SCIENTIFIC CORRESPONDENCE

Associations of selected medications and visual function: the Beaver Dam Eye Study

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Aim: To investigate association of drug use and visual function.

Methods: A cross sectional population based study was carried out on participants in the 1993–5 examination phase of the Beaver Dam Eye Study. All drugs in current use by study participants were recorded. Performance based and self assessed visual functions were obtained at the time of the study evaluation. The main outcome measure was the relation of levels of visual functions by use of specific drugs.

Results: Many classes of drugs were associated with decreases in at least two performance based visual functions. For example, high blood pressure drugs were significantly associated with poorer best corrected visual acuity, poorer near vision, and poorer contrast sensitivity ($p < 0.001$ for all). Patterns of association for self assessed visual functions were not as strong. However, use of glaucoma drops and benzodiazepines were associated with poorer self assessed visual functions in most circumstances cited.

Conclusions: Many commonly used medications are inversely associated with visual functions in a middle and older aged population. This may influence the ability to perform complex tasks and quality of life.

Normal visual function results from a complicated series of neural pathways resulting in detection, tracking, and recognition of stimuli. It can be disturbed in many ways, including factors that interfere with perceiving visual stimuli, integrating them, and interpreting them. Most commonly used measures of visual function are psychophysical so that even in the presence of intact anatomy and physiology, measured visual function may not be optimal. Drugs have been evaluated as potential risk factors associated with specific age related eye diseases.^{1–4} However, it is possible that drugs may alter results of performance based visual function tests and self assessed visual function without obvious evidence of ocular disease. We explored this possibility in data from the Beaver Dam Eye Study.

METHODS

The Beaver Dam Eye Study is a population based study of age related ocular disorders. A private census was conducted to identify all people between the ages of 43–84 years who were residents of the city or township of Beaver Dam, WI, USA, in 1987–8.⁵ Of the 5925 eligible people identified, 4926 (83.1%) were examined during the baseline examination (1988–90), 225 (3.8%) died before examination, 91 (1.5%) had moved out of the area, 23 (0.4%) could not be located, 269 (4.5%) completed a questionnaire only, and 391 (6.6%) refused to participate. Non-participants were older than participants.^{6–9}

During 1993–5, a 5 year follow up examination of the cohort was conducted using the same methodology as the first

examination.¹⁰ Of the 4541 people surviving to the beginning of the 1993–5 period, 3684 (81.1%) actually participated in the follow up examination, in addition to 38 who failed to participate in the baseline examination. Of the 857 not participating, 423 (9.3%) refused to participate, 259 (5.7%) completed a questionnaire only, 171 (3.8%) died before examination, and four people could not be located. Surviving participants who were not re-examined in the follow up eye study ($n=686$) were older, had less education, lower income, poorer visual acuity, were more likely to have a history of cardiovascular disease, and smoked more at baseline than participants in the 5 year follow up examination.¹⁰ Procedures at the follow up were the same as at the baseline examination. Details are summarised below.

A refraction was performed for each eye and the best corrected visual acuity was measured according to an adaptation of the Early Treatment of Diabetic Retinopathy Study Protocol.¹¹ Near vision was measured using a specified protocol with appropriate correction in place.¹¹ Pelli-Robson letter charts were used to measure contrast sensitivity.¹²

During the interview, we asked a series of questions related to visual function. First, we asked about vision in general with the following possible responses: excellent, very good, good, fair, poor, or don't know.¹¹ Thereafter, the following specific questions were asked: "When wearing glasses (if you need them), how much of the time does your vision limit you in the following areas: (1) reading small print like the telephone book or the classified ads?, (2) reading regular print like in a newspaper, magazine, recipe, menu, or numbers on the telephone?, (3) reading road signs (such as speed limit signs) or counting pins at the end of a bowling alley?, (4) recognising people or objects across the street (can you tell the features of their face)?" The participant selected a response of "none," "little," "some," "most," "all," or "don't know" for each of the four questions. The participant was then asked "Do you drive at night?" If the response was "no," the participant was asked "Is this because of your vision?" If the response was "yes" or "don't know," the participant was asked "When you drive at night, about how much of the time are you limited by your vision?" The participant selected a response for this question of "none," "little," "some," "most," "all," or "don't know."

The questionnaire was administered at each examination. Participants were asked to bring to the examination all medications (prescription and over the counter) that they were regularly taking. The study examiner listed all medications that were brought to the examination. When participants failed to bring all their medications, a follow up phone call was made to obtain the missing information. Only data on current use at the second examination are reported because this was the first examination at which some of the visual function data were available. In addition, during the medical interview subjects were asked whether a doctor had ever told them that they had diabetes or high blood pressure, as well as some other conditions.

Ocular evaluation included measurement of pupil size with a hand held template in ambient illumination, pupillary dilatation if it was judged to be safe to do so, and standardised

Table 1 Performance based visual functions in the better eye by drug use. The Beaver Dam Eye Study, 1993–5

	Taking	No	Good	Fair	Poor	p Value*
Best corrected visual acuity						
High blood pressure medication	No	2047	82.27	14.85	2.88	
	Yes	1558	68.49	23.75	7.77	<0.001
Barbiturates	No	3564	76.32	18.71	4.97	
	Yes	57	70.18	14.04	15.79	0.099
Antidepressant	No	3421	77.58	17.74	4.68	
	Yes	200	53.00	34.00	13.00	<0.001
Antipsychotic	No	3556	76.66	18.45	4.89	
	Yes	65	52.31	29.23	18.46	<0.001
Antianxiety	No	3292	77.34	17.95	4.71	
	Yes	329	65.05	25.53	9.42	0.011
Benzodiazepines	No	3287	77.43	17.95	4.62	
	Yes	334	64.37	25.45	10.18	0.004
Glaucoma drops	No	3511	77.02	18.17	4.81	
	Yes	108	51.85	32.41	15.74	0.039
Narcotic analgesic	No	3495	76.77	18.51	4.72	
	Yes	127	60.63	22.05	17.32	<0.001
Aspirin	No	2188	75.46	19.01	5.53	
	Yes	1430	77.34	18.11	4.55	<0.001
Cardiac medication	No	3435	77.55	17.79	4.66	
	Yes	186	51.61	34.41	13.98	0.134
Oral hypoglycaemics	No	3467	76.55	18.40	5.05	
	Yes	155	68.39	23.87	7.74	0.966
Insulin	No	3512	76.99	18.31	4.70	
	Yes	110	50.91	29.09	20.00	<0.001
Multivitamins	Never	995	78.39	16.98	4.62	
	Past	896	77.46	17.63	4.91	0.205
	Current	1716	74.65	19.99	5.36	
Near visual acuity						
High blood pressure medication	No	2030	82.61	11.03	6.35	
	Yes	1542	69.33	16.99	13.68	<0.001
Barbiturates	No	3530	76.91	13.63	9.46	
	Yes	57	70.18	10.53	19.30	0.185
Antidepressant	No	3395	77.70	13.17	9.13	
	Yes	192	60.94	20.83	18.23	<0.001
Antipsychotic	No	3529	77.16	13.32	9.52	
	Yes	58	55.17	29.31	15.52	0.022
Antianxiety	No	3262	78.20	12.88	8.92	
	Yes	325	62.77	20.62	16.62	<0.001
Benzodiazepines	No	3262	78.14	12.91	8.95	
	Yes	325	63.38	20.31	16.31	<0.001
Glaucoma drops	No	3482	77.46	13.33	9.22	
	Yes	103	55.34	22.33	22.33	0.092
Narcotic analgesic	No	3462	77.33	13.43	9.24	
	Yes	125	62.40	17.60	20.00	0.005
Aspirin	No	2162	76.97	13.23	9.81	
	Yes	1422	76.51	14.14	9.35	0.055
Cardiac medication	No	3405	78.30	12.75	8.96	
	Yes	182	48.90	29.12	21.98	0.011
Oral hypoglycaemics	No	3434	77.34	13.34	9.32	
	Yes	153	64.71	18.95	16.34	0.132
Insulin	No	3479	77.52	13.31	9.17	
	Yes	108	53.70	22.22	24.07	<0.001
Multivitamins	Never	991	76.79	14.13	9.08	
	Past	887	78.58	14.09	7.33	0.709
	Current	1694	76.21	13.05	10.74	
Contrast sensitivity						
High blood pressure medication	No	2008	82.12	10.71	7.17	
	Yes	1485	65.99	19.12	14.88	<0.001
Barbiturates	No	3449	75.36	14.32	10.32	
	Yes	55	69.09	10.91	20.00	0.292
Antidepressant	No	3327	75.74	14.19	10.07	
	Yes	177	66.10	15.82	18.08	0.064
Antipsychotic	No	3452	75.32	14.31	10.37	
	Yes	52	71.15	11.54	17.31	0.825
Antianxiety	No	3195	76.37	13.65	9.98	
	Yes	309	63.75	20.71	15.53	0.041
Benzodiazepines	No	3201	76.26	13.62	10.12	
	Yes	303	64.69	21.12	14.19	0.120
Glaucoma drops	No	3404	76.38	13.87	9.75	
	Yes	98	37.76	27.55	34.69	<0.001
Narcotic analgesic	No	3393	75.71	14.15	10.14	
	Yes	111	61.26	18.02	20.72	0.008
Aspirin	No	2104	76.09	13.55	10.36	
	Yes	1397	73.94	15.39	10.67	0.084
Cardiac medication	No	3338	77.05	13.72	9.23	
	Yes	166	39.16	25.30	35.54	<0.001
Oral hypoglycaemics	No	3356	75.95	14.06	9.98	
	Yes	148	59.46	18.92	21.62	0.009
Insulin	No	3408	76.09	14.20	9.71	
	Yes	96	45.83	16.67	37.50	<0.001
Multivitamins	Never	974	77.21	12.83	9.96	
	Past	862	77.49	13.11	9.40	0.165
	Current	1659	73.06	15.67	11.27	

*Mantel-Haenszel adjusted for age.

Table 2 Self assessed visual function by drug use. The Beaver Dam Eye Study, 1993–5

	Taking	No	None of the time	Little or some of the time	Most or all of the time	p Value*
Vision limited when:						
Driving at night						
High blood pressure medication	No	1777	66.74	30.95	2.31	0.258
	Yes	1137	62.80	34.48	2.73	
Barbiturates	No	2878	65.25	32.35	2.40	0.207
	Yes	44	59.09	34.09	6.82	
Antidepressant	No	2799	65.56	32.12	2.32	0.013
	Yes	123	56.10	38.21	5.69	
Antipsychotic	No	2889	65.32	32.29	2.39	0.035
	Yes	33	51.52	39.39	9.09	
Antianxiety	No	2710	65.65	32.21	2.14	0.011
	Yes	212	58.96	34.43	6.60	
Benzodiazepines	No	2715	65.64	32.19	2.17	0.015
	Yes	207	58.94	34.78	6.28	
Glaucoma drops	No	2807	65.30	32.24	2.46	0.631
	Yes	68	58.82	38.24	2.94	
Narcotic analgesic	No	2843	65.28	32.33	2.39	0.294
	Yes	79	60.76	34.18	5.06	
Aspirin	No	1758	66.78	30.83	2.39	0.134
	Yes	1160	62.84	34.57	2.59	
Cardiac medication	No	2828	65.28	32.28	2.44	0.940
	Yes	94	61.70	35.11	3.19	
Oral hypoglycaemics	No	2811	65.64	31.87	2.49	0.045
	Yes	111	53.15	45.05	1.80	
Insulin	No	2859	65.13	32.35	2.52	0.450
	Yes	63	66.67	33.33	0.00	
Multivitamins	Never	858	70.51	27.86	1.63	<0.001
	Past	723	64.73	32.92	2.35	
	Current	1334	62.07	34.86	3.07	
Reading regular newsprint						
High blood pressure medication	No	2093	89.01	8.79	2.20	0.022
	Yes	1585	84.73	10.85	4.42	
Barbiturates	No	3637	87.41	9.57	3.02	0.002
	Yes	56	73.21	16.07	10.71	
Antidepressant	No	3495	87.47	9.56	2.98	0.131
	Yes	198	82.32	11.62	6.06	
Antipsychotic	No	3629	87.30	9.62	3.09	0.344
	Yes	64	81.25	12.50	6.25	
Antianxiety	No	3361	87.71	9.43	2.86	0.011
	Yes	332	81.93	12.05	6.02	
Benzodiazepines	No	3358	87.94	9.32	2.74	<0.001
	Yes	335	79.70	13.13	7.16	
Glaucoma drops	No	3516	87.83	9.36	2.82	<0.001
	Yes	113	71.68	18.58	9.73	
Narcotic analgesic	No	3564	87.49	9.71	2.81	<0.001
	Yes	130	78.46	9.23	12.31	
Aspirin	No	2243	87.52	9.23	3.25	0.882
	Yes	1446	86.65	10.37	2.97	
Cardiac medication	No	3509	87.77	9.26	2.96	0.045
	Yes	184	76.09	17.39	6.52	
Oral hypoglycaemics	No	3533	87.57	9.40	3.03	0.012
	Yes	161	78.26	16.15	5.59	
Insulin	No	3586	87.65	9.37	2.98	<0.001
	Yes	108	71.30	20.37	8.33	
Multivitamins	Never	1030	87.67	10.00	2.33	0.619
	Past	905	86.41	10.28	3.34	
	Current	1746	87.34	9.22	3.44	
Reading road signs						
High blood pressure medication	No	2090	92.54	6.36	1.10	0.129
	Yes	1577	89.41	8.69	1.90	
Barbiturates	No	3625	91.26	7.31	1.43	0.368
	Yes	57	85.96	12.28	1.75	
Antidepressant	No	3484	91.30	7.41	1.29	0.257
	Yes	198	88.89	7.07	4.04	
Antipsychotic	No	3620	91.24	7.40	1.35	0.127
	Yes	62	87.10	6.45	6.45	
Antianxiety	No	3353	91.47	7.19	1.34	0.156
	Yes	329	88.15	9.42	2.43	
Benzodiazepines	No	3349	91.61	7.26	1.13	0.002
	Yes	333	86.79	8.71	4.50	
Glaucoma drops	No	3507	91.56	7.16	1.28	0.008
	Yes	111	80.18	15.32	4.50	
Narcotic analgesic	No	3553	91.36	7.26	1.38	0.109
	Yes	129	86.05	10.85	3.10	
Aspirin	No	2233	91.54	6.90	1.57	0.971
	Yes	1445	90.59	8.17	1.25	
Cardiac medication	No	3500	91.43	7.17	1.40	0.775
	Yes	182	86.26	11.54	2.20	
Oral hypoglycaemics	No	3523	91.51	7.04	1.45	0.040
	Yes	159	83.65	15.09	1.26	
Insulin	No	3575	91.30	7.30	1.40	0.250
	Yes	107	86.92	10.28	2.80	
Multivitamins	Never	1027	92.79	6.13	1.07	0.126
	Past	905	90.50	7.62	1.88	
	Current	1737	90.56	8.06	1.38	

*Mantel-Haenszel adjusted for age.

Table 2 Continued

	Taking	No	None of the time	Little or some of the time	Most or all of the time	p Value*
Reading small print						
High blood pressure medication	No	2092	73.66	21.51	4.83	
	Yes	1585	68.39	23.26	8.34	0.056
Barbiturates	No	3633	71.70	22.16	6.14	
	Yes	57	54.39	28.07	17.54	0.001
Antidepressant	No	3493	71.77	22.22	6.01	
	Yes	197	65.48	22.84	11.68	0.081
Antipsychotic	No	3627	71.66	22.08	6.26	
	Yes	63	58.73	31.75	9.52	0.149
Antianxiety	No	3359	72.64	21.49	5.86	
	Yes	331	59.21	29.91	10.88	<0.001
Benzodiazepines	No	3355	72.70	21.61	5.69	
	Yes	335	58.81	28.66	12.54	<0.001
Glaucoma drops	No	3514	72.23	22.05	5.72	
	Yes	112	55.36	26.79	17.86	0.002
Narcotic analgesic	No	3560	71.83	22.30	5.87	
	Yes	130	60.77	20.77	18.46	<0.001
Aspirin	No	2241	71.53	21.82	6.65	
	Yes	1445	71.21	22.98	5.81	0.354
Cardiac medication	No	3505	72.10	22.03	5.88	
	Yes	185	58.92	26.49	14.59	0.033
Oral hypoglycaemics	No	3529	71.83	22.10	6.06	
	Yes	161	62.73	25.47	11.80	0.026
Insulin	No	3583	72.01	21.99	6.00	
	Yes	107	52.34	30.84	16.82	<0.001
Multivitamins	Never	1029	72.59	22.25	5.15	
	Past	905	70.72	23.20	6.08	0.282
	Current	1743	71.20	21.80	7.00	
Recognising people across the street						
High blood pressure medication	No	2094	89.30	8.83	1.86	
	Yes	1579	85.18	11.21	3.61	0.146
Barbiturates	No	3632	87.58	9.80	2.62	
	Yes	56	83.93	12.50	3.57	0.619
Antidepressant	No	3494	87.86	9.67	2.46	
	Yes	194	81.44	12.89	5.67	0.039
Antipsychotic	No	3624	87.61	9.80	2.59	
	Yes	64	82.81	12.50	4.69	0.577
Antianxiety	No	3356	88.35	9.24	2.41	
	Yes	332	79.22	15.96	4.82	<0.001
Benzodiazepines	No	3352	88.63	9.13	2.24	
	Yes	336	76.49	16.96	6.55	<0.001
Glaucoma drops	No	3513	88.13	9.59	2.28	
	Yes	112	69.64	19.64	10.71	<0.001
Narcotic analgesic	No	3562	87.82	9.66	2.53	
	Yes	127	79.53	14.96	5.51	0.031
Aspirin	No	2239	88.03	9.33	2.64	
	Yes	1445	86.71	10.66	2.63	0.867
Cardiac medication	No	3507	87.97	9.52	2.51	
	Yes	181	79.01	16.02	4.97	0.385
Oral hypoglycaemics	No	3528	87.98	9.58	2.44	
	Yes	161	77.64	15.53	6.83	0.001
Insulin	No	3581	87.99	9.52	2.49	
	Yes	108	72.22	20.37	7.41	<0.001
Multivitamins	Never	1027	89.87	8.57	1.56	
	Past	904	87.39	9.85	2.77	0.005
	Current	1744	86.18	10.61	3.21	
Self reported visual function†			Excellent/very good	Good/fair	Poor	
High blood pressure medication	No	2101	14.33	74.44	11.23	
	Yes	1588	10.58	73.55	15.87	0.164
Barbiturates	No	3647	12.81	74.03	13.16	
	Yes	57	8.77	70.18	21.05	0.143
Antidepressant	No	3503	12.90	74.28	12.82	
	Yes	201	9.95	68.66	21.39	0.040
Antipsychotic	No	3637	12.76	74.15	13.09	
	Yes	67	11.94	64.18	23.88	0.293
Antianxiety	No	3370	13.00	74.36	12.64	
	Yes	334	10.18	70.06	19.76	0.044
Benzodiazepines	No	3366	13.16	74.39	12.45	
	Yes	338	8.58	69.82	21.60	0.001
Glaucoma drops	No	3528	12.81	74.35	12.84	
	Yes	113	3.54	69.03	27.43	0.004
Narcotic analgesic	No	3575	12.70	74.38	12.92	
	Yes	130	13.85	63.08	23.08	0.252
Aspirin	No	2251	13.15	74.81	12.04	
	Yes	1449	12.08	72.67	15.25	0.128
Cardiac medication	No	3517	13.25	74.18	12.57	
	Yes	187	3.21	70.05	26.74	0.001
Oral hypoglycaemics	No	3544	12.98	74.18	12.84	
	Yes	161	7.45	69.57	22.98	0.006
Insulin	No	3596	13.01	74.14	12.85	
	Yes	109	3.67	68.81	27.52	<0.001
Multivitamins	Never	1032	12.60	73.26	14.15	
	Past	906	13.25	74.06	12.69	0.320
	Current	1752	12.61	74.37	13.01	

* =Mantel-Haenszel adjusted for age. †Corresponds to the question "In general, would you say your vision was excellent, very good, good, fair, or poor?"

photographs of the lenses and retina according to protocols developed for this study. The photography and grading protocols for lens and retina for age related lesions^{13,14} have been previously reported. For these analyses, central cataract refers to nuclear cataract or posterior subcapsular or cortical cataract involving 25% or more of the central circle of the grading grid.

During the course of grading there was a continuous quality control procedure to monitor intragrader and intergrader variability. There was no evidence of marked or consistent change in variability during the course of either the prevalence or follow up studies or between the two study periods. Reproducibility of gradings using these systems has been published and was similar for intragrader and intergrader comparisons.¹⁵

Definitions

Hypertension was defined as a systolic blood pressure of 160 mm Hg or more or a diastolic blood pressure of 95 mm Hg or more at the time of the examination, or a history of hypertension and current use of medication for hypertension.

Diabetes was defined as a previous history of diabetes treated with insulin, oral hypoglycaemic agents, or diet. Newly diagnosed diabetes was defined as no previous medical history of diabetes or glycosylated haemoglobin at the baseline examination with elevated glycosylated haemoglobin¹⁶ at this, the second visit.

In analyses of performance based visual functions, we used the following categories: visual acuity/near vision (using Snellen equivalents), good refers to vision of 20/20 or better, fair refers to vision of 20/25–20/32, and poor refers to 20/40 or worse, all in the better eye; contrast sensitivity, good refers to logarithm greater than 1.55 dB, poor refers to 1.45–1.55 dB, and bad refers to less than 1.45 dB. In analyses of the self assessed functions (as described in detail previously), participants were asked how much of the time their vision limited their abilities in specific circumstances, the responses were categorised in three groups as none, little or some, and most or all of the time. For the general self reported visual function question, responses were grouped as excellent or very good, good or fair, and poor.

Statistical analyses were performed using SAS.¹⁷ Trends in proportions were tested for significance using the Mantel-Haenszel procedure.

RESULTS

There were approximately 671 different drugs preparations used in the population. We present data for only selected preparations based on number of users ($n > 50$) and on the potential for relations to visual function.

The associations of the performance based and self assessed visual functions with the drugs of interest are given in Tables 1 and 2, respectively. Use of antihypertensives, antidepressants, antipsychotics, antianxiety drugs (including benzodiazepines), benzodiazepines, glaucoma drops (excluding β blockers, which were included in analyses of all β blockers which had no effects), narcotic analgesics, cardiac glycosides, oral hypoglycaemics, and insulin were associated with decrease in at least two of the performance based measures. Use of aspirin was associated with better visual acuity. Use of sedatives (barbiturate and non-barbiturate), antidepressants, antipsychotic drugs, antianxiety drugs, benzodiazepines, glaucoma drops, narcotic analgesics, cardiac glycosides, oral hypoglycaemics, and insulin were associated with poorer self assessed visual functions in at least two categories. We did not have information about the diagnoses that prompted use of most of these drugs except for antihypertensives and hypoglycaemic agents.

Many people taking glaucoma drops were taking pilocarpine or a derivative of it ($n = 30$). People taking glaucoma drops had smaller pupils than those not taking such medications ($p < 0.001$ crude analysis, $p = 0.051$ after age adjustment).

There were 89 (2.6%) people not taking glaucoma drops who had pupil diameters of 2 mm, while 16 (14.7%) of those taking glaucoma drops had pupils of this diameter. Use of narcotic analgesics was not associated with pupil size.

No classes of drugs were associated with better self assessed visual functions in at least two categories. Confining these analyses to people who were free of central cataract or late stages of age related maculopathy did not alter the patterns of association of either performance based or self assessed visual functions with these drugs. Further subcategorisation of those taking antihypertensives by specific type of agent (for example, β blockers including those used topically as eye drops, thiazide or loop diuretics, etc) suggests that associations with visual functions were more consistent for loop diuretics (data not shown). We were not able to determine whether presence of diabetes or its treatment explained the associations of hypoglycaemic agents to visual functions.

DISCUSSION

We found significant associations of visual functions with several drugs or classes of drugs. Most of these are used for psychotropic disorders. One might anticipate that drugs result in poor performance on psychophysical functions. An effect of lorazepam, a benzodiazepine, on visual perception has been reported.¹⁸ McCarty *et al* have assessed the role of various psychotropic drugs on visual function and cataract in the Melbourne Visual Impairment Project.¹ They found that phenothiazines were associated with cataract, but reported no specific association of psychotropic medications with vision. Nearly all neuroleptic (antipsychotic) drugs decrease motor activity and decrease interest in the environment.¹⁹ Thus, whether or not such drugs actually alter the physiology of vision, they may decrease visual perception or attention, resulting in poorer measured (and self reported) visual functions. Similar results may occur from antianxiety drugs.^{19,20}

Some antidepressants have been noted to cause sedation, blurry vision, and difficulty in concentrating. These known side effects could have an effect on visual function.^{19,20} Opioid or narcotic analgesics may produce drowsiness and "mental clouding",²¹ as may some non-narcotic analgesics. In addition, morphine may cause constriction of the pupil which may in turn decrease vision especially in conditions of decreased illumination.²¹ However, we did not find pupil size to be smaller in those taking narcotics in our population. Pupils were on average smaller in those taking drops (excluding β blockers) for glaucoma. It is plausible that this accounts for the association of glaucoma drops with the visual function.

Aside from these drugs, which have intended effects on the nervous systems, there are other widely used drugs prescribed for other reasons whose desired effects are mediated by the nervous system. β Blockers are widely used in our population, often for blood pressure control,² although some participants use drops (primarily timolol) to lower the intraocular pressure. Use of β blockers is associated with fatigue, sleep disturbances, and depression.²² These may influence performance in vision testing and this may be reported as diminished self assessed function as well.

That poorer visual functions were more common in those with glaucoma is not surprising. Average pupil size in those taking drops, aside from β blockers, for glaucoma was smaller than those not taking such medications as stated above. It is not possible in our data to sort out the relative importance of the disease from its treatment in these analyses. A limitation to our analyses is that we do not have information on duration of use. Our implicit assumption was that the effects of most of the preparations were not duration related but only reflective of visual functions at the time the medications were being used. That is why our analyses were cross sectional. We analysed the relation of these medications to change in visual function 5 years later (data not shown). We found no evidence of an association.

It is possible that dose could affect the associations we examined. We have no information to evaluate this. It is possible that some medications may interact with others to cause diminished visual functions or to counteract such effects. Because of the plethora of drugs that our participants took, the number of comparisons would be excessively large and the possibility of many chance associations high. Similarly, drugs may interact synergistically or antagonistically with systemic disorders to effect visual function. Again, because of the number of comparisons, chance may yield spurious findings. Instead, we have chosen a relatively simple approach, limiting the number of drugs to those which we hypothesised would influence visual functions and evaluating each individually. In addition, we have no measures of cognitive ability or depression, nor knowledge of the diagnoses associated with the use of many of these drugs, so that we cannot evaluate the possibility of confounding as a result of these conditions.

In conclusion, we have found significant association between the use of several drugs and visual functions in a population of older adults. These associations may be important when best possible vision is needed to perform complex or possibly dangerous tasks such as operating machinery. They may also influence vision related quality of life.

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