ORIGINAL ARTICLE

The Correlation of Quality of Life Impact of Refractive Correction Score with Visual Disturbances and Contrast Sensitivity in Spectacle Wearers: A Preliminary Study

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ABSTRACT

Introduction: This study aimed to evaluate the correlation between Quality of Life Impact of Refractive Correction (QIRC) score with visual disturbances and contrast sensitivity in spectacle wearers. **Methods:** A total of 21 spectacle-corrected moderate myopes was recruited. Subjects completed the QIRC questionnaire for quality of life assessment. The functional and emotional QIRC scores were analysed separately. Visual disturbances were evaluated using the Halo and Glare Simulator, and contrast sensitivity was measured by the M&S Smart System II. All measurements were taken binocularly in 1 lux illumination. Spearman's test was employed to evaluate the correlations. **Results:** The most common visual disturbance was diffuse glare. The functional QIRC score was significantly correlated with glare intensity (r = -0.54, P = 0.01). Whereas, the emotional QIRC score was significantly correlated with contrast sensitivity (r = 0.45, P = 0.04). **Conclusion:** The functional QIRC score is lower when the glare intensity is greater, and the emotional QIRC score is higher in person with greater contrast sensitivity. Hence, glare intensity and contrast sensitivity measurements are suggested to predetermine spectacle wearers' functional vision and well-being, respectively.

Keywords: Contrast sensitivity, Glare, Spectacle wearer, Quality of life

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INTRODUCTION

Uncorrected refractive error is the leading cause of visual impairment worldwide (1). It causes reduction of visual functions that deteriorates person's employment, productivity and academic performance (1–3). This refractive error can be corrected by spectacles, contact lenses or refractive surgery which enhances person's visual functions (4). However, each refractive correction mode affects the person's quality of life (QoL) differently (4–6).

Previous literatures reported that spectacle wearers had lower Quality of Life Impact Refractive Correction (QIRC) score than those with contact lens correction (5) and who had done refractive surgery (6). Furthermore, moderate to high refractive error groups with spectacle correction had a lower QIRC score than low refractive error group (7). Nevertheless, the associated factors that correlated to lower QIRC score among spectacle wearers remain unexplored.

Visual disturbance and visual function such as glare and contrast sensitivity were frequently reported to cause decreased driving performance, especially in night-time (8,9). These glare and contrast sensitivity are also expected to be the factors for lower QIRC scores in spectacle wearers. Hence, this study aimed to evaluate the correlation between QIRC score with visual disturbances strength and contrast sensitivity in spectacle wearers.

MATERIALS AND METHODS

Subjects

A total of 21 spectacle-corrected moderate myopes were recruited in this cross-sectional study. Moderate myopia is defined as refractive error in spherical equivalent (SE) from -3.00 to -5.00 D (10). Only subjects with corrected distance visual acuity (CDVA) of 6/6 or better with their current spectacles, had no history of ocular surgery and disease or systemic disease were included in this study (11). Those who had astigmatism higher than 1.25 D and mesopic pupil size larger than 6 mm were excluded since the larger pupil influences higher spherical aberration (12). All subjects were explained about the procedures, benefits, and risks of this study. Once the subjects were fully understood and all inquiries were addressed accordingly, written consents were obtained from the eligible subjects. The study obeyed the tenets of the Declaration of Helsinki and was approved by the Institutional Ethics Committee (IIUM/504/14/11/2/IREC 2019-KAHS[U]).

All the tests were conducted in low mesopic illumination of 1 lux, which mimics night driving ambient (13). The MS6612 digital light meter (Mastech Group, North Carolina, United States) was used to monitor the illumination level throughout this study. All tests were done while the subjects were wearing their current spectacle correction.

The QIRC

The QIRC is a 20-item questionnaire with five response scales which designs for the assessment of QoL impact with refractive correction (14). The items were categorised into two major domains; 'functional' related to vision (items 1-13) and 'emotional' well-being (items 14-20) (15). Therefore, this study analysed the functional and emotional QIRC scores separately. Five response scales (Scale 1 = not at all to Scale 5 = extremely) for functional items and other five response scales (Scale 1 = never to Scale 5 = always) for emotional items were employed. If the item was not applicable, subjects had chosen Scale 0 (don't know/not applicable), and it was not counted in the final QIRC score.

Subjects self-administered the QIRC questionnaire and returned the completed questionnaire to the investigator on the same day for evaluation. Each item response was converted to a score based on the QIRC scoring table. All the scores were summed up and divided by the total questions answered to obtain the final QIRC score as outlined by Pesudovs et al. (14). Higher QIRC score indicates better QoL of the subject (14).

Visual Disturbance

The subjective visual disturbance was evaluated using the Halo and Glare Simulator (Carl Zeiss Meditec, Jena, Germany). There are three common visual disturbances during night-time driving incorporated in this simulator, namely halo, glare and shadowing. Clinically, halo is classified into three types which are H1 (diffuse halo), H2 (starburst halo) and H3 (distinct halo ring) (16). Glare consisted of G1 (diffuse glare) and G2 (starburst glare). There is only one type of shadowing (E1, general shadow).

The assessment was performed binocularly within 5 minutes after 20 minutes of real low mesopic night-time driving. Same driving route was used for all subjects. Subjects' pupil size were measured in 5, 15 and 20 minutes of the driving session and prior to the visual disturbances assessment to comply with pupil size criteria of less than 6 mm. Subjects were instructed to choose the types of halo and glare according to their real night-time driving experience with aided mesopic vision. Subjects adjusted the slide bar in the simulator, ranging from 0% (none) to 100% (extremely disturbing) to assess visual disturbances' size and intensity. If the subjects also experienced shadowing in their night-time driving, they modified the shadowing separation and intensity bar (E1).

Contrast Sensitivity

Contrast sensitivity was measured using the M&S Smart System II (M&S Technologies Inc., Niles, Illinois, United States). following manufacturer instructions. The M&S Smart System II is a valid alternative to the standard Pelli-Robson chart in evaluating contrast sensitivity. The system incorporates 25 levels of the contrast sensitivity ranges from 0.4 to 100% (equivalent to 0.0 to 2.3 logs units) with an increment of 0.1 log unit each level (17). The display screen was adjusted at 85 cd/m^2. Subjects were initially presented with a single Sloan letter (100% contrast) randomly at 4 m. The contrast was reduced following each correct response (0.1 log unit steps) until the subject failed to identify the letter correctly (18). Prior to the contrast sensitivity test, pupil size was re-measured to ensure it was not greater than 6 mm under low mesopic illumination of 1 lux. The contrast measurement was performed binocularly and the result was recorded in log unit.

Statistical Analysis

Data were analysed using SPSS v_25 (SPSS Inc., Chicago, Illinois, United States). The Shapiro-Wilk test confirmed normality of the data. Spearman's correlation test was employed to evaluate the association of the QIRC score with visual disturbances and contrast sensitivity. A significance level (*P*) of 0.05 was set in all cases.

RESULTS

The mean age of 21 subjects was 22.71 ± 1.79 years (ranges from 20 to 27 years). Most of the subjects were females (95.2%). The mean SE in the right and left eyes were -4.10 ± 0.71 D (uncorrected distance visual acuity [UDVA], 1.15 ± 0.11 logMAR), and -3.95 ± 0.73 D (UDVA, 1.14 ± 0.11 logMAR), respectively (*P* = 0.33). The CDVA in the right and left eyes were -0.04 ± 0.32 logMAR and -0.04 ± 0.31 logMAR, respectively (*P* = 0.67). The astigmatism correction in the right and left eyes were -0.54 ± 0.52 D and 0.49 ± 0.53 D, respectively (*P* = 0.49). The mesopic pupil size in the right and left eyes were 5.21 ± 0.46 mm and 5.31 ± 0.49 mm, respectively (*P* = 0.13).

QIRC Score

The total QIRC score was 39.74 ± 4.11. The functional and emotional QIRC scores were 38.43 ± 4.14 and 42.18 ± 2.91, respectively, but the difference between these two domains was insignificant (*P* = 0.24). The two functional QIRC items with lowest scores were '*concerned about medical complications from spectacle wearing*' and '*trouble is not being able to see at the* *beach or swimming in the sea or pool without spectacle'*, while two functional QIRC items with highest scores were '*eyes feeling tired or strained*' and '*trouble is not being able to use off-the-shelf sunglasses*' (Fig. 1). For emotional QIRC items, the lowest score was '*felt able to do the intended things*' and the highest score was '*felt complimented*' (Fig. 2).

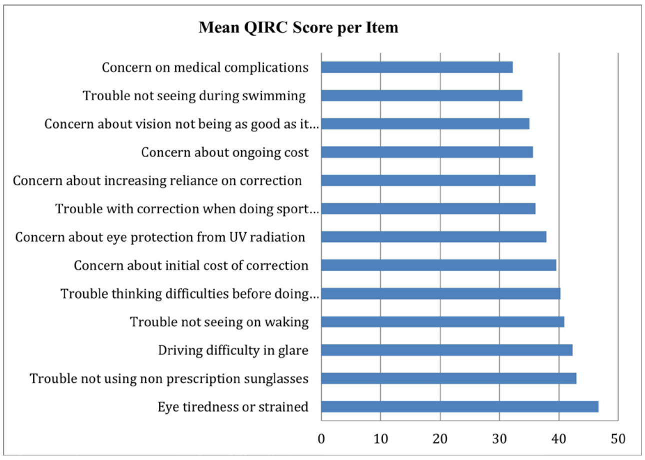

Figure 1: Score distribution of functional QIRC items

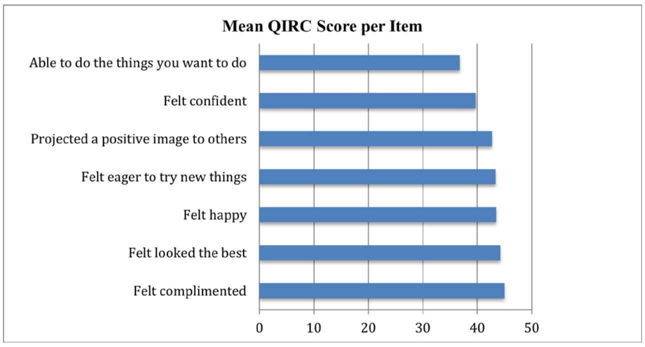

Figure 2: Score distribution of emotional QIRC items

Visual Disturbance

Glare was the most prominent visual disturbance compared to halo and shadowing with both glare size and glare intensity strengths showed the highest mean values (Table I). All subjects experienced diffuse glare, 62% perceived halo (38% reported diffuse halo and 24% were starburst halo) and 48% noted shadowing. Only glare intensity strength revealed a significant correlation with functional QIRC score (Spearman's r = -0.54, P = 0.01 [Fig. 3]). Fig. 4 illustrates the simulation condition of glare and halo (in mean value) perceived by the subjects.

Table I: Summary of visual disturbance strength by the Halo and Glare Simulator

Type	Parameter	Mean (SD)	Median %	IQR
Halo	Size	13.24 (19.58)	8.00	0.00 - 20.00
	Intensity	22.52 (27.55)	14.00	0.00 - 43.00
Glare	Size	23.86 (13.07)	22.00	12.50 - 21.50
	Intensity	28.81 (23.98)	21.00	10.00 - 36.00
Shadowing	Separation	18.24 (29.38)	0.00	0.00 - 33.50
	Intensity	13.71 (22.87)	0.00	0.00 - 29.50

SD = standard deviation; IQR = interquartile range

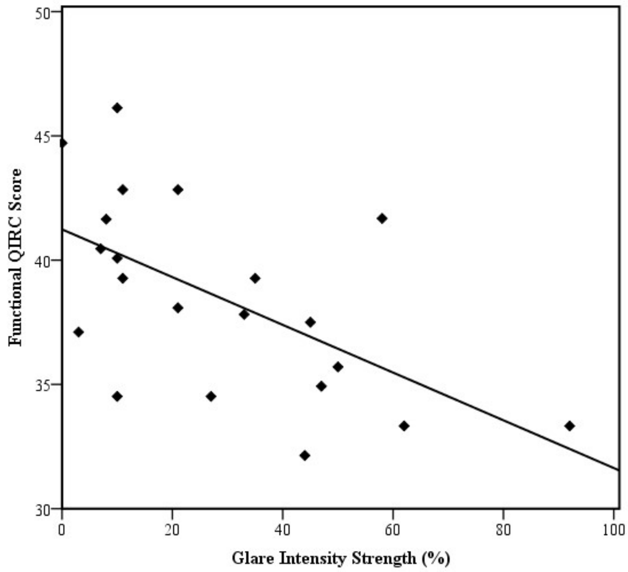

Figure 3: Correlation of functional QIRC score and glare intensity strength in spectacle wearers

Figure 4: Simulation condition of glare and halo perceived by spectacle wearers

Contrast Sensitivity

The median contrast sensitivity for moderate myopes with spectacle correction was 1.5 log unit, interquartile range (IQR): 1.4-1.5 log unit (mean, 1.49 ± 0.17 log unit). The contrast sensitivity showed no significant correlation with functional QIRC score (Spearman's r = 0.37, P = 0.1). However, there was a significant correlation between the contrast sensitivity and emotional QIRC score (Spearman's r = 0.45, P = 0.04 [Fig. 5]).

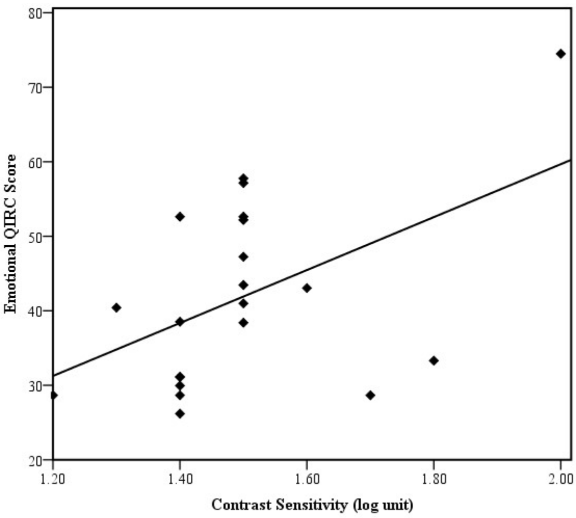

Figure 5: Correlation of emotional QIRC score and contrast sensitivity in spectacle wearers

DISCUSSION

In this current study, spectacle wearers concerned about medical complications from spectacle wearing. This finding is in line with previous study, where 695 individuals had an ocular injury caused by spectacles during contact and racquet sports involvement (19). Moreover, spectacle wearers in this current study revealed that they had seeing difficulty at the beach or during swimming without correction. The mean UDVA of these moderate myopes was about 1.10 logMAR which is equivalent to 5/60 Snellen. Consequently, this low vision condition limits the mobility and object recognition of moderate myopes without spectacle correction. Our subjects scored higher on 'e*yes feeling tired or strained*' as this visual symptom was susceptible to contact lens wearers (6). We speculate this finding is contributed by high visual demand in young adults' daily tasks. Higher QIRC score on '*trouble is not being able to use off-the-shelf sunglasses*' could be due to the popularity of photochromic lens as a sunglasses alternative among spectacle wearers. In fact, the photochromic lens has proven to reduce glare disability and discomfort (20). For emotional items, moderate myopes with spectacles felt that they had low ability to perform the intended things. We postulate the feeling arose among spectacle wearers because of some limitation while wearing spectacle in doing certain activities and low acuity condition without correction.

Spectacle wearers with moderate myopia revealed that all of them were experiencing diffuse glare in night visual perception. Our study found a significant correlation between the glare intensity strength and functional QIRC score. In general, this finding suggests that someone who is experiencing greater glare disturbance to lower QoL related to vision. This could be related to the significant correlation between glare symptoms with spherical aberration and total aberration as revealed by previous result (21).

Contrast sensitivity of moderate myopes with spectacle correction in this study was relatively good. It was higher than contrast sensitivity reported in pterygium (17) and glaucomatous eyes (18) measured using the M&S Smart System II. Previous study reported that low driving performance in healthy older people had a significant correlation with the reduction of contrast sensitivity (8). On the contrary, healthy young adult myopes in the present study showed that contrast sensitivity had no significant correlation with functional QIRC score, including the item related to difficulty in driving. This could be related to the high parafoveal contrast thresholds in younger population as suggested by previous literature (22). Interestingly, contrast sensitivity was found to have a significant positive correlation with emotional QIRC score. It translates that moderate myopes with good contrast sensitivity have better well-being such as felt complimented, have looked best and happy. With the improvement of sight clarity and contrast by spectacle correction, people can perform daily activities efficiently, subsequently increasing their confidence (2).

The small sample size was the limitation that should be highlighted in this present study. Clearly, further study in a large number of subjects with all refractive error groups is needed to uncover the reasons for the correlation between glare with functional QIRC, and contrast sensitivity with emotional QIRC scores.

CONCLUSION

In moderate myopia spectacle wearers, glare is the most common visual disturbance and its intensity is well-correlated with the functional QIRC score. Therefore, glare intensity may predict person's functional vision. Whereas, contrast sensitivity is positively correlated with the emotional QIRC score. Thus, it is suggested to be one of the predictors for person's well-being.

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