



## Research paper

# The association of vision loss and dimensions of depression over 12 years in older adults: Findings from the Three City study



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## ABSTRACT

**Background:** The established relationship between vision impairment and depression is limited by the examination of depression only as a unidimensional construct. The present study explores the vision-depression relationship using a dimensional approach.

**Methods:** 9036 participants aged 65 years and above enrolled in the Three-City study were included. Relationships between baseline near Vision Impairment (VI) or self-reported distance Visual Function (VF) loss with trajectory of four dimensions of depression – depressed affect, positive affect, somatic symptoms and interpersonal problems – over 12 years were examined using mixed-effects models. Depression dimensions were determined using the four-factor structure of the Centre for Epidemiology Studies-Depression Scale (CESD).

**Results:** In the fully adjustment models, mild near VI predicted poorer depressed affect ( $b = 0.04, p = .002$ ) and positive affect ( $b = -0.06, p < 0.001$ ) over time, with evidence of longer term adjustment. Distance VF loss was associated with poorer depressed affect ( $b = 0.27, p \leq .001$ ), positive affect ( $b = -0.15, p = .002$ ), and somatic symptoms ( $b = 0.18, p \leq .001$ ) at baseline, although only the association with depressed affect was significant longitudinally ( $b = 0.01, p = .001$ ). Neither near VI nor distance VF loss was associated with interpersonal problems.

**Limitations:** This paper uses a well-supported model of depression dimensions, however, there remains no definite depression dimension model. Distance VF loss was self-reported, which can be influenced by depression symptoms.

**Conclusions:** Vision impairment in older adults is primarily associated with affective dimensions of depression. A reduction in social connectedness and ability to engage in pleasurable activities may underlie the depression-vision relationship. Older adults with vision impairment may benefit from targeted treatment of affective symptoms, and pleasant event scheduling.

Vision impairment (VI) is common in older adults, with an estimated prevalence of 25% in those aged over 70 (Stevens et al., 2013); and VI substantially contributes to burden of disease in Europe (Mathers & Loncar, 2006). An association between VI and depression in the elderly population is well established (Carriere et al., 2013; Court et al., 2014; Hong et al., 2015), with prevalence of comorbid depression in older adults with VI estimated to be around 30% (Hayman et al., 2007; Hong et al., 2015). Comorbid depression leads to marked reductions in quality of life, increased disability, and increased mortality

risk (Eisele et al., 2015; Hernandez Trillo & Dickinson, 2012; Zheng et al., 2012), underscoring the need to better understand the relationship between VI and depression and the long-term trajectory of depression symptoms in VI.

To date, when examining the association with VI, depression has been examined as a single disorder-based category; a methodology with substantial limitations. Major depressive disorder (MDD) is a polythetic disorder, characterised by a number of combinations of different symptoms (Vrieze et al., 2014). A unidimensional approach to

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depression fails to capture the substantial heterogeneity seen between individuals with depression (Basso et al., 2013; Watson, 2009). Emerging evidence highlights the utility of a dimensional approach, which explores symptom dimensions rather than dichotomizing depression. Divergent prognoses, treatment needs, and quality of life outcomes have been reported for varying depression dimensions (Shafer, 2006; Soskin et al., 2012; Uher et al., 2012; Wardenaar et al., 2015). Moreover, different depression dimensions have been shown to differentially correlate with other mental and physical conditions (Watson, 2009) and may have different neurobiological substrates (Basso et al., 2013). Thus analyses using disorder-based categories may result in a substantial loss of valuable information (Brown & Barlow, 2009). By contrast, a dimensional approach is better suited to understanding the pathogenesis and course of psychiatric disorders and meeting the mental health needs of the elderly population (Bryant et al., 2013; Prisciandaro & Roberts, 2009).

Currently a dimensional approach to depression has not been applied in VI research, limiting understanding of the VI-depression association and the related needs of older adults with VI. This study therefore aims to examine the longitudinal relationship between near VI and distance Visual Function (VF) loss in older adults with depression dimension symptoms over 12 years.

## 1. Method

This study forms part of the SENSE-Cog multi-phase research programme, funded by European Union Horizon 2020 programme. SENSE-Cog aims to promote mental well-being in older adults with sensory and cognitive impairments ([www.sense-cog.eu/](http://www.sense-cog.eu/)). The first work package of this project aims to better understand the links between sensory, cognitive and mental ill-health in older Europeans.

### 1.1. Sample

Participants were recruited as part of the multi-centre Three-City (3C) study (The 3C Study Group, 2003), a prospective cohort study of community-dwelling French adults aged 65 years and over. A total of 9294 participants were recruited from electoral rolls in three cities (Bordeaux, Dijon and Montpellier) between 1999 and 2001. A standardised evaluation including a face-to-face interview and clinical examinations were undertaken at baseline. Participants were followed up at 2–3 year intervals for up to 12 years. The study protocol was approved by the Ethics Committees of the University–Hospitals and written informed consent was obtained from each participant.

### 1.2. Depression measures

Depression symptoms were examined using the 20-item Centre for Epidemiology Studies-Depression scale (CESD) (Radloff, 1977). A four-factor structure proposed by Radloff is most commonly replicated (Radloff, 1977; Shafer, 2006). The four factors reflect different dimensions of depression symptoms: depressed affect (DA) assessed by 7 items (felt sad, crying spells, could not shake the blues, depressed, lonely, fearful, felt as though life is a failure); positive affect (PA) assessed by 4 items (hope about the future, enjoyed life, felt as good as others, felt happy); somatic symptoms (S) as represented by 7 items (poor appetite, restless sleep, could not get going, concentration difficulties, everything an effort, bothered by things, talked less than usual); and 2 items that examine interpersonal problems (IP; people dislike me, people were unfriendly). The four dimensions are reported to be phenomenologically and psychometrically distinct (Devins et al., 1988; Leventhal et al., 2008; Shafer, 2006). The four-factor structure of the CESD has been validated across a number of populations (Shafer, 2006) including community dwelling older adults (Gellis, 2010) and has also been validated in the French version of the CESD in a population of community dwelling French adults (Morin et al., 2011). The scores for

each item were summed for the different dimensions. For PA, items were not reverse scored as is required for calculating total CESD scores, thus lower scores indicate more severe depression. For the other dimensions, higher scores are indicative of more severe depression symptomatology.

### 1.3. Vision measures

Binocular near visual acuity was assessed using the Parinaud scale (a Jaeger-like reading test commonly used in France) at all time points. Assessment was undertaken using presenting vision with usual optical correction where applicable. Identical cards were used at each centre with a standardised reading distance of 33 cm. Mild VI was classified as Parinaud 3 or 4 (Snellen equivalent 20/30–20/60) and moderate to severe VI as Parinaud > 4 (Snellen equivalent < 20/60). Distance visual function was assessed in the face-to-face interview. Distance VF loss was classified as self-reported inability or difficulty in recognising a familiar face at 4 m.

### 1.4. Socio-demographic and health variables

Socio-demographic and health-related information was collected during the standardized interview at baseline. Known covariates of depression and/or vision were assessed, including variables such as education level (elementary schooling, secondary school, higher education), monthly income (low <€760, €760–2280, >€2280, withheld/missing), and marital status. Alcohol consumption (<10 g, 10–40 g, >40 g per day), tobacco use (current-, past -, or non-smoker) and falls during the past 12 months were also assessed. A composite score representing activity limitations was calculated based on scores from the Rosow–Breslau scale, the Lawton–Brody Instrumental Activities of Daily Living (IADL) scale and the Katz Index of Independence in Activities of Daily Living; activity limitations were (categorised as autonomous; dependent for mobility; mobility and IADL limitations; and dependent in 3 or more areas of functioning; Barberger–Gateau et al., 2000). During the detailed medical questionnaire history of myocardial infarction and use of psychotropic medication (ATC classification codes: N05A-C, N06A-B) in the past month was obtained. A medical examination assessed diabetes (fasting glycemia  $\geq 7$  mmol/L and/or anti-diabetic treatment), and blood pressure was measured using a digital electronic tensiometer OMRON M4. Hypertension was defined using the 140/90 mm Hg threshold or treatment with blood-pressure lowering drugs. Cognitive functioning was also assessed using the Mini Mental State Examination (MMSE; <16, 16–23 or  $\geq 24$ ).

### 1.5. Statistical analysis

The relationship between baseline near VI and distance VF loss at baseline with the trajectory of depression dimension symptoms over 12 years were assessed using multilevel growth models. Due to few participants reporting any IP symptomatology, the distribution of IP problems was not amenable to linear models, thus only S, DA and PA dimensions were examined using multilevel models (IP was examined using logistic mixed models). Due to non-normal distribution, dimension scores for PA, DA and S were transformed using the estimated link function (Proust-Lima, 2015). Scores were then converted to z-scores for subsequent analyses.

A series of exploratory models (Singer & Willett, 2003) were undertaken separately for each depression dimension (PA, DA, S) to assess the longitudinal effects of vision on depression symptoms over time; with all vision-related variables entered in a single model, thus models adjusted for the effect of VI on VF loss and VF loss on VI. In an initial step, an unconditional growth model adjusted only for time was undertaken to examine if depression dimension symptoms changed significantly over time. Secondly, time and its quadratic trend were

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