ONLINE APPENDIX

Alterations in Retinal Microvascular Geometry in Young Type 1 Diabetes

Sasongko et al.

Supplemental Table 1. Baseline characteristics, according to the gradability of retinal photograph

Characteristics	Gradable N = 944	Ungradable N = 215	P-value
Sex, % male	47.0	42.8	0.260
Pubertal stage, %			
1	5.4	4.6	0.450
2	11.9	13.8	
3	16.1	10.9	
4	25.4	28.7	
5	41.1	42.0	
	Mean (SE)		
Age, years	14.1 (0.05)	13.9 (0.10)	0.023
BMI, kg/m^2	21.9 (0.11)	21.8 (0.23)	0.902
Systolic BP, mmHg	111.89 (0.38)	113.5 (0.79)	0.052
Diastolic BP, mmHg	67.4 (0.26)	67.9 (0.55)	0.370
Mean arterial BP, mmHg	82.2 (0.26)	83.1 (0.55)	0.128
Cholesterol, mmol/L	4.4 (0.03)	4.4 (0.06)	0.327
Duration of diabetes, years	6.2 (0.11)	5.6 (0.22)	0.026
HbA1c, %	8.5 (0.04)	8.5 (0.09)	0.944

N = Number at risk; Data are age-adjusted means (Standard Error (SE)), except for age and %.

Supplemental Table 2. Associations of retinal arteriolar parameters with baseline characteristics.

Characteristics		N	Curvature tortuosity $(x10^3)$	Branching angle	Optimality deviation $(x10^2)$	Length to Diameter Ratio
Age, years	12 – 14	640	34.9 (34.0, 35.8)	83.7 (82.8, 84.5)	72.0 (70.6, 73.4)	71.8 (65.9, 78.3)
	14 – 20	519	33.4 (32.4, 34.4)	83.7 (82.8, 84.7)	71.8 (70.2, 73.4)	71.2 (64.9, 78.0)
	P-value		0.028	0.917	0.870	0.888
	Per SD increase*		-0.73 (-1.37, -0.10)	0.21 (-0.41, 0.83)	0.09 (-0.95, 1.13)	-1.87 (-7.90, 4.17)
Sex	Female	623	34.3 (33.4, 35.2)	84.4 (83.5, 85.2)	71.8 (70.3, 73.2)	72.6 (66.6, 79.1)
	Male	536	34.2 (33.3, 35.2)	83.0 (82.0, 83.9)	72.1 (70.5, 73.6)	70.6 (64.4, 77.3)
	P-value		0.941	0.033	0.762	0.665
Pubertal stage	Stage 1	47	34.4 (30.1, 37.9)	82.5 (79.2, 85.9)	72.5 (66.7, 78.2)	68.4 (52.0, 97.6)
	Stage 2	110	36.4 (34.0, 38.7)	84.1 (81.8, 86.4)	70.5 (66.5, 74.4)	72.4 (57.6, 91.0)
	Stage 3	135	35.3 (33.3, 37.2)	84.6 (82.7, 86.5)	72.1 (68.8, 75.3)	70.9 (58.9, 85.5)
	Stage 4	233	35.2 (33.7, 36.7)	83.9 (82.4, 85.4)	73.0 (70.4, 75.5)	67.0 (58.3, 77.1)
	Stage 5	369	33.4 (32.0, 34.8)	83.2 (81.8, 84.5)	72.5 (70.2, 74.8)	66.7 (58.6, 76.0)
	P for trend		0.252	0.728	0.885	0.971
BMI, kg/m²	≤18.0	121	36.0 (33.9, 38.0)	84.2 (82.2, 86.2)	72.8 (69.5, 76.1)	73.9 (60.5, 90.3)
	18.1 – 21.0	410	33.5 (32.4, 34.7)	84.1 (83.0, 85.2)	71.9 (70.0, 73.7)	76.3 (68.5, 85.1)
	21.1 – 25.0	436	34.4 (33.3, 35.5)	83.6 (82.5, 84.6)	71.5 (69.8, 73.3)	67.2 (60.6, 74.5)
	≥ 25.1	192	34.3 (32.7, 35.9)	83.0 (81.4, 84.5)	72.2 (69.6, 74.9)	71.3 (61.1, 83.2)
	P for trend		0.216	0.236	0.910	0.422
	Per SD increase*		-0.07 (-0.77, 0.40)	-0.37 (-1.06, 0.31)	0.18 (-1.33, 0.96)	-2.55 (-9.58, 4.48)
SBP, mmHg	≤ 120	798	34.4 (33.7, 35.1)	83.9 (83.2, 84.6)	72.2 (71.0, 73.3)	73.9 (69.1, 79.1)
	> 120	146	33.5 (31.8)	82.8 (81.2, 84.5)	70.4 (67.7, 73.2)	59.3 (50.2, 70.2)
	P-value		0.321	0.266	0.257	0.018
	Per SD increase*		-0.29 (-0.95, 0.40)	-0.14 (-0.80, 0.52)	0.26 (-0.85, 1.36)	-10.0 (-16.3, -3.69)
DBP, mmHg	≤ 60.0		34.1 (33.0, 35.3)	83.9 (82.8, 84.9)	70.6 (68.7, 72.5)	77.1 (68.7, 85.6)
	60.1 – 80.0		34.3 (33.5, 35.1)	83.8 (83.0, 84.6)	72.5 (71.1, 73.8)	70.1 (64.7, 75.9)
	≥ 80.0		34.1 (30.9, 37.4)	81.4 (78.2, 84.5)	73.7 (69.4, 78.9)	56.2 (40.0, 78.3)
	P-value		0.791	0.891	0.093	0.150
	Per SD increase*		0.02 (-0.65, 0.69)	-0.14 (-0.80, 0.51)	0.96 (-0.14, 2.05)	-9.03 (-15.3, -2.70)
MABP, mmHg	≤ 86.7	863	34.2 (33.5, 35.0)	83.8 (83.1, 84.6)	72.0 (70.8, 73.3)	76.4 (71.1, 82.1)
	≥ 86.8	296	34.3 (33.0, 35.6)	83.4 (82.1, 84.7)	71.6 (69.4, 73.7)	58.2 (51.1, 66.2)
	P-value		0.424	0.582	0.725	<0.0001
	Per SD increase*		-0.12 (-0.80, 0.56)	-0.16 (-0.83, 0.50)	0.77 (-0.34, 1.89)	-10.8 (-17.13, -4.44)
Cholesterol, mmol/L	1st Quartile, ≤ 3.7	280	33.7 (32.4, 35.1)	83.2 (81.8, 84.5)	72.4 (70.2, 74.6)	66.3 (58.2, 75.6)
	2nd Quartile, 3.8 – 4.3	319	34.1 (32.9, 35.3)	83.7 (82.5, 84.9)	71.1 (69.1, 73.1)	68.9 (61.3, 77.5)

		N				
	3rd Quartile, 4.4 – 4.8	244	35.7 (34.3, 37.1)	84.6 (83.2, 86.0)	72.4 (70.0, 74.7)	71.5 (62.6, 81.7)
	4th Quartile, ≥ 4.9	266	33.5 (32.1, 34.9)	83.9 (82.6, 85.3)	72.7 (70.3, 75.0)	78.7 (68.8, 90.1)
	P for trend		0.121	0.515	0.735	0.070
	Per SD increase*		-0.02 (-0.70, 0.66)	0.44 (-0.20, 1.09)	0.36 (-0.77, 1.49)	3.58 (-2.12, 9.30)
Duration, years	≤ 5.0	522	33.7 (32.7, 34.7)	82.8 (81.8, 83.7)	71.0 (69.4, 72.7)	72.0 (65.4, 79.1)
	5.1 – 10.0	455	34.9 (33.8, 35.9)	83.8 (82.8, 84.9)	71.8 (70.1, 73.5)	72.1 (65.2, 79.7)
	≥ 10.1	182	34.3 (32.6, 35.9)	85.9 (84.4, 87.5)	75.6 (71.9, 77.2)	69.7 (59.7, 81.4)
	P for trend		0.278	0.001	0.041	0.930
	Per SD increase*		0.49 (-0.16, 1.14)	1.15 (0.52, 1.78)	1.29 (0.22, 2.35)	-0.46 (-6.62, 5.69)
HbA1c, %	≤ 8.5	605	33.4 (32.5, 34.3)	83.5 (82.6, 84.4)	71.4 (69.9, 72.9)	71.6 (65.5, 78.2)
	> 8.5	554	35.1 (34.2, 36.1)	83.9 (83.0, 84.8)	72.4 (70.9, 73.9)	71.7 (65.6, 78.4)
	P-value		0.008	0.951	0.373	0.977
	Per SD increase*		0.34 (-0.35, 1.03)	-0.08 (-0.76, 0.60)	1.05 (-0.07, 2.18)	-0.71 (-7.63, 6.21)

Data are age and gender-adjusted means (95% Confidence Intervals), except for rows with*

*Age- and gender- adjusted beta coefficient, obtained from linear regression models. SD for age (1.5 years), BMI (3.5 kg/m^2), SBP (12 mmHg), MABP (8.5 mmHg), cholesterol (0.9 mmol/L), duration of diabetes (3.3 years), and HbA1c (1.3%)

Supplemental Table 3. Associations of retinal venular parameters with baseline characteristics.

Characteristics		N	Curvature tortuosity ($x10^3$)	Branching angle	Optimality deviation ($x10^2$)	Length to Diameter Ratio
Age, years	12 – 14	640	31.9 (31.0, 32.8)	79.2 (78.3, 80.2)	61.8 (60.3, 63.3)	80.6 (74.1, 87.6)
	14 – 20	519	30.3 (29.2, 31.2)	79.56 (78.5, 80.6)	64.3 (62.7, 66.0)	74.3 (67.9, 81.2)
	P-value		0.016	0.635	0.027	0.189
	Per SD increase*		-0.90 (-1.54, -0.26)	0.28 (-0.41, 0.97)	0.40 (-1.32, 2.12)	-2.36 (-8.26, 3.53)
Sex	Female	623	31.1 (30.2, 32.0)	79.6 (78.6, 80.6)	63.0 (61.5, 64.5)	77.8 (71.5, 84.5)
	Male	536	31.2 (30.3, 32.2)	79.1 (78.1, 80.1)	62.9 (61.3, 64.5)	77.6 (71.0, 84.9)
	P-value		0.857	0.499	0.932	0.975
Pubertal stage	Stage 1	47	31.9 (28.4, 35.4)	80.4 (76.6, 84.3)	58.8 (53.5, 64.7)	72.5 (52.9, 99.3)
	Stage 2	110	32.0 (29.7, 34.4)	79.9 (77.3, 82.6)	62.9 (58.1, 66.1)	70.8 (56.3, 89.1)
	Stage 3	135	32.8 (30.8, 34.8)	79.9 (77.7, 82.1)	60.9 (57.8, 64.3)	74.8 (62.2, 89.9)
	Stage 4	233	30.7 (29.2, 32.2)	79.2 (77.5, 80.9)	61.3 (58.8, 63.9)	75.0 (65.2, 86.5)
	Stage 5	369	30.5 (29.1, 31.9)	79.1 (77.6, 80.7)	65.5 (63.1, 68.0)	76.5 (67.2, 87.2)
	P for trend		0.435	0.960	0.103	0.989
BMI, kg/m^2	≤18.0	121	30.7 (28.7, 32.8)	80.7 (78.5, 82.9)	61.3 (58.0, 64.8)	74.2 (61.1, 90.0)
	18.1 – 21.0	410	31.6 (30.5, 32.8)	80.0 (78.8, 81.2)	63.8 (61.9, 65.8)	79.0 (69.1, 87.7)
	21.1 – 25.0	436	31.0 (29.9, 32.0)	78.9 (77.7, 80.0)	62.4 (60.6, 64.2)	76.3 (69.0, 84.4)
	≥ 25.1	192	31.0 (29.3, 32.6)	78.3 (76.6, 80.0)	63.4 (60.7, 66.2)	80.6 (69.3, 93.7)
	P for trend		0.803	0.227	0.521	0.878
	Per SD increase*		0.13 (-0.57, 0.84)	-0.58 (-1.24, 0.09)	0.45 (-1.46, 2.36)	3.47 (-3.40, 10.34)
SBP, mmHg	≤ 120		31.3 (30.6, 32.0)	79.5 (78.8, 80.3)	63.1 (61.8, 64.1)	79.0 (74.4, 83.9)
	> 120		30.3 (28.6, 32.0)	78.4 (76.5, 80.2)	63.0 (60.2, 66.0)	68.7 (58.6, 81.5)
	P-value		0.283	0.251	0.927	0.128
	Per SD increase*		-0.55 (-1.23, 0.12)	-0.26 (-0.91, 0.37)	0.17 (-1.67, 2.02)	-5.52 (-11.7, 0.65)
DBP, mmHg	≤ 60.0		31.9 (30.7, 33.0)	80.4 (79.2, 81.6)	63.4 (61.3, 65.4)	75.9 (68.7, 85.6)
	60.1 – 80.0		30.9 (30.0, 31.7)	78.9 (78.0, 79.8)	62.6 (61.3, 64.1)	78.3 (73.0, 85.6)
	≥ 80.0		29.3 (26.2, 32.6)	78.8 (75.4, 82.3)	64.2 (58.8, 70.0)	67.4 (49.4, 92.8)
	P-value		0.231	0.143	0.776	0.619
	Per SD increase*		-0.51 (-1.18, 0.16)	-0.63 (-1.26, -0.00)	-0.25 (-2.06, 1.57)	-4.13 (-10.3, 2.06)
MABP, mmHg	≤ 86.7	863	31.5 (30.7, 32.2)	80.1 (79.1, 81.2)	62.6 (61.4, 64.0)	80.6 (75.2, 86.5)
	≥ 86.8	296	30.2 (28.9, 31.6)	78.8 (77.8, 79.7)	63.7 (61.5, 66.1)	69.0 (60.8, 78.3)
	P-value		0.108	0.079	0.417	0.036
	Per SD increase*		-0.61 (-1.29, 0.07)	-0.56 (-1.20, 0.08)	0.08 (-1.94, 1.76)	-5.37 (-11.58, 0.84)
Cholesterol, mmol/L	1st Quartile, ≤ 3.7	280	31.3 (30.0, 32.7)	77.6 (76.1, 79.0)	64.3 (62.0, 66.7)	74.5 (65.6, 84.6)

		N				
	2nd Quartile, 3.8 – 4.3	319	31.4 (30.1, 32.6)	79.7 (78.3, 81.0)	64.3 (62.2, 66.5)	71.8 (64.0, 80.5)
	3rd Quartile, 4.4 – 4.8	244	32.3 (30.9, 33.7)	80.7 (79.1, 82.2)	62.6 (60.2, 65.0)	80.9 (71.2, 92.0)
	4th Quartile, ≥ 4.9	266	29.9 (28.5, 31.3)	79.7 (78.2, 81.2)	61.4 (59.1, 63.7)	82.7 (72.6, 94.2)
	P for trend		0.116	0.033	0.221	0.331
	Per SD increase*		-0.71 (-1.40, -0.02)	0.44 (-0.20, 1.09)	-1.90 (-3.75, -0.05)	3.54 (-2.95, 10.03)
Duration, years	≤ 5.0	522	31.6 (30.6, 32.6)	79.7 (78.6, 80.7)	62.1 (60.5, 63.9)	81.2 (74.0, 89.2)
	5.1 – 10.0	455	30.9 (29.9, 32.0)	79.2 (78.0, 80.3)	62.9 (61.2, 64.7)	76.4 (69.4, 76.7)
	≥ 10.1	182	30.6 (29.0, 32.3)	79.1 (77.3, 80.8)	65.0 (62.2, 67.9)	72.0 (62.0, 83.6)
	P for trend		0.506	0.766	0.249	0.368
	Per SD increase*		-0. 22 (-0.88, 0.43)	-0.26 (-0.88, 0.36)	1.44 (-0.31, 3.19)	-3.21 (-9.23, 2.82)
HbA1c, %	≤ 8.5	605	31.2 (30.3, 32.2)	79.6 (78.6, 80.6)	62.7 (61.1, 64.2)	77.9 (71.5, 85.0)
	> 8.5	554	31.1 (30.2, 32.0)	79.6 (78.2, 80.2)	63.2 (61.6, 64.8)	77.4 (83.6, 84.4)
	P-value		0.848	0.5762	0.643	0.922
	Per SD increase*		-0.190 (-0.88, 0.50)	-0.30 (-0.96, 0.35)	0.09 (-1.79, 1.98)	-0.17 (-6.82, 6.48)

Data are age and gender-adjusted means (95% Confidence Intervals), except for rows with*

*Age- and gender- adjusted beta coefficient, obtained from linear regression models. SD for age (1.5 years), BMI (3.5 kg/m^2), SBP (12 mmHg), MABP (8.5 mmHg), cholesterol (0.9 mmol/L), duration of diabetes (3.3 years), and HbA1c (1.3%)