Clinical science

Ophthalmic quality of life in the adult Danish population: an epidemiological study

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ABSTRACT

Background Ophthalmic quality of life (OQoL) has been investigated in selected parts of general populations and in patients with ocular disease, but OQoL in unselected general populations has not been studied in detail. The present study reports OQoL obtained from a representative sample of the adult Danish population 2020–2022.

Methods The FORSYN study invited 10 350 citizen representatives for the adult Danish population for a non-mydriatic eye examination and answer the National Eye Institute Visual Function Questionnaire with 39 items in the validated Danish translation. The results from the 3384 (32.7%) persons who participated in the study were weighted on the basis of relevant socio-economic factors, and data were projected to represent the total population. Binocular visual acuity was below 0.1 corresponding to legal blindness in 0.22% of this population.

Results OQoL was positively correlated with binocular visual acuity up to better than 93 ETDRS letters, negatively correlated with age for persons younger than 60 years of age and again positively correlated with age for persons older than 60 years. OQoL was negatively correlated with increasing ametropia and refractive error above 1 dioptre and encompassed more OQoL parameters for hyperopic than for myopic persons.

Conclusions The study underlines the benefits of improving visual acuity even within the normal range and of adjusting uncorrected refraction errors in the general population. OQoL is positively correlated with age in older persons independently of visual acuity, sex, refractive power and previous cataract surgery.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Visual Function Questionnaires are used to assess how ocular disease affects patients' quality of life (QoL). However, ophthalmic QoL (OQoL) has not been studied in an unselected normal population.

WHAT THIS STUDY ADDS

⇒ That OQoL in the normal population was positively correlated with visual acuity. Also, OQoL was negatively correlated with age until the age of 60 years, after which the correlation with age was positive.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Studies of OQoL should consider complex effects of visual acuity and age on the results.

INTRODUCTION

Visual function is assessed by a number of psychophysical techniques such as by measurement of visual acuity (VA) and by testing of visual fields and colour vision. The quantitative measures of visual performance obtained with these techniques are subsequently related to normal values for the general population or specific disease groups. However, these clinical measures of visual function may not reflect the individual's own perception of how visual performance affects the quality of life (QoL). This impression may depend on individual preferences, needs and expectations that may be different from those of the clinician. Subjective aspects of ophthalmic QoL (OQoL) can be evaluated by questionnaires of which the 25-question Visual Function Questionnaire (VFQ25) and the extended version VFQ39 that contains an appendix with 14 additional questions have gained general acceptance in ophthalmological practice.[1] These questionnaires have been validated in a number of languages including Danish.[2] The VFQ25 and VFQ39 have been used to study OQoL in a number of ocular diseases and to study the effects of therapeutic interventions on visual function[3 4] and in specific age groups.[5 6] In the normal population, OQoL has been studied using the VFQ25 on persons at working age,[7] which showed that OQoL decreases with age and is worse in women than in men. However, the study excluded persons outside the working age, and the influence of other risk factors than age, sex and VA and their associations with subcategories of visual function in the questionnaire were not evaluated.

Therefore, the present study investigated the level and factors contributing to OQoL assessed with the VFQ39 in the adult Danish population 2020–2022. The study was part of an epidemiological study of visual status and causes of visual impairment after the recent years' advances in the prevention and treatment of ocular disease.

MATERIALS AND METHODS

Aim

To study OQoL in a representative sample from the adult Danish population.

Participants

In the study FORSYN (FORekomsten af synshjælpemidler og SYNshandicap i Danmark), Statistics

Denmark randomly selected 10 350 citizens who were representative of the adult Danish population with respect to age, sex, ethnicity and socioeconomic background, and who had their home address within 40 km from Aarhus University Hospital.[8] Among these, 9708 living persons who had not in the meantime changed home address to be outside the area were invited for an eye examination between 1 May 2020 and 1 July 2022. The invitation to participate was accepted by 3384 (32.7%) of the original population sample. The participants consisted of 1520 males and 1864 females, aged in years (mean±SD, range) 51.5±18.7, 18.6–98.9 and with best-corrected binocular VA in Early Treatment for Diabetic Retinopathy Study (ETDRS) letters of (mean±SD, 95% percentile) 89.2±0.15, 76–95. The demographic characteristics of the participants were reported in detail in Bek and Bech.[8]

Questionnaire

At arrival, the participants were asked to fill out of the National Eye Institute VFQ-25 supplemented with the 14 additional items to result in the VQF39 in the validated Danish translation.[2] The questionnaire was presented on an iPad on which the participant read and responded to the questions. In three cases with illiteracy, the test was read out to the participant and help was provided for entering data on the iPad. The answers were transferred directly from the iPAD into a secure database for later analysis.

Clinical examination

The elements of the examination programme have been described in detail in Bek and Bech.[8] In brief, the participant underwent a non-mydriatic examination that included measurement of VA on each eye separately and binocularly without correction, with usual correction and with optimal correction. This was followed by biometry, tonometry and peripapillar optical coherence tomography scanning.

Projection to the total population

The identities of the persons who accepted to participate were returned to Statistics Denmark which calculated weights on the basis of age, sex and relevant socioeconomic factors so that the studied sample could be projected to 10 458 persons who were representative of the original population sample.[8]

Dependent variables

The aggregation of the scores from the VFQ-39 followed the guidelines of the questionnaire.[1] Scores from each item were recoded so that a higher score implied higher patient quality for all questions and were subsequently transformed to a scale from 0 to 100 with four or five steps with equal distance. Subsequently, the scores from 1 or more groups of items were averaged to altogether 1 group score for general health and 12 subgroup scores representing, respectively, general vision, ocular pain, near activities, distance activities, vision specific scores for social functioning, mental health, role difficulties, dependency, driving performance, colour vision, peripheral vision and a VFQ-39 composite score that was an average of the scores of all items referring to vision.[1]

Explanatory variables

Ordinal scale variables were as follows:

(1) VA as best-corrected binocular VA in ETDRS letters. The patients were also allocated to one of the three VA groups: (1) VA≤35 ETDRS letters, (2) 35<VA≤60 ETDRS letters and (3) 60<VA≤85 ETDRS letters, and to 15 groups with a lower limit of VA successively increasing by 1 ETDRS letter from 85 to 100.

Dichotomous variables were as follows:

2. Sex with the coding of male=1 or female=0.

3. Verified previous cataract surgery with the coding of yes=1 or no=0

Continuous variables were as follows:

(4) Age in years is the difference between the day of the examination and the day of birth with two decimals. The patients were also allocated to one of the age groups (in years): (1) 18<age≤40 and (2) 40<age≤60 and (3) >60.

(5) Anisometropia was calculated as the numerical value of the spherical equivalent of refraction (the spherical refraction added by half of the cylinder refraction) from the right eye subtracted by the value from the left eye. The patients were also allocated to groups with anisometropia (in dioptres) of (1) <1 and (2) <2.

(6) Refraction was set to the spherical equivalent from the eye that deviated most from zero. The parameter was included as the numerical value of all refractions and for myopic and hyperopic participants separately. Additionally, the patients were allocated to groups with numeric refraction (in dioptres) of (1) <1 and (2) <2 and for myopic persons <6.

Statistical analyses

All analyses were performed in STATA (V.14.2, StataCorp). The sign was shifted in negative anisometropia values and in the spherical equivalents of myopic eyes so that a higher number indicated increasing anisometropia and ametropia for both myopic and hyperopic eyes. The OQoL for each score was calculated after adjusting the frequencies to represent the original population representative sample using the 'expand weight' command in STATA which resulted in 10 458 population-adjusted observations.

For the 3384 unadjusted observations, the explanatory variables were entered into multiple linear regression models with the OQoL composite score and each of the subscores as dependent variables. The continuous variables were analysed by Q-Q plots, and the normal distribution of residuals was achieved by raising anisometropia to the power of 0.25 and the spherical equivalent to the power of 0.33. The regressions were performed with inverse probability weighting of the variables so that confidence intervals were corrected according to the number of participants.[9]

Validation of questionnaire

The use of the questionnaire in normal persons was tested in a graded response model using the Stata commands 'irt grm'. The analysis required the same number of levels for each item. Therefore, scores with value 6 indicating missing values that are an alternative in some of the questions and all scores from questions 15 a–c referring to driving with fewer than five answering options were removed from the analysis. The calculation required five iterations and showed an overall coefficient of discrimination of (mean, 95% CI) 0.83, 0.80 to 0.85, p<0.0001.

RESULTS

Table 1 shows the mean±SD, the IQR of the scores and the population-adjusted numbers of observations for each of the OQoL groups projected to represent the population invited for the examination.

Table 2 shows that increasing binocular VA contributed positively, whereas increasing age and ametropia contributed negatively to the variation in the composite OQoL. The included

Table 1 The mean±SD, IQR and population corrected number (n) of observations for each OQoL score

	Mean±SD	IQR	n
General health	71.5±19.0	60.0–82.5	10 450
General vision	76.4±13.7	70.0–85.0	10 450
Ocular pain	86.1±17.1	75.0–100.0	10 450
Near activities	86.6±18.8	79.2–100.0	9991
Distance activities	90.9±12.4	87.5–100.0	10 032
Social functioning	97.7±7.6	100.0–100.0	10 345
Mental health	84.5±15.8	80.0–95.0	10 450
Role difficulties	92.2±13.5	87.5–100.0	10 450
Dependency	97.1±9.9	100.0–100.0	10 450
Driving	55.2±12.2	50.3–67.0	8748
Colour vision	98.1±8.6	100.0–100.0	10 412
Peripheral vision	92.5±16.2	100.0–100.0	10 440
Composite VFQ-39	88.0±7.9	85.0–93.5	8514

OQoL, ophthalmic quality of life; VFQ-39, Visual Function Questionnaire with 39 items.

variables contributed with 6.4% of the variation to the composite OQoL.

Table 3 shows which explanatory variables contributed significantly to the variation in OQoL within the individual groups of OQoL. A positive contribution of increasing binocular VA could be observed for all subgroups of OQoL and within all the studied VA intervals (not shown). The significant increase in composite OQoL was observed with increasing binocular VA better than up to 93 ETDRS letters which comprised 1206/3384 (38.0%) of the studied persons.

Increasing age showed a significantly negative contribution to the composite OQoL, the general health score and 4 of the 11 OQoL subscores related to vision, and correlated positively with 2 of the 11 subscores related to vision. However, this heterogeneous pattern covered marked differences among different age groups. In persons aged 18–40 years, age contributed negatively to only OQoL related to general vision and near activities, in persons aged 40–60 years, increasing age also contributed negatively to social functioning, mental health, colour vision and peripheral vision, whereas in persons above the age of 60 years, increasing age contributed positively to the composite OQoL and 5 of the 11 subscores.

Table 2 Coefficients, 95% CI and p values from the multiple linear regression of the studied risk factors to explain the composite quality of life score.

Variable	Value	Coeff	95% CI	P value
Binocular visual acuity (ETDRS letters)		0.29	(0.16 to 0.42)	<0.0001
Age (years)		−0.032	(−0.058 to 0.006)	0.017
Sex	Female	0		
	Male	0.64	(−0.07 to 1.34)	0.08
Cataract surgery	No	0		
	Yes	−0.45	(−2.09 to 1.17)	0.58
Anisometropia (dioptres)		−0.94	(−2.08 to 0.20)	0.11
Spheric equivalent (dioptres)		−1.49	(−2.38 to −0.61)	0.001
Intercept		6505	(52.14 to 77.95)	<0.0001

Sex showed no significant contribution to the composite OQoL, but men had a better subscore than women for ocular pain, near activities and driving, whereas women had a better score for social functioning and colour vision.

Previous cataract surgery showed no significant contribution to the composite OQoL, which may be due to lack of sensitivity of the questionnaire,[10] but the response covered a positive contribution to colour vision and a negative contribution to distance activities, social functioning, role difficulties and peripheral vision.

Increasing anisometropia showed no significant contribution to the composite OQoL score, but a negative contribution to the subscores for dependency and driving. The significant contribution disappeared when the analysis was repeated for anisometropias less than 1 dioptre.

Increasing ametropia in the best eye showed a significant negative contribution to the composite OQoL, but the effect was different between persons with myopia and hyperopia. Increasing myopia in the best eye contributed positively to OQoL related to dependency and negatively to the score related to distance activities, but the contributions disappeared for myopia lower than −1 dioptre. When the analysis was repeated on patients with myopia <6 dioptres on the least myopic eye, the spherical equivalent also correlated negatively with the subgroups ocular pain and near activities. However, increasing hyperopia in the best eye correlated negatively with general vision, distance activities, mental health and peripheral vision. The contributions disappeared for refractions lower than +1 dioptre.

DISCUSSION

Vision is considered to be the most important sensory quality for conducting a normal human life.[11] However, the quality of vision can be defined from different perspectives, and there may be marked differences between the clinician's objective measures of visual quality and the patients' subjective sense of vision-related QoL. QoL related to vision can be assessed by questionnaires,[12] of which the VFQ25 and VFQ39 were originally developed and validated on the basis of input from patients with the ocular disease.[1] It has subsequently been shown that these questionnaires refer to more broader aspects of ocular function[10] and might, therefore, more rightfully be referred to as measuring OQoL which is used in the present study. The questionnaires have been used to assess OQoL in patients with as diverse conditions as age-related macular degeneration,[13] glaucoma and cataract,[14] optic neuritis[15] and dry eye disease,[16] and also to assess the effects of interventions on these conditions.[4 14] However, in recent years, there has also become increasing awareness about the limitations of these methods for assessing visual function.[17] In normal persons, the visual needs, priorities and preferences in normal persons may differ significantly from those of patients with ocular disease. Therefore, it is likely that questionnaires developed on the basis of visual symptoms from patients with vision-threatening diseases may have limitations for assessing OQoL in the general population. This is supported by the present study where the included explanatory parameters only contributed to a little more than 6% of the variation in OQoL and the observed scores were much higher than those observed in patients with ocular disease.[4 12 18] This reduction in difficulty for the respondents underlines that OQoL in normal persons depends on other factors than those directly related to ocular function and although the coefficient of discrimination of the test was reasonable, the overall limitations in methodology may reduce the predictive value of the study. Another limitation was that the VFQ39 scores were obtained by using a summary

Table 3 The signs of the coefficients for the significantly contributing parameters in the multiple linear regressions to the scores for general health (upper row), the OQoL subgroups (inside highlighted box) and the composite score (lower row)

	Binocular visual acuity (ETDRS letters)	Age (years)				Sex	Cataract surgery	Anisometropia (D)	Myopia (D)	Hyperopia (D)
		All	18<age<=40	40<age<=60	60<age					
General health	+	–	–	–						
General vision	+	–	–	–						–
Ocular pain	+					+				
Near activities	+	–	–	–	+	+				
Distance activities	+	+			+		–		–	–
Social functioning	+			–	+	–	–			
Mental health	+			–	+					–
Role difficulties	+	+			+		–			
Dependency	+							–	+	
Driving	+	–				+		–		
Colour vision	+			–		–	+			
Peripheral vision	+	–		–			–			–
Composite VFQ-39	+	–		–	+				–	–

+ sign: significant (p<0.05) positive contribution. – sign: Significant (p<0.05) negative contribution. No sign: No significant contribution (p≥0.05).
It is important that a part of the table is delimited as a box with thicker lines as in the submitted manuscript. Otherwise, the table legend will not make sense.
OQoL, ophthalmic quality of life; VFQ-39, Visual Function Questionnaire with 39 items.

scoring method that treats ordinal data as continuous. This erroneously assumes that each item has the same worth and that every response is equidistant from each other. Additionally, it is a limitation that the psychometric properties of the graded response method were used to assess the questionnaire, but the scores derived from the item response theory were not used as outcome measures. A few prior studies have evaluated OQoL in normal persons using the validated VFQs. In a study from Taiwan, it was shown that OQoL decreased with increasing myopia in junior high school students,[19] and a study from Germany on persons at working age showed that increasing age and anisometropia, lower VA and female sex contributed negatively to the OQoL.[20] The present study confirmed the positive contributions of better VA to OQoL[20] and the fact that this parameter contributed positively to all OQoL subscores underlines the dominant role of this parameter for OQoL. Surprisingly, OQoL was also postively correlated with increasing binocular VA above up to 93 ETDRS letters, corresponding to values around a decimal acuity of 1.6. This argues against VA as a limiting factor for treating ocular disease when the accompanying risk for adverse effects is acceptable, even when VA is within the normal range.

The study confirms previous reports of a negative correlation of the composite OQoL with age.[20] This negative correlation was also observed for the OQoL subgroups related to general health, general vision and driving performance which may be due to a relationship between general health and skills that are important for driving such as short reaction times and visual-motor processing speed.[21] However, the pattern was more complex within the individual age groups. In the two youngest groups of participants aged 18–40 and 40–60 years, there was a negative correlation between age and as well general health as general vision and near activities, and the 40–60 years age group also of social functioning, mental health colour vision and peripheral vision which may be a consequence of progressive presbyopia and nuclear sclerosis. Conversely, the group aged 60+ years reported no negative contributions of increasing age to OQoL, but five of the subgroups of vision-related questions were positively correlated with age. This may be because persons with low OQoL had other illnesses, and therefore had died at an earlier age to leave persons with a high OQoL alive to respond to the questionnaires. An additional explanation may be an increasing age-related positive attitude to life. This is supported by findings that psychological well-being in high-income countries shows a U-shaped curve with a minimum in the mid-age years from which well-being increases with age.[22] The trend may be a consequence of fewer life stressors and more cognitive control that leaves older persons more free to follow personal preferences in life.[23 24] However, this effect may be restricted to countries with well-established social security networks since a similar improvement in psychological well-being with age has not been found in previous east block countries.[25]

The present study also confirms previous findings of a lack of effect of sex on the composite OQoL,[5] although a study found a positive contribution of male sex to the composite OQoL.[20] However, the contribution of sex was different for different subgroups of OQoL. The fact that females reported a more positive vision-related social function and colour vision and men reported more ocular pain and capacity for near activities and driving confirms studies of differences in behaviour and interests among males and females.[26 27]

It has been extensively documented that cataract surgery is accompanied with improvement in OQoL with an effect that reflects the improvement in VA.[14] This was confirmed by the present study where the composite OQoL was not positively correlated with cataract surgery independently of binocular vision. This suggests that the positive effect of cataract surgery is linked to the improvement in other factors such as VA. However, the result covered opposite trends within the individual OQoL subgroups. Thus, cataract surgery showed a separate positive correlation with better colour vision independently of the effect on VA which may be the consequence of the removal of a nuclear sclerosis. Additionally, the fact that cataract surgery reduced the OQoL related to distance activities, social functioning, role difficulties and peripheral vision independently of VA, may potentially be the result of a coupling between the development of cataract and the general health.[28]

The negative contribution of anisometropia to dependency and driving may be related to challenges with binocular vision such as aniseikonia and stereopsis.[29] This is confirmed by the fact that the negative contribution of anisometropia for OQoL disappeared for values less than 1 dioptre where the difference in magnification among the two eyes is minimal. The primary goal of refractive corrections is to optimise VA at specified distances, but the need for and use of such corrections also have secondary effects on daily life. A previous study has shown that persons with refractive anomalies are more worried and have more difficulties with daily activities, unwanted sensations, psychosocial well-being and economy.[30] This was confirmed in the present study where the composite OQoL score was negatively affected by increasing ametropia. However, the pattern became more differentiated when myopia and hypermetropia were considered separately. This showed that increasing myopia had a positive effect on dependency, but a negative effect on distance activities which may be explained as a consequence of the need for correction of myopia. However, increasing hyperopia also reduces OQoL for general vision, mental health and peripheral vision which emphasises that hyperopia is disadvantageous for vision at any distance and that refractive correction is necessary for all persons who do not have sufficient accommodative power to compensate for the hyperopia. A coupling between VRQL and accommodative power and not hyperopia per se is confirmed by a study which showed that high school students with myopia were challenged with both near vision and distance vision which was not the case for students with hyperopia who could accommodate the hyperopia.[19]

In conclusion, the study has shown that the parameters important for OQoL in patients with vision loss may not be optimal for assessing OQoL in normal persons. OQoL was positively correlated with binocular VA even within the normal VA range, was positively correlated with age for persons above the age of 60 years and negatively correlated with ametropia for refractive errors above 1 dioptre. The study underlines the benefits of improving VA and adjusting refraction in the general population, even when VA is within the normal range, and not only in patients with ocular disease.

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Competing interests None declared.

Patient consent for publication Consent obtained directly from patient(s).

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