



Preliminary psychometric evaluation of the Arabic 5-item dry eye questionnaire (DEQ-5) in a conflict-affected population in southern Palestine

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ABSTRACT

Background: Dry eye symptoms are common among populations exposed to prolonged stress and adverse living conditions, yet brief patient-reported symptom assessment instruments have rarely been evaluated in conflict-affected settings. This study aimed to conduct a preliminary psychometric evaluation of the Arabic Dry Eye Questionnaire-5 (DEQ-5) among internally displaced adults in the southern Gaza Strip, with an emphasis on internal consistency, internal structure, and exploratory cross-language agreement.

Methods: A cross-sectional observational study was conducted in the Al-Mawasi camps among internally displaced adults using snowball sampling. Data were collected through face-to-face interviews using paper-based questionnaires. The Arabic DEQ-5 was administered to the primary study sample, while a bilingual subset completed the Arabic version first and the English version 72 hours later for an exploratory fixed-order bilingual agreement analysis. Internal consistency was evaluated using Cronbach's alpha and McDonald's omega total. Item-level analyses included corrected item-total correlations and Cronbach's alpha if item deleted. Internal structure was examined using eigenvalue decomposition, scree plot inspection, and parallel analysis. Bilingual agreement was assessed using the intraclass correlation coefficient (ICC[2,1]), quadratic weighted kappa, and Bland-Altman analysis.

Results: Complete Arabic DEQ-5 responses were obtained from 234 participants. Mean (SD) total DEQ-5 score was 8.52 (3.65). Overall, 181 participants (77.4%) met the prespecified symptom-screening threshold of a DEQ-5 score ≥ 6 , including 49 (20.9%) with scores ≥ 12 . The Arabic DEQ-5 showed acceptable internal consistency (Cronbach's alpha = 0.73; McDonald's ω_t = 0.82) and a dominant one-factor structure supported by eigenvalue decomposition, scree plots, and parallel analysis. In the fixed-order bilingual subset, total scores showed good point-estimate agreement (ICC[2,1] = 0.763), with weighted kappa values ranging from 0.364 to 0.840. Bland-Altman analysis showed minimal mean English-Arabic score bias but relatively wide limits of agreement.

Conclusions: The Arabic DEQ-5 demonstrated acceptable internal consistency and supportive evidence of a dominant one-factor structure in this conflict-affected displaced population. In the bilingual subset, total scores showed good point-estimate agreement; however, variable item-level agreement and wide limits of agreement do not support individual-level interchangeability between the Arabic and English versions. These findings suggest that the Arabic DEQ-5 may serve as a practical brief instrument for assessing dry eye symptoms in humanitarian and field research settings. However, because external validation measures, clinical assessments, confirmatory psychometric analyses, and test-retest reliability were beyond the scope of this study, the findings should be interpreted as a preliminary psychometric evaluation rather than a comprehensive validation. Further multicenter psychometric validation in diverse Arabic-speaking populations, including larger bilingual samples, is warranted.

KEYWORDS

dry eye disease, questionnaire, translations, cronbach's alpha, DEQ-5, Al-Mawasi camp, internal consistency, Bland-Altman analysis

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INTRODUCTION

During the 2023–2025 war in the Gaza Strip, large numbers of internally displaced persons were relocated to the Al-Mawasi area following evacuation orders and its designation as a humanitarian zone. Concurrent restrictions on the entry of humanitarian aid, including food trucks, further exacerbated shortages of food and other essential supplies in displacement camps [1, 2]. Al-Mawasi camps are characterized by severe overcrowding and shortages of safe drinking water, food, and electricity, with many residents relying on contaminated or salinized water because of the collapse of water and sanitation infrastructure [3, 4].

The Tear Film and Ocular Surface Society Dry Eye Workshop II (TFOS DEWS II) defines dry eye disease (DED) as “a multifactorial disease of the ocular surface characterized by a loss of homeostasis of the tear film, accompanied by ocular symptoms, in which tear film instability and hyperosmolarity, ocular surface inflammation and damage, and neurosensory abnormalities play etiological roles” [5]. DED is one of the most prevalent ocular surface disorders and is associated with ocular discomfort, visual disturbance, and progressive ocular surface damage [6]. Symptom-based questionnaires are widely regarded as the primary approach for evaluating patient-reported symptoms of DED. A range of instruments has been developed and used for this purpose, including the McMonnies Questionnaire [7], Ocular Surface Disease Index (OSDI) [8], OSDI-6 [9], Contact Lens Dry Eye Questionnaire-8 (CLDEQ-8) [10], Standard Patient Evaluation of Eye Dryness (SPEED) [11], Ocular Comfort Index (OCI) [12], and Dry Eye Questionnaire-5 (DEQ-5) [13]. However, the TFOS DEWS II specifically recommends use of the OSDI and DEQ questionnaires [14].

Two studies investigating DED were conducted in the Gaza Strip during the 2023–2025 conflict. Both used the validated Arabic version of the OSDI, supporting its applicability in conflict-affected populations [15, 16]. To our knowledge, published studies evaluating the use of the DEQ-5 in conflict-affected populations remain limited.

The five-item DEQ-5, developed in 2009, is a brief symptom assessment tool that offers simplicity, ease of administration, and straightforward cross-cultural adaptation [14]. It evaluates the frequency and intensity of dry eye symptoms experienced over the previous month [17]. The questionnaire has been translated and evaluated in several languages, including Arabic (Moroccan version), Mexican Spanish, Portuguese, Chilean Spanish, Chinese, and Thai [18, 19–23]. However, evidence regarding its use and psychometric performance in conflict-affected populations remains limited.

The present study aimed to conduct a preliminary psychometric evaluation of the Arabic version of the DEQ-5 in a conflict-affected displaced population in the Gaza Strip by examining its internal consistency, internal structure, and exploratory cross-language agreement. Establishing these preliminary psychometric properties may facilitate future validation studies and support the use of the Arabic DEQ-5 for assessing dry eye symptoms in Arabic-speaking populations affected by armed conflict, including those in Yemen, Sudan, and Libya.

METHODS

A cross-sectional observational study was conducted in the Al-Mawasi camps in southern Gaza. The study adhered to ethical principles for research in conflict-affected settings, with particular emphasis on protecting participant confidentiality. Written informed consent was obtained from all participants prior to enrollment. The study protocol was approved by the Palestinian Health Research Council (Approval No. PHRC/HC/883/21). Participants were recruited using a snowball sampling strategy initiated through multiple index participants within the Al-Mawasi camps. This approach was adopted because population registers, feasible probability-based sampling frames, safe systematic sampling procedures, and reliable communication infrastructure were unavailable under conflict conditions. Consequently, the study sample should be regarded as a field-accessible sample of internally displaced adults rather than a probability-based representative sample of the Gaza Strip. Eligible participants were adults (≥ 18 years) who were able to provide informed consent and complete the dry eye symptom questionnaire.

Data were collected during face-to-face field interviews using paper-based case report forms. Completed questionnaires were subsequently entered into Fillout.com for data management and quality control before export for statistical analysis. The primary psychometric analyses were performed using the Arabic DEQ-5 responses from 234 participants; among them, a bilingual subset of 31 completed the Arabic version first and the English version 72 hours later. Both questionnaires were administered by the same interviewer using otherwise similar face-to-face field procedures. The paired Arabic and English responses from this subset were used for an exploratory fixed-order bilingual agreement analysis. Because the administration order was fixed rather than randomized or counterbalanced, the analysis was not intended to establish language equivalence, measurement invariance, or

individual-level interchangeability. Participants outside the bilingual subset completed only the Arabic version and were therefore not included in the agreement analysis.

Dry eye symptoms were assessed using the DEQ-5, which comprises five scored items evaluating frequency of ocular discomfort, dryness, and watery eyes, together with the end-of-day intensity of discomfort and dryness. Item scores are summed to generate a total score ranging from 0 to 22, with higher scores indicating greater symptom burden [13]. For descriptive purposes, two commonly used thresholds were applied: a DEQ-5 score ≥ 6 , indicating symptoms warranting further evaluation for dry eye, and a score ≥ 12 , representing a higher symptom burden that has been proposed as a threshold for additional diagnostic evaluation in selected clinical settings [13].

Translation and preliminary psychometric evaluation: The DEQ-5 was translated into Arabic, the primary language of the study population, in accordance with established guidelines for translation and cross-cultural adaptation. The translation process comprised forward translation, backward translation, reconciliation, expert review, and pilot testing [24, 25].

Forward translation from English into Arabic was performed independently by three bilingual investigators: a Syrian senior lecturer in clinical pharmacy from International Islamic University Malaysia, a Sudanese senior lecturer in clinical pharmacy from Management and Science University, and a Palestinian non-medical investigator from Arab American University. All forward translators were fluent in both Arabic and English and had prior experience in questionnaire translation.

The reconciled Arabic draft was subsequently back-translated into English by two independent bilingual investigators who had not participated in the forward translation: a Syrian medical investigator and an Iraqi non-medical investigator from Management and Science University. Both back translators were fluent in Arabic and English and had prior experience in translation.

The back-translated English version was compared with the original English DEQ-5 to identify discrepancies in wording, conceptual meaning, and item interpretation. Any discrepancies were reviewed and resolved by consensus by a multidisciplinary panel comprising medical and non-medical investigators, all of whom held PhD degrees, were fluent in Arabic and English, and had prior translation experience. The reconciled Arabic version subsequently underwent final linguistic and clinical review by two PhD-level ophthalmology professionals from Syria and Yemen. The pre-final Arabic DEQ-5 was pilot-tested among 10 randomly selected internally displaced adults residing in Al-Mawasi camp who were not included in the main survey. All pilot participants were of broadly similar socioeconomic status, as they were internally displaced. During pilot testing, all questionnaire items were completed, responses were adequately distributed across items, and interviewers observed that participants clearly understood the questions. No major comprehension difficulties were identified; therefore, the finalized Arabic version was used in the main field survey. Formal cognitive interviewing was not undertaken. Instead, interviewer observations during pilot testing were used to assess item clarity, comprehension, and cultural appropriateness. Pilot participants were not included in the primary psychometric sample or the bilingual agreement subset. The overall workflow of the translation and preliminary psychometric evaluation of the Arabic DEQ-5 is presented in Figure 1.

All statistical analyses were performed using Python (pandas and NumPy for data management; SciPy and statsmodels for statistical analyses; and matplotlib for graphical presentation). Internal consistency was evaluated using Cronbach's alpha (α) and McDonald's omega total (ω_t), with values ≥ 0.70 considered indicative of acceptable internal consistency for this preliminary psychometric evaluation. Item-level analyses included descriptive statistics (mean and standard deviation [SD]), corrected item-total correlations, and Cronbach's alpha if the item was deleted. Internal structure was explored using principal component analysis of the inter-item correlation matrix, scree plot inspection, and parallel analysis. Components were retained when the observed eigenvalue exceeded the 95th percentile of eigenvalues generated from randomly permuted datasets. These findings were interpreted as preliminary evidence regarding dimensionality rather than definitive confirmation of a latent factor structure. Exploratory bilingual agreement analyses were restricted to the subset of 31 participants who completed the Arabic version first and the English version 72 hours later. Agreement for total DEQ-5 scores was evaluated using the two-way random-effects intraclass correlation coefficient for absolute agreement (ICC[2,1]) and Bland-Altman analysis. Agreement for individual questionnaire items was assessed using quadratic weighted kappa (κ) statistics. Because language, administration order, and time were confounded by the fixed-order design, these analyses were interpreted as agreement under the specified administration conditions rather than evidence of language equivalence or individual-level interchangeability.

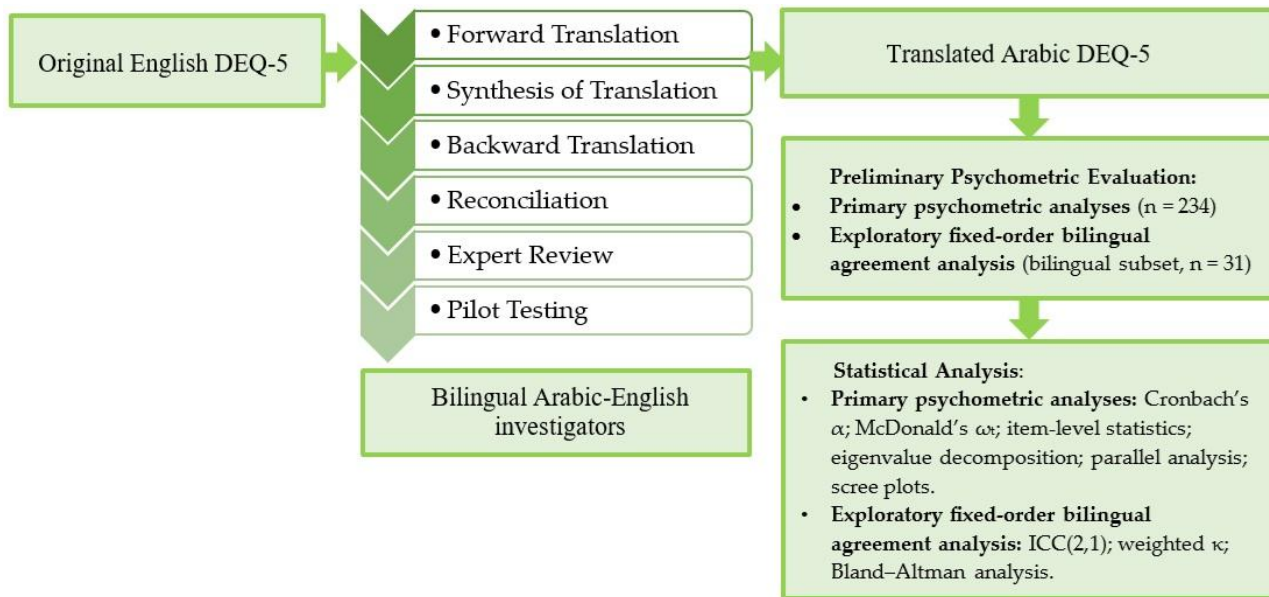


Figure 1. Overall workflow of the translation and preliminary psychometric evaluation of the Arabic DEQ-5. Abbreviations: DEQ-5, five-item Dry Eye Questionnaire; n, number of participants; ICC, intraclass correlation coefficient.

RESULTS

Complete Arabic DEQ-5 questionnaire data were obtained from 234 internally displaced adults and used for the primary psychometric analyses. Among these participants, a bilingual subset of 31 completed the English version of the DEQ-5 72 hours after the Arabic administration, generating paired responses for the exploratory fixed-order bilingual agreement analysis.

Mean (SD) age of the primary Arabic sample was 28.11 (10.06) years and 148 participants (63.2%) were female. Most participants held a bachelor's degree ($n = 138$, 59.0%), followed by a diploma ($n = 29$, 12.4%), secondary education ($n = 26$, 11.1%), master's degree ($n = 16$, 6.8%), doctorate ($n = 16$, 6.8%), and other educational qualifications ($n = 9$, 3.8%). Nearly half of participants were students ($n = 105$, 44.9%), followed by employed individuals ($n = 39$, 16.7%), self-employed individuals ($n = 33$, 14.1%), unemployed individuals ($n = 29$, 12.4%), homemakers ($n = 24$, 10.3%), and participants in other occupational categories ($n = 4$, 1.7%). Within the bilingual subset, mean (SD) age was 28.63 (8.97) years, and 16 participants (51.6%) were female. Mean (SD) Arabic DEQ-5 total score was 8.52 (3.65), with scores ranging from 0 to 19. Overall, 181 participants (77.4%) met the prespecified symptom-screening threshold of a DEQ-5 score ≥ 6 , including 49 participants (20.9%) with scores ≥ 12 . Sample characteristics and summary psychometric findings are presented in [Table 1](#).

The Arabic DEQ-5 showed acceptable internal consistency (Cronbach's $\alpha = 0.73$; McDonald's $\omega_t = 0.82$) ([Table 1](#)). Corrected item-total correlations ranged from 0.29 to 0.63. Item 3 showed the weakest corrected item-total correlation ($r = 0.29$), and Cronbach's α increased slightly from 0.73 to 0.75 when this item was deleted, whereas deletion of each of the other items resulted in lower α values ranging from 0.62 to 0.68. These findings indicate generally acceptable item performance while identifying Item 3 as comparatively weaker and warranting further evaluation in future studies. One-factor loadings ranged from 0.45 to 0.83, providing additional support for a dominant one-factor structure ([Table 2](#)). Although the English version showed higher internal consistency estimates (Cronbach's $\alpha = 0.91$; McDonald's $\omega_t = 0.93$) ([Table 1](#)), these findings should be interpreted cautiously because they were derived from the smaller bilingual subset.

Evaluation of internal structure supported a dominant one-factor solution in both language versions. For the Arabic questionnaire, the first observed eigenvalue (2.441) exceeded both the second eigenvalue (0.949) and the corresponding 95th percentile permuted eigenvalue obtained from parallel analysis, supporting retention of one factor. Similar results were observed for the English version, in which only the first observed eigenvalue exceeded the corresponding permuted eigenvalue, again supporting retention of one factor ([Table 3](#)). Scree plots for both language versions showed a clear inflection (elbow) after the first factor, further supporting a dominant one-factor structure ([Figures 2 and 3](#)).

Exploratory fixed-order bilingual agreement analyses were performed using the bilingual subset ($n = 31$), who completed the Arabic version first and the English version 72 hours later. Total DEQ-5 scores showed good point-estimate agreement ($\text{ICC}[2,1] = 0.763$). Bland–Altman analysis showed a small mean difference between the English and Arabic administrations (-0.290), with limits of agreement ranging from -6.260 to 5.680 . Item-level quadratic weighted kappa values ranged from 0.364 to 0.840 , indicating variable agreement across individual questionnaire items (Table 4). Although the mean bias between administrations was minimal, the relatively wide 95% limits of agreement in relation to the DEQ-5 total score range (0 – 22) suggest that individual participant scores may differ meaningfully between administrations. Because language, administration order, and time could not be examined separately, these findings should be interpreted as exploratory agreement under the specified administration conditions and do not establish language equivalence or individual-level interchangeability.

Table 1. Participant characteristics and summary psychometric properties of the Arabic and English DEQ-5

Characteristic	Arabic ($n = 234$)	English ($n = 31$)
Age (y), Mean $\pm$ SD	28.11 $\pm$ 10.06	28.63 $\pm$ 8.97
Sex (Male / Female), n (%)	86 (36.8) / 148 (63.2)	15 (48.4) / 16 (51.6)
DEQ-5 total score, Mean $\pm$ SD	8.52 $\pm$ 3.65	8.61 $\pm$ 4.97
Cronbach's α (95% CI)	0.73 (0.66, 0.78)	0.91 (0.83, 0.95)
McDonald's ω_t (95% CI)	0.82 (0.78, 0.85)	0.93 (0.88, 0.96)
First eigenvalue	2.44	3.71
Second eigenvalue	0.95	0.53
Factors retained (parallel analysis)	1	1

Abbreviation: DEQ-5, five-item Dry Eye Questionnaire; n , number of participants; y , years; SD, standard deviation; %, percentage; CI, confidence interval; α , Cronbach's alpha; ω_t , McDonald's omega total. Note: The English version was administered only to the bilingual subset included in the exploratory fixed-order agreement analysis ($n = 31$).

Table 2. Item statistics and one-factor loadings of the Arabic and English DEQ-5

Language	Item	Mean $\pm$ SD	Loading (1-factor)	Corrected item-total r	α if deleted	Missing %
Arabic	١	1.82 $\pm$ 0.94	0.70	0.50	0.68	0.0
Arabic	٢	2.17 $\pm$ 1.09	0.71	0.51	0.68	0.0
Arabic	٣	1.45 $\pm$ 0.99	0.75	0.54	0.67	0.0
Arabic	٤	1.72 $\pm$ 1.23	0.83	0.63	0.62	0.0
Arabic	٥	1.37 $\pm$ 1.00	0.45	0.29	0.75	0.0
English	1A	1.87 $\pm$ 1.02	0.86	0.78	0.89	0.0
English	1B	2.00 $\pm$ 1.32	0.90	0.83	0.88	0.0
English	2A	1.65 $\pm$ 1.23	0.87	0.80	0.88	0.0
English	2B	1.87 $\pm$ 1.28	0.90	0.85	0.87	0.0
English	3	1.23 $\pm$ 0.88	0.76	0.65	0.91	0.0

Abbreviation: DEQ-5, five-item Dry Eye Questionnaire; SD, standard deviation. Note: Corrected item-total r is the correlation between the item and the total score excluding that item.

Table 3. Internal structure (eigenvalues and parallel analysis) of the Arabic and English DEQ-5

Language	Rank	Observed eigenvalue	Permuted 95% eigenvalue
Arabic	1	2.441	1.270
Arabic	2	0.949	1.149
Arabic	3	0.812	1.039
Arabic	4	0.529	0.967
Arabic	5	0.270	0.899
English	1	3.708	1.793
English	2	0.533	1.363
English	3	0.425	1.085
English	4	0.224	0.896
English	5	0.110	0.683

Abbreviation: DEQ-5, five-item Dry Eye Questionnaire. Note: Parallel analysis supports factors where observed eigenvalue exceeds the 95th percentile of permuted eigenvalues.

Table 4. Exploratory fixed-order bilingual agreement between English and Arabic DEQ-5 administrations

Statistic	Value	N pairs
ICC(2,1) absolute agreement (total score)	0.763	31
Bland–Altman mean difference (EN–AR)	-0.290	31
Bland–Altman LOA (lower)	-6.260	31
Bland–Altman LOA (upper)	5.680	31
Quadratic weighted κ (1A vs. ١أ)	0.500	31
Quadratic weighted κ (1B vs. ١ب)	0.364	31
Quadratic weighted κ (2A vs. ٢أ)	0.692	31
Quadratic weighted κ (2B vs. ٢ب)	0.840	31
Quadratic weighted κ (3 vs. ٣)	0.412	31

Abbreviations: DEQ-5, five-item Dry Eye Questionnaire; ICC, intraclass correlation coefficient; EN–AR, English minus Arabic; LOA, limits of agreement; κ , kappa. Note: Agreement analyses were restricted to the 31 bilingual participants who completed the Arabic version first and the English version 72 hours later. These analyses should be interpreted as exploratory because of the small bilingual subset and fixed administration order.

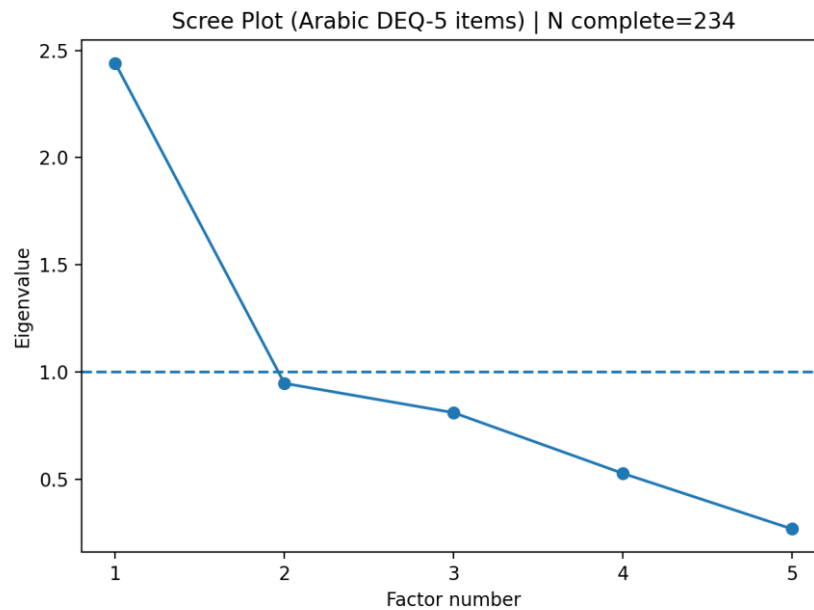


Figure 2. Scree plot for Arabic five-item Dry Eye Questionnaire (DEQ-5) items.

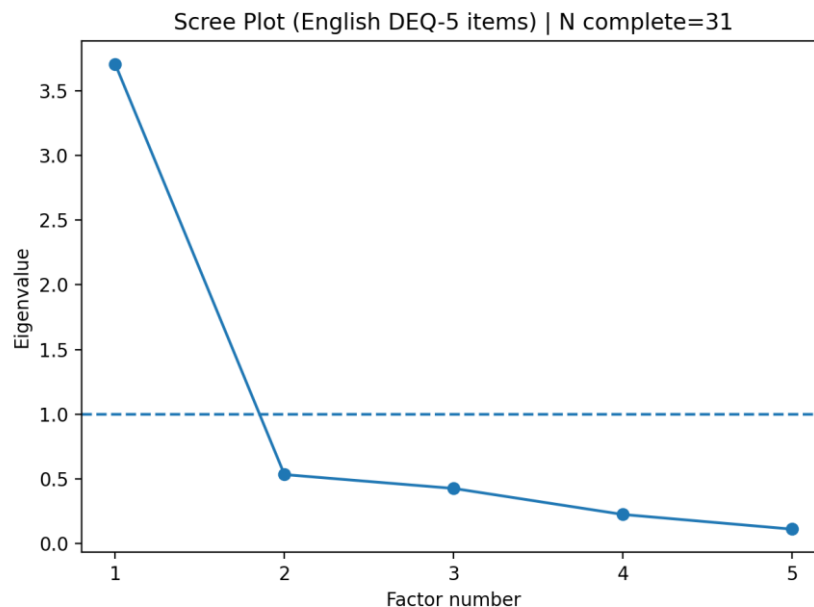


Figure 3. Scree plot for English five-item Dry Eye Questionnaire (DEQ-5) items.

DISCUSSION

This study provides preliminary psychometric evidence supporting the use of the Arabic DEQ-5 in a conflict-affected displaced population in the Gaza Strip. The questionnaire showed acceptable internal consistency and preliminary evidence of a dominant one-factor structure. In the fixed-order bilingual subset, total scores showed good point-estimate agreement, but item-level agreement was variable and the limits of agreement were wide. The findings also showed that a high proportion of participants met the prespecified symptom-screening threshold for dry eye. Although the psychometric evaluation was preliminary, these results suggest that the Arabic DEQ-5 may be a practical instrument for symptom assessment in humanitarian settings and provide a foundation for future comprehensive validation studies.

Our findings are broadly consistent with those reported in the Moroccan Arabic DEQ-5 validation by Bouazza et al. [18]. Both studies supported a unidimensional structure of the Arabic DEQ-5, although different psychometric approaches were used. Bouazza et al. [18] demonstrated unidimensionality using Rasch analysis and exploratory factor analysis, together with criterion validity against the Arabic OSDI, and identified an optimal DEQ-5 screening cut-off of 5.5 by receiver operating characteristic analysis. This threshold is closely aligned with the widely used screening cut-off of $DEQ-5 \geq 6$ adopted in the present study. However, the two investigations addressed different validation objectives. The Moroccan study provided a comprehensive cross-cultural validation, including external criterion validation, discriminant validity, concurrent validity, and receiver operating characteristic analysis [18]. In contrast, our study was conducted under the logistical constraints of a conflict-affected humanitarian setting and focused on preliminary psychometric properties, including internal consistency, internal structure, and exploratory cross-language agreement. Consequently, our findings complement the Moroccan validation [18] by extending preliminary psychometric evidence to a displaced conflict-affected population, rather than replicating the broader validation framework reported previously.

The present study extends the cross-cultural evaluation of the DEQ-5 to a unique population of internally displaced adults living in a conflict-affected humanitarian setting. Despite the markedly different sociocultural and environmental context, the Arabic DEQ-5 demonstrated psychometric properties that were broadly consistent with previous language adaptations [18, 20–22]. Internal consistency was acceptable (Cronbach's $\alpha = 0.73$; McDonald's $\omega = 0.82$), indicating satisfactory homogeneity among the five items while preserving the brevity of the instrument. Although the Cronbach's α observed in our study was slightly lower than those reported for the Moroccan Arabic ($\alpha = 0.80$) [18], Portuguese ($\alpha = 0.887$) [20], Chilean Spanish ($\alpha = 0.8085$) [21], and Chinese ($\alpha \geq 0.872$) versions [22], all studies exceeded the generally accepted threshold for acceptable reliability, supporting the robustness of the DEQ-5 across diverse linguistic and cultural settings [18, 20–22].

Evidence supporting the internal structure of the questionnaire was broadly consistent with previous validation studies [18, 21]. In the present study, only the first observed eigenvalue exceeded both the second eigenvalue and the corresponding permuted eigenvalue in parallel analysis, while scree plots demonstrated a clear elbow after the first factor, supporting retention of a dominant one-factor structure. Similarly, the Moroccan Arabic validation [18] demonstrated unidimensionality using Rasch principal component analysis of standardized residuals, with a first residual contrast eigenvalue of 1.7, despite employing a different psychometric framework [18]. In contrast, the Chilean Spanish adaptation identified a two-factor structure, in which the watery-eye item formed a separate factor from the discomfort and dryness items, suggesting potential differences in symptom perception or construct representation across populations and analytical approaches [21]. These findings suggest broadly similar internal-structure results across several DEQ-5 language adaptations, although the dimensionality identified may vary according to the study population and psychometric methodology.

An important distinction of the present study is the inclusion of an exploratory bilingual agreement analysis comparing Arabic and English administrations among the same participants. Previous DEQ-5 translation studies primarily evaluated the reliability of translated versions rather than direct agreement between different language versions. The Mexican Spanish [19] and Portuguese [20] validation studies evaluated the test-retest reliability of the translated questionnaires, whereas the Chinese adaptation additionally examined comparability between the English and Chinese versions alongside test-retest reliability [22]. Specifically, the Mexican Spanish validation assessed short-term test-retest reliability by repeated administration of the translated questionnaire on the same day and again three days later [19]. In contrast, the present study directly evaluated cross-language agreement using bilingual responses. Although the mean difference between administrations was minimal (-0.290) and total scores showed good point-estimate agreement ($ICC[2,1] = 0.763$), the relatively wide Bland–Altman limits of agreement and variable item-level weighted kappa values indicate that individual participant scores may differ meaningfully between administrations. Because the Arabic version

was consistently administered first and the English version 72 hours later, potential language effects could not be separated from administration-order effects, recall, familiarity with the questionnaire, or temporal variation in symptoms. These findings should therefore be interpreted as exploratory agreement under the specified administration conditions and do not establish language equivalence or individual-level interchangeability. Given the small bilingual subset and fixed administration order, confirmation in larger bilingual populations using randomized or counterbalanced administration is warranted.

Unlike several previous validation studies, our investigation did not include external criterion measures such as the OSDI, receiver operating characteristic analysis, or clinical ocular surface examinations to establish convergent or criterion validity [18, 19, 22]. Instead, our primary objective was to evaluate the internal psychometric performance of the Arabic DEQ-5 under the challenging conditions of a conflict-affected humanitarian setting. Consequently, the present study complements rather than replicates previous validation studies [18, 19, 22] by demonstrating acceptable internal consistency and preliminary evidence of a dominant single dimension in a highly vulnerable displaced population, while highlighting the need for future studies incorporating clinical assessments, external validation measures, test-retest reliability, confirmatory factor analysis, and measurement invariance testing.

This study has several strengths. To our knowledge, it is the first to provide a preliminary psychometric evaluation of the Arabic DEQ-5 in a conflict-affected displaced population. The study followed established cross-cultural adaptation guidelines and incorporated complementary psychometric methods to evaluate internal consistency, internal structure, and cross-language agreement. The findings should be interpreted in light of several limitations. First, this study was designed as a preliminary psychometric evaluation rather than a comprehensive validation study. Although the internal structure analyses supported a dominant one-factor solution, confirmatory factor analysis and measurement invariance testing were beyond the scope of the study. Consequently, the structural validity of the Arabic DEQ-5 should be considered preliminary and warrants confirmation in larger, independent samples. Second, criterion and convergent validity could not be evaluated because no additional dry eye symptom questionnaire, clinical examination, or objective ocular surface measure was available for comparison. Third, test-retest reliability was not evaluated and therefore the temporal stability of the questionnaire remains unknown. Fourth, the bilingual agreement analysis was based on a relatively small subset ($n = 31$) and used a fixed administration order, with the Arabic version completed first and the English version 72 hours later. Consequently, potential language effects could not be separated from administration-order effects, recall, familiarity with the questionnaire, or temporal variation in symptoms. Although the mean English–Arabic difference was minimal, item-level agreement was variable and the limits of agreement were relatively wide in relation to the 0–22 DEQ-5 score range. Therefore, these findings should be interpreted as exploratory and do not establish language equivalence or individual-level interchangeability between the Arabic and English versions. Finally, the use of snowball sampling may have introduced selection bias and limits generalizability of the findings beyond the conflict-affected displaced population studied. Future research should include larger and more representative samples, external validation against clinical and patient-reported dry eye measures, assessment of test-retest reliability, and confirmatory psychometric analyses, including confirmatory factor analysis and measurement invariance testing.

CONCLUSIONS

This study provides preliminary psychometric evidence supporting the use of the Arabic DEQ-5 among internally displaced adults living in a conflict-affected setting in the southern Gaza Strip. The Arabic DEQ-5 demonstrated acceptable internal consistency, generally acceptable item-level performance despite comparatively weaker performance for Item 3, and preliminary evidence of a dominant single dimension, suggesting that the questionnaire may serve as a practical brief instrument for assessing dry eye symptoms in humanitarian and field research settings. In the bilingual subset, total scores showed good point-estimate agreement; however, variable item-level agreement and wide limits of agreement do not support individual-level interchangeability between the Arabic and English versions. This study represents a preliminary psychometric evaluation rather than a comprehensive validation. Further studies incorporating larger and more representative samples, including adequately powered bilingual samples, confirmatory psychometric analyses, external validation against clinical and patient-reported measures, and test-retest reliability are required before the instrument can be considered fully validated for broader clinical and research applications.

ETHICAL DECLARATIONS

Ethical approval: The study adhered to ethical principles for research conducted in conflict-affected settings, with particular emphasis on safeguarding participant confidentiality. Written informed consent was obtained from all participants before enrollment. The study protocol was approved by the Palestinian Health Research Council (Approval No. PHRC/HC/883/21).

Conflict of interest: None.

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REFERENCES

1. Dardona Z, Amame M, Dardona A, Boussaa S. Health and environmental impacts of Gaza conflict (2023-2024): A review. *One Health Bulletin*. 2025 Mar 1;5(1):1-12. doi: 10.4103/ohbl.ohbl_42_24.
2. Migdad M, Al Karriri A, Buheji M. Challenges in delivering humanitarian aid during war on Gaza. *International Journal of Multidisciplinary Research and Growth Evaluation*. 2025 Mar;6(2):1329-38. doi: 10.54660/IJMRGE.2025.6.2.1329-1338.
3. Hassoun A, Al-Muhammad K, Haddarah A, Slim F, Iriqat D, Hamad A, Faddoul A, Buheji M (2025). 'Environmental consequences of conflict: Lessons from the recent war on Gaza. In War on Gaza: Consequences on Sustainability and Global Security 2025 May 31 (pp. 173-188)'. Cham: Springer Nature Switzerland. Print ISBN: 978-3-031-88499-3; Online ISBN: 978-3-031-88500-6. doi: 10.1007/978-3-031-88500-6_11.
4. Hassoun A, Parra-López C, Ben Hassen T, Ben Abdallah S, Shehadeh L, Socol CT, Rejeb A, Mahdi N, Samadhiya A, Buheji M, Ahmed D. The Gaza conflict and its implications for the sustainable development goals: a comprehensive analysis. *Environment, Development and Sustainability*. 2025 Oct 7:1-33. doi: 10.1007/s10668-025-06763-7.
5. Craig JP, Nichols KK, Akpek EK, Caffery B, Dua HS, Joo CK, Liu Z, Nelson JD, Nichols JJ, Tsubota K, Stapleton F. TFOS DEWS II Definition and Classification Report. *Ocul Surf*. 2017 Jul;15(3):276-283. doi: 10.1016/j.jtos.2017.05.008. Epub 2017 Jul 20. PMID: 28736335.
6. Yousefi-Manesh H, Aghamollaei H, Dehpour AR, Sheibani M, Tavangar SM, Bagheri M, Shirooie S, Daryabari SH, Noori T. The role of saffron in improvement of ocular surface disease in a mouse model of Lacrimal Gland Excision-induced dry eye disease. *Exp Eye Res*. 2022 Aug;221:109127. doi: 10.1016/j.exer.2022.109127. Epub 2022 Jun 7. PMID: 35688213.
7. Nichols KK, Nichols JJ, Mitchell GL. The reliability and validity of McMonnies Dry Eye Index. *Cornea*. 2004 May;23(4):365-71. doi: 10.1097/00003226-200405000-00010. PMID: 15097131.
8. Schiffman RM, Christianson MD, Jacobsen G, Hirsch JD, Reis BL. Reliability and validity of the Ocular Surface Disease Index. *Arch Ophthalmol*. 2000 May;118(5):615-21. doi: 10.1001/archophth.118.5.615. PMID: 10815152.
9. Pult H, Wolffsohn JS. The development and evaluation of the new Ocular Surface Disease Index-6. *Ocul Surf*. 2019 Oct;17(4):817-821. doi: 10.1016/j.jtos.2019.08.008. Epub 2019 Aug 20. PMID: 31442595.
10. Chalmers RL, Begley CG, Moody K, Hickson-Curran SB. Contact Lens Dry Eye Questionnaire-8 (CLDEQ-8) and opinion of contact lens performance. *Optom Vis Sci*. 2012 Oct;89(10):1435-42. doi: 10.1097/OPX.0b013e318269c90d. PMID: 22960615.
11. Ngo W, Situ P, Keir N, Korb D, Blackie C, Simpson T. Psychometric properties and validation of the Standard Patient Evaluation of Eye Dryness questionnaire. *Cornea*. 2013 Sep;32(9):1204-10. doi: 10.1097/ICO.0b013e318294b0c0. PMID: 23846405.
12. Johnson ME, Murphy PJ. Measurement of ocular surface irritation on a linear interval scale with the ocular comfort index. *Invest Ophthalmol Vis Sci*. 2007 Oct;48(10):4451-8. doi: 10.1167/iiov.06-1253. PMID: 17898265.
13. Chalmers RL, Begley CG, Caffery B. Validation of the 5-Item Dry Eye Questionnaire (DEQ-5): Discrimination across self-assessed severity and aqueous tear deficient dry eye diagnoses. *Cont Lens Anterior Eye*. 2010 Apr;33(2):55-60. doi: 10.1016/j.clae.2009.12.010. Epub 2010 Jan 25. PMID: 20093066.
14. Wolffsohn JS, Arita R, Chalmers R, Djalilian A, Dogru M, Dumbleton K, Gupta PK, Karpecki P, Lazreg S, Pult H, Sullivan BD, Tomlinson A, Tong L, Villani E, Yoon KC, Jones L, Craig JP. TFOS DEWS II Diagnostic Methodology report. *Ocul Surf*. 2017 Jul;15(3):539-574. doi: 10.1016/j.jtos.2017.05.001. Epub 2017 Jul 20. PMID: 28736342.

15. Aljarousha M, Alghamdi WM, Che Azemin MZ, Mahmud M. Epidemiology of ocular surface symptoms and their association with stress levels among the Gazan population in crowded shelters during the 2023 Israel war. *Cont Lens Anterior Eye*. 2025 Jul;48(4):102403. doi: [10.1016/j.clae.2025.102403](https://doi.org/10.1016/j.clae.2025.102403). Epub 2025 Mar 17. PMID: [40102140](https://pubmed.ncbi.nlm.nih.gov/40102140/).
16. Aljarousha M, Azemin MZC, Ariffin IA, Alhoot MA, Elmanama AA, Alsaqqa HH, Aljeesh Y, Isa MZA, Ang MY, Alghamdi WM, Mizher HAA, Shaqoura EIH. Depression, anxiety, stress, and dry eye disease among Gazan undergraduate health sciences and nursing students: a structural equation modeling study. *Cont Lens Anterior Eye*. 2026 Feb;49(1):102504. doi: [10.1016/j.clae.2025.102504](https://doi.org/10.1016/j.clae.2025.102504). Epub 2025 Sep 8. PMID: [40925815](https://pubmed.ncbi.nlm.nih.gov/40925815/).
17. Begley CG, Chalmers RL, Mitchell GL, Nichols KK, Caffery B, Simpson T, DuToit R, Portello J, Davis L. Characterization of ocular surface symptoms from optometric practices in North America. *Cornea*. 2001 Aug;20(6):610-8. doi: [10.1097/00003226-200108000-00011](https://doi.org/10.1097/00003226-200108000-00011). PMID: [11473162](https://pubmed.ncbi.nlm.nih.gov/11473162/).
18. Bouazza S, Abbouyi S, Ragala ME, El Hilaly J, El Rhazi K, Zarrouq B. Cross-cultural validation of the Arabic version of the dry eye questionnaire-5 (DEQ-5) scale. *Acta Biomed*. 2024;95(6): e2024171. doi: [10.23750/abm.v95i6.16065](https://doi.org/10.23750/abm.v95i6.16065).
19. Martinez JD, Galor A, Amescua G, Ramos-Betancourt N, Beltrán F, Babayán Sosa A, Santacruz Valdés C, Ramírez-Assad C, Mora Juárez E, Hernández-Quintela E. Transcultural validation of the 5-Item Dry Eye Questionnaire for the Mexican population. *Int Ophthalmol*. 2019 Oct;39(10):2313-2324. doi: [10.1007/s10792-018-01068-3](https://doi.org/10.1007/s10792-018-01068-3). Epub 2019 Jan 14. PMID: [30644026](https://pubmed.ncbi.nlm.nih.gov/30644026/).
20. Gross LG, Pozzebon ME, Favarato AP, Ayub G, Alves M. Translation and validation of the 5-Item Dry Eye Questionnaire into Portuguese. *Arq Bras Oftalmol*. 2022 Nov 4;87(3):e2022-0197. doi: [10.5935/0004-2749.2022-0197](https://doi.org/10.5935/0004-2749.2022-0197). Epub ahead of print. PMID: [36350916](https://pubmed.ncbi.nlm.nih.gov/36350916/); PMCID: [PMC11627234](https://pubmed.ncbi.nlm.nih.gov/PMC11627234/).
21. Goya MC, Traipe L, Bahamondes R, Rodríguez C, López D, Salinas D, López R, León A. Adaptation culturally and linguistically to the Chilean population and validation the Dry Eye Questionnaire 5. *Arch Soc Esp Oftalmol (Engl Ed)*. 2023 Jun;98(6):307-316. doi: [10.1016/j.oftale.2023.01.004](https://doi.org/10.1016/j.oftale.2023.01.004). Epub 2023 Mar 22. PMID: [36963486](https://pubmed.ncbi.nlm.nih.gov/36963486/).
22. Guo B, Chan KY, Li PH, Tse JSH, Liao X, Eng D, Chen C, Meng Z, Wei R, Cheong A, Ngo W, Lam TC. Validation and repeatability assessment of the Chinese version of the Ocular Surface Disease Index (OSDI), 5-item dry eye (DEQ-5), and contact lens dry eye questionnaire-8 (CLDEQ-8) questionnaires. *Cont Lens Anterior Eye*. 2025 Jun;48(3):102353. doi: [10.1016/j.clae.2024.102353](https://doi.org/10.1016/j.clae.2024.102353). Epub 2024 Dec 18. PMID: [39694733](https://pubmed.ncbi.nlm.nih.gov/39694733/).
23. Tonkerdmongkol D, Poyomtip T, Poolsanam C, Watcharapalakorn A, Tawonkasiwattanakun P. Prevalence and associated factors for self-reported symptoms of dry eye among Thai school children during the COVID-19 outbreak. *PLoS One*. 2023 Apr 24;18(4):e0284928. doi: [10.1371/journal.pone.0284928](https://doi.org/10.1371/journal.pone.0284928). Erratum in: *PLoS One*. 2024 Nov 20;19(11):e0314413. doi: [10.1371/journal.pone.0314413](https://doi.org/10.1371/journal.pone.0314413). PMID: [37093868](https://pubmed.ncbi.nlm.nih.gov/37093868/); PMCID: [PMC10124893](https://pubmed.ncbi.nlm.nih.gov/PMC10124893/).
24. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine (Phila Pa 1976)*. 2000 Dec 15;25(24):3186-91. doi: [10.1097/00007632-200012150-00014](https://doi.org/10.1097/00007632-200012150-00014). PMID: [11124735](https://pubmed.ncbi.nlm.nih.gov/11124735/).
25. Cruchinho P, López-Franco MD, Capelas ML, Almeida S, Bennett PM, Miranda da Silva M, Teixeira G, Nunes E, Lucas P, Gaspar F; Handovers4SafeCare. Translation, Cross-Cultural Adaptation, and Validation of Measurement Instruments: A Practical Guideline for Novice Researchers. *J Multidiscip Healthc*. 2024 May 31;17:2701-2728. doi: [10.2147/JMDH.S419714](https://doi.org/10.2147/JMDH.S419714). PMID: [38840704](https://pubmed.ncbi.nlm.nih.gov/38840704/); PMCID: [PMC11151507](https://pubmed.ncbi.nlm.nih.gov/PMC11151507/).