

## Ocular Surface Disease Index<sup>®</sup> and the five-item dry eye questionnaire: A comparison in Indian patients with dry eye disease

Samrat Chatterjee, Deepshikha Agrawal, Pravda Chaturvedi

**Purpose:** To compare the suitability of the Ocular Surface Disease Index (OSDI) and the 5-item Dry Eye Questionnaire (DEQ-5) in Indian patients with dry eyes. **Methods:** This cross-sectional study evaluated the OSDI and DEQ-5 in patients with tear film abnormalities. Tear film breakup time, tear film height, Schirmer's I, lissamine green staining, and meibomian gland expressibility were performed on each patient. **Results:** There were 101 patients with symptoms and/or signs of tear film abnormality. Both OSDI and DEQ-5 questionnaires significantly correlated ( $\rho = 0.566$ ,  $P < 0.0001$ ) with each other. The OSDI questionnaire showed a good correlation with all dry eye tests, whereas the DEQ-5 correlated significantly only with the tear film breakup time and the lissamine green score. None of the questionnaires correlated with meibomian gland expressibility. The Bland-Altman analysis revealed a marginal bias (-0.01 unit) for DEQ-5. The DEQ-5 scored higher in patients with mild symptoms. While 101 (100%) patients answered all the questions in the DEQ-5, only 19 (18.8%) patients answered all the questions in the OSDI questionnaire. The least responses were recorded in the vision-function-related and environmental trigger subscales of the OSDI. **Conclusion:** The OSDI and DEQ-5 scores showed a moderate correlation. The OSDI questionnaire correlated with a higher number of dry eye tests than the DEQ-5. The large number of skipped questions in the vision-function-related and environmental trigger subscales of the OSDI suggests that the questionnaire is not adequately adapted to the Indian population. Patients with a negative OSDI score should be reassessed with the DEQ-5 to exclude symptom positivity.

**Key words:** Dry eye disease, health-related quality of life, ocular surface disease index, patient-reported outcome questionnaire, 5-item Dry Eye Questionnaire

The assessment of symptoms in dry eye disease (DED) is important for two reasons: as a screening tool before performing other tests and for monitoring disease progression and treatment responses.<sup>[1]</sup> A precise measurement of symptoms in the new millennia is central to the diagnosis of DED and has been given the same importance as signs in both the Dry Eye Workshop 2007 (DEWS I)<sup>[2]</sup> and 2017 (DEWS II)<sup>[1]</sup> reports, unlike the older guidelines<sup>[3]</sup> where a greater emphasis was laid on the evaluation of signs. The various symptom questionnaires in current use either measure only symptoms or, in addition, evaluate the impact of symptoms on the health-related quality of life (HRQoL).<sup>[1,4,5]</sup> The DEWS II report recommends the use of either the Ocular Surface Disease Index<sup>®</sup> (OSDI, Allergan Inc, California, USA) or the 5-item Dry Eye Questionnaire (DEQ-5) for assessing the symptoms.<sup>[1]</sup> The OSDI is a popular questionnaire that assesses both symptom frequency and HRQoL.<sup>[6-9]</sup> It contains 12 questions divided into three subscales: ocular symptoms, vision-related functions, and environmental triggers. On the other hand, the DEQ-5, which was more recently developed, measures only symptoms across dimensions of frequency, severity, and diurnal variation.<sup>[10-12]</sup>

An ideal questionnaire should be intelligible, appropriate, unambiguous, well-coded, and self-validating.<sup>[13]</sup> When used

in a population that is different from the one for which it was originally developed, the questionnaire should undergo cross-cultural adaptation, and revalidation to ensure that it still measures the same ideas after adaptation.<sup>[14,15]</sup> The OSDI and the DEQ-5 questionnaires were developed in English in North America. While the OSDI has been translated and validated in several languages,<sup>[16-22]</sup> the DEQ-5 has been translated and validated only in Spanish.<sup>[23]</sup>

Some studies have found that many questions in the OSDI questionnaire, particularly those that measured the HRQoL aspects, are left unanswered by patients.<sup>[21,24,25]</sup> Also, the vision-function-related subscale of the OSDI displayed poor internal consistency<sup>[21]</sup> and the patients had difficulty in comprehending certain questions or differentiating between the degrees of severity of their symptoms.<sup>[26]</sup> There are no published reports of validation of these two questionnaires in India, where for the most part English is not the mother tongue and people belong to a different culture and lifestyle than the West. Therefore, it is logical to evaluate the performance of both these questionnaires in Indian patients. It is also reasonable to assume that the DEQ-5 may perform better as it measures

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Cornea and Anterior Segment Services, MGM Eye Institute, Raipur, Chhattisgarh, India

**Correspondence to:** Dr. Samrat Chatterjee, Cornea and Anterior Segment Services, MGM Eye Institute, 5<sup>th</sup> Mile, Vidhan Sabha Road, PO Mandhar, Raipur - 493 111, Chhattisgarh, India. E-mail: samrat@mgmeye.org

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only symptoms and not the HRQoL concepts that require more adaptation. Therefore, this study aimed at comparing the efficacy of the OSDI with the DEQ-5 in Indian patients with tear film abnormalities.

## Methods

### Participants

This cross-sectional study was carried out at a tertiary eye care institute in central India between April and August 2019. All consecutive patients attending the cornea clinic during the study period with any one of the following were included: (1) OSDI score  $\geq 13$ , (2) fluorescein tear film breakup time (FTBUT)  $< 10$  seconds, or (3) Schirmer's test I (ST I)  $< 10$  mm at 5 minutes. Participants were excluded if they had any ocular infection or uveitis, eye lid or ocular surface anatomical abnormalities, and ocular surgery within the previous 3 months. The study was approved by the institutional review board and adhered to the tenets of the Declaration of Helsinki. Written informed consent was obtained from all participants before the examination.

### Dry eye workup

All participants underwent a comprehensive eye examination that included symptom history, slit-lamp examination, applanation tonometry, fundus evaluation, and DED tests. The dry eye evaluation was done on the same day, and the sequence of DED tests was the administration of the questionnaires (OSDI and DEQ-5), tear film height (TFH), FTBUT, ST I, lissamine green stain score (LGS), and meibomian gland expressibility. The details of the tests<sup>[1-3,6-8,27,28]</sup> are given in Appendix 1. If the patient had an OSDI score  $\geq 13$ , then the DEQ-5 was administered immediately, whereas if the OSDI score was  $< 13$ , then DEQ-5 was administered after the dry eye tests. A single investigator (PC) performed the examinations in a single examination room where the temperature ( $20^{\circ}\text{C}$ – $22^{\circ}\text{C}$ ) and humidity (50%–60%) were uniformly maintained. A diagnosis of DED was made if the symptom score was positive along with any one sign (FTBUT  $< 10$  s or LGS score  $> 2$ ).<sup>[2]</sup> An OSDI score of  $\geq 13$ <sup>[8]</sup> and a DEQ-5 score of  $\geq 6$ <sup>[12]</sup> were considered positive for symptoms. DED and its subtypes were classified as per current recommendations.<sup>[2]</sup>

### The questionnaires

A Hindi-language version of the OSDI questionnaire (Allergan India®, Bengaluru, India) was used after acquiring copyright permission [Appendix 2]. The DEQ-5 was first translated from the English version<sup>[12]</sup> to Hindi [Appendix 3] and then translated back to English by two ophthalmologists and a language expert. A third ophthalmologist reviewed the translations to assess comprehension. The internal consistency and intraclass reliability of both these questionnaires were tested before the study. The intraclass reliability was assessed by administering the questionnaires on 30 participants twice within an interval of 7 days. The internal consistency (Cronbach's  $\alpha$ ) was 0.660 for OSDI and 0.875 for DEQ-5. The intraclass correlation coefficient was 0.763 (95% confidence interval [CI; 0.502, 0.887],  $P < 0.0001$ ) for OSDI and 0.795 (95%CI [0.568, 0.902],  $P < 0.0001$ ) for DEQ-5. These values were acceptable.

### Statistical analysis

The mean scores of both questionnaires in different types of DED were analyzed using the Student's *t* test. The Spearman correlation coefficient ( $\rho$ ) was used to examine the correlations and Pearson's Chi-square analysis was used to assess the associations between the tests. The interrater agreement was examined with Cohen's kappa. Bland-Altman analysis was used to evaluate the differences between OSDI and DEQ-5 after

normalizing the scores.<sup>[29]</sup> The scores were normalized because both questionnaires did not score the symptoms in the same way. The scores from both the questionnaires were normalized by applying the algebraic method of the norm of a vector, that is, normalization to a norm of one.<sup>[30]</sup> The distribution between the differences of scores was confirmed by the Shapiro-Wilk test for normal distribution. All statistical analysis was computed using statistical software SPSS Version 23.0 (SPSS Chicago, IL). A two-tailed *P* value less than 0.05 was considered statistically significant.

## Results

There were 101 patients, of which 35 (34.7%) were male, and 66 (65.3%) were female. The mean age of the patients was  $47.1 \pm 13.2$  (20–79) years. There were 26 (25.7%) patients with aqueous-deficient DED, 55 (54.5%) patients with evaporative DED, and 20 (19.8%) patients with signs of DED but a negative symptom score. Of the 26 patients with aqueous-deficient DED, there were 4 (15.4%) patients with primary Sjögren's syndrome and 22 (84.6%) patients with secondary Sjögren's syndrome. Of the 55 patients with evaporative DED, there were 49 (89.1%) patients with MGD, whereas 6 (10.9%) patients had other non-MGD-related causes.

### Results of DED tests

The mean OSDI score was  $33.3 \pm 19.2$  (2–92), DEQ-5 score was  $9.6 \pm 4.1$  (0–20), TFH was  $0.5 \pm 0.3$  (0.1–0.8) mm, FTBUT was  $4.3 \pm 2.6$  (0–13) seconds, ST I was  $16.9 \pm 11.8$  (0–35) mm and LGS was  $1.4 \pm 1.2$  (0–4). The mean OSDI score in patients with aqueous tear deficiency DED was  $43.4 \pm 15.7$  and in patients with evaporative DED, it was  $37.7 \pm 17.9$ , but this difference was not statistically significant ( $P = 0.081$ ). The DEQ-5 score in patients with aqueous tear deficiency DED was  $11.5 \pm 3.1$  and in evaporative DED, it was  $9.9 \pm 3.7$ , but the difference was not statistically significant ( $P = 0.085$ ). The findings of the dry eye tests in various groups of the DED patients are given in Appendix 4.

An OSDI score of  $\geq 13$  was present in 82 (81.2%) patients, and a DEQ-5 score of  $\geq 6$  was present in 85 (84.2%) patients. A comparison of both questionnaires with various dry eye tests [Table 1] did not reveal any statistically significant differences.

### DED diagnosis

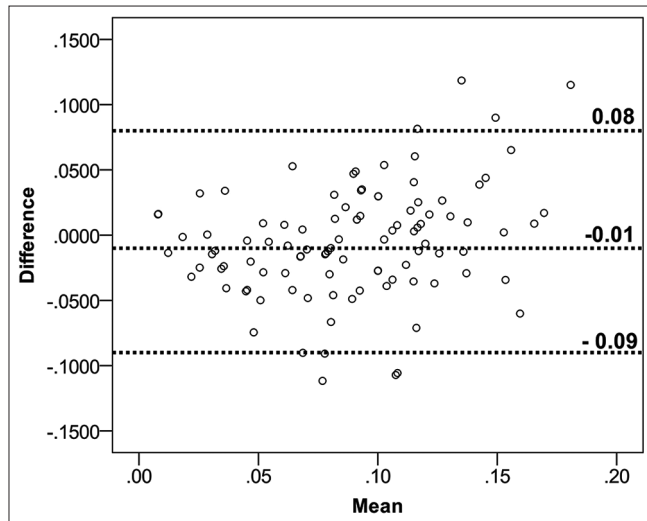
There were two patients who had positive symptom scores but no clinical sign of DED. Therefore, the number of patients diagnosed using the DED with the OSDI questionnaire was 80 (79.2%), whereas 83 (82.2%) patients were diagnosed with the DEQ-5 questionnaire. The interrater reliability of DEQ-5 compared with OSDI was moderate (Cohen's kappa: 0.587) and statistically significant ( $P < 0.0001$ ). To calculate the specificity and sensitivity of both the questionnaires, decreased FTBUT was taken as the standard. The sensitivity and specificity of OSDI were 81.4% and 75.0% and of DEQ-5 were 85.6% and 100%, respectively.

The OSDI and the DEQ-5 scores in various dry eye types are provided in Appendix 5. An analysis of the scores between the same dry eye types was not significant.

### Correlations

A significant correlation was observed between the OSDI and the DEQ-5 questionnaires ( $\rho = 0.566$ ,  $P < 0.0001$ ). The correlation between ocular symptoms, vision-function-related symptoms, and environmental triggers subscales of the OSDI with DEQ-5 was  $\rho = 0.530$  ( $P < 0.0001$ ),  $\rho = 0.175$  ( $P = 0.080$ ), and  $\rho = 0.404$  ( $P < 0.0001$ ), respectively. The OSDI scores

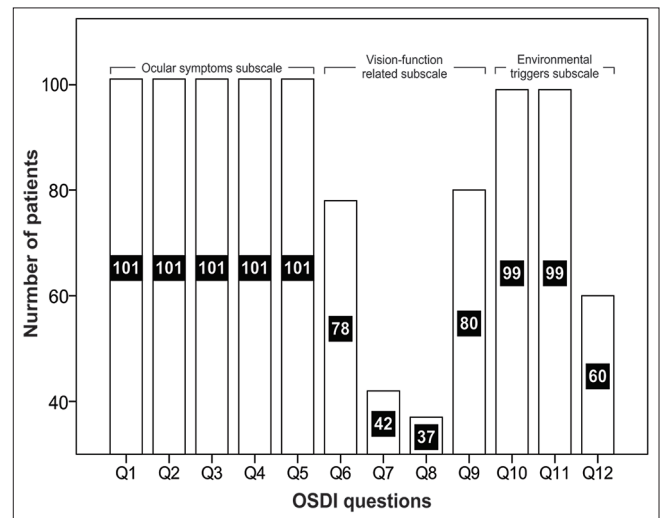
correlated significantly with all DED tests but not with the meibomian glands expressibility and quality [Table 2]. The vision-function-related subscale score had the least correlation with any of the DED tests. The DEQ-5 questionnaire correlated only with FTBUT and LGS and not with any other DED tests or meibomian glands expressibility and quality.



**Figure 1:** Bland–Altman plot for the normalized DEQ-5 and OSDI scores. The x-axis indicates the mean and the y-axis indicates the difference (OSDI – DEQ-5) between the two questionnaire scores. The central dotted-line depicts the mean difference, that is, bias, between the normalized scores from the two questionnaires, whereas the superior and the inferior dotted lines depict the intervals that include 95.6% of all the differences

**Differences between OSDI and DEQ-5**

Bland–Altman analysis [Fig. 1] for clinical agreement between the normalized OSDI and DEQ-5 scores revealed a clinical difference (bias) of – 0.01 units (95% CI [–0.09, 0.08]). Linear regression analysis of the normalized OSDI and DEQ-5 scores revealed that there was a significant difference between their scores ( $\beta$  coefficient = 0.300,  $P = 0.005$ ). This signified that overall the DEQ-5 scored symptoms marginally higher than the OSDI questionnaire. The distribution of points in the plot signifies that when symptom score



**Figure 2:** Bar diagram showing the number of questions in the OSDI questionnaire answered by the patients. Q1 to Q12 denote the 12 questions of the questionnaire

**Table 1: Comparison of OSDI and DEQ-5 with different DED tests**

	OSDI	DEQ-5	$\chi^2$	P
	Score $\geq 13$ (n=82)	Score $\geq 6$ (n=85)		
Fluorescein tear film breakup time <10 s (97 patients)	79 (81.4)	83 (85.6)	0.002	0.967
Lissamine green score $\geq 2$ (45 patients)	41 (91.1)	44 (97.8)	0.005	0.942
Tear film height <0.3 mm (30 patients)	26 (86.7)	25 (83.3)	0.024	0.878
Schirmer's I test <10 mm (35 patients)	32 (91.4)	33 (94.3)	0.001	0.979
Signs of meibomian gland dysfunction (89 patients)	71 (79.8)	75 (84.3)	0.006	0.938

Numbers in parentheses are in percentages. OSDI: Ocular Surface Disease Index, DEQ-5: 5-item Dry Eye Questionnaire

**Table 2: Correlation between the DEQ-5, OSDI questionnaire, and various dry eye tests**

Dry eye tests	DEQ-5		OSDI							
			Overall score		Ocular symptom subscale score		Vision-function subscale score		Environmental triggers subscale score	
	$\rho$	P	$\rho$	P	$\rho$	P	$\rho$	P	$\rho$	P
Fluorescein tear film break up time	-0.246	0.013	0.298	0.002	-0.283	0.004	0.000	0.998	0.187	0.062
Lissamine green score	0.249	0.012	0.482	<0.001	0.435	<0.001	0.097	0.334	0.294	0.003
Tear film height	-0.098	0.328	0.250	0.012	-0.190	0.058	-0.082	0.413	-0.199	0.046
Schirmer's I	-0.148	0.141	-0.242	0.015	-0.201	0.044	-0.049	0.629	-0.293	0.003
Meibomian gland expressibility	0.117	0.244	0.120	0.233	0.161	0.108	0.157	0.118	0.077	0.444

OSDI: Ocular Surface Disease Index, DEQ-5: 5-item Dry Eye Questionnaire,  $\rho$ : Spearman correlation coefficient

tended to be low, DEQ-5 scored more than OSDI, and when symptoms in patients were higher, OSDI scored equally or slightly more than the DEQ-5.

### Response rate of the questionnaires

All (100%) the patients completed the DEQ-5 questionnaire, and no questions were skipped. In comparison, only 19 (18.8%) patients completed the 12 questions in the OSDI questionnaire, 21 (20.8%) patients completed 11 questions, 20 (19.8%) patients completed 10 questions, 16 (15.8%) patients completed 9 questions, 22 (21.8%) patients completed 8 questions, and 3 (3.0%) patients completed 7 questions. The mean number of OSDI questions answered by the patients was  $9.9 \pm 1.6$  (range 7–12). The mean number of questions answered in the ocular symptom subscale was  $5.0 \pm 0$  questions, in the vision-function-related subscale was  $2.3 \pm 1.2$  (0–4) questions, and in the environmental trigger function, it was  $2.6 \pm 0.6$  (1–3) questions. The questions related to “using computers or automated teller machines,” “driving at night” and “staying in air-conditioned” rooms were the three most commonly skipped questions [Fig. 2].

## Discussion

In our study, while both the questionnaires exhibited moderate sensitivity, the DEQ-5 questionnaire had a higher specificity. The correlation between the two questionnaires was only moderate. An earlier article by Simpson *et al.* had reported a higher correlation coefficient of 0.76 between the OSDI and the DEQ-5 questionnaires.<sup>[31]</sup> The moderate correlation coefficient in our study was probably influenced by the lack of correlation between the vision-function-related subscale of the OSDI with the DEQ-5. We also found that although the overall OSDI score correlated with all the DED tests, the vision-function-related subscale again showed a lack of correlation. On the other hand, the DEQ-5 correlated with only FTBUT and LGS. In contrast, Begley *et al.* had shown a moderate but statistically significant correlation between the DEQ-5 and DED tests.<sup>[11]</sup> Their study included a larger number of patients with keratoconjunctivitis sicca than our study, and the greater correlation reported by Begley *et al.* may be due to this difference.<sup>[11]</sup> The poor correlation of DEQ with TFH and ST I in our patients is a concern because these tests discriminate aqueous tear-deficient DED from evaporative DED. Another recent study that evaluated five questionnaires (OSDI, DEQ-5, McMonnies Dry Eye Questionnaire, Symptom Assessment in Dry Eye, and Standard Patient Evaluation of Eye Dryness questionnaires) found that although all the questionnaires had the modest ability to discriminate positive dry eye tests, the OSDI performed better than the DEQ-5.<sup>[32]</sup> The failure of both the questionnaires to correlate with MGD in our study is another concern as the latter is widely prevalent in India.<sup>[24]</sup> As a large part of the treatment of MGD is symptom dependent,<sup>[33]</sup> the inability to accurately score symptoms may lead to a clinical conundrum.

The results of the Bland–Altman analysis indicated a good agreement between the two questionnaires. However, a careful examination of the plot revealed that when the mean symptom score was low, the DEQ-5 questionnaire scored higher than the OSDI. Based on this finding, we would recommend that patients with an OSDI score <13 in the presence of any sign of tear film abnormality should be reassessed with the DEQ-5.

In our study, few patients completed the entire set of 12 questions in the OSDI questionnaire, whereas all completed the five questions in the DEQ-5. The OSDI is designed to make all questions in the ocular symptom subscale obligatory to answer, whereas the questions in the remaining two subscales

are optional. The questions most commonly left unanswered by patients were Question No. 8 (working with a computer or bank machine) and Question No. 7 (driving at night). The response rate of the OSDI varies and can be as low as 15.3%<sup>[24]</sup> in Indian participants to 55%<sup>[25]</sup> in Western participants. The formula for calculating the OSDI score has the total number of answered questions as the denominator. Therefore, the number of unanswered questions does not affect the total score. However, the purpose of the OSDI as a tool to assess HRQoL is lost when patients leave a majority of the questions that measure these aspects unanswered.

The low response rates in the OSDI HRQoL subscales appear to be related to the sociocultural and lifestyle differences of Indian patients. Driving at night, using computers or bank machines, or staying in an air-conditioned environment may be common activities in North America, where the OSDI questionnaire was originally developed,<sup>[6]</sup> but not in India. This shortcoming of the OSDI has also been reported from other countries. In a study evaluating a Japanese version of the OSDI questionnaire, the authors reported that most of the elderly patients skipped Question No. 7 as they never drove at night because of the availability of a good public transport system in the city.<sup>[21]</sup> The same authors also showed that the internal consistency of the vision-function-related subscale could be increased by excluding Question No. 7. An attempt to address the drawbacks of the OSDI questionnaire was made by Pult and Wolfsohn,<sup>[26]</sup> who reduced the 12-questions format to a leaner six-questions format, excluding questions that appeared to be difficult for the patients to comprehend. However, the questions related to experiential aspects such as “driving at night,” “watching television,” and “living in low humidity” were retained in the new format, which may again restrict its use to a specific population. Although the above were examples of lack of experiential adaptation, the study by Martinez *et al.* illustrates the importance of linguistic adaptation.<sup>[23]</sup> The authors reported that while adapting the DEQ-5 questionnaire to the Mexican population, they found that the terms for “constantly” and “frequently” used to denote symptom severity were synonymous after translation into Spanish. These terms then had to be replaced by other words to retain their discriminatory property. Linguistic adaptation is also important in India where English as a mother tongue is spoken by a very small fraction of the population.<sup>[34]</sup> Although many Indians are conversant in English, it is with variable degrees of proficiency. In the absence of a standard translated version of the DED questionnaire, the common practice in most clinics is to verbally translate the text from original English to the local language extemporarily. Such an approach is casual, variable, and can lead to ambiguity and inaccuracy. Therefore, it is important to have a single translated version of the questionnaire that has been standardized so that the measurements are consistent and repeatable.

A particular limitation of our study was, that it was restricted to a single center and we included only one language, whereas India is a multilingual nation, and the culture and lifestyle vary geographically. Nearly all our patients were from the urban areas; hence our findings cannot be generalized to patients from a rural setting. We did not attempt a complete cross-cultural adaptation of the questionnaires and restricted ourselves to only linguistic translations. Additionally, a sample calculation would have made the findings of our study more robust. However, this is one of the first attempts to critically analyze dry eye symptom questionnaires in India. We believe that both the questionnaires are relevant in the Indian context, although each has certain advantages and limitations.

## Conclusion

In our study, the OSDI correlated well with all DED tests unlike the DEQ-5 and therefore should be used as a primary tool. However, the DEQ-5 appears to be more sensitive in patients with milder symptoms. Therefore, patients with a negative OSDI score must be re-evaluated with the DEQ-5. Given the many languages spoken in India and the diversity in culture and lifestyle, it is time to develop an indigenous DED questionnaire in various local languages.

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## Conflicts of interest

There are no conflicts of interest.

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## Appendix

### Appendix 1: Tests used to evaluate dry eye disease

#### Ocular Surface Disease Index

The Ocular Surface Disease Index®(OSDI, Allergan Inc., Irvine, California, USA) is a 12-item patient reported outcome questionnaire designed to provide a rapid assessment of symptoms of ocular irritation consistent with DED and their impact on vision related functions.<sup>[6]</sup> The questionnaire consists of three domains: Ocular symptoms, Vision related functions and Environmental triggers. The 12-item questionnaire is graded on a Likert-type scale of 0 to 4 points, where 0 = none of the time, 1 = some of the time, 2 = half of the time, 3 = most of the time, and 4 = all the time. The total OSDI is then calculated with the formula

$$\text{OSDI score} = \frac{\text{sum of score of all the questions} * 100}{\text{No. of questions answered} * 4}$$

The OSDI score is on a scale of 0 to 100 with higher scores indicating greater degree of disease. A score of  $\geq 13$  is the cutoff between the symptomatic and asymptomatic individuals.<sup>[8]</sup>

#### Measurement of tear film height

The beam of the slit lamp (Haag Streit BM 900) was tilted 90° to lie parallel to the eye lid margin. The lower tear meniscus was viewed through 16 × oculars and the height just below the pupil was measured by rotating the micrometer scale. Three measurements were recorded and then averaged. A value of 0.2 mm or less was taken to distinguish an abnormal tear film height.<sup>[2]</sup>

#### Fluorescein tear film breakup time

The stability of the tear film was assessed by FTBUT and was measured by a standard technique that had been previously described. Fluorescein sodium was instilled in the inferior palpebral conjunctiva using a fluorescein sodium ophthalmic strip (Fluorostrip®, Contacare Ophthalmics & Diagnostics, Vadodara, Gujarat, India). Following instillation, the participant was asked to blink naturally several times to distribute the fluorescein. After 10 to 30 seconds, the participant was asked to look straight ahead without blinking. The tear film was examined under cobalt-blue filter of the slit lamp viewed through 10 × magnification. The time interval was recorded with a stopwatch and was the time between the last blink and the appearance of first random dark spot in the fluorescein-stained tear film. Three such readings were recorded, and the average of the three was considered as TFBUT. Times  $\leq 10$  seconds was considered as dry eye and  $>10$  seconds was considered as normal. Time  $>15$  seconds was recorded as 15 seconds.<sup>[2]</sup>

#### Schirmer's test

The Schirmer's test was carried out without anesthesia to assess tear production. The participant was seated comfortably and asked to look straight ahead in slight up gaze. A Whatman paper No. 41 (TearStrips®, Contacare Ophthalmics & Diagnostics, Vadodara, Gujarat, India) was placed at the junction of the outer and inner one third of the lower eye lid carefully without touching the cornea, and the participant was asked to normally blink the eyes. The reading was taken at 5 minutes. A reading of  $<10$  mm at 5 minutes signified aqueous tear deficiency.<sup>[1,3]</sup>

#### Lissamine green staining of ocular surface

Lissamine green stain was used to evaluate the corneal and conjunctival surface by instilling lissamine green ophthalmic strip (Lissamine Green Sterile Strips®, Contacare Ophthalmics & Diagnostics, Vadodara, Gujarat, India). The ocular surface was divided into three regions: corneal, nasal conjunctiva, and temporal conjunctiva. Staining was graded according to the panels of the Oxford scheme and was graded on a scale of 0 to 5. The grading of the Oxford scheme represented the lissamine green score and was abnormal if  $\geq 2$ .<sup>[27]</sup>

#### Meibomian gland expression

Meibomian gland expression was done by applying a firm pressure with the index finger at the central lower eye lid over the tarsal plate against the globe, maintaining the pressure for 15 seconds.<sup>[28]</sup> The area of focus was the central eight glands.

Meibum quality was graded as 0 = clear fluid, 1 = cloudy fluid, 2 = cloudy particulate fluid, and 3 = inspissated, toothpaste like. Meibum expressibility was graded as 0 = all glands expressible, 1 = three to four glands expressible, 2 = one to two glands expressible, and 3 = no glands expressible. MGD was diagnosed based on a score of 1 for both quality and expressibility or a score of more than 1 for either quality or expressibility.<sup>[28]</sup>

## Appendix 2: Hindi version of OSDI

### आँखों की सतह पर होने वाले रोगों की प्रश्नावली (OSDI ©)

कृपया इन सवालों के जवाब दें। इसके लिए उस बॉक्स में ✓ निशान लगाएँ जो आपके जवाब के सबसे करीब हो।

क्या आपने पिछले 7 दिनों में इनमें से कुछ महसूस किया है:

	हमेशा	ज़्यादातर	अकसर	कभी-कभी	कभी नहीं
1 रोशनी में आँखों को परेशानी होती है?					
2 आँखों में किरकिरी महसूस होती है?					
3 आँखें दुखती हैं?					
4 नज़र धुँधली है?					
5 नज़र कमज़ोर है?					

क्या आपकी आँखों की परेशानियों के कारण पिछले 7 दिनों में आपके इनमें से किसी कामकाज में कमी आई है:

	हमेशा	ज़्यादातर	अकसर	कभी-कभी	कभी नहीं	मुझ पर लागू नहीं होता
6 पढ़ना?						
7 रात में गाड़ी, साइकिल आदि चलाना?						
8 कंप्यूटर या बैंक मशीन (एटीएम) का इस्तेमाल करना?						
9 टीवी देखना?						

क्या पिछले 7 दिनों में इनमें से किसी हालत में आपकी आँखों में तकलीफ़ हुई है:

	हमेशा	ज़्यादातर	अकसर	कभी-कभी	कभी नहीं	मुझ पर लागू नहीं होता
10 हवा चलने पर?						
11 कम नमी वाली (बहुत सूखी) जगह पर?						
12 ऐसी जगह जहाँ ऐसी (या पंखे) चल रहे हों?						

कॉपीराइट © 1995 Allergan, Inc.

## Appendix 3: Hindi version of DEQ-5

### DEQ 5

1) आँखों में होने वाली तकलीफ या असुविधा के लिए प्रश्न

a) पिछले महीने के किसी भी सामान्य दिन में आपकी आँखों में कितनी बार असुविधा या तकलीफ महसूस हुयी?

- 0) कभी नहीं
- 1) शायद ही कभी
- 2) कभी कभी
- 3) अक्सर
- 4) हर समय

b) जब आपकी आँखें कोई तकलीफ या असुविधा महसूस करती थीं तो दिन के अन्त में (जैसे सोने के दो घण्टे पहले) यह कितनी बढ़ जाती थी?

- |          |              |   |   |   |  |             |
|----------|--------------|---|---|---|--|-------------|
| कभी नहीं | बिल्कुल नहीं |   |   |   |  | बहुत ज्यादा |
| 0        | 1            | 2 | 3 | 4 |  | 5           |

2) आँखों के सूखेपन से संबंधित प्रश्न

a) पिछले महीने के किसी भी सामान्य दिन में आपकी आँखें कितनी बार सूखी महसूस हुयीं हैं?

- 0) कभी नहीं
- 1) शायद ही कभी
- 2) कभी कभी
- 3) अक्सर
- 4) हर समय

b) जब आपकी आँखें सूखी महसूस हुयीं तो दिन के अंत में (जैसे सोने के दो घंटे पहले) यह कितनी बढ़ जाती थी?

- |          |              |   |   |   |  |             |
|----------|--------------|---|---|---|--|-------------|
| कभी नहीं | बिल्कुल नहीं |   |   |   |  | बहुत ज्यादा |
| 0        | 1            | 2 | 3 | 4 |  | 5           |

3) आँखों से पानी आने से संबंधित प्रश्न

a) पिछले महीने के किसी भी सामान्य दिन में आपकी आँखें कितनी बार पानी से भरी हुयी महसूस हुयीं?

- 0) कभी नहीं
- 1) शायद ही कभी
- 2) कभी कभी
- 3) अक्सर
- 4) हर समय

This Hindi version of the DEQ-5 has been translated from the original English text which was published in the following study: Chalmers RL, Begley CG, Caffery B. Validation of the 5-item dry eye questionnaire (DEQ-5): discriminant across self-assessed severity and aqueous tear deficient dry eye diagnoses. Cont Lens Anterior Eye 2010;3:55-60.

We acknowledge the authors for designing the original English version.



#### Appendix 4: Scores of dry eye tests in different types of dry eye disease

Type of dry eye	TBUT (seconds)	ST 1 (mm)	TFH (mm)	LGS	ME score	MQ score
Aqueous-deficient dry eye disease: Primary Sjögren's syndrome	0.6±0.7	3±1.4	0.1±0.1	3±0	2.3±0.5	1.3±1.0
Aqueous-deficient dry eye disease: Secondary Sjögren's syndrome	2.8±2.0	12.0±10.0	0.2±0	1.8±1.2	1.9±0.8	1.1±0.8
Evaporative dry eye disease: Meibomian gland dysfunction	4.7±2.3	17.8±11.8	0.6±0.2	1.4±1.2	1.7±0.6	1.1±0.8
Evaporative dry eye disease: others	5.2±2.2	19.3±13.2	0.7±0.3	0.7±0.8	0.7±0.5	0.2±0.4

All values are in Mean and standard deviation. LGS: Lissamine green score; ME: meibomian glands expressibility; MQ: meibum quality; ST 1: Schirmer's test 1, TBUT: tear film breakup time, TFH: tear film height

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**Appendix 5: Scores of OSDI and DEQ-5 in various types of dry eye disease**

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Type of dry eye	OSDI score (Mean±SD)	DEQ-5 score (Mean±SD)
Aqueous-deficient dry eye disease: Primary Sjögren's syndrome	53.4±13.1	12.8±4.0
Aqueous-deficient dry eye disease: Secondary Sjögren's syndrome	43.4±16.7	10.0±3.8
Evaporative dry eye disease: Meibomian gland dysfunction	38.0±15.6	10.9±3.5
Evaporative dry eye disease: others	28±13.7	10.0±2.4

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OSDI: Ocular Surface Disease Index, DEQ-5: 5-item Dry Eye Questionnaire. Statistical significance: OSDI score between aqueous-deficient dry eye disease - primary Sjögren's syndrome and aqueous deficient dry eye disease - secondary Sjögren's syndrome:  $P=0.270$ ; OSDI score between evaporative dry eye disease - Meibomian gland dysfunction and evaporative dry eye disease - others:  $P=0.140$ ; DEQ-5 score between aqueous-deficient dry eye disease - primary Sjögren's syndrome and aqueous-deficient dry eye disease - secondary Sjögren's syndrome:  $P=0.200$ ; DEQ-5 score between evaporative dry eye disease - Meibomian gland dysfunction and evaporative dry eye disease - others:  $P=0.393$