Mastery and self-esteem mediate the association between visual acuity and mental health: a population-based longitudinal cohort study

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Abstract

Background With deteriorating eyesight, people often become dependent on others for many aspects of their daily lives. As a result, they feel less 'in control' and experience lower self-esteem. Lower sense of mastery and self-esteem are known to predict depression, but their roles in people with visual impairment remain unknown. Therefore, this study aimed to determine the influence of mastery and self-esteem on the relationship between visual acuity and mental health.

Methods A longitudinal cohort study was performed using data from the Longitudinal Aging Study Amsterdam (LASA). Data on vision was available from the fifth cycle (2001), with a mean follow-up of 5.9 years. A community-based population was studied, containing older adults from eleven municipalities in three culturally distinct geographical regions in the Netherlands. A total of 2599 older adults (aged 55 to 85 years at baseline) were included, who were randomly selected from population registers in 1992. The first (2001) and last (2012) included measurements contained 1961 and 1522 participants, respectively. Primary study outcomes were logMAR visual acuity, sense of mastery, self-esteem, depression and anxiety. Instead of standard questionnaire scores, latent trait scores (θ) were obtained through -) Item Response Theory (IRT-) analysis.

Results Mean age was 72 years, with 56% females and 2% qualifying as low vision. Visual impairment was associated with a lower sense of mastery ($\beta = -0.477$, $p < 0.001$), lower self-esteem ($\beta = -0.166$, $p = 0.008$) and more depression ($\beta = 0.235$, $p < 0.001$). No significant association between visual acuity and anxiety was found. The relationship between visual acuity and depression was mediated partially by self-esteem (25%) and fully by sense of mastery (76%).

Conclusions Vision loss was associated with depression. This association was mediated by self-esteem and sense of mastery. This provides us with new possibilities to identify, support and treat those at risk for developing depression by aiming to increase their self-esteem and sense of mastery.

Background

Globally, around 285 to 440 million people are estimated to suffer from visual impairment, mostly due to uncorrected refractive errors and cataract(1, 2). Increasing life expectancy rates in high-income countries(3) are expected to dramatically raise the prevalence of visual impairment and subsequent need for eye-care services and associated health care costs for years to come(4). Global health is also greatly impacted by mental health issues(5), especially in the elderly(6) and in those with visual impairment(7–11). The prevalence of depression in older adults with visual impairment is estimated to approximate a staggering 30%, compared to roughly 11% in control groups(12, 13). With an estimated prevalence of 15%, anxiety symptoms are twice as common in older adults with visual impairment than those without visual impairment(14).

Prior studies have shown that the association between visual impairment and mental health issues could be attenuated through effective interventions, i.e. self-management programmes, behavioural activation, cognitive-behavioural therapeutic protocols and problem-solving treatment (PST) and a stepped-care programme(15–18). This suggests that the association between these conditions may be modifiable.

However, few studies have been performed to truly clarify the nature of the association between visual impairment and mental health. It has been suggested that this association is influenced by factors other than vision loss itself. In a previous cross-sectional study, functional limitations (i.e. mobility and self-care) and social network size were found to mediate the association between visual impairment and depression(11). Also, vision-specific distress (i.e. the practical and social challenges associated with visual impairment) was found to be strongly related to depression(19), whilst one's psychological response to vision loss (i.e. acceptance) was found to be critical for mental health.

In the general population, the link between low self-esteem and depression is undisputed(20), and a high level of mastery is known to predict recovery from depression(21). As our society relies heavily on visual functioning, those with visual disabilities often experience a loss of control and independency(22). This experience of an 'external locus of control' has been shown to be a major factor in the development of depressive symptoms(23).

However, the precise roles of mastery (i.e., feeling 'in control') and self-esteem have been researched only marginally in this context and with contradictory results(24). Identifying the influences of self-esteem and mastery could provide us with a greater insight into depression in patients with visual impairment, and provide us with new ways to address this problem. Therefore, this study aims to provide novel insights on the roles of mastery and self-esteem in the association between visual impairment and mental health based on longitudinal data in a large elderly population.

Methods

Study design

A longitudinal cohort study was performed, using data from four time points from the Longitudinal Aging Study Amsterdam (LASA)(25), collected from 2001 through 2012. In this period, participants were measured four times; in 2001–2002 (cycle E), in 2005–2006 (cycle F), in 2008–2009 (cycle G) and in 2011–2012 (cycle H).

Participants

LASA's first cohort was formed in 1992 from a random sample of people aged 55 to 85 years, drawn from population registers in eleven municipalities in the Netherlands. The acquired sample was stratified for age, gender and level of urbanisation. This sample was first used in the NESTOR study on Living Arrangements and Social Networks (LSN). In 2002–2003, a second cohort was formed from an identical sampling frame. This process has further been described in detail in previous publications. In total, data was collected on 2599 unique participants. Selection bias(26) was kept to a minimum by including a very large population, by recruiting participants from three culturally distinct areas with different levels of urbanisation and by contacting members of a general population rather than clinical recruitment.

Outcome measures

Visual acuity

Visual acuity was reported in terms of visual acuity rating (VAR), measured using a Colenbrander 1-meter chart with + 1.00 dioptre magnifying glasses(27). For analysis, all obtained VAR scores were converted to log units (logarithm of the Minimal Angle of Resolution, logMAR)(28). Visual acuity of the better eye was used for analysis, regardless of lateralisation.

Mental health

Validated Dutch translations of widely-used questionnaires were deployed to assess different aspects of mental health. For depressive symptoms, the Center for Epidemiologic Studies – Depression Scale (CES-D)(29) was used. The CES-D questionnaire contains 20 items, measuring depressive symptoms on a 4-point Likert scale (scored 0–3). For symptoms of anxiety, the Hospital Anxiety and Depression Scale – Anxiety Subscale (HADS-A)(30) was used. The HADS-A contains 7 items, measuring symptoms of anxiety on a 4-point Likert scale (scored 0–3). For mastery, the Pearlin Mastery Scale (PMS)(31) was used. The PMS questionnaire contains 7 items, measuring mastery on a 5-point Likert scale (scored 0–4). For self-esteem, the Rosenberg Self-Esteem Scale (RSES)(32) was used. The RSES questionnaire contains 10 items, of which the first 4 were included, measuring self-esteem on a 5-point Likert scale (scored 0–4). Items using adverse wording were coded reversely. Thus, higher scores corresponded with greater levels of depression, anxiety, mastery and self-esteem, respectively.

Other variables

Additionally, other variables were obtained, including age, education, nationality, living arrangement, marital status, partner status, personal network size, functional limitations, special housing adjustments and chronic somatic comorbid disorders. These variables were chosen either to describe essential characteristics of the research population, or because previous literature showed them to be factors of importance in the studied associations. During statistical analysis, age was found to grossly violate the linearity assumption, rendering the variable unfit to be included as a continuous measure. Therefore, age was divided into three groups to facilitate separate analysis for three clinically relevant groups: the working-age population, a general population of elderly and the oldest old: i.e. (1) up to 65 years, (2) 65 to 90 years and (3) 90 years and older. To address the possible issue of information bias(26), data collection on outcomes occurred in a highly structured fashion and similarly for all participants.

Statistical methods

Statistical analysis was divided into three distinct stages: (1) data preparation and Item Response Theory (IRT)-analyses, (2) logMAR-based visual acuity analyses and (3) mediation analyses. For the last two stages of analysis, linear mixed modelling (LMM) with maximum likelihood (ML) estimation was chosen as the preferred statistical method, using random intercepts and fixed variables. This particular model was chosen for its superior properties in dealing with missing values – which were inherent to the design of the study – and its integration of both interpersonal and intrapersonal variance(33). Possible confounding(26) was analysed and adjusted for.

Data preparation

IRT-analyses – also called latent trait analyses – were performed on the used questionnaires at all measurements in time to estimate individual latent trait (θ-)scores per item. These statistical models incorporate the characteristics of questionnaire items and all obtained responses, rendering a more accurate representation of the respondent's score on the latent construct, which was originally set out to be measured. Item-response models provide certain compelling advantages, describing the relationship between a latent trait, the characteristics of the items in the scale and the answers of respondents to the individual items(34). This results in a more accurate estimation of one's true latent trait (e.g. level of depression), increasing the validity of the used questionnaires and the accuracy of the obtained results. A Graded Response Model (GRM) was chosen as the preferred IRT-model for its flexibility regarding to item goodness-of-fit(35). In order for IRT-analyses to be accurate, questionnaires should meet the criteria for three crucial assumptions; unidimensionality, local independence of items and monotonicity(36). Unidimensionality was tested using standard indices. Local independence of items and monotonicity were checked by analysing residual covariance and plotting results of Mokken analyses, respectively(37). Confirmatory Factor Analysis (CFA) was conducted to assess goodness-of-fit and the estimated number of fundamental factors in the model. Based upon the retrieved parameters, the acquired θ (ranging from − 4.0 to + 4.0) was used in further analysis. Data preparation was conducted in RStudio, Version 0.99.896. Further analysis was conducted in IBM SPSS Statistics, Version 22.0.

Visual acuity analyses

Analyses were carried out using logMAR visual acuity as a continuous independent measure for visual impairment. LMM analyses were then performed to estimate the associations between logMAR visual acuity and mastery, self-esteem, depression and anxiety.

Mediation analyses

First, LMM analysis was performed to estimate the total effect of logMAR visual acuity on mastery, self-esteem, depression and anxiety. Second, LMM analysis was performed to estimate the association between visual acuity and a

potential mediator. Third, LMM analysis was performed to estimate the direct effect of visual acuity on the dependent variables, whilst controlling for the potential mediator by including it in the model. Consequently, these three pathways were compared and the mediated proportion was estimated (38).

Results

Participants

Data pertaining to participant inclusion, follow-up rates and attrition was retrieved from previous LASA publications(25). A summary is available in Figure I. Participants were deemed ineligible when they no longer met the initial target criteria(39). Due to the study design and complex inclusion of participants at various moments in time, a baseline summary containing data extracted from participants' first available measurement chronologically, is available in Table I. Mean age was 72 years, with 56% female and 2% qualifying as low vision. Mean follow-up time was 5.9 years with a standard error of 0.070 years, calculated using the difference between age at first measurement and age at last measurement for each participant.

Data preparation

A lack-of-fit was found for the 7-item Pearlin Mastery Scale (PMS). Two items performed poorly, violating both the monotonicity and unidimensionality assumptions. During principal components analysis, second factor loadings were remarkably high for these items. The items were therefore omitted, one of which was disregarded in previous research as well because of redundancy. This resulted in the 5-item mastery scale ('PMS-5'), which was used during further analysis, with evidently better performance on all indices, most importantly a decrease of the Root Mean Square Error of Approximation (RMSEA) from 0.106 to 0.078.

Visual acuity analyses

For LMM analyses based on continuous logMAR visual acuity data, regression coefficients, standard errors and p-values are summarised in Table II. All models were adjusted for gender, age and number of comorbid chronic diseases. In the adjusted analyses, logMAR visual acuity (i.e. visual impairment) was associated with significantly higher depression scores ($\beta = 0.235$, $p < 0.001$) and a lower sense of mastery ($\beta = -0.477$, $p < 0.001$) and self-esteem ($\beta = -0.166$, $p = 0.008$). No significant association between visual acuity and anxiety was found.

Mediation analyses

Self-esteem

With self-esteem included as a potential mediator, the total effect of visual acuity on depression declined from $\beta = 0.235$ to a direct effect of $\beta = 0.178$ in the adjusted model, translating to a mediated proportion of 25% (see Table III).

Mastery

With mastery included as a potential mediator, the total effect of visual acuity on depression declined from $\beta = 0.235$ to a direct effect of $\beta = 0.054$ in the adjusted model, translating to a mediated proportion of 76% (see Table IV).

Discussion

Key results and interpretation

Visual impairment was found to be associated with significantly more depression, lower sense of mastery and lower self-esteem. This accentuates the importance of adequate screening and detection of mental health changes in those who

develop visual impairment.

In apparent contrast to results from previous research, an association between vision loss and anxiety was not found. However, vision loss encompasses more than just visual acuity (e.g. visual field defects), which may, in turn, indeed be associated with anxiety. Additionally, the use of self-reported (subjective) vision loss as a measurement for visual impairment in other studies might also explain this difference, potentially inviting response bias (e.g. recall and social desirability bias) and confounding by personality type(40, 41).

Mediation analyses showed that the association of visual impairment and depression is mediated partially by loss of self-esteem and fully by loss of mastery – as supported by recent literature(42, 43). This provides us with new ways to approach the imminent problem of depression in patients with visual impairment. The outcomes of our mediation analyses will help identify those who are at risk for developing depression and to be able to intervene at an earlier stage.

Future research

As mastery has also been found to mediate the association between unemployment and depression(44), future research should attempt to further unravel the apparent final common pathway that seemingly leads to depression, of which one key factor – loss of mastery – has now been identified.

Strengths and limitations

Strengths. The use of longitudinal data from a large population has augmented this study's value. Most notably, this research has contributed to visual impairment research by unravelling the mediating roles of self-esteem and mastery in the association between visual acuity and depression, which has not previously been attempted.

Limitations. Visual impairment has a relatively low prevalence in the investigated general population. Moreover, visual acuity is but a partial measure for visual functioning. For example, the integrity of the visual field and high-contrast dependency have not been taken into account. Future studies may attempt to incorporate these aspects to more fully assess visual functioning in relation to mental health.

Generalizability

Because of the large and representative sample size and the broad study design, our findings may be generalizable to all older, community-dwelling populations in high-income countries. For countries fundamentally dissimilar to the Netherlands, the strength of the found associations might be different. However, the loss of mastery that visual impairment yields, and its dominant effect on the development of depression are plausibly inherent to humankind and therefore universal.

Conclusion

In our longitudinal cohort study (n = 2599), better visual acuity was associated with greater sense of mastery and self-esteem, and less depression. The relationship between visual acuity and depression was mediated partially by self-esteem (25%) and fully by mastery (76%) rather than vision loss itself. This can be addressed in mental health programs to ultimately reduce depression.

Abbreviations

LASA
Longitudinal Aging Study Amsterdam

IRT
Item Response Theory
PST
problem-solving treatment
LSN
Living Arrangements and Social Networks
METc
Medical Ethics Committee
VAR
visual acuity rating
logMAR
logarithm of the Minimal Angle of Resolution
CES-D
Center for Epidemiologic Studies – Depression Scale
HADS-A
Hospital Anxiety and Depression Scale – Anxiety Subscale
PMS
Pearlin Mastery Scale
RSES
Rosenberg Self-Esteem Scale
LMM
linear mixed modelling
ML
maximum likelihood
GRM
Graded Response Model
CFA
Confirmatory Factor Analysis
RMSEA
Root Mean Square Error of Approximation

Declarations

Ethics approval and consent to participate

Data collection was approved by the Medical Ethics Committee (METc) for the LASA study. Respondents were asked to provide informed consent before inclusion by signing an informed consent form. The study has been performed according to the ethical standards of the Declaration of Helsinki (1964) and its later amendments.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

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Author's contributions
IM, HvdA and RvN conceived of the study and its design. GvR, AB and JT advised in the development of the design. IM and HvdA drafted the manuscript, which was revised by the other authors. All authors read and approved the final manuscript.

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Tables

Table I. Demographics and characteristics at baseline *
(n = 1961 for cycle E, n = 638 for cycle F)

Independent variables	
Visual acuity (logMAR), mean (SE)	0.077 (0.00343)
Dependent variables ▯	
Depression (θ), mean (SE)	0.0044 (0.0186)
Anxiety (θ), mean (SE)	0.086 (0.0170)
Mastery (θ), mean (SE)	0.046 (0.0192)
Self-esteem (θ), mean (SE)	-0.00122 (0.0186)
Other variables	
Age, mean (SE; range)	72 (0.181; 57 – 94)
Female gender	1457 (56%)
Living independently	2251 (96%)
Currently married	1573 (61%)
Dutch nationality	2585 (100%)
Network size, mean (SE; range)	16.1 (0.200; 0 – 67)
Number of chronic disorders	
None	650 (28.0%)
One	892 (38.4%)
Two or more	783 (33.6%)
No functional limitations	1075 (47%)
Having a partner	1683 (65%)
No special housing adjustments	1709 (73%)

* Data are presented as number (percentage) of participants unless stated otherwise

† No visual impairment was defined as logMAR visual acuity lower than 0.50

‡ Pinhole improvement was defined as a decrease in logMAR visual acuity of at least 0.14

▯ Factor scores (range: -4.0 to 4.0), representing latent trait scores, acquired by Item Response Theory (IRT-)analysis on the used questionnaires – for depression; CES-D (Center for Epidemiologic Studies – Depression Scale)(29), HADS-A (Hospital Anxiety and Depression Scale – Anxiety Subscale)(30),
PMS-5 (5-item Pearlin Mastery Scale)(31) and RSES (Rosenberg Self-Esteem Scale)(32)

Table II. Linear mixed models (LMMs) on logMAR visual acuity

		Dependent variables						**Potential mediators**					
		Depression (CES-D)			**Anxiety (HADS-A)**			**Mastery (PMS-5)**			**Self-esteem (RSES)**		
_		β	SE	p	β	SE	p	β	SE	p	β	SE	p
Visual Impairment													
	Crude analysis	**0.341**	0.059	0.000	0.082	0.057	0.147	**-0.589**	0.066	0.000	**-0.215**	0.062	0.000
_	Adjusted analysis ▯	**0.235**	0.060	0.000	0.032	0.058	0.579	**-0.477**	0.067	0.000	**-0.166**	0.063	0.008

▯ Adjusted for gender, age and number of comorbid chronic disorders

CES-D (Center for Epidemiologic Studies – Depression Scale)(29), HADS-A (Hospital Anxiety and Depression Scale – Anxiety Subscale)(30),
PMS-5 (5-item Pearlin Mastery Scale)(31) and RSES (Rosenberg Self-Esteem Scale)(32)

Table III. Linear mixed models (LMMs) on mediation through self-esteem

			Crude model				Adjusted model		
			β	SE	*p*		*β*	SE	*p*
Total effect	***c***	Visual impairment	**0.341**	0.059	0.000		**0.235**	0.060	0.000
a-path	***a***	Visual impairment	**-0.232**	0.063	0.000		**-0.177**	0.064	0.006
Direct effect	***c'***	Visual impairment	**0.284**	0.060	0.000		**0.178**	0.061	0.003
	b	Self-esteem	**-0.345**	0.014	0.000		**-0.327**	0.013	0.000

 Adjusted for gender, age and number of comorbid chronic disorders

Table IV. Linear mixed models (LMMs) on mediation through mastery

			Crude model				Adjusted model		
			β	SE	*p*		*β*	SE	*p*
Total effect	***c***	Visual impairment	**0.341**	0.059	0.000		**0.235**	0.060	0.000
a-path	***a***	Visual impairment	**-0.600**	0.067	0.000		**-0.458**	0.063	0.000
Direct effect	***c'***	Visual impairment	**0.124**	0.059	0.032		0.054	0.060	0.366
	b	Mastery	**-0.388**	0.013	0.000		**-0.366**	0.013	0.000

 Adjusted for gender, age and number of comorbid chronic disorders

Figures

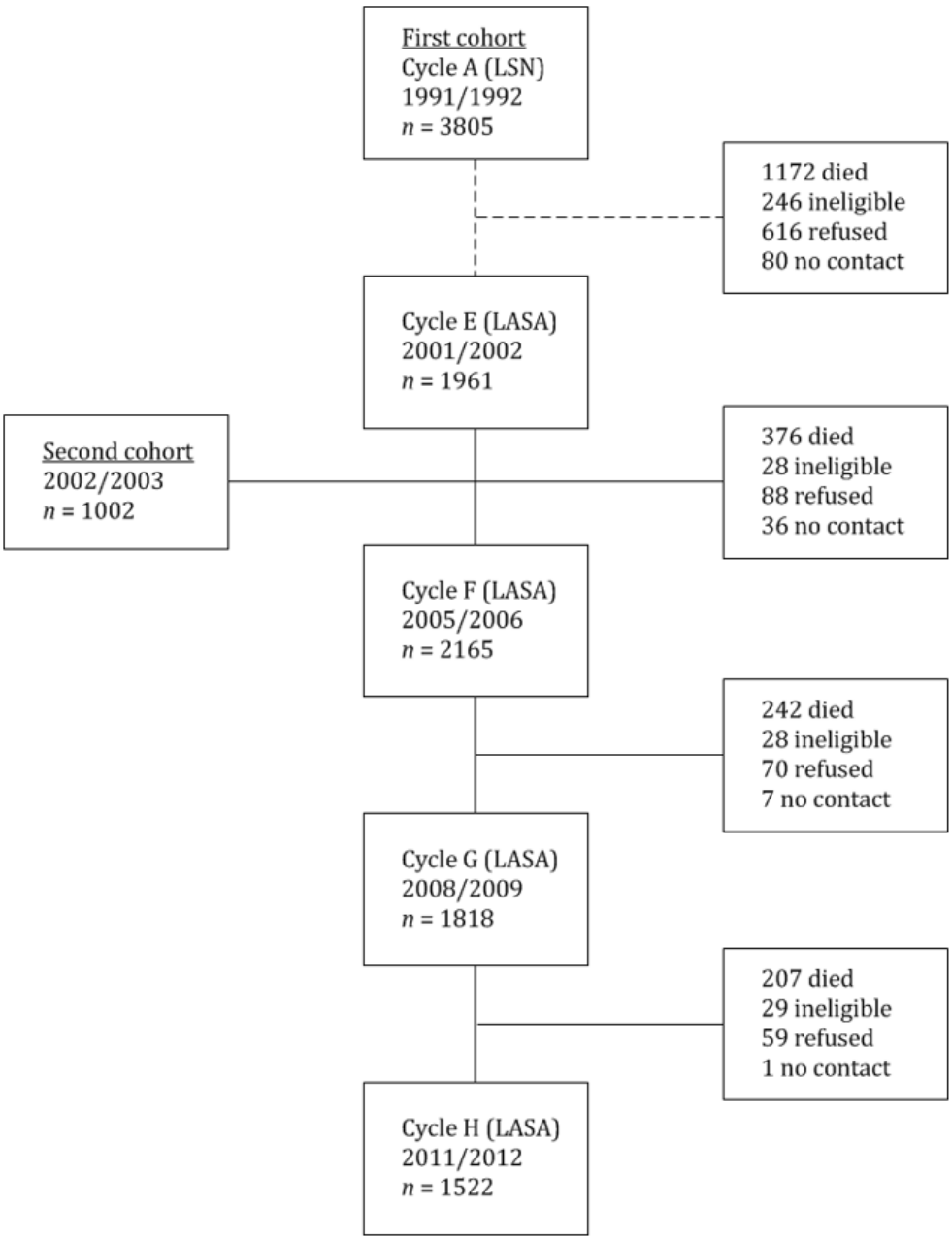

Figure 1

Inclusion, loss to follow up and attrition per measurement