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Health-Related Quality of Life Following Blind Rehabilitation

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Abstract

Purpose—The purpose of this study was to investigate the effect of residential blind rehabilitation on patients' vision targeted health-related quality of life (HRQOL) and general physical and mental function.

Methods—The National Eye Institute 25-item Visual Function Questionnaire (NEI VFQ) plus appendix questions, the 12 item Short-Form Health Survey (SF-12), Hope Scale and Coopersmith self-esteem inventory were administered to 206 legally blind veterans prior to their entering a residential (in-patient) blind rehabilitation program and again to 185 and 176 of the original cohort at two and six months after completion of the rehabilitation program, respectively. Data on visual acuity, visual field extent, contrast sensitivity and scanning ability were also collected. The duration of the in-patient rehabilitation programs ranged from 11–109 days. Questionnaire scores were compared pre-rehabilitation and post-rehabilitation.

Results—Following rehabilitation there was a significant improvement in nine of eleven NEI VFQ subscales and in a composite score at both 2- and 6-month post-rehab intervals. Mental health (SF-12) and self esteem also improved significantly although physical health ratings declined over the course of the study (approximately 10 months).

Conclusions—Residential blind rehabilitation appears to improve patients' self-reported vision-targeted HRQOL, self-esteem, and mental health aspects of generic HRQOL.

Keywords

Health related quality of life; NEI-VFQ; SF-12; Hope Scale; self-esteem; profound low vision; vision rehabilitation; blind rehabilitation; United States veterans

Introduction

For many years the assessment of functional outcomes such as traditional clinical or physiological measures (e.g. symptoms, signs, visual acuity or intraocular pressure) has been important in the study of medical and surgical interventions in eye disease. However, in the past decade, the evaluation of health and eye care has increasingly focused on health-related quality of life (HRQOL) as a critical outcome of treatment [1–5]. The reason is that functional

measurements may not provide adequate characterization of the burden of disability in day-to-day activities from the patient's perspective. Furthermore, improvements in function or the ability to perform different tasks as a result of an intervention may not be meaningful to the individual if they do not address one's needs or improve one's psychological state [5,6]. Health-related quality of life measures are designed to be more comprehensive and include assessment of physical, psychological and social function, and general health. Some measures, such as the National Eye Institute Visual Function Questionnaire (NEI VFQ) target specific domains, in this example visual function and how it affects HRQOL [7].

Vision is central to the functioning of the individual and it is clear from numerous studies over the past two decades that impaired vision exerts dramatic effects on function and on quality of life [8–14]. It has also been shown that interventions which improve visual function, such as cataract surgery, also improve HRQOL [15–20]. For persons with permanent visual impairment (i.e. not correctable with spectacles, contact lenses or surgical interventions) interventions to improve function are based on learning compensatory skills, training in the use of technological aids, or both. These vision interventions range from simple prescription of low vision aids with minimal training to comprehensive in-patient training regimens like the blind rehabilitation program of the Department of Veterans Affairs (DVA) in the United States. The DVA program, which is the focus of this study is intended to improve the ability of legally blind veterans to perform tasks in specific skill areas including: Orientation and Mobility (O&M), Manual Skills, Activities of Daily Living (ADL), Communication, and Low Vision. Blind rehabilitation is generally acknowledged to improve functional status [21–24] and the implicit assumption is that it also enhances HRQOL.

However, it has only been recently that studies have gone beyond anecdotal reports and directly investigated the effects of vision and blind rehabilitation services on HRQOL. Most of the studies have focused on outpatient low vision services and have yielded different outcomes, from evidence of great success of low vision care [5,25–28] to having little or no effect on the recipient's HRQOL [29]. Only a few studies have looked at the effects on HRQOL of participation in comprehensive in-patient blind rehabilitation programs such as the one administered by the DVA [25,26,30]. The most recent of these were conducted by Stelmack and colleagues [26,30]. In one study, Stelmack & Stelmack, et al., [26] administered the NEI VFQ (25-item version plus supplement) to veterans upon admission and discharge from one of the DVA blind rehabilitation programs. They found only 7 of 34 items were sensitive to change after rehabilitation and nearly all of these targeted activities related to near vision tasks, primarily reading. They found no change in vision specific social functioning, role limitation, dependency, or mental health. They concluded that the lack of change in these dimensions occurred because they were not activities targeted during rehabilitation. However, this interpretation is complicated by the fact that both the pre and post-tests were administered at the rehabilitation center, just after clients had arrived for training and just prior to discharge. This procedure may have introduced different types of bias, raising questions about the accuracy of the results. Respondents may have overestimated abilities in areas that were specifically addressed by the rehabilitation program as a result of a halo effect. On the other hand dimensions such as social function and mental health may not have shown change because respondents had not had the opportunity to evaluate the impact of their new functional abilities in everyday life.

In a second study Stelmack & Moran, et al. [30] used a visual function questionnaire that they developed to assess outcomes of blind rehabilitation. The questionnaire focused on activities that are specifically addressed in DVA blind rehabilitation programs. It was administered over the phone just before rehabilitation began and again at 3 and 12 month after rehabilitation had been completed. This procedure avoided the problems associated with their initial study [26]. The outcome measure was a single metric of visual ability that showed a significant increase

at both times after rehabilitation despite a significant decline between 3 and 12 months. The changes in visual ability as a result of rehabilitation were quite large and impressive. However, the new test instrument did not assess domains such as social functioning or mental health leaving questions about the impact of vision rehabilitation on them raised by their first study unanswered.

One of the goals of the present study was to provide data on the NEI VFQ in a population of visually impaired veterans before and at several time intervals after treatment in a DVA blind rehabilitation program. Another goal of the study was provide data on HRQOL before and after rehabilitation using a non-vision targeted test instrument and on subjects medical and functional characteristics. In addition we assessed two psychological dimensions that we thought were important to mental health and might be affected by rehabilitation; hope and self-esteem. Collecting these data addresses a weakness of many studies of low vision and blind rehabilitation HRQOL outcomes and that is that a single vision targeted measurement instrument is typically used. Assessment of health status, mental and psychological health, for example is rarely done outside of the vision targeted domain. This information could be important in interpreting the data on vision rehabilitation outcomes. A third goal was to compare our results with those of Stelmack & Stelmack et al. [26] to determine if the testing procedure they used might explain why they saw no changes in NEI VFQ subscales related to role difficulties, social function, dependency and mental health.

To achieve these goals vision targeted and generic HRQOL was assessed prior to rehabilitation and again at 2 and 6 months after rehabilitation was completed. The two-month delay was implemented to avoid halo effects that have been reported to be present immediately after rehabilitation and can result in higher than normal ratings of function and life satisfaction. It was felt that 2 months would be adequate time for the halo effects to recede and for individuals to evaluate, through independent application in their home environment, the skills they had learned during rehabilitation. The 6 month duration was selected to give an indication of longer term effects and it was felt to be sufficient time to show erosion of rehabilitation effects if they were present.

Methods

Subjects

Male and female Veterans scheduled to enter the blind rehabilitation program at the DVA Southeastern Blind Rehabilitation Center in Birmingham Alabama were recruited prospectively by telephone. Two-hundred thirty-nine individuals were contacted and 209 agreed to participate. Recruitment for the study occurred over an approximate 2.5 year time period, from January of 2000 – May of 2002. Since no screening data were collected prior to the informed consent we cannot determine if there were differences between those who chose not to participate and those who did. Three persons who had agreed to participate dropped out upon admission to the blind rehabilitation program, leaving 206 individuals who participated in the study, 196 males and 10 females. All participants met the U.S. statutory definition of legal blindness (visual acuity of 20/200 or worse in the better eye or visual field diameter of 20 degrees or less in the better eye).

During the initial telephone interview informed consent was obtained verbally. In all cases permission was obtained to record on audio tape the verbal consent. Written consent was subsequently obtained when the subjects entered the rehabilitation program. The Birmingham DVA Medical Center's Institutional Review Board approved this study and it was conducted in accordance with the Helsinki Declaration. Each subject gave written informed consent after the nature and intent of the study had been fully explained and they were read the informed consent document.

Test Instruments

The primary quality of life test instrument was the NEI VFQ 39 item version (standard 25 item version plus appendix questions) [7,31]. This is a vision specific HRQOL assessment in that questions are aimed at determining how an individual's current level of vision affects performance of specific tasks or impacts roles, social function, mental health and dependency. The 39 item version includes additional questions that contribute to the subscales and composite score associated with the more commonly used 25-item version. We thought it might provide more stable results than the 25-item version. Also it was also the version used by Stelmack & Stelmack et al. [26] whose data we wanted to compare with ours. The interviewer version of the questionnaire was used and the wording was modified slightly to address the possible use of low vision aids [12,26]. Participants were told to answer all of the questions as if they were using whatever vision correction they normally used to perform that activity including spectacles, contacts, and any low vision aids. Other outcome measures included the Short Form Health Survey 12-item version (SF-12) [32], a questionnaire designed to assess generic HRQOL which provides a physical and a mental component summary score (PCS and MCS, respectively), self-esteem measured with the Coopersmith self-esteem inventory [33] and hope/hopelessness with the Hope Scale [34]. These instruments were all administered over the telephone prior to and again at 2 and 6 months after rehabilitation.

Additional data on visual function, cognitive function, depression, health co-morbidities and basic demographics were also collected but only at the beginning of the study. Visual function measures included distance visual acuity (Bailey-Lovie charts), Goldmann visual field (binocular) with the III/4e target at standard background luminance, contrast sensitivity using the Pelli-Robson chart and a brief test of scanning ability [35]. The Short-Portable test was used to assess cognitive function [36], the Center for Epidemiological Studies Depression Scale (CESD) [37,38] was used as the depression inventory, and a checklist to determine health problems and their severity [39].

Procedures

After obtaining consent and prior to admission to the program subjects were administered, by telephone interview, the NEI VFQ, SF-12, Hope Scale, and Coopersmith self-esteem inventory in that order. The remainder of the test instruments, CESD, Short-Portable and health survey and the vision tests, were administered within a few days after subjects had been admitted to the blind rehabilitation program. Post rehabilitation testing took place at 2 and 6 months after subjects had been discharged from the rehabilitation program. This testing was completed during telephone interviews and included re-administrations of the NEI VFQ, SF-12, Hope Scale and Coopersmith self-esteem inventory. A three-week window after the 2 and 6 month post discharge dates was allowed for collection of the follow-up data.

Blind Rehabilitation

The DVA blind rehabilitation program is a comprehensive in-patient program in which clients receive training in different skill areas including O&M, low vision, ADL, communication, and manual skills. O&M training focuses on techniques to remain oriented in and negotiate different travel environments, street crossings, use of public transportation and use of the long cane. Low vision training focuses on techniques and technologies to maximize remaining vision including instruction in the use of low vision aids such as magnifiers, closed circuit televisions and telescopes for reading and spotting targets. ADL and communication includes instruction in activities such as home and personal effects organization, cooking, grooming, shopping, and financial management. Manual skills focuses on developing confidence in using other senses, such as touch, to accomplish tasks and training in the use of adaptive devices useful for home maintenance and hobbies. In addition, clients receive a complete low vision examination,

medical evaluation and meet with a psychologist and social worker to determine if they have specific social and psychological needs.

The training day is divided into seven, 45 minute instructional periods with 15 minute breaks in-between. During a typical day, for example, a client might have two periods of O&M, two of low vision, one of manual skills, one of ADL and one for other appointments (e.g., social work or research). The average length of stay in the blind rehabilitation program is 6–7 weeks, but this varies depending on client vision rehabilitation needs and goals as well as general mental and physical health. For example, the average client receives 35–40 hours of O&M training. However the exact amount and how the time is spent will depend on needs and type of vision loss. Persons with severe peripheral field restrictions from diseases like retinitis pigmentosa (RP) often have severe mobility limitations and are likely to spend more time overall in O&M and in the program as a whole; much of it learning and practicing long cane skills. In contrast, persons with central vision loss due to macular disease generally usually do not have severe mobility limitations. For example, they can get around without a long cane and as a result do not require extensive training in its use.

Statistical Analysis

The NEI VFQ results were scored according to methods specified by the test developers [31]. The results are typically summarized into twelve subscales and a composite score. However, since only eleven subjects reported any driving activity, the driving subscale data were not analyzed nor were they used to calculate the composite score. Non-parametric methods including, Friedman analysis of variance (ANOVA) and the Wilcoxin test were used for variable that were not normally distributed. Parametric methods, including repeated measures ANOVA, paired t test and linear regression, were used for normally distributed variables. Comparisons were made between assessment times, specifically pre rehabilitation versus 2 and 6 months post rehabilitation and also 2 versus 6 months post rehabilitation. No adjustments were made for multiple tests. Multiple linear regression was used to determine the effects of age, visual acuity, contrast sensitivity, visual field extent, SF-12 mental and physical subscale score, and eye disease diagnosis on the difference in pre-rehab NEI VFQ composite scores from NEI VFQ composite scores at both 2 and 6 months post-rehab. Backwards-selection procedures were used to determine the optimal model. Analyses were carried out using SPSS version 14.

Results

Of the 206 participants who completed the pre-rehabilitation interview, 185 completed the 2 month post-rehabilitation interview and 176 the 6 month post rehabilitation interview. There were a few cases where participants who completed the 6 month interview did not complete the 2 month interview and vice versa. Out of the sample, 167 participants completed all three interviews. The most common reason for loss to follow-up was the inability to contact subjects within three weeks after the 2 and 6 month post-rehabilitation dates despite repeated attempts (n=18). Four subjects decided not to continue the study, 4 were deceased, 3 cited illness at the time of one of the follow-up interviews, declined to be interviewed at that time and then could not be re-contacted in the three week window, 2 left rehabilitation early and were not interviewed later, 4 cited various reasons including hearing impairment, one subject's data were not used because his spouse was also on the line answering questions for him, and no reason for the loss was listed in the study notes for 3 subjects. For this paper we analyzed all data that were available for specific comparisons, not just that from participants who completed all three interviews.

Table 1 contains the demographic and clinical descriptive data. Participants ranged in age from 30 to 91 years, with an average age of 70 years. Ninety-five percent of the sample were men.

Eighty-seven percent were white. The majority of the sample had vision loss due to macular disease, followed by glaucoma, diabetic retinopathy, optic nerve disease, RP, and other (e.g., ocular histoplasmosis or trauma). Binocular distance visual acuity was measurable on 180 participants and they had an average logarithm of the minimum angle of resolution (log MAR) of 1.04 or 20/220 Snellen equivalent. However, the acuity range for the sample was from -0.2 logMAR (20/13) to no light perception. Note that the high acuity of some subjects does not indicate normal vision. These individuals had diseases such as RP that are characterized by a loss of peripheral vision with sparing of central vision. In some cases high acuity is maintained in the remaining central area even though it may only be a few degrees across. If a logMAR of 1.7 (20/1000) is arbitrarily assigned to the thirteen percent of individuals whose acuity was so poor as to not be measurable, then average acuity changes to logMAR of 1.12 or 20/265, which better reflects the level of acuity for the sample. Average contrast sensitivity on the Pelli-Robson was 0.5 log unit which is approximately 1.0 log unit below scores for older adults with normal vision. Visual field extent averaged approximately half that of a full normal binocular field for a young adult [35]. Out of 13 targets in the scanning test subjects were on average able to locate 4 in ten seconds which is about 50% of age-normal performance. As with the other vision variables, field extent and scanning ranged from un-measurable to normal.

Other baseline population characteristics included normal cognitive function with a mean Short Portable score of 0.67 where 1–2 errors are normal [36] and a depression score of 6 where the normal range on the CESD is from 0–16 [38]. On the health inventory subjects reported an average of 5.25 co-morbid health conditions and a health score of 10.9 out of 30 maximum points with higher scores indicating poorer health. These latter indicators suggest our sample has reasonably normal physical and mental health for their age [39]. On average, they stayed in the blind rehabilitation program for approximately 1.5 months. This varied as a function of diagnosis. As noted previously subjects with greater mobility needs tend to remain in the rehabilitation program longer and in our sample subjects with RP were in the program on average 10 days longer than those with macular disease.

Pre and post rehabilitation subscale and composite score averages for eleven subscales (driving not included) and the composite scores and the results of the statistical analysis are summarized in Table 2. Significant differences were observed ($p < 0.05$) in all subscale categories as a function of test administration time except ocular pain and peripheral vision. Significant positive (or negative) differences between pre and post-rehabilitation scores on the NEI VFQ assessment can be thought of in terms of rehabilitation gain or (loss), respectively. As illustrated in Figure 1, for the nine subscale categories that showed significant differences over assessment time, scores at 2 months post rehabilitation and also at 6 months post rehabilitation were all significantly higher than the pre-rehabilitation scores with the exception of general health (Wilcoxin $p = 0.014$ to < 0.001). Between 2 and 6 months, scores in six categories declined and four increased. Among these changes only the declines for distance vision, role difficulties, and the composite score were statistically significant ($p = 0.019$; 0.041 ; 0.015 , respectively).

We also found significant changes in the SF-12 MCS and PCS scores after rehabilitation, although the changes were in opposite directions (Table 2). The MCS score increased significantly after rehabilitation, indicating improved mental function and remained elevated after 6 months ($p = 0.024$). Prior to rehabilitation the veterans' MCS score was approximately 3 points below that of the mean of persons between 65–74 years of age, but by 6 months after rehabilitation it had increased by nearly 3 points and was now within 0.2 points of the general population average. In contrast the PCS score declined significantly over time ($p = 0.011$) although at the beginning of the study participants PCS score was comparable to those of the general United States population of 65–74 year olds. Neither component summary score was significantly correlated with age or cause of vision loss in our sample. Lastly, the SF-12 data are paralleled by similar changes in the NEI VFQ mental health and general health subscale

scores that increased and declined over time, respectively. This is consistent with previous findings that related these two NEI VFQ subscales to SF-36 scores [40].

The remaining two tests administered were the Hope Scale and the Coopersmith self-esteem inventory. Average results from these tests are also shown in Table 2. Scores on the Hope Scale averaged approximately 37.0 and did not change after rehabilitation. In contrast, scores on the Coopersmith showed a small but highly significant positive change ($p < 0.001$), despite being in the high self-esteem category at baseline (a score of 75 or higher is considered to be in the high self esteem category).

Table 3 presents the adjusted results from the linear regression analysis for both the full and best-fit regression models. For the final model, predicting differences from pre-rehab NEI VFQ composite scores to composite scores 2 months post-rehab, a 1 year increase in age was associated with a significant ($p < 0.0001$), 0.53-point decrease in mean composite score difference. Additionally, a 1 unit change in visual acuity (logMAR) in the direction of improvement (lower logMAR number) was significantly associated with a 7.69-point increase ($p = 0.0038$) in mean composite score difference. Examining how eye disease diagnosis affected mean composite score difference, when compared to macular disease there was a significant decreased association between the “other” diagnosis ($\beta = -10.38$, $p = 0.0239$) and composite score difference. While all remaining diagnoses had decreased associations as well when compared to macular disease, none were significant. This suggests that for all practical purposes, cause of vision loss was not associated with the variation in composite scores differences.

For the mean difference between pre-rehab and 6 month post-rehab composite scores, the final model only included visual acuity. In particular, a 1 unit change in visual acuity was significantly associated with a 6.87-point increase in mean composite score difference ($p = 0.0128$).

Discussion

This study evaluated the intervention of a comprehensive in-patient blind rehabilitation training program delivered to a generally older veteran population by measuring changes in the perceived HRQOL of individuals who received it. It provides needed data on the NEI VFQ for this population. Two months after rehabilitation we found significant increases in every category related to visual function on the NEI VFQ except peripheral vision and ocular pain. The changes ranged from 5 percentage points for color vision and far vision to nearly 30 for near vision. We also found significant changes in all mental health and related subscales that ranged from 8 to 13 percentage points. The increases in NEI VFQ subscale scores at 2 months persisted at 6 months after rehabilitation. This was true for both visual function and mental health related aspects of HRQOL. Although some subscale scores appeared to decline slightly between 2 and 6 months after rehabilitation only two of those, distance vision and the composite score were statistically significant. Also two subscale scores moved in the opposite direction. If subscales that showed no change (peripheral vision and ocular pain), physical health and the composite are excluded and direction of change is analyzed we find out of eight subscales, six showed a decline and two showed an increase. This is not statistically significant (Binomial Test $p = 0.145$) and indicates that the effects of the rehabilitation are relatively persistent over a 6 month time span.

Indicators of mental and physical health from the SF-12 support results from Table 1 that suggest the mental and physical health of our sample was relatively normal for their age. The pre-rehabilitation SF-12 mental and physical subscale scores are similar to those of a sample from the general population in the age range 65–74 years, where most of our population fell.

The general population sample mean mental subscale is 52.10 versus 49.29 for our group while the comparable physical subscales are 43.65 versus 44.08 [32]. However, physical health of subjects clearly declined over the course of our study. As expected because of similarities in wording, this was evidenced in both the SF-12 and NEI VFQ general health scores where change over time was statistically significant. Although declining health over time is expected, the changes are relatively large considering the time elapsed from the first to the last interview was less than a year. For that we do not have a good explanation. The other health indicators do not suggest our sample was particularly unhealthy at the outset of the study and thus prone to experience a rapid decline in health. In light of the declining physical health of the sample, the positive changes in vision targeted HRQOL and general mental health over the same time period seem all the more impressive.

The other two assessments that were used in this study were the Hope scale and the Coopersmith self-esteem inventory. Although neither is typically viewed as an indicator of HRQOL, they do assess specific psychological factors that contribute to mental health, which is a component of HRQOL. We included the Hope Scale because a previous study indicated higher scores were significantly correlated with greater reported functional ability [34]. Since rehabilitation has been shown to improve functional ability we reasoned that scores on this scale would increase after rehabilitation. However, they did not change. This is perhaps partially explained by the fact that scores for our subjects were relatively high to begin with and we may have had a ceiling effect but also because hope is regarded as a relatively stable set of beliefs. The high levels of hope may simply be a characteristic of many of the veterans who, despite advanced age and illness have made a decision to enter an intensive rehabilitation program. This is because higher levels of hope are associated with a greater sense of determination to meet personal goals and a greater sense of being able to do so successfully [34]. An interesting question would be; are there differences in the level of hope between persons who choose to participate in comprehensive rehabilitation programs and those who do not?

In contrast to hope, self-esteem did increase after rehabilitation. However, while statistically reliable, the increase was small. Like hope, an important aspect of the self-esteem result is that the subjects entered the rehabilitation program with already high levels of self-esteem. Like high levels of hope, this may be an important characteristic that distinguishes those who elect to take part in comprehensive rehabilitation programs from those who do not. Although self-esteem by itself was correlated with overall vision targeted functional abilities, it did not enter any models that predicted the amount of change in HRQOL after rehabilitation.

The third goal of our study was to compare our findings for the NEI VFQ dimensions of role difficulties, dependency, social function and mental health with those of Stelmack & Stelmack et al. [26] to determine if differences in test procedures influenced outcomes. Our data indicate this is the case. Stelmack & Stelmack et al., found rehabilitation had no effect on these dimensions, whereas we found significant changes on the order of 10 points at both 2 and 6 months post rehabilitation. The difference between studies is that they administered the post-rehabilitation assessment immediately after subjects completed rehabilitation whereas we waited for two months. We believe we found a positive change because that wait gave respondents the necessary time to assess how skills acquired during rehabilitation impacted them in everyday life. This is important because the DVA blind rehabilitation program and vision rehabilitation in general does not specifically target areas like social function and mental health. Also, the rehabilitation environment does not provide the individual with the milieu of daily life in which to experience how improved functional abilities in areas such as mobility or near vision affect them overall.

The best predictors of change in the VFQ composite score 2 months after rehabilitation were age and baseline visual acuity. Younger subjects and subjects with better acuity tended to show

larger changes in the composite scores suggesting the intervention had a greater impact on their HRQOL. At 6 months after rehabilitation, only acuity was associated with changes in the composite score. These findings would not come as a surprise to rehabilitation specialists who work with this population on a day-to-day basis. Age, for example is associated with poorer physical health which in turn can place limits on the ability of older subjects to fully participate in a comprehensive program. Many of the older veterans entering the rehabilitation program have multiple health problems that preclude them from participating in some aspects of the program (e.g., mobility training) and often remove them for varying periods of time during the program due to illness. Also, visual acuity was correlated with other visual function measures (contrast sensitivity and scanning) and it makes intuitive sense that subjects with relatively good vision may be able to participate initially at a higher level of functioning and thus gain more from training in areas such as mobility, activities of daily living and low vision (reading) than subjects with very poor visual function.

Overall, our findings of improvement in HRQOL after blind rehabilitation are consistent with most other studies involving blind rehabilitation or comprehensive low vision services [5,24–28]. Our finding of positive changes at 2 and 6 months after rehabilitation are also consistent with results reported by Stelmack & Moran et al. [30]. They found a significant improvement in visual ability 3 months after a group of veterans completed a comparable intensive inpatient rehabilitation program to that used in the present study. They also found the improvement persisted at 1 year post rehabilitation even though there was a significant decline between 3 months and 1 year.

An obvious question is, do these changes in vision targeted HRQOL represent a real benefit to the patient? Visual function questionnaires do not directly address this question. They measure an individual's perception of his ability to perform tasks that are considered important to HRQOL and provide information about changes in limitations. However, they do not provide a measure of what the limitations and changes in them mean to the individual. This might be better addressed by preference-based measures, which can also be used to compare cost-effectiveness of different rehabilitation programs. These measures are just now starting to be considered for evaluating vision rehabilitation interventions [6,41]. Despite this weakness, some context can be provided that might help interpret the results of the present study. For example, in a recent study of uncorrected refractive error it was found that individuals whose acuity was improved by at least two lines with correction showed significant changes in NEI VFQ scores for general vision, distance visual acuity, near acuity and mental health [42]. By comparison, the magnitude of change in distance vision and near acuity scores in the present study was approximately four times larger. This amount seems consistent with the change in visual ability reported by Stelmack et al., [26,30] which after blind rehabilitation equated to a gain of four to eight lines on the ETDRS acuity chart. As an example, for a person with 20/200 acuity this represents a functional improvement in acuity as a result of using aid and compensatory skills to between 20/80 and 20/32. In addition, our own regression model indicated that the amounts of rehabilitation gain measured at 2 and 6 months were associated with a 1 unit improvement in LogMAR which is roughly an equivalent gain.

A limitation of this study is that it lacked a comparison group. Under the circumstances we did not feel it was ethical to ask control subjects to delay their rehabilitation for upwards of one year in order to participate in the study. The population was elderly, with declining health and vision and growing rehabilitation needs and many had already been on the rehabilitation waiting list for some time. For these reasons we also doubted that many would sign up to voluntarily delay treatment for that length of time. Despite this limitation, the study's strengths are its prospective design, use of validated vision and non-vision targeted test instruments and reporting of subjects medical and functional characteristics. We believe that the observed improvements in vision and mental health related outcomes primarily reflect the impact of the

training the subjects received and are not the result of drift of scores over time, social contact or medical interventions to improve vision. It is difficult to imagine how drift or social contact could explain the large gains in activities related to near and distance vision such as reading or watching television. A more likely explanation is that the gains are due to the training they received in the use of low vision aids that magnifying images and viewing techniques to perform these tasks. Furthermore, if social contact were a major factor then how does one explain the lack of any change in NEI VFQ domains related to mental health and social function when assessed immediately after rehabilitation versus significant changes in these domains two months later? Lastly, changes in medications or surgical interventions are not the norm for clients in the blind rehabilitation program. Training in the skill areas mentioned previously is the primary purpose of the program. Individuals entering the program are not newly diagnosed patients, but are referred from other DVA medical centers where they have been receiving vision and medical care for some time.

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Abbreviations

HRQOL	Health-Related Quality of Life
NEI VFQ	National Eye Institute Visual Function Questionnaire
SF-12	Short Form Health Survey 12-item version
DVA	Department of Veterans Affairs
O&M	Orientation and Mobility
ADL	Activities of Daily Living
PCS	Physical Component Summary
MCS	Mental Component Summary
CESD	Center for Epidemiological Studies Depression Scale
RP	Retinitis Pigmentosa
ANOVA	Analysis of Variance

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Figure 1.

Differences in NEI VFQ subscale scores for pre rehabilitation to 2- and 6-months post rehabilitation and between 2 and 6-months post rehabilitation.

Table 1

Subject demographic and clinical variables.

	Mean (Median)	SD	Min–Max
Age (yrs)	70.2 (73.5)	12.6	30–91
Binocular Visual Acuity	1.04 (1.0)	0.4	–0.2 – 1.58
Pelli-Robson Contrast Sensitivity	0.53 (0.45)	0.5	0.0 – 1.65
Visual Field (%)	49 (59)	30	0 – 97
Scanning Score	4.1 (4)	2.9	0 – 13
Short Portable Score	0.7 (0)	0.89	0 – 4
Depression Scale Score	6 (3)	8.5	0 – 39
Comorbidity Score	5.25 (5)	2.3	1 – 11
Health Score	10.9 (10)	5.8	1 – 29
Length of stay (days)	48.23 (46)	16.3	11 – 109
Number (%)			
Gender			
Male	196 (95)		
Female	10 (5)		
Race			
White	179 (87)		
Black	25 (12)		
Hispanic	2 (1)		
Ocular Condition			
Macular Disease	116 (56)		
Glaucoma	29 (14)		
Diabetic Retinopathy	23 (11)		
Retinitis Pigmentosa	10 (5)		
Optic Nerve Disease.	11 (6)		
Other	17 (8)		

Table 2

Mean (SD) NEI VFQ (VFQ) subscale scores, SF-12 MCS and PCS scores and Hope Scale and Coppersmith scores, before and at 2 and 6 months after rehabilitation.

Subscale and Test Scores	Before Rehab. N=206	2 Mo Post N=185	6 Mo Post N=176
VFQ General Health ^{*P}	55.1(26.4)	49.0(28.3) ⁺	47.6(28.1) ⁺
VFQ General Vision [*]	34.3(17.4)	39.7(20.4) ⁺	38.9(19.3) ⁺
VFQ Near Vision ^{*P}	30.3(14.8)	59.5(21.8) ⁺	58.5(22.2) ⁺
VFQ Distance Vision [*]	32.3(18.3)	45.9(21.9) ⁺	43.5(20.0) ^{+a}
VFQ Peripheral Vision	51.3(31.7)	55.5(32.5)	57.6(30.4)
VFQ Color Vision [*]	50.1(33.4)	59.1(33.5) ⁺	58.3(33.3) ⁺
VFQ Ocular Pain	76.2(23.9)	77.1(24.5)	75.6(24.0)
VFQ Role Difficulties ^{*P}	38.2(22.9)	48.0(22.3) ⁺	45.9(21.8) ^{+a}
VFQ Dependency [*]	44.5(29.7)	56.2(27.6) ⁺	56.6(27.9) ⁺
VFQ Social Function ^{*P}	54.8(24.7)	62.2(21.6) ⁺	62.0(21.9) ⁺
VFQ Mental Health [*]	45.1(27.9)	55.3(27.1) ⁺	56.6(26.1) ⁺
VFQ Composite ^{*P}	46.4(14.7)	55.2(15.0) ⁺	54.6(14.7) ^{+a}
SF-12 MCS [*]	49.2 (11.7)	51.2 (11.6) ⁺	51.9 (10.9) ⁺
SF-12 PCS [*]	44.1 (10.8)	41.4 (12.1) ⁺	40.3 (11.9) ^{+a}
Hope Scale	37.8 (9.9)	36.9 (10.0)	36.9 (10.0)
Coppersmith [*]	76.2 (18.3)	79.5 (18.4) ⁺	80.4 (18.2) ⁺

^{*} = Significant effect of time of administration (pre versus post rehabilitation).

^P = parametric methods were used, otherwise non-parametric methods were used.

⁺ = Significantly different from pre rehabilitation scores.

^a = Significantly different than 2 month post-rehabilitation score.

Table 3

Full and adjusted linear regression models for mean difference in NEI VFQ composite scores pre-rehabilitation and at 2 months and 6 months post-rehabilitation

	2 months			6 months		
	Full model		Final Model	Full model		Final Model
	β	p-value	β	p-value	β	p-value
Age (years)	-0.54	<0.0001	-0.53	<0.0001	-0.27	0.0122
Visual acuity	6.86	0.0330	7.69	0.0038	4.70	0.1481
Contrast sensitivity	-0.24	0.9298	-	-	0.16	0.9525
Visual field extent	-0.08	0.1020	-	-	-0.04	0.3811
SF-12 pre-rehab						
MCS	0.09	0.3013	-	-	0.01	0.8685
PCS	-0.07	0.4388	-	-	-0.04	0.6866
Diagnosis						
Glaucoma	-6.99	0.0611	-5.27	0.1085	-2.46	0.5290
Diabetic retinopathy	-3.76	0.2931	-2.00	0.5605	-4.54	0.2007
Macular disease	Ref	Ref	Ref	Ref	Ref	Ref
Optic nerve disease	-11.822	0.0539	-9.06	0.1267	-4.80	0.4261
Retinitis pigmentosa	-9.79	0.0873	-6.90	0.1932	-1.84	0.7277
Other	-12.66	0.0089	-10.38	0.0239	-4.75	0.3164