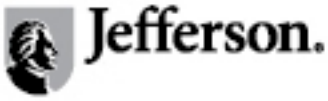

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Personality and functional vision in older adults with age-related macular degeneration

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Abstract

Introduction: To determine whether personality traits influence self-reported functional vision in patients with Age-Related Macular Degeneration (AMD).

Methods: This is a prospective cross-sectional analysis of baseline data from the Low Vision Depression Prevention Trial. Participants (N=182) over age 65 with bilateral AMD, visual acuity worse than 20/70 in the better-seeing eye, and subthreshold depression were recruited from the Wills Eye Hospital retina practice. Assessments included visual acuity, contrast sensitivity, National Eye Institute Visual Function Questionnaire-25 plus Supplement (NEI VFQ) near and distance subscales, depression, and personality testing. Structural equation models were used to investigate the relationship of the NEI VFQ near-activities and distance-activities with the various demographic, clinical, and psychological predictors.

Results: In the single predictor model for near functional vision, visual acuity at logMAR ≤ 1 (estimate = -0.33 [95% confidence interval (CI) -0.46, -0.20]; $p \leq 0.001$), neuroticism (estimate = - 0.05 [95% CI -0.08,-0.01]; p = 0.01), and education (estimate = -0.08 [95% CI 0.01, 0.15]; p = 0.03) were statistically significant predictors . In the single predictor model for distance functional vision, only visual acuity at logMAR ≤ 1 (estimate = -0.49 [95% CI -0.69, -0.29]; $p \leq 0.001$) and neuroticism (estimate = - 0.09 [95% CI -0.15,0.02]; p = 0.008) were statistically significant predictors.

Discussion: Self-reported functional vision depends on the severity of vision loss as well as the personality trait of neuroticism.

Implications for Practitioners: Assessment of personality traits, particularly neuroticism, may increase the precision of rating scales of functional vision and suggest new rehabilitative interventions to improve the functional vision and quality of life of patients with AMD.

Trial Registration: clinicaltrials.gov Identifier: NCT00572039

Introduction

Perceived functional vision refers to the self-reported ability to perform vision-dependent activities and is often an outcome in epidemiological studies of vision loss and clinical trials of ophthalmologic and rehabilitative treatments to improve vision and everyday functioning. Functional vision is distinct from visual function, which more properly refers to the physiologic activity and function of the eyes and the visual system (Colenbrander, 2005). In principle, functional vision ought to be closely tied to objective measures of visual function but the correlation with visual acuity, for example, ranges from 0.5 to 0.68 (Massof, 2001; Revicki, 2010). This suggests that non-ophthalmologic factors may contribute to the relationship. One of those factors may be the characteristic way patients perceive and report difficulty in their lives. Functional vision is assessed by asking patients to rate the difficulty they experience when performing various activities like reading newsprint or doing housework. Their responses reflect their perceived difficulty, the value they place on the activity, their mood, and personality. Depressed mood is known to impair functional vision, perhaps through loss of interest, low self-efficacy, and low motivation (Casten and Rovner, 2008; Horowitz, 2005; Owsley, 2004; Rovner, 2006; Zhang, 2013). Only a few studies have evaluated the impact of personality, which shapes an individual's style of perceiving, responding to, and reporting visual difficulties (Boerner, 2006; Rovner, 2001; Tabrett, 2012; Warrian, 2009). In fact, personality provides a more stable and enduring representation of a person than depression, which tends to be transient and situation dependent (McCrae and Costa, 1990).

One facet of personality is the trait of neuroticism, which refers to the increased tendency to experience negative, distressing emotions (McCrae and Costa, 1990). This trait is distributed normally in the population without a threshold indicative of disorder and is moderately heritable (Wray, 2008). Individuals on the extreme of the distribution get upset easily by life events and stay upset longer than others who face similar difficulties. They tend to be temperamental, anxious, and inflexible and to hold pessimistic views of themselves and their circumstances. Thus, given the same degree of vision loss, people high and low in neuroticism might vary substantially in their reporting of functional vision. If their scores on the National Eye Institute Visual Function Questionnaire (NEI-VFQ) differ, we cannot assume that the person who reports worse functional vision (i.e., has a lower NEI VFQ score) has worse visual acuity than a person with a higher score (Mangione, 2001). The former person may simply have a perceptual bias that conveys greater distress and disability. The extent to which this phenomenon occurs in patients with AMD is uncertain because no studies to our knowledge have investigated it. If the extent is substantial it may confound the results of studies on vision loss and disability or on the efficacy of ophthalmologic and rehabilitative treatments. In this study, we tested the hypothesis that personality traits would influence self-ratings of functional vision independent of objective measures of vision (i.e., visual acuity, contrast sensitivity) in older persons with bilateral age-related macular degeneration (AMD). The subjects were enrolled in the Low VIsion Depression Prevention TriAL (VITAL), which is a randomized controlled clinical trial that compares the efficacy of a combined mental health and low vision rehabilitation intervention with standard low vision rehabilitation to prevent depression.

Methods

This study reports baseline data obtained before randomization into the VITAL clinical trial (clinicaltrials.gov: NCT00572039). All subjects signed an informed consent form approved by the Institutional Review Boards of Thomas Jefferson University and Wills Eye Hospital. We recruited 182 patients with AMD from the Midatlantic Retina practice associated with the Wills Eye Hospital in Philadelphia, Pennsylvania between October 2009 and September 2012. The inclusion criteria were: 1) age over 65 years; 2) bilateral AMD (either neovascular (i.e., "wet" AMD) or geographic atrophy (i.e., "dry" AMD); 3) best corrected visual acuity worse than 20/70 in the better-seeing eye; 4) more than 5 anti-vascular endothelial growth factor (VEGF) injections if the better eye had "wet" AMD. These injections (e.g., ranibizumab) reduce the growth of abnormal blood vessels in the macula and have greatly improved the prognosis of this condition (Sloan and Hanrahan, 2014). In the present study, requiring patients with wet AMD to have had more than 5 anti-VEGF injections identified those whose vision was not likely to improve with additional anti-VEGF treatment. This was an important consideration in this clinical trial of low vision rehabilitation.; 5) subthreshold depressive symptoms (defined as a Patient Health Questionnaire-9 score ≥ 5 or depressed mood or anhedonia several days per week; and 6) moderate difficulty performing a valued vision-dependent activity. The exclusion criteria were: 1) on-going or anticipated anti-VEGF treatment; 2) current Diagnostic and Statistical Manual (DSM) IV-defined depressive disorder; 3) uncontrolled glaucoma, diabetic retinopathy, corneal dystrophy, or anticipated cataract surgery; 4) low vision rehabilitation within the previous year; and 5) cognitive impairment on an abbreviated version of the Mini-Mental Status Examination (MMblind) that omits vision-dependent items (Reischies, 1997).

Study Measures

A research nurse with training in psychiatry and ophthalmology conducted in-home assessments to obtain demographic data and assess the following domains at baseline.

Functional Vision: The NEI VFQ-25 plus supplement was used to measure near-vision and distance functional vision. The NEI VFQ is a self-rated instrument that assesses difficulty with daily activities, social functioning, general health, problems with vision, and quality of life (Mangione, 2001). The near-vision subscale is comprised of 6 items that rate the difficulty level of reading newsprint; doing housework or hobbies; finding something on a crowded shelf; reading small print on a medication bottle or legal form; determining whether bills are accurate; and performing personal hygiene tasks. The distance-vision subscale rates the difficulty of reading street signs or the names of stores; going down steps, stairs, or curbs in dim light or at night; going out to see movies or plays; recognizing people across a room; taking part in active sports or other outdoor activities; and seeing and enjoying programs on TV. Subjects rated these items on an ordinal scale from 1 (no difficulty) to 5 (stopped doing the activity because of vision loss). If subjects stopped doing an activity for non-vision reasons the item was scored as missing data. Previous studies have demonstrated that these subscales are responsive to low vision rehabilitation and anti-VEGF treatment and can be used to estimate interval scales (Chang, 2007; Marella, 2010; McKean-Cowdin, 2010; Ryan, 2008; Stelmack, 2002).

Vision Status: Best-corrected vision (with current spectacles) was assessed using the Lighthouse Ferris-Bailey Early Treatment Diabetic Retinopathy Study chart to measure visual

acuity and the Pelli-Robson Contrast Sensitivity chart to measure contrast sensitivity. Near and distance visual acuities were assessed at 16 inches and 5 feet (41 cm and 1.5 m), respectively, using back illumination. For statistical analyses, log transformations (i.e., logMAR and log contrast) were used for visual acuity and contrast sensitivity, respectively. LogMAR refers to the logarithm of the minimum angle of resolution, which specifies a linear scale of visual acuity, and recognizes that increases in letter size on visual acuity charts follow a geometric progression. Statistical analyses in logMAR units yield more precise comparisons.

Physical Health Status: The Chronic Disease Score (CDS) was used to assess the severity of comorbid medical problems. This score is based on a weighted sum of medications taken for chronic diseases and is a valid predictor of health care utilization, costs, and mortality (Von Korff, 1992). Higher scores indicate worse medical status. We also used the Multilevel Assessment Inventory Health Conditions Check List to record the presence of acute and chronic medical conditions (Lawton, 1982).

Depression: The Patient Health Questionnaire-9 (PHQ-9) was used to assess depression (Kroenke, 2001). This is one of the most commonly used reliable and validated depression assessment instruments in health care settings. It includes the 9 criteria that define the DSM-IV diagnoses of depression and can be used as a continuous indicator of depression severity. Symptoms are scored as the frequency of occurrence over the past two weeks on an ordinal scale from 0 (not at all) to 3 (every day). Scores range from 0 to 27, with higher scores indicating worse depression.

Personality: The Revised Neuroticism, Extroversion, Openness Five Factor Inventory (NEO-FFI) was used to assess the personality traits of neuroticism, conscientiousness, and openness to experience. The NEO-FFI is a 60-item psychological personality inventory that measures these common personality traits (Costa and McCrae, 1992). Higher scores signify higher standing on a given trait. Extensive research substantiates the NEO's inter-rater reliability, validity, stability over time, and applicability across different ages, cultures, and methods of measurement (McCrae, 2011).

Statistical Methods

Descriptive statistics for baseline demographic and clinical variables are presented as means (SD) for continuous data and as frequencies (percentages) for categorical data. We used two separate structural equation models to investigate the relationship of the NEI VFQ near-activities and distance-activities subscales with the various demographic, clinical, and psychological predictors (Moustaki, 2003; Skrondal, 2004). Because we expected subjects' responses on the two functional vision subscales to depend on multiple variables, our models assume that each subject has a self-perceived ability to perform near or distance activities that is manifested by their responses to the 6 NEI VFQ near activity items (i.e., the composite latent variable of "near functional vision"), and the 6 NEI VFQ distance activities (i.e., the composite latent variable of "distance functional vision"), respectively.

The structural equation model has two parts. The first part reduces the 6 observed items to a single latent variable. The second part models the relationship between the latent variable and

other observed covariates through a linear regression model. The value of the latent variable can be estimated for each subject based on the model parameter estimates and the subject's observed NEI VFQ items and other characteristics. While the model has two parts, the parameters of both parts are estimated simultaneously.

The main focus of the analysis was to estimate the association between the two latent variables and the clinical and psychological predictors. The latent variable is centered on zero and is normally distributed. After initial fitting of the latent variable model without any explanatory variables, estimated latent variable scores were plotted against the clinical and psychological predictors to determine whether a linear relationship could be assumed. A linear relationship seemed reasonable for most factors except visual acuity, which had a different relationship for acuities less than logMAR of 1.0 vs. those greater than 1.0. Consequently, a piecewise regression model was used for visual acuity to allow for different slopes below and above logMAR values of 1.0. We fit two sets of models. The first considered the association of near or distance functional vision and various clinical and psychological predictors individually (single predictor models). The second considered the association of near or distance functional vision with the predictors simultaneously (multivariable models). The values of the latent functional vision variables were estimated for each subject from the multivariable models. All structural equation models were fit using Mplus version 6 (Muthe'n, 2010).

Results

The demographic, clinical, and psychological characteristics of the 182 subjects are summarized in Table 1. Their mean [standard deviation (SD)] age was 84.1 (6.7) years and 129 (71%) were women. The mean near visual acuity logMAR of .66 corresponds to a Snellen visual acuity of about 20/80. The mean neuroticism score was 20.5 (SD 6.4). This is nearly identical to the score of 20.7 (SD 7.3) that we found in an earlier study of patients with AMD and comparable to the average score of 19.1 (SD 7.7) in the community (Costa and McCrae, 1992; Rovner, 2001). The correlations of neuroticism with near visual acuity, distance visual acuity, and contrast sensitivity were all ≤ 0.10 and not significant. The correlation of the NEI VFQ -25 near and distance subscales was 0.58; $p < 0.001$, indicating that these indicators of functional vision share some variance but assess somewhat independent domains.

In the single predictor models for near functional vision, only visual acuity at logMAR ≤ 1 (estimate = -0.33 [95% confidence interval (CI) -0.46, -0.20]; $p < 0.001$), neuroticism (estimate = - 0.05 [95% CI -0.08,-0.01]; $p = 0.01$), and education (estimate = -0.08 [95% CI 0.01, 0.15]; $p = 0.03$) were statistically significant predictors . In the single predictor model for distance functional vision, only visual acuity at logMAR ≤ 1 (estimate = -0.49 [95% CI -0.69, -0.29]; $p < 0.001$) and neuroticism (estimate = - 0.09 [95% CI -0.15,0.02]; $p < 0.008$) were statistically significant predictors. These estimates represent the change in the latent functional vision variable associated with a 1 unit increase in the predictor (except for visual acuity where the change represents a 0.1 increase). Age, sex, contrast sensitivity, Chronic Disease Score, PHQ-9 score, conscientiousness, and openness were unrelated to the functional vision variables.

Table 2 shows the results of the multivariable models for near and distance functional vision wherein we considered the unique effect of the predictors that were significant in the single predictor models after controlling for the effects of the other variables. Both models reveal that visual acuity at logMAR ≤ 1 and neuroticism were independently associated with difficulty with near and distance activities. Age was marginally associated with near activities and significantly associated with distance activities. No other variables were associated with the ability to perform near or distance activities after adjustment for these predictors.

The Figure shows the strong correlation of both domains of functional vision with visual acuity at the average of all variables in the model (solid line) but also the considerable variability that remains. There is a noticeable flattening of the relationship of the near and distance functional vision with visual acuities after acuities of logMAR ≥ 1.0, which led to the introduction of the piecewise regression terms in the final models. The short dash line depicts the relationship between visual acuity and functional vision for persons who score high in neuroticism (i.e., one standard deviation [6.4 points] above average). The long dash line depicts that relationship for persons who score low in neuroticism (i.e., one standard deviation below average). The comparison of the 2 lines indicate that at any given level of visual acuity, persons high in neuroticism will report worse functional vision, and persons low in neuroticism will report better functional vision, than the average person. A 1 SD increase in neuroticism is associated with a decrease of 0.05 X 6.4 = 0.32 (or 0.25 SD) in the near functional vision latent variable. Similarly, for distance functional vision, a 1 SD increase in neuroticism was associated with a 0.07 X 6.4 = 0.45 (or 0.25 SD) decrease in the latent variable.

Discussion

Most everyday activities require a specific level of vision to complete them successfully and independently but whether or not someone reports difficulty when carrying them out depends on other factors like general health, compensatory strategies, depression, cognition, and personality (Clemons, 2006; Goldstein, 2012; Horowitz, 2005; Rees, 2009; Rovner, 2006; Rovner, 2011; Whitson, 2012). Because personality is stable throughout the life span and shapes one's characteristic responses to life circumstances, knowing if someone is disposed to optimism and resilience or pessimism and vulnerability is important. It has direct relevance when functional vision is an outcome in a clinical trial of a new ophthalmologic treatment or rehabilitative approach because reporting bias may obscure treatment effects. In fact, accounting for reporting bias is relevant to treatment responses in any disease in which the relationships between the disease, disease perception, symptom reporting, and illness behavior are complex. In clinical practice, clinicians intuitively incorporate a patient's personality, or reporting style, into their formulation of the patient's disease severity and disability but in research, where a surveyor lacks informed knowledge of the person and the disease, discerning this relationship is more difficult. The result is that bias is introduced systematically to the extent that persons high in neuroticism, who report more somatic complaints and disability, are represented in population or clinic-based samples (Costa and McCrae, 1985; Lockenhoff, 2008).

We found, as expected, that visual acuity was strongly correlated with both near and distance functional vision. The personality trait of neuroticism was also associated with both domains of functional vision. Studying a sample of adults with mixed visual impairment (the majority of

whom had macular disease), Tabrett and Latham (2012) found that lower levels of neuroticism were significantly associated with better adjustment to vision loss independent of severity of vision loss, vision-related activity loss, and duration of vision loss. Interestingly, Warrian et al (2008), however, found no significant correlations between neuroticism and near or distance functional vision in patients with glaucoma, perhaps because glaucoma and AMD cause different types of vision loss (i.e., peripheral versus central loss, respectively).

In terms of other variables we examined, we found that contrast sensitivity added no additional explanatory value after controlling for visual acuity. Depression was also not related to functional vision, likely because variability in depressive symptoms was limited, as we enrolled patients with a narrow, low range of depressive symptoms (i.e., patients with severe depression or no depression were excluded). Aside from the weak correlations with older age, no other demographic, medical, or personality characteristics were related to functional vision after controlling for visual acuity and neuroticism. Other studies have reached similar conclusions. Russo et al (1997) demonstrated in a primary care population that neuroticism explained significant variance in disability independent of demographics, medical comorbidity, and depression. Costa and McCrae (1987) found that neuroticism was related to increased somatic complaints but not objective signs of disease in persons with coronary artery disease.

Although our results are consistent with these studies, they must be viewed in light of this study's limitations. The subjects were drawn from specialty eye clinics, had specific vision and other clinical characteristics, and had enrolled in a clinical trial to prevent depression. These unique factors limit generalizability. The study also lacked measures of retinal pathology, other

measures of vision (e.g., visual fields), and performance-based tests that might better characterize the direct effects of AMD on functional vision. The strengths of the study include the large sample size, systematic ascertainment and assessment of patients whose visual, psychological, medical, and functional characteristics were evaluated using instruments of known reliability and validity, and the use of structural equations to estimate an interval scale of functional vision.

The present data suggest that the personality trait of neuroticism is related to self-reported functional vision, and that this trait may affect the results of vision research studies and the care of patients. For researchers who use the NEI VFQ in clinical trials, measuring neuroticism may reduce the confounding effect of reporting bias on self-rated outcomes and identify subgroups of patients for whom an intervention is more or less effective. For this reason, researchers may want to consider administering the 12–item Neuroticism subscale of the NEO-FFI (which takes only about 5 minutes to administer) to control for this factor. For low vision rehabilitative and other clinical practitioners, encountering patients whose functional vision is worse than expected, given the objective measures of vision (e.g., visual acuity), should prompt consideration of nonophthalmologic factors in the genesis of the patient's difficulty. Although we recognize that vision loss is distressing to almost everyone, most individuals adapt relatively quickly, compensate for impairments, and establish a new equilibrium. Persons who are high in neuroticism, however, adapt less well and experience persistent distress and disability. Rehabilitation specialists working with such patients might first recognize and accept, rather than minimize or be repelled by the latters' disproportionate emotionalism and cognitive distortions (e.g. "I'll never get better"), and reassure them that as they do more in rehabilitation their sense

of self-efficacy and functional abilities will improve (Alma, 2013). Besides requiring more time and sensitivity, neuroticism translates to higher healthcare costs. The economic costs of neuroticism exceed those of common mental and physical disorders, ranging from low per capita costs for persons at the lowest level of neuroticism (< $3,000) to very high costs among those at the highest level (>$22, 000) (Cuijpers, 2010). These higher costs are often driven by exaggerated negative health perceptions and resulting excess medical service use but might be mitigated with appropriate recognition and treatment.

As the population ages and the prevalence of disabling chronic diseases increases, understanding the role of person-level factors, often ones that fall outside the traditional medical model, will become increasingly important. This is especially true as Accountable Care Organizations begin to provide comprehensive care to populations of people, whose perceptions of health and disability depend as much at times on personality as on clinical factors (Lockenhoff, 2008). This fact recommends the use of brief, validated personality screening tests to identify persons with high levels of neuroticism. Once identified, referral to mental health treatment may be helpful. The selective serotonin uptake inhibitor, paroxetine, appears to have a specific pharmacological effect on neuroticism when used to treat depression, and cognitive and behavior activation therapies may also have beneficial effects (Andrews, 1996; Tang, 2009). These promising treatments may mitigate the negative impact of this vulnerability factor (e.g., reduce the effect of distress on healthcare use) and may improve the functional vision of older persons with AMD.

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Figure caption

Figure 1. Scatterplot of Near and Distance Functional Vision versus Visual Acuity