Original Article

Impact of vision correction on the visual impairment status and quality of life score in patients with type II diabetes mellitus

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ABSTRACT

Background: Visual impairment (VI) in patients with diabetes mellitus (DM) worsens as the disease progresses. Therefore, quality of life (QOL) may also be affected. Furthermore, in the absence of macular involvement, some patients may benefit from visual intervention. However, not many Malaysians with known DM had their eyes screened or used correctable spectacles. Consequently, the QOL and VI status of patients with DM in Malaysia remain unclear. This study was aimed at determining the impact of optometric intervention on the QOL and VI status of adults with type II DM.

Methods: This was a quasi-self-controlled, experimental study involving adults with known type II DM. We conducted face-to-face interviews using the low vision quality-of-life questionnaire (LVQOL). The habitual visual acuity (VA) of all participants was recorded. All participants underwent fundus photography to grade diabetic retinopathy (DR) in both eyes. Correctable VA was determined following subjective refraction when the best-corrected distance visual acuity (BCDVA) was 6 /9 and better. After a 3-week adaptation to the prescribed refractive error correction, LVQOL was repeated via a phone interview.

Results: A total of 47 participants with type II DM, including 16 (34%) men and 31 (66%) women, with a mean (standard deviation [SD]) age of 49.0 (7.9) years were recruited. The age range was 32 – 59 years, and the baseline mean (SD) habitual binocular VA was 0.52 (0.31) decimal. Only 15% (n = 7 patients) of the participants had their vision tested and wore glasses; however, some were uncomfortable with the current corrections. All patients had undercorrected or uncorrected refractive errors, namely, hyperopic astigmatism (47%), myopic astigmatism (38%), hyperopia (6%), myopia (4%), and antimetropia (4%). Among the 47 participants, 89% (n = 42) had uncorrected presbyopia. The mean (SD) LVQOL score at baseline was 91.9 (17.3), which improved significantly with visual intervention to 122.8 (3.2) ($P < 0.05$). Refractive error corrections significantly improved the VI status ($P < 0.05$), as all participants achieved a BCDVA of 6 / 9 and better.

Conclusions: Our findings indicate that optometric intervention is effective in improving the LVQOL and VI status of adults with type II DM. Further clinical optometric studies on type II DM with DR with a longer follow-up should be carried out to understand the clinical characteristics of this cohort and the impact of meticulous refractions on QOL in providing better services in the future.

KEYWORDS

type 2 diabetes mellitus, health-related quality of life, low vision, habilitation, visual impairment, spectacles, myopias, myopic astigmatism, hypermetropia

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How to cite this article: Mohamad NS, Majumder C, Omar R. Impact of vision correction on the visual impairment status and quality of life score in patients with type II diabetes mellitus. Med Hypothesis Discov Innov Optom. 2022 Winter; 3(4): 142-151. https://doi.org/10.51329/mehdioptometry163

Received: 23 November 2022; Accepted: 09 January 2023

INTRODUCTION

Diabetes mellitus (DM) is becoming a major public health concern and is the most common cause of blindness in the middle-aged and elderly populations [1]. In Malaysia, the prevalence of DM increased from 11.2% in 2011 to 18.3% in 2019 [2]. Diabetes is expected to affect 7 million Malaysians aged ≥ 18 years by 2025, with a prevalence of diabetes of 31.3% [2]. Uncontrolled DM can lead to diabetic retinopathy (DR), and in Malaysia, the prevalence of any form of DR and proliferative DR (PDR) is 36.8% and 7.1%, respectively [3]. However, a study from Borneo Island at a primary eye care setting in 2011 reported a prevalence of PDR of 3.2% [4].

Many patients with DM are becoming visually impaired as a complication of DR and other diabetes-associated ocular diseases. This may jeopardize their ability to secure or maintain employment, productivity, and independence [5, 6]. Therefore, visual rehabilitation is part of the treatment that can be adopted to optimize the quality of life (QOL) [7].

DR may lead to significant visual impairment (VI) after prolonged type II DM. Therefore, we should understand how affected people face tremendous challenges in leading their lives normally [8]. In Malaysia, only 45% of patients with DM have their eyes screened, although routine yearly eye examinations are recommended by the Ministry of Health, Malaysia [9]. Therefore, the status of correctable VI in most patients with known DM in Malaysia remains unclear. A previous study on correctable VI among patients with DM in Hong Kong found that nearly 70% of the 221 screened patients with VI benefited from spectacle correction [10]. However, the QOL has not been documented or qualitatively measured.

To assess the success of a visual rehabilitation program, a qualitative measure of the treatment outcome, such as its effect on QOL, is essential. Greater VI, worse DR status, and macular edema have been associated with a greater negative impact on QOL scores [11]. A low vision-related quality of life (LVQOL) questionnaire was used to evaluate the effects of low vision intervention and visual rehabilitation [12]. It is an effective tool for measuring the outcome of a visual rehabilitation program in patients with low vision and the elderly [13, 14].

Visual rehabilitation can increase independence and improve QOL of people with DM, while simultaneously promoting cost-effectiveness for the government [15-17]. Malaysian patients with DM and VI had a poorer QOL [18]. To the best of our knowledge, no information is available regarding the effect of correctable vision on QOL using the LVQOL questionnaire or the status of VI among patients with type II DM in Malaysia. Thus, the aim of the present study was to determine the effect of correctable vision on QOL using the LVQOL questionnaire and the status of VI in patients with type II DM.

METHODS

This prospective, quasi-self-controlled experimental study was conducted at the Ophthalmology Clinic, Hospital Sultanah Bahiya, Alor Setar, Malaysia, over a period of 4 months. The study protocol was approved by the Research and Ethics Committee of the National University of Malaysia (code UKM 1.5.3.5/244/NN-086-201) and The National Medical Research Register (approval number: NMRR-11-482-9075). All study procedures were performed in compliance with the conditions set by the Declaration of Helsinki. Informed consent was obtained from all participants.

We included patients diagnosed with type II DM, aged between 30 and 59 years, with a habitual visual acuity (VA) between 6 / 5 and 2 / 60. We excluded patients with PDR, presence of any maculopathies or ocular pathologies, history of concurrent ocular intervention (surgical or laser treatment), and pregnant or lactating women.

We conducted face-to-face interviews using the LVQOL questionnaire during the case history. It comprises 25 items related to distance vision, mobility, lighting, reading, and fine work [13]. Activities of daily living scores ranged from 0 to 125 points. Participants were required to rate each item on a scale of 1 to 5. A score of 1 indicated poor QOL and that of 5 indicated very good QOL, resulting in a total score of 125 points. However, if any patient chose not to respond, the total score was < 125. LVQOL scores were classified into four categories: very low (0 – 32), low (33 – 64), moderate (65 – 96), and high (97 – 125). Thus, a higher total LVQOL questionnaire score indicates better QOL and vice versa. This questionnaire has excellent internal consistency, with a Cronbach's alpha of 0.88 and good reliability. This is a rapid method for quantifying vision-specific QOL in clinical settings [19]. Furthermore, its availability in the Malay language assists in minimizing miscommunication between the interviewer and patients [14]. At baseline, LVQOL responses were obtained via face-to-face interviews. Participants were provided the opportunity to ask questions to resolve any misunderstanding or requirement of examples for any item.

Demographic data, such as the education level [20], employment status, duration of DM, latest blood glucose level, and last eye examination results, were also obtained during the face-to-face interview.

Next, the distance VA was measured and recorded in decimals before and after the optometric intervention. VA was classified into categories of visual impairment. The World Health Organization International Statistical Classification of Diseases and Related Health Problems or ICD-10 [21] was used to classify VI. VI was defined as VA worse than 6/18 (logarithm of the minimum angle of resolution [logMAR] ≥ 0.48) in the better eye with full correction. We classified VI into three categories: no VI (VA in the better eye ≥ 6/18; logMAR < 0.48), mild VI (VA in the better eye of 6/18 – 6/60; logMAR ≥ 0.48 but < 1.0) and severe VI (VA in the better eye ≤ 6/60; logMAR ≥ 1.0). Patients were divided into two groups based on baseline habitual VA: group 1, including patients with type II DM and habitual VA of 6/18 or worse (≤ 6/18); and group 2, including patients with type II DM and habitual VA better than 6/18 (> 6/18). Subjective refraction was then performed to obtain the best-corrected distance visual acuity (BCDVA) using the Snellen chart (a series of the BS 4274-1:2003 type) [22, 23] and recorded in decimals following prescription of the final proper glasses.

Fundus photographs of each patient were captured using a Canon Non-mydriatic Fundus Camera (Canon CR-DGI Non-Mydriatic Retinal Camera; Canon, Tokyo, Japan). This non-mydriatic fundus camera has high sensitivity and specificity [24]. This instrument eliminates the requirement of dilation, thereby promoting compliance, efficiency, and safety. An ophthalmologist graded all fundus photographs into four categories using the Early Treatment DR Study severity scale: no DR changes, mild non-proliferative DR (NPDR), moderate NPDR, and severe NPDR [25]. After 4 weeks of receiving prescription glasses, phone interviews were conducted using LVQOL and recorded.

Statistical analyses were performed using the SPSS Statistics for Windows (version 21.0; IBM Corp., Armonk, NY, USA). Shapiro – Wilk statistics were used to test the normality of data distribution. Data were not normally distributed; therefore, non-parametric tests were employed throughout the analysis. Descriptive analyses were used to obtain the mean (standard deviation [SD]) and median (range). The Mann – Whitney U and chi-square tests were performed to compare demographic and clinical characteristics between the groups. Spearman's rank correlation was used to investigate the correlation between VA and LVQOL. The non-parametric Wilcoxon signed-rank test was used to compare the median QOL score and VI status before and after achieving correctable vision. Finally, a stepwise forward multivariate linear regression analysis was used to test the strength of the relationship between the LVQOL score and the VI status before and after correctable vision was achieved. For non-parametric tests, the alpha level used as reference was 0.05. All tests were two-tailed, with a significance level of 5%.

RESULTS

We enrolled a total of 47 patients with type II DM, including 16 (34%) men and 31 (66%) women, with a mean (SD) age of 49.0 (7.9) years, ranging from 32 to 59 years. Most participants had a secondary level of education; almost 50% of participants were employed, while the rest were housewives or pensioners. Table 1 demonstrates the demographic and clinical characteristics of the study participants. Both groups showed comparable demographic and clinical characteristics (all $P > 0.05$; Table 1).

Participants were asked to wear existing spectacles if they used one. Only seven (15%) patients wore their own glasses during testing for habitual VA at baseline; however, some were uncomfortable with the current corrections. Most (85%) participants reported no history of vision testing. The mean (SD) and median (range) baseline habitual binocular VA for all participants were 0.52 (0.31) and 0.3 (0.16 – 1.00), respectively, 0.24 (0.02) and 0.25 (0.16 – 0.25) in group 1, respectively, and 0.79 (0.20) and 0.8 (0.3 – 1.00) in group 2, respectively. The baseline habitual binocular VA in group 1 was significantly poorer ($P < 0.001$; Table 2).

BCDVA was obtained after refraction, with patients wearing the best binocular refractive error correction, and VA was documented. The mean (SD) VA increased for all participants and in each group. The mean (SD) and median (range) BCDVA for all participants was 0.92 (0.12) and 1 (0.3 – 1.00), respectively, showing a significant improvement ($P < 0.001$). The mean (SD) and median (range) BCDVA were 0.87 (0.15) and 1 (0.63 –1.00) in group 1, respectively, and 0.97 (0.06) and 1 (0.8 – 1.00) in group 2, respectively, showing a significant improvement in both groups after correction (both $P < 0.05$) and a greater improvement in group 2 ($P < 0.05$; Table 2). The mean difference in cumulative BCDVA was 0.40 (0.28). Thus, vision intervention with proper spectacle correction improved the VI status of participants, with all showing a BCDVA of 6 / 9. The median difference between the VAs pre- and post-intervention was significant ($P < 0.01$).

Overall, all participants had undercorrected or uncorrected refractive errors, namely hyperopic astigmatism (47%), myopic astigmatism (38%), hyperopia (6%), myopia (4%), and antimetropia (4%), while 89% (n = 42)

Table 1. Baseline demographics and clinical characteristics of study groups

Variables	Group 1 (n = 23)	Group 2 (n = 24)	*P*-value
Sex (Men / Women), n (%)	8 (35) / 15 (65)	8 (33) / 16 (67)	0.910
Age (y), Mean ± SD	49.3 ± 7.9	48.7 ± 8.1	0.800
Educational level, n (%)			0.900
Primary	6 (26)	5 (21)	
Secondary	12 (52)	13 (54)	
Tertiary	5 (22)	6 (25)	
Occupation, n (%)			0.880
Employed	11 (48)	12 (50)	
Unemployed	12 (52)	12 (50)	
Duration of DM (y), Mean ± SD	7.4 ± 5.0	9.0 ± 4.4	0.140
Latest blood sugar level (mmol/L), Mean ± SD	8.5 ± 2.8	8.8 ± 3.4	0.890
DR, n (%)			0.950
No DR	9 (39)	8 (33)	
Mild NPDR	6 (26)	6 (25)	
Moderate NPDR	6 (26)	8 (33)	
Severe NPDR	2 (9)	2 (8)	

Abbreviations: n, number of participants; %, percentage; y, years; SD, standard deviation; DM, type II diabetes mellitus; mmol/L, millimoles per liter; DR, diabetic retinopathy; NPDR, nonproliferative diabetic retinopathy. Note: Group 1, including patients with type II DM and habitual VA of 6 / 18 or worse; Group 2, including patients with type II DM and habitual VA better than 6 / 18.

Table 2. Binocular visual acuity and low vision-related quality of life score at baseline and post-intervention for all participants and study groups

Variable	All participants (n = 47)	Group 1 (n = 23)	Group 2 (n = 24)	P_1-value
	Mean ± SD	Mean ± SD	Mean ± SD	
Baseline binocular habitual visual acuity (decimal)	0.52 ± 0.31	0.24 ± 0.02	0.79 ± 0.20	**< 0.001**
Best-corrected distance binocular visual acuity (decimal)	0.92 ± 0.12	0.87 ± 0.15	0.97 ± 0.06	**0.004**
P_2-value	**< 0.001**	**< 0.001**	**< 0.001**	
Baseline LVQOL (score)	91.9 ± 17.3	83.6 ± 15.1	99.9 ± 15.6	**< 0.001**
Post-intervention LVQOL (score)	122.8 ± 3.2	122.0 ± 3.6	123.5 ± 2.6	**0.104**
P_2-value	**< 0.001**	**< 0.001**	**< 0.001**	

Abbreviations: n, number of participants; SD, standard deviation; LVQOL, low vision quality-of-life questionnaire. Note: P_1-value, comparison between study groups; P_2-value: comparison between baseline and post-intervention values of all participants or study groups; Group 1, including patients with type II DM and habitual VA of 6 / 18 or worse; Group 2, including patients with type II DM and habitual VA better than 6 / 18; LVQOL scores were classified into four categories: very low (0 – 32), low (33 – 64), moderate (65 – 96), and high (97 – 125).

of participants had uncorrected presbyopia. Regarding laterality in refractive error, hyperopic astigmatism and myopic astigmatism accounted for 42.6% and 40.4% of the right eyes, respectively, and 40.4% and 36.2% of the left eyes, respectively. Astigmatism alone was present in 6.4% and 8.5% of the right and left eyes, respectively. Thus, almost 90% of participants had some degree of astigmatism. Hyperopia accounted for 10.6% of the right eyes and 8.5% of the left eyes. Myopia and emmetropia accounted for 4.3% and 2.1% of the left eyes, respectively.

The mean (SD) LVQOL score of all participants was 91.9 (17.3), ranging from 57 to 123. Group 1 had a score ranging from 57 to 110, with a mean (SD) of 83.6 (15.1). Group 2 had a score ranging from 63 to 123, with a mean (SD) of 99.9 (15.6). The baseline LVQOL score was significantly higher in group 2 than in group 1 ($P < 0.001$; Table 2). Habitual VA and LVQOL correlated positively at baseline (r = 0.39, $P = 0.009$).

After a 3-week adaptation period to the prescribed refractive error correction, LVQOL was re-evaluated via phone interviews. The mean (SD) LVQOL score of all participants was 122.8 (3.2), ranging from 112 to 125, with a significant improvement ($P < 0.001$; Table 2). The LVQOL score was higher than at baseline, with a mean of 30.9. The same trend was observed in both groups, with the mean (SD) and median (range) LVQOL scores increasing to 122.0 (3.6) and 123 (112 – 125) in group 1, respectively, and 123.5 (2.6) and 125 (115 – 125) in group 2, respectively. Both groups showed significant improvement after vision correction (both $P < 0.001$), with the improvement being greater in group 2 ($P < 0.05$; Table 2). Thus, all participants achieved higher LVQOL after the optometric intervention. The median difference between the LVQOL scores at baseline and post-intervention differed significantly ($P < 0.001$). Finally, a linear regression was performed to examine the effectiveness of visual intervention on the LVQOL score. Sex or age was not significant in this model. The fitted regression model had a post-intervention LVQOL of 117.43 + 0.06 (baseline LVQOL score). The overall regression was statistically significant ($R^2 = 0.1$, $P = 0.031$), with a small effect size (Cohen's $f^2 = 0.01$). Thus, optometric intervention significantly predicted the LVQOL score ($P = 0.031$).

DISCUSSION

All participants had some degree of refractive error at baseline. Approximately 85% of participants had never had their vision tested. Participants in group 1 had VI at baseline based on their habitual VA. Although a fair proportion of participants in group 2 had normal to mild VI at baseline, most were unaware of their visual status. Consistent with the significant improvement in VA, the QOL score showed significant improvement in all participants in each group.

Despite seven (15%) participants wearing spectacles for habitual correction, all complained of discomfort or blurring of vision because of an undercorrected refractive error and failed to undergo a vision test in the past year. Zhu et al. reported a prevalence of 61.11% of undercorrected refractive errors in adults with DM [26]. However, this study failed to document the type of DM involved [26]. Regardless of the VI status at baseline, all our participants achieved normal VA after optometric intervention with BCDVA of 6 / 9 and better. Zhu et al. found that 75.93% of participants experienced an improvement in VA by at least one line with the prescription of appropriate spectacles [26].

Approximately 90% of participants had some degree of astigmatism. This rate differs from the results of Lin et al., who reported prevalence of myopia, high myopia, hyperopia, astigmatism, and anisometropia among 1929 of participants with type II DM as 43.1%, 8.5%, 21.5%, 61.0%, and 17.2%, respectively [27]. The optometric examination revealed that one patient reported fluctuating vision and that another patient complained of dry eye. A thorough investigation was performed, including history-taking, careful refraction, tear film evaluation, and testing of the diabetic control status. Fluctuations in blood glucose levels and subsequent changes in refraction occur in patients with DM [28] and may cause fluctuating vision. Similarly, further investigation of our patient with fluctuating vision revealed that her blood sugar level was not well controlled. Therefore, patient education and awareness were provided to all participants regarding the risks that poorly controlled blood sugar may worsen DR sequelae, as knowledge of DM and DR among patients is essential for controlling the disease and reducing complications [29].

All participants required spectacle corrections to improve VA. They were provided with the prescription immediately, and none of them reported reduced or uncomfortable vision in the final phase. Yang et al. found a prevalence of 25.63% of uncorrected refractive error among patients with type II DM [30], which differed from our results. Habitual VA and post-intervention BCDVA showed a significant difference. The VI status improved using refractive error correction by at least two lines (0.4) on the Snellen chart. Before and after intervention, 25% and 75% of participants achieved a VA of 0.80, respectively. This improvement paralleled the improvement in the QOL score. Zhu et al. [26] found that 16.63% of adults with DM aged ≥ 60 years had uncorrected refractive error and reported improvement in VA in 75.93% of patients, consistent with the improvement in the QOL score. Similarly, Clarke et al. found a negative association between reduced VA and QOL scores in patients with type II DM [31]. Matza et al. found that changes in VA were associated with corresponding changes in QOL in patients with DR [32].

Our participants exhibited no DR or mild-to-severe NPDR in at least one eye. Despite a higher mean blood sugar level, only one of them reported fluctuating vision. This may be because of the absence of maculopathy and macular edema in the present study. Refractive changes can occur in patients with DM, and any sudden refractive change can result from chronic elevation in the blood sugar level [33-35]. Nevertheless, current practice using pinhole VA [36], an Amsler chart [37], or the Watzke – Allen test on slit-lamp examination [38] could provide some clues into macular integrity in the event of reduced vision in patients with DM.

Most participants had hyperopic or myopic astigmatism. This is in agreement with reports of hydration or dehydration of the lens leading to changes in the refractive index or curvature, resulting in a myopic or hyperopic shift [33]. Furthermore, most of our participants exhibited some degree of astigmatism with apparently normal anterior- and posterior-segment examinations and no cataract or macular involvement at baseline. Therefore, the possibility of DM inducing astigmatism in adults should be further investigated, although studies on various refractive effects on DM have been published [33-35].

An increased risk of VI is associated with a higher glycated hemoglobin level [39]. However, Bansal et al. found that the improvement in VA was independent of the baseline glycated hemoglobin level [40]. Huntjens et al. reported that normal short-term fluctuations in blood glucose concentration in patients with type I or II DM are not associated with acute changes in refractive error [41]. Saw et al. found no significant difference in refractive error between patients with DM and healthy controls [42]. However, spectacle correction should be delayed until the refractive error stabilizes in patients with fluctuating blood sugar levels [43]. In the present study, spectacle correction improved VI in all participants with type II DM.

At baseline, the mean LVQOL scores differed significantly between groups 1 and 2. This was attributed to differences in the VI status between the groups. The mean LVQOL score at baseline was lower in group 1 than in group 2 but slightly higher than the mean score of the low-vision patient population studied by Wolffsohn et al. [13]. In the present study, the LVQOL score was higher in the younger age group and moderate in most participants aged between 50 and 59 years. Habitual VA and the LVQOL score correlated positively at baseline, suggesting that a higher LVQOL score was significantly associated with better VA. Thus, by optimizing VA through optometric intervention, adults with type II DM may have a better QOL. Reduced VA was negatively associated with QOL in patients with type II DM [31].

In the present study, vision intervention improved the LVQOL score in the early stage of DR and in a few patients with severe NPDR (n = 4). The mean LVQOL score improved significantly after vision intervention in both groups. Furthermore, the scores for all participants were higher than those of healthy people, as verified by Wolffsohn et al. using the same questionnaire [13]. However, despite being significant, the effect size was low (Cohen's $f^2 = 0.01$). Therefore, future studies with larger sample sizes are required. Potential bias can be minimized by conducting face-to-face interviews [13] to verify our findings.

The LVQOL questionnaire is effective and simple for the low-vision population and the elderly [13, 14, 44, 45]. It has been receiving more attention in rehabilitation-based research since its translation into Spanish [46], Chinese [47], and Thai [48]. A study by Lamoureux et al. on vision-specific functional VF-11 in Malay Asians concluded that a greater VI, monocular or binocular, was significantly associated with poor visual function [49]. In Asia, studies are limited on vision-specific QOL of patients with DM and vision-related QOL questionnaires. Therefore, knowing and systematically employing a specific type of QOL questionnaire to suit the study objectives are essential.

Women and older patients were frequently observed with moderate VI. This is in agreement with a previous report that women had more years of life loss and years lived with disability, with Malaysian women with diabetes showing a higher mortality rate [50]. In the present study, BCDVA was predicted to be slightly lower in women than in men.

Sex did not interfere with the prediction of LVQOL scores after the optometric intervention in the present study. The QOL score and VI status of all patients improved significantly after optometric intervention. Although the effect size was small, it could have improved by increasing the sample size. Thus, the effect of other confounding factors influencing the LVQOL score among adults with DM could be a good potential research topic, as this will assist in promoting better QOL among them. However, no association between QOL and uncorrected VA was reported by Nutheti et al. who conducted a study on the impact of VI and ocular diseases on the QOL in South India [51]. A considerable area of vision-specific QOL among patients with diabetes [52-54] is still available for investigation. Further investigation of the effects of uncorrected VA and ocular disease on QOL among Malaysians could provide better multidisciplinary management to eye care providers.

DM affects generalized metabolic abnormalities and the end-organ response [55]. Therefore, early detection is crucial for timely management of the manifestation and progression of DR [56, 57]. VI may result in reduced mobility and communication skills [58], twice the risk of falls [59], and high risks of hip fractures [60], depression [61, 62], and emotional distress [63, 64]. Furthermore, high mortality and injury rates correlated in a population with VI [65, 66]. Thus, VI limits one's independence, lowers QOL, shortens one's life in terms of physical and mental health, and has a socioeconomic impact by lowering employment rates, possible social isolation, and higher use of medical expenses [67]. Almost half of our participants were unemployed, and a simple intervention using appropriate corrective glasses resulted in a significant improvement in their QOL score, as all achieved a BCDVA of 6 / 9 and better.

Optometrists are effective in screening DR [68-71]. They are front-line eye care practitioners in the community and may become an important source of referral to ophthalmologists for detecting ocular emergencies and pathologies, including DR [72]. The role of optometrists has expanded, as they detect and refer to DR cases and can manage and optimize visual function in patients with DM, with or without DR, through vision intervention [68, 73]. In the present study, such an intervention improved QOL and VI status of adults with type II DM.

This study highlights the effectiveness of optometric interventions in improving the QOL of patients with type II DM in Malaysia. This could be repeated using the same protocol, but aiming at a larger sample size with equal numbers of men and women. Furthermore, patients from all stages of DR should be included to test the effectiveness of visual rehabilitation on QOL improvement, even in advanced stages of DR. Many other variables such as body mass index, hypertension, and hyperlipidemia status may be studied to determine their association with VI and QOL status in adults with type II DM. Sex distribution was uneven in the present study. To avoid bias and misinterpretation, this limitation should be addressed in future studies. This study was unable to associate other demographic factors with the QOL score or VI status; thus, it would be good practice to know them in future studies. Despite treating the patients affected by the disease, most patients with DM could improve their VI and QOL, particularly in Malaysia, through spectacle correction. A proper understanding of the disease process by optometrists may assist in better multidisciplinary approaches to preserve vision of patients with DM, thereby promoting their independence and better QOL.

CONCLUSIONS

All participants had undercorrected or uncorrected refractive errors. Many patients in the present study who had never had their vision tested should alarm eye care practitioners, particularly optometrists, as the number of patients is large. Vision intervention was effective in improving the VI status of patients with mild-to-moderate NPDR and improved their LVQOL scores. Thus, the LVQOL score and VI status at baseline and post-intervention can be used to predict the outcome of vision intervention. Outreach programs should be implemented in the community to increase the independence and ability of patients with DM to perform activities of daily living. Comprehensive studies on optimizing visual and QOL status among adults with type II DM are highly recommended, as this will lead to independence and higher productivity; therefore, it will promote cost-effectiveness for the government.

ETHICAL DECLARATIONS

Ethical approval: The study protocol was approved by the Research and Ethics Committee of the National University of Malaysia (code UKM 1.5.3.5/244/NN-086-201) and The National Medical Research Register (approval number: NMRR-11-482-9075). All study procedures were performed in compliance with the conditions set by the Declaration of Helsinki. Informed consent was obtained from all participants.
Conflict of interest: Porofessor Rokiah Omar has been assigned as journal board member (2022 – 2023).

FUNDING

None.

ACKNOWLEDGMENTS

Articles submitted by the board, staff, and editors of this journal are also subjected to peer review. These types of papers are handled by another person on the editorial board (without conflicts of interest). Those with a conflict of interest were not involved in any process.

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