

Table 1:

	Colour fundus photographs	OCT images
Good	Fovea and optic disc are clearly seen and large retinal vessels are visible across more than 90% of the image	Artifacts are not present and signal strength appears optimal for interpretation of the image set
Adequate	Fovea and optic disc are clearly seen and more than 67% of the remainder of the image is visible	Artifacts are present and/or signal strength is reduced, but there is still sufficient intensity to distinguish major interfaces across the entire dataset
Inadequate	Either the fovea or the optic disc or more than 33% of the total image are not visible	Severe artifacts are present (e.g. "impossible" deviations in retinal contour) or the signal strength is reduced across the image set to the extent that major interfaces cannot be clearly identified

Supplementary Table 1 legend: Image quality definitions for colour fundus photographs and OCT images

Table 2:

Visual impairment category	Monocular visual impairment (n=6,682)		Binocular visual impairment - Binocular visual impairment - better seeing eye (n=1,677) worse seeing eye (n=1,677)			
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
Mild (LogMAR>0.3 to <0.45)	3,677	55.0 (53.8,56.2)	1,062	63.3 (61.0,65.6)	461	27.5 (25.4,29.6)
Moderate (LogMAR 0.45 to <1.0)	2,593	38.8 (37.6,40.0)	596	35.5 (33.2,37.8)	1,099	65.5 (63.3,67.8)
Severe (LogMAR 1.0 to <1.3)	373	5.6 (5.0,6.1)	19	1.1 (0.6,1.6)	104	6.2 (5.0,7.4)
Blindness (LogMAR ≥1.3)	39	0.6 (0.4,0.8)	0	-	13	0.8 (0.4,1.2)

Supplementary Table 2 legend: Categories of visual impairment in the UK Biobank participants

Table 3:

Baseline characteristic (summary statistic)	Recorded for cases and controls (n)	Controls	Cases - Visual Impairment		
		(n=24,438)	All (n=8,359)	Monocular (n=6,682)	Binocular (n=1,677)
Age Median (IQR)	32,797	60 (53, 64)	61 (54, 65)	61 (54, 65)	61 (54, 65)
Sex	32,797				
Female: n (%)		13498 (55.2)	4641 (55.5)	3723 (55.7)	918 (54.7)
Male: n (%)		10940 (44.8)	3718 (44.5)	2959 (44.3)	759 (45.3)
Ethnic Group	32,630				
White: n (%)		22045 (90.7)	7465 (89.7)	6015 (90.4)	1450 (87.1)
Asian or Asian British: n (%)		757 (3.1)	285 (3.4)	222 (3.3)	63 (3.8)
Black or Black British: n (%)		1100 (4.5)	414 (5.0)	309 (4.6)	105 (6.3)
Other ethnic group: n (%)		409 (1.7)	155 (1.9)	109 (1.6)	46 (2.8)
Townsend deprivation score quintiles	32,757				
1: n (%) least deprived		4162 (17.0)	1275 (15.3)	1051 (15.8)	224 (13.4)
2: n (%)		4729 (19.4)	1498 (18.0)	1225 (18.4)	273 (16.3)
3: n (%)		4717 (19.3)	1560 (18.7)	1279 (19.2)	281 (16.8)
4: n (%)		5590 (22.9)	1885 (22.6)	1506 (22.6)	379 (22.6)
5: n (%) most deprived		5215 (21.4)	2126 (25.5)	1608 (24.1)	518 (30.9)
Employment	32,409				
Paid / Self-employment / Student: n (%)		12621 (52.2)	4024 (48.8)	3260 (49.4)	764 (46.3)
Retired: n (%)		9722 (40.2)	3431 (41.6)	2740 (41.5)	691 (41.9)
Unable to work / Unemployed / Carer / Voluntary Work: n (%)		1816 (7.5)	795 (9.6)	600 (9.1)	195 (11.8)
Blood pressure diastolic: Median (IQR)	32,606	82 (75, 89)	82 (75, 89)	82 (75, 89)	82 (75, 89)
Blood pressure systolic: Median (IQR)	32,605	140 (127, 153)	141 (127, 154)	140 (127, 154)	141 (128, 155)
BMI category	31,684				
Normal / Underweight: n (%)		7597 (32.2)	2523 (31.3)	2021 (31.3)	502 (31.3)
Overweight: n (%)		10287 (43.5)	3459 (42.9)	2801 (43.4)	658 (41.0)
Obese: n (%)		5738 (24.3)	2080 (25.8)	1634 (25.3)	446 (27.8)
Whole body impedance: median (IQR)	31,831	597 (534, 665)	596 (532, 662.5)	597 (533, 663)	592 (530, 662)
Waist Hip Ratio: median (IQR)	32,696	0.88 (0.81, 0.94)	0.88 (0.81, 0.95)	0.88 (0.81, 0.94)	0.89 (0.82, 0.95)
Pulse wave Arterial Stiffness index: median (IQR)	32,445	9.33 (7.3, 11.34)	9.44 (7.35, 11.46)	9.44 (7.36, 11.47)	9.43 (7.25, 11.41)
Current Smoking	32,728				
No: n (%)		22263 (91.3)	7468 (89.4)	5996 (89.8)	1472 (87.9)
Yes: n (%)		1500 (6.2)	663 (7.9)	507 (7.6)	156 (9.3)
Occasionally: n (%)		616 (2.5)	218 (2.6)	172 (2.6)	46 (2.7)
Past smoking	30,460				
Smoked on most or all days: n (%)		6075 (26.6)	2034 (26.6)	1631 (26.5)	403 (26.7)
Smoked occasionally: n (%)		3349 (14.7)	1113 (14.5)	886 (14.4)	227 (15.0)
Just tried once or twice: n (%)		3655 (16.0)	1160 (15.1)	951 (15.5)	209 (13.8)
I have never smoked: n (%)		9721 (42.6)	3353 (43.8)	2680 (43.6)	673 (44.5)
Any smoker in household	30,528				
No: n (%)		20643 (90.3)	6841 (89.1)	5481 (88.9)	1360 (89.8)
Yes: n (%)		2207 (9.7)	837 (10.9)	682 (11.1)	155 (10.2)
Estimated daily nutrient intake					
Total energy: median (IQR)	21,075	8458 (7006, 10137)	8439 (6897, 10110)	8434 (6934, 10111)	8449 (6739, 10082)
Total carotene: median (IQR)	21,075	2524 (1192, 4312)	2505 (1103, 4270)	2546 (1140, 4292)	2322 (917, 4058)
Total Retinol: median (IQR)	20,757	294 (193, 414)	282 (184, 411)	282 (184, 412)	283 (181, 408)
Total Vitamin C: median (IQR)	21,075	129 (78, 195)	128 (74, 194)	130 (76, 194)	122 (71, 189)
Total Vitamin E: median (IQR)	21,075	8.43 (6.14, 11.28)	8.27 (5.93, 11.27)	8.33 (6, 11.31)	8.03 (5.65, 10.94)
Average monthly number of alcoholic drinks: median (IQR)	7,753	3 (1, 6)	3 (1, 5)	3 (1, 5)	2 (0, 6)
Number of days/week of moderate/vigorous physical exercise: median (IQR)	32,020	4 (2, 5)	4 (2, 6)	4 (2, 6)	4 (2, 6)
Medications					
Systemic hypertension: n (%)	32,562	5570 (22.9)	2130 (25.7)	1674 (25.3)	456 (27.5)
Hypercholesterolaemia: n (%)	32,562	5044 (20.8)	1876 (22.7)	1509 (22.8)	367 (22.1)
Medical History					
Cancer: n (%)	32,797	2393 (9.8)	871 (10.4)	687 (10.3)	184 (11.0)
Diabetes: n (%)	25,647	1385 (7.3)	595 (8.8)	461 (8.5)	134 (10.0)
Cardiovascular and cerebrovascular disease: n (%)	25,647	7601 (40.2)	2866 (42.6)	2280 (42.3)	586 (43.9)
Depression: n (%)	25,647	1312 (6.9)	476 (7.1)	383 (7.1)	93 (7.0)

Current Smoking	32,728				
No: n (%)		22263 (91.3)	7468 (89.4)	5996 (89.8)	1472 (87.9)
Yes: n (%)		1500 (6.2)	663 (7.9)	507 (7.6)	156 (9.3)
Occasionally: n (%)		616 (2.5)	218 (2.6)	172 (2.6)	46 (2.7)
Past smoking	30,460				
Smoked on most or all days: n (%)		6075 (26.6)	2034 (26.6)	1631 (26.5)	403 (26.7)
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Just tried once or twice: n (%)		3655 (16.0)	1160 (15.1)	951 (15.5)	209 (13.8)
I have never smoked: n (%)		9721 (42.6)	3353 (43.8)	2680 (43.6)	673 (44.5)
Any smoker in household	30,528				
No: n (%)		20643 (90.3)	6841 (89.1)	5481 (88.9)	1360 (89.8)
Yes: n (%)		2207 (9.7)	837 (10.9)	682 (11.1)	155 (10.2)
Estimated daily nutrient intake					
Total energy: median (IQR)	21,075	8458 (7006, 10137)	8439 (6897, 10110)	8434 (6934, 10111)	8449 (6739, 10082)
Total carotene: median (IQR)	21,075	2524 (1192, 4312)	2505 (1103, 4270)	2546 (1140, 4292)	2322 (917, 4058)
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Total Vitamin C: median (IQR)	21,075	129 (78, 195)	128 (74, 194)	130 (76, 194)	122 (71, 189)
Total Vitamin E: median (IQR)	21,075	8.43 (6.14, 11.28)	8.27 (5.93, 11.27)	8.33 (6, 11.31)	8.03 (5.65, 10.94)
Average monthly number of alcoholic drinks: median (IQR)	7,753	3 (1, 6)	3 (1, 5)	3 (1, 5)	2 (0, 6)
Number of days/week of moderate/vigorous physical exercise: median (IQR)	32,020	4 (2, 5)	4 (2, 6)	4 (2, 6)	4 (2, 6)
Medications					
Systemic hypertension: n (%)	32,562	5570 (22.9)	2130 (25.7)	1674 (25.3)	456 (27.5)
Hypercholesterolaemia: n (%)	32,562	5044 (20.8)	1876 (22.7)	1509 (22.8)	367 (22.1)
Medical History					
Cancer: n (%)	32,797	2393 (9.8)	871 (10.4)	687 (10.3)	184 (11.0)
Diabetes: n (%)	25,647	1385 (7.3)	595 (8.8)	461 (8.5)	134 (10.0)
Cardiovascular and cerebrovascular disease: n (%)	25,647	7601 (40.2)	2866 (42.6)	2280 (42.3)	586 (43.9)
Depression: n (%)	25,647	1312 (6.9)	476 (7.1)	383 (7.1)	93 (7.0)

Supplementary Table 3 legend: Baseline characteristics for the cases and controls

Table 4:

Variable	Univariate - compared to Controls		Multivariable* - compared to Controls	
	Association with Monocular Visual Impairment Relative Risk Ratio - RRR (95% CI)	Association with Binocular Visual Impairment Relative Risk Ratio - RRR (95% CI)	Association with Monocular Visual Impairment Relative Risk Ratio - RRR (95% CI)	Association with Binocular Visual Impairment Relative Risk Ratio - RRR (95% CI)
Age (per decade) ^{##}	1.12 (1.08, 1.16)	1.18 (1.1, 1.26)	1.13 (1.09, 1.17)	1.24 (1.15, 1.33)
Sex (compared to male)				
Female	0.98 (0.93, 1.04)	1.02 (0.92, 1.13)	0.97 (0.92, 1.03)	1.01 (0.92, 1.12)
Ethnic Group (compared to White) ^{##}				
Asian or Asian British	1.07 (0.92, 1.25)	1.27 (0.97, 1.64)	1.07 (0.92, 1.25)	1.21 (0.93, 1.58)
Black or Black British	1.03 (0.9, 1.17)	1.45 (1.18, 1.79)	1.01 (0.88, 1.15)	1.29 (1.04, 1.6)
Other ethnic group	0.98 (0.79, 1.21)	1.71 (1.25, 2.33)	0.95 (0.77, 1.18)	1.53 (1.12, 2.09)
Townsend deprivation score quintiles (compared to quintile 1 = least deprived) ^{##}				
2	1.03 (0.94, 1.13)	1.07 (0.89, 1.29)	1.03 (0.94, 1.13)	1.08 (0.9, 1.3)
3	1.07 (0.98, 1.18)	1.11 (0.92, 1.33)	1.08 (0.98, 1.18)	1.11 (0.93, 1.33)
4	1.07 (0.98, 1.17)	1.26 (1.06, 1.49)	1.08 (0.99, 1.18)	1.26 (1.06, 1.49)
5 - most deprived	1.22 (1.12, 1.33)	1.85 (1.57, 2.17)	1.25 (1.14, 1.36)	1.84 (1.56, 2.17)
Employment (compared to Paid / Self-employment / Student) ^{##}				
Retired	1.09 (1.03, 1.16)	1.17 (1.06, 1.31)		
Unable to work / Unemployed / Carer / Voluntary Work	1.28 (1.16, 1.41)	1.77 (1.5, 2.09)		
BP diastolic (per increase 1)	0.999 (0.996, 1.001)	0.999 (0.995, 1.004)		
BP systolic (per increase 1) ^{##}	1.001 (1.000004, 1.003)	1.003 (1.001, 1.006)		
BMI category (compared to normal / underweight) [#]				
Overweight	1.02 (0.96, 1.09)	0.97 (0.86, 1.09)		
Obese	1.07 (0.99, 1.15)	1.18 (1.03, 1.34)		
Whole body impedance (per increase 100)	0.995 (0.97, 1.03)	0.95 (0.9, 1.01)		
Waist Hip Ratio (per increase 0.1) ^{##}	1.04 (1.01, 1.07)	1.14 (1.08, 1.2)		
Pulse wave Arterial Stiffness index (per increase 1)	1.003 (0.997, 1.01)	1.002 (0.99, 1.01)		
Current Smoking (compared to No) ^{##}				
Yes	1.25 (1.13, 1.39)	1.57 (1.32, 1.87)		
Occasionally	1.04 (0.87, 1.23)	1.13 (0.83, 1.53)		
Past smoking (compared to smoked on most or all days)				
Smoked occasionally	0.99 (0.9, 1.08)	1.02 (0.86, 1.21)		
Just tried once or twice	0.97 (0.89, 1.06)	0.86 (0.73, 1.02)		
I have never smoked	1.03 (0.96, 1.1)	1.04 (0.92, 1.19)		
Smoker in household (compared to No) ^{##}				
Yes	1.16 (1.06, 1.27)	1.07 (0.9, 1.27)		
Estimated daily nutrient intake				
Total energy (per increase 1)	0.999997 (0.99998, 1.00001)	0.99998 (0.99996, 1.00001)		
Total carotene (per increase 1)	1.000001 (0.99999, 1.00001)	0.99998 (0.99996, 1.00001)		
Total Retinol (per increase 1) [#]	0.9998 (0.9996, 1.00001)	0.9997 (0.9993, 1.0001)		
Total Vitamin C (per increase 1)	1.0001 (0.9998, 1.0004)	0.9996 (0.9989, 1.0003)		
Total Vitamin E (per increase 1)	1.001 (0.994, 1.008)	0.99 (0.97, 1.0001)		
Average monthly number of alcoholic drinks (per increase 1)	0.995 (0.98, 1.01)	0.99 (0.96, 1.01)		
Number of days / week of moderate / vigorous physical exercise (per increase 1)	1.004 (0.99, 1.02)	1.02 (0.998, 1.04)		
Medications (compared to none)				
Systemic hypertension ^{##}	1.14 (1.07, 1.21)	1.27 (1.14, 1.42)		
Hypercholesterolaemia ^{##}	1.13 (1.05, 1.2)	1.08 (0.96, 1.22)		
Medical History (compared to none)				
Cancer	1.06 (0.97, 1.15)	1.14 (0.97, 1.33)		
Diabetes ^{##}	1.18 (1.06, 1.32)	1.41 (1.17, 1.7)		
Cardiovascular and cerebrovascular disease ^{##}	1.09 (1.03, 1.16)	1.16 (1.04, 1.3)		
Depression	1.03 (0.91, 1.15)	1 (0.81, 1.25)		

[#] Univariate association with Visual Impairment at 10% level - included in initial multivariable model

^{##} Univariate association with Visual Impairment at 5% level - included in initial multivariable model

^{*} Those variables identified as associated univariately (<10% level) were included in a multivariable model and remained in model if significantly associated at 5% level. As cases were matched by age, sex and ethnic group, these variables were included in the multivariable model irrespective of their association.

Past smoking (compared to smoked on most or all days)		
Smoked occasionally	0.99 (0.9, 1.08)	1.02 (0.86, 1.21)
Just tried once or twice	0.97 (0.89, 1.06)	0.86 (0.73, 1.02)
I have never smoked	1.03 (0.96, 1.1)	1.04 (0.92, 1.19)
Smoker in household (compared to No) ^{##}		
Yes	1.16 (1.06, 1.27)	1.07 (0.9, 1.27)
Estimated daily nutrient intake		
Total energy (per increase 1)	0.999997 (0.99998, 1.00001)	0.99998 (0.99996, 1.00001)
Total carotene (per increase 1)	1.000001 (0.99999, 1.00001)	0.99998 (0.99996, 1.00001)
Total Retinol (per increase 1) [#]	0.9998 (0.9996, 1.00001)	0.9997 (0.9993, 1.0001)
Total Vitamin C (per increase 1)	1.0001 (0.9998, 1.0004)	0.9996 (0.9989, 1.0003)
Total Vitamin E (per increase 1)	1.001 (0.994, 1.008)	0.99 (0.97, 1.0001)
Average monthly number of alcoholic drinks (per increase 1)	0.995 (0.98, 1.01)	0.99 (0.96, 1.01)
Number of days / week of moderate / vigorous physical exercise (per increase 1)	1.004 (0.99, 1.02)	1.02 (0.998, 1.04)
Medications (compared to none)		
Systemic hypertension ^{##}	1.14 (1.07, 1.21)	1.27 (1.14, 1.42)
Hypercholesterolaemia ^{##}	1.13 (1.05, 1.2)	1.08 (0.96, 1.22)
Medical History (compared to none)		
Cancer	1.06 (0.97, 1.15)	1.14 (0.97, 1.33)
Diabetes ^{##}	1.18 (1.06, 1.32)	1.41 (1.17, 1.7)
Cardiovascular and cerebrovascular disease ^{##}	1.09 (1.03, 1.16)	1.16 (1.04, 1.3)
Depression	1.03 (0.91, 1.15)	1 (0.81, 1.25)

[#] Univariate association with Visual Impairment at 10% level - included in initial multivariable model

^{##} Univariate association with Visual Impairment at 5% level - included in initial multivariable model

[∇] Those variables identified as associated univariately (<10% level) were included in a multivariable model and remained in model if significantly associated at 5% level. As cases were matched by age, sex and ethnic group, these variables were included in the multivariable model irrespective of their association.

Supplementary Table 4 legend: Associations with monocular or binocular visual impairment by univariate and multivariable logistic regression analysis

Table 5:

Primary diagnosis	Monocular visual impairment (n=1684)		Binocular visual impairment - better seeing eye (n=406)		Binocular visual impairment - worse seeing eye (n=406)	
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
Amblyopia	218	12.9 (11.3,14.5)	4	1 (0.0,0.2)	8	2 (0.6,3.4)
ARMD	25	1.5 (0.9,2.1)	8	2 (0.6,3.4)	6	1.5 (0.3,2.7)
Cannot grade	3	0.2 (0,0.4)	3	0.7 (-0.1,1.5)	5	1.2 (0.1,2.3)
Cataract	255	15.1 (13.4,16.8)	78	19.2 (15.4,23.0)	71	17.5 (13.8,21.2)
Diabetic retinopathy	2	0.1 (-0.1,0.3)	2	0.5 (-0.2,1.2)	3	0.7 (-0.1,1.5)
Glaucoma	10	0.6 (0.2,1.0)	3	0.7 (-0.1,1.5)	4	1 (0.0,2.0)
Inherited retinal disease	7	0.4 (0.1,0.7)	3	0.7 (-0.1,1.5)	4	1 (0.0,2.0)
Myopic degeneration	12	0.7 (0.3,1.1)	2	0.5 (-0.2,1.2)	1	0.2 (-0.2,0.6)
None identified	822	48.8 (46.4,51.2)	202	49.8 (44.9,54.7)	199	49 (44.1,53.9)
Uncorrected refractive error	215	12.8 (11.2,14.4)	80	19.7 (15.8,23.6)	76	18.7 (14.9,22.5)
Other media opacity	20	1.2 (0.7,1.7)	5	1.2 (0.1,2.3)	0	0
Other retinal or optic nerve pathology	19	1.1 (0.6,1.6)	2	0.5 (-0.2,1.2)	9	2.2 (0.8,3.6)
Other retinal vascular disease	11	0.7 (0.3,1.1)	2	0.5 (-0.2,1.2)	2	0.5 (-0.2,1.2)
Retinal detachment	5	0.3 (0.0,0.6)	0	0	1	0.2 (-0.2,0.6)
Vitreo-retinal interface abnormalities	60	3.6 (2.7,4.5)	12	3 (1.3,4.7)	17	4.2 (2.2,6.2)

Supplementary Table 5 legend: Primary diagnoses leading to monocular and binocular visual impairment