

Indonesian client satisfaction questionnaire-18 for evaluating AI-assisted diabetic retinopathy screening in primary care: reliability and patient satisfaction

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pISSN: 0853-1773 • eISSN: 2252-8083
<https://doi.org/10.13181/mji.oa.268503>
Med J Indones. 2026;35:133–40

Received: October 31, 2025

Accepted: May 19, 2026

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ABSTRACT

BACKGROUND Diabetic retinopathy (DR) is a leading cause of preventable blindness. However, Indonesia lacks a comprehensive screening program. Artificial intelligence (AI)-assisted screening in primary health care (PHC) is a promising solution. Patient satisfaction is crucial for ensuring the participation and sustainability of such programs. This study aimed to adapt Indonesian version of evaluate client satisfaction questionnaire-18 (CSQ-18) and evaluate its acceptability.

METHODS This study was conducted from August 5–29, 2024 at 2 public PHCs in Jakarta. Patients with diabetes underwent DR screening, which included fundus photography and an AI-based grading system (RADR). Referable cases were graded secondarily by ophthalmologists. Satisfaction was assessed from November 10–20, 2024 using the Indonesian-translated CSQ-18, adapted through forward-backward translation, expert review, and pilot testing. Reliability was assessed using Cronbach's alpha, validity was evaluated using Pearson's correlation, and satisfaction scores were summarized as descriptive statistics.

RESULTS Of 300 selected participants, 216 completed telephone or in-person interviews. The Indonesian CSQ-18 demonstrated a strong internal consistency (Cronbach's alpha = 0.886). All items showed acceptable item-total correlations. The mean (SD) satisfaction score was 60.19 (5.50) of 72, with a median of 59, indicating high patient satisfaction. Most participants expressed positive perceptions of screening duration, accessibility, and provider competence, although awareness-related items scored slightly lower. Potential interviewer bias and nonresponse may have affected the findings.

CONCLUSIONS The Indonesian CSQ-18 is a reliable tool for assessing patient satisfaction with DR screening. These findings confirm the feasibility and acceptability of AI-assisted DR screening at the PHC level, supporting its potential for broader implementation in Indonesia.

KEYWORDS artificial intelligence, diabetic retinopathy, patient satisfaction, primary health care, surveys and questionnaires

Diabetic retinopathy (DR) can lead to blindness and affects approximately 16.9% of patients with diabetes.¹ Untreated DR may lead to visual impairment or blindness.² The prevalence of DR in Yogyakarta, Indonesia was 43.1%, of which 26.3% were classified as vision-threatening DR (VTDR). Both the DR and VTDR were higher in patients with long-term diabetes.³ Early and regular

screening for DR is necessary to prevent DR-related vision loss.

Unfortunately, Indonesia lacks a comprehensive DR screening program.⁴ Previous studies have noted key challenges related to implementation, including low disease awareness among patients and healthcare providers, unequal access to diagnostic tools, shortages of trained eye care personnel, and financial barriers to accessing health services.⁵ Due to these limitations, artificial intelligence (AI) may serve as a promising tool for DR screening.

AI-based DR grading using retinal photographs enhances diagnostic accuracy, expands access to screening, and provides cost-effective solutions.⁶ Integrating AI into DR screening in primary health care (PHC) is a promising strategy for improving coverage. Moreover, patient satisfaction and experience are critical to the success of any screening program as they influence participation, compliance, and service improvement.⁷⁻⁹

The client satisfaction questionnaire (CSQ) is a validated measurement tool for assessing treatment satisfaction, with a maximum score of 72. By covering nine domains of satisfaction—physical surroundings, staff support, type of services, staff treatment, quality of services, number of services, outcome of services, general satisfaction, and procedure—the questionnaire showed excellent psychometric properties.^{10,11} Several studies demonstrated robust psychometric properties in diverse healthcare settings.¹²⁻¹⁴

To date, the client satisfaction questionnaire-18 (CSQ-18) has been translated into more than 30 languages. However, no official Indonesian version has yet been developed.¹⁵ Language plays a critical role in establishing the response-formation process, as comprehending the meaning of a question is essential for generating accurate responses. It is further influenced by cultural norms and practices, which may affect how questions are interpreted and answered.¹⁶ Therefore, adapting the CSQ-18 based on Indonesian language and cultural background is essential to accurately capture patient satisfaction with healthcare services, including DR screening programs. This study aimed to process CSQ-18 from Indonesian context and demonstrate its reliability for assessing patient satisfaction. This study also evaluated the acceptability of AI-assisted DR screening in primary care settings.

METHODS

Study methods and participants

This study was conducted at two PHCs—Puskesmas Tanjung Priok and Puskesmas Pasar Rebo—as part of a pilot project for an AI-assisted DR screening program. The DR screening was performed from August 2024 to November 2024. Data were collected in the last step of the screening to determine patient satisfaction after the entire screening process.

Participants were selected from among the diabetes mellitus (DM) patients who underwent screening for DR at PHC. We used an online randomization tool with a minimum target sample size of 150 individuals per PHC. The sample size calculation was based on at least 50% of patients with DM who underwent DR screening at each PHC. The inclusion criteria were as follows: (1) patients diagnosed with DM who completed the screening process at the two PHCs selected through randomization, (2) accessible via telephone, and (3) willing to participate in the study. Exclusion criteria included inability to communicate in Indonesian, failure to respond after three phone calls, or refusal to provide informed consent.

Pilot testing of DR screening

The screening process began with hands-on training of health care providers at both PHCs, including general practitioners (GPs) and nurses. The training included orientation to the study workflow based on the modules developed by ophthalmologists.

Patients with DM were invited to participate through WhatsApp messages (Meta Inc., USA), communication announcements by community health cadres, or direct notifications from nurses during routine monthly checkups. On the day of screening, the participants underwent a series of examinations, including a medical history review, visual acuity (VA) assessment using a Snellen chart, anterior segment evaluation with a handheld flashlight, and fundus photography using a Topcon TRC-NW400 fundus camera (Topcon, Japan). The patients were assessed without mydriatic agents. If the generated images were inadequate, the patients were administered mydriatics. The best-quality images of both the eyes were selected and uploaded to the AI-based robust domain-adversarial-based regression (RADR) grading system. RADR is an AI-based software developed by Universitas Gadjah Mada. This framework consists of

three stages: the feature map, encoder, and classifier. The RADR is trained to classify fundus images as: no DR, mild non-proliferative DR (NPDR), moderate NPDR, severe NPDR, proliferative DR (PDR), VTDR, and diabetic macular edema (DME).

Image grading was performed semi-automatically. RADR classified images as either “refer” or “not refer.” “Refer” images are defined as moderate NPDR with VTDR, severe NPDR, PDR, VTDR, and DME. Ungradable images are also referred for further evaluation. All “refer” cases were reviewed by ophthalmologists for secondary grading. If the secondary grading confirmed “refer,” patients were referred to a higher-level healthcare facility. Patients whose images were graded as “not refer” were given further knowledge about the disease and were scheduled for routine follow-up screening. Patient satisfaction was evaluated using the CSQ-18 questionnaire, administered via telephone approximately 1 month after the screening.

Questionnaire validation

Translation and cultural adaptation process

The CSQ-18 was translated into Indonesian by a certified, sworn translator (ML). To ensure the conceptual equivalence and cultural relevance of the translated items, the preliminary Indonesian version was reviewed and completed by a panel constituting experts fluent in Indonesian and experienced in the field. Revisions were made to increase clarity and contextual appropriateness based on their feedback.

Following these adjustments, the revised Indonesian version was back-translated into English by a separate sworn translator (ML) from a different translation agency to minimize bias. Furthermore, the original, translated, and back-translated versions were compared to evaluate their consistency and semantic equivalence. This process ensured that the meaning of each item was preserved across all versions. Following the development of the final version of the questionnaire, a pilot test was conducted by PHC staff on a small randomized sample of diabetic patients from both PHCs to assess item clarity and usability. Using an online randomization tool, 15 participants were selected from a pool of patients with DM at both PHCs.

During the pilot study, the participants were asked to complete the questionnaire and provide feedback on the clarity, relevance, and ease of understanding of each item. Feedback was sought explicitly for any item

perceived as confusing or unclear. A threshold was established such that if 20% or more of the participants identified an item as unclear, it was subjected to further revision.¹⁷

Finalization of the Indonesian version of the CSQ-18 questionnaire

In the preliminary testing phase, the questionnaire was administered to 15 participants at each PHC, totaling 30 participants for both PHCs. Participants were randomly chosen using an online randomization tool. They reviewed each question and provided feedback on its clarity. From the testing, no items in the questionnaire received feedback of “unclear” for more than 20%; therefore, no revisions were made. The final Indonesian version can be obtained through contact with the author.

Data collection procedure

Data for CSQ-18 was collected by a designated interviewer at each PHC. Participants completed the questionnaire in an interviewer-administered format. Since diabetic patient examinations were conducted monthly, those returning for follow-up in the following month were interviewed. Participants who did not return were contacted via telephone and those who were unreachable after three call attempts were excluded from the study.

Prior to data collection, all the participants were informed about the study objectives and they provided verbal informed consent. Upon obtaining consent, the interviewers administered the CSQ-18 and recorded the responses for each item. The interview process took approximately 5–10 min to complete.

Statistical analysis

Data were tabulated using Microsoft Excel (Microsoft, USA) and analyzed using SPSS software version 25 (IBM Corp., USA). For validity testing, Pearson’s or Spearman’s correlation coefficients were used depending on the data distribution. Internal consistency reliability was assessed using the Cronbach’s alpha coefficient. Validity and reliability assessments were conducted during both the preliminary pilot test involving 30 participants and the full data collection phase to ensure robustness of the questionnaire across different sample sizes.

Descriptive statistics were used for qualitative variables, including the frequency and percentage distributions of sociodemographic data. Additional

analyses of distribution, including skewness value and Kolmogorov–Smirnov test, as well as mean and standard deviation (SD), were calculated to yield the overall satisfaction scores and individual item scores of the CSQ-18.

Ethical considerations

This study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the Ethics Committee of the Faculty of Medicine, Universitas Indonesia–Cipto Mangunkusumo Hospital (No: KET-112/UN2.F1/ETIK/PPM.00.02/2024). Written or verbal informed consent was obtained from all participants before data collection.

RESULTS

Participants characteristics

Of 536 patients who underwent DR screening, 300 (150 from each PHC) were randomly selected for inclusion. Out of 300, we successfully contacted 216 participants (72.0%) who completed the survey through either in-person or telephone interviews.

Among the respondents, 140 (64.8%) were from Puskesmas Pasar Rebo and 76 (35.2%) were from Puskesmas Tanjung Priok. The study sample consisted of 137 female (63.4%) and 79 male (36.6%) participants. The mean age of the respondents was 60.68, with the youngest being 36 and the oldest being 79 years of age. Ninety-two respondents (42.6%) had been diagnosed with DM for less than 5 years. The DR status is presented in Table 1.

Validity and reliability results

Validity and reliability testing of the Indonesian-translated CSQ-18 was conducted in two phases: a preliminary pilot test involving 30 randomized participants and the main data collection phase involving 216 participants. Item-total correlations were assessed by comparing the Pearson's correlation coefficient (r) for each item with the critical r -value from the Pearson table. All items demonstrated adequate validity, with correlation coefficients exceeding the threshold (Supplementary Table 1). The internal consistency, as measured by Cronbach's alpha, was 0.878.

Table 1. DR distribution of the respondents

DR severity	Number of eyes		Number of person (N = 216)
	Right (N = 216)	Left (N = 216)	
No DR	172 (79.6)	169 (78.2)	154 (71.3)
Mild NPDR	7 (3.2)	7 (3.2)	10 (4.6)
Moderate NPDR	10 (4.6)	11 (5.1)	11 (5.1)
Severe NPDR	0 (0)	2 (0.9)	1 (0.5)
PDR	2 (0.9)	1 (0.5)	2 (0.9)
Ungradable	25 (11.6)	26 (12.0)	38 (17.6)

DR=diabetic retinopathy; NPDR=non-proliferative diabetic retinopathy; PDR=proliferative diabetic retinopathy

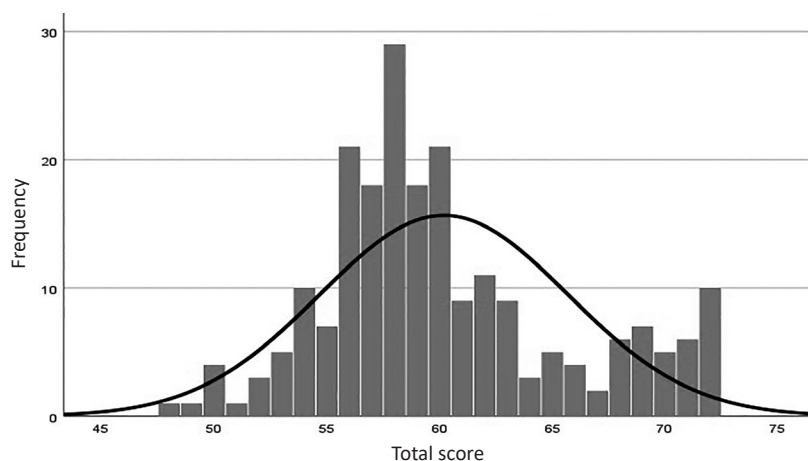


Figure 1. Total score of client satisfaction questionnaire-18 (CSQ-18) distribution (N = 216)

Table 2. Distribution of each item score

Item	Frequencies (%)				N
	1	2	3	4	
Item 1	0 (0)	24 (11.1)	146 (67.6)	46 (21.3)	216
Item 2	1 (0.5)	11 (5.1)	146 (67.6)	58 (26.9)	216
Item 3	2 (0.9)	23 (10.6)	130 (60.2)	61 (28.2)	216
Item 4	1 (0.5)	4 (1.9)	140 (64.8)	71 (32.9)	216
Item 5	1 (0.5)	1 (0.5)	97 (44.9)	117 (54.2)	216
Item 6	0 (0)	2 (0.9)	59 (27.3)	155 (71.8)	216
Item 7	0 (0)	3 (1.4)	169 (78.2)	44 (20.4)	216
Item 8	0 (0)	3 (1.4)	116 (53.7)	97 (44.9)	216
Item 9	13 (6.0)	68 (31.5)	94 (43.5)	41 (19.0)	216
Item 10	1 (0.5)	1 (0.5)	155 (71.8)	59 (27.3)	216
Item 11	0 (0)	6 (2.8)	162 (75.0)	48 (22.2)	216
Item 12	0 (0)	11 (5.1)	149 (69.0)	56 (25.9)	216
Item 13	0 (0)	4 (1.9)	141 (65.3)	71 (32.9)	216
Item 14	0 (0)	1 (0.5)	53 (24.5)	162 (75.0)	216
Item 15	0 (0)	3 (1.4)	156 (72.2)	57 (26.4)	216
Item 16	0 (0)	4 (1.9)	145 (67.1)	67 (31.0)	216
Item 17	0 (0)	1 (0.5)	63 (29.2)	152 (70.4)	216
Item 18	0 (0)	1 (0.5)	32 (14.8)	183 (84.7)	216

Following the final phase of data collection involving 216 participants, validity and reliability analyses were conducted using the methods employed in the preliminary phase. For the validity assessment, each item demonstrated a Pearson's correlation coefficient greater than the critical value from the Pearson table, indicating that all items were valid for measuring client satisfaction (Supplementary Table 2). Reliability testing revealed a Cronbach's alpha of 0.886.

Satisfactory level

Of 300 randomized respondents, 216 were successfully contacted. The satisfaction score had a mean (SD) of 60.19 (5.502) and a median of 59 (as shown in Figure 1). The data was positively skewness and were abnormally distributed, with a Kolmogorov–Smirnov value of <0.001. The maximum score on the questionnaire was 72, achieved by 10 respondents (4.9%). The distribution of scores for each item is shown in Table 2.

DISCUSSION

The cross-cultural adaptation was undertaken to modulate the existing English questionnaire into

Indonesian, while maintaining the semantic, idiomatic, experiential, and conceptual equivalence of the original questionnaire.¹⁸ Cross-cultural adaptation involves translating and adapting the existing questionnaire for use in the new setting, particularly when the questionnaire is relevant to different cultures and countries with entirely different languages. This process is effective at achieving more reliable and generalizable results as well as generating higher response rates.¹⁹

Based on these results, the internal consistency reliability of the Indonesian version of the CSQ-18 was comparable to that of the English version, with a Cronbach's alpha of 0.9111. It was also similar to the Cebuano version, with a Cronbach's alpha of 0.85, and the Waray version, with a Cronbach's alphas of 0.84 and 0.8712. A value of 0.7 or more indicates appropriate reliability.²⁰ Thus, the Indonesian version of the CSQ-18 is efficient for measuring patient satisfaction with DR screening programs.

The mean (SD) and median scores demonstrated a satisfactory level of participation in the DR screening program at the PHCs using the developed model. Overall, the screening model was considered acceptable for all patients. The scores were mainly concentrated at 3 and 4 for each item, except for item

9. Regarding the CSQ-18, the higher the score, the higher was the level of satisfaction, with a maximum score of 72 and a minimum of 18.

Item 1 addressed the duration of the screening process. Most respondents perceived DR screening, which involves VA testing by nurses and examination of the anterior and posterior segments by GPs at a PHC, to be sufficiently fast. Most responses were clustered around scores of three or four on the satisfaction scale. Based on a previous study, waiting time was considered as one of the factors influencing treatment adherence.²¹ Therefore, a time-effective DR screening program should be considered to improve patient coverage and compliance with screening and reference programs. The use of AI has also been proven to increase diagnostic speed with reasonable accuracy, as the determination of DR grading and reference was performed in real time.^{22,23}

Items 2 and 3 evaluated the acceptability of the screening program location. Most respondents agreed that PHCs in Jakarta provide a comfortable environment for diabetic patients and do not discourage them from participating in the screening process. Based on previous studies, the screening place should be spatially closer to people and accessible for improving patient compliance, especially in low- to middle-income countries where the primary care system plays a significant role in managing patients with DM.^{24,25}

In items 7, 10, and 11, most patients were satisfied with the healthcare providers implementing the screening process. These results suggest that GPs and nurses at PHCs were able to deliver appropriate examinations and provide adequate education to diabetic patients throughout the screening process. This was also reflected for items 4–6 regarding the perceived quality and importance of care provided by healthcare professionals. Most respondents expressed satisfaction with the care received and believed that the screening program was effective in the management of diabetes-related complications, including DR. Item 8 also addressed the alignment between the care provided and respondents' expectations. Most of the participants agreed that their care met their expectations.

Previous studies have demonstrated that integrating AI into PHC services can strengthen preventive strategies and promote comprehensive accessible care. In the context of DR screening, AI has the potential to reduce the workload of

ophthalmologists,²⁶ which is particularly important given the limited number of ophthalmologists in Indonesia. Ensuring the high sensitivity and specificity of AI-based systems, along with adequate training of healthcare providers at PHCs, is essential for ensuring a robust screening process. Implementing DR screening at the PHC level may be an effective strategy to increase screening coverage and improve patient compliance.

For item 9, it can be seen that the most chosen answers were 2 and 3, which could reflect a lack of knowledge among patients regarding DR screening. Following a previous study by Prajnaparamita,²⁷ one of the significant barriers in the early detection of DR was limited awareness among diabetes patients, who only seek medical care after they develop symptoms. Therefore, despite the favorable acceptability of the DR screening program, education and socialization regarding the DR process, symptoms, and examinations should be included in the screening program.

Items 12–18 assessed overall satisfaction with the DR screening program. Based on the distribution of responses, most participants found the program sufficiently helpful. Most of the respondents reported a high level of satisfaction. These findings indicated that they would recommend screening other patients in need and would be willing to return for future examinations.

The results of the satisfaction rate measured using the Indonesian version of the CSQ-18 provide evidence for the scale-up of DR screening implementation in Indonesia. The questionnaire enables the development of evidence-based policies and systemic evaluation of AI-based DR screening. With highly satisfactory results, AI-based DR screening could be implemented in Jakarta and Indonesia. AI-based DR screening programs have the potential to reach DM patients at PHCs, facilitating accessible, convenient, and comprehensive DM management. Early detection of DR allows timely intervention, thereby improving patient outcomes. With this model, DR screening coverage will be improved, and global eye targets will be achieved by 2030. Furthermore, comprehensive DR and DM management data are essential for evidence-based policymaking.

This study has several limitations. First, although the cross-cultural adaptation process followed commonly accepted translation methods, a harmonization step was not conducted. This may have limited the opportunity to further refine the translated version

based on the collective input. Second, the study did not assess psychometric properties other than internal consistency, such as construct validity or test-retest reliability, which could provide a more comprehensive evaluation of the instrument. Third, the analysis of patient satisfaction was limited to descriptive statistics without examining the associations with sociodemographic variables, which may have provided more profound insights into the factors influencing satisfaction. Fourth, the study may have been subject to interviewer-administered survey bias. Selection bias may have been introduced, as a proportion of selected patients could not be contacted for the survey. The limitations of this study are that it addresses overall patient satisfaction with DR screening rather than specifically evaluating satisfaction with the AI integration components of the program. The imbalanced distribution of respondents across the two PHCs may have also introduced bias.

In conclusion, the cross-cultural adaptation and psychometric assessment of the Indonesian version of the CSQ-18 demonstrated that it is a reliable tool for measuring patient satisfaction with DR screening programs in PHC settings. A high internal consistency score (Cronbach's $\alpha = 0.886$) confirmed the reliability of the scale. Overall, the Indonesian CSQ-18 is a valuable instrument for evaluating service quality and guiding enhancements of DR screening efforts in Indonesia. The results of the satisfaction survey showed that the DR screening program at the PHC centers was well accepted by patients, with positive perceptions of duration, location, and quality of care. These findings indicate the feasibility and acceptability of DR screening at the primary care level in Indonesia.

Conflict of Interest

Dicky Levenus Tahapary and Saleha Sungkar are the editorial board member of this journal but was not involved in the review or decision-making process of the article.

Acknowledgment

We acknowledge Clifford Attkins as the original developer of CSQ-18 questionnaire. The original CSQ-18 questionnaire can be obtained upon request from Clifford Attkins.

Funding Sources

This study was supported by Postgraduate Research Grant Universitas Indonesia number NKB-83/UN2.RST/HKP.05.00/2024.

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