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Association Between Depression and Functional Vision Loss in Persons 20 Years of Age or Older in the United States, NHANES 2005–2008

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Abstract

Importance—This study provides further evidence from a national sample to generalize the relationship between depression and vision loss to adults across the age spectrum. Better recognition of depression among people reporting reduced ability to perform routine activities of daily living due to vision loss is warranted.

Objectives—To estimate, in a national survey of US adults 20 years of age or older, the prevalence of depression among adults reporting visual function loss and among those with visual acuity impairment. The relationship between depression and vision loss has not been reported in a nationally representative sample of US adults. Previous studies have been limited to specific cohorts and predominantly focused on the older population.

Design—The National Health and Nutrition Examination Survey (NHANES) 2005–2008.

Setting—A cross-sectional, nationally representative sample of adults, with prevalence estimates weighted to represent the civilian, noninstitutionalized US population.

Participants—A total of 10 480 US adults 20 years of age or older.

Main Outcome Measures—Depression, as measured by the 9-item Patient Health Questionnaire depression scale, and vision loss, as measured by visual function using a questionnaire and by visual acuity at examination.

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Author Contributions: Drs Zhang and Bullard had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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Online-Only Material: The eTable is available at jamaophth.com.

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Results—In 2005–2008, the estimated crude prevalence of depression (9-item Patient Health Questionnaire score of ≥ 10) was 11.3% (95% CI, 9.7%–13.2%) among adults with self-reported visual function loss and 4.8% (95% CI, 4.0%–5.7%) among adults without. The estimated prevalence of depression was 10.7% (95% CI, 8.0%–14.3%) among adults with presenting visual acuity impairment (visual acuity worse than 20/40 in the better-seeing eye) compared with 6.8% (95% CI, 5.8%–7.8%) among adults with normal visual acuity. After controlling for age, sex, race/ethnicity, marital status, living alone or not, education, income, employment status, health insurance, body mass index, smoking, binge drinking, general health status, eyesight worry, and major chronic conditions, self-reported visual function loss remained significantly associated with depression (overall odds ratio, 1.9 [95% CI, 1.6–2.3]), whereas the association between presenting visual acuity impairment and depression was no longer statistically significant.

Conclusions and Relevance—Self-reported visual function loss, rather than loss of visual acuity, is significantly associated with depression. Health professionals should be aware of the risk of depression among persons reporting visual function loss.

Vision loss and depression have been reported in older adult cohorts around the world.^{1–8} A meta-analysis⁹ has shown that vision loss is among the most common chronic conditions associated with depression in old age. However, for younger adults, the relationship between vision loss and depression has not been well studied. Furthermore, in the United States, the national-level associations of visual function and visual acuity with depression remain unknown. Many conditions resulting in vision loss can be delayed or prevented,^{10,11} and depression is a treatable condition^{12,13} that can be identified by screening.¹⁴ Estimates of the prevalence of depression among people with and without vision loss, on a national level, could inform the need for medical care and referral services. Alleviating the joint burden of depression and vision loss would improve the quality of life for those affected.

Herein, we examine the prevalence of depression among community-dwelling adults in the United States 20 years of age or older with normal vision and those with vision loss, and we describe the associations between depression and vision loss as measured by reported loss of visual function and by measured visual acuity.

METHODS

STUDY POPULATION

The National Health and Nutrition Examination Survey (NHANES) is a nationally representative survey conducted by the Centers for Disease Control and Prevention (CDC).¹⁵ In NHANES 2005–2008, a total of 10 480 persons 20 years of age or older were interviewed to collect sociodemographic, medical, and family information, and subsequently they underwent a detailed medical examination at the Medical Examination Center. The response rates were 74% for those participating in the home interview and 71% for those reporting to the Medical Examination Center.¹⁶ The NHANES protocol was approved by a human subjects review board at the CDC. Informed consent was obtained from all participants.

VISUAL FUNCTION

In their home, participants were asked about eyesight and activity limitations due to their vision. The questions used were selected from the National Eye Institute 25-item Visual Functioning Questionnaire, for which reliability and validity have been reported previously.¹⁷ Limitations in activities of daily living due to vision were assessed in 6 survey questions asking about the degree of difficulty (none, a little, moderate, extreme, or unable to do) in the following: reading ordinary newsprint; doing work or hobbies that require seeing well up close; going down steps, stairs, or curbs in dim light or at night; noticing

objects off to the side while walking; finding objects on a crowded shelf; and daytime driving in familiar places. Responses to these individual items were dichotomized (presence or absence), and 2 derived measures were coded to represent overall visual function loss based on cumulative responses to the following items: number of visual function problems (ranging from 0 to 6) and the presence of any visual function loss.

VISUAL ACUITY

The physical examination in the Medical Examination Center included a vision examination. With the use of a Nidek ARK-760 autorefractor containing built-in visual acuity charts, presenting distance visual acuity was measured in each eye with whichever form of correction (eg, glasses or contact lenses), if any, that the participant was wearing at the time of the examination. For eyes with presenting acuity of 20/30 or worse, distance visual acuity was reassessed after an objective autorefraction. Persons who were completely blind (ie, unable to see in both eyes) or who had a severe infection in at least 1 eye were excluded from the vision examination (n=17).

Presenting visual acuity impairment was defined as a presenting visual acuity of worse than 20/40 in the better-seeing eye. Uncorrectable visual acuity impairment was defined as a visual acuity of worse than 20/40 in the better-seeing eye after the autorefractor provided optical correction. Correctable visual acuity impairment (ie, impairment due to refractive error) was defined as a presenting visual acuity of worse than 20/40 in the better-seeing eye that improved to 20/40 or greater after objective autorefraction.

DEPRESSION MEASURE

The 9-item Patient Health Questionnaire (PHQ-9) depression scale was used to measure depression. The PHQ, which is widely used in both clinical and research settings, is a self-administered version of the Primary Care Evaluation of Mental Disorders.¹⁸ The validity and reliability of the PHQ and its 9-item depression module to establish depressive diagnosis and grade severity have been widely documented.^{19–22} The PHQ-9 has also been used to assess depression among those with visual impairment in other studies.^{3,6,23} A PHQ-9 score of 10 or greater is recommended as a cut point for screening purposes, yields 88% sensitivity and 88% specificity for identifying major depression,¹⁸ and was used in our study to identify cases of depression.

OTHER MEASUREMENTS

We considered factors that have been reported in the literature as being associated with both vision loss and depression as possible covariates.⁴ All participants were asked about age (20–39, 40–64, or 65 years), sex, race/ethnicity (non-Hispanic white, non-Hispanic black, Mexican American, or those who selected multiple races or other racial/ethnic groups), educational attainment (less than a high school diploma, high school graduate, or education beyond high school), household income (poverty income ratio [PIR] < 1, 1 ≤ PIR < 3, or PIR ≥ 3), marital status (yes or no), living alone (yes or no), employed (yes or no), health insurance status (yes or no), smoking status (current, former, or never), binge drinking (defined as having ever consumed 5 drinks of any kind of alcoholic beverage almost every day; yes or no), and history of cardiovascular diseases (yes or no). A history of cardiovascular diseases was ascertained by self-report of coronary heart disease, angina, myocardial infarction, stroke, or congestive heart failure. A prior self-reported history of cancer was included. Diabetes was defined as a self-report of a previous diagnosis of the disease by a health care provider (excluding gestational diabetes mellitus) or a hemoglobin A_{1c} level of 6.5% or greater (which is the American Diabetes Association's diagnostic criterion for diabetes [to convert to proportion of total hemoglobin, multiply by 0.01]).²⁴ Hypertension was defined as antihypertensive medication use or a reported blood pressure

of 140/90 mm Hg or higher. The participants were also asked how much of the time they worried about their eyesight (none, a little, some, most, or all of the time). Height and weight were measured in the Medical Examination Center, and body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. We divided respondents into 3 BMI groups: normal weight or underweight (BMI < 25), overweight (BMI = 25 to <30), and obese (BMI ≥ 30).

STATISTICAL METHODS

Statistical analyses were conducted using SAS, version 9.2 (SAS Institute Inc), and SUDAAN, version 10.1 (Research Triangle Institute), to calculate national estimates and their standard errors, accounting for the survey's complex sampling design. Taylor series linearization was used for variance estimation.²⁵ Missing values were imputed to avoid bias associated with listwise deletion of participants with missing values from the analysis. We used multiple imputation by chained equations, a technique using regression based on all variables in the model, to attribute missing data.^{26,27} Five imputations per missing observation were performed and analyzed. Characteristics of the study population are described using mean values for continuous variables and percentages for categorical variables. The *t* test was used for continuous variables, and the χ^2 test was used for categorical variables. We estimated the crude prevalence of depression (PHQ-9 score of ≥ 10) by sociodemographic characteristics in the adult US population. In addition, we provided specific estimates of depressive symptoms by severity using 3 categories: mild (PHQ-9 score of 5–9), moderate (PHQ-9 score of 10–14), and moderate severe to severe (PHQ-9 score of 15–27). Logistic regression was used to assess the associations between visual function loss and depression and between visual acuity impairment and depression after adjusting for other covariates. Odds ratios (ORs) and associated 95% CIs were calculated. Associations were considered to be statistically significant if the *P* value was less than .05.

RESULTS

The NHANES sample for this analysis included 10 480 participants whose mean age was 47 years (Table 1). Fifty-two percent of participants were female, 71% were non-Hispanic whites, 11% were non-Hispanic blacks, and 8% were Mexican Americans. Overall, 23% were current smokers, 15% were binge drinkers, and many had chronic health conditions such as hypertension (33%), diabetes (11%), cardiovascular disease (7%), and cancer (9%).

The estimated (weighted) crude prevalence of depression (PHQ-9 score of ≥ 10) in the 2005–2008 sample was 11.3% (95% CI, 9.7%–13.2%) among those with visual function loss and 4.8% (95% CI, 4.0%–5.7%) among those without (Table 2). Across age groups, adults with visual function loss were more likely to report depression than their counterparts (13.0% vs 4.7% for those 20–39 years of age, 11.5% vs 6.0% for those 40–59 years, and 9.6% vs 3.0% for those ≥ 60 years) (eTable, jamaophth.com). In addition, 20.1% (95% CI, 18.5%–21.8%) of adults with visual function loss had some mild depressive symptoms (PHQ-9 score of 5–9) compared with 12.1% (95% CI, 11.0%–13.2%) of those without impaired visual function.

The findings for overall depression and depression severity by each specific visual function activity all showed a similar pattern (Table 2). Among persons with difficulty reading ordinary newsprint, approximately 13.4% (95% CI, 11.0%–16.2%) had depression compared with 5.3% (95% CI, 4.5%–6.3%) of those without difficulty reading. Approximately 12.9% (95% CI, 10.6%–15.7%) of those with difficulty seeing up close when doing work or hobbies had depression, whereas 5.6% (95% CI, 4.8%–6.5%) of those without difficulty seeing up close had depression. The prevalence of depression was also

higher among those with difficulty seeing steps, noticing objects off to the side, those with difficulty finding objects on a crowded shelf, and those with difficulty driving in daytime compared with those without such difficulties (15.9% vs 5.3%, 19.7% vs 5.8%, 18.4% vs 5.6%, and 25.0% vs 6.1%, respectively). Moreover, as the number of visual function problems increased among the participants, the prevalence and the severity of depression also increased (Figure).

In contrast, the estimated (weighted) crude prevalence of depression was 10.7% (95% CI, 8.0%–14.3%) among those with presenting visual acuity impairment and 6.8% (95% CI, 5.8%–7.8%) among persons without presenting visual acuity impairment (Table 3). Among those with presenting visual acuity impairment, approximately 6.8% (95% CI, 5.9%–7.8%) of those with correctable visual acuity impairment and 10.9% (95% CI, 7.7%–15.2%) of those with uncorrectable visual acuity impairment had depression.

Table 4 shows the associations of depression with visual function loss and visual acuity impairment among US adults. In multivariate analysis, overall visual function loss was associated with increased odds (OR, 2.6 [95% CI, 2.2–3.1]) of depression after adjusting for age, sex, and race/ethnicity (Table 4, model I). The ORs slightly decreased (OR, 2.4 [95% CI, 2.0–2.9]) after further adjustment for socioeconomic characteristics (model II: model I plus marriage, living alone, education, income, employment status, and health insurance). The odds of depression were significantly higher among those with any visual function difficulty (OR, 1.9 [95% CI, 1.6–2.3]), even after controlling for all other factors, including unhealthy behavior (eg, smoking and binge drinking), self-reported health, BMI, and other chronic conditions (model III: model II plus BMI, smoking, binge drinking, self-reported health, worry about eyesight, diabetes, hypertension, cardiovascular disease, and cancer). Across all models, each measure of visual function loss was consistently significantly associated with depression. After controlling for age, sex, and race/ethnicity (model I), adults with presenting visual acuity impairment had higher odds of depression than their counterparts (OR, 1.6 [95% CI, 1.1–2.2]). However, there was no statistically significant association between depression and visual acuity impairment (presenting, correctable, and uncorrectable) in any models after controlling for other additional factors (models II and III).

COMMENT

One in 10 US adults reporting loss of visual function meets criteria for clinically significant depressive disorder, and an additional 1 in 5 exhibits mild depressive symptoms (PHQ-9 score of 5–9). These rates of depression are comparable to rates of depression in persons with other chronic conditions.²⁸ Blindness was ranked as the fourth most feared health condition, after AIDS, cancer, and Alzheimer disease.²⁹ People with any kind of visual function loss are more likely than those with none to report depression, especially in key activities of daily living such as driving. Even after considering possible confounding factors, adults with visual function loss are at least 90% more likely to have depression than those without visual function loss.

To the best of our knowledge, this is the first study to assess, in a national sample, depressive symptoms in conjunction with visual function and visual acuity loss. Previous studies have used the Structured Clinical Interview for the *Diagnostic and Statistical Manual of Mental Disorders* (Fourth Edition),³⁰ the Center for Epidemiologic Studies–Depression scale,⁷ the Geriatric Depression Scale,³⁰ the Beck Depression Inventory,³¹ the Hamilton Rating Scale for Depression,³² the 12- or 36-item Short Form Health Survey,⁴ and the *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* codes^{33,34} to assess depression and depressive symptomology. Although previous

studies^{35–37} have suggested an association between vision loss and depression among the older population, our study provides further evidence to generalize this relationship to adults across the age spectrum.

VISION LOSS AND DEPRESSION

Self-reported visual functioning reflects a person's perception of his or her ability to perform vision-related daily activities. The association between visual function loss and depression is complicated. Depression and disability may exist in a bidirectional relationship in which depression leads to disability and in which disability causes depression.³⁸ Although it is not possible from this cross-sectional analysis to determine whether depression is a cause or an effect of visual function loss, it may be that people with depressive symptoms have actual physical limitations or perceived limitations. Individuals whose lifestyles have been influenced by a real or perceived reduced ability to perform instrumental activities of daily living (such as reading a medication label, recognizing a face, writing a check, or driving a vehicle) have been shown to be at higher risk for depression.³⁹ Studies^{40,41} have reported that the presence of major age-related eye diseases (such as age-related macular degeneration [AMD] and glaucoma) are associated with an increased risk of depression. People with impaired vision often report that they feel unhappy, lonely, or even hopeless.⁴² In the English Longitudinal Study of Aging (Waves 1 and 2),⁷ self-reported vision loss was a consistent predictor of both onset and persistence of depression after adjusting for other covariates. Findings from the present study are consistent with this published literature. Moreover, a large population-based study⁵ from 10 European countries found that persons with self-reported impaired vision were more likely to report concentration problems; losing interest and enjoyment; feeling fatigued, irritable, sad, and tearful; having less hope for the future; and, in some cases, wishing for death.

People who are depressed may not seek out eye care when experiencing visual difficulties. They also may not realize, unless asked, that they even have difficulties with their vision. For those with diagnosed eye conditions, depression may cause poor adherence to treatment, which may, in turn, hasten the progression of vision loss. As a result, the association between visual function and depression could be further complicated because a depressive mood might adversely affect a person's self-reported visual function.^{2,30} Such an inverse association has also been found in other diseases.^{31,43–45} One study⁴⁶ found that depressive symptoms explained 40% to 50% of the variance of participation in daily activities and social roles. Another study³ suggested that vision-specific distress was the strongest unique predictor of depressive symptoms; the emotional consequence of vision loss thus plays a critical role that is separate from the severity and duration of visual acuity impairment and functional loss. A study by Ishii et al⁴⁷ found that cataract surgery, which improves a patient's eyesight significantly, improved the vision-related quality of life and depressive mental status of elderly patients. Owsley et al⁴⁸ reported that nursing home residents with uncorrected refractive error improved their quality of life and decreased their depressive symptoms after undergoing refractive correction.

Visual acuity and contrast sensitivity are 2 major predictors of visual function loss.^{1,49–51} Visual acuity is important for activities involving good resolution and adaptation to changing light conditions, whereas contrast sensitivity is associated with activities involving distance judgments, night driving, and mobility.⁴⁹ There is a substantial literature reporting the effect of loss of visual acuity on a decrease in quality of life and an increase in depression among people with AMD.^{2,30,52–59} Among persons 65 years of age or older with glaucoma, those with vision loss (identified using *ICD-9* codes) were more likely to develop depression (OR, 1.63 [95% CI, 1.54–1.73]) than those without vision loss.³³ A recent population-based, retrospective cohort study³⁴ in an older population in Quebec, Canada,

found that clinically diagnosed vision impairment independently increased the risk of depression (hazard ratio, 1.35 [95% CI, 1.10–1.66] for severe cases; hazard ratio, 1.35 [95% CI, 1.09–1.69] for moderate visual impairment). Other studies^{2,37,41,60} also found that visual acuity loss and depressive symptoms were independently associated with visual function status in people 65 years of age or older.

In this analysis, the significance level of the association between visual function loss and depression was lower after we controlled for socioeconomic factors, and it was further reduced after we controlled for other confounding behavior and health condition factors. However, we did not find a statistically significant association between impairment of visual acuity (presenting, correctable, and uncorrectable) and depression after controlling for all potential confounders. Bookwala and Lawson,⁶¹ using data from National Social Life, Health, and Aging Project, also found that objective vision (visual acuity) contributed significantly to functional limitations but was unrelated to depressive symptoms. Likely, the association between vision loss and depression could be related to other factors in addition to reduced visual acuity, particularly the disability that vision loss causes in a person's life. People with uncorrectable visual acuity impairment may have adjusted to their physical limitation or may have implemented compensatory strategies and do not have strong depressive feelings. However, failing to reject the null hypothesis does not imply that the null hypothesis is true, only that the effect, if present, was too weak to detect with our sample. In addition, self-reported visual function loss represents a person's actual health condition and its effect on his or her daily activities. Their perceptions may reflect the overall function of vision, including not only the effect of loss of visual acuity but also other effects due to impairment (such as contrast sensitivity) of optical organs.

PUBLIC HEALTH IMPLICATIONS

The high prevalence of depression among people with visual function loss, especially among the older population, suggests that eye care providers and primary care providers should be aware of the increased risk of depression among those with vision loss. Depression alone is a major cause of disability independent of vision loss.^{62,63} Moreover, people with vision loss are more likely than those without to have other comorbid chronic conditions, disability, lack of social networking, worse overall health, and reduced access to health care.^{64,65} The capability to perform daily tasks of persons with both vision loss and depression is even more compromised.⁶⁶ In particular, difficulty may be experienced when driving to a clinic and communicating with health care professionals owing to the combined effects of vision loss and depression. These circumstances limit these persons' ability to seek needed care. Several studies^{67,68} have indicated that receipt of rehabilitation services and the use of assistive devices are useful in addressing the issue of depression. A randomized, controlled trial⁵³ of a self-management program involving cognitive and behavioral interventions for persons with AMD reported a significantly, clinically meaningful reduction in depressive symptoms after a 6-month follow-up. Improvements in mood and function were significantly greater for those with depression than for those without depression.⁶⁹ Another study⁷⁰ also found that interventions that teach patients problem-solving skills and that teach patients to identify practical solutions could prevent depressive disorders in patients with AMD.

Our findings suggest that eye care professionals should consider patients' psychological conditions and provide referrals to those exhibiting depressive symptoms. Early diagnosis and prompt treatment could offer real benefit. For those at higher risk for depression, a potential screening tool might be useful. For example, eye care professionals and primary care providers may use PHQ-9 in clinical settings to screen patients with depressive symptoms and refer them for further evaluation if needed. Moreover, it is important for health care professionals to be aware of the prevalence of such conditions because they are

often the first to interact with these patients on a consistent basis. Brody et al³⁰ found that, among 151 adults with advanced AMD who were 60 years of age or older, almost one-third had a depressive disorder. Shmueli-Dulitzki et al⁶³ found that 38.6% of people entering a low-vision clinic met the criteria for major depression according to the *Diagnostic and Statistical Manual of Mental Disorders* (Third Edition Revised) criteria, and yet only a very few received treatment. Another study⁷¹ found that fewer than 1 in 3 eye care providers attempt to identify depressive symptoms as a regular component of patient care. Effective training of eye care professionals of vision loss and depression might allow them to better prepare patients and their families to identify and manage depressive symptoms, especially among older persons whose activities of daily living have already been compromised by other chronic conditions.

The strengths of our study include its population-based national sample, its inclusion of persons with measured visual acuity impairment, and its effective detection of depressive symptoms using a short, easy-to-administer, and well-validated instrument, the PHQ-9. Survey participants who had no light perception or who had a severe infection in 1 or both eyes were excluded; this might bias the prevalence estimates toward the null, although the number of individuals excluded for these reasons were few. Because of data limitations, we were unable to assess the association of glare or contrast sensitivity with depression. Owing to limitations inherent with the NHANES sampling frame, we were unable to estimate the prevalence among racial/ethnic groups other than non-Hispanic whites, non-Hispanic blacks, and Mexican Americans. Finally, our data's cross-sectional nature makes it difficult to make causal inference. However, our findings are consistent with the existing literature and highlight the emerging public health need to address depression among people reporting loss of visual function.

In conclusion, our study provides nationally representative estimates on the prevalence of depression among persons with visual function loss and impairment in visual acuity. We found strong associations between loss of visual function (rather than loss of visual acuity) and the presence of depressive symptoms among US adults. Better recognition of depression among people reporting reduced ability to perform routine activities of daily living due to vision loss is warranted. Improved access to screening, diagnosis, and treatment of depression by eye care professionals and primary care providers may help to reduce the burden of depression-related excess disability and improve the quality of life among people with vision loss.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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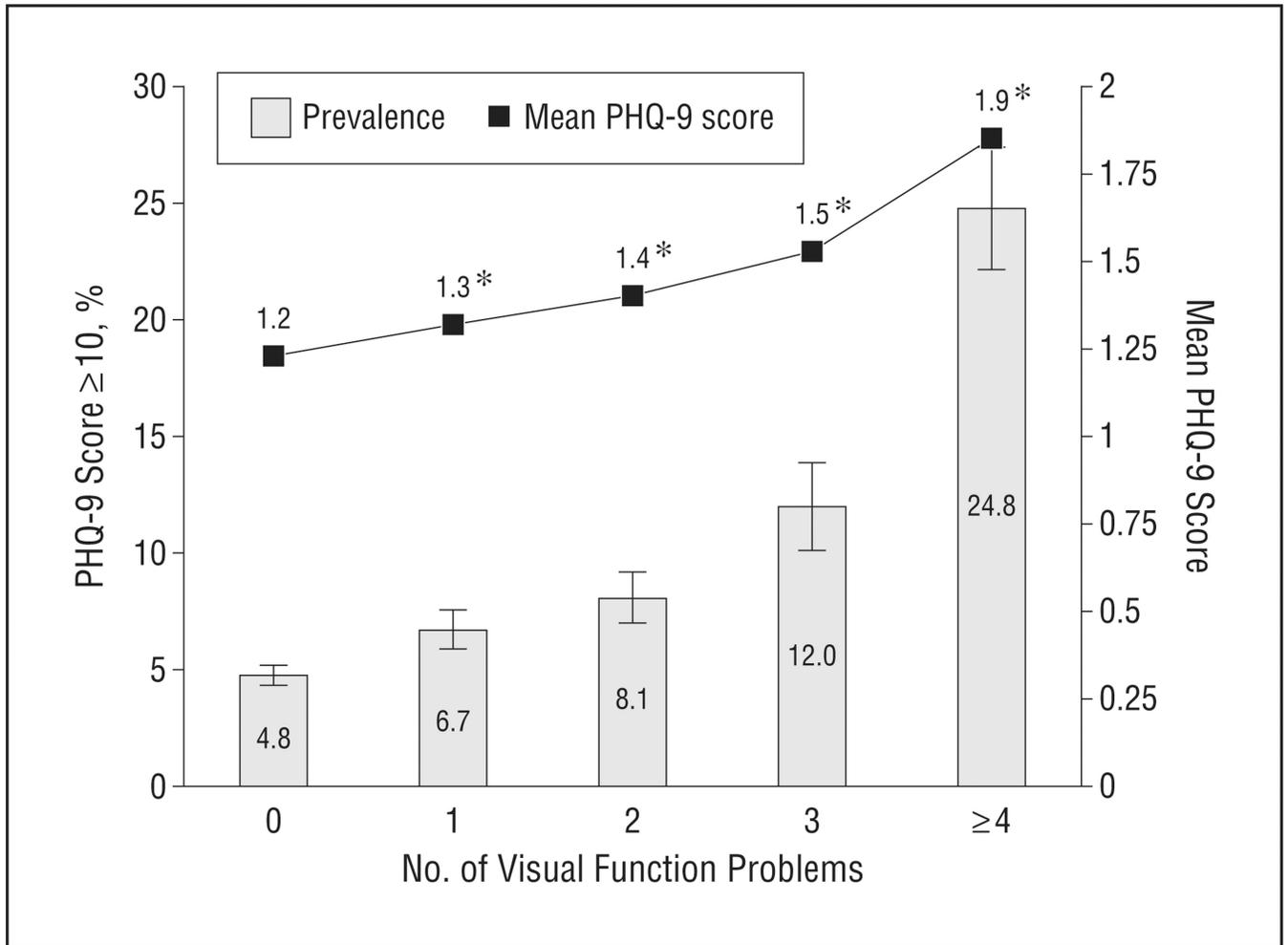
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**Figure.**

Crude prevalence (weighted percentages are presented) of depression (defined as a PHQ-9 score of ≥ 10) from the National Health and Nutrition Examination Survey 2005–2008. * $P < .01$ for comparison with mean PHQ-9 score by number of visual function problems (reference: mean PHQ-9 score for those reporting no visual function problems). PHQ-9 indicates 9-item Patient Health Questionnaire.

Table 1

Selected Characteristics of 10 480 US Adults 20 Years of Age or Older, NHANES 2005–2008

Characteristic	Weighted % (95% CI)
Age group, y	
20–39	37.8 (35.8–39.7)
40–64	38.9 (37.2–40.6)
65	23.3 (21.3–25.5)
Age, mean, y	46.7 (45.8–47.5)
Male sex	48.1 (47.3–48.9)
Race/ethnicity	
Non-Hispanic white	70.6 (65.7–75.1)
Non-Hispanic black	11.4 (8.9–14.4)
Mexican American	8.2 (6.5–10.2)
Other	9.8 (7.9–12.2)
<High school	19.2 (17.1–21.4)
PIR	
PIR <1	12.8 (11.4–14.2)
1 PIR <3	36.5 (34.0–39.1)
PIR ≥ 3	50.8 (47.4–54.1)
Currently working	65.7 (63.4–67.9)
Married or living with partner	64.8 (62.5–67.0)
Living alone	13.6 (12.5–14.7)
Uninsured	19.2 (17.2–21.4)
BMI ^a	
Normal weight or underweight	32.4 (30.8–34.0)
Overweight	33.6 (32.5–34.8)
Obese	34.0 (32.2–35.9)
Smoking status	
Current smoker	23.4 (21.6–25.2)
Former smoker	24.5 (23.2–25.8)
Never smoked	52.2 (50.0–54.3)
Binge drinker ^b	15.1 (14.0–16.3)
Self-rated fair or poor health	17.6 (16.2–19.1)
Hypertension ^c	33.0 (31.4–34.6)
Diabetes ^d	10.5 (9.5–11.6)
History of CVDs	7.0 (6.1–7.9)
History of cancer	8.6 (7.9–9.3)

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); CVDs, cardiovascular diseases; NHANES, National Health and Nutrition Examination Survey; PIR, poverty to income ratio.

^aThe BMI was divided into 3 groups: normal weight or underweight (BMI <25), overweight (BMI = 25 to <30), and obese (BMI ≥ 30).

^bDefined as having ever consumed 5 drinks or more of any kind of alcoholic beverage almost every day.

^cDefined as antihypertensive medication use or a reported blood pressure of 140/90 mm Hg or higher.

^dDefined as self-reported diabetes diagnosed by a health professional (all adults) or a hemoglobin A_{1c} level of 6.5% or greater (to convert to proportion of total hemoglobin, multiply by 0.01) (nonpregnant adults only).

Crude Prevalence of Depression by Visual Function Status and Depression Severity in US Adults 20 Years of Age or Older, NHANES 2005–2008^a

Table 2

Status	Participants, No.	Prevalence of Depression, Weighted % (95% CI)			
		Moderate to Severe (PHQ-9 Score of 10)	Mild (PHQ-9 Score of 5–9)	Moderate (PHQ-9 Score of 10–14)	Moderately Severe to Severe (PHQ-9 Score of 15)
Difficulty reading ordinary newsprint ^b					
No	8046	5.3 (4.5–6.3)	13.3 (12.3–14.5)	3.5 (3.0–4.1)	1.7 (1.3–2.3)
Yes	2419	13.4 (11.0–16.2)	20.6 (18.4–23.0)	8.5 (6.7–10.8)	4.6 (3.5–6.2)
Difficulty seeing up close when doing work or hobbies					
No	8527	5.6 (4.8–6.5)	13.8 (12.7–14.9)	3.8 (3.3–4.5)	1.7 (1.3–2.2)
Yes	1938	12.9 (10.6–15.7)	19.6 (17.3–22.1)	7.7 (6.0–9.8)	5.1 (3.8–6.8)
Difficulty seeing steps or curbs in dim light					
No	8510	5.3 (4.5–6.1)	13.0 (11.9–14.2)	3.5 (3.0–4.1)	1.7 (1.3–2.2)
Yes	1954	15.9 (13.0–19.2)	24.4 (22.1–26.8)	9.9 (7.8–12.4)	5.9 (4.6–7.5)
Difficulty noticing objects off to the side					
No	9328	5.8 (5.0–6.7)	14.0 (13.0–15.1)	3.9 (3.3–4.6)	1.8 (1.4–2.2)
Yes	1140	19.7 (16.0–24.0)	23.8 (20.1–27.9)	11.2 (8.5–14.5)	8.4 (6.4–10.9)
Difficulty finding object on a crowded shelf					
No	9119	5.6 (4.8–6.6)	13.9 (13.0–14.9)	3.8 (3.2–4.5)	1.7 (1.3–2.3)
Yes	1347	18.4 (15.1–22.3)	22.8 (19.9–26.1)	10.9 (8.3–14.2)	7.4 (5.5–9.8)
Difficulty driving in the daytime in a familiar place					
No	9798	6.1 (5.2–7.2)	14.6 (13.6–15.6)	4.1 (3.4–4.8)	2.0 (1.6–2.5)
Yes	655	25.0 (20.0–30.7)	20.2 (15.8–25.3)	15.1 (11.2–20.1)	9.7 (6.2–14.9)
Impaired visual function ^c					
No	6609	4.8 (4.0–5.7)	12.1 (11.0–13.2)	3.2 (2.7–3.8)	1.5 (1.1–2.0)
Yes	3871	11.3 (9.7–13.2)	20.1 (18.5–21.8)	7.1 (5.9–8.6)	4.0 (3.2–5.1)

Abbreviations: NHANES, National Health and Nutrition Examination Survey; PHQ-9, 9-item Patient Health Questionnaire.

^aDefined as a PHQ-9 score of 10 or greater.

^bModerate, extreme, or unable to do.

^cDefined as any of the impaired visual functions listed.

Table 3
Crude Prevalence of Depression by Visual Impairment Status in US Adults 20 Years of Age or Older, NHANES 2005–2008^a

Status	Participants, No.	Prevalence of Depression, Weighted % (95% CI)			
		Moderate to Severe (PHQ-9 Score of 10)	Mild (PHQ-9 Score of 5–9)	Moderate (PHQ-9 Score of 10–14)	Moderately Severe to Severe (PHQ-9 Score of 15)
Presenting visual acuity impairment ^b					
No	9541	6.8 (5.8–7.8)	14.7 (13.8–15.7)	4.3 (3.7–5.0)	2.3 (1.9–2.8)
Yes	939	10.7 (8.0–14.3)	16.6 (13.9–19.6)	8.0 (5.6–11.2)	2.7 (1.6–4.6)
Among those with presenting visual acuity impairment					
Correctable	252	6.8 (5.9–7.8)	14.8 (13.8–15.8)	4.3 (3.7–5.0)	2.3 (1.9–2.8)
Uncorrectable	687	10.9 (7.7–15.2)	16.2 (13.0–19.9)	8.3 (5.7–12.0)	2.6 (1.2–5.2)

Abbreviations: NHANES, National Health and Nutrition Examination Survey; PHQ-9, 9-item Patient Health Questionnaire.

^aDefined as a PHQ-9 score of 10 or greater.

^bDefined as presenting visual acuity worse than 20/40 in the better-seeing eye. Uncorrectable visual acuity impairment was defined as visual acuity worse than 20/40 in the better-seeing eye after the autorefractor provided optical correction. Correctable visual acuity impairment (ie, impairment due to refractive error) was defined as presenting visual acuity worse than 20/40 in the better-seeing eye before an objective autorefractor test that eventually improved visual acuity (< 20/40) after objective autorefractor.

Table 4

Multivariate Analysis for Depression Associated With Visual Function Loss and Visual Impairment, Each Modeled Separately in US Adults 20 Years of Age or Older, NHANES 2005–2008^a

Status	Odds Ratio (95% CI)		
	Model I ^b	Model II ^c	Model III ^d
Visual function loss			
No difficulty	1 [Reference]	1 [Reference]	1 [Reference]
Difficulty reading ordinary newsprint ^e	2.7 (2.1–3.6)	2.4 (1.9–3.2)	1.9 (1.5–2.6)
Difficulty seeing up close when doing work or chores	2.6 (2.1–3.2)	2.5 (2.0–3.1)	2.0 (1.6–2.5)
Difficulty seeing steps or curbs in dim light	3.4 (2.7–4.3)	2.8 (2.2–3.5)	2.0 (1.6–2.6)
Difficulty noticing objects off to the side	3.8 (3.0–4.9)	3.1 (2.5–4.0)	2.4 (1.8–3.1)
Difficulty finding object on crowded shelf	3.8 (3.0–4.9)	3.1 (2.4–4.0)	2.4 (1.8–3.2)
Difficulty driving in the daytime in a familiar place	4.9 (3.5–6.8)	3.4 (2.4–4.7)	2.7 (1.8–3.9)
Impaired visual function ^f	2.6 (2.2–3.1)	2.4 (2.0–2.9)	1.9 (1.6–2.3)
Visual impairment			
No impairment	1 [Reference]	1 [Reference]	1 [Reference]
Presenting	1.6 (1.1–2.2)	1.1 (0.8–1.6)	1.1 (0.8–1.5)
Correctable	1.6 (1.1–2.3)	1.2 (0.8–1.8)	1.2 (0.8–1.8)
Uncorrectable	1.4 (0.7–2.9)	0.9 (0.4–1.8)	0.8 (0.4–1.7)

Abbreviation: NHANES, National Health and Nutrition Examination Survey.

^aDefined as a 9-item Patient Health Questionnaire score of 10 or greater.

^bControlling for age, sex, and race/ethnicity.

^cModel I plus marriage, living alone, education, income, employment status, and health insurance.

^dModel II plus body mass index, smoking, binge drinking, self-reported health, worry about eyesight, diabetes, hypertension, cardiovascular disease, and cancer.

^eModerate or extreme difficulty or unable to do.

^fDefined as any of the impaired visual functions listed.