BMJ Open

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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2018-026163
Article Type:	Research
Date Submitted by the Author:	20-Aug-2018
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Keywords:	Depression & mood disorders < PSYCHIATRY, GERIATRIC MEDICINE, OPHTHALMOLOGY

Depressive symptoms in people with a vision impairment: A cross-sectional study to identify who is most at risk

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Word count: 4473 (exc title page, abstract, tables, footnotes and references)

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ABSTRACT

Objective: To identify the risk factors for significant depressive symptoms in people with visual impairment in England and Wales to provide information on who is most at risk and to whom support services could be targeted in future.

Design: A cross-sectional study using baseline data from a pragmatic randomised controlled trial.

Setting and Participants: 990 participants aged 18 or over attending one of fourteen low vision rehabilitation primary care optometry based clinics in South Wales or two hospital clinics in London.

Outcome measure: A score of ≥6 on the Geriatric Depression Scale (GDS-15) was classed as clinically significant depressive symptoms.

Results: In a multivariable logistic regression model, significant depressive symptoms were associated with age (adjusted odds ratio (AOR) = 0.82, 95%CI: 0.66 to 0.90, p<0.001), ethnicity (AOR non-white compared to white = 1.72, 95%CI: 1.05 to 2.81, P=0.031), number of physical illnesses (AOR for one versus no illnesses = 1.28, 95%CI: 0.77 to 2.13; two versus no illnesses = 1.96, 95%CI: 1.14 to 3.37; three or more versus no illnesses = 1.68 , 95%CI: 0.86 to 3.29, p =0.051), total number of eye conditions (AOR for two versus one condition = 0.98 , 95%CI: 0.67 to 1.43; three or more versus one condition = 0.34 , 95%CI: 0.15 to 0.75, p = 0.026), self-reported health (AOR for excellent versus poor= 0.01, 95%CI: 0.00 to 0.12; very good versus poor= 0.06, 95%CI: 0.03 to 0.13; good versus poor= 0.14, 95%CI: 0.08 to 0.24; fair versus poor= 0.28, 95%CI: 0.18 to 0.46, p<0.001) and self-reported visual functioning (AOR = 1.45, 95%CI: 1.31 to 1.61, p<0.001).

Conclusion: Younger age, a non-white ethnicity, more physical illnesses, fewer eye conditions and poorer self-reported health and visual function are risk factors for significant depressive symptoms in this population.

Trial registration: ISRCTN46824140

KEYWORDS

depression, vision impairment, sight loss, risk factor, depressive symptoms

ARTCILE SUMMARY

Strengths and Limitations of the Study

- This is the first study of risk factors for depressive symptoms in people seeking help for vision impairment in England and Wales.
- It benefits from a large sample size (n=990) and a high response rate (n=990/1323, 74.8%) which increase the generalisability of the findings.
- It examines factors which can be readily assessed by practitioners in primary care and general hospital clinics who come into contact with people with vision impairment, enabling them to be alerted to those most at risk and in need of signposting to support services.
- However, it excludes some more difficult to measure factors, such as vision specific distress, coping style and perceived social support, which may also predict depression in this population.
- The study uses a cross-sectional design so conclusions about direction of causality cannot be made.

BACKGROUND

Vison impairment impacts on all aspects of life and is associated with reduced functional ability, falls, social isolation and reduced quality-of-life.[1-3] There is also a growing awareness that it has a negative impact on mental health status too. Population based studies provide robust evidence of an association between vision impairment and depression. Typically those with a vision impairment are 2 to 3 times more likely to be depressed.[4, 5] In Britain, for example, a large survey of >13,000 older adults found that the prevalence of significant depressive symptoms in those with good vision living in the community was about 4.6% while in those with a vision impairment (<6/18) it was 13.5%.[5]

The prevalence of significant depressive symptoms is also high in those accessing rehabilitation services. Results from a study in Australia found that when screened with the two item Patient Health Questionnaire (PHQ-2), 37% of patients attending rehabilitation clinics or eye care services screened positive for depressive symptoms.[6] Here in the UK, we screened over 1000 patients attending low vision rehabilitation appointments using the Geriatric Depression Scale (GDS-15), as part of the Depression in Visual Impairment Trial (DEPVIT), a randomised controlled trial.[7] We found that 43% of patients reported significant depressive symptoms (score ≥6) and, significantly, 74.8% were not receiving any treatment for depression.[8] This finding supports previous reports that people with a vision impairment are less likely to have their depression identified than those with good vision.[9-11]

Because depression goes under-detected in this patient group, there is a need to improve routine screening. The National Institute for Health and Care Excellence (NICE), in their guidelines on 'Depression in adults with a chronic physical health problem'[12] suggest that practitioners working in primary care and general hospital clinics should be aware that patients with a chronic physical health problem, especially those with functional impairment, are at a high risk of depression. They recommend being alert to possible depression and asking two simple screening questions to detect depression.[12] Those screening positively should be referred to an appropriate professional for assessment, in most cases, the patient's General Practitioner (GP). Screening should occur in both low vision specific settings such as rehabilitation clinics, and in primary care and general clinical settings such as diabetes or stroke clinics, where vision impairment is prevalent. In busy primary care and general clinics, understanding who is most at risk of depression amongst this patient group using easy to determine factors may help clinicians to target depression screening and signpost patients to supportive services.

Previous cross-sectional studies of patients from outpatient eye clinics and low vision rehabilitation services have identified several risk factors for depression including: being female, being relatively younger in age, living alone and having lower acceptance of vision loss[13], reporting poorer self-reported health and having a history of mental health problems,[13, 14] reporting poorer vision specific functioning, higher levels of vision

specific distress, having an avoidant coping style and lower perceived adequacy of social support[14]. A longitudinal prospective cohort study of 540 patients from outpatient low vision organisations in the Netherlands and Belgium found that people who developed depressive symptoms over a two year period were more likely to be: living alone, having just enough money to cover their expenses, have macular degeneration, have problems with adaptation to vision loss, have reduced health related quality of life and be experiencing symptoms of anxiety.[15]

The above studies were conducted in the Netherlands, Belgium and Australia and we do not know if the same risk factors apply to a British population. Therefore, it is useful to examine the risk factors for depressive symptoms in people with sight loss in England and Wales, using a large sample of consecutive attendees to services. The findings will enable clinicians in primary care and general hospital clinics to allocate resources to screening those most at risk.

The aim of this study was to identify the risk factors for significant depressive symptoms in people with vision impairment attending rehabilitation clinics in England and Wales using baseline data from a randomised controlled trial of interventions for depression (DEPVIT).[7] We focused our examination mainly on characteristics which can be easily identified in routine practice for example, age and ethnicity, to provide a straightforward approach to identifying high risk patients based on readily available information.

METHODS

Study Design and Participants

This cross-sectional study was undertaken as part of the Depression in Visual Impairment Trial (DEPVIT).[7] Eligible participants were consecutive adult patients who were seeking help for vision impairment at specialist visual rehabilitation services taking part in DEPVIT. Fourteen primary care based rehabilitation services recruited participants in South Wales. Services were readily accessible high street practices, accepted self-referral and tended to cater to older adults with age-related eye conditions living in the local community. A secondary care rehabilitation clinic based at Guys and St Thomas' Hospital and an NHS outreach clinic providing low vision services in Southwark recruited participants from the London area. Access to these two specialist clinics was by referral only. All consecutive attendees aged 18 or over were considered eligible for the study, unless they lived outside the catchment area for the trial or if they had previously been screened for depression as part of the study (some people had more than one appointment during the length of the study, but we only wanted to screen them and invite them to take part once). Ethical approval was obtained from the NHS South East Wales Research Ethics Committee Panel B. All

participants provided written informed consent for their anonymised data to be used and the study adhered to the Declaration of Helsinki.

Funding and Public and Patient Involvement

The study was funded by Guide Dogs, a voluntary sector organisation who work closely with people with vision impairment and understand their experiences and preferences. They carried out a review prior to funding to ensure the research questions were relevant and the study design appropriate. Patients with a vision impairment reviewed and provided feedback on the depression questionnaire. Patients were not involved in the recruitment to or conduct of the study.

Measures

Depression

The Geriatric Depression Scale (GDS-15)[16] is one of the most widely used instruments for the screening of depression in older adults. The questionnaire has 15 questions and completion time is approximately 5 minutes. Possible scores range from 0 to 15, with higher scores indicating a greater number of depressive symptoms. We chose to use dichotomous categories rather than the continuous scale as this reflects the scale's use in clinical practice as a screening tool to identify those who warrant further investigation. We used the conventional scoring approach rather than Rasch analysis to facilitate direct comparison with published studies and to facilitate clinically valid results. A score of 6 or more was taken to be indicative of significant depressive symptoms[5].

Risk Factors

We recorded gender, age, ethnicity (White, Asian/Asian British, Black/Black British or Other), physical illness (number and type) and ocular diagnosis (number and type of eye conditions), factors which would be readily available to clinicians working with people with sight loss and have been considered in previous studies.

We also measured self-reported general health as this has consistently been shown to be a risk factor for depression[6, 13-15] and can be easily measured using a single item question from the SF-12, "In general, would you say your overall health is: excellent, very good, good, fair or poor?". The question has had widespread use as a single-item measure, including in previous studies of visual impairment and depression[5, 14] and has shown to be significantly and independently associated with specific health problems, use of health services, changes in functional status, recovery from episodes of ill health, mortality, and sociodemographic characteristics of respondents.[17]

To provide information on vision related factors for low vision practitioners who have access to this information, we also measured visual acuity (corrected binocular vision using ETDRS LogMAR) and recorded

time since vision loss in years. As previous studies have found no evidence of an association between objective measures of visual acuity and depression[13-15], we were interested to see whether a subjective measure of visual function would be associated. Self-reported visual functioning was measured using the 7 item National Eye Institute Visual Function Questionnaire (NEI-VFQ 7) which includes a subset of questions from the National Eye Institute Visual Function Questionnaire that have previously been shown to be responsive to rehabilitation service intervention.[18] As the NEI-VFQ 7 is commonly reported in the published literature with Rasch analysis, we transformed the Likert responses using the Rasch derived scoring key provided by Ryan et al (2008)[18] to calculate a score for each completed questionnaire. Questionnaires with 3 or more missing items were counted as missing and excluded from the analysis.

Procedures

Participants who were eligible to take part in the study were sent a questionnaire in large print format containing the GDS-15, NEI-VFQ 7 and single-item question about health, along with their appointment letter at least one week before their low vision assessment. They were asked to complete the questionnaire at home, with assistance if needed, and to bring it along to their appointment. Those who did not return a completed questionnaire were given the opportunity to complete another copy at the clinic, before their appointment. The low vision practitioner reviewed the participant's responses with them at the start of the assessment and asked for their written consent to use their anonymised responses in the study. For those who consented, information on gender, date of birth, ethnicity, physical illness, primary ocular diagnosis, corrected ETDRS Log MAR acuity and time since vision loss first identified were recorded on a Case Report Form (CRF). Those who screened positive for depressive symptoms (GDS-15 score of ≥6) were offered entry to the DEPVIT trial if eligible, or a referral to their GP if not eligible.[19]

Case Report Forms completed by the clinicians were sent to the research coordinating centre at Cardiff University by secure FAX where the validity and completeness of the data was checked. Any missing or out of range data were queried with the practitioner and checked with clinical notes. Five percent of all CRFs and surveys were double entered. The error rate was less than 2% and identified errors were corrected. The number of eligible patients who did not complete the survey and the number who did not consent for their data to be used for research purposes were also recorded. The final dataset was then locked and transferred to the statistical team for analysis. The descriptive statistics were tabulated using SPSS Version 23 and the regression models were fitted using STATA Version 13.1.

Statistical analysis

Participant characteristics were summarised for those with significant depressive symptoms (GDS-15 ≥6) and those without (GDS-15 <6). Categorical variables were summarised as numbers and percentages and

continuous variables as medians with interquartile ranges. In all cases we report the number of participants for whom data was missing.

Where the GDS-15 was not fully completed, completed answers were totalled to give a final score provided that the number of questions not answered was 2 or less[5]. If 3 or more questions were unanswered, the GDS-15 data were regarded as missing and the participant excluded from the analysis.

Logistic regression was used to determine the independent relationship between each of the potential risk factors and significant depressive symptoms. The potential risk factors were initially included individually (univariable analysis) and then entered into a multivariable logistic regression analyses in blocks to determine which variables remain associated with significant depressive symptoms after controlling for the other factors. The events-per-variable was sufficient to allow inclusion of all potential risk factors, so no selection was required.[20] However, due to co-linearity, it was not possible to include both number and type of physical illnesses or both number and type of eye conditions. Therefore, a decision was made to include only number of illnesses and eye conditions, as it was hypothesized that burden of multiple diagnoses would be more important than type of diagnosis: those with multiple morbidity are at twice the risk of depression than those without multiple morbidity.[21] The variables were entered into the analysis in blocks, starting with the risk factors which could be most easily identified in routine clinics, and ending with those requiring more time or adaptation to practice to assess. The blocks were: 1) Demographics (gender/age/ethnicity), 2) Demographics and Physical Health (number of illnesses), 3) Demographics, Physical health and Eye health (number of eye conditions/visual acuity/time since vision loss), 4) Demographics, Physical Health, Eye health and Self-report measures (self-report health/visual functioning). We calculated the area under the ROC curve to quantify the overall ability of each (additional) block of variables to correctly discriminate between those with and without depression.

RESULTS

A total of 1323 consecutive adult patients attended the low vision rehabilitation clinics during the 30 month recruitment period. Of these, 312 were not screened for depression because the practitioner felt it was inappropriate at the time (because the patient was too ill, had dementia or was recently bereaved); or the patient had forgotten to complete the questionnaire and there was no time at the assessment; or they did not consent for their data to be used for research. An additional 21 patients had 3 or more missing items on the GDS-15 and were excluded, leaving a final sample size of 990 and a complete response rate of 74.8%. The median age of the participants was 79.0 years (IQR= 66.0 to 85.0), 62.2% were female (n=616) and 85% were white (n= 842). The overall prevalence of significant depressive symptoms was 42.5%. This varies very

slightly from our previously reported study (43%)[8] due to the methodology used in this study to calculate the total GDS-15 score (excluding those with ≥3 missing items).

Tables 1-4. outline the demographics characteristics of the participants, their physical health measures, eye health measures and self-report health and vision measures respectively, split by those with and without significant depressive symptoms.

Demographic Characteristics	**GDS-15 Score <6**	**GDS-15 Score ≥6**	**Total**
Total Sample, n (%)	569 (57.5%)	421 (42.5%)	990 (100%)
Gender, n (%)			
Male	201 (53.7%)	173 (46.3%)	374 (100%)
Female	368 (59.7%)	248 (40.3%)	616 (100%)
Data missing	0	0	0
Age (years), Median (IQR)	80.0 (72.0, 86.0)	77.0 (57.0, 85.0)	79.0 (66.0, 85.0)
Data missing, n (%)	22 (52.4%)	20 (47.6%)	42 (100%)
Ethnicity, n (%)			
White	508 (60.3%)	334 (39.7%)	842 (100%)
Asian/Asian/British	12 (52.2%)	11 (47.8%)	23 (100%)
Black/Black British	40 (38.5%)	64 (61.5%)	104 (100%)

Other ethnic group Data missing	9 (45%) 0 (0%)	11 (55%) 1 (100%)	20 (100%) 1 (100%)
Ethnicity (collapsed categories), n (%) White Non-White Data missing	 508 (60.3%) 61 (41.5%) 0 (0%)	 334 (39.7%) 86 (58.5%) 1 (100%)	 842 (100%) 147 (100%) 1 (100%)

Table 1. Summarises the demographic characteristics of those with and without significant depressive symptoms

Table 2. Summarises the physical health of those with and without significant depressive symptoms

Physical health	**GDS-15 Score <6**	**GDS-15 Score ≥6**	**Total**
Physical Illnesses, n (%)*			
Diabetes	119 (47.8%)	130 (52.2%)	249 (100%)
Epilepsy	8 (57.1%)	6 (42.9%)	14 (100%)
Stroke	31 (50.8%)	30 (49.2%)	61 (100%)
Thyroid	27 (47.4%)	30 (52.6%)	57 (100%)
Heart Disease	94 (50.3%)	93 (49.7%)	187 (100%)
High Blood Pressure	246 (55.5%)	197 (44.5%)	443 (100%)
Respiratory Disease	48 (59.3%)	33 (40.7%)	81 (100%)
Other	113 (48.9%)	118 (51.1%)	231 (100%)
No medical illness	113 (70.2%)	48 (29.8%)	161 (100%)
Data missing	4 (100%)	0 (0%)	4 (100%)
Total number of physical illnesses, n (%)			
0	113 (70.2%)	48 (29.8%)	161 (100%)
1	277 (60.6%)	180 (39.4%)	457 (100%)
2	127 (48.3%)	136 (51.7%)	263 (100%)
3	41 (47.7%)	45 (52.3%)	86 (100%)
4	4 (28.6%)	10 (71.4%)	14 (100%)
5	2 (50%)	2 (50%)	4 (100%)
6	1 (100%)	0 (0%)	1 (100%)
Data missing	4 (100%)	0 (0%)	4 (100%)
Total number of physical illnesses (collapsed categories), n (%)			
0	113 (70.2%)	48 (29.8%)	161 (100%)
1	277 (60.6%)	180 (39.4%)	457 (100%)
2	127 (48.3%)	136 (51.7%)	263 (100%)
3 or more	48 (45.7%)	57 (54.3%)	105 (100%)
Data missing	4 (100%)	0 (0%)	4 (100%)

** Participants may have had more than one physical illness*

Table 3. Summarises the eye health of those with and without significant depressive symptoms

Eye health	GDS-15 Score <6	GDS-15 Score ≥6	Total
Ocular Diagnosis, n (%)*			
AMD wet	117 (59.4%)	80 (40.6%)	197 (100%)
AMD dry	259 (64.6%)	142 (35.4%)	401 (100%)
Glaucoma	104 (63.0%)	61 (37%)	165 (100%)
Cataract	95 (70.4%)	40 (29.6%)	135 (100%)
Diabetic eye disease	59 (48.0%)	64 (52.0%)	123 (100%)
Other eye condition	157 (47.9%)	171 (52.1%)	328 (100%)
Data missing	1 (50%)	1 (50%)	2 (100%)
Total number of eye conditions, n (%)			
1	381 (56%)	299 (44.0%)	680 (100%)
2	153 (58.8%)	107 (41.2%)	260 (100%)
3	32 (72.7%)	12 (27.3%)	44 (100%)
4	2 (66.7%)	1 (33.3%)	3 (100%)
5	0 (0%)	1 (100%)	1 (100%)
Data missing	1 (50%)	1 (50%)	2 (100%)
Total number of eye conditions (collapsed categories), n (%)			
1	381 (56.0%)	299 (44.0%)	680 (100%)
2	153 (58.8%)	107 (41.2%)	260 (100%)
3 or more	34 (70.8%)	14 (29.2%)	48 (100%)
Data missing	1 (50%)	1 (50%)	2 (100%)
Corrected binocular visual acuity (logMar), Median (IQR)	0.60 (0.40, 0.94)	0.70 (0.50, 1.00)	0.67 (0.40, 1.0)
Data missing, n (%)	0	0	0
Years since vision loss, Median (IQR)	5.5 (2.2, 12.0)	5.0 (2.1, 10.2)	5.2 (2.2, 11.1)
Data missing, n (%)	13 (81.25%)	3 (18.75%)	16 (100%)

** Participants may have had more than one ocular diagnosis*

Table 4. Summarises the self-reported health and visual function of those with and without significant depressive symptoms

Self-report measures	GDS-15 Score <6	GDS-15 Score ≥6	Total
Self-rated health(SF-12), n (%)			
Excellent	22 (95.7%)	1 (4.3%)	23 (100%)
Very Good	93 (86.1%)	15 (13.9%)	108 (100%)
Good	201 (72.6%)	76 (27.4%)	277 (100%)
Fair	192 (52.5%)	174 (47.5%)	366 (100%)
Poor	33 (18.5%)	145 (81.5%)	178 (100%)
Data Missing	28 (73.7%)	10 (26.3%)	38 (100%)
Visual functioning (NEI VFQ-7), Median (IQR)	0.23 (-1.43, 1.46)	1.41 (0.17, 2.49)	0.78 (-0.80, 1.91)
Data missing n (%)	23 (67.6%)	11 (32.4%)	34 (100%)

The variables ethnicity, number of physical illnesses and number of eye conditions had a small number of participants in some categories, hence the categories were collapsed before being entered into the regression analysis. Both the original and collapsed categories are presented in the tables. Table 5. Summarises the results of the univariable and multivariable logistic regression using odds rations (OR) and adjusted odds ratios (AOR) and presented with 95% confidence intervals (CI) and p values.

Block	Characteristic	Univariable				Multivariable Block 1 N=947			Multivariable Block 2 N=943			Multivariable Block 3 N=926			Multivariable Block 4 N=877		
		N	OR	95% CI	P	AOR	95% CI	P	AOR	95% CI	P	AOR	95% CI	P	AOR	95% CI	P
1. Demographics	**Gender: Reference category male**																
	• Female	990	0.78	0.60 to 1.01	0.064	0.87	0.66 to 1.14	0.311	0.89	0.67 to 1.17	0.390	0.90	0.68 to 1.19	0.462	0.85	0.61 to 1.19	0.350
	Age (per decade)	948	0.82	0.74 to 0.90	<0.001	0.82	0.82 to 0.90	<0.001	0.82	0.74 to 0.90	<0.001	0.82	0.74 to 0.90	<0.001	0.82	0.66 to 0.90	<0.001
	Ethnicity: Reference category white																
	• Non-white	989	2.14	1.50 to 3.06	<0.001	1.54	1.05 to 2.27	0.027	1.64	1.10 to 2.43	0.014	1.61	1.08 to 2.40	0.020	1.72	1.05 to 2.81	0.031
2. Physical Health	**Total illnesses: Reference category 0 illness**																
	• 1 illness	986	1.53	1.04 to 2.25	<0.001				2.06	1.34 to 3.18	<0.001	2.09	1.36 to 3.24	<0.001	1.28	0.77 to 2.13	0.051
	• 2 illnesses		2.52	1.66 to 3.82					3.55	2.23 to 5.65		3.62	2.26 to 5.78		1.96	1.14 to 3.37	
	• 3 + illnesses		2.80	1.68 to 4.66					3.91	2.24 to 6.82		4.02	2.27 to 7.11		1.68	0.86 to 3.29	
3. Eye Health	**Total eye conditions: Reference category 1 cond.**																
	• 2 conditions	988	0.89	0.67 to 1.19	0.123							0.91	0.66 to 1.27	0.114	0.98	0.67 to 1.43	0.026
	• 3 + conds.		0.52	0.28 to 1.00								0.48	0.24 to 0.96		0.34	0.15 to 0.75	
	Visual acuity	990	1.01	0.99 to 1.03	0.568							1.00	0.98 to 1.03	0.929	1.00	0.97 to 1.03	0.942
	Time since vision loss (per year)	974	0.99	0.99 to 1.01	0.818							0.99	0.98 to 1.00	0.075	0.99	0.98 to 1.00	0.244
4. Self-report Measures	**Subjective Health: Reference category poor**																
	• Excellent	952	0.01	0.00 to 0.08	<0.001										0.01	0.00 to 0.12	<0.001
	• Very Good		0.04	0.02 to 0.07											0.06	0.03 to 0.13	
	• Good		0.09	0.05 to 0.14											0.14	0.08 to 0.24	
	• Fair		0.21	0.13 to 0.32											0.28	0.18 to 0.46	
	Visual Functioning	956	1.48	1.36 to 1.60	<0.001										1.45	1.31 to 1.61	<0.001
Area Under ROC Curve						0.59			0.65			0.65			0.81		

Table 5. Summaries the results of the univariable logistic regression and multivariable regression analyses, with blocks of variables added sequentially to the model.

Demographics

Table 1. Shows that those with a higher prevalence of significant depressive symptoms were male, younger or non-white. In the univariable analysis, age and ethnicity were associated with significant depressive symptoms. An increase in age was associated with lower odds of participants having depression and having ethnicity other than white was associated with higher odds of having depression (see Table 5.). These variables remain associated once other variables were controlled for in the multivariable analysis final model. There was no evidence of an association between gender and significant depressive symptoms.

Physical health

The prevalence of depression was lowest in those with no physical illness (29.8%) and highest in those with three or more illnesses (54.3% - Table 2.). In the univariable analysis, an increase in the number of physical illnesses was associated with higher odds of having significant depressive symptoms and this association remained in the multivariable final model.

Eye health

Those with a higher prevalence of depression had one eye condition, worse visual acuity or less time since vision loss (Table 3.). The univariable analysis found no evidence of an association between significant depressive symptoms and number of eye conditions, visual acuity and time since vision loss. However, when controlling for other factors in the final model, an increase in the number of eye conditions was associated with lower odds of having depression.

Self-report measures

The prevalence of depression was highest in those with poor self-rated health (81.5%) and lowest in those with excellent health (4.3%). Those with depression had worse self-rated visual functioning (Table 4.). Worse self-rated health and visual functioning were associated with higher odds of having significant depressive symptoms in both the univariable analysis and multivariable final model.

The area under the ROC curve was 0.59 when demographics alone were entered into the model, increasing to 0.65 when physical and eye health variables were considered, and reaching 0.81 when self-report measures were added.

DISCUSSION

This study identified the risk factors for significant depressive symptoms in people with vision impairment attending vision rehabilitation clinics in England and Wales. We focused mainly on risk factors which can be easily identified in primary care and general hospital clinics, so as to provide a pragmatic approach to identifying high risk patients. To inform ophthalmic clinicians who may have access to more detailed information on eye health, we also included a range of vision related variables. Our findings showed that amongst older adults, those of relatively younger age, with an ethnicity other than white, poorer physical health and poorer self-reported health and visual function had higher odds of having significant depressive symptoms. The number of eye conditions was not an independent predictor of depressive symptoms, but was related to depression when other variables were controlled: less number of eye conditions was associated with higher odds. There was no evidence that gender, time since vision loss and visual acuity were associated with depression.

With regard to demographic factors, our findings demonstrate some support for, and discrepancies with, previous studies. Whilst some studies have shown that age is not a predictor[14, 15], one recently demonstrated, as did ours, that relatively younger age was a risk factor for depression[13]. This perhaps reflects the finding in the general population that people aged 40–59 years have higher rates of depression than those aged ≥60 years[22] and those in middle-age have the highest risk[23]. The reasons for this are not clearly understood, but one theory is that by mid-life, individuals have learnt to adapt to their strengths and weaknesses, and in mid-life 'quell their infeasible aspirations' [23]. In those with vision loss, being affected in middle-age rather than old age may add to this sense of lost aspirations and could also result in more restriction in life including difficulties in finding and staying in work, playing sport etc. We included participants aged 18 and over whereas other studies included only older participants which may explain differences in findings between this and some other studies. We found that having an ethnicity other than white was a risk factor. Recent studies on vision impairment and depression have not measured ethnicity, however an earlier study conducted in New Zealand found that ethnicity was not related to depression[24]. Differences between that study and ours may be due to the different populations, with a wider variation in ethnicities in the UK and London in particular. The New Zealand study only recorded 'New Zealand born European' or 'other'. Therefore, future studies should include ethnicity as a variable to provide further clarification.

There is more consistency between studies in terms of health. We demonstrated that those with poorer self-reported health were at much higher risk of depressive symptoms. This confirms previous research in vision impaired people which has shown that poorer perceived health status[13], poorer self-reported health[14] and poorer health related quality of life[24] are all predictors of depression. This is not surprising as patients may

include their emotional health in a question about general health. Our study also found that a higher number of physical illnesses was a risk factor for depression. This is in line with findings from the non-vision impaired population. A recent meta-analysis found a substantial relationship between multimorbidity (the presence of two or more chronic physical illnesses) and depression, reporting that people with multimorbidity are at twice the risk of depression to those without multimorbidity, and nearly three times at risk compared to those with no chronic physical condition[21]. The authors suggest the relationship is bi-directional and cite the Activity Restriction Model of Depressed Affect[25] which explains that multimorbidity contributes significantly to depressive symptoms through having to give up valued activities due to physical limitations. In our sample, the limitations of conditions such as stroke and diabetes may have compounded any mobility and functional issues already caused by sight loss, which can make self-care, engaging in hobbies and getting out and about more difficult.

In terms of vision related factors, it is logical to assume that the chances of having depressive symptoms increases as visual acuity decreases. However, in line with other studies[13-15], the results of the regression analysis do not support this hypothesis. What seems to be more important is self-reported visual function: those with worse self-reported visual function are more at risk of depressive symptoms. Therefore clinicians should take care not to make assumptions about the likelihood of depression in only those with the lowest levels of vision as assessed by visual acuity. The relationship is likely to be bidirectional, with poorer visual function leading to loss of valued activities and mood, whilst lowered mood may influence a person's perception of their vision function. As with previous studies[13, 15], time since the vision loss was first identified was also not a predictor of depression, indicating that patients may develop symptoms at any point on their sight loss journey.

This research added to the literature by examining risk factors in a British sample of people with vision impairment. The study benefited from a large sample size and a high response rate, enhancing the generalisability of the findings. As we included primary and secondary care low vision rehabilitation clinics, we believe the findings are transferrable to both settings. Our study employed validated measures of depressive symptoms and incorporated risk factors which are easy to identify in primary care and hospital clinics. Therefore the results can be easily integrated in clinical practice to target screening.

However, inevitably there were some value judgements in how we chose our criteria for selecting the range of potential factors in our study. This means that other parameters which have previously been shown to be predictors of depression, for example, vision specific distress, lower perceived adequacy of social support and avoidant coping[14], were not measured and therefore cannot be included in the risk profile advice to clinicians. These parameters can only be assessed using additional questionnaires which would have

increased the overall response burden in the study and furthermore, it is unlikely that these variables would be measured in routine practice and therefore were not within the scope of our study.

We chose to dichotomise the GDS-15 to reflect how it would be used in practice, as a screening tool for identifying patients who would benefit from screening in clinic and potentially signposting to support services. However, we acknowledge that this may have led to a reduction in power and loss of information.[26] A further limitation of the study is the use of a cross-sectional design, which means conclusions about direction of causality are not possible. Finally, a number of patients were not screened at the discretion of the practitioners, including because they felt the patient was too ill, had dementia or had recently been bereaved. Given that these significant life events are associated with depression[27] and we have shown physical health to be a risk factor for depression, it is quite possible that our estimate of the prevalence of depressive symptoms is a conservative one.

For the first time, for a population in England and Wales, our study demonstrates that for patients with vision impairment, there are several risk factors for depression which can be easily identified by those coming in to contact with people with sight loss. We recommend that all clinicians working with people with sight loss are alert to these factors. We advise screening higher risk patients using the simple two question screen recommended in the NICE guidelines[12]. If a patient is identified as having likely depression they should be managed according to the guidelines, which includes referral to an appropriate professional, for example, the GP. Local pathways should be established to manage this referral. However, because the prevalence of depressive symptoms is so high in low vision clinics, we recommend that low vision practitioners introduce depression screening as part of routine care with all patients.

Future research could include qualitative work to clarify the pathway from the risk factors identified here to the onset of depression, to aid the development of interventions for depression in this population.

ACHNOWLEDGEMENTS

The authors wish to thank the following for data collection: Sandra Jumbe, Rowanne Black, Kathy Davies, Denise Banford, Ian Cousins, Huw Bellamy, Norma Davies, Ceri Goodman, Sharon Beatty, Lisa Evans, Leighton Griffiths, Matthew Harvey, David Jenkins, Jane Savage, Marek Karas, John Butler, Seema Rajoria, Rajiv Raja, Jane De Courcy, Ahalya Subramanian, Sonal Rughani and Sarah Janikoun.

FOOTNOTES

Contributors: TM, DS, RTE and MS conceived the idea for the study and acquired funding. CN project managed the study, supervised data collection, performed data cleaning, statistical analysis and wrote the first draft of the manuscript. CB and BR substantially contributed to the design of the study and to the acquisition of data. NB and RC contributed to the design of the study. DG provided statistical advice and

supervision. All authors contributed to the design of the protocol, critically reviewed the manuscript for important intellectual content and approved the final manuscript.

Funding: The work was supported by Guide Dogs grant number OR2009-07b.

Competing interests: None declared.

Patient consent: Not required – no identifiable information from a living individual included.

Ethics approval: The NHS South East Wales Research Ethics Committee Panel B approved this study.

Data sharing statement: There is no additional unpublished data from this study.

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies (Nollett et al)*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6, 7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	-
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7, 8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8
		(*e*) Describe any sensitivity analyses	-
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9, 10, 11
		(b) Indicate number of participants with missing data for each variable of interest	9, 10, 11
Outcome data	15*	Report numbers of outcome events or summary measures	9-13
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9-13
		(*b*) Report category boundaries when continuous variables were categorized	6
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	16
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	17, 18
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	16-18
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Depressive symptoms in people with a vision impairment: A cross-sectional study to identify who is most at risk

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2018-026163.R1
Article Type:	Research
Date Submitted by the Author:	07-Nov-2018
Complete List of Authors:	Nollett, Claire; Cardiff University, Centre for Trials Research Ryan, Barbara; Cardiff University, School of Optometry and Vision Sciences Bray, Nathan; Centre for Health Economics and Medicines Evaluation, Bangor University, Bunce, Catey; kings College london, School of Population and Environmental Sciences Casten, Robin; Thomas Jefferson University, Department of Psychiatry and Human Behaviour Edwards, Rhiannon; Bangor University, Centre for Health Economics & Medicines Evaluation Gillespie, David; Cardiff University, Centre for Trials Research Smith, Daniel; University of Glasgow, Institute of Health and Wellbeing Stanford, Miles; St Thomas' Hospital, Medical Eye Unit Margrain, Tom; Cardiff University, School of Optometry and Vision Sciences
Primary Subject Heading:	Ophthalmology
Secondary Subject Heading:	Mental health
Keywords:	Depression & mood disorders < PSYCHIATRY, GERIATRIC MEDICINE, OPHTHALMOLOGY

Depressive symptoms in people with a vision impairment: A cross-sectional study to identify who is most at risk

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ABSTRACT

Objective: To identify the risk factors for significant depressive symptoms in people with visual impairment in England and Wales to provide information on who is most at risk and to whom support services could be targeted in future.

Design: A cross-sectional study using baseline data from a pragmatic randomised controlled trial.

Setting and Participants: 990 participants aged 18 or over attending one of fourteen low vision rehabilitation primary care optometry based clinics in South Wales or two hospital clinics in London.

Outcome measure: A score of ≥6 on the Geriatric Depression Scale (GDS-15) was classed as clinically significant depressive symptoms.

Results: In a multivariable logistic regression model, significant depressive symptoms were associated with age (adjusted odds ratio (AOR) = 0.82, 95%CI: 0.66 to 0.90, p<0.001), ethnicity (AOR non-white compared to white = 1.72, 95%CI: 1.05 to 2.81, P=0.031), total number of eye conditions (AOR for two versus one condition = 0.98 , 95%CI: 0.67 to 1.43; three or more versus one condition = 0.34 , 95%CI: 0.15 to 0.75, p = 0.026), self-reported health (AOR for excellent versus poor= 0.01, 95%CI: 0.00 to 0.12; very good versus poor= 0.06, 95%CI: 0.03 to 0.13; good versus poor= 0.14, 95%CI: 0.08 to 0.24; fair versus poor= 0.28, 95%CI: 0.18 to 0.46, p<0.001) and self-reported visual functioning (AOR = 1.45, 95%CI: 1.31 to 1.61, p<0.001).

Conclusion: Younger age, a non-white ethnicity, fewer eye conditions and poorer self-reported health and visual function are risk factors for significant depressive symptoms in this population.

Trial registration: ISRCTN46824140

KEYWORDS

depression, vision impairment, sight loss, risk factor, depressive symptoms

ARTCILE SUMMARY

Strengths and Limitations of the Study

- This is the first study of risk factors for depressive symptoms in people seeking help for vision impairment in England and Wales.
- It benefits from a large sample size (n=990) and a high response rate (n=990/1323, 74.8%) which increase the generalisability of the findings.
- It examines factors which can be readily assessed by practitioners in primary care and general hospital clinics who come into contact with people with vision impairment, enabling them to be alerted to those most at risk and in need of signposting to support services.
- However, it excludes some more difficult to measure factors, such as vision specific distress, coping style and perceived social support, which may also predict depression in this population.
- The study uses a cross-sectional design so conclusions about direction of causality cannot be made.

BACKGROUND

Vison impairment impacts on all aspects of life and is associated with reduced functional ability, falls, social isolation and reduced quality-of-life.[1-3] There is also a growing awareness that it has a negative impact on mental health status too. Population based studies provide robust evidence of an association between vision impairment and depression. Typically those with a vision impairment are 2 to 3 times more likely to be depressed.[4 5] In Britain, for example, a large survey of >13,000 older adults found that the prevalence of significant depressive symptoms in those with good vision living in the community was about 4.6% while in those with a vision impairment (<6/18) it was 13.5%.[5]

The prevalence of significant depressive symptoms is also high in those accessing rehabilitation services. Results from a study in Australia found that when screened with the two item Patient Health Questionnaire (PHQ-2), 37% of patients attending rehabilitation clinics or eye care services screened positive for depressive symptoms.[6] Here in the UK, we screened over 1000 patients attending low vision rehabilitation appointments using the Geriatric Depression Scale (GDS-15), as part of the Depression in Visual Impairment Trial (DEPVIT), a randomised controlled trial.[7] We found that 43% of patients reported significant depressive symptoms (score ≥6) and, significantly, 74.8% were not receiving any treatment for depression.[8] This finding supports previous reports that people with a vision impairment are less likely to have their depression identified than those with good vision.[9-11]

Because depression goes under-detected in this patient group, there is a need to improve routine screening. The National Institute for Health and Care Excellence (NICE), in their guidelines on 'Depression in adults with a chronic physical health problem'[12] suggest that practitioners working in primary care and general hospital clinics should be aware that patients with a chronic physical health problem, especially those with functional impairment, are at a high risk of depression. They recommend being alert to possible depression and asking two simple screening questions to detect depression.[12] Those screening positively should be referred to an appropriate professional for assessment, in most cases, the patient's General Practitioner (GP). Screening should occur in both low vision specific settings such as rehabilitation clinics, and in primary care and general clinical settings such as diabetes or stroke clinics, where vision impairment is prevalent. In busy primary care and general clinics, understanding who is most at risk of depression amongst this patient group using easy to determine factors may help clinicians to target depression screening and signpost patients to supportive services.

Previous cross-sectional studies of patients from outpatient eye clinics and low vision rehabilitation services have identified several risk factors for depression including: being female, being relatively younger in age, living alone and having lower acceptance of vision loss[13], reporting poorer self-reported health and having a history of mental health problems,[13 14] reporting poorer vision specific functioning, higher levels of vision

specific distress, having an avoidant coping style and lower perceived adequacy of social support[14]. A longitudinal prospective cohort study of 540 patients from outpatient low vision organisations in the Netherlands and Belgium found that people who developed depressive symptoms over a two year period were more likely to be: living alone, having just enough money to cover their expenses, have macular degeneration, have problems with adaptation to vision loss, have reduced health related quality of life and be experiencing symptoms of anxiety.[15]

The above studies were conducted in the Netherlands, Belgium and Australia and we do not know if the same risk factors apply to a British population. Therefore, it is useful to examine the risk factors for depressive symptoms in people with sight loss in England and Wales, using a large sample of consecutive attendees to services. The findings will enable clinicians in primary care and general hospital clinics to allocate resources to screening those most at risk.

The aim of this study was to identify the risk factors for significant depressive symptoms in people with vision impairment attending rehabilitation clinics in England and Wales using baseline data from a randomised controlled trial of interventions for depression (DEPVIT).[7] We focused our examination mainly on characteristics which can be easily identified in routine practice for example, age and ethnicity, to provide a straightforward approach to identifying high risk patients based on readily available information.

METHODS

Study Design and Participants

This cross-sectional study was undertaken as part of the Depression in Visual Impairment Trial (DEPVIT).[7] Eligible participants were consecutive adult patients who were seeking help for vision impairment at specialist visual rehabilitation services taking part in DEPVIT. Fourteen primary care based rehabilitation services recruited participants in South Wales. Services were readily accessible high street practices, accepted self-referral and tended to cater to older adults with age-related eye conditions living in the local community. A secondary care rehabilitation clinic based at Guys and St Thomas' Hospital and an NHS outreach clinic providing low vision services in Southwark recruited participants from the London area. Access to these two specialist clinics was by referral only. All consecutive attendees aged 18 or over were considered eligible for the study, unless they lived outside the catchment area for the trial or if they had previously been screened for depression as part of the study (some people had more than one appointment during the length of the study, but we only wanted to screen them and invite them to take part once). Ethical approval was obtained from the NHS South East Wales Research Ethics Committee Panel B. All participants provided written informed consent for their anonymised data to be used and the study adhered to the Declaration of Helsinki.

Funding and Public and Patient Involvement

The study was funded by Guide Dogs, a voluntary sector organisation who work closely with people with vision impairment and understand their experiences and preferences. They carried out a review prior to funding to ensure the research questions were relevant and the study design appropriate. Patients with a vision impairment reviewed and provided feedback on the depression questionnaire. Patients were not involved in the recruitment to or conduct of the study.

Measures

Depression

The Geriatric Depression Scale (GDS-15)[16] is one of the most widely used instruments for the screening of depression in older adults. The questionnaire has 15 questions and completion time is approximately 5 minutes. Possible scores range from 0 to 15, with higher scores indicating a greater number of depressive symptoms. We chose to use dichotomous categories rather than the continuous scale as this reflects the scale's use in clinical practice as a screening tool to identify those who warrant further investigation. We used the conventional scoring approach rather than Rasch analysis to facilitate direct comparison with published studies and to facilitate clinically valid results. A score of 6 or more was taken to be indicative of significant depressive symptoms[5].

Risk Factors

We recorded gender, age, ethnicity (White, Asian/Asian British, Black/Black British or Other), physical illness (number and type from a list of seven plus an 'other' category) and ocular diagnosis (number and type of eye conditions from a list of five plus an 'other' category), factors which would be readily available to clinicians working with people with sight loss and have been considered in previous studies.

We also measured self-reported general health as this has consistently been shown to be a risk factor for depression[6 13-15] and can be easily measured using a single item question from the SF-12, "In general, would you say your overall health is: excellent, very good, good, fair or poor?". The question has had widespread use as a single-item measure, including in previous studies of visual impairment and depression[5 14] and has shown to be significantly and independently associated with specific health problems, use of health services, changes in functional status, recovery from episodes of ill health, mortality, and sociodemographic characteristics of respondents.[17]

To provide information on vision related factors for low vision practitioners who have access to this information, we also measured presenting corrected binocular visual acuity using ETDRS LogMAR and recorded time since vision loss in years. As previous studies have found no evidence of an association between

objective measures of visual acuity and depression[13-15], we were interested to see whether a subjective measure of visual function would be associated. Self-reported visual functioning was measured using the 7 item National Eye Institute Visual Function Questionnaire (NEI-VFQ 7) which includes a subset of questions from the National Eye Institute Visual Function Questionnaire that have previously been shown to be responsive to rehabilitation service intervention.[18] As the NEI-VFQ 7 is commonly reported in the published literature with Rasch analysis, we transformed the Likert responses using the Rasch derived scoring key provided by Ryan et al (2008)[18] to calculate a score for each completed questionnaire. A higher score indicates a greater perceived difficulty with visual functioning. Questionnaires with 3 or more missing items were counted as missing and excluded from the analysis.

Procedures

Participants who were eligible to take part in the study were sent a questionnaire in large print format containing the GDS-15, NEI-VFQ 7 and single-item question about health, along with their appointment letter at least one week before their low vision assessment. They were asked to complete the questionnaire at home, with assistance if needed, and to bring it along to their appointment. Those who did not return a completed questionnaire were given the opportunity to complete another copy at the clinic, before their appointment. The low vision practitioner reviewed the participant's responses with them at the start of the assessment and asked for their written consent to use their anonymised responses in the study. For those who consented, information on gender, date of birth, ethnicity, physical illness, ocular diagnosis, corrected ETDRS Log MAR acuity and time since vision loss first identified were recorded on a Case Report Form (CRF). Those who screened positive for depressive symptoms (GDS-15 score of ≥6) were offered entry to the DEPVIT trial if eligible, or a referral to their GP if not eligible.[19]

Case Report Forms completed by the clinicians were sent to the research coordinating centre at Cardiff University by secure FAX where the validity and completeness of the data was checked. Any missing or out of range data were queried with the practitioner and checked with clinical notes. Five percent of all CRFs and surveys were double entered. The error rate was less than 2% and identified errors were corrected. The number of eligible patients who did not complete the survey and the number who did not consent for their data to be used for research purposes were also recorded. The final dataset was then locked and transferred to the statistical team for analysis. The descriptive statistics were tabulated using SPSS Version 23 and the regression models were fitted using STATA Version 13.1.

Statistical analysis

Participant characteristics were summarised for those with significant depressive symptoms (GDS-15 ≥6) and those without (GDS-15 <6). Categorical variables were summarised as numbers and percentages and

continuous variables as medians with interquartile ranges. In all cases we report the number of participants for whom data was missing.

Where the GDS-15 was not fully completed, completed answers were totalled to give a final score provided that the number of questions not answered was 2 or less[5]. If 3 or more questions were unanswered, the GDS-15 data were regarded as missing and the participant excluded from the analysis.

Logistic regression was used to determine the independent relationship between each of the potential risk factors and significant depressive symptoms. The potential risk factors were initially included individually (univariable analysis) and then entered into a multivariable logistic regression analyses in blocks to determine which variables remain associated with significant depressive symptoms after controlling for the other factors. The events-per-variable was sufficient to allow inclusion of all potential risk factors, so no selection was required.[20] However, due to co-linearity, it was not possible to include both number and type of physical illnesses or both number and type of eye conditions. Therefore, a decision was made to include only number of illnesses and eye conditions, as it was hypothesized that burden of multiple diagnoses would be more important than type of diagnosis: those with multiple morbidity are at twice the risk of depression than those without multiple morbidity.[21] The variables were entered into the analysis in blocks, starting with the risk factors which could be most easily identified in routine clinics, and ending with those requiring more time or adaptation to practice to assess. The blocks were: 1) Demographics (gender/age/ethnicity), 2) Demographics and Physical Health (number of illnesses), 3) Demographics, Physical health and Eye health (number of eye conditions/visual acuity/time since vision loss), 4) Demographics, Physical Health, Eye health and Self-report measures (self-report health/visual functioning). We calculated the area under the ROC curve to quantify the overall ability of each (additional) block of variables to correctly discriminate between those with and without depression.

RESULTS

A total of 1323 consecutive adult patients attended the low vision rehabilitation clinics during the 30 month recruitment period. Of these, 312 were not screened for depression because the practitioner felt it was inappropriate at the time (because the patient was too ill, had dementia or was recently bereaved); or the patient had forgotten to complete the questionnaire and there was no time at the assessment; or they did not consent for their data to be used for research. An additional 21 patients had 3 or more missing items on the GDS-15 and were excluded, leaving a final sample size of 990 and a complete response rate of 74.8%. The median age of the participants was 79.0 years (IQR= 66.0 to 85.0), 62.2% were female (n=616) and 85% were white (n= 842). The overall prevalence of significant depressive symptoms was 42.5%. This varies very slightly

from our previously reported study (43%)[8] due to the methodology used in this study to calculate the total GDS-15 score (excluding those with ≥3 missing items).

Tables 1-4. outline the demographics characteristics of the participants, their physical health measures, eye health measures and self-report health and vision measures respectively, split by those with and without significant depressive symptoms.

Table 1. Summarises the demographic characteristics of those with and without significant depressive symptoms

Demographic Characteristics	**GDS-15 Score <6**	**GDS-15 Score ≥6**	**Total**
Total Sample, n (%)	569 (57.5%)	421 (42.5%)	990 (100%)
Gender, n (%)			
Male	201 (53.7%)	173 (46.3%)	374 (100%)
Female	368 (59.7%)	248 (40.3%)	616 (100%)
Data missing	0	0	0
Age (years), Median (IQR)	80.0 (72.0, 86.0)	77.0 (57.0, 85.0)	79.0 (66.0, 85.0)
Data missing, n (%)	22 (52.4%)	20 (47.6%)	42 (100%)
Ethnicity, n (%)			
White	508 (60.3%)	334 (39.7%)	842 (100%)
Asian/Asian/British	12 (52.2%)	11 (47.8%)	23 (100%)
Black/Black British	40 (38.5%)	64 (61.5%)	104 (100%)
Other ethnic group	9 (45%)	11 (55%)	20 (100%)
Data missing	0 (0%)	1 (100%)	1 (100%)
Ethnicity (collapsed categories), n (%)			
White	508 (60.3%)	334 (39.7%)	842 (100%)
Non-White	61 (41.5%)	86 (58.5%)	147 (100%)
Data missing	0 (0%)	1 (100%)	1 (100%)

Table 2. Summarises the physical health of those with and without significant depressive symptoms

Physical health	GDS-15 Score <6	GDS-15 Score ≥6	Total
Physical Illnesses*, n (%)			
Diabetes	119 (47.8%)	130 (52.2%)	249 (100%)
Epilepsy	8 (57.1%)	6 (42.9%)	14 (100%)
Stroke	31 (50.8%)	30 (49.2%)	61 (100%)
Thyroid	27 (47.4%)	30 (52.6%)	57 (100%)
Heart Disease	94 (50.3%)	93 (49.7%)	187 (100%)
High Blood Pressure	246 (55.5%)	197 (44.5%)	443 (100%)
Respiratory Disease	48 (59.3%)	33 (40.7%)	81 (100%)
Other	113 (48.9%)	118 (51.1%)	231 (100%)
No medical illness	113 (70.2%)	48 (29.8%)	161 (100%)
Data missing	4 (100%)	0 (0%)	4 (100%)
Total number of physical illnesses, n (%)			
0	113 (70.2%)	48 (29.8%)	161 (100%)
1	277 (60.6%)	180 (39.4%)	457 (100%)
2	127 (48.3%)	136 (51.7%)	263 (100%)
3	41 (47.7%)	45 (52.3%)	86 (100%)
4	4 (28.6%)	10 (71.4%)	14 (100%)
5	2 (50%)	2 (50%)	4 (100%)
6	1 (100%)	0 (0%)	1 (100%)
Data missing	4 (100%)	0 (0%)	4 (100%)
Total number of physical illnesses (collapsed categories), n (%)			
0	113 (70.2%)	48 (29.8%)	161 (100%)
1	277 (60.6%)	180 (39.4%)	457 (100%)
2	127 (48.3%)	136 (51.7%)	263 (100%)
3 or more	48 (45.7%)	57 (54.3%)	105 (100%)
Data missing	4 (100%)	0 (0%)	4 (100%)

** Participants may have had more than one physical illness*

Table 3. Summarises the eye health of those with and without significant depressive symptoms

Eye health	GDS-15 Score <6	GDS-15 Score ≥6	Total
Ocular Diagnosis*, n (%)			
AMD wet	117 (59.4%)	80 (40.6%)	197 (100%)
AMD dry	259 (64.6%)	142 (35.4%)	401 (100%)
Glaucoma	104 (63.0%)	61 (37%)	165 (100%)
Cataract	95 (70.4%)	40 (29.6%)	135 (100%)
Diabetic eye disease	59 (48.0%)	64 (52.0%)	123 (100%)
Other eye condition	157 (47.9%)	171 (52.1%)	328 (100%)
Data missing	1 (50%)	1 (50%)	2 (100%)
Total number of eye conditions, n (%)			
1	381 (56%)	299 (44.0%)	680 (100%)
2	153 (58.8%)	107 (41.2%)	260 (100%)
3	32 (72.7%)	12 (27.3%)	44 (100%)
4	2 (66.7%)	1 (33.3%)	3 (100%)
5	0 (0%)	1 (100%)	1 (100%)
Data missing	1 (50%)	1 (50%)	2 (100%)
Total number of eye conditions (collapsed categories), n (%)			
1	381 (56.0%)	299 (44.0%)	680 (100%)
2	153 (58.8%)	107 (41.2%)	260 (100%)
3 or more	34 (70.8%)	14 (29.2%)	48 (100%)
Data missing	1 (50%)	1 (50%)	2 (100%)
Corrected binocular visual acuity (logMar), Median (IQR)	0.60 (0.40, 0.94)	0.70 (0.50, 1.00)	0.67 (0.40, 1.0)
Data missing, n (%)	0	0	0
Years since vision loss, Median (IQR)	5.5 (2.2, 12.0)	5.0 (2.1, 10.2)	5.2 (2.2, 11.1)
Data missing, n (%)	13 (81.25%)	3 (18.75%)	16 (100%)

** All ocular diagnoses - participants may have had more than one.*

Table 4. Summarises the self-reported health and visual function of those with and without significant depressive symptoms

Self-report measures	GDS-15 Score <6	GDS-15 Score ≥6	Total
Self-rated health(SF-12), n (%)			
Excellent	22 (95.7%)	1 (4.3%)	23 (100%)
Very Good	93 (86.1%)	15 (13.9%)	108 (100%)
Good	201 (72.6%)	76 (27.4%)	277 (100%)
Fair	192 (52.5%)	174 (47.5%)	366 (100%)
Poor	33 (18.5%)	145 (81.5%)	178 (100%)
Data Missing	28 (73.7%)	10 (26.3%)	38 (100%)
Visual functioning* (NEI VFQ-7), Median (IQR)	0.23 (-1.43, 1.46)	1.41 (0.17, 2.49)	0.78 (-0.80, 1.91)
Data missing n (%)	23 (67.6%)	11 (32.4%)	34 (100%)

* NEI VFQ-7 scores have been Rasch analysed and a higher score indicates a greater perceived difficulty with visual functioning.

The variables ethnicity, number of physical illnesses and number of eye conditions had a small number of participants in some categories, hence the categories were collapsed before being entered into the regression analysis. Both the original and collapsed categories are presented in the tables. Table 5 Summarises the results of the univariable and multivariable logistic regression using odds ratios (OR) and adjusted odds ratios (AOR) and are presented with 95% confidence intervals (CI) and p values.

Block	Characteristic	Univariable				Multivariable Block 1 N=947			Multivariable Block 2 N=943			Multivariable Block 3 N=926			Multivariable Block 4 N=877		
		N	OR	95% CI	P	AOR	95% CI	P	AOR	95% CI	P	AOR	95% CI	P	AOR	95% CI	P
1. Demographics	**Gender: Reference category male**																
	• Female	990	0.78	0.60 to 1.01	0.064	0.87	0.66 to 1.14	0.311	0.89	0.67 to 1.17	0.390	0.90	0.68 to 1.19	0.462	0.85	0.61 to 1.19	0.350
	Age (per decade)	948	0.82	0.74 to 0.90	<0.001	0.82	0.82 to 0.90	<0.001	0.82	0.74 to 0.90	<0.001	0.82	0.74 to 0.90	<0.001	0.82	0.66 to 0.90	<0.001
	Ethnicity: Reference category white																
	• Non-white	989	2.14	1.50 to 3.06	<0.001	1.54	1.05 to 2.27	0.027	1.64	1.10 to 2.43	0.014	1.61	1.08 to 2.40	0.020	1.72	1.05 to 2.81	0.031
2. Physical Health	**Total illnesses: Reference category 0 illness**																
	• 1 illness	986	1.53	1.04 to 2.25	<0.001				2.06	1.34 to 3.18	<0.001	2.09	1.36 to 3.24	<0.001	1.28	0.77 to 2.13	0.051
	• 2 illnesses		2.52	1.66 to 3.82					3.55	2.23 to 5.65		3.62	2.26 to 5.78		1.96	1.14 to 3.37	
	• 3 + illnesses		2.80	1.68 to 4.66					3.91	2.24 to 6.82		4.02	2.27 to 7.11		1.68	0.86 to 3.29	
3. Eye Health	**Total eye conditions: Reference category 1 cond.**																
	• 2 conditions	988	0.89	0.67 to 1.19	0.123							0.91	0.66 to 1.27	0.114	0.98	0.67 to 1.43	0.026
	• 3 + conds.		0.52	0.28 to 1.00								0.48	0.24 to 0.96		0.34	0.15 to 0.75	
	Visual acuity	990	1.01	0.99 to 1.03	0.568							1.00	0.98 to 1.03	0.929	1.00	0.97 to 1.03	0.942
	Time since vision loss (per year)	974	0.99	0.99 to 1.01	0.818							0.99	0.98 to 1.00	0.075	0.99	0.98 to 1.00	0.244
4. Self-report Measures	**Subjective Health: Reference category poor**																
	• Excellent	952	0.01	0.00 to 0.08	<0.001										0.01	0.00 to 0.12	<0.001
	• Very Good		0.04	0.02 to 0.07											0.06	0.03 to 0.13	
	• Good		0.09	0.05 to 0.14											0.14	0.08 to 0.24	
	• Fair		0.21	0.13 to 0.32											0.28	0.18 to 0.46	
	Visual Functioning	956	1.48	1.36 to 1.60	<0.001										1.45	1.31 to 1.61	<0.001
Area Under ROC Curve						0.59			0.65			0.65			0.81		

Table 5. Summaries the results of the univariable logistic regression and multivariable regression analyses, with blocks of variables added sequentially to the model.

Demographics

Table 1. Shows that those with a higher prevalence of significant depressive symptoms were male, younger or non-white. In the univariable analysis, age and ethnicity were associated with significant depressive symptoms. An increase in age was associated with lower odds of participants having depression and having ethnicity other than white was associated with higher odds of having depression (see Table 5.). These variables remain associated once other variables were controlled for in the multivariable analysis final model. There was no evidence of an association between gender and significant depressive symptoms.

Physical health

The prevalence of depression was lowest in those with no physical illness (29.8%) and highest in those with three or more illnesses (54.3% - Table 2.). In the univariable analysis, an increase in the number of physical illnesses was associated with higher odds of having significant depressive symptoms. This association remained when controlling for demographics and eye health but was no longer associated when controlling for subjective health and visual function.

Eye health

Those with a higher prevalence of depression had one eye condition, worse visual acuity or less time since vision loss (Table 3.). The univariable analysis found no evidence of an association between significant depressive symptoms and number of eye conditions, visual acuity and time since vision loss. However, when controlling for other factors in the final model, an increase in the number of eye conditions was associated with lower odds of having significant depressive symptoms.

Self-report measures

The prevalence of depression was highest in those with poor self-rated health (81.5%) and lowest in those with excellent health (4.3%). Those with significant depressive symptoms had worse self-rated visual functioning (Table 4.). Worse self-rated health and visual functioning were associated with higher odds of having significant depressive symptoms in both the univariable analysis and multivariable final model.

The area under the ROC curve was 0.59 when demographics alone were entered into the model, increasing to 0.65 when physical and eye health variables were considered, and reaching 0.81 when self-report measures were added.

DISCUSSION

This study identified the risk factors for significant depressive symptoms in people with vision impairment attending vision rehabilitation clinics in England and Wales. We focused mainly on risk factors which can be easily identified in primary care and general hospital clinics, so as to provide a pragmatic approach to identifying high risk patients. To inform ophthalmic clinicians who may have access to more detailed information on eye health, we also included a range of vision related variables. Our findings showed that amongst older adults, those of relatively younger age, with an ethnicity other than white, and poorer self-reported health and visual function had higher odds of having significant depressive symptoms. Number of physical illnesses was an independent predictor of depressive symptoms, but there was no evidence of an association when controlling for subjective health and vision function. The number of eye conditions was not an independent predictor of depressive symptoms, but was related to depression when other variables were controlled: less number of eye conditions was associated with higher odds. There was no evidence that gender, time since vision loss and visual acuity were associated with depression.

With regard to demographic factors, our findings demonstrate some support for, and discrepancies with, previous studies. In a study with an Australian population[14], a univariate analysis provided evidence that younger age was associated with depressive symptoms, and in a European and Australian sample (relatively) younger age was shown to be associated with subthreshold depression in a multivariable analysis[13]. Our study corroborates these findings in a UK sample. This perhaps reflects the finding in the general population that people aged 40–59 years have higher rates of depression than those aged ≥60 years[22] and those in middle-age have the highest risk[23]. The reasons for this are not clearly understood, but one theory is that by mid-life, individuals have learnt to adapt to their strengths and weaknesses, and in mid-life 'quell their infeasible aspirations' [23]. In those with vision loss, being affected in middle-age rather than old age may add to this sense of lost aspirations and could also result in more restriction in life including difficulties in finding and staying in work, playing sport etc. Our research found no evidence of an association between gender and depressive symptoms. Previous studies examining this association have differed in their findings. An Australian study showed no association in a univariate analysis[14], whilst a model with a European and Australian sample found being female was a predictor of subthreshold depression[13]. The authors of a study with Dutch and Belgian participants reported that their findings on gender were inconclusive[15]. Differences in findings across the studies may indicate this factor is country specific, or may be due to differences in the measures used to assess depression. For example, we included people with all levels of depressive symptoms, whereas the European/Australian study included only subthreshold depression. It may be that being female is associated with subthreshold depression but there is no association when all levels of severity are considered. We found that having an ethnicity other than white was a risk factor. Recent studies on vision impairment and depression have not measured ethnicity, however an earlier study conducted in New Zealand found that ethnicity was not related to depression[24]. Differences between that study and ours may be due to the different populations,

with a wider variation in ethnicities in the UK and London in particular. The New Zealand study only recorded 'New Zealand born European' or 'other'. Therefore, future studies should include ethnicity as a variable to provide further clarification.

There is more consistency between European and Australasian studies and our UK study in terms of health. We demonstrated that those with poorer self-reported health were at much higher risk of depressive symptoms. This confirms previous research in vision impaired people which has shown that poorer perceived health status[13], poorer self-reported health[14] and poorer health related quality of life[24] are all predictors of depression. This is not surprising as patients may include their emotional health in a question about general health. Our study also found that a higher number of physical illnesses was an independent risk factor for depression. This is in line with findings from the non-vision impaired population. A recent meta-analysis found a substantial relationship between multimorbidity (the presence of two or more chronic physical illnesses) and depression, reporting that people with multimorbidity are at twice the risk of depression to those without multimorbidity, and nearly three times at risk compared to those with no chronic physical condition[21]. The authors suggest the relationship is bi-directional and cite the Activity Restriction Model of Depressed Affect[25] which explains that multimorbidity contributes significantly to depressive symptoms through having to give up valued activities due to physical limitations. In our sample, the limitations of conditions such as stroke and diabetes may have compounded any mobility and functional issues already caused by sight loss, which can make self-care, engaging in hobbies and getting out and about more difficult.

In terms of vision related factors, it is logical to assume that the chances of having depressive symptoms increases as visual acuity decreases. However, in line with other European and Australian studies[13-15], the results of the regression analysis do not support this hypothesis. What seems to be more important is self-reported visual function: those with worse self-reported visual function are more at risk of depressive symptoms[26]. Therefore clinicians should take care not to make assumptions about the likelihood of depression in only those with the lowest levels of vision as assessed by visual acuity. The relationship is likely to be bidirectional, with poorer visual function leading to loss of valued activities and mood, whilst lowered mood may influence a person's perception of their vision function. As with previous studies[13 15], time since the vision loss was first identified was also not a predictor of depression, indicating that patients may develop symptoms at any point on their sight loss journey. The more surprising finding was that whilst number of eye conditions was not an independent predictor of depressive symptoms, when other factors were controlled then having more eye conditions was associated with lower odds of having depression. It is possible that this can be explained by the fact that those with three or more eye conditions were more likely to report other physical health conditions and this may reflect the presence of eye conditions induced by physical illnesses such as diabetes. Our research suggests that not all of the factors related to depressive symptoms in people with vision impairment are specific to that particular population. As with the general population, age, ethnicity and health

are associated with risk of depression and this needs to be taken into consideration when understanding the link between vision impairment and depression, and when considering suitable interventions.

This research added to the literature by examining risk factors in a British sample of people with vision impairment. The study benefited from a large sample size and a high response rate, enhancing the generalisability of the findings. As we included 14 low vision rehabilitation clinics across primary and secondary care, we believe the findings are transferrable to both settings in the UK. Our study employed validated measures of depressive symptoms and incorporated risk factors which are easy to identify in primary care and hospital clinics. Therefore the results can be easily integrated in clinical practice to target screening.

However, inevitably there were some value judgements in how we chose our criteria for selecting the range of potential factors in our study. This means that other parameters which have previously been shown to be predictors of depression, for example, vision specific distress, lower perceived adequacy of social support and avoidant coping[14], were not measured and therefore cannot be included in the risk profile advice to clinicians. These parameters can only be assessed using additional questionnaires which would have increased the overall response burden in the study and furthermore, it is unlikely that these variables would be measured in routine practice and therefore were not within the scope of our study.

We chose to dichotomise the GDS-15 to reflect how it would be used in practice, as a screening tool for identifying patients who would benefit from screening in clinic and potentially signposting to support services. However, we acknowledge that this may have led to a reduction in power and loss of information.[27]A further limitation of the study is the use of a cross-sectional design, which means conclusions about direction of causality are not possible. Finally, whilst the completion rate of the GDS-15 was high, a number of patients were not screened at the discretion of the practitioners, including because they felt the patient was too ill, had dementia or had recently been bereaved, or they did not consent for their answers be used for research. Therefore there may be a risk of bias as the non-completers may be systematically different from those that completed the questionnaire and consented to their data being used. Similarly, we excluded cases with missing data from the multivariable analysis and this simple approach to missing data may have introduced some bias. However, as only 113/990 (11%) were excluded, the risk of bias is low,

For the first time, for a population in England and Wales, our study demonstrates that for patients with vision impairment, there are several risk factors for depression which can be easily identified by those coming in to contact with people with sight loss. We recommend that all clinicians working with people with sight loss are alert to these factors. We advise screening higher risk patients using the simple two question screen recommended in the NICE guidelines[12]. If a patient is identified as having likely depression they should be managed according to the guidelines, which includes referral to an appropriate professional, for example, the GP. Local pathways should be established to manage this referral. However, because the prevalence of

depressive symptoms is so high in low vision clinics, we recommend that low vision practitioners introduce depression screening as part of routine care with all patients.

Future research could include qualitative work to clarify the pathway from the risk factors identified here to the onset of depression, to aid the development of interventions for depression in this population.

ACHNOWLEDGEMENTS

The authors wish to thank the following for data collection: Sandra Jumbe, Rowanne Black, Kathy Davies, Denise Banford, Ian Cousins, Huw Bellamy, Norma Davies, Ceri Goodman, Sharon Beatty, Lisa Evans, Leighton Griffiths, Matthew Harvey, David Jenkins, Jane Savage, Marek Karas, John Butler, Seema Rajoria, Rajiv Raja, Jane De Courcy, Ahalya Subramanian, Sonal Rughani and Sarah Janikoun.

FOOTNOTES

Contributors: TM, DS, RTE and MS conceived the idea for the study and acquired funding. CN project managed the study, supervised data collection, performed data cleaning, statistical analysis and wrote the first draft of the manuscript. CB and BR substantially contributed to the design of the study and to the acquisition of data. NB and RC contributed to the design of the study. DG provided statistical advice and supervision. All authors contributed to the design of the protocol, critically reviewed the manuscript for important intellectual content and approved the final manuscript.

Funding: The work was supported by Guide Dogs grant number OR2009-07b.

Competing interests: None declared.

Patient consent: Not required – no identifiable information from a living individual included.

Ethics approval: The NHS South East Wales Research Ethics Committee Panel B approved this study.

Data sharing statement: There is no additional unpublished data from this study.

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies (Nollett et al)*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6, 7
Bias	9	Describe any efforts to address potential sources of bias	*7*
Study size	10	Explain how the study size was arrived at	-
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7, 8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8
		(*e*) Describe any sensitivity analyses	-
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9, 10, 11
		(b) Indicate number of participants with missing data for each variable of interest	9, 10, 11
Outcome data	15*	Report numbers of outcome events or summary measures	9-13
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9-13
		(*b*) Report category boundaries when continuous variables were categorized	6
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	16
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	18
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	16-18
Generalisability	21	Discuss the generalisability (external validity) of the study results	17/18
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Depressive symptoms in people with a vision impairment: A cross-sectional study to identify who is most at risk

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2018-026163.R2
Article Type:	Research
Date Submitted by the Author:	26-Nov-2018
Complete List of Authors:	Nollett, Claire; Cardiff University, Centre for Trials Research Ryan, Barbara; Cardiff University, School of Optometry and Vision Sciences Bray, Nathan; Centre for Health Economics and Medicines Evaluation, Bangor University, Bunce, Catey; kings College london, School of Population and Environmental Sciences Casten, Robin; Thomas Jefferson University, Department of Psychiatry and Human Behaviour Edwards, Rhiannon; Bangor University, Centre for Health Economics & Medicines Evaluation Gillespie, David; Cardiff University, Centre for Trials Research Smith, Daniel; University of Glasgow, Institute of Health and Wellbeing Stanford, Miles; St Thomas' Hospital, Medical Eye Unit Margrain, Tom; Cardiff University, School of Optometry and Vision Sciences
Primary Subject Heading:	Ophthalmology
Secondary Subject Heading:	Mental health
Keywords:	Depression & mood disorders < PSYCHIATRY, GERIATRIC MEDICINE, OPHTHALMOLOGY

Depressive symptoms in people with a vision impairment: A cross-sectional study to identify who is most at risk

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ABSTRACT

Objective: To identify the risk factors for significant depressive symptoms in people with visual impairment in England and Wales to provide information on who is most at risk and to whom support services could be targeted in future.

Design: A cross-sectional study using baseline data from a pragmatic randomised controlled trial.

Setting and Participants: 990 participants aged 18 or over attending one of fourteen low vision rehabilitation primary care optometry based clinics in South Wales or two hospital clinics in London.

Outcome measure: A score of ≥6 on the Geriatric Depression Scale (GDS-15) was classed as clinically significant depressive symptoms.

Results: In a multivariable logistic regression model, significant depressive symptoms were associated with age (adjusted odds ratio (AOR) = 0.82, 95%CI: 0.66 to 0.90, p<0.001), ethnicity (AOR non-white compared to white = 1.72, 95%CI: 1.05 to 2.81, P=0.031), total number of eye conditions (AOR for two versus one condition = 0.98 , 95%CI: 0.67 to 1.43; three or more versus one condition = 0.34 , 95%CI: 0.15 to 0.75, p = 0.026), self-reported health (AOR for excellent versus poor= 0.01, 95%CI: 0.00 to 0.12; very good versus poor= 0.06, 95%CI: 0.03 to 0.13; good versus poor= 0.14, 95%CI: 0.08 to 0.24; fair versus poor= 0.28, 95%CI: 0.18 to 0.46, p<0.001) and self-reported visual functioning (AOR = 1.45, 95%CI: 1.31 to 1.61, p<0.001).

Conclusion: Younger age, a non-white ethnicity, fewer eye conditions and poorer self-reported health and visual function are risk factors for significant depressive symptoms in this population.

Trial registration: ISRCTN46824140

KEYWORDS

depression, vision impairment, sight loss, risk factor, depressive symptoms

ARTCILE SUMMARY

Strengths and Limitations of the Study

- This is the first study of risk factors for depressive symptoms in people seeking help for vision impairment in England and Wales.
- It benefits from a large sample size (n=990) and a high response rate (n=990/1323, 74.8%) which increase the generalisability of the findings.
- It examines factors which can be readily assessed by practitioners in primary care and general hospital clinics who come into contact with people with vision impairment, enabling them to be alerted to those most at risk and in need of signposting to support services.
- However, it excludes some more difficult to measure factors, such as vision specific distress, coping style and perceived social support, which may also predict depression in this population.
- The study uses a cross-sectional design so conclusions about direction of causality cannot be made.

BACKGROUND

Vison impairment impacts on all aspects of life and is associated with reduced functional ability, falls, social isolation and reduced quality-of-life.[1-3] There is also a growing awareness that it has a negative impact on mental health status too. Population based studies provide robust evidence of an association between vision impairment and depression. Typically those with a vision impairment are 2 to 3 times more likely to be depressed.[4 5] In Britain, for example, a large survey of >13,000 older adults found that the prevalence of significant depressive symptoms in those with good vision living in the community was about 4.6% while in those with a vision impairment (<6/18) it was 13.5%.[5]

The prevalence of significant depressive symptoms is also high in those accessing rehabilitation services. Results from a study in Australia found that when screened with the two item Patient Health Questionnaire (PHQ-2), 37% of patients attending rehabilitation clinics or eye care services screened positive for depressive symptoms.[6] Here in the UK, we screened over 1000 patients attending low vision rehabilitation appointments using the Geriatric Depression Scale (GDS-15), as part of the Depression in Visual Impairment Trial (DEPVIT), a randomised controlled trial.[7] We found that 43% of patients reported significant depressive symptoms (score ≥6) and, significantly, 74.8% were not receiving any treatment for depression.[8] This finding supports previous reports that people with a vision impairment are less likely to have their depression identified than those with good vision.[9-11]

Because depression goes under-detected in this patient group, there is a need to improve routine screening. The National Institute for Health and Care Excellence (NICE), in their guidelines on 'Depression in adults with a chronic physical health problem'[12] suggest that practitioners working in primary care and general hospital clinics should be aware that patients with a chronic physical health problem, especially those with functional impairment, are at a high risk of depression. They recommend being alert to possible depression and asking two simple screening questions to detect depression.[12] Those screening positively should be referred to an appropriate professional for assessment, in most cases, the patient's General Practitioner (GP). Screening should occur in both low vision specific settings such as rehabilitation clinics, and in primary care and general clinical settings such as diabetes or stroke clinics, where vision impairment is prevalent. In busy primary care and general clinics, understanding who is most at risk of depression amongst this patient group using easy to determine factors may help clinicians to target depression screening and signpost patients to supportive services.

Previous cross-sectional studies of patients from outpatient eye clinics and low vision rehabilitation services have identified several risk factors for depression including: being female, being relatively younger in age, living alone and having lower acceptance of vision loss[13], reporting poorer self-reported health and having a history of mental health problems,[13 14] reporting poorer vision specific functioning, higher levels of vision

specific distress, having an avoidant coping style and lower perceived adequacy of social support[14]. A longitudinal prospective cohort study of 540 patients from outpatient low vision organisations in the Netherlands and Belgium found that people who developed depressive symptoms over a two year period were more likely to be: living alone, having just enough money to cover their expenses, have macular degeneration, have problems with adaptation to vision loss, have reduced health related quality of life and be experiencing symptoms of anxiety.[15]

The above studies were conducted in the Netherlands, Belgium and Australia and we do not know if the same risk factors apply to a British population. Therefore, it is useful to examine the risk factors for depressive symptoms in people with sight loss in England and Wales, using a large sample of consecutive attendees to services. The findings will enable clinicians in primary care and general hospital clinics to allocate resources to screening those most at risk.

The aim of this study was to identify the risk factors for significant depressive symptoms in people with vision impairment attending rehabilitation clinics in England and Wales using baseline data from a randomised controlled trial of interventions for depression (DEPVIT).[7] We focused our examination mainly on characteristics which can be easily identified in routine practice for example, age and ethnicity, to provide a straightforward approach to identifying high risk patients based on readily available information.

METHODS

Study Design and Participants

This cross-sectional study was undertaken as part of the Depression in Visual Impairment Trial (DEPVIT).[7] Eligible participants were consecutive adult patients who were seeking help for vision impairment at specialist visual rehabilitation services taking part in DEPVIT. Fourteen primary care based rehabilitation services recruited participants in South Wales. Services were readily accessible high street practices, accepted self-referral and tended to cater to older adults with age-related eye conditions living in the local community. A secondary care rehabilitation clinic based at Guys and St Thomas' Hospital and an NHS outreach clinic providing low vision services in Southwark recruited participants from the London area. Access to these two specialist clinics was by referral only. All consecutive attendees aged 18 or over were considered eligible for the study, unless they lived outside the catchment area for the trial or if they had previously been screened for depression as part of the study (some people had more than one appointment during the length of the study, but we only wanted to screen them and invite them to take part once). Ethical approval was obtained from the NHS South East Wales Research Ethics Committee Panel B. All participants provided written informed consent for their anonymised data to be used and the study adhered to the Declaration of Helsinki.

Funding and Public and Patient Involvement

The study was funded by Guide Dogs, a voluntary sector organisation who work closely with people with vision impairment and understand their experiences and preferences. They carried out a review prior to funding to ensure the research questions were relevant and the study design appropriate. Patients with a vision impairment reviewed and provided feedback on the depression questionnaire. Patients were not involved in the recruitment to or conduct of the study.

Measures

Depression

The Geriatric Depression Scale (GDS-15)[16] is one of the most widely used instruments for the screening of depression in older adults. The questionnaire has 15 questions and completion time is approximately 5 minutes. Possible scores range from 0 to 15, with higher scores indicating a greater number of depressive symptoms. We chose to use dichotomous categories rather than the continuous scale as this reflects the scale's use in clinical practice as a screening tool to identify those who warrant further investigation. We used the conventional scoring approach rather than Rasch analysis to facilitate direct comparison with published studies and to facilitate clinically valid results. A score of 6 or more was taken to be indicative of significant depressive symptoms[5].

Risk Factors

We recorded gender, age, ethnicity (White, Asian/Asian British, Black/Black British or Other), physical illness (number and type from a list of seven plus an 'other' category) and ocular diagnosis (number and type of eye conditions from a list of five plus an 'other' category), factors which would be readily available to clinicians working with people with sight loss and have been considered in previous studies.

We also measured self-reported general health as this has consistently been shown to be a risk factor for depression[6 13-15] and can be easily measured using a single item question from the SF-12, "In general, would you say your overall health is: excellent, very good, good, fair or poor?". The question has had widespread use as a single-item measure, including in previous studies of visual impairment and depression[5 14] and has shown to be significantly and independently associated with specific health problems, use of health services, changes in functional status, recovery from episodes of ill health, mortality, and sociodemographic characteristics of respondents.[17]

To provide information on vision related factors for low vision practitioners who have access to this information, we also measured presenting corrected binocular visual acuity using ETDRS LogMAR and recorded time since vision loss in years. As previous studies have found no evidence of an association between

objective measures of visual acuity and depression[13-15], we were interested to see whether a subjective measure of visual function would be associated. Self-reported visual functioning was measured using the 7 item National Eye Institute Visual Function Questionnaire (NEI-VFQ 7) which includes a subset of questions from the National Eye Institute Visual Function Questionnaire that have previously been shown to be responsive to rehabilitation service intervention.[18] As the NEI-VFQ 7 is commonly reported in the published literature with Rasch analysis, we transformed the Likert responses using the Rasch derived scoring key provided by Ryan et al (2008)[18] to calculate a score for each completed questionnaire. A higher score indicates a greater perceived difficulty with visual functioning. Questionnaires with 3 or more missing items were counted as missing and excluded from the analysis.

Procedures

Participants who were eligible to take part in the study were sent a questionnaire in large print format containing the GDS-15, NEI-VFQ 7 and single-item question about health, along with their appointment letter at least one week before their low vision assessment. They were asked to complete the questionnaire at home, with assistance if needed, and to bring it along to their appointment. Those who did not return a completed questionnaire were given the opportunity to complete another copy at the clinic, before their appointment. The low vision practitioner reviewed the participant's responses with them at the start of the assessment and asked for their written consent to use their anonymised responses in the study. For those who consented, information on gender, date of birth, ethnicity, physical illness, ocular diagnosis, corrected ETDRS Log MAR acuity and time since vision loss first identified were recorded on a Case Report Form (CRF). Those who screened positive for depressive symptoms (GDS-15 score of ≥6) were offered entry to the DEPVIT trial if eligible, or a referral to their GP if not eligible.[19]

Case Report Forms completed by the clinicians were sent to the research coordinating centre at Cardiff University by secure FAX where the validity and completeness of the data was checked. Any missing or out of range data were queried with the practitioner and checked with clinical notes. Five percent of all CRFs and surveys were double entered. The error rate was less than 2% and identified errors were corrected. The number of eligible patients who did not complete the survey and the number who did not consent for their data to be used for research purposes were also recorded. The final dataset was then locked and transferred to the statistical team for analysis. The descriptive statistics were tabulated using SPSS Version 23 and the regression models were fitted using STATA Version 13.1.

Statistical analysis

Participant characteristics were summarised for those with significant depressive symptoms (GDS-15 ≥6) and those without (GDS-15 <6). Categorical variables were summarised as numbers and percentages and

continuous variables as medians with interquartile ranges. In all cases we report the number of participants for whom data was missing.

Where the GDS-15 was not fully completed, completed answers were totalled to give a final score provided that the number of questions not answered was 2 or less[5]. If 3 or more questions were unanswered, the GDS-15 data were regarded as missing and the participant excluded from the analysis.

Logistic regression was used to determine the independent relationship between each of the potential risk factors and significant depressive symptoms. The potential risk factors were initially included individually (univariable analysis) and then entered into a multivariable logistic regression analyses in blocks to determine which variables remain associated with significant depressive symptoms after controlling for the other factors. The events-per-variable was sufficient to allow inclusion of all potential risk factors, so no selection was required.[20] However, due to co-linearity, it was not possible to include both number and type of physical illnesses or both number and type of eye conditions. Therefore, a decision was made to include only number of illnesses and eye conditions, as it was hypothesized that burden of multiple diagnoses would be more important than type of diagnosis: those with multiple morbidity are at twice the risk of depression than those without multiple morbidity.[21] The variables were entered into the analysis in blocks, starting with the risk factors which could be most easily identified in routine clinics, and ending with those requiring more time or adaptation to practice to assess. The blocks were: 1) Demographics (gender/age/ethnicity), 2) Demographics and Physical Health (number of illnesses), 3) Demographics, Physical health and Eye health (number of eye conditions/visual acuity/time since vision loss), 4) Demographics, Physical Health, Eye health and Self-report measures (self-report health/visual functioning). We calculated the area under the ROC curve to quantify the overall ability of each (additional) block of variables to correctly discriminate between those with and without depression.

RESULTS

A total of 1323 consecutive adult patients attended the low vision rehabilitation clinics during the 30 month recruitment period. Of these, 312 were not screened for depression because the practitioner felt it was inappropriate at the time (because the patient was too ill, had dementia or was recently bereaved); or the patient had forgotten to complete the questionnaire and there was no time at the assessment; or they did not consent for their data to be used for research. An additional 21 patients had 3 or more missing items on the GDS-15 and were excluded, leaving a final sample size of 990 and a complete response rate of 74.8%. The median age of the participants was 79.0 years (IQR= 66.0 to 85.0), 62.2% were female (n=616) and 85% were white (n= 842). The overall prevalence of significant depressive symptoms was 42.5%. This varies very slightly

from our previously reported study (43%)[8] due to the methodology used in this study to calculate the total GDS-15 score (excluding those with ≥3 missing items).

Tables 1-4. outline the demographic characteristics of the participants, their physical health measures, eye health measures and self-report health and vision measures respectively, split by those with and without significant depressive symptoms. They also summarise the results of the univariable logistic regression using odds ratios (OR) presented with 95% confidence intervals (CI) and P values. The variables ethnicity, number of physical illnesses and number of eye conditions had a small number of participants in some categories, hence the categories were collapsed before being entered into the regression analysis. Both the original and collapsed categories are presented in the tables. Table 5 Summarises the results of the multivariable logistic regression using adjusted odds ratios (AOR) and are presented with 95% confidence intervals (CI) and P values.

Table 1. Summarises the demographic characteristics of those with and without significant depressive symptoms

Demographic Characteristics	**GDS-15 Score <6**	**GDS-15 Score ≥6**	**Total**	**Univariable logistic regression analysis**			
Total Sample, n (%)	569 (57.5%)	421 (42.5%)	990	**N**	**OR**	**95% CI**	**P Value**
Gender, n (%)							
Male^	201 (53.7%)	173 (46.3%)	374				
Female	368 (59.7%)	248 (40.3%)	616	990	0.78	0.60 to 1.01	0.064
Data missing	0	0	0				
Age (years), Median (IQR)	80.0 (72.0, 86.0)	77.0 (57.0, 85.0)	79.0 (66.0, 85.0)	948	0.82	0.74 to 0.90	<0.001
Data missing, n (%)	22 (52.4%)	20 (47.6%)	42				
Ethnicity, n (%)							
White	508 (60.3%)	334 (39.7%)	842				
Asian/Asian/British	12 (52.2%)	11 (47.8%)	23				
Black/Black British	40 (38.5%)	64 (61.5%)	104	Not entered into regression analysis~			
Other ethnic group	9 (45%)	11 (55%)	20				
Data missing	0 (0%)	1 (100%)	1				
Ethnicity (collapsed), n(%)							
White^	508 (60.3%)	334 (39.7%)	842				
Non-White	61 (41.5%)	86 (58.5%)	147	989	2.14	1.50 to 3.06	<0.001
Data missing	0 (0%)	1 (100%)	1				

^Reference category ~Collapsed categories entered instead

Table 2. Summarises the physical health of those with and without significant depressive symptoms

Physical health	GDS-15 Score <6	GDS-15 Score ≥6	Total	Univariable logistic regression analysis			
				N	OR	95% CI	P Value
Physical Illnesses*, n (%)							
Diabetes	119 (47.8%)	130 (52.2%)	249				
Epilepsy	8 (57.1%)	6 (42.9%)	14				
Stroke	31 (50.8%)	30 (49.2%)	61				
Thyroid	27 (47.4%)	30 (52.6%)	57				
Heart Disease	94 (50.3%)	93 (49.7%)	187	Not entered into regression analysis⁺			
High Blood Pressure	246 (55.5%)	197 (44.5%)	443				
Respiratory Disease	48 (59.3%)	33 (40.7%)	81				
Other	113 (48.9%)	118 (51.1%)	231				
No medical illness	113 (70.2%)	48 (29.8%)	161				
Data missing	4 (100%)	0 (0%)	4				
Total number of physical illnesses, n (%)							
0	113 (70.2%)	48 (29.8%)	161				
1	277 (60.6%)	180 (39.4%)	457				
2	127 (48.3%)	136 (51.7%)	263				
3	41 (47.7%)	45 (52.3%)	86	Not entered into regression analysis~			
4	4 (28.6%)	10 (71.4%)	14				
5	2 (50%)	2 (50%)	4				
6	1 (100%)	0 (0%)	1				
Data missing	4 (100%)	0 (0%)	4				
Total number of physical illnesses (collapsed categories), n (%)							
0^	113 (70.2%)	48 (29.8%)	161				
1	277 (60.6%)	180 (39.4%)	457		1.53	1.04 to 2.25	
2	127 (48.3%)	136 (51.7%)	263	986	2.52	1.66 to 3.82	<0.001
3 or more	48 (45.7%)	57 (54.3%)	105		2.80	1.68 to 4.66	
Data missing	4 (100%)	0 (0%)	4				

** Participants may have had more than one physical illness ⁺Not entered due to high correlation with number of physical illnesses ~Collapsed categories entered instead ^Reference category*

Table 3. Summarises the eye health of those with and without significant depressive symptoms

Eye health	GDS-15 Score <6	GDS-15 Score ≥6	Total	Univariable logistic regression analysis			
				N	OR	95% CI	P Value
Ocular Diagnosis*, n (%)							
AMD wet	117 (59.4%)	80 (40.6%)	197				
AMD dry	259 (64.6%)	142 (35.4%)	401				
Glaucoma	104 (63.0%)	61 (37%)	165				
Cataract	95 (70.4%)	40 (29.6%)	135	Not entered into regression analysis⁺			
Diabetic eye disease	59 (48.0%)	64 (52.0%)	123				
Other eye condition	157 (47.9%)	171 (52.1%)	328				
Data missing	1 (50%)	1 (50%)	2				
Total number of eye conditions, n (%)							
1	381 (56%)	299 (44.0%)	680				
2	153 (58.8%)	107 (41.2%)	260				
3	32 (72.7%)	12 (27.3%)	44	Not entered into regression analysis~			
4	2 (66.7%)	1 (33.3%)	3				
5	0 (0%)	1 (100%)	1				
Data missing	1 (50%)	1 (50%)	2				
Total number of eye conditions (collapsed), n(%)							
1^	381 (56.0%)	299 (44.0%)	680				
2	153 (58.8%)	107 (41.2%)	260	988	0.89	0.67 to 1.19	0.123
3 or more	34 (70.8%)	14 (29.2%)	48		0.52	0.28 to 1.00	
Data missing	1 (50%)	1 (50%)	2				
Corrected binocular visual acuity (logMar), Median (IQR)	0.60 (0.40, 0.94)	0.70 (0.50, 1.00)	0.67 (0.40, 1.0)	990	1.01	0.99 to 1.03	0.568
Data missing, n (%)	0	0	0				
Years since vision loss, Median (IQR)	5.5 (2.2, 12.0)	5.0 (2.1, 10.2)	5.2 (2.2, 11.1)	974	0.99	0.99 to 1.01	0.818
Data missing, n (%)	13 (81.25%)	3 (18.75%)	16				

** All ocular diagnoses - participants may have had more than one. ⁺Not entered due to high correlation with number of eye conditions ~Collapsed categories entered instead ^Reference category*

Table 4. Summarises the self-reported health and visual function of those with and without significant depressive symptoms

Self-report measures	GDS-15 Score <6	GDS-15 Score ≥6	Total	Univariable logistic regression analysis			
				N	OR	95%CI	P Value
Self-rated health (SF-12), n (%)							
Excellent	22 (95.7%)	1 (4.3%)	23		0.01	0.00 to 0.08	
Very Good	93 (86.1%)	15 (13.9%)	108		0.04	0.02 to 0.07	
Good	201 (72.6%)	76 (27.4%)	277	952	0.09	0.05 to 0.14	<0.001
Fair	192 (52.5%)	174 (47.5%)	366		0.21	0.13 to 0.32	
Poor^	33 (18.5%)	145 (81.5%)	178				
Data Missing	28 (73.7%)	10 (26.3%)	38				
Visual functioning* (NEI VFQ-7), Median (IQR)	0.23 (-1.43, 1.46)	1.41 (0.17, 2.49)	0.78 (-0.80, 1.91)	956	1.48	1.36 to 1.60	<0.001
Data missing n (%)	23 (67.6%)	11 (32.4%)	34				

*^Reference category *NEI VFQ-7 scores have been Rasch analysed and a higher score indicates a greater perceived difficulty with visual functioning.*

The variables ethnicity, number of physical illnesses and number of eye conditions had a small number of participants in some categories, hence the categories were collapsed before being entered into the regression analysis. Both the original and collapsed categories are presented in the tables. Table 5 Summarises the results of themultivariable logistic regression using odds ratios (OR) and adjusted odds ratios (AOR) and are presented with 95% confidence intervals (CI) and p values.

Block	Characteristic	Multivariable Block 1 N=947			Multivariable Block 2 N=943			Multivariable Block 3 N=926			Multivariable Block 4 N=877		
		AOR	**95% CI**	**P**	**AOR**	**95% CI**	**P**	**AOR**	**95% CI**	**P**	**AOR**	**95% CI**	**P**
1. Demographics	**Gender: Reference category male**												
	• Female	0.87	0.66 to 1.14	0.311	0.89	0.67 to 1.17	0.390	0.90	0.68 to 1.19	0.462	0.85	0.61 to 1.19	0.350
	Age (per decade)	0.82	0.82 to 0.90	<0.001	0.82	0.74 to 0.90	<0.001	0.82	0.74 to 0.90	<0.001	0.82	0.66 to 0.90	<0.001
	Ethnicity: Reference category white												
	• Non-white	1.54	1.05 to 2.27	0.027	1.64	1.10 to 2.43	0.014	1.61	1.08 to 2.40	0.020	1.72	1.05 to 2.81	0.031
2. Physical Health	**Total illnesses: Reference category 0 illness**												
	• 1 illness				2.06	1.34 to 3.18		2.09	1.36 to 3.24		1.28	0.77 to 2.13	
	• 2 illnesses				3.55	2.23 to 5.65	<0.001	3.62	2.26 to 5.78	<0.001	1.96	1.14 to 3.37	0.051
	• 3 + illnesses				3.91	2.24 to 6.82		4.02	2.27 to 7.11		1.68	0.86 to 3.29	
3. Eye Health	**Total eye conditions: Reference category 1 cond.**												
	• 2 conditions							0.91	0.66 to 1.27		0.98	0.67 to 1.43	
	• 3 + conditions							0.48	0.24 to 0.96	0.114	0.34	0.15 to 0.75	0.026
	Visual acuity							1.00	0.98 to 1.03	0.929	1.00	0.97 to 1.03	0.942
	Time since vision loss (per year)							0.99	0.98 to 1.00	0.075	0.99	0.98 to 1.00	0.244
4. Self-report Measure	**Subjective Health: Reference category poor**												
	• Excellent										0.01	0.00 to 0.12	
	• Very Good										0.06	0.03 to 0.13	
	• Good										0.14	0.08 to 0.24	<0.001
	• Fair										0.28	0.18 to 0.46	
	Visual Functioning										1.45	1.31 to 1.61	<0.001
Area Under ROC Curve		0.59			0.65			0.65			0.81		

Table 5. Summaries the results of the multivariable regression analyses, with blocks of variables added sequentially to the model.

Demographics

Table 1. Shows that those with a higher prevalence of significant depressive symptoms were male, younger or non-white. In the univariable analysis, age and ethnicity were associated with significant depressive symptoms. An increase in age was associated with lower odds of participants having depression and having ethnicity other than white was associated with higher odds of having depression . These variables remain associated once other variables were controlled for in the multivariable analysis final model (Table 5.). There was no evidence of an association between gender and significant depressive symptoms.

Physical health

The prevalence of depression was lowest in those with no physical illness (29.8%) and highest in those with three or more illnesses (54.3% - Table 2.). In the univariable analysis, an increase in the number of physical illnesses was associated with higher odds of having significant depressive symptoms. This association remained when controlling for demographics and eye health but was no longer associated when controlling for subjective health and visual function.

Eye health

Those with a higher prevalence of depression had one eye condition, worse visual acuity or less time since vision loss (Table 3.). The univariable analysis found no evidence of an association between significant depressive symptoms and number of eye conditions, visual acuity and time since vision loss. However, when controlling for other factors in the final model, an increase in the number of eye conditions was associated with lower odds of having significant depressive symptoms.

Self-report measures

The prevalence of depression was highest in those with poor self-rated health (81.5%) and lowest in those with excellent health (4.3%). Those with significant depressive symptoms had worse self-rated visual functioning (Table 4.). Worse self-rated health and visual functioning were associated with higher odds of having significant depressive symptoms in both the univariable analysis and multivariable final model.

The area under the ROC curve was 0.59 when demographics alone were entered into the model, increasing to 0.65 when physical and eye health variables were considered, and reaching 0.81 when self-report measures were added.

DISCUSSION

This study identified the risk factors for significant depressive symptoms in people with vision impairment attending vision rehabilitation clinics in England and Wales. We focused mainly on risk factors which can be easily identified in primary care and general hospital clinics, so as to provide a pragmatic approach to identifying high risk patients. To inform ophthalmic clinicians who may have access to more detailed information on eye health, we also included a range of vision related variables. Our findings showed that amongst older adults, those of relatively younger age, with an ethnicity other than white, and poorer self-reported health and visual function had higher odds of having significant depressive symptoms. Number of physical illnesses was an independent predictor of depressive symptoms, but there was no evidence of an association when controlling for subjective health and vision function. The number of eye conditions was not an independent predictor of depressive symptoms, but was related to depression when other variables were controlled: less number of eye conditions was associated with higher odds. There was no evidence that gender, time since vision loss and visual acuity were associated with depression.

With regard to demographic factors, our findings demonstrate some support for, and discrepancies with, previous studies. In a study with an Australian population[14], a univariate analysis provided evidence that younger age was associated with depressive symptoms, and in a European and Australian sample (relatively) younger age was shown to be associated with subthreshold depression in a multivariable analysis[13]. Our study corroborates these findings in a UK sample. This perhaps reflects the finding in the general population that people aged 40–59 years have higher rates of depression than those aged ≥60 years[22] and those in middle-age have the highest risk[23]. The reasons for this are not clearly understood, but one theory is that by mid-life, individuals have learnt to adapt to their strengths and weaknesses, and in mid-life 'quell their infeasible aspirations' [23]. In those with vision loss, being affected in middle-age rather than old age may add to this sense of lost aspirations and could also result in more restriction in life including difficulties in finding and staying in work, playing sport etc. Our research found no evidence of an association between gender and depressive symptoms. Previous studies examining this association have differed in their findings. An Australian study showed no association in a univariate analysis[14], whilst a model with a European and Australian sample found being female was a predictor of subthreshold depression[13]. The authors of a study with Dutch and Belgian participants reported that their findings on gender were inconclusive[15]. Differences in findings across the studies may indicate this factor is country specific, or may be due to differences in the measures used to assess depression. For example, we included people with all levels of depressive symptoms, whereas the European/Australian study included only subthreshold depression. It may be that being female is associated with subthreshold depression but there is no association when all levels of severity are considered. We found that having an ethnicity other than white was a risk factor. Recent studies on vision impairment and depression have not measured ethnicity, however an earlier study conducted in New Zealand found that ethnicity was not related to depression[24]. Differences between that study and ours may be due to the different populations,

with a wider variation in ethnicities in the UK and London in particular. The New Zealand study only recorded 'New Zealand born European' or 'other'. Therefore, future studies should include ethnicity as a variable to provide further clarification.

There is more consistency between European and Australasian studies and our UK study in terms of health. We demonstrated that those with poorer self-reported health were at much higher risk of depressive symptoms. This confirms previous research in vision impaired people which has shown that poorer perceived health status[13], poorer self-reported health[14] and poorer health related quality of life[24] are all predictors of depression. This is not surprising as patients may include their emotional health in a question about general health. Our study also found that a higher number of physical illnesses was an independent risk factor for depression. This is in line with findings from the non-vision impaired population. A recent meta-analysis found a substantial relationship between multimorbidity (the presence of two or more chronic physical illnesses) and depression, reporting that people with multimorbidity are at twice the risk of depression to those without multimorbidity, and nearly three times at risk compared to those with no chronic physical condition[21]. The authors suggest the relationship is bi-directional and cite the Activity Restriction Model of Depressed Affect[25] which explains that multimorbidity contributes significantly to depressive symptoms through having to give up valued activities due to physical limitations. In our sample, the limitations of conditions such as stroke and diabetes may have compounded any mobility and functional issues already caused by sight loss, which can make self-care, engaging in hobbies and getting out and about more difficult.

In terms of vision related factors, it is logical to assume that the chances of having depressive symptoms increases as visual acuity decreases. However, in line with other European and Australian studies[13-15], the results of the regression analysis do not support this hypothesis. What seems to be more important is self-reported visual function: those with worse self-reported visual function are more at risk of depressive symptoms[26]. Therefore clinicians should take care not to make assumptions about the likelihood of depression in only those with the lowest levels of vision as assessed by visual acuity. The relationship is likely to be bidirectional, with poorer visual function leading to loss of valued activities and mood, whilst lowered mood may influence a person's perception of their vision function. As with previous studies[13 15], time since the vision loss was first identified was also not a predictor of depression, indicating that patients may develop symptoms at any point on their sight loss journey. The more surprising finding was that people with three or more eye conditions had lower odds of having significant depressive symptoms than those with just one eye condition. On consultation with the literature, we suggest this finding may be explained in terms of acceptance: lower acceptance of vision loss has shown to be a predictor of subthreshold depression[13]. In their work with people with diabetic eye disease and partial sight loss (some of whom also had glaucoma), Oehler-Giarratana and Fitzgerald report that patients described being in a state of "limbo" where they experienced uncertainty, fear and hope that vision might improve[27]. Perhaps surprisingly, they expressed the view that total loss of vision

would be a relief, as they could proceed through a healing phase and make plans for their future care. In our study, it is possible that those with three or more eye conditions had come to terms with the likelihood of further vision loss and reached a point of acceptance, whereas those with one eye condition were in the "limbo" phase, with the hope that sight may improve but the fear that it might deteriorate, and therefore not reached this point of acceptance thus increasing their risk of depressive symptoms. None of the studies referred to in our introduction included number of eye conditions as a risk factor, and we could not find any studies which included both number of eye conditions and level of acceptance. Therefore, further research is needed to better understand this finding and possible explanation. Our research suggests that not all of the factors related to depressive symptoms in people with vision impairment are specific to that particular population. As with the general population, age, ethnicity and health are associated with risk of depression and this needs to be taken into consideration when understanding the link between vision impairment and depression, and when considering suitable interventions.

This research added to the literature by examining risk factors in a British sample of people with vision impairment. The study benefited from a large sample size and a high response rate, enhancing the generalisability of the findings. As we included 14 low vision rehabilitation clinics across primary and secondary care, we believe the findings are transferrable to both settings in the UK. Our study employed validated measures of depressive symptoms and incorporated risk factors which are easy to identify in primary care and hospital clinics. Therefore the results can be easily integrated in clinical practice to target screening.

However, inevitably there were some value judgements in how we chose our criteria for selecting the range of potential factors in our study. This means that other parameters which have previously been shown to be predictors of depression, for example, vision specific distress, lower perceived adequacy of social support and avoidant coping[14], were not measured and therefore cannot be included in the risk profile advice to clinicians. These parameters can only be assessed using additional questionnaires which would have increased the overall response burden in the study and furthermore, it is unlikely that these variables would be measured in routine practice and therefore were not within the scope of our study.

We chose to dichotomise the GDS-15 to reflect how it would be used in practice, as a screening tool for identifying patients who would benefit from screening in clinic and potentially signposting to support services. However, we acknowledge that this may have led to a reduction in power and loss of information.[28]A further limitation of the study is the use of a cross-sectional design, which means conclusions about direction of causality are not possible. Finally, whilst the completion rate of the GDS-15 was high, a number of patients were not screened at the discretion of the practitioners, including because they felt the patient was too ill, had dementia or had recently been bereaved, or they did not consent for their answers be used for research. Therefore there may be a risk of bias as the non-completers may be systematically different from those that

completed the questionnaire and consented to their data being used. Similarly, we excluded cases with missing data from the multivariable analysis and this simple approach to missing data may have introduced some bias. However, as only 113/990 (11%) were excluded, the risk of bias is low

For the first time, for a population in England and Wales, our study demonstrates that for patients with vision impairment, there are several risk factors for depression which can be easily identified by those coming in to contact with people with sight loss. We recommend that all clinicians working with people with sight loss are alert to these factors. We advise screening higher risk patients using the simple two question screen recommended in the NICE guidelines[12]. If a patient is identified as having likely depression they should be managed according to the guidelines, which includes referral to an appropriate professional, for example, the GP. Local pathways should be established to manage this referral. However, because the prevalence of depressive symptoms is so high in low vision clinics, we recommend that low vision practitioners introduce depression screening as part of routine care with all patients.

Future research could include qualitative work to clarify the pathway from the risk factors identified here to the onset of depression, to aid the development of interventions for depression in this population.

ACHNOWLEDGEMENTS

The authors wish to thank the following for data collection: Sandra Jumbe, Rowanne Black, Kathy Davies, Denise Banford, Ian Cousins, Huw Bellamy, Norma Davies, Ceri Goodman, Sharon Beatty, Lisa Evans, Leighton Griffiths, Matthew Harvey, David Jenkins, Jane Savage, Marek Karas, John Butler, Seema Rajoria, Rajiv Raja, Jane De Courcy, Ahalya Subramanian, Sonal Rughani and Sarah Janikoun.

FOOTNOTES

Contributors: TM, DS, RTE and MS conceived the idea for the study and acquired funding. CN project managed the study, supervised data collection, performed data cleaning, statistical analysis and wrote the first draft of the manuscript. CB and BR substantially contributed to the design of the study and to the acquisition of data. NB and RC contributed to the design of the study. DG provided statistical advice and supervision. All authors contributed to the design of the protocol, critically reviewed the manuscript for important intellectual content and approved the final manuscript.

Funding: The work was supported by Guide Dogs grant number OR2009-07b.

Competing interests: None declared.

Patient consent: Not required – no identifiable information from a living individual included.

Ethics approval: The NHS South East Wales Research Ethics Committee Panel B approved this study.

Data sharing statement: There is no additional unpublished data from this study.

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies (Nollett et al)*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6, 7
Bias	9	Describe any efforts to address potential sources of bias	*7*
Study size	10	Explain how the study size was arrived at	-
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7, 8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8
		(*e*) Describe any sensitivity analyses	-
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9, 10, 11
		(b) Indicate number of participants with missing data for each variable of interest	9, 10, 11
Outcome data	15*	Report numbers of outcome events or summary measures	9-13
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9-13
		(*b*) Report category boundaries when continuous variables were categorized	6
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	16
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	18
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	16-18
Generalisability	21	Discuss the generalisability (external validity) of the study results	17/18
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.