saturation

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Simms et al., Choriocapillaris Perfusion after 8 Weeks of High-Speed Circuit Training in Older Healthy Adults, 2024	Healthy older adults (65 - 85 years), United States (USA)	18	Clinical trial	High-speed circuit resistance training (HSCRT)	8 weeks	Swept-source OCT angiography (SS-OCTA)	Choriocapillaris flow deficit percentage (FD%), flow deficit number (FDn), flow deficit size (FDs)	No statistically significant change in choriocapillaris density was observed after 8 weeks of HSCT in either the intervention group (63.3% ± 5% to 64.7% ± 4%, p = 0.19) or the control group (63.3% ± 3% to 62.7% ± 5%, p = 0.66). The between-group difference in change was also not significant (p = 0.29).	No significant within- or between-group change

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Karaküçük Y et al., Evaluation of the effect of high-intensity interval training on macular microcirculation via swept-source optical coherence tomographyan giography in young football players, 2021	Young male football players (elite athletes), Turkey	15	Prospective interventional study	High-intensity interval training (HIIT)	6 weeks	Swept-source OCT angiography (SS-OCTA)	Superficial capillary plexus vessel density (SCP-VD), deep capillary plexus vessel density (DCP-VD), foveal avascular zone (FAZ) area, central macular thickness (CMT), SFCT	Enhanced retinal vessel density and macular perfusion following HIIT.	HIIT increased central deep capillary plexus vessel density and central choriocapillaris vessel density, whereas superficial vessel density, FAZ, CMT and SFCT remained unchanged

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Yu et al., Effects of Physical Exercise Breaks on Executive Function in a Simulated Classroom Setting: Uncovering a Window into the Brain, 2025	Healthy college students, China (Shenzhen University)	71	Randomized crossover trial	15-min moderate-intensity cycling break (MIC) or vigorous-intensity cycling break (VIC) during prolonged sitting	Acute intervention (single experimental session)	Static retinal vessel analysis	CRAE, CRVE, AVR	Moderate- and vigorous-intensity exercise breaks produced acute increases in retinal arteriolar and venular caliber compared with prolonged sitting, whereas AVR did not demonstrate a significant condition-by-time interaction.	Acute exercise-related vascular response

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Triantafyllou GA et al., Association of Cerebral Oxygenation During Exercise With Target Organ Damage in Middle-Aged Hypertensive and Normotensive Individuals, 2022	Middle-aged hypertensive and normotensive adults, Greece	93	Cross-sectional study	Maximal cardiopulmonary exercise testing; cerebral oxygenation response during exercise	Single assessment	Static retinal vessel analysis	CRAE, CRVE, AVR	Retinal vascular phenotype was cross-sectionally associated with cerebral oxygenation during exercise testing and target-organ damage; the study did not demonstrate exercise-induced retinal adaptation.	Cross-sectional association; not an intervention effect

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Krobot Čutura N. et al., Association Between Intraocular Pressure Changes and Optic Nerve Head and Macular Perfusion Parameters During Isometric Exercise: OCTA Study, 2026	Healthy adults	12	Prospective experimental study (within-subject repeated-measures design)	Isometric exercise	Acute intervention (single experimental session)	Optical coherence tomography angiography (OCTA)	Optic nerve head perfusion parameters, macular perfusion parameters, intraocular pressure (IOP)	Acute isometric exercise decreased optic nerve head vessel density without affecting macular vessel density.	Acute physiological response

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Saloň A. et al., Randomized Trial: A Pilot Study Investigating the Effects of Transcendental Meditation and Yoga Through Retinal Microcirculation in Cardiac Rehabilitation, 2025	Patients enrolled in cardiac rehabilitation, Austria	30	Pilot single-blind parallel-group randomized controlled trial	Transcendental meditation and yoga	Intervention study	Retinal vessel analysis (microcirculation assessment)	CRAE, CRVE, AVR	No significant between-group differences in CRAE, CRVE, or AVR after standard cardiac rehabilitation supplemented with yoga or transcendental meditation. These complementary mind–body interventions were analyzed separately from conventional structured exercise training.	No significant between-group effect

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Żmijewska M.A. et al., Retinal Microcirculation Measurements in Response to Endurance Exercises Analysed by Adaptive Optics Retinal Camera, 2024	Healthy endurance-trained adults, Poland	25	Prospective before–after experimental study	Endurance exercise	Acute exercise session	Adaptive Optics Retinal Camera (AORC)	Retinal arteriolar vessel diameter, lumen diameter, wall thickness, wall-to-lumen ratio (WLR), and wall cross-sectional area (WCSA)	Acute endurance exercise induced retinal arteriolar vasoconstriction, reflected by reduced vessel diameter, wall-to-lumen ratio and wall cross-sectional area.	Acute physiological response

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Ludyga et al. Influence of physical fitness and retinal microcirculation on the development of cognitive abilities from childhood to preadolescence, 2023	School-aged children followed into preadolescence, Switzerland	365	Longitudinal cohort study (cross-lagged panel design)	Physical fitness (cardiorespiratory fitness)	Longitudinal follow-up from childhood to preadolescence	Static retinal vessel analysis (SVA)	CRAE, CRVE	Higher cardiorespiratory fitness predicted narrower CRVE and better cognitive development, although retinal microcirculation was not a significant mediator.	Positive longitudinal association

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Twerenbold S. et al., Short-term high-intensity interval training improves micro- but not macrovascular function in hypertensive patients, 2023	HyperVasc cohort[1]; adults with hypertension, Switzerland	41 randomized; 38 analyzed (19 HIIT, 19 control)	Randomized controlled trial	High-intensity interval training (HIIT)	8 weeks	Dynamic retinal vessel analysis; flow-mediated dilatation (FMD) assessment	Arteriolar flicker-induced dilatation (aFID), venular flicker-induced dilatation (vFID), arteriolar constriction (aCON), FMD	Retinal microvascular endothelial function improved after 8 weeks of HIIT, primarily through increased arteriolar flicker-induced dilatation, whereas macrovascular endothelial function assessed by FMD remained unchanged.	Improved retinal arteriolar endothelial function; no significant macrovascular FMD change
Köchli S. et al., Socioeconomic Status and Parental Lifestyle Are Associated With Vascular Phenotype in Children, 2021	School-aged children, Switzerland	833	Cross-sectional study	Physical activity, parental lifestyle, and socioeconomic status	Single assessment	Static retinal vessel analysis (SVA)	CRAE, CRVE, AVR	Higher parental physical activity was associated with a more favorable retinal vascular phenotype (higher AVR), but the association was not independent of parental smoking.	Observational association

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Hua D. et al., Retina vascular perfusion dynamics during exercisewith andwithout face masks in healthy young adults: An oct angiography study, 2021	Healthy young adults, China / Germany (multicenter)	23	Prospective crossover experimental study	Acute exercise performed with and without face masks	Single exercise session	Optical coherence tomography angiography (OCTA)	Superficial retinal vessel density, deep retinal vessel density, optic nerve head vessel density, choriocapillaris flow area	Exercise induced reductions in retinal vessel density, while surgical and N95 masks further reduced superficial plexus vessel density and exercise performance.	Decreased superficial plexus vessel density
Hauser C. et al. Cardiorespiratory fitness and development of childhood cardiovascular risk: The EXAMIN YOUTH follow-up study, 2023	Children and adolescents from the EXAMIN YOUTH cohort, Switzerland	1171 at baseline/664 completed 4-year follow-up	Prospective longitudinal cohort study (4-year follow-up)	Cardiorespiratory fitness	Longitudinal follow-up	Static retinal vessel analysis (SVA)	CRAE, CRVE, AVR	Higher baseline cardiorespiratory fitness was associated with lower BMI, lower systolic blood pressure and higher AVR after 4 years, while wider CRAE occurred only indirectly through BMI-mediated effects.	Improved retinal microvascular health (higher AVR)

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Streese et al., Microvascular wall-to-lumen ratio in patients with arterial hypertension: A randomized controlled exercise trial, 2023	HyperVasc cohort[1]; adults with arterial hypertension, Switzerland	60 (41 hypertensive patinets, 19 normotensive controls)	Cross-sectional study with an embedded randomized controlled exercise trial	High-intensity interval training (HIIT)	8 weeks	Adaptive Optics Retinal Camera (AORC)	Retinal vessel wall (RVW), lumen, wall-to-lumen ratio (WLR)	Significant reduction in retinal arteriolar wall-to-lumen ratio following HIIT, indicating favorable arteriolar remodeling ($p < 0.05$).	Reduced retinal wall-to-lumen ratio (WLR)

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Vieversytė-Dvylienė et al., Sex Differences in Intraocular Pressure and Retinal Vessel Responses After Sustained Isometric Knee Extension in Young Adults: A Quasi-Experimental Study, 2026	Healthy young adults, Lithuania	43	Prospective parallel-group quasi-experimental pre–post study	Sustained isometric knee extension exercise	Acute intervention (single session)	Static retinal vessel analysis (SVA)	CRAE, CRVE, AVR, intraocular pressure (IOP)	Acute isometric knee extension reduced CRAE and AVR in both sexes, while CRVE increased only in females.	Reduced arteriolar-to-venular ratio (AVR)

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Brinkmann et al., Evaluating Retinal and Choroidal Perfusion Changes after Isometric and Dynamic Activity Using Optical Coherence Tomography Angiography, 2021	Healthy adults	34	Prospective pilot pre–post study (within-subject design)	Isometric and dynamic exercise	Acute intervention (single session)	Optical coherence tomography angiography (OCTA)	SCPP, DCPP, CCP, SLP, HLP	Retinal perfusion (SCPP and DCPP) remained unchanged after both isometric and dynamic exercise, whereas dynamic exercise significantly increased perfusion in all choroidal sublayers (CCP, SLP, HLP).	No change in retinal perfusion; increased choroidal perfusion after dynamic exercise.
Jiang et al., 2025	Patients with Parkinson's disease, USA	20 completed the intervention; 17 successfully imaged	Prospective intervention / correlational analysis	YogaCue or Hatha yoga	24 weeks	OCTA + RFI	CPD (RVN, SVP, DVP), RBF	Changes in RBF correlated with CPD changes across retinal slabs (r=0.58–0.83, p<0.05); increases in RBF and SVP CPD were associated with improved Trail Making A performance, and RVN CPD change with delayed verbal recall.	Exercise-related microcirculatory changes associated with cognitive improvement; complementary PD-yoga report

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Hoover et al., 2026	Patients with Parkinson's disease, USA	15 completers	Prospective intervention; complementary cohort report	Yoga	6 months	Multimodal retinal neurovascular imaging (OCTA + RFI)	RBF, RVD/RVLD, RTP, RCF and related neurovascular measures	Six-month yoga was evaluated for longitudinal retinal neurovascular responses in Parkinson's disease; this report arises from the same underlying PD-yoga program as the 2025 complementary publications.	Longitudinal retinal neurovascular response; complementary PD-yoga report
Alten et al., 2021	Healthy adults and adults with T1DM without diabetic retinopathy, Germany	40 (20 healthy adults; 20 adults with T1DM)	Retrospective analysis of two prospective HIIT cohorts	All-out HIIT	4 weeks (8 sessions)	OCTA	Choriocapillaris flow-deficit number, size, total flow-deficit area; signal-intensity metrics	HIIT produced differential choriocapillaris responses in healthy adults and T1DM. Selected CC parameters changed in healthy participants but not T1DM, with significant group × time interactions for selected metrics ($p \leq 0.029$).	Differential choriocapillaris response according to metabolic status

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Wefelnberg et al., 2026	Cancer patients receiving active anticancer treatment and healthy controls, Germany	24 (12 cancer patients; 12 healthy controls)	Prospective comparative acute-exercise study	HIIT (7 x 1 min at 90% PPO)	Acute intervention (single session)	OCTA (OCTAVA analysis)	VAD, VLD, TVL, vessel diameter, tortuosity in superficial/deep retina and optic disc	Significant group × time interactions were observed for several superficial and deep retinal microvascular parameters (η^2 0.165–0.473; mainly $p<0.01$), but not at the optic disc.	Differential acute retinal microvascular response in cancer patients vs controls
Wan et al., 2025	Patients with Parkinson's disease, USA	15 completers	Prospective interventional pilot study	YogaCuer or Hatha yoga	24 weeks	OCTA	Choriocapillaris density (CCD)	No significant overall change in CCD (62.9±3.9% to 62.9±3.2%; $p>0.05$). Exploratory subgroup analyses suggested different responses by disease duration/severity; baseline CCD inversely correlated with ΔCCD ($\rho=-0.77$, $p<0.001$).	No overall change; exploratory disease-stage-dependent response

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Luo et al., 2026	Adults >=60 years with POAG and age-matched controls, China	180 (100 with POAG; 80 controls)	Cross-sectional observational study	Habitual physical activity assessed by IPAQ and wrist actigraphy	>=7 days of actigraphy	SS-OCTA	Choroidal vascular volume (CVV), choroidal vascularity index, choriocapillaris flow density (CCFD)	POAG participants had lower PA, CVV and CC FD than controls. Within POAG, longer MVPA was independently associated with greater CVV (β=0.04, p=0.021) and higher CC FD (β=0.06, p=0.004).	Higher MVPA associated with better macular choroidal circulation in POAG
Petersen et al., 2022	Healthy adults, Denmark	55	Secondary analysis of previously recorded physiological data	Isometric exercise and flicker stimulation	Acute assessment (single session)	Retinal arteriole video analysis + Fourier analysis	Arteriolar diameter and vasomotion frequency/power	Isometric exercise constricted retinal arterioles by 1.76±3.56% (p=0.02) and increased very-low-frequency vasomotion; flicker caused dilation and reduced oscillatory power.	Acute autoregulatory response: arteriolar constriction with increased vasomotion

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Fang et al., 2021	Cognitively normal older adults, USA	20	Cross-sectional study	Physical fitness assessed as total work during the YMCA cycle ergometer test	Single assessment	OCTA	RVN, SVP and DVP vessel density	Retinal microvascular densities were not significantly related to physical fitness (r_s=−0.05 to 0.18; p>0.05). SVP vessel density correlated with MoCA (r_s=0.53, p=0.02).	No significant association between physical fitness and retinal vessel density
Jiang et al., 2023	Healthy older adults, USA	18 (11 HSCT; 7 non-training controls)	Prospective controlled intervention	High-speed circuit resistance training (HSCT), 3 sessions/week	8 weeks	RFI + OCTA	RBF, retinal capillary density (RCD), retinal capillary function (RCF=RBF/RCD)	RCF increased by 25% after HSCT (2.07±0.64 to 2.59±0.54 nL·s−1·Dbox−1; p=0.0003), with no significant RCF change in controls (p=0.58).	Increase in retinal capillary function; complementary 8-week Miami cohort report

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Gameiro et al., 2025	Healthy older adults, USA	30 (15 YogaCue; 15 Hatha yoga)	Randomized allocation to two active yoga modalities; no non-exercise control	Yoga, 3 x 60 min/week	24 weeks	OCTA + RFI + flavoprotein fluorescence imaging	RBF, RTP, RCF, RVD, RVLD, FAZ, CCD	RBF increased (2.21→2.72 nL/s, p=0.002), RCF increased (0.12→0.14 nL/s/mm, p=0.004), and RTP increased (1.91→2.38 nL/s/mm³, p=0.004). RVD, RVLD, FAZ and CCD showed no significant overall change.	Improved perfusion/capillary-function measures; no significant density change
Uğurlu & İçel, 2021	Adult athletes and nonathletes, Turkey	60 (30 athletes; 30 nonathletes)	Cross-sectional observational study	Regular physical activity / athlete status	Habitual exposure (single assessment)	SD-OCT + OCTA	SCP-VD, DCP-VD, radial peripapillary capillary VD, FAZ area/perimeter/circularity	Nonathletes had lower superficial, deep and radial peripapillary capillary vessel densities and lower FAZ circularity, with larger FAZ area/perimeter (all p<0.05).	Athlete status associated with higher retinal/peripapillary VD and more compact FAZ morphology

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Nie et al., 2022	Patients with POAG and healthy controls, China	47 participants/47 eyes (25 POAG; 22 controls)	Prospective repeated-measures acute-exercise study	Moderate running	20-min acute intervention with 30-min recovery	OCTA	Macular superficial VD, FAZ parameters, radial peripapillary capillary VD	Macular superficial VD increased in selected regions during 30-min recovery; optic-disc perfusion did not change significantly. IOP decreased immediately after exercise and recovered by 30 min.	Acute regional macular perfusion response; no significant ONH change

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Li et al., 2021	Myopic and emmetropic children, China	58 (40 myopic; 18 emmetropic)	Repeated-measures acute-exercise study	Stationary cycling	20-min acute intervention with post-exercise recovery	SS-OCT + SS-OCTA	Superficial/deep retinal VD; choriocapillaris/deeper choroidal VD; choroidal thickness	In myopic eyes, deep retinal VD decreased immediately after exercise (p=0.02) and superficial VD increased after rest (p=0.03); in emmetropic eyes, superficial and deep VD increased after rest (p<0.01). Choroidal VD did not change significantly.	Transient, layer- and refractive-status-dependent retinal response
Zhang et al., 2021	Healthy older adults, USA	18 (11 HSCT; 7 non-training controls)	Prospective controlled intervention	High-speed circuit resistance training (HSCT), 3 sessions/week	8 weeks	Retinal Function Imager	RBF, retinal tissue perfusion (RTP)	RTP increased by 26% in the HSCT group (2.99±0.91 to 3.77±0.86 nL·s−1·mm−3; p<0.001); changes in selected cognitive measures were associated with RTP changes.	Increase in retinal tissue perfusion; complementary 8-week Miami cohort report

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Drachmann et al., 2023	Healthy adults, Denmark	30	Acute physiological study	Isometric exercise	Acute intervention (single session)	Retinal oximetry + Doppler OCT	Arteriolar/venular O_2 saturation, vessel diameter, retinal blood flow	Isometric exercise caused significant arteriolar contraction ($p<0.01$) and increased venular O_2 saturation ($p<0.001$) in peripheral and macular regions; peripheral blood flow increased whereas macular flow did not.	Region-specific acute autoregulatory oxygenation/ blood-flow response
Liang et al., 2024	Healthy adults, China	30 participants/30 eyes	Prospective repeated-measures study	Exercise at 75-80% HRmax under no-mask, surgical-mask, and N95 conditions	Acute intervention with 30-min recovery	SS-OCTA	Functional VD in macular SP/DP and ONH superficial/nerve-fiber/small-vessel plexuses	Immediately after exercise, selected ONH functional VD measures decreased significantly ($p<0.05$); changes recovered by 30 min in all mask conditions.	Transient acute vessel-density reduction with recovery toward baseline

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Ikemura et al., 2022	Healthy younger and older men, Japan	36 (18 younger; 18 older)	Acute experimental study	Cycling at 60% heart-rate reserve	30-min acute intervention	Laser speckle flowgraphy	Retinal arteriolar pulse-waveform/stiffness indices; retinal blood-flow velocity	Retinal arteriolar pulse-waveform indices did not significantly change after acute exercise, whereas systemic CAVI decreased. Retinal blood-flow measures showed post-exercise reductions.	No significant change in retinal arteriolar stiffness; acute blood-flow reduction
Mauget-Faÿsse et al., 2021	Marathon runners, France	31 enrolled; 29 completed the post-race assessment	Non-randomized prospective cohort / pre–post study	Paris Marathon	Acute pre-post assessment	Fundus photography + SD-OCT + OCTA	Retinal vascular plexus density; choroidal thickness; macular/RNFL thickness	Retinal vascular plexus density decreased after the marathon ($p<0.01$); macular/RNFL thickness increased and choroidal thickness decreased ($p<0.01$).	Acute reduction in retinal vascular density after prolonged endurance exercise

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Zhou et al., 2025	Healthy older adults, USA	30 (15 HSCT; 15 controls)	Randomized controlled trial; complementary 24-week Miami report	High-speed circuit resistance training (HSCT), 3 sessions/week	24 weeks	OCTA	Choriocapillaris perfusion density (CCD)	CCD did not change significantly in HSCT (62.6±6.1% to 63.7±6.1%; p=0.21) or control (62.8±5.6% to 63.8±4.9%; p=0.18).	No significant choriocapillaris density change
Bek & Jeppesen, 2021	Healthy adults, Denmark	20	Acute physiological study	Isometric exercise	Acute intervention (single session)	Retinal oximetry	Arteriolar/venular O_2 saturation, oxygen extraction, vessel diameter	Peripheral retinal oxygen extraction decreased from 36.0±2.3% to 30.6±2.1% (p=0.002), while macular oxygen extraction did not change significantly (p=0.37); arteriolar diameter was unchanged.	Region-specific acute retinal metabolic response

Study	Population, Country	N	Study design	Exercise/Fitness variable	Duration	Retinal assessment method	Retinal biomarker(s)	Main findings	Direction of effect
Ben Aoun et al., 2025	Patients with effort angina, Tunisia	38 eyes	Prospective comparative study	Exercise stress test	Acute intervention (single session)	OCTA	SCP/DCP vessel density, blood flow, intercapillary spaces, choriocapillaris density, CAZ parameters	DCP vessel density decreased significantly after exercise stress testing (p=0.03); SCP density, choriocapillaris density and CAZ parameters did not change significantly.	Acute reduction in deep capillary plexus density
Liang et al., 2025	Patients with POAG, China	41 patients/74 eyes	Cross-sectional observational study	Habitual physical activity assessed as average daily steps	7-day accelerometer assessment	OCTA	Optic-disc whole-image all-vessel density (WIAVD) and capillary vessel density (WICVD)	Participants averaging >10,000 steps/day had greater WIAVD and WICVD than those with ≤10,000 steps/day (p=0.026 and p=0.032); associations persisted after multivariable adjustment.	Higher habitual physical activity associated with greater optic-disc vessel density

Abbreviations: AORC, adaptive optics retinal camera; AVR, arteriovenous ratio; CAZ, central avascular zone; CCD, choriocapillaris density; CCFD, choriocapillaris flow density; CPD, capillary perfusion density; CRAE, central retinal arteriolar equivalent; CRVE, central retinal venular equivalent; DCP/DVP, deep capillary/deep vascular plexus; FAZ, foveal avascular zone; HIIT, high-intensity interval training; HSCT, high-speed circuit re-sistance training; MVPA, moderate-to-vigorous physical activity; OCTA, optical coherence tomography angiography; ONH, optic nerve head; PA, physical activity; RBF, retinal blood flow; RCF, retinal capillary function; RCD, retinal capillary density; RFI, Retinal Function Imager; RTP, retinal tissue perfusion; RVN, retinal vascular network; SCP/SVP, superficial capillary/superficial vascular plexus; SS-OCTA, swept-source OCTA; VD, ves-sel density; VAD, vessel area density; VLD/RVLD, vessel length density/retinal vessel length density; WLR, wall-to-lumen ratio.

Cohort note: Twerenbold et al., Streese et al., and Müller et al. are complementary HyperVasc reports. The Miami 8-week HSCT publications (Zhang et al.; Jiang et al.; and related reports), the 24-week HSCT publications (Simms et al.; Zhou et al.), and the Parkinson/yoga publications (Jiang et al.; Wan et al.; Hoover et al.) contain overlapping or complementary analyses and should not be interpreted as independent replication.