ORIGINAL ARTICLE

# Evaluation of vision-related quality of life and its associated factors in patients with diabetic vitreoretinal disease post trans pars plana vitrectomy using visual functioning questionnaire-25

**Zhong Yang Lai**

Universiti Sains Malaysia - Kampus Kesihatan, Ophthalmology and Visual Science, Universiti Sains Malaysia, Kampus Kesihatan, Kota Bharu, Kelantan, Malaysia

**ABSTRACT**

**Introduction: Diabetic vitreoretinal disease often requires trans pars plana vitrectomy (TPPV) to preserve useful vision. Its impact on patients' vision-related quality of life (VRQoL) has not been fully detailed locally, especially Kelantan. We evaluated post-operative changes in VRQoL, using the validated Malay version National Eye Institute-Visual Functioning Questionnaire-25 (NEI-VFQ-25) questionnaire, and identified pre-operative and clinical factors associated with 3-months post TPPV NEI-VFQ-25 scores.**

**Materials and Methods: In this prospective cohort study, 85 patients with type 1 or 2 diabetic vitreoretinal disease undergoing first TPPV at Hospital Pakar Universiti Sains Malaysia and Hospital Raja Perempuan Zainab II were recruited between December 2023 and December 2024. Demographic data, systemic and ocular profiles were reviewed and recorded. VRQoL was assessed pre-operatively and at 3-months post TPPV using the NEI-VFQ-25 questionnaire. Factors associated with VRQoL at 3-months post TPPV were analysed using linear regression analysis.**

**Results: A total 85 patients completed 3 months follow-up post TPPV. NEI-VFQ-25 composite score significantly improved from 49.28±13.98 pre-operatively to 57.45±12.30 at 3-months post TPPV (mean difference 8.16; 95% Confidence Interval 7.13-9.20; p<0.001). In univariate analyses, employment, hyperlipidaemia, diabetic nephropathy, pre-operative blindness status, tertiary education level and pre-operative NEI-VFQ-25 score were the significant factors associated with 3-months post TPPV VRQoL (p<0.05). In multivariable regression, secondary and tertiary education level, presence of other comorbid and pre-operative NEI-VFQ-25 score were the significant factors (p<0.001).**

**Conclusion: TPPV yields significant improvements in VRQoL by 3 months. Patients' pre-operative VRQoL, as well as higher education levels and presence of other comorbid are among the strongest determinants of post-operative VRQoL, emphasising the value of early intervention and patient counselling.**

**KEYWORDS:**
*Diabetic vitreoretinal disease, pars plana vitrectomy, vision-related quality of life, VFQ-25, linear regression.*

## INTRODUCTION

Diabetes mellitus remains a prominent global health concern, ranking among the top ten non-communicable causes of morbidity and mortality.[1] In 2019, an estimated 463 million adults worldwide had diabetes, and this number is projected to reach 700 million by 2045.[2,3] A significant complication of diabetes is diabetic retinopathy (DR), characterized by progressive retinal microvascular damage due to sustained hyperglycaemia.[4] Over two decades, nearly all patients with type 1 diabetes and around 60% of type 2 diabetes patients develop some stage of DR. This disease progresses from mild non-proliferative diabetic retinopathy (NPDR), characterized by microaneurysms, to moderate and severe forms displaying more extensive retinal haemorrhages, venous beading, and intraretinal microvascular anomalies. Advanced stages, termed proliferative diabetic retinopathy (PDR), involve neovascularization with or without haemorrhages and can evolve into advanced diabetic eye disease (ADED), featuring complications like retinal detachment, vitreous haemorrhage, and macular anomalies.

In Malaysia, DR is prevalent in approximately 51.6% of diabetic patients, with 28.1% experiencing vision-threatening PDR and 26.7% developing maculopathy.[5] Then, up to 15.0% of eyes had vision threatening DR needing laser or surgery at their first visit.[6] Notable risk factors for DR progression include longer diabetes duration, hypertension, and systemic complications such as nephropathy and peripheral neuropathy.[5] Data from the Early Treatment Diabetic Retinopathy Study (ETDRS) indicate a cumulative five-year incidence of diabetic vitrectomy at approximately 5.3%, with frequent follow-up examinations and timely scatter panretinal photocoagulation, primarily due to non-clearing vitreous haemorrhage and retinal detachment.[7] Poor glycaemic and metabolic control notably elevates the likelihood of requiring surgical intervention.[8] Chronic hyperglycaemia plays a central role in DR development via multiple metabolic pathways including the polyol pathway,

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*Corresponding Author: Lai Zhong Yang*
*Email: lai.zhongyang@gmail.com*

advanced glycation end-products, protein kinase C activation, and the hexosamine pathway. These biochemical changes initially result in retinal vessel dilation and altered blood flow, subsequently causing pericyte loss, endothelial apoptosis, and capillary occlusion. Retinal ischemia elevates vascular endothelial growth factor, exacerbating vascular permeability and retinal damage.[9] Concurrently, chronic low-grade inflammation, driven by increased leukocyte adhesion and elevated cytokines such as tumour necrosis factor-α, interleukin-6, and chemokines, further deteriorates the retinal microvasculature and barrier function.[9] Neuronal apoptosis and mitochondrial dysfunction are additional factors significantly contributing to retinal neurodegeneration and DR progression.[9] Trans pars plana vitrectomy (TPPV) is a standard surgical intervention employed to manage severe vitreoretinal complications of diabetes such as retinal detachments and vitreous haemorrhages, significantly enhancing postoperative visual acuity and visual functioning.[10,11] Studies have demonstrated that TPPV effectively improves vision-related quality of life (VRQoL), particularly in general vision, near and distance activities, and social and emotional scale (domains).[12-14] The National Eye Institute Visual Functioning Questionnaire-25 (NEI-VFQ-25) has been validated extensively to evaluate these patient-centred outcomes across diverse populations.[15-17] Despite its effectiveness, TPPV carries potential risks, including retinal tears, haemorrhages, and postoperative complications such as cataracts and glaucoma.[10]

Therefore, assessing VRQoL and associated factors following TPPV, especially within local Malaysian contexts, is essential. This study addresses the critical need for region-specific observational data regarding TPPV outcomes on visual acuity and quality of life (QoL) among diabetic vitreoretinal patients, filling a gap crucial for clinical decision-making and patient counselling.

## MATERIALS AND METHODS

### Study Design

A prospective cohort study was conducted at Ophthalmology Clinic, Hospital Pakar Universiti Sains Malaysia and Hospital Raja Perempuan Zainab II between December 2023 and December 2024. Approval for the study was obtained from the Human Research Ethics Committee of Universiti Sains Malaysia (JEPeM Code: USM/JEPeM/23110908) and in accordance with the tenets of Declaration of Helsinki. National Medical Research Register approval number: NMRR ID- 23-03058-NYY (IIR).

### Patient Selection and Data Collection

A total of 85 patients were enrolled in this study. All of them underwent first TPPV with the indication of diabetic vitreoretinal disease with underlying diabetes mellitus (type 1 & 2). All of them aged over 18 years old.

Patients who are less than 18 years old, undergoing more than once TPPV, reoperation of TPPV within 3 months, unable to complete questionnaire with assistance of doctors, undergoing TTPV with indications other than diabetic vitreoretinal disease, those with retinal disease affecting the macula (e.g., inherited retinal diseases, pathologic myopia), those with ophthalmologic conditions other than diabetic vitreoretinal disease such as ocular inflammation (e.g., uveitis), ocular malignancy, or any media opacity that obscure fundus view, those who have been diagnosed with depression or any mental health issues, those with cognitive dysfunctions such as, dementia, Alzheimer's disease or memory lost, those with physical disabilities such as, post lower limbs amputation or post trauma, and those with concurrent terminal illness, such as cancer were excluded from this study.

Patients were classified as having diabetic vitreoretinal disease with tractional retinal detachment (TRD), either with or without vitreous haemorrhage, or as combined TRD and rhegmatogenous retinal detachment (RRD), also with or without vitreous haemorrhage.

All patients were screened for inclusion and exclusion criteria during an interview session. A written informed consent was obtained after an explanation of the nature and consequences of the study. Demographic data, including age, gender, marital status, race and occupation were collected. Systemic history including history of co-morbidity such as hypertension, hyperlipidaemia, diabetic nephropathy, type of vitreoretinal disease and laterality. Only one principal investigator conducted the session to minimize errors. Distance best corrected visual acuity (BCVA) was recorded using Snellen's chart at 6 meters for both eyes. Blindness is defined as BCVA of poorer than 3/60 in the better eye with best possible correction.[18]

Previous documentation of clinical presentation, eye examinations and investigations were collected from the medical records. Patients were referred to Ophthalmology Clinic for eye examinations if there were no previous eye examinations before.

### National Eye Institute-Visual Functioning Questionnaire-25

In this study, the NEI-VFQ-25 questionnaire was used to assess the VRQoL. The questionnaire consists of 25 vision-targeted questions covering 11 vision-related scales, along with an additional single-item general health rating question. The NEI-VFQ-25 generates vision-targeted scales, including global vision rating, difficulty with near and distance vision activities, limitations in social functioning due to vision, role limitations due to vision, dependency on others due to vision, mental health symptoms due to vision, driving difficulties, limitations with peripheral and colour vision, and ocular pain. To overcome the language barrier, the questionnaire was translated into the national language of each respective country, including a Malay version for the Malaysian population.

The NEI-VFQ-25 scoring process, with or without optional items, involves two steps: Step 1 involves re-coding of the answer to a new value according to the Table I. All items are scored so that a higher score represents better functioning. Each item is then converted to a 0 to 100 scale, where the lowest score is 0, and the highest possible score is 100 points. Step 2 involves calculating scale scores. Items within each scale are averaged together to create the 12 scale scores. Table II indicates which items contribute to each specific scale. Items left blank (missing data) are not taken into account when calculating the scale scores. Each subscale item was given 5- and 6- points on the Likert scale, and the higher

score for each subscale represents better functioning. This two-step process ensures a standardised and consistent approach to scoring the NEI-VFQ-25, allowing for accurate interpretation and comparison of results.

In this study, the principal investigator administered the previously Malay translated and validated questionnaires face to face, on one-to-one approach in the consultation room of the ophthalmology clinic. To ensure a comfortable and patient-friendly environment, all interviews were conducted in a quiet room, free from interruptions. Each question was explained to the patient and after proper understanding of the question; the patient's answers were recorded. If difficulty comprehending the question aroused, a relative or caregiver present helped to explain the question to the patient. The NEI-VFQ-25 questionnaire took approximately 20 minutes. Pre-operatively, the NEI-VFQ-25 questionnaire was done within 1 week before operation, whereas 3-months post TPPV, the NEI-VFQ-25 questionnaire was done within 2 weeks. To minimise errors while conducting the study, the same questionnaire was used for the purpose of all measurements in the study, a single interviewer performed the task of asking the questions to minimise variation, and the questionnaire was conducted face to face, one on one approach.

**Statistical Analysis**

All relevant data such as age, race, gender, marital status, history of systemic diseases, and ocular profile from the case report form as well as NEI-VFQ-25 questionnaires were analysed using Statistical Package for Social Sciences (SPSS) version 26. All data were rechecked to avoid wrong data entry and missing data.

Descriptive statistics were used to analyse the demographic data, clinical profiles and distribution of the VRQoL scores pre- and post-TPPV, and of each scale of NEI-VFQ-25. Paired t-test was used to compare the VRQoL score between pre-operative and at 3-months post TPPV.

Simple and multiple linear regression analysis was conducted to determine the factors associated with NEI-VFQ-25 composite score including all the demographic factors, systemic comorbidities, and ocular profile. A p-value less than 0.05 was considered statistically significant.

## RESULTS

A total of 85 patients with diabetic vitreoretinal disease planned for TPPV were enrolled in this study. The mean age of the patients is 60.73±9.79 years old. There was a male preponderance of slightly more than half (51.8%) among the patients. Among the subjects, 41 patients (48.2%) had tertiary education, and 43 patients (50.6%) were employed. Out of the total, 59 patients (69.4%) have other systemic comorbidities, which included stroke (7 patients, 8.24%), chronic obstructive pulmonary disease (10 patients, 11.76%), ischaemic heart disease (7 patients, 8.24%), cancer (5 patients, 5.88%), bronchial asthma (12 patients, 14.12%), and allergic rhinitis (18 patients, 21.18%). There was a slightly higher number of patients with bilateral diabetic vitreoretinal disease (56.5%). Most of the subjects were not blind (91.8%). Out of the total, 47 patients (55.3%) have TRD only, with those having vitreous haemorrhage consists of 8 patients (9.41%), 38 patients (44.7%) have both TRD and RRD, with those having vitreous haemorrhage consists of 5 patients (5.88%). Out of the overall patients, only 1 (1.2%) had post TPPV complication, which was secondary high intraocular pressure which resolved after 1 month. The socio-economic data and clinical profiles of patients with diabetic vitreoretinal disease is shown in Table III.

All 85 patients completed the interview for VRQoL using NEI-VFQ-25 pre-operatively and at 3-months post TPPV. General vision scale demonstrated increasing number of patients for good subscale from 10 (11.8%%) patients pre-operative to 31 (36.5%) patients at 3-months post TPPV. As for distance and near activities scales, there were reduction in number of patients for subscale extreme difficulty from 27 (31.8%) patients pre-operative to 8 (9.4%) patients at 3-months post TPPV and from 17 (20.0%) patients pre-operative to 7 (8.2%) patients at 3-months post TPPV, respectively. Both colour vision and peripheral vision scales showed increasing number of patients for subscale little difficulty from 31 (36.5%) patients pre-operative to 50 (58.8%) patients at 3-months post TPPV, and from 10 (11.8%) patients pre-operative to 50 (58.8%) patients at 3-months post TPPV, respectively.

VRQoL improved markedly at 3-months post TPPV (Table IV). The mean composite NEI-VFQ-25 score rose from 49.28±13.98 pre-operatively to 57.45±12.30 at 3-months post TPPV. Nearly all vision-targeted scales showed significant gains-most notably general vision, peripheral vision, and mental health, each $p<0.001$, while general health remained unchanged and ocular pain improved only slightly.

As peripheral vision and social functioning scales violated normality, Wilcoxon signed-rank tests were applied. Both scales shifted upward: median peripheral vision improved significantly from 50.00 to 75.00 ($Z = -7.27$; $p<0.001$), and social functioning increased from a median of 50.00 to 66.67 ($Z = -5.89$; $p<0.001$). These nonparametric confirmations reinforce that TPPV produces consistent patient-perceived benefits across even skewed QoL measures.

The associated factors affecting the NEI-VFQ-25 score at 3-months post TPPV were analysed using linear regression analysis. In a simple linear regression model, tertiary education level, employment, hyperlipidaemia, diabetic nephropathy, pre-operative blindness status, pre-operative NEI-VFQ- 25 score were significant factors associated with 3-months post TPPV NEI-VFQ-25 score. For the factors with p-value <0.25 during simple linear regression model and factors clinically meaningful were included in the multiple linear regression analysis: age, education level, occupation, hypertension, hyperlipidaemia, diabetic nephropathy, presence of other comorbid, laterality, pre-operative blindness status, type of vitreo-retinal disease and pre-operative NEI-VFQ-25 score. However, only secondary education level, tertiary education level, presence of other comorbid and pre-operative NEI-VFQ-25 score were the significant associated factors affecting 3-months post TPPV NEI-VFQ-25 score during multiple linear regression model.

**Table I: Step 1: Scoring key of NEI-VFQ-25**

| Item Numbers | Original Response Category(a) | Recorded Value: |
|---|---|---|
| 1,3,5,15c(b) | 1 | 100 |
| | 2 | 75 |
| | 3 | 50 |
| | 4 | 25 |
| | 5 | 0 |
| | 1 | 100 |
| | 2 | 80 |
| | 3 | 60 |
| | 4 | 60 |
| | 5 | 60 |
| | 6 | 0 |
| 17,18,19,20,21,22,23,24, | 1 | 0 |
| 25,A11a,A11b,A12,A13 | 2 | 25 |
| | 3 | 50 |
| | 4 | 75 |
| | 5 | 100 |
| A1, A2 | 0 to 10 | 0 to 100 |

**Footnotes:**
(a) Precoded response choices as printed in the questionnaire.
(b) Item 15c has four-response levels, but is expanded to five-levels using item 15b.
Note: If 15b=1, then 15c should be recoded to "0". If 15b=2 or 3, then 15c should be recoded to missing.
(c) "A" before the item number indicates an optional item from the Appendix. If optional items are used, the NEI-VFQ developers encourage users to use all items for a given sub-scale.
This enhances the comparability of sub-scale scores across studies.
(d) Response choice "6" indicates the person does not perform the activity because of non-vision related problems. If selected, the item is coded as "missing."

**Table II: Step 2: Averaging of items to generate NEI-VFQ-25 scales**

| Scale | Number of items | Items to be averaged (after recoding per Table II) |
|---|---|---|
| General Health | 1 | 1 |
| General Vision | 1 | 2 |
| Ocular Pain | 2 | 4, 19 |
| Near Activities | 3 | 5, 6, 7 |
| Distance Activities | 3 | 8, 9, 14 |
| Vision Specific: | | |
| Social Functioning | 2 | 11, 13 |
| Mental Health | 4 | 3, 21, 22, 25 |
| Role Difficulties | 2 | 17, 18 |
| Dependency | 3 | 20, 23, 24 |
| Driving | 3 | 15c, 16, 16a |
| Colour Vision | 1 | 12 |
| Peripheral Vision | 1 | 10 |

Education level was a strong positive determinant of VRQoL. Compared with primary education, tertiary education had a 5.43 higher score of post TPPV NEI-VFQ-25 score, while secondary schooling had a 4.32 higher score of post TPPV NEI-VFQ-25 score, after controlling for presence of other comorbid and pre-operative NEI-VFQ-25 score. Those with presence of other comorbid had 3.69 points higher score post TPPV NEI-VFQ-25 score compared to those without, after controlling for education level and pre-operative NEI-VFQ-25 score. Whereas for pre-operative NEI-VFQ-25 score, 1 unit increase of score would increase 0.77 score in post TPPV NEI-VFQ-25 score, after controlling education level and presence of other comorbid (Table V).

The model met the assumptions of Multiple Regression analysis and accounted for 91.3% of the variability in the 3-months post TPPV NEI-VFQ-25 score. There is no multicollinearity problem. There is a significant interaction between other comorbid with pre- op VFQ- 25 score. p-value <0.05 is statistically significant

These results show that higher education, with presence of other systemic illness and level of pre-operative NEI-VFQ-25 score, predict a better post TPPV NEI-VFQ-25 score. Targeting these modifiable factors- through patient education, metabolic optimization, and early surgical referral- may maximize VRQoL gains after TPPV.

## DISCUSSION

Patients with diabetic vitreoretinal disease frequently endure severe visual impairment, which profoundly compromises daily activities, social engagement, emotional health, and overall quality of life.[19] TPPV is a well- established surgical intervention to address advanced complications such as TRD and non- clearing vitreous haemorrhage, preserving or restoring functional vision.[10] However, patient-reported outcomes, particularly VRQoL measured by the NEI-VFQ-25, have received comparatively less attention in Malaysian populations. This study demonstrates that TPPV yields significant and clinically meaningful improvements in

**Table III: Socio-Demographic Data and Clinical Profiles of Patient with Diabetic Vitreoretinal Disease, (n=85)**

| Variables | n (%) |
|---|---|
| Age (years) [mean (SD)] | 60.73 (9.79) |
| Gender | |
| Male | 44 (51.8) |
| Female | 41 (48.2) |
| Race | |
| Malay | 75 (88.2) |
| Non- Malay | 10 (11.8) |
| Education Level | |
| Primary | 14 (16.5) |
| Secondary | 30 (35.3) |
| Tertiary | 41 (48.2) |
| Occupation | |
| Unemployed | 42 (49.4) |
| Employed | 43 (50.6) |
| Hypertension | |
| Present | 50 (58.8) |
| Absent | 35 (41.2) |
| Hyperlipidaemia | |
| Present | 22 (25.9) |
| Absent | 63 (74.1) |
| Diabetic nephropathy | |
| Present | 12 (14.1) |
| Absent | 73 (85.9) |
| Other co- morbid(s) | |
| Present | 59 (69.4) |
| Absent | 26 (30.6) |
| Laterality | |
| Unilateral | 37 (43.5) |
| Bilateral | 48 (56.5) |
| Pre-operative blindness status | |
| unilateral blindness | 0 (0.0) |
| bilateral blindness | 7 (8.2) |
| not blind | 78 (91.8) |
| Post-TPPV blindness status | |
| unilateral blindness | 0 (0.0) |
| bilateral blindness | 7 (8.2) |
| not blind | 78 (91.8) |
| Types of Vitreoretinal Disease | |
| TRD only | 47 (55.3) |
| TRD and RRD | 38 (44.7) |

TRD: tractional retinal detachment, RRD: rhegmatogenous retinal detachment,
TPPV: trans pars plana vitrectomy

**Table IV: Mean Vision Related Quality of Life based on NEI-VFQ-25 Score in Patients with Diabetic Vitreoretinal Disease**

| NEI-VFQ-25 Scale | NEI-VFQ-25 Score | | Mean difference (95% CI) | t-statistic (df) | p-value |
|---|---|---|---|---|---|
| | Pre-operative Mean (SD) | At 3-months post TPPV Mean (SD) | | | |
| Composite Score | 49.28 (13.98) | 57.45 (12.30) | 8.17 (7.13, 9.20) | 15.68 (84) | <0.001 |
| Scale score | | | | | |
| General health | 46.18 (13.98) | 47.12 (14.76) | 0.94 (-0.35, 2.23) | 1.45 (84) | 0.152 |
| General vision | 44.53 (17.97) | 59.64 (18.12) | 15.12 (12.61, 17.62) | 12.02 (84) | <0.001 |
| Ocular pain | 66.91 (16.22) | 68.38 (15.74) | 1.47 (0.19, 2.75) | 2.29 (84) | 0.024 |
| Distance activity | 46.27 (17.03) | 53.82 (15.84) | 7.55 (5.85, 9.24) | 8.85 (84) | <0.001 |
| Near activity | 46.13 (15.49) | 57.55 (11.81) | 11.42 (9.88, 12.97) | 14.70 (84) | <0.001 |
| Driving | 25.88 (22.59) | 30.49 (22.59) | 4.61 (2.49, 6.73) | 4.32 (84) | <0.001 |
| Colour vision | 59.71 (24.12) | 66.76 (20.91) | 7.06 (4.22, 9.89) | 4.95 (84) | <0.001 |
| Peripheral vision | 44.12 (16.21) | 64.71 (15.57) | 20.59 (17.24, 23.93) | 12.23 (84) | <0.001 |
| Mental health | 49.76 (16.78) | 60.76 (14.59) | 11.00 (9.69, 12.31) | 16.72 (84) | <0.001 |
| Social Functioning | 53.82 (22.11) | 61.06 (20.23) | 7.23 (5.37, 9.10) | 7.70 (84) | <0.001 |
| Role difficulties | 50.67 (18.07) | 60.22 (12.72) | 9.55 (7.73, 11.37) | 10.43 (84) | <0.001 |
| Dependency | 57.43 (18.76) | 64.11 (14.69) | 6.69 (4.82, 8.56) | 7.12 (84) | <0.001 |

SD: standard deviation
NEI- VFQ- 25: National Eye Institute- Visual Function Questionnaire- 25
TPPV: trans pars plana vitrectomy
Paired t-test, p- value <0.05 is statistically significant

**Table V: Factors Associated with Vision Related Quality of Life based on NEI-VFQ-25 among Patients with Diabetic Vitreoretinal Disease**

| Factors | Simple Linear Regression | | Multiple Linear Regression | |
|---|---|---|---|---|
| | Bb (95% CI) | p-value | Adj. Bc (95% CI) | p-value |
| Age (year) | -0.19 (-0.46, 0.08) | 0.160 | | |
| Gender | | | | |
| Male | 2.59 (-2.73, 7.90) | 0.340 | | |
| Female | | | | |
| Race | | | | |
| Malay | 1.75 (-4.20, 7.71) | | | |
| Non- Malay | 0.560 | | | |
| Education level | | | | |
| Primary | | | | |
| Secondary | -0.52 (-6.11, 5.06) | 0.853 | 4.32 (1.69, 6.95) | 0.020 |
| Tertiary | 9.14 (4.19, 14.10) | <0.001 | 5.43 (2.76, 8.10) | <0.001 |
| Occupation | | | | |
| Unemployed | | | | |
| Employed | 6.00 (0.82, 11.12) | 0.024 | | |
| Hypertension | | | | |
| Yes | | | | |
| No | 1.28 (-4.14, 6.70) | 0.640 | | |
| Hyperlipidaemia | | | | |
| Yes | | | | |
| No | 8.30 (2.48, 14.12) | 0.006 | | |
| Diabetic nephropathy | | | | |
| Yes | | | | |
| No | 17.19 (10.50, 23.87) | <0.001 | | |
| Presence of other comorbid | | | | |
| No | | | | |
| Yes | 1.34 (-4.45, 7.13) | 0.650 | 3.69 (1.86, 5.52) | <0.001 |
| Laterality | | | | |
| Bilateral | | | | |
| Unilateral | 4.82 (-0.46, 10.10) | 0.073 | | |
| Pre-operative blindness status | | | | |
| Unilateral blindness | | | | |
| Bilateral blindness | | | | |
| Not blind | 20.47 (11.85, 29.09) | <0.001 | | |
| Type of vitreoretinal disease | | | | |
| TRD and RRD | | | | |
| TRD only | -2.84 (-8.17, 2.49) | 0.293 | | |
| Pre-operative NEI-VFQ-25 score | 0.83 (0.76, 0.89) | <0.001 | 0.77 (0.71, 0.84) | <0.001 |

[b]Crude regression coefficients
[c]Adjusted regression coefficient
CI: Confidence Interval
TRD: tractional retinal detachment, RRD: rhegmatogenous retinal detachment
NEI-VFQ-25: National Eye Institute- Visual Function Questionnaire- 25

VRQoL at 3-months post TPPV, and identifies key demographic, ocular, and systemic factors that independently shape postoperative VRQoL.

We observed that the mean composite NEI-VFQ-25 increase of 8.17 points (95% CI, 7.13-9.20; p<0.001), exceeding the minimal clinically important difference of 4-6 points for this instrument.[12,13] The largest gains occurred in the General Vision (Δ15.12; p<0.001), Peripheral Vision (Δ20.59; p<0.001), and Mental Health (Δ11.00; p<0.001) scales, underscoring that TPPV not only enhances central acuity but also restores broader aspects of visual function and emotional well-being.[20] Comparable magnitude improvements have been reported by Abu-Ameerh et al. in a Jordanian cohort.[12] The improvement also reported by Okamoto et al. following vitrectomy for PDR.[20] Smaller gains in Ocular Pain scale and non-significant changes in General Health scale are expected, as diabetic retinal disease is typically painless and systemic health perceptions evolve more slowly than vision-specific domains.[20]

In the univariate model, pre-operative blindness status found to be one of the strong predictors of post TPPV VRQoL. Okamoto et al. demonstrated that in PDR patients undergoing vitrectomy, better pre-operative BCVA was associated with larger gains in both composite and scale NEI-VFQ-25 scores at follow-up, underscoring that residual vision confers greater perceived benefit.[20] Cusick et al. similarly found strong correlations between central visual function measures (including BCVA) and the near- and distance-activities scales of the NEI-VFQ-25 in diabetic cohorts, indicating that even modest preserved vision translates into meaningful functional improvements.[21] In a cross-sectional study from Jordan, Abu-Ameerh et al. reported that patients with less severe baseline visual impairment experienced more pronounced VRQoL enhancement after vitrectomy than

those starting with profound vision loss.[12] In the simple regression, pre-operative blindness was significantly associated with post TPPV NEI-VFQ-25 scores, but this effect vanished in the multiple regression once key factors (notably the pre-operative NEI-VFQ-25 score) were included. This pattern indicates confounding- the univariate relationship between blindness and outcome was not independent, but rather driven by baseline visual function. Patients who were blind pre-operatively had very low baseline NEI-VFQ-25 scores, and that pre-operative NEI-VFQ-25 proved to be a stronger predictor of post TPPV VRQoL. Thus, when pre-operative NEI-VFQ-25 score was added to the model, it attenuated the apparent effect of the pre-operative blindness status. This phenomenon is well-recognized: a factor can seem significant in isolation but lose significance when a correlated, more explanatory variable is included. A study shows intensive diabetes mellitus control delays the onset and slows the progression of DR, nephropathy and neuropathy.[22] Besides, optimal systemic control is integral to DR management. In our univariate model, absence of hyperlipidaemia (B=+8.30; p=0.006) was associated with better post TPPV VRQoL. This effect likely reflects the protective impact of systemic cardiovascular risk factor control on retinal perfusion and surgical prognosis.[23]

Whereas in the multivariate model, pre-operative NEI-VFQ-25 score emerged as one of the strongest independent predictors of post TPPV VRQoL in our cohort: patients with higher NEI-VFQ-25 scores before surgery tended to have higher NEI-VFQ-25 scores after surgery, even after adjusting for the other factors. In other words, those who perceived better visual functioning and QoL at baseline also reported better QoL outcomes at 3-months post TPPV. This makes intuitive sense- baseline NEI-VFQ-25 reflects the degree of visual disability prior to surgery, which inherently limits the maximum achievable postoperative score. A patient starting from a very low NEI-VFQ-25 (severely impaired QoL pre-operative) can certainly improve substantially, but may still not reach the same absolute post TPPV NEI-VFQ-25 score as someone who began with a moderately higher baseline. Our finding aligns with prior observations in the literature. This finding is consistent with multiple studies highlighting the critical role of baseline visual function in shaping patient-reported outcomes after vitreoretinal surgery.[12,21] Its significance in the model highlights the prognostic value of baseline VRQoL- patients who start off with less visual disability tend to end up with better QoL scores after intervention.

Several mechanisms likely underlie this phenomenon. First, ceiling and floor effects of the NEI-VFQ-25 mean that individuals with extreme baseline deficits have limited scope for measurable improvement, whereas those with some remaining sight can register larger relative gains.[15] Second, preserved preoperative vision enables better engagement in daily activities- reading, mobility, and social interaction- which are directly captured by NEI-VFQ-25 scales, thus amplifying perceived QoL.[20,21] Third, early surgical intervention before the onset of blindness may prevent irreversible retinal damage, allowing patients to recover functional vision that supports independence and psychosocial well-being. These insights emphasize the importance of timely referral for TPPV in diabetic vitreoretinal disease, ideally before patients reach the threshold of legal blindness. Clinicians should counsel patients about the prognostic significance of their current visual status: maintaining residual vision not only preserves functional capacity but also maximizes postoperative QoL outcomes. Education influenced VRQoL outcomes substantially: compared with primary- educated patients, those with secondary schooling scored 4.32 points higher and those with tertiary education 5.43 points higher at 3-months post TPPV. This parallels broader health literature linking higher education to better health-related QoL, likely reflecting superior health literacy, treatment adherence, and self- management skills.[24] In DR, patients with greater educational attainment may better understand the rationale for pre- and post-operative care, leading to enhanced visual rehabilitation and adaptive coping strategies.

Interestingly, the presence of other comorbid (e.g., stroke, chronic obstructive pulmonary disease, heart disease) was associated with a +3.69 points higher NEI-VFQ-25 score ($p<0.001$)- a seemingly paradoxical result, since additional illnesses typically degrade QoL. We postulate that several mechanisms may explain this "reverse comorbidity effect." First, patients with multiple comorbidities often have more frequent healthcare contacts, leading to enhanced patient education, closer monitoring, and timelier interventions ("intensity of care" hypothesis).[25] Second, a response- shift phenomenon may occur: chronically ill patients recalibrate their internal standards and values, perceiving vision improvements more positively despite overall health challenges.[26] Third, selection bias is possible: those who survive and qualify for surgery despite multiple comorbidities may inherently possess greater resilience or functional reserve, thus achieving better subjective outcomes than healthier counterparts ("survivor bias" effect).[27] Future prospective work is needed to disentangle these complex interactions. There is a significant interaction between other comorbid and pre-operative NEI-VFQ-25 score, whereby presence of other comorbid might affect the pre-operative NEI-VFQ-25 score.

Our data reinforce that TPPV confers pronounced VRQoL benefits, particularly when performed before profound impairment of VRQoL. Baseline VRQoL assessment via NEI-VFQ-25 should be incorporated into surgical planning to inform expectations and personalize follow-up care. Educational interventions tailored to lower-literacy patients may help bridge outcome gaps. Besides, attention to the unique needs of multimorbid patients can exploit response shifts and healthcare engagement to maximize patient satisfaction and function.

Our limitations comprise the single-region tertiary hospital setting, which may limit generalizability, and the snapshot review of the VRQoL rather than capturing changes over time. Longer-term data are needed to evaluate VRQoL trajectories and the durability of gains. Qualitative studies could probe the nuanced experiences of patients with multiple comorbidities to validate the response-shift and care-intensity hypotheses.

## CONCLUSION

TPPV leads to substantial and clinically meaningful improvements in VRQoL among Malaysian patients with diabetic vitreoretinal disease. Patients' pre-operative NEI-VFQ-25 score, higher educational attainment, and optimal systemic health independently predict better postoperative outcomes. A holistic care model- combining early surgical referral, targeted education, rigorous systemic risk factor management, and attention to the psychosocial context- is essential to optimize patient- reported outcomes in this population.

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## CONFLICT OF INTEREST

The authors confirm that this article's content has no conflict of interest.

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