Outcomes of Multidisciplinary Low-Vision Rehabilitation Using Two Questionnaires and the International Classification of Functioning, Disability, and Health

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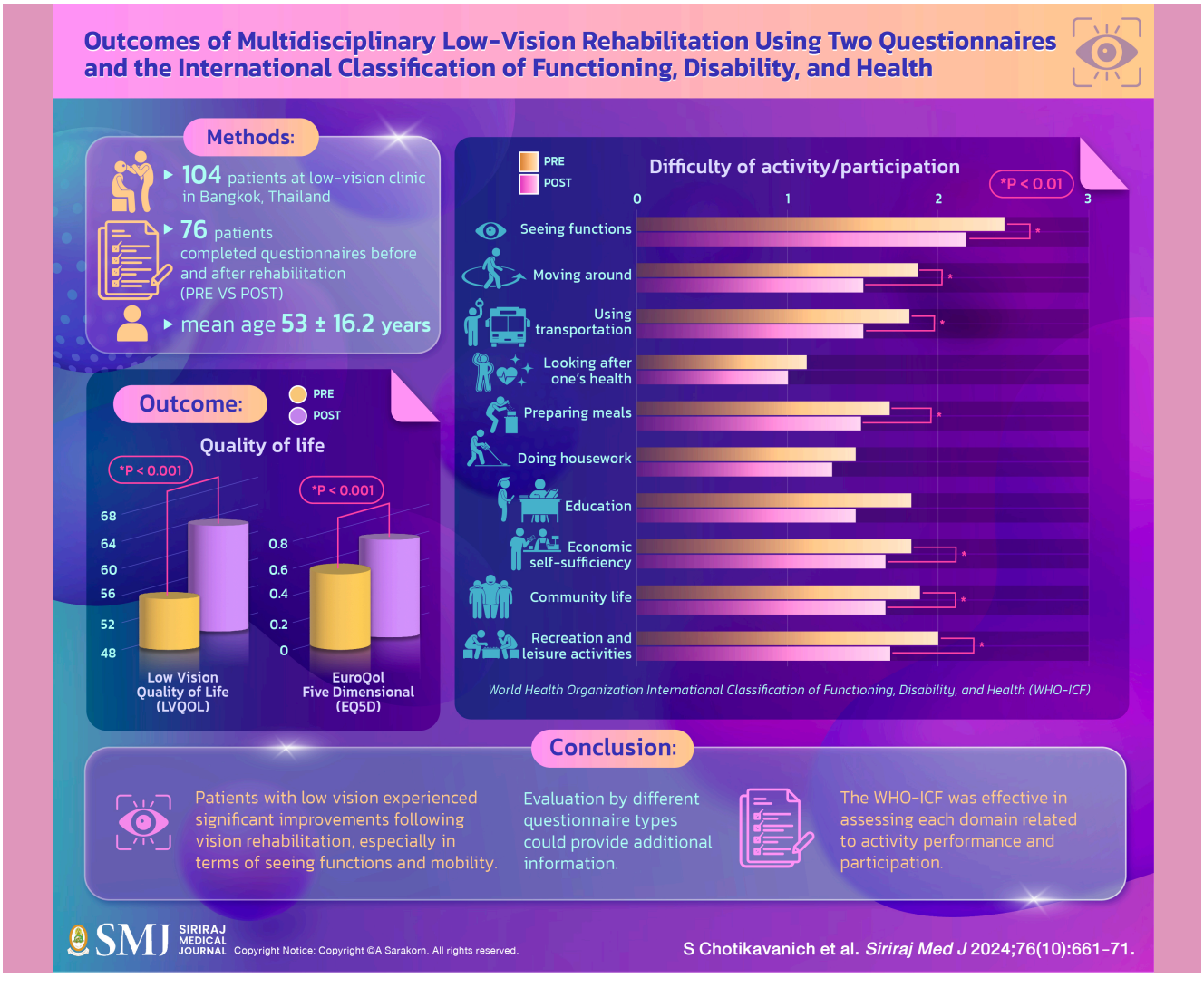

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ABSTRACT

Objective: To evaluate the effectiveness of a low-vision service by using three tools and to identify the specific outcomes obtained from each instrument.

Materials and Methods: Patients consecutively visiting the low-vision clinic at Siriraj Hospital, Bangkok, Thailand, were enrolled. The impact of the prescribed rehabilitation on patient quality of life was measured using three tools: the Low-Vision Quality-Of-Life Questionnaire (LVQOL); the generic EuroQol Five-Dimensional Questionnaire (EQ-5D); and the World Health Organization International Classification of Functioning, Disability, and Health (WHO-ICF).

Results: Out of the 104 patients recruited, 76 patients (mean age, 53 ± 16.2 years) completed the questionnaires before and after rehabilitation, which was assessed after 5.8 ± 2.0 months. Post-rehabilitation, the time of follow-up, patients had significant improvements in the mean scores of both the LVQOL scores and mean EQ-5D scores compared to before rehabilitation ($P < 0.001$), with Cohen's effect sizes of 0.85 and 0.67, respectively. Subgroup analyses by age, severity, and cause of visual impairment also showed significant improvements in the LVQOL ($P < 0.05$), but not the EQ-5D score in the blindness severity subgroup. The ICF scores also showed significant improvement in most domains, including seeing functions, mobility across different locations, transportation use, meal preparation, economic self-sufficiency, community life, and recreational activities ($P < 0.01$).

Conclusion: Patients with low vision experienced significant improvements following vision rehabilitation, especially in terms of seeing functions and mobility. Evaluation by different questionnaire types could provide additional information. The WHO-ICF was effective in assessing each domain related to activity performance and participation.

Keywords: International classification of functioning disability and health; low vision; quality of life; Thailand; vision rehabilitation (Siriraj Med J 2024; 76: 661-671)

INTRODUCTION

Low-vision rehabilitation aims to help patients with visual impairments improve their ability to perform activities of daily living, and thus enhances their well-being and quality of life. Despite encouragement for the integration of low vision care into ophthalmology services within hospitals, this service remains limited in many countries, including Thailand. There is a need to investigate the benefits of such interventions in real-life settings to facilitate their integration into health policies.

Since there is no gold standard to evaluate the outcomes of the service, most studies rely on quality-of-life questionnaires. These questionnaires have predominantly been vision-specific[1-4], and includes the Low-Vision Quality-Of-Life Questionnaire (LVQOL),[1] which has demonstrated improvements in quality of life following rehabilitation. Some studies also utilize generic questionnaires like the EuroQol Five-Dimensional Questionnaire (EQ-5D).[5,6] However, based on our review of English-language literature, there is a lack of research investigating outcomes of low-vision rehabilitation in Thailand. It is important to recognize that cultural and geographical differences may influence well-being of patients and potentially yield varying outcomes in different contexts.

Interestingly, the International Classification of Functioning, Disability and Health (ICF),[7] one of the World Health Organization's (WHO) Family of International Classifications, aims to define the health status issued from functioning and disability, rather than solely relying on disease diagnoses as with the International Classification of Diseases.[8] One key advantage of ICF is its ability to assess and code patients' capabilities in terms of "activities" and "participation", which are dimensions that align closely with quality of life measures that can be enhanced through rehabilitation interventions. Additionally, the ICF offers a comprehensive overview of functional domains with clearly defined scales of grading, unlike traditional quality of life questionnaires. Moreover, the ICF is recognized for providing a universal language internationally, thereby facilitating better communication among multidisciplinary health professionals and policymakers. In line with Thailand's health policy to focus on individuals with disabilities, a national committee recreated the ICF into Thai language,[9] an initiative that was endorsed by the Strategy and Planning Division, Ministry of Public Health in 2012.

Previous publications have only described the utility of ICF in assessing the health of patients with visual impairment,[10,11] however, there has been no

prior publication, to our knowledge, utilizing the ICF to examine outcomes of low-vision rehabilitation service. Meanwhile, the ICF has been applied to evaluate quality-of-life outcomes across other services, such as post-acute stroke rehabilitation,[12] computerized cognitive training in acquired brain injury,[13] and upper-limb tetraplegia surgery.[14]

The primary objective of this study was to assess outcomes of a hospital-based, low-vision rehabilitation service using different tools, namely, the LVQOL and EQ-5D self-reported quality of life questionnaires, and the WHO-ICF. The secondary aim was to evaluate characteristics of results obtained from these tools within the same population.

MATERIALS AND METHODS

Ethics approval and subjects

The study was conducted according to the principles of the Declaration of Helsinki. Approval for the research was obtained from the Committee for the Protection of Human Participants in Research at the Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand (approval number:349/2556[EC3]). Furthermore, the study was registered as quasi-experimental research in the Thai Clinical Trials Registry (identification number: 20171013002). Recruitment occurred between August 2015 and May 2017, with consecutive new patients attending the low-vision rehabilitation clinic at Siriraj Hospital, which is one of the largest tertiary referral centres. Patients were enrolled if they had difficulty performing activities because of visual loss (visual acuity [VA] and/or visual field loss) at any severity level.[15] However, ophthalmologists had referred most of the patients when they had abnormal visual function defined as "low vision" or "blindness".[16] Some patients with near-normal vision still attended the clinic when they had difficulties performing their activities because of visual problems (such as decreased contrast acuity, which makes reading very small newsprint very difficult and night blindness, which makes travelling at night difficult).

The inclusion criteria for this study were an age of 18 or older, and being able to respond to a face-to-face questionnaire-based interview. The exclusion criteria were subjects who had undergone previous low-vision rehabilitation elsewhere. The patients also needed to be willing to comply with the protocol, which included at least two follow-up visits, and to provide written informed consent before enrolment.

Rehabilitation services

After a review of the ocular pathology and medical history of the patients, assessments of their visual functions were made, including visual acuity (VA) using the Early Treatment of Diabetic Retinopathy Study VA chart; visual field evaluation through the Goldmann or Humphrey perimetry; trial frame refraction; and identification of the preferred retinal locus for seeing (eccentric viewing) using the clock-face method. Additionally, the functional history was evaluated by gathering information from both patients and their caregivers regarding the specific challenges encountered in activities such reading, daily activities, safety, and psychosocial well-being. After providing rehabilitation counselling, service objectives were set for each individual patient. These objectives took into account the expectations of each patient, but they were modified to reflect the realistic possibility for rehabilitation as assessed by the service provider. Once the service goals were finalized based on discussions between the patient and service provider, rehabilitation services were executed. The clinic was staffed by a multidisciplinary team that included an ophthalmologist, rehabilitation teachers, orientation and mobility instructors, and social workers.

The services available at the low-vision rehabilitation clinic included the prescribing of, and training in the use of, optical and non-optical devices (mostly supported by Sirindhorn National Medical Rehabilitation Institute, Ministry of Public Health). Basic activities-of-daily-living training was also provided in personal hygiene, meal preparation, and house cleaning. Additionally, orientation and mobility training for independent travel was available (partly supported by Ratchasuda College, Mahidol University, and the National Health Security Office). Examples of the items covered by the 80-hour orientation and mobility program were route and orientation training, long-cane training, sighted guide training, and the use of visual substitutes training. The use of a video magnifier, a closed-circuit television system or vision-assistive technology could be suggested. Participation in support groups and referral for further occupational or educational rehabilitation could be endorsed. If necessary, a patient was prescribed multiple services.

The clinic offered free services to patients with a recognized legal visual disability, and assistance with registration for Thai visual disability status was available for eligible individuals. To qualify, a patient's VA had to be below 6/18, or their visual field had to be narrower than 30 degrees in the better eye. Legal visual disability was further classified into two categories: low vision, defined as VA worse than 6/18 to 3/60, and blindness, characterized by VA worse than 3/60 to no light perception.

Questionnaires

The study incorporated two distinct categories of self-reported quality-of-life questionnaires, including the EQ-5D, a broadly applicable, non-disease-specific quality-of-life questionnaire. This questionnaire was utilized in its Thai version, which was validated and received approval from the EuroQol group.[17,18] The EQ-5D consists of five questions covering the dimensions of mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension was scored on one of three levels of severity. The utility scores applied in this research were based on preference scores from the Thai population for EQ-5D health states, determined through a Time Trade-Off (TTO) method[18] from a random sample of the general population in Thailand. The final EQ-5D score is a single-index value, where higher scores indicate a better quality of life.

The second quality-of-life questionnaire used in this study was the vision-specific LVQOL questionnaire, developed by Wolffsohn and Cochrane.[1] This study used a validated Thai version of the LVQOL, consisting of 22 questions spanning areas such as reading and fine work, distance vision and mobility, and activities of daily living and adjustment.[19] Responses were scored on a scale from 5 (no difficulty due to vision impairment) to 1 (significant difficulty), with an option for 0 (unable to perform the activity). An "irrelevant" option was also available for items not pertinent to the respondent's daily life, ensuring that individuals marking more items as irrelevant did not receive a disproportionately lower overall score, which could suggest a poorer quality of life.[1] The LVQOL's final score is a single-index value, with higher scores indicating a better quality of life.

The third instrument employed was the Thai version of the WHO-ICF (Supplement 1)[9], with a focus on the "activity and participation" component for those with visual disabilities. This included scoring performances across 10 domains of visual functions, such as mobility, transportation use, personal health care, meal preparation, housework, education, economic self-sufficiency, community life, recreation, and leisure. Table 1 shows the ICF qualifier scale for each domain category, where a higher score denotes greater difficulty. The scale uses "8" to indicate "not specified" which is applicable when there is insufficient information to accurately rate a difficulty level. For example, this was applied when patients did not know there is a problem with an activity or if the degree of that problem is mild or severe. The numeric scale "9" was assigned to indicate "not applicable" and was used when an activity was not performed for reasons unrelated to visual difficulties. An example is when patients did not perform an activity because they disliked it or felt that I was not necessary to do rather than due to visual difficulties.

Two interviewers (T.L. and V.K.) who had no prior exposure to the services received by the patients during the study, conducted face-to-face interviews using those questionnaires at both pre- and post-rehabilitation appointments. Given the individual nature of the rehabilitation service plans, some patients underwent multiple follow-up visits throughout the rehabilitation process, with intervals ranging from one to six months between visits. To reduce inconvenience for the patients, both questionnaires were administered during their regular clinic visits. The pre-rehabilitation questionnaire was filled out before starting rehabilitation, and the post-rehabilitation questionnaire was conducted during the first visit after the conclusion of all prescribed rehabilitation services, and verification of completion, as confirmed by patient accounts and hospital medical records.

Statistical analysis

Data analysis was performed using IBM SPSS Statistics for Windows, version 23.0 (IBM Corp., Armonk, NY, USA). The quality-of-life scores from the LVQOL and EQ-5D questionnaires, both before and after rehabilitation, were reported as means and medians. The distribution normality of the data across the entire sample and within each subgroup was assessed using the Kolmogorov–Smirnov test. Score changes were analyzed using paired t-tests or the non-parametric Wilcoxon signed-rank test for data a not adhering to normal distribution.

For evaluating changes in in the difficulty rating within each WHO-ICF category domain before and after rehabilitation, the non-parametric Wilcoxon signed-rank test was employed. This analysis was limited to ICF qualifier scales ranging from 0 to 4, as outlined in Table 1. Qualifiers scored as 8 and 9 were treated as missing data. A p-value of < 0.05 was considered statistically significant.

RESULTS

Subject demographics and characteristics

Out of 104 patients who were initially enrolled, 76 successfully completed the questionnaires both before and after undergoing rehabilitation. The gender distribution showed a slight female predominance (52.6%) over males (47.4%), with an average age of patients being 53.4 ± 16.2 years (range: 18-78 years). Detailed demographic data, characteristics of the patients' visual impairments, and rehabilitation services provided are outlined in Table 2. The average duration between the initial and post-

TABLE 1. World Health Organization International Classification of Functioning, Disability and Health Qualifier Scales.

Numerical scale		Percentage (%)
0	NO problem/difficulty (none, absent, negligible, . . .)	0–4
1	MILD problem/difficulty (slight, low, . . .)	5–24
2	MODERATE problem/difficulty (medium, fair, . . .)	25–49
3	SEVERE problem/difficulty (high, extreme, . . .)	50–95
4	COMPLETE problem/difficulty (total, . . .)	96–100
8	Not specified	
9	Not applicable	

rehabilitation assessment was 5.8 ± 2.0 months (range: 1-12 months).

Most patients had low vision rather than blindness. The most common severity of visual impairment identified was a VA worse than 6/18 but not exceeding 6/60 and a visual field of less than 30 degrees (46.1% and 68.4%, respectively). The primary causes of visual impairment were retinitis pigmentosa (38.2%), glaucoma (26.3%), and various macular diseases, including age-related macular degeneration, macular scar and macular dystrophy (18.4%).

The top three rehabilitation services provided to the patients included reading devices (82.9%), orientation and mobility training (81.6%), and basic activities of daily living training (72.4%). It was common for patients to receive more than on type of service tailored to their needs.

Changes in LVQOL scores

The LVQOL scores, both before and after rehabilitation, demonstrated a normal distribution and showed a significant shift towards higher mean quality-of-life scores (Table 3). There was a notable improvement in the mean LVQOL score, increasing from 55.2 ± 9.2 before rehabilitation to 63.9 ± 11.5 after rehabilitation, with the difference being statistically significant ($P < 0.001$).

Given that the quality of life can be influenced by various factors such as working age or retired, the severity of visual impairment (categorized as low vision or blindness), or the underlying cause of visual impairment (e.g.; retinitis pigmentosa, glaucoma, macular disease, or other conditions), analyses were conducted across patient subgroups. Notably, significant improvements in LVQOL scores were observed in all subgroups, regardless of age, severity of visual impairment, and type of ocular disease, with all showing $P < 0.05$. To assess the meaningfulness of these improvements, Cohen's effect sizes were calculated, which measure the magnitude of differences in mean scores relative to the pooled standard deviation across these groups. According to Cohen's guidelines, effect sizes are considered small if between 0.2 to 0.3, medium at 0.5, and large at ≥ 0.8.[20,21] For this study, the overall effect size was large (Cohen's effect size = 0.85), indicating substantial improvements in quality of life for most patient subgroups.

Changes in EQ-5D scores

The EQ-5D scores before and after rehabilitation, as well as their respective changes, are shown in Table 4. There was a significant improvement in the mean EQ-5D quality-of-life score, rising from 0.549 ± 0.195 before rehabilitation to 0.680 ± 0.197 following rehabilitation, with a $P < 0.001$. Significant improvements in the EQ-5D scores were also observed across all patient subgroups when categorized by age and ocular disease responsible for visual impairment ($P < 0.05$). When analyzing subgroups based on the severity of visual impairment, significant improvements were only observed in the low-vision subgroup, where VA was not worse than 3/60. This occurred despite the quality-of-life scores having improved for the overall levels of visual impairment.

Changes in ICF ratings

For the ICF ratings, the difficulty scales for activity and participation components before and after low-vision rehabilitation are presented in Fig 1. After excluding

TABLE 2. Demographic data, characteristics of visual impairment, and rehabilitation services provided to patients

Information	Total 76 (100%)
Unemployed	44 (57.9%)
Income ≤5,000 THB/month	40 (52.6%)
No/inadequate financial support	50 (65.8%)
No/inadequate transportation support	30 (39.5%)
Living alone	9 (11.8%)
Multiple disability: visual and hearing loss	1 (1.3%)
Visual acuity	
Equal to or better than 6/18 (normal or near normal)	16 (21.1%)
Worse than 6/18 to 6/60 (low vision)	35 (46.1%)
Worse than 6/60 to 3/60 (low vision)	9 (11.8%)
Worse than 3/60 to 1/60 (blindness)	9 (11.8%)
Worse than 1/60 to PL (blindness)	7 (9.2%)
Visual field	
Central scotoma	8 (10.5%)
Visual field of less than 30 degrees	52 (68.4%)
Normal/visual field of 30 degrees or larger	15 (19.7%)
No data	1 (1.3%)
Ocular diseases	
Retinitis pigmentosa	29 (38.2%)
Glaucoma	20 (26.3%)
Macular diseases†	14 (18.4%)
Others	13 (17.1%)
Services	
Reading devices	63 (82.9%)
Orientation & mobility training	62 (81.6%)
Basic activities of daily living training	55 (72.4%)
Assistive technology	2 (2.6%)
Referral for education/occupation	7 (9.2%)

PL, perception of light

† Macular diseases include age-related macular degeneration, macular scar and macular dystro

TABLE 3. Changes in scores of low-vision quality of life questionnaire before and after low vision rehabilitation.

	Pre-rehabilitation		Post-rehabilitation	*P* value	Cohen's
	Mean ± SD	Median (P25, P75)	Mean ± SD	Median (P25, P75)	effect size
Total (n = 76)	55.2 ± 9.2	55.0 (49.1, 59.0)	63.9 ± 11.5	62.0 (57.0, 70.3)	< 0.001*	0.85
Subgroups: Age						
< 60 years (n = 44)	53.2 ± 7.8	54.0 (48.0, 57.8)	62.3 ± 9.5	60.5 (57.0, 67.8)	< 0.001*	1.05
≥ 60 years (n = 32)	57.8 ± 10.4	56.1 (51.0, 63.0)	66.2 ± 13.5	62.3 (57.0, 77.0)	*< 0.001**	–
Subgroups: Visual impairment						
Equal to or better than 6/18 (n = 16)	57.4 ± 8.5	56.0 (53.3, 63.5)	62.6 ± 10.4	61.5 (55.5, 70.0)	0.036*	0.57
Worse than 6/18 to 6/60 (n = 35)	56.5 ± 9.4	56.0 (50.0, 60.0)	65.6 ± 12.5	62.0 (58.0, 75.0)	*< 0.001**	–
Worse than 6/60 to 3/60 (n = 9)	51.3 ± 9.5	48.7 (45.0, 56.0)	60.2 ± 10.8	58.0 (51.5, 62.5)	*0.007**	–
Worse than 3/60 to 1/60 (n = 9)	55.0 ± 7.9	55.0 (49.0, 63.0)	64.1 ± 11.1	63.0 (55.5, 69.0)	0.024*	0.93
Worse than 1/60 to PL (n = 7)	48.4 ± 8.4	53.0 (38.0, 56.0)	63.1 ± 10.9	61.0 (55.9, 73.0)	0.002*	1.96
Subgroups: Ocular disease						
Retinitis pigmentosa (n = 29)	55.1 ± 8.2	55.0 (51.00, 58.5)	65.2 ± 12.7	63.0 (58.0, 73.0)	*< 0.001**	0.94
Glaucoma (n = 20)	56.6 ± 8.6	56.0 (53.3, 62.8)	64.1 ± 9.9	62.5 (57.0, 69.8)	*0.001**	–
Macular diseases (n = 14)	55.2 ± 13.3	53.0 (45.8, 59.3)	65.5 ± 13.6	60.3 (56.8, 75.8)	*0.009**	–
Others (n = 13)	52.9 ± 7.6	51.0 (47.9, 58.0)	59.1 ± 7.3	58.0 (53.0, 64.5)	*0.008**	0.83

SD, standard deviation; P25, 25th percentile; P75, 75th percentile; PL, perception of light

* *P* value is considered statistically significant by a paired t-test or nonparametric Wilcoxon signed-rank test (italicised *P* values)

TABLE 4. Changes in mean scores of EuroQol Five-Dimensional Questionnaire before and after low-vision rehabilitation.

	Pre-rehabilitation		Post-rehabilitation		*P* value	Cohen's effect size
	Mean ± SD	Median (P25, P75)	Mean ± SD	Median (P25, P75)		
Total (n= 76)	0.549 ± 0.195	0.513 (0.398, 0.645)	0.680 ± 0.197	0.677 (0.560, 0.766)	< 0.001*	0.67
Subgroups: Age						
< 60 years (n = 44)	0.586 ± 0.206	0.543 (0.428, 0.707)	0.737 ± 0.184	0.693 (0.591, 1.000)	*< 0.001**	–
≥ 60 years (n = 32)	0.498 ± 0.170	0.484 (0.392, 0.618)	0.602 ± 0.190	0.626 (0.463, 0.693)	0.001*	0.58
Subgroups: Visual impairment						
Equal to or better than 6/18 (n = 16)	0.563 ± 0.199	0.513 (0.425, 0.642)	0.667 ± 0.203	0.672 (0.524, 0.748)	0.01*	0.74
Worse than 6/18 to 6/60 (n = 35)	0.537 ± 0.192	0.573 (0.392, 0.677)	0.688 ± 0.200	0.677 (0.573, 0.766)	*< 0.001**	–
Worse than 6/60 to 3/60 (n = 9)	0.583 ± 0.269	0.513 (0.380, 0.854)	0.705 ± 0.201	0.666 (0.574, 0.883)	0.012*	1.08
Worse than 3/60 to 1/60 (n = 9)	0.561 ± 0.199	0.513 (0.409, 0.656)	0.639 ± 0.185	0.634 (0.483, 0.726)	0.091	0.64
Worse than 1/60 to PL (n = 7)	0.517 ± 0.121	0.513 (0.392, 0.618)	0.692 ± 0.229	0.645 (0.556, 1.000)	0.071	0.83
Subgroups: Ocular disease						
Retinitis pigmentosa (n = 29)	0.556 ± 0.182	0.513 (0.431, 0.656)	0.686 ± 0.177	0.677 (0.573, 0.739)	*< 0.001**	–
Glaucoma (n = 20)	0.561 ± 0.164	0.535 (0.435, 0.645)	0.679 ± 0.172	0.677 (0.564, 0.756)	0.001*	0.70
Macular diseases (n = 14)	0.459 ± 0.156	0.421 (0.392, 0.564)	0.585 ± 0.199	0.625 (0.392, 0.726)	0.021*	0.70
Others (n = 13)	0.613 ± 0.279	0.618 (0.380, 0.883)	0.772 ± 0.246	0.766 (0.543, 1.000)	*0.008**	–

SD, standard deviation; P25, 25th percentile; P75, 75th percentile; PL, perception of light

* *P* value which is considered statistically significant by a paired t-test or nonparametric Wilcoxon signed-rank test (italicised *P* values)

Activity and participation	n (%)†		Difficulty 0 1 2 3 4	*P* value	Difficulty n (%) 8	Difficulty n (%) 9
1. Seeing functions	76 (100%)	Pre-rehabilitation		<0.001*	-	-
	74 (97.4%)	Post-rehabilitation			-	2 (2.6%)
2. Moving around different locations	75 (98.7%)	Pre-rehabilitation		<0.001*	1 (1.3%)	-
	75 (98.7%)	Post-rehabilitation			1 (1.3%)	-
3. Using transportation	75 (98.7%)	Pre-rehabilitation		0.001*	1 (1.3%)	-
	75 (98.7%)	Post-rehabilitation			1 (1.3%)	-
4. Looking after one's health	76 (100%)	Pre-rehabilitation		1.222	-	-
	75 (98.7%)	Post-rehabilitation			-	1 (1.3%)
5. Preparing meals	57 (75.0%)	Pre-rehabilitation		0.008*	3 (3.9%)	16 (21.1%)
	61 (80.3%)	Post-rehabilitation			-	15 (19.7%)
6. Doing housework	66 (86.9%)	Pre-rehabilitation		0.073	3 (3.9%)	7 (9.2%)
	66 (86.9%)	Post-rehabilitation			2 (2.6%)	8 (10.5%)
7. Education	13 (17.1%)	Pre-rehabilitation		0.18	9 (11.8%)	54 (71.1%)
	10 (13.2%)	Post-rehabilitation			3 (3.9%)	63 (82.9%)
8. Economic self-sufficiency	73 (96.1%)	Pre-rehabilitation		0.006*	2 (2.6%)	1 (1.3%)
	76 (100%)	Post-rehabilitation			-	-
9. Community life	66 (86.9%)	Pre-rehabilitation		0.001*	3 (3.9%)	7 (9.2%)
	71 (93.4%)	Post-rehabilitation			1 (1.3%)	4 (5.3%)
10. Recreation and leisure	69 (90.8%)	Pre-rehabilitation		0.003*	2 (2.6%)	5 (6.6%)
	73 (96.1%)	Post-rehabilitation			1 (1.3%)	2 (2.6%)

Fig 1. Classification of Functioning, Disability, and Health scales of difficulty before and after low-vision rehabilitation.
The box-plot shows the mean (plus sign), median (dark bar), 25th and 75th percentile (box), range of the scales of difficulty (whisker), and potential outlier (circles) of each domain before and after rehabilitation. The changes in the scales of difficulty for each ICF category domain were analysed by the non-parametric Wilcoxon signed-rank test.
† Remaining number of patients after removing the missing data ("8" and "9")
**P* value which is considered statistically significant.

the ICF qualifiers of 8 and 9 as missing data, the figure indicates the number of patients evaluated. Improvements were noted across all domains in the ICF difficulty scales, with significant enhancements in specific areas such as seeing functions, mobility across different locations, use of transportation, meal preparation, economic self-sufficiency, community life, and recreation and leisure activities ($P < 0.01$). The numerical qualifier 9 was most frequently recorded in domains of doing housework (about 10% of patients), meal preparation, (about 20%), and education (more than 70%).

DISCUSSION

This prospective study was undertaken to assess the outcomes of low-vision rehabilitation practice, using validated tools to quantify the effects. In the absence of a consensus on the most effective assessment tool, three different instruments were utilized to gain a better understanding of the problems and to best evaluate the outcomes. Additionally, the WHO-ICF framework was applied to ensure findings could be understood by personnel working in broader medical and socioeconomic fields related to visual disability.

The study used the vision-specific, self-reported LVQOL questionnaire, and found significant improvements in quality of life that were clinically meaningful. This positive shift in score aligns with outcomes observed in a similar study conducted by a low-vision clinic in Australia, which also employed the tool.[1] Moreover, significant enhancements in LVQOL scores, indicating large clinical significance, were observed across all patient subgroups analyzed. However, the smallest effect size was noted among patients with near-normal VA. This was probably because this subgroup typically experienced only mild problems, leading to less pronounced changes in outcomes.

In assessing the outcomes of the same population with the generic, self-reported EQ-5D questionnaire, a significant improvement in overall EQ-5D quality of life scores was observed, although the effect size was smaller compared to that of LVQOL. Notably, the improvement in EQ-5D scores did not achieve statistical significance for the subgroup classified as blind. These EQ-5D results may reflect less favourable outcomes for this subgroup. These results might be explained by the fact that the EQ-5D had only four out of its five questions that are likely to be influenced by visual impairment, with the remaining item focused on pain or discomfort, a factor

generally unrelated to visual impairment or the outcomes of vision rehabilitation and more connected to broader heath factors. Similarly, a recent report from the US found that EQ-5D was undemonstrative as an outcome measure for low-vision rehabilitation.[5] This suggests that generic questionnaires might not be as sensitive as vision-specific ones in evaluating outcomes.[22] However, a recent Portuguese study reported a strong correlation between EQ-5D and visual ability, suggesting that the EQ-5D could be effective in illustrating the impact of visual impairment.[23] The variation in utility scores derived from population-based preferences in different countries could contribute to the mixed results. Therefore, the suitability of the EQ-5D for measuring outcomes in low-vision rehabilitation remains inconclusive.

Although the WHO-ICF does not consolidate its findings into a single index like the quality-of-life questionnaires, it proved useful for detailed examinations of outcomes within low-vision rehabilitation, specifically within each domain of activity and participation. In this research, the low-vision rehabilitation outcomes in domains such as seeing functions, mobility across different locations, use of transportation, meal preparation, economic self-sufficiency, community life, and recreational activities all showed significant progress. ($P < 0.01$). However, no significant advancements were detected in the areas of personal health care, housekeeping, and education. This lack of perceived improvement in these categories might be explained to patients' pre-existing ability to manage daily tasks within their homes, leading to an underestimation of any change.

The only prior study that utilized a measurement related to the ICF for evaluating rehabilitation outcomes was conducted using the Dutch ICF activity inventory.[2] This tool was based on (rather than a direct translation of) the original WHO-ICF. Instead, the research team developed several unique questions that focused exclusively on the domains of reading, writing, and watching television. Similar to the findings of the current study, the Dutch researchers observed a reduction in difficulty scores in three domains from the baseline.

The "not applicable" response was the most commonly observed in the education category, largely due to the average age of participants being 53.4 ± 16.2 years, with very few in the school-going demographic. Similarly, response of "not applicable" were frequent for tasks related to housework and meal preparation. This trend aligns with the fact that most Thai patients reside with family or friends, and not alone, as shown in Table 2. Hence, they likely received assistance with these activities.

The time frame used to assess the rehabilitation outcomes is another influencing factor in any questionnaire, and the duration has varied in other studies.[24–26] In principle, the follow-up span should be long enough to observe meaningful changes, yet short enough to avoid complications from disease progression or shifts in the patients' environmental or personal circumstances. *Wang et al.* reported an improvement in the quality-of-life scores over a longer period (1 month *vs.* 3 months).[24] Meanwhile, *Stelmack et al.* noted that these effects diminished after a year.[25,26] Interestingly, another recent study found no significant difference between outcomes measured at three months and those at 1 year.[27]

In the current study, the mean follow-up duration was 5.8 ± 2 months (range, 1-12 months). The broad spectrum of follow-up times was a limitation of the study. These variations in duration were due to various patient characteristics, the range of services, and the patients' differing abilities to attend follow-up visits, whether short or long. Further investigation is needed to explore specific patient groups and to continue ongoing evaluations over extended periods to determine if the improvements in the quality-of-life outcomes are sustained. Another limitation was the potential for bias, which could be minimized by employing a control group, such as patients on a clinic waiting list. However, ethical considerations of delaying low-vision rehabilitation also needs to be considered.

CONCLUSION

This study assessed the self-reported quality of life among patients with low vision and blindness, and revealed significant improvements following rehabilitation. Notably, the improvements were most evident in seeing functions and mobility. The use of various questionnaires, including LVQOL, EQ-5D, and WHO-ICF, leveraged their individual strengths and provided additional information about the outcomes.

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Author Contributions

S.C., A.E. designed the research; T.L., W.K., S.L., R.Y., S.D., W.N., J.J., N.S., E.E., S.S., P.C. conducted the study; S.C., T.L. wrote the main manuscript text; A.E. approved the final manuscript.

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