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**MINIREVIEWS**

- 125 Neuropsychiatric issues after stroke: Clinical significance and therapeutic implications  
*Zhang S, Xu M, Liu ZJ, Feng J, Ma Y*

**ORIGINAL ARTICLE**

**Observational Study**

- 139 Visual impairment and depression: Age-specific prevalence, associations with vision loss, and relation to life satisfaction  
*Brunes A, Heir T*

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## Observational Study

**Visual impairment and depression: Age-specific prevalence, associations with vision loss, and relation to life satisfaction**

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**Informed consent statement:** All participants gave their informed consent to take part in the study.

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**Abstract****BACKGROUND**

To our knowledge, no study has obtained specific estimates of depression for young and middle-aged adults with visual impairment (VI). As estimates of depression varies across age groups in the general population, it is of interest to examine whether the same applies to adults with low vision or blindness.

**AIM**

To estimate depression prevalence and its association with VI-related characteristics and life satisfaction in adults with VI.

**METHODS**

A telephone-based cross-sectional survey was conducted between January and May 2017 in an age-stratified sample of adults who were members of the Norwegian Association of the Blind and Partially Sighted. Participants were asked questions about their sociodemographic characteristics, VI characteristics, and life satisfaction. Depression was measured with the Patient Health Questionnaire. The diagnostic scoring algorithm was used to calculate the point prevalence of depression (*i.e.*, major depression and other depressive disorders) across categories of gender and age (years: 18-35, 36-50, 51-65, ≥ 66). The associations were estimated using regression models.

**RESULTS**

Overall, 736 adults participated in the study (response rate: 61%). The prevalence estimates of depression varied across different age groups, ranging from 11.1%-22.8% in women and 9.4%-16.5% in men, with the highest rates for the two youngest age groups. Results from the multivariable models including sociodemographic and VI-related variables showed that losing vision late in life [Prevalence ratio (PR), 1.76, 95% CI: 1.11, 2.79] and having other impairments (PR:

given by each participant, the data are to be stored properly and in line with EU Regulation 2017/679 (General Data Protection Regulation (GDPR)). However, anonymized data is available to researchers who provide a methodologically sound proposal in accordance with the informed consent of the participants. Interested researchers can contact project leader Trond Heir (trond.heir@medisin.uio.no) with a request for our study data.

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1.88, 95%CI: 1.32, 2.67) were associated with higher rates of depression, whereas older age was associated with lower rates (PR: 0.83, 95%CI: 0.74, 0.93). Additionally, participants who were depressed had lower life satisfaction than those who were not depressed (adjusted  $\beta$ : -2.36, 95%CI: -2.75, -1.98).

## CONCLUSION

Our findings suggest that depression in adults with VI, and especially among young and middle-aged adults, warrants greater attention by user organisations, clinicians, and healthcare authorities.

**Key words:** Blindness; Depression; Life satisfaction; Major depression; Vision loss; Visual impairment

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**Core tip:** Depression in people with visual impairment (VI) goes often unrecognized and untreated, yet knowledge about its occurrence can help to inform the design of mental health services targeting the specific population. The study's findings of a high rate of depressive disorders in adults with VI, particularly among young and middle-aged adults, should in part be interpreted in the light of the extensive stigma, discrimination, isolation, and loneliness that they experience. For depressed adults with VI, the consequences may be severe in terms of a lower quality of life.

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## INTRODUCTION

Visual impairment (VI) refers to a substantial and often irreversible loss in one of the functions of the visual system<sup>[1]</sup>. About 1.3 billion people are classified with near or distance VI on a global basis<sup>[2,3]</sup> and the numbers are projected to increase in the future due to an aging population and the greater burden of vision-threatening conditions such as diabetes and stroke<sup>[2]</sup>. Researchers, clinicians and others often refer to VI as a single entity, but VI is, in fact, a highly heterogeneous condition in terms of the visual function affected, onset age, severity, cause, and prognosis of vision loss. A distinction is often made between congenital and acquired vision loss, and between moderate VI, severe VI and blindness<sup>[1]</sup>.

The literature on depression in people with VI is quite extensive<sup>[4-12]</sup>, with many studies suggesting a link between vision loss and depression<sup>[6-8,10,12]</sup>. However, the prevalence estimates for depression have been found to vary greatly across studies. A meta-analysis of depression or depressive symptoms in people with vision-related conditions revealed that the prevalence estimates ranged between 5% and 57%, with a mean of 25%<sup>[12]</sup>. Much of the variation in the reported prevalence estimates is related to the inclusion of small and non-representative samples. In addition, most of the studies have been restricted to specific vision conditions or to older adults. Of studies involving young and middle-aged adults from the VI population<sup>[8,11]</sup>, none have estimated the prevalence of depression for these age groups. As estimates of depression differ across different age groups in the general population<sup>[13,14]</sup>, it is of interest to examine whether the same applies to adults with low vision or blindness.

Most studies of people with VI have relied on symptom rating scales in their screening for depression, while few studies have estimated the prevalence of depressive disorders<sup>[12,15,16]</sup>. Although clinical interviews are considered the gold standard for diagnostic classification, the impracticability of interviews in large surveys has led to the development of brief screening tools that match the criteria set in official diagnostic systems. One such questionnaire is the nine-item Patient Health Questionnaire (PHQ-9)<sup>[17]</sup>. The PHQ-9 has been applied in research on people with various health conditions<sup>[18]</sup>. Furthermore, the operational characteristics of the PHQ-9 are either equal or superior to other depression measures<sup>[18]</sup>, and the results of a recent

meta-analysis, which included 40 studies, have confirmed its validity as a diagnostic measure in primary care settings (sensitivity: 41%-71%; specificity: 88%-97%)<sup>[19]</sup>.

There is little consensus in the literature about whether there are certain subgroups of the VI population at greater risk of developing depression than others. Earlier research has mostly focused on the association between the severity of vision loss and depression<sup>[4,7,9,11,16,20-22]</sup>, often finding no relationships<sup>[4,5,7,11,20-22]</sup>, whereas more inconsistent evidence has been reported for factors such as the duration and cause of vision loss<sup>[4,9,22]</sup>. Furthermore, we have not identified any publications related to the risk of depression among adults with congenital or childhood vision loss, and more research is therefore needed.

We conducted a cross-sectional study that included a large, age-stratified sample of Norwegian adults with VI. Data were obtained *via* structured telephone interviews, and the PHQ-9 was used to obtain a probable diagnosis of current depression. This study had three main aims: To estimate the point prevalence of depressive disorders in stratified age groups of adults with VI; to examine whether depression was associated with different characteristics of vision loss; and to describe the association between depression and life satisfaction.

## MATERIALS AND METHODS

### **Ethical considerations**

The Regional Committee for Medical and Health Research Ethics was sought, and the committee confirmed that the study required no formal ethical approval as it was carried out in accordance with principles of anonymized data (Reference number: 2016/1615A). Prior to the survey, the participants were informed about all aspects of the research project, including potential risks and the voluntary nature of the survey. The participants consented by completing the interviews. No identifying information was collected.

### **Design and participants**

An anonymous cross-sectional survey was conducted in an age-stratified sample of adult members (aged  $\geq 18$  years) of the Norwegian Association of the Blind and Partially Sighted. For a person to be granted full membership of the organization, he or she needs to enclose in their application form medical documentation of either VI or an untreatable eye condition that will progress towards low vision or blindness. Data were collected between January and May 2017, through structured telephone interviews. The interview guide contained more than 120 questions covering a wide range of topics, including sociodemographic factors, cause and onset of vision loss, serious life events, coping, mental health, and quality of life. Each interview took about 30 min to complete.

Most people with VI are of old age<sup>[1]</sup>. We therefore used an age-stratified sampling technique to allow for more precise estimations across all age groups in the adult VI population. First, the study population was divided into four age groups (years: 18-35, 36-50, 51-65,  $\geq 66$ ) and then we surveyed an equal number of members across the different age groups. The sample size calculations showed that it was desirable to enrol about 200 participants to estimate a prevalence with a precision of  $\pm 5\%$ , at a 95% confidence interval (CI), within each age group<sup>[23]</sup>. The calculations were founded on the assumption that the prevalence for different mental health outcomes would not exceed 15% in the study population. We almost reached our target, ending up with 156-200 participants per age group. A flow chart of the sample selection is provided elsewhere<sup>[24]</sup>.

### **Assessment and evaluation**

**Depression:** Depression was assessed by the nine-item PHQ depression module (PHQ-9), with one item anchored to each of the nine symptoms required to establish a probable diagnosis of depression (*i.e.*, major depression and other depressive disorder) based on the criteria listed in the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV)<sup>[18]</sup>. The PHQ-9 also matches the new DSM-V criteria<sup>[25]</sup>. The participants were presented a list of nine symptoms, and instructed to indicate how often they have experienced each symptom during the past two weeks. The response alternatives were: (0) "not at all"; (1) "several days"; (2) "more than half of the days"; and (3) "nearly every day". In the study, the PHQ-9 had a Cronbach's alpha of 0.84.

We categorized depressive disorders using the DSM-based diagnostic algorithm created by Spitzer *et al*<sup>[17]</sup>. To be classified with major depression, the algorithm requires that at least five symptoms are scored as 2 ("more than half of the days") (1,

“several days” for the suicidal ideation item), in which one of the symptoms is anhedonia or depressed mood. For other depressive disorders, two to four symptoms, including anhedonia or depressed mood, are endorsed with a score of at least 2 (“more than half of the days”) (“several days” for suicidal ideation). A final item assesses functional limitations caused by the depressive symptoms, and in our study, it included the following four response alternatives: “No difficulties”, “somewhat difficult”, “very difficult”, and “extremely difficult”. We categorized the item into a dichotomous variable (“no difficulties”, “difficulties”).

**Life satisfaction:** Cantril’s Ladder of Life Satisfaction was employed in the questionnaire to measure current life satisfaction<sup>[26]</sup>. The participants were asked to imagine a ladder with 10 steps, with the bottom step representing the worst possible life (a score of 1) and the top step representing the best possible life (a score of 10). The scale was treated as an untransformed continuous variable in the main analyses.

**Referral to psychologist:** During the study it became apparent that the need for professional help was large and unmet in the sample population. Based on early feedback we received from the participants, we decided to offer referrals for psychological counselling for the subsequent participants (421 of 736 participants). Patients were referred to psychological counselling for subjectively experienced mental disorder with the desire for professional help. The psychologist recorded the number of participants who met for counselling and the main themes of the consultations.

**Independent variables:** The participants were asked questions about their age (years: 18-35, 36-50, 51-65,  $\geq 66$ ), gender, education (years:  $< 11$ , 11-13,  $\geq 14$ ), native origin (Norwegian, non-Norwegian), place of residence (village/town, small or large city), the current status of their vision loss (stable, progressive), and whether they had other impairments (no, yes). Moreover, the severity of vision loss was assessed by asking the following question: “How good is your current vision (better-seeing eye, with glasses or contact lenses)”. The question had the following response alternatives: “blind”, “severely impaired”, “moderately impaired”, and “unspecified”. As only 42 participants reported unspecified VI, we chose to merge the unspecified VI category with the category moderately impaired because we considered those participants to have a lower degree of vision loss than those who reported severe impairment and blindness. Lastly, we created an “age of VI onset” variable by subtracting the participant’s age with the number of years since VI onset. The variable was categorized into the following three categories: “Congenital”, “childhood/adolescence (2-24 years)”, and “adulthood ( $\geq 25$  years)”.

### Statistical analysis

All statistical analyses were performed using Stata Version 15 (Stata Corp., Texas, United States). The significance level was set at  $P = 0.05$ . Descriptive statistics included frequencies and percentages, and differences in frequency counts were assessed by Pearson’s chi-squared or Fisher’s exact tests. To account for the age-stratified sampling method, we tested in all analyses whether the estimates varied across the different age groups (years: 18-35, 36-50, 51-65,  $\geq 66$ ) by performing statistical analyses of cross-tabulated data or by including a product term between age and each independent variable in a regression model.

Depressive disorders involved major depression and other depressive disorders. We estimated the point prevalence and corresponding 95% exact CIs for all depressive disorders separately for women and men and for each of the four age groups. Next, to explore differences between classification methods, we performed supplementary analysis by using the sum score method of the PHQ-9 dichotomized into no or mild depression (a sum score  $< 10$ ) and moderate to severe depression (a sum score  $\geq 10$ )<sup>[18]</sup>. A sum score of 10 or higher has been recommended as the most optimal cut-off in screening for major depression<sup>[18,19]</sup>.

Binomial generalized linear models with log-link function were used to derive unadjusted and adjusted estimates of associations between the independent variables (sociodemographic factors and VI characteristics) and depression<sup>[27]</sup>. The results were presented in terms of prevalence ratios (PRs) and 95% CIs. We did not include national origin and municipality size in the adjusted models because the full model resulted in less accurate estimates of the independent variables<sup>[28]</sup>. To reduce the risk of sparse data bias, we decided to model age (10-year intervals) and education as continuous variables. This decision had minor impact on the model fit.

The association between depression and life satisfaction was estimated using linear regression. The models were either unadjusted or adjusted for all indicated covariates. Our data met all assumptions relating to linear regression, and we did not find any impact from outliers or multi-collinearity on the main results.

**Statistical review**

The statistical methods of the study were reviewed by Ragnhild Sørum Falk, PhD, Oslo University Hospital (e-mail: Rs@ous-hf.no).

**RESULTS**

A total of 1216 members were contacted, of which 736 participated (response rate: 61%). We had no additional sources of missing data; all participants answered all questions and none of the participants chose to withdraw from the study after completing the interviews. The characteristics of the VI population for women and men are listed in [Table 1](#). Women were more likely than men to be of non-Norwegian origin and to have self-reported moderate VI. There were no gender differences in age, education, native origin, place of residence, onset-age or current status of vision loss, or whether the participants had any other impairments.

**Point prevalence of depressive disorders**

The results presented in [Table 2](#) show the prevalence of depressive disorders in the VI population according to participants' age and gender. The point prevalence varied in different age groups between 4.2% and 15.6% for major depression (women: 5.6%-17.8%, men: 2.4%-12.9%), 4.0% and 6.2% for other depression (women: 3.8%-5.6%, men: 3.5%-7.1%), and 10.3% and 19.9% for any depression (women: 11.1%-22.8%, men: 9.4%-16.5%). Overall, the estimates were highest in the age group 36-50 years and lowest in the age group 66 years or above. There were no statistically significant differences between women and men (results not shown).

We then performed a supplementary analysis by estimating the proportion of the study population with moderate to severe levels of depression. Although this type of categorization resulted in higher rates of depression, the results from the analysis supported our main findings of severe depression being most prevalent among the youngest participants ([Online Supplementary Table 1](#)).

**Associated factors of depression**

The unadjusted and adjusted PRs for depressive disorders across different characteristics of the VI population are listed in [Table 3](#). Having additional impairments, losing vision in adulthood, and having progressive vision loss were associated with a higher prevalence of depression in the unadjusted models. In contrast, lower rates of depression were found with older age. In the fully adjusted models, the PRs did not change much after adjusting for age, gender, education, and all indicated VI characteristics, except that the VI stability variable turned out to be non-significant. Depression was not related to gender, education or the severity of VI. There were no statistical interactions between age and any of the other independent variables ( $P > 0.05$ ).

**Functional limitations**

Eighty-seven percent of depressed participants reported functional limitations in daily life, against 47% in those without depression. There was also a somewhat higher rate of functional limitations among depressed participants in the two youngest age groups (18-35 years and 36-50 years) than found among the older participants ( $P = 0.10$ ).

**Life satisfaction**

The life satisfaction of participants with any depressive disorder was considerably lower than that of participants without depression (mean: 4.64 *vs* 7.18,  $\beta$  -2.54, 95% CI: -2.93, -2.16). The strength of the association remained similar after adjusting for age, gender, education, national origin, municipality size, and each of the four VI variables ( $\beta$  -2.36, 95% CI: -2.75, -1.98). None of the interactions involving age and the other independent variables reached statistical significance ( $P > 0.05$ ).

**Referral to a psychologist**

Among the 421 participants that were offered mental health care, 45 (10.7%) participants had a consultation with a psychologist, with similar rates across the different age groups ( $P = 0.91$ ). Of the 45 referred to counselling, 30 (8.4%) had no depression, 13 (28.9%) had major depression, and 2 (10.0%) had other depression ( $P < 0.001$ ). The main themes of the consultations were related to minority stress and struggles in handling stigma that had been internalized in many cases. Other important themes were feelings of marginalization and the violation of basic human rights. Some participants described that having VI involved feelings of anxiety.



**Table 1 Characteristics of the sample by gender**

Characteristics	Total (n = 736), n (%)	Women (n = 403), n (%)	Men (n = 333), n (%)	P value <sup>1</sup>
Age <sup>2</sup>				0.93
18-35 yr	157 (21.3)	88 (21.8)	69 (20.7)	
36-50 yr	186 (25.3)	101 (25.1)	85 (25.5)	
51-65 yr	200 (27.2)	106 (26.3)	94 (28.2)	
≥ 66 yr	193 (26.2)	108 (26.8)	85 (25.5)	
Education				0.20
< 11 yr	115 (15.6)	69 (17.1)	46 (13.8)	
11-13 yr	286 (38.9)	162 (40.2)	124 (37.2)	
≥ 14 yr	335 (45.5)	172 (42.7)	163 (49.0)	
Native origin				0.006 <sup>b</sup>
Norwegian	645 (87.6)	341 (84.6)	304 (91.3)	
Non-Norwegian	91 (12.4)	62 (15.4)	29 (8.7)	
Place of residence				0.21
Village/town	399 (54.2)	227 (56.3)	172 (51.7)	
Small or large city	337 (45.8)	176 (43.7)	161 (48.3)	
VI severity				0.05 <sup>a</sup>
Moderate	254 (34.5)	155 (38.5)	99 (29.7)	
Severe	296 (40.2)	152 (37.7)	144 (43.2)	
Blindness	186 (25.3)	96 (23.8)	90 (27.0)	
Age of VI onset				0.24
Congenital	330 (44.8)	118 (46.7)	142 (42.6)	
Childhood/adolescence	142 (19.3)	69 (17.1)	73 (21.9)	
Adulthood	264 (35.9)	146 (36.2)	118 (35.4)	
Current VI status				0.06
Stable	523 (74.5)	275 (68.2)	248 (74.5)	
Progressive	213 (25.5)	128 (31.8)	85 (25.5)	
Other impairments				0.46
No	478 (64.9)	257 (63.8)	221 (66.4)	
Yes	258 (35.1)	146 (36.2)	112 (33.6)	

<sup>a</sup>P < 0.05.

<sup>b</sup>P < 0.01.

<sup>1</sup>P-value derived from Pearson’s Chi-squared test.

<sup>2</sup>The sample had a mean age of 51.4 years (SD: 17.2), 51.7 for women and 51.1 for men. VI: Visual impairment.

## DISCUSSION

### Key findings

In our cross-sectional study we found that the prevalence of having any depressive disorder varied considerably across the four age groups, with 11%-23% in women and 9%-17% in men, and with highest rates for the youngest participants. Losing vision in adulthood and having addition impairments were found to be independently associated with increased rates of depression, whereas older age was associated with decreased rates. Furthermore, participants who were depressed had considerably lower life satisfaction compared with those who were not depressed.

### Strengths and limitations

Our study is the largest study to date to address the prevalence of depression in VI populations across the entire adult age range, and the first to report estimates of other depressive disorder. The stratified sampling procedure made it possible to obtain robust depression estimates in all four age groups. The use of telephone interviews, the good response rate, and the lack of missing data increased the validity of the study findings.

Our study had also some limitations. First, it relied on cross-sectional data, which restricted our ability to make causal inferences about the observed associations. Second, the rates of PHQ-defined depressive disorders were not validated by a clinical interview and therefore the estimates reflected a probable diagnosis instead of

**Table 2** The point prevalence of depressive disorders in the visual impairment population by age and gender

Disorders	Cases/total	Total (n = 736) (95%CI)	Women (n = 403) (95%CI)	Men (n = 333) (95%CI)
Major depression				
18-35 yr	18/157	11.5 (6.9, 17.5)	12.5 (6.4, 21.3)	10.1 (4.2, 19.8)
36-50 yr	29/186	15.6 (10.7, 21.6)	17.8 (10.9, 26.7)	12.9 (6.6, 22.0)
51-65 yr	14/200	7.0 (3.9, 11.5)	7.6 (3.3, 14.3)	6.4 (2.4, 13.4)
≥ 66 yr	8/193	4.2 (1.8, 8.0)	5.6 (2.1, 11.7)	2.4 (0.3, 8.2)
P value		0.003 <sup>b</sup>	0.05 <sup>a</sup>	0.08
Other depression				
18-35 yr	7/157	4.5 (1.8, 9.0)	4.6 (1.3, 11.2)	4.4 (0.9, 12.2)
36-50 yr	8/186	4.3 (1.9, 8.3)	5.0 (1.6, 11.2)	3.5 (0.7, 10.0)
51-65 yr	8/200	4.0 (1.7, 7.7)	3.8 (1.0, 9.4)	4.3 (1.2, 10.5)
≥ 66 yr	12/193	6.2 (3.3, 10.6)	5.6 (2.1, 11.7)	7.1 (2.6, 14.7)
P value		0.76	0.95	0.75
Any depression				
18-35 yr	25/157	15.9 (10.6, 22.6)	17.1 (9.9, 26.6)	14.5 (7.2, 25.0)
36-50 yr	37/186	19.9 (14.4, 26.4)	22.8 (15.0, 32.2)	16.5 (9.3, 26.1)
51-65 yr	22/200	11.0 (7.0, 16.2)	11.3 (6.0, 18.9)	10.6 (5.2, 18.7)
≥ 66 yr	20/193	10.3 (6.5, 15.6)	11.1 (5.9, 18.6)	9.4 (4.2, 17.7)
P value		0.07	0.59	0.16

<sup>a</sup>P < 0.05.<sup>b</sup>P < 0.01.

diagnosed depression. Researchers have been concerned about the possibility that standard rating scales could overestimate the prevalence of depression in VI populations, given that certain depressive symptoms and especially somatic symptoms bear resemblance to complications of vision loss<sup>[4,7]</sup>. However, the PHQ algorithm method used in our study may produce fewer false positives than continuous cut-off scores, as it puts more weight on the core symptoms of depression (*i.e.*, depressed mood and anhedonia) and thus downplays the importance of somatic symptoms. Third, there was a potential risk of misclassification of the VI characteristics because some of the participants might not have known or been able to recall specific details about their condition. We expect non-differential misclassification, and in studies like ours, which include high-prevalent outcomes, the magnitude of the bias is likely to be low and drawn towards the null value<sup>[29]</sup>. Fourth, and lastly, because our sample was recruited from a member organization for the blind and partially sighted, it may be questioned whether it was representative of the broader VI population. However, the demographics of our sample were comparable with the 2015 census data of people with self-rated vision loss provided by Statistics Norway<sup>[30]</sup>, except that our sample had a higher level of education. Since high levels of education may protect against the development of depression, we assume that the depression rates in our study were underestimated.

### Comparison with the literature

To our knowledge, this is the first study of its kind to estimate the prevalence of depressive disorders in young and middle-aged adults with VI. The 16% and 20% rates in the respective age groups 18-35 years and 36-50 years were almost twice as high as those obtained in similar age groups in a survey of the general United States population in which depression was classified using the PHQ algorithm<sup>[28]</sup>. Furthermore, the prevalence rates of major depression in the same age groups were two to three times higher than the age-specific estimates for the general Western European population<sup>[13,14]</sup>. We also found that the youngest adults had worse outcomes than the older adults in terms of functional limitations. Our results illustrate that visually impaired adults of young or middle age are at particular risk of developing depressive disorders and that the demand for mental health care in these age groups is substantial.

The prevalence rates of depressive disorders or major depression in our two oldest age groups with VI were similar to those reported in earlier studies<sup>[4,5,7]</sup> or lower<sup>[9,10]</sup>. Furthermore, our depression rates did not differ from those reported elsewhere for older adults in the general Western European population<sup>[13,14]</sup>. These findings reflect

**Table 3 Prevalence ratios for depressive disorders with sociodemographic factors and characteristics of visual impairment estimated using regression analysis (n = 736)**

Variables	Any depressive disorder			
	Cases/total	%	Unadjusted PR (95%CI)	Adjusted PR (95%CI)
Age (continuous) <sup>2</sup>	-	-	0.89 (0.81, 0.99) <sup>1</sup>	0.83 (0.74, 0.93) <sup>1</sup>
Gender				
Men	42/333	12.6	1 [Reference]	1 [Reference]
Women	62/403	15.4	1.22 (0.85, 1.76)	1.17 (0.82, 1.68)
Education (continuous)	-	-	0.85 (0.72, 1.01)	0.86 (0.72, 1.02)
VI severity				
Moderate	40/254	15.8	1 [Reference]	1 [Reference]
Severe	44/296	14.9	0.94 (0.64, 1.40)	0.87 (0.60, 1.32)
Blind	20/186	10.8	0.68 (0.41, 1.13)	0.82 (0.49, 1.36)
Age of VI onset				
Congenital	35/330	10.6	1 [Reference]	1 [Reference]
Childhood/adolescence	26/142	18.3	1.73 (1.08, 2.76) <sup>1</sup>	1.63 (1.03, 2.58) <sup>1</sup>
Adulthood	43/264	16.3	1.54 (1.01, 2.33) <sup>1</sup>	1.76 (1.11, 2.79) <sup>1</sup>
Current VI status				
Stable	65/523	12.4	1 [Reference]	1 [Reference]
Progressive	39/213	18.3	1.47 (1.02, 2.12) <sup>1</sup>	1.43 (0.99, 2.06)
Other impairments				
No	50/478	10.5	1 [Reference]	1 [Reference]
Yes	54/258	20.9	2.00 (1.41, 2.85) <sup>1</sup>	1.88 (1.32, 2.67) <sup>1</sup>

<sup>1</sup>Results indicate statistical significance.

<sup>2</sup>Rescaled into 10-year age intervals. VI: Visual impairment; CI: Confidence interval; PR: Prevalence ratio.

the mixed results of previous studies of elderly adults in which the aim was to compare differences in estimates for visually impaired people and non-impaired people<sup>[5,7,10]</sup>.

We found that adults who acquired VI late in life and adults with other impairments in addition to their vision loss had particularly high rates of depression. Vision loss may result in dramatic changes to people’s lives and have implications for daily life activities, such as driving and travelling outside the home. Depression may develop as people struggle to cope with vision loss and its consequences for daily life<sup>[15,16]</sup>. Such challenges may be even greater for those with additional impairments. When people experience vision loss or receive a VI diagnosis, significant changes in self-esteem, self-efficacy, identity, social relations, and well-being may occur<sup>[31]</sup>. Many experience stress reactions such as shock, fear, frustration, helplessness, and grief<sup>[31]</sup>, and their future life prospects become distorted. By contrast, those who have lost their vision earlier in life might have adapted to their vision loss during this period and accepted their life situation.

The high rates of depression in people with vision loss should be discussed also in the light of discrimination, stigmatization, alienation, and social isolation. Social interaction is considered an integral part of a fully-fledged life, and unmet needs could make life less pleasurable and less meaningful<sup>[32]</sup>. Loneliness and isolation are common in VI populations<sup>[33]</sup>. Also, those populations are more likely than their sighted peers to experience discrimination<sup>[34]</sup>. Exposure to negative social events may induce feelings of alienation, persistent negative thoughts and mood, distorted blaming of oneself and others, and loss of trust and faith in oneself and others<sup>[24]</sup>. Once people experience negative social events or social exclusion, they may become socially inactive or avoid certain situations in which they might experience further adverse events. This could become part of a downward spiral, resulting in isolation, loneliness, and depression<sup>[35]</sup>.

We did not find any evidence of a relationship between self-reported VI severity and depression, which is consistent with the literature on this subject<sup>[7,9,11,20-22]</sup>. For example, in a survey of 1232 elderly outpatients from low vision rehabilitation services, van der Aa et al<sup>[7]</sup> did not find any differences in depression rates across the participants’ degree of visual acuity loss. Direct or self-reported measures of visual functions may not capture the overall impact of a condition on people’s daily lives<sup>[1]</sup>,

and moderate vision loss may be as challenging to manage as a more severe one<sup>[31]</sup>.

Our finding of a strong association between depression and lower life satisfaction is in accordance with documented findings relating to the general population<sup>[36,37]</sup>. Although causality may be reversed in that people who are less satisfied with life may be more likely to be depressed, our findings probably point to the negative impact of depression on several life domains.

### **Implications**

Our findings suggest that the risk of depressive disorders is high among young and middle-aged adults with VI. Vision loss can occur abruptly, resulting in a sudden loss of function, or it may develop gradually over a longer period, accompanied by the uncertainty about what the further development will cause. The high risk of depression should receive greater public attention, and special attention should be paid to adults of young age, the loss of vision in adulthood or those who have other impairments in addition to their vision loss. Preventive strategies, such as improved access to education, work, social services, and de-stigmatization programs, is also warranted. Ophthalmologists and other professionals who face people with vision loss should be aware of the high risk of depression and consider the need for referral to mental health care.

Quite unintentionally, our survey revealed an unmet need for consultations with a psychologist. People with vision loss may have a higher threshold when it comes to seeking help due to personal concerns such as a desire for self-reliance or avoidance of being labelled a “victim”. More importantly, there is a lack of knowledge among health personal about the mental health adversities associated with VI<sup>[38]</sup>, and to date, special mental health care services for people who are blind or have low vision is lacking in countries such as Norway. Thus, these issues should be addressed by both health care authorities and user organizations in cooperation.

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## **ARTICLE HIGHLIGHTS**

### **Research background**

People with visual impairment (VI) may be at risk of depression, but previous studies have demonstrated inconsistent results and have either reported extremely low rates or reported rates that ranged as high as 60%. Furthermore, previous studies of depression have mainly been restricted to older people or to specific subgroups of the population.

### **Research motivation**

Depression in this population goes often unrecognized and untreated. We have yet to fully understand the magnitude of the problem and who is at particular risk of developing depression. By obtaining more precise knowledge about the age-specific prevalence and associated factors of depression, this information can be valuable in the design of preventive efforts and to anticipate service needs.

### **Research objectives**

We conducted a large, age-stratified study in the adult population of people with low vision or blindness, with the following three main aims: (1) To estimate the point prevalence of depressive disorders in stratified age groups of adults with VI; (2) To examine whether depression was associated with different characteristics of vision loss; and (3) And to describe the association between depression and life satisfaction. By doing so, we hoped to examine and better understand the age-specific risk of depression among people with VI, as well as its associated factors and potential consequences on people's quality of life.

### **Research methods**

The study was conducted as a cross-sectional interview-based survey between January and May 2017 and included an age-stratified sample of adults with VI. All participants were recruited through the members list of the Norwegian Association of the Blind and Partially Sighted. A total of 736 (61%) adults participated by completing the interview.

### Research results

The prevalence of depression in different age groups varied from 11.1%-22.8% in women to 9.4%-16.5% in men. The estimates were highest in the two youngest age groups, and these rates were two times higher than those presented in previous studies of Westernized populations. Additionally, we found that depression was independently associated with having other impairments and loss of vision late in life, indicating that having difficulties in adapting to a new situation of being visually impaired or blind may put people at increased risk of developing depression. Lastly, depressed people in our study sample had considerably lower life satisfaction and were more likely to be referred for psychological counselling than were people without depression. The themes most often brought up by the participants during their consultations with the psychologist were related to problems with minority stress and handling stigma. We therefore argue that the high rates of depression in people with VI should be viewed in terms of stigma, discrimination, loneliness, and isolation.

### Research conclusions

To our knowledge, our study is the first to provide estimates of depression for the youngest part of the adult VI population. We have identified some subgroups of the population at greater risk of depression than others. Because of the high depression rates and their strong associations with quality of life, we recommend the initiation of efforts that would improve access to professionals trained in the needs and challenges of people with VI.

### Research perspectives

Our research findings should be supported by future studies that include a large probability sample of the entire adult VI population and that diagnose depression through clinical interviews. Moreover, future research should involve measures of modifiable risk factors of depression so that effective interventions can be designed to reduce the burden of depression for this population.

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