

# Vision-targeted quality of life under different degrees of visual impairment

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## **Abstract**

*To determine differences of vision-targeted quality of life (QOL) under different degrees of visual impairment using the National Eye Institute Visual Function Questionnaire (NEI-VFQ) in a German sample of 241 consecutive patients. Patients with severe visual impairment and partly patients with moderate visual impairment suffered the most from a decrease in vision-targeted QOL. We assume that the NEI-VFQ is a very useful and reliable psychodiagnostic inventory assessing vision-specific QOL and we suggest the use of this instrument in future studies.*

**Key-words:** *Quality of life; Visual function.*

Visual function is important for an optimal orientation in functional and social life and has an effect on physical and emotional well-being<sup>1</sup>. Therefore, loss of vision leads to restrictions in all areas of health-related quality of life<sup>2</sup> (QOL). In ophthalmology, traditional measures such as retinal photographs and performance-based examinations like Snellen visual acuity predominate. Recently the construct of QOL has gained increasing importance in medical<sup>3</sup> and psychosomatic research. In ophthalmology QOL was first studied in patients with cataract<sup>4-8</sup>, possibly due to the frequency of cataract operations. Therefore, questionnaires were developed that were specifically designed for this group of patients<sup>9-15</sup>. However, they may not fully describe the range of disability and functional impairment experienced by patients with other ocular diseases. To remove these limitations a survey entitled the National Eye Institute Visual Function Questionnaire (NEI-VFQ)<sup>16,17</sup> was developed, which allows a comparison between groups of patients under different ocular conditions. This questionnaire was derived from an analy-

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sis of the transcript-content of 26 focus-groups with different ocular disease and its usefulness was demonstrated in several studies<sup>17-20</sup>. The aim of the present study is to determine differences of vision-targeted QOL under degrees of visual impairment, and to investigate the psychometric properties and usefulness of the National Eye Institute Visual Function Questionnaire (NEI-VFQ) in a German sample.

## METHODS

### *Study population*

Case patients consisted of 241 consecutive in- and out-patients observed at the Department of Ophthalmology, University Hospital Essen, FRG, during a 6-month period from January to June, 1998. We excluded patients already in other clinical trials, no other exclusion criteria were used. Leading diagnosis of patients were: diabetic retinopathy (n=60), cataract (n=96), glaucoma (n=29), and malignant choroidal melanoma (n=56).

### *Questionnaires*

For all QOL scales, the highest possible score, 100, represents the highest level of functioning or the minimal subjective impairment. A short version of the 51-item field test version of the NEI-VFQ<sup>17</sup>, the NEI-VFQ-25 with 25 item-groups and 42 items<sup>20</sup> was used. The NEI-VFQ was designed to evaluate patients' percep-

tions of the effect of ocular disease on daily functioning and QOL. It assesses patients' ability to perform a broader range of tasks and was designed for ophthalmologic patients in general. It consists of the following 12 subscales, general health, general vision, ocular pain, near vision, distance vision, vision-specific social functioning, vision-specific emotion/well-being, vision-specific role difficulties, vision-specific dependency, driving, color vision, and peripheral vision<sup>17</sup>.

Upon receipt of the original American NEI-VFQ questionnaire, the instructions, items and responses were translated into German by two independent native German speakers with excellent knowledge of English. The translators then met to discuss and agree upon a common version of the questionnaire, keeping all alternative translations for further modification of the form if necessary. The common version was then evaluated by two other native German-speaking raters in terms of conceptual equivalence, linguistic performance and clarity. The German version approved by this procedure was then back-translated into English by two independent native English translators with excellent knowledge of German. These translators had to agree on a common back-translated version.

All translators then met to discuss and agree upon a common German version of the questionnaire<sup>21</sup>.

The SF-36 Health Survey<sup>22</sup> includes 1 multi-item scale that assesses 8 health concepts: (1) limitations in physical activities because of health

problems, (2) limitations in social activities because of physical or emotional problems, (3) limitations in usual role activities because of physical health problems, (4) bodily pain, (5) general mental health (psychological distress and well-being), (6) limitations in usual role activities because of emotional problems, (7) vitality (energy and fatigue), and (8) general health perceptions. This instrument was chosen to assess global health-related QOL because of its demonstrated validity and reliability<sup>22</sup>. The official German version of the SF-36 was used<sup>21</sup>.

### *Procedures*

The study was approved by the Center of Ophthalmology, University Hospital Essen, FRG, and informed consent was obtained from each study participant. Demographic questions, the NEI-VFQ and SF-36 were administered in this order by a personal interview conducted by a single interviewer. This interviewer was trained in the Institute of Medical Psychology, University Hospital Essen, FRG, by one of the authors (G.H.F.) who has conducted numerous psychodiagnostic studies. The participation rate for the interviews was 95% (lack of time was the main reason for rejecting participation). Ophthalmologists who were unaware of the patients' NEI-VFQ and SF-36 scores, performed complete ophthalmologic examinations on all case patients. Best-corrected visual acuity (measured on the same day before or

after the psychodiagnostic investigation) and primary ocular diagnosis were extracted from patients' medical record.

To assess non-ophthalmic comorbidities, the Karnofsky Index<sup>23</sup> was used.

Monocular Snellen visual acuity<sup>24-26</sup> was measured while patients were wearing their current "walking about" correction. Patients' visual acuity status was then summarized in terms of weighted average logMAR (where MAR indicated the numerator of visual acuity divided by the denominator of visual acuity), with the better eye given a weight of 0.75 and the worse eye given a weight of 0.25. Weighted average logMAR (WMAR)<sup>1,27</sup> was computed because this summary score encompasses visual information from both eyes.

### *Analysis*

The statistical analysis was designed to explore the association between QOL scores and visual acuity in different groups of visually impaired patients, and to explore the independent associations between questionnaire subscales and visual acuity.

Case patients were categorized into quartiles of visual acuity, and analyses of variance were used to examine the association among the four groups of different visual acuity and NEI-VFQ scores.

The associations between objective vision values and questionnaire scores were examined using a corre-

lation analysis, Persons *r* is reported. In a study of this size, even weak correlations attain statistical significance, so the *p* value does not constitute a useful measure of the importance of a relationship. Correlations were classified into ranges of importance: not statistically significant; significant, but weak  $r < 0.32$  ( $r^2 < 10\%$ ,  $p < .05$ ); modest, *r* from 0.32 to 0.55 ( $r^2$  from 10% to 30%); and moderate,  $r > 0.55$  ( $r^2 > 30\%$ ).

Multiple regression analysis was used to examine the independent as-

sociations between the NEI-VFQ subscales and demographic data (age, gender), comorbidity, primary cause of visual impairment, vision (Snellen visual acuity better eye, Snellen visual acuity worse eye), and global QOL (SF-36).

To determine whether the NEI-VFQ and the SF-36 were reliable when administered to the patients, Cronbach's  $\alpha$  was calculated as a measure of internal consistency for each of the multi-item subscales (Table 1).

Table 1 - Characteristics of Case Patients

<i>Visual impairment /Variables</i>	<i>No</i>	<i>Mild</i>	<i>Moderate</i>	<i>Severe</i>	<i>Sum</i>	<i>Sign. Test</i>	<i>p</i>
No. of patients	22	119	81	19	241		
Mean (SD) age	52.6 (11.6)	61.5 (13.2)	67.6 (11.7)	70.7 (11.31)	63.5 (13.3)	F(3.237) =11.7	.0001
Gender: Male	9	59	27	9	104	$\chi^2$ =5.37	.15
Female	13	60	54	10	137		
Mean (SD) comorbidity score	87.3 (9.9)	80.4 (13.0)	77.0 (11.3)	70.0 (14.5)	79.1 (12.9)	F(3.237) =7.84	.0001
Primary cause of visual impairment						$\chi^2$ =81.82	.0001
Cataract	-	25%	68%	58%	40%		
DRP	9%	28%	22%	37%	25%		
Glaucoma	27%	18%	1%	5%	12%		
MCM	64%	29%	9%	-	23%		
Mean (SD) WMAR score	0.002 (0.000)	-0.175 (0.010)	-0.473 (0.120)	-1.167 (0.254)	-0.337 (0.315)		
Minimum (maximum) Snellen Visual Acuity better eye	0.100 (1.25)	0.50 (1.00)	0.20 (0.50)	0.03 (0.20)	0.03 (1.25)		
Minimum (maximum) Snellen Visual Acuity worse eye	0.80 (1.25)	0 (0.80)	0 (0.32)	0 (0.10)	0 (1.25)		

Note: Comorbidity score indicates the Karnofsky-Index (100=best, 0=worst). DRP indicates diabetic retinopathy, MCM indicates malignant choroidal melanoma. WMAR: weighted average logMAR (where MAR indicates the numerator of visual acuity divided by the denominator of visual acuity).

## RESULTS

### Summary statistics

Patients were divided into visual acuity quartiles: no visual impairment (n=22) (WMAR $\geq$ 0), mild visual impairment (n=119) (WMAR<0 to >-0.35), moderate visual impairment (n=81) (WMAR=-0.35 to -0.80), and

severe visual impairment (n=19) (WMAR $\leq$ -0.80).

Table 1 provides clinical and demographic characteristics of the 241 participants. There was a linear trend in mean age and in comorbidity across the visual impairment quartiles. There was no significant difference between the groups in terms of gender (Table 2).

Table 2 - Vision specific Quality of Life (QOL): Means and standard deviations (in parentheses) of the NEI-VFQ-scales.

Scale	No (N=22)	Mild (N=119)	Moderate (N=81)	Severe (N=19)	Sum (N=241)	F	P
GH	52.8 (17.3)	49.3 (19.2)	44.3 (20.33)	38.7 (19.1)	47.1 (19.2)	F(3.237) =3.04	.03
GV	77.3 (15.3)	56.3 (15.5)	47.6 (16.8)	41.6 (18.6)	54.1 (18.4)	F(3.237) =23.93	<b>.0001</b>
OP	87.5 (18.5)	83.4 (22.3)	85.5 (22.8)	75.7 (26.5)	83.9 (22.5)	F(3.237) =1.20	.31
NV	89.8 (15.0)	74.8 (24.4)	61.5 (27.4)	22.2 (14.9)	67.6 (28.7)	F(3.237) =33.77	<b>.0001</b>
DV	95.1 (7.5)	82.5 (21.1)	65.9 (26.9)	24.2 (15.9)	73.5 (27.9)	F(3.237) =48.11	<b>.0001</b>
VSSF	99.2 (2.6)	91.0 (16.4)	77.5 (25.8)	39.1 (30.3)	83.1 (25.3)	F(3.237) =40.99	<b>.0001</b>
VSEWB	74.1 (17.4)	70.0 (21.9)	61.6 (27.6)	28.4 (20.4)	64.3 (26.0)	F(3.237) =18.68	<b>.0001</b>
VSRD	60.2 (17.0)	56.9 (20.2)	47.2 (25.4)	18.5 (13.9)	50.9 (23.9)	F(3.237) =19.57	<b>.0001</b>
VSD	99.1 (4.0)	84.9 (27.6)	73.4 (33.2)	27.6 (28.7)	77.8 (32.8)	F(3.237) =26.74	<b>.0001</b>
D1	82.6 (17.0)	70.7 (25.7)	56.3 (23.1)	54.6 (25.8)	66.5 (25.5)	F(3.132) =6.38	<b>.0001</b>
CV	98.9 (5.3)	92.0 (20.6)	88.0 (25.0)	50.0 (36.3)	88.0 (25.5)	F(3.237) =20.29	<b>.0001</b>
PV	96.6 (11.7)	82.6 (26.1)	81.2 (30.2)	35.5 (29.2)	79.7 (30.0)	F(3.237) =20.51	<b>.0001</b>

**Note:** For the NEI-VFQ: GH indicates general health, GV, general vision, OP, ocular pain, NV, near vision, DV, distance vision, VSSF, vision-specific social functioning, VSEWB, vision specific emotion/well-being, VSRD, vision-specific role difficulties, VSD, vision-specific dependency, D, driving, CV, color vision; and PV, peripheral vision.

<sup>1</sup>Driving: Only 136 patients drive a car.

P<.004 adjusted for multiple comparison underlined.

### *Vision targeted QOL*

Regarding the results of the NEI-VFQ (Table 2), 10 out of 12 subscales demonstrated statistically significant differences between the four visually impaired groups of patients ( $p < .004$  adjusted for 12 comparisons). In summary, patients with severe visual impairment and partly patients with moderate visual impairment suffered the most.

To examine if the group differences in the 10 subscales of the NEI-

-VFQ were independent from the demographic variables age and gender, and the clinical variables comorbidity and disease group, additional sets of analyses of variance with these variables as covariates were performed. However, differences between disease groups remained substantial in each of the 10 subscales. Comorbidity explained 8% of variance in the general health scale (Table 3).

Correlations between visual acuity and the two questionnaire scores for patients the are given in Table 3,

**Table 3 - Correlations between visual acuity (Snellen visual acuity better eye, Snellen visual acuity worse eye, WMAR) and Questionnaire Scores**

	<i>Better</i>		<i>Worse</i>		<i>WMAR</i>	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
SF-36						
Physical Functioning	.36*	.0001	.16+	.02	.34*	.0001
Role Physical	.09	.17	.03	.61	.09	.17
Bodily Pain	.09	.16	-.03	.69	.10	.12
General Health	.02	.77	-.04	.59	.01	.92
Vitality	.13+	.04	-.02	.73	.18+	.01
Social Functioning	.18+	.006	.06	.38	.13+	.05
Role Emotional	.25+	.0001	.04	.58	.24+	.001
Mental Health	.20+	.002	.03	.60	.20+	.01
NEI-VFQ						
General Health	.29+	.0001	.10	.12	.23+	.0001
General Vision	.46*	.0001	.46*	.0001	.43*	.0001
Ocular Pain	.06	.35	-.01	.92	.06	.35
Near Vision	.56**	.0001	.37*	.0001	.58**	.0001
Distance Vision	.61**	.0001	.40*	.0001	.63**	.0001
Social Functioning	.55**	.0001	.37*	.0001	.62**	.0001
Emotion/Well-Being	.43*	.0001	.27+	.0001	.46*	.0001
Role Difficulties	.44*	.0001	.20+	.002	.45*	.0001
Dependency	.49*	.0001	.30+	.0001	.53*	.0001
Driving <sup>1</sup>	.38*	.0001	.28+	.001	.33*	.0001
Color Vision	.38*	.0001	.21+	.001	.47*	.0001
Peripheral Vision	.29+	.0001	.32*	.0001	.42*	.0001

**Note:** <sup>1</sup>Driving: Only 136 patients drive a car. \*weak correlation (statistically significant and  $r < 0.32$ ), <sup>+</sup>modest correlation ( $r \geq 0.32$  and  $r < 0.55$ ), \*\*moderate correlation ( $r \geq 0.55$ )

demonstrating that only a few SF-36 scores were weakly correlated with visual acuity, except for a modest correlation between physical functioning and WMAR. Partial correlations between SF-36 scores and visual acuity, which were adjusted for age, gender, and comorbidity, were comparably weak, including a weak correlation between physical functioning and WMAR.

Regarding the NEI-VFQ, ocular

pain was not correlated with visual acuity. Eleven of the 12 subscales of the NEI-VFQ were weakly to moderately correlated with visual acuity. Partial correlations between NEI-VFQ scores and visual acuity, adjusted for age, gender, comorbidity, and disease group were also highly significant and were ordered by strength across questionnaires, as were the unadjusted correlations (Table 4).

Stepwise hierarchical regression

Table 4 - Hierarchical multiple regression analysis predicting the subscales of the NEI-VFQ

NEI-VFQ Subscales	Step Entered	Variable	Multiple R	DF	F*	$\beta$	R <sup>2</sup>
GH	1	SF-8	.69	1.239	219.6	.69	.48
	2	SF-1	.73	2.238	135.9	.29	.53
	3	SF-7	.75	3.237	78.2	.21	.54
	3	SF-6	.76	3.237	64.1	.14	.56
	4	Age	.76	4.236	79.0	-.10	.56
GV	5	Comorb	.76	5.235	65.0	.10	.57
	1	Worse	.46	1.239	63.90	.46	.21
	2	SF-7	.54	2.238	48.69	.28	.28
	3	Group	.57	3.237	37.78	.20	.32
	4	SF-3	.59	4.236	31.13	.17	.33
OP	1	SF-6	.29	1.239	22.47	.29	.08
	2	SF-3	.34	2.238	15.14	.17	.11
NV	1	SF-1	.58	1.239	118.9	.58	.33
	2	Better	.69	2.238	107.1	.40	.47
	3	SF-4	.70	3.237	77.5	.16	.50
DV	1	Better	.61	1.239	137.9	.61	.36
	2	SF-1	.71	2.238	120.7	.40	.50
	3	SF-4	.73	3.237	89.1	.17	.52
VSSF	1	Better	.55	1.239	102.0	.62	.30
	2	SF-1	.62	2.238	74.8	.30	.38
	3	SF-5	.64	3.237	54.9	.17	.40

**Note**

\* All  $p < .0001$ . SF indicates scales of the SF-36 Health Survey: SF-1. Physical Functioning; SF-2. Role Physical; SF-3, Bodily Pain; SF-4. General Health; SF-5. Vitality; SF-6. Social Functioning; SF-7. Role Emotional; SF-8. Mental Health. Comorb, Cormorbidity; Group, Disease Group see Table 1. NEI-VFQ-scales see Table 2.

Continue - Table 4 - Hierarchical multiple regression analysis predicting the subscales of the NEI-VFQ

<i>NEI-VFQ Subscales</i>	<i>Step Entered</i>	<i>Variable</i>	<i>Multiple R</i>	<i>DF</i>	<i>F*</i>	<i>β</i>	<i>R<sup>2</sup></i>
VSEWB	1	SF-5	.53	1.239	94.8	.53	.29
	2	Better	.64	2.238	83.1	.36	.41
	3	SF-4	.68	3.237	68.9	.27	.47
	4	SF-1	.69	4.236	53.9	.13	.48
	5	Gender	.70	5.235	44.6	.10	.49
VSRD	1	SF-1	.55	1.239	102.9	.55	.30
	2	Better	.61	2.238	69.3	.28	.36
	3	SF-7	.64	3.237	54.6	.26	.40
	4	SF-4	.65	4.236	44.0	.15	.42
	5	Age	.66	5.235	36.7	.13	.43
VSD	1	SF-1	.60	1.239	131.6	.60	.35
	2	Better	.67	2.238	94.5	.32	.44
	3	SF-4	.69	3.237	72.1	.20	.47
	4	Gender	.70	4.236	57.0	.12	.48
	5	SF-3	.71	5.235	47.2	.12	.49
D <sup>1</sup>	1	Better	.38	1.134	21.9	.38	.14
	2	SF-2	.42	2.133	14.1	.19	.16
CV	1	Better	.38	1.239	39.2	.38	.14
	2	SF-4	.44	2.238	29.1	.24	.19
	3	SF-1	.47	3.237	21.9	.16	.21
	4	Gender	.50	4.236	19.1	.17	.23
PV	1	SF-1	.32	1.239	27.2	.32	.10
	2	Worse	.42	2.238	25.1	.27	.17

**Note**

\* All  $p < .0001$ . SF indicates scales of the SF-36 Health Survey: SF-1, Physical Functioning; SF-2, Role Physical; SF-3, Bodily Pain; SF-4, General Health; SF-5, Vitality; SF-6, Social Functioning; SF-7, Role Emotional; SF-8, Mental Health. Comorb, Comorbidity; Group, Disease Group see Table 1. NEI-VFQ-scales see Table 2. <sup>1</sup>Driving: Only 136 patients drive a car.

models were used to predict the NEI-VFQ subscales with sociodemographic (age, gender), ophthalmic (visual acuity better eye, visual acuity worse eye, disease group), medical (comorbidity), and global QOL data (SF-36 subscales). Results indicated that higher scores in the general health subscale were predicted by four subscales of the SF-36 (56% explanation of variance); and with minor im-

portance for age and comorbidity (each 1% explanation of variance). The subscale ocular pain was predicted by two subscales of the SF-36, but only 11% of variance was explained. Four of the remaining 10 subscales were mainly predicted by visual acuity of the better eye (explanation of variance 14% in case of driving and color vision to 36% in case of distance vision). In 3 subscales, visual

acuity of the better eye was the second predictor (explanation of variance 6% to 12%). In the case of general vision visual acuity of the worse eye explained 21% of variance as the main predictor; in the case of peripheral vision it explained 7%. Age, gender, comorbidity and disease group played minor important roles explaining variance of NEI-VFQ subscales.

### *Reliability of the NEI-VFQ and SF-36 subscales*

Cronbach's  $\alpha$  showed moderate to excellent reliability for the NEI-VFQ subscales, ranging from .61 for ocular pain to .91 for near vision. Five subscales had reliability estimates above .78, a range that is sufficient for group to group comparisons<sup>28</sup>. The SF-36 showed slightly better reliability with 6 of 8 subscales at or above .78.

## CONCLUSION

In this study, we investigated the psychometric properties and usefulness of the National Eye Institute Visual Function Questionnaire (NEI-VFQ) in a German sample to determine differences of vision-specific QOL under different degrees of visual impairment.

Limitations of the study are considered to be based on the non-equal distribution of patients among the different visually impaired groups, and in the restriction to only four different ocular diseases investigated. Data limitation is due to the data col-

lecting process in a university hospital, with exclusion of patients participating in other studies. Future studies should evaluate a broader range of ocular diseases, e.g. patients with different forms of macular degeneration.

From a psychosomatic point of view, it is interesting that even mild visually impaired patients suffered significantly from lower QOL due to lower general vision compared with visually non-impaired patients. This is the only, but important difference between the two groups of mild visually impaired and non-impaired patients. In conclusion, attention has to be drawn to a marked decrease in vision-specific QOL in the mild visually impaired.

Most of the scores of the NEI-VFQ are associated with the level of visual acuity, even after adjusting for age, gender, comorbidity, and disease group. Multiple linear regression analysis revealed that visual acuity explained substantial variance in ten of 12 NEI-VFQ scales. Vision-related QOL is also associated with general QOL, measured by the SF-36. Despite these two sources of explanation of variance, sociodemographic variables like gender and age as well as comorbidity and disease group played a minor role in predicting vision related QOL.

We conclude the NEI-VFQ to be a very useful and reliable psychodiagnostic inventory, assessing vision-specific QOL. We suggest the use of this instrument in future studies on QOL of visually impaired patients.

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