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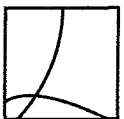
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Vision-Related Quality of Life in Patients with Complete Homonymous Hemianopia Post Stroke

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Purpose: The aim is to determine the characteristics of vision-specific quality of life restriction using the National Eye Institute Visual Function Questionnaire (NEI VFQ-25) and Veterans Affairs Low Vision Visual Function Questionnaire (VA LV VFQ-48) in patients with complete homonymous hemianopia (HH) post stroke. **Method:** Prospective cohort study of patients with complete HH compared to age- and gender-matched subjects with normal visual fields. **Results:** In the NEI VFQ-25, scores on five subscales were significantly reduced after multiple logistic regression accounting for vision and comorbidities. The five subscales are vision-specific social functioning, vision-specific mental health, vision-specific dependency, driving, and peripheral vision. In the VA LV VFQ-48 postregression analysis, mobility is the only domain that is significantly affected in the people with HH. **Conclusion:** Identification of the significant areas of visual difficulties and their effects on quality of life is important as it can help better address the patients' rehabilitation needs. The current study identifies the need for orientation and mobility training as well as independent living rehabilitation in patients with HH to help address the difficulties in their vision-specific quality of life and maximize their residual vision. **Key words:** *homonymous hemianopia, quality of life, rehabilitation, vision*

Homonymous hemianopia (HH) is a loss of the right or left half of the visual field of both eyes. In the United States, the incidence of stroke is approximately 700,000 per year,¹ and complete HH occurs in about 10%.² HH can impact significantly on the quality of life post stroke with issues such as finding objects and reading.³ The aim of this study is to define the areas of vision-specific health-related quality of life (HR-QoL) restriction in patients with HH. Identification of these HR-QoL restrictions is important to help strategize rehabilitation programs that will best suit these patients and maximize their residual vision to help with activities of daily living (ADLs).⁴

There is a growing recognition of the importance of patient-reported outcomes of visual functioning.⁵ One validated global vision-specific HR-QoL questionnaire is the National Eye Institute Visual Function Questionnaire (NEI VFQ-25) that includes the Activities of Daily Living Vision Scale.⁶ The vision-targeted questions are grouped into 11 subscales subtending general vision,

near activities, vision-specific social functioning, and driving.⁷ Another vision-specific HR-QoL instrument is the Veteran Affairs Low Vision Visual Function Questionnaire (VA LV VFQ-48).⁸ This is designed specifically to measure the visual ability of a person with irreversible low vision, including visual field defects, to function in daily life. It is also sensitive in detecting changes following vision rehabilitation.⁹ The questionnaire consists of 48 items relating to daily tasks, and the responses have been calibrated to derive an algorithm that estimates each person's visual ability in five subscales. These subscales are visual ability, reading, mobility, visual information, and visual motor function.¹⁰

The specific aim of this study is to use the NEI VFQ-25 and VA LV VFQ-48 to determine the vision

domains with significant reduction in patients with complete HH post stroke. The global aim is to maximize the patient's quality of life with vision rehabilitation by addressing the domains which are difficult.

Method

Subjects

This was a prospective cohort study of 10 consecutive patients with complete HH due to cerebrovascular events in the subacute period post stroke (between 2 weeks and 6 months of stroke) who were seen by a single neuro-ophthalmologist (C.S.C.) over a 6-month period. All patients had static automated perimetry (SAP) confirming the complete HH visual field defect. The control group consisted of age-matched patients referred to the same neuro-ophthalmologist for glaucoma suspicion or general eye review with SAP showing normal visual fields. The study was approved by the Flinders Clinical Research Ethics Committee of Southern Adelaide Health Service, and all subjects gave their informed consent prior to participating.

Questionnaire administration

All patients consented to study, and the questionnaire was administered by an interviewer who was independent of the treating neuro-ophthalmologist. In NEI VFQ-25, response to each question is recorded and then grouped as per the NEI VFQ-25 scoring manual.¹¹ There are 12 subscales from the NEI VFQ-25. These are general health, general vision, ocular pain, near activities, distant activities, vision-specific social functioning, vision-specific mental health, vision-specific role difficulties, vision-specific dependency, driving, color vision, and peripheral vision. The questions and response categories for each question in the NEI VFQ-25 and their subscales are listed in **Appendix A**. The subscale scores are then derived by grouping the items into the appropriate domains. The response category is converted to the appropriate value scored on a 0–100 point scale, with 0 indicating the worst score and 100 the best possible score based on instruction on the NEI VFQ-25 scoring algorithm.¹¹ The composite NEI VFQ-25 score is the mean score of all items except for the general health item score.

The questions for VA LV VFQ-48 are listed in **Appendix B**. For each question, the patients are asked to respond with nominal categorical answers that include not difficult, slightly/moderately difficult, extremely difficult, impossible, and could not perform the task for nonvisual reasons. The response categories are then entered onto an Excel spreadsheet with a built-in formula that transforms the rating category ranks to average functional reserve as described by Stelmack and Massof.^{9,10}

Ophthalmology examination

All participants received a comprehensive eye examination that include the best corrected visual acuity in each eye and binocularly, near vision, contrast sensitivity, intraocular pressure measurements, and slit lamp examination. All patients received static visual fields testing with automated perimetry (Medmont M700 Automated Perimeter, Medmont International Pty. Ltd., Cremore, New South Wales, Australia).

Statistical analysis

The subscale domains of the NEI VFQ-25 and VA LV VFQ-48 are expressed as a mean \pm standard deviation. Univariate analyses of these scores were compared between the HH and control groups using a two-tailed Student *t* test with adjustment for unequal variance as indicated. Multivariate linear regression was performed in a semi-automated fashion using covariates from the univariate analyses that had a $p < .10$ or were factors hypothesized to be significantly different between the two groups (eg, comorbidities such as presence of cataract, visual acuities, color vision, and contrast sensitivity). Statistical analyses were performed with Stata statistical software, version 9.0 (Stata Corp., College Station, Texas, USA). In all analyses, $\alpha = 0.05$ was considered to be statistically significant.

Results

Demographics

In the HH group, the mean age was 68.3 ± 14.1 years, with five men and five women. All participants had best corrected visual acuity of at

least 6/18 binocularly and were able to mobilize a distance of 35 meters independently or with standby assistance. None of the patients had received vision rehabilitation for HH at the time of the vision assessment.

The control group was matched for age and gender and had an automated perimetry confirming normal visual fields. The reasons for referral in the control group include cataract assessment, general eye assessment, or glaucoma suspects. The ocular comorbidities (eg, glaucoma, cataract, age-related macular degeneration) were recorded in both groups.

NEI VFQ-25

In the HH group, the mean NEI VFQ-25 score was significantly smaller compared to controls (69.4 ± 19.7 vs. 94.7 ± 5.8 ; $p = .0013$). In the subscale analysis (Table 1), the differences between the two groups were significant in the general health, general vision, near activities, distance activities, vision-specific mental health, vision-specific role difficulties, vision-specific dependency, driving, and peripheral vision. In the questions such as for near activities and distant activities, most subjects with HH noted moderate to extreme difficulty performing tasks such as reading newspapers, performing hobbies, finding objects on a crowded shelf, reading street signs, or going down steps or stairs at night (questions 5 to 9 on NEI VFQ-25). The questions were vision specific. Patients were given choices in the response category if they had stopped doing the task due to eyesight or stopped due to other reasons

or were not interested in doing the task. None of the HH patients had stopped doing the task because of eyesight despite the reported difficulty. The most significant category is driving; all subjects with HH were not driving and had given up driving because of eyesight (question 15).

On multivariate analysis, adjusting for visual acuity, reading acuity, contrast sensitivity, and concurrent ocular morbidities (eg, cataract) showed that scores were significantly lower in five domains only. These are vision-specific social functioning, vision-specific mental health, vision-specific dependency, driving, and peripheral vision.

VA LV VFQ-48

In the VA LV VFQ-48 assessment, patients with HH have significantly more difficulties with self-reported visual ability, mobility, and visual motor functioning. There were no significant differences in the reading and visual information subscales (Table 2).

Following multivariate analysis accounting for visual acuity, reading acuity, contrast sensitivity, and confounding ocular conditions, a reduced level of mobility in the HH group was the only domain showing a statistically significant difference ($p = .025$).

Discussion

This study shows that there are significant impairments associated with HH in terms of visual quality of life using two validated vision-specific

Table 1. NEI VFQ-25 score between the HH group and Control group

NEI VFQ-25 score (0–100)	HH group	Control group	<i>p</i> value univariate	<i>p</i> value multivariate
General health	87.5 ± 17.6	52.5 ± 24.8	.0019	.156
General vision	66.0 ± 25.0	90.0 ± 14.1	.016	.081
Ocular pain	88.8 ± 19.9	97.5 ± 5.2	.196	.096
Near activities	65.8 ± 33.4	91.6 ± 8.8	.029	.657
Distance activities	71.6 ± 23.6	94.2 ± 8.8	.011	.205
Vision-specific social functioning	81.2 ± 25.1	95.2 ± 8.4	.091	.021*
Vision-specific mental health	61.2 ± 27.3	100 ± 0	.0003	.024*
Vision-specific role difficulties	68.7 ± 25.8	97.5 ± 5.2	.0029	.115
Vision-specific dependency	68.3 ± 36.8	100 ± 0	.014	.042*
Driving	0	93.1 ± 8.1	.0000	.000*
Color vision	85 ± 21.0	90 ± 12.9	.53	.927
Peripheral vision	57.5 ± 16.8	100 ± 0	.000	.000*

Note: NEI VFQ-25 = National Eye Institute Visual Function Questionnaire; HH = homonymous hemianopia.

* $p < .05$ after multivariate regression analysis.

Table 2. VA LV VFQ-48 score between HH and Control groups

VA LV VFQ-48 (range 1.58–13)	HH group	Control group	<i>p</i> value univariate	<i>p</i> value multivariate
Visual ability	6.41 ± 4.78	1.68 ± 0.11	.0059	.168
Reading	4.32 ± 3.46	2.09 ± 0.49	.058	.223
Mobility	8.48 ± 5.40	1.59 ± 0.03	.0008	.025*
Visual information	3.04 ± 2.45	1.64 ± 0.08	.087	.324
Visual motor	6.62 ± 4.77	1.58 ± 0	.0037	.134

Note: VA LV VFQ-48 = Veterans Affairs Low Vision Visual Function Questionnaire; HH = homonymous hemianopia.

**p* < .05 after multivariate regression analysis.

HR-QoL questionnaires. This study identifies that the main domain of visual impairment in a patient with HH is a decline in their mobility that is vision specific. In addition, there is a significant effect of a complete HH on a person's peripheral vision and driving and, combined with a decline in their mobility, it results in a reduced quality of life as measured by vision-specific social functioning, mental health, and dependency.

Identification of these areas of visual difficulties and their effect on quality of life can help better address the patients' rehabilitation needs. The aim of vision rehabilitation is to maximize a person's residual vision, specifically to try to overcome the visual disabilities that are most troublesome to them. Currently, there is no standardization in vision rehabilitation in stroke patients with HH, and service delivery is therapist dependent. The therapies can vary from a comprehensive combined static and mobility training to the simple prescription of vision magnifiers with minimal instruction in their use.

This study identifies the need for orientation and mobility training in people with HH to help maximize their ADLs. In this study, all 10 subjects with HH were able to mobilize a distance of 35 meters independently or with supervision or standby assistance. Hence the restriction in mobility is independent of the physical ailment post stroke but is vision specific as identified by the vision-specific HR-QoL instrument. This is likely due to difficulty with seeing objects in the hemianopic field, which results in bumping into obstacles. Several patients in our study complained of objects suddenly appearing from the hemianopic to the normal field, which

affected their confidence when mobilizing. In addition, low vision rehabilitation in the form of independent living is likely to help people with complete HH, given the finding on reduction in quality of life in vision-specific social functioning and dependency.

Our study contrasts with that of Parageorgiou et al³ who used the German version of NEI VFQ-25 in patients with homonymous visual field defects and correlated the findings to the characteristics on automated perimetry. Their study found significant reduction in the five domains that we have described; in addition, they found a significant reduction in near vision activities. In the current study, the univariate analysis yielded a significant decline in near vision function, but the multivariate analysis was equivocal. One reason for these findings may be related to an inherent limitation of this study because of its small sample size and hence inability to subanalyze the group with or without macular sparing. However the current study also differs from that of Parageorgiou et al in its design. Our study had concurrent parallel controls with a prospective analysis; the prior study was a case series using historical controls. Furthermore, our study used VA LV VFQ-48 in addition to the NEI VFQ-25, because one of the criticisms of the NEI VFQ-25 is that there are too few items in each subscale.¹² For instance, there are only three items addressing near activities. These are related to self-reported difficulties in reading the newspaper, working on hobbies that require close vision such as cooking or sewing, and difficulty finding things on a crowded shelf. In the VA LV VFQ-48, the psychometric qualities

were characterized and the responses to the questions calibrated to the functional reserve of a patient in the appropriate domain. For instance, a question on difficulty reading mail addresses tests both visual ability as well as reading vision. There are also items such as identifying money, identifying medicines, difficulties regarding reading signs on grocery store aisles, and reading small print on a package label that help cross-examine the true extent of difficulty in each visual domain. In our study, reading and visual ability were not significantly reduced in the HH group in VA LV VFQ-48.

In this study, the HH patients were examined in the subacute stage post stroke and before any vision rehabilitation, such that the results reflect baseline visual deficits prior to the development of compensatory mechanisms such as scanning that may interfere with the results. In the subacute stage post stroke, physical and psychological rehabilitation are important to maximize a person's function.¹³ This is the rationale for focusing our study of HH specifically during this subacute period when intervention may be most efficacious.

The current study reinforces the negative impact of poststroke HH on a patient's quality of life and the need to categorize such disability objectively. There are three main principles of vision rehabilitation in people with hemianopia. These are optical-based therapy such as using prism glasses, visual field restitution therapy, and eye movement-based therapy.¹⁴ Rehabilitation is an integral part of management in patients

with hemianopia post acquired brain injury, and the rehabilitation strategies should aim to address these areas of vision-specific quality of life difficulties such as vision-specific social functioning and mobility. For instance, in eye movement-based therapy, static scanning training and scanning training during mobilization can be incorporated. Further study directed at whether visual rehabilitation has a positive impact on these metrics using a randomized, double-blind parallel group intervention is suggested.

Conclusion

The current study identifies mobility, driving, peripheral vision and vision-specific dependence, social functioning, and mental health as being significantly affected in people with HH. It is important to identify the significant areas of visual difficulties and their effect on quality of life as it can help better address the patients' rehabilitation needs.

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APPENDIX A

Questions in National Eye Institute Visual Function Questionnaire (NEI VFQ-25) and the Subscales to Which Each Question Belongs

Item	Question and response category	Response category	Subscale
1	In general, would you say your health is:	Excellent (1) Very good (2) Good (3) Fair (4) Poor (5)	General health
2	At the present time, would you say your eyesight using both eyes (with glasses or contact lenses, if you wear them) is:	Excellent (1) Good (2) Fair (3) Poor (4) Very poor (5) Completely blind (6)	General vision
3	How much of the time do you feel sorry about your eyesight?	None of the time (1) A little of the time (2) Some of the time (3) Most of the time (4) All of the time (5)	Vision-specific mental health
4	How much pain or discomfort have you had in and around your eyes (eg, burning, itching or aching)? Would you say it is:	None (1) Mild (2) Moderate (3) Severe (4) Very severe (5)	Ocular pain
5	How much difficulty do you have reading ordinary print in newspapers? Would you say you have:	No difficulty at all (1) A little difficulty (2) Moderate difficulty (3) Extreme difficulty (4) Stopped doing this because of your eyesight (5) Stopped doing this for other reasons (6)	Near activities
6	How much difficulty do you have doing work or hobbies that require you to see well up close, such as cooking, sewing, fixing things around the house, or using hand tools? Would you say:	No difficulty at all (1) A little difficulty (2) Moderate difficulty (3) Extreme difficulty (4) Stopped doing this because of your eyesight (5) Stopped doing this for other reasons (6)	Near activities

Item	Question and response category	Response category	Subscale
7	Because of your eyesight, how much difficulty do you have finding something on a crowded shelf?	No difficulty at all (1) A little difficulty (2) Moderate difficulty (3) Extreme difficulty (4) Stopped doing this because of your eyesight (5) Stopped doing this for other reasons (6)	Near activities
8	How much difficulty do you have reading street signs or the names of stores?	No difficulty at all (1) A little difficulty (2) Moderate difficulty (3) Extreme difficulty (4) Stopped doing this because of your eyesight (5) Stopped doing this for other reasons (6)	Distant activities
9	Because of your eyesight, how much difficulty do you have going down steps, stairs, or curbs in dim light or at night?	No difficulty at all (1) A little difficulty (2) Moderate difficulty (3) Extreme difficulty (4) Stopped doing this because of your eyesight (5) Stopped doing this for other reasons (6)	Distant activities
10	Because of your eyesight, how much difficulty do you have noticing objects off to the side while you are walking along?	No difficulty at all (1) A little difficulty (2) Moderate difficulty (3) Extreme difficulty (4) Stopped doing this because of your eyesight (5) Stopped doing this for other reasons (6)	Peripheral vision
11	Because of your eyesight, how much difficulty do you have seeing how people react to things you say?	No difficulty at all (1) A little difficulty (2) Moderate difficulty (3) Extreme difficulty (4) Stopped doing this because of your eyesight (5) Stopped doing this for other reasons (6)	Vision specific social functioning
12	Because of your eyesight, how much difficulty do you have picking out and matching your own cloths?	No difficulty at all (1) A little difficulty (2) Moderate difficulty (3) Extreme difficulty (4) Stopped doing this because of your eyesight (5) Stopped doing this for other reasons (6)	Color vision
13	Because of your eyesight, how much difficulty do you have visiting with people in their homes, at parties, or in restaurants?	No difficulty at all (1) A little difficulty (2) Moderate difficulty (3) Extreme difficulty (4) Stopped doing this because of your eyesight (5) Stopped doing this for other reasons (6)	Vision specific social functioning
14	Because of your eyesight, how much difficulty do you have going out to see movies, plays, or sports events?	No difficulty at all (1) A little difficulty (2) Moderate difficulty (3) Extreme difficulty (4) Stopped doing this because of your eyesight (5) Stopped doing this for other reasons (6)	Distant activities
15	Now, I'd like to ask about driving a car. Are you currently driving? If no, a) have you never driven a car or given up driving? b) If gave up driving, was that mainly because of your eyesight?	Yes (1) No (2)	Driving
16	How much difficulty do you have driving at night? Would you say you have:	No difficulty at all (1) A little difficulty (2) Moderate difficulty (3) Extreme difficulty (4) Stopped doing this because of your eyesight (5) Stopped doing this for other reasons (6)	Driving

(Continued)

APPENDIX A. *Continued*

Item	Question and response category	Response category	Subscale
17	Do you accomplish less than you would like because of your vision?	All of the time (1) Most of the time (2) Some of the time (3) A little of the time (4) None of the time (5)	Vision-specific role difficulties
18	Are you limited in how long you can work or do other activities because of your vision?	All of the time (1) Most of the time (2) Some of the time (3) A little of the time (4) None of the time (5)	Vision-specific role difficulties
19	How much does pain or discomfort in or around the eye (eg, burning, itching, or aching) keep you from doing what you'd like to be doing?	All of the time (1) Most of the time (2) Some of the time (3) A little of the time (4) None of the time (5)	Ocular pain
20	I stay home most of the time because of my eyesight	Definitely true (1) Mostly true (2) Not sure (3) Mostly false (4) Definitely false (5)	Vision specific dependency
21	I feel frustrated a lot of the time because of my eyesight.	Definitely true (1) Mostly true (2) Not sure (3) Mostly false (4) Definitely false (5)	Vision-specific mental health
22	I have much less control over what I do because of my eyesight.	Definitely true (1) Mostly true (2) Not sure (3) Mostly false (4) Definitely false (5)	Vision-specific mental health
23	Because of my eyesight, I have to rely too much on what other people tell me.	Definitely true (1) Mostly true (2) Not sure (3) Mostly false (4) Definitely false (5)	Vision-specific dependency
24	I need a lot of help from others because of my eyesight.	Definitely true (1) Mostly true (2) Not sure (3) Mostly false (4) Definitely false (5)	Vision-specific dependency
25	I worry about doing things that will embarrass myself or others because of my eyesight.	Definitely true (1) Mostly true (2) Not sure (3) Mostly false (4) Definitely false (5)	Vision-specific mental health

For each question, participants were asked to rate the level of difficulty as:

1 = not difficult, 2 = slightly/moderately difficult, 3 = extremely difficult, 4 = impossible, 5 = don't do for other reasons.

APPENDIX B

Questions in VA LV VFQ-48

How much difficulty do you have with:

Read newspaper headlines	Get around outdoors in places you know
Read newspaper or magazine articles	Get around indoors in places you know
Read mail	Get around in unfamiliar places
Read menus	Go down steps in dim light
Read small print on a package label	Go out at night
Keep your place while reading	Get around in a crowd
Read street signs and store names	Avoid bumping into things
Read signs (eg, grocery store aisle)	Cross street at a traffic light
Read print on TV	Use public transportation
See photos	Find public restrooms
Find something on a crowded shelf	Play sports
Identify medicine	Adjust to bright light
Identify money	Do yard work
Tell time	Play table and card games
Watch TV	Work on your favorite hobby
Recognize people up close	Make out a check
Recognize people from across the room	Sign your name
Identify food on a plate	Take a message
Match clothes	Fix a snack
Handle finances	Prepare meals
Keep clean/keep your clothes clean	Use appliance dials
Groom yourself	Physically get dressed
Eat and drink neatly	Go to the movies
Clean the house	Go to spectator events
