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Cultural adaptation and predictive modelling of the eating disorder examination questionnaire (EDE-Q) using hybrid statistical approaches among Bengalee female adolescents

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Abstract

Introduction and objectives The abnormal eating and related lifestyle attitudes are termed as eating disorders (ED), which often arise among adolescent females and become the third most common chronic illness. The Eating Disorder Examination Questionnaire (EDE-Q) is a widely used screening tool for ED, but has limited cultural validation, which could be a linguistic barrier across diverse populations. Appropriate translation and cultural adaptation are crucial for accurately estimating the prevalence of ED. Therefore, the study aimed to evaluate the dimension structure and appropriateness of the EDE-Q items in the Bengali version, assess its validity and reliability, and identify the important items contributing to ED risk.

Materials and methods A cross-sectional school-based study was conducted among 472 Bengalee adolescent female students aged 13–19 years from both rural and urban areas of North 24 Parganas district of West Bengal. EDE-Q was translated into Bengali language following standard forward translation procedure and administered to participants. Incomplete responses were excluded from the analysis. ED risk was defined using the global EDE-Q score based on established cut-off criteria. Principal component analysis (PCA) was performed to examine dimensionality and ensure cultural adaptation of the items. The reliability and validity of the questionnaire were assessed to ensure its consistency and accuracy. Artificial Neural Network (ANN) modeling was used to evaluate the relative contribution of each dimension and item in predicting ED risk and model performance was assessed using metrics such as sensitivity and specificity.

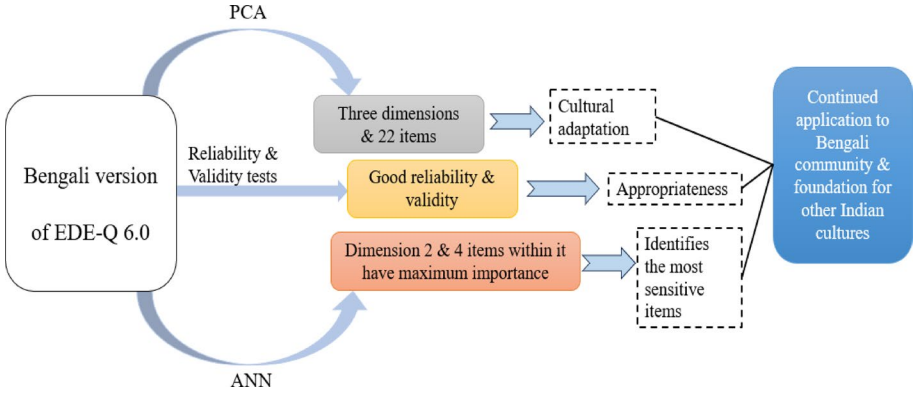
Results PCA produces three dimensions (subscales) named as 'Cognitive-preoccupation and self-evaluation', 'Restrained-eating attitudes', 'Weight and shape concerns', comprising all twenty-two items. The Bengali version has a high internal consistency score of 0.941, along with 0.868, 0.898, and 0.871, respectively, for the three dimensions. The items also have an acceptable to good convergent validity. ANN

reveals that the 'Restrained-eating attitudes' dimension contributed most significantly to the prediction of ED risk with acceptable sensitivity and specificity.

Conclusion The Bengali EDE-Q demonstrates a three-dimension structure encompassing all items, supporting their relevance in predicting ED risk among Bengalee adolescent females. This hybrid analytical approach highlights the novel contribution of the study in integrating statistical validation with predictive modelling, which could improve the practical utility of the tool. It also provides a foundation for future translation into other Indian languages.

Keywords Artificial neural network, Eating disorder, Eating disorder examination questionnaire, Principal component analysis, Validity

Graphical Abstract



1 Introduction

The abnormal eating and related lifestyle attitudes are termed as eating disorders (ED) that are closely related to negative body image concern or body dissatisfaction (BD). It is a serious issue as it deteriorates health and quality of life [1]. ED often emerges during adolescence, a critical developmental period marked by physical, psychological, social and cognitive transformations [2]. Asia is experiencing a higher trend of ED in recent years due to a sharp increase in the number of BD cases [1]. ED becomes a global health issue [3] and the third most common chronic illness in adolescent females [4]. Studies suggested the need for specific approaches for evaluating ED among adolescents, considering their unique developmental trajectory [5].

The Eating Disorder Examination-Questionnaire (EDE-Q), (current version is EDE-Q 6.0 and it has been used in this study and termed as EDE-Q) was developed from the Eating Disorder Examination Interview. Out of total twenty-eight items, twenty-two are divided into four subscales (dimensions)- Restraint, Eating, Shape, and Weight Concerns to determine the frequency of eating-related behaviors on a 7-point Likert scale. The remaining items assess bingeing and purging behaviors for last 28 days [6, 7]. EDE-Q is a self-report version for measuring ED symptoms [6, 8]. It is a widely used assessment tool in community settings and often regarded as a 'gold standard'. However, it faces challenges related to appropriate dimensional structure and its utility across different populations [9], because the established four-dimensional model was not empirically validated and responses are largely attributable to cultural and contextual variations. Therefore, the interpretation of the results should be approached with caution [10]. Due to lack of standardized factor-structure and validated tools, the magnitude of specific components of ED i.e., behaviors and attitudes, is difficult to compare among individuals

[11]. Moreover, socio-cultural interactions manifest social identity and develop the magnitude of body image concern and ED [12]. The pitfalls of the original version such as inclusion of 'item 8' in both weight and shape concerns subscales created conceptual overlap, leading to confusion among researchers. Additionally, 'item 10', which primarily addressed weight concern, was incorporated within the shape concern subscale. This further raise complication with factor structure. An appropriate factor structure focuses on identifying the underlying dimensional configuration of the tool, which may vary across populations due to cultural and contextual influences. Then, validation ensures linguistic appropriateness and overall applicability of the tool within a target population. In this regard, the appropriate translation and cultural adaptation of the internationally accepted ED measurement tool are crucial for advancing ED research and establishing accurate findings within any nation.

There are isolated researches on prevalence and risk factors of ED among adolescents in India [13–15], but none executed cultural validation of the measurement tool. Thangaruju et al. applied the EDE-Q among undergraduate students and reported a cut-off point that differed from the original version [16]; however, the reason for this variation was not established. State-wise prevalences of several mental illnesses in India reported ED as a component of mental disorders, even in West Bengal. Despite various government initiatives, the services have not achieved much success due to a lack of integrated and holistic approaches [17]. Therefore, a proper, validated tool is needed. The only validation and adaptation of EDE-Q in India was conducted by Smith et al. [3] in English language, which could be a linguistic barrier and was restricted to urban adolescents. However, their findings have limitations in terms of applicability in linguistically diverse groups such as Bengali-speaking adolescents. Without validation and cultural adaptation, the risk of misclassification remains high, particularly in diverse linguistic contexts such as India. This study addresses a critical gap in assessing the psychometric robustness of the tool (Fig. 1). Existing validation efforts in India have some limitations. Importantly, these studies have not adequately examined whether the underlying factor structure of the EDE-Q remains consistent in this cultural context. Given the cross-cultural variation across India, there is a clear need to both validate and re-examine the factor structure of the EDE-Q in the Bengalee population, which enhances the relevance and utility of the tool across the nation.

2 Objectives

The present study aimed to culturally validate the Bengali version of the EDE-Q among Bengalee adolescent females. The specific objectives are-

i. Evaluation of psychometric properties and appropriateness of the questionnaire by examining its dimensional structure and item performance.

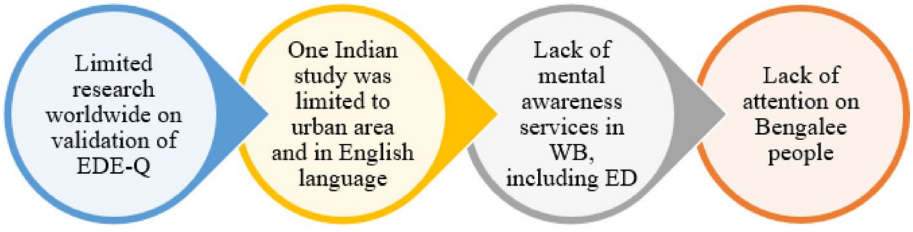


Fig. 1 The figure outlines the research gaps in existing knowledge

ii. Evaluation of construct validity, and internal reliability of the questionnaire to strengthen psychometric soundness of the instrument.
iii. In addition, the study sought to identify the most influential questionnaire items contributing to ED risk among this population that enhance cultural relevance and practical utility.

Identifying these key items extends beyond conventional validation procedures by highlighting culturally relevant indicators that may enhance the sensitivity and practical utility of ED screening. Overall, this assessment will provide a culturally validated version of EDE-Q and support more effective screening of ED among Bengalee adolescents, an underrepresented population in previous studies. By focusing on this demographic, the research will explore more avenues for considering cultural relevance in context of ED.

Based on existing gaps and objectives, the following research question has been developed and schematically presented in Fig. 2.

3 Materials and methods

The method section was designed in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies to ensure comprehensive and standardized reporting. The method is described below.

3.1 Study design

A cross-sectional school-based study was conducted between May 2022 and October 2023. The schools were selected using simple random sampling procedure. Eating-related behavioral data were recorded using self-reported surveys. The presence of diversity in the characteristics of students in a single setting makes 'schools' an ideal site for sample collection.

3.2 Setting

Data were collected from the government Bengali medium girls' or coeducational schools in North 24 Parganas district of West Bengal, due to its high population density,

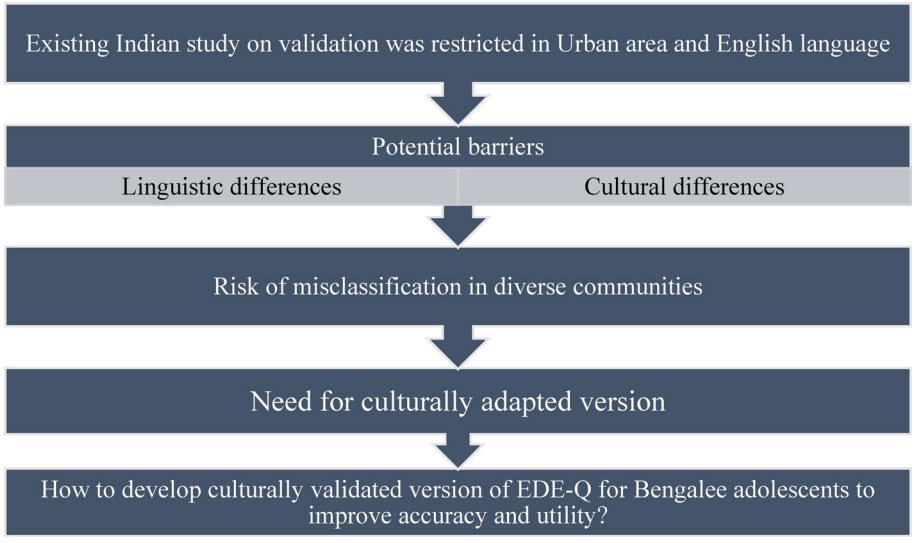


Fig. 2 The figure outlines the development of research question

geographical proximity to Kolkata, and the absence of previous investigations in this area.

3.3 Participants

Out of a total of 216 government secondary and higher secondary schools, both in rural and urban areas of the four subdivisions of the district, 191 schools fulfilled the eligibility criteria for being girls' and co-educational in nature and Bengali medium. Twenty-five (25%) proportion was applied to four subdivisions of the district and total of 48 schools were selected using simple random sampling method. Within each selected school, female students from classes IX and XI were considered. Each class consists of some sections. The sections were regarded as clusters. From these available clusters, two clusters were selected using simple random sampling method. A list of all female students in the selected clusters was prepared with the assistance of the class teachers. The students were informed about the purpose, procedures, and importance of the study. The selection was restricted to students who had expressed a voluntary willingness to participate. Then the names of voluntary participants were listed. From this list, 10 students were selected using a simple random sampling method. Written informed consent was obtained from their guardians before participation. Following the willingness to participate, an additional 20 students were included. The design of sample collection has been shown in Fig. 3.

To maintain homogeneity in response, the research followed some inclusion criteria such as 13–19 years, unmarried, Bengali speaking, apparently free from any other diseases (assessed via self-reported medical history, absence of current clinical symptoms, and no ongoing treatment for chronic conditions as confirmed by participants or guardians), residing in the respective rural or urban area since birth (reported by participants and cross-checked by guardians), living with family, cooperative, and present until completion of the survey. These criteria were assessed through self-reported information collected during the investigation. Participants who did not meet these pre-defined inclusion criteria were excluded from the study.

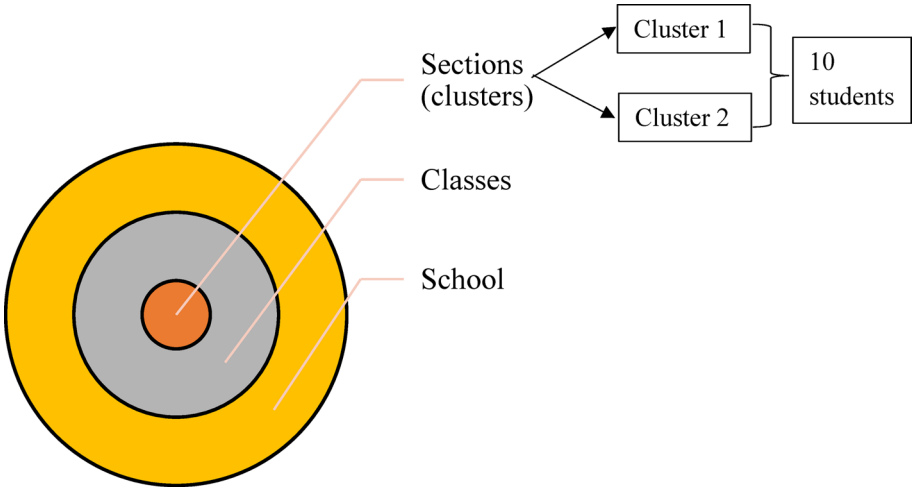


Fig. 3 The design of sample collection within a school

3.4 Items

The study examined eating-related behaviors in adolescent females using EDE-Q, focusing on specific dimensions of eating psychopathology. The study did not include any other predictors, potential confounders, or modifier items.

3.5 Data sources

The primary items of interest were eating-related thoughts and behaviors obtained using EDE-Q [6, 7]. The questionnaire was translated into the native Bengali language by three bilingual independent researchers following a forward multi-step process. During translation, the conceptual meaning of the original questionnaire was prioritized. To enhance comprehensibility, the three translated versions were compared in front of two subject experts. Item-by-item discrepancies were discussed. Minor cultural adaptations were made rather than a literal translation to improve contextual relevance. The harmonized version was reviewed by the institutional review committee.

We did not check the back-translation procedure due to its shortcomings in providing the highest accuracy. Recent studies suggest that the formal back-translation procedure may overemphasize the semantic and literal meaning rather than conceptual equivalence [18]. Therefore, we employed multiple forward translations and adopted a harmonization approach to preserve construct validity. Some minor adaptations were made to certain items to align with our cultural context, which enhances understanding among the participants. We tried to maintain the original scoring pattern of the questionnaire as much as possible. For e.g., 7-point Likert scale was used instead of 5- point scale as in Smith et al. [3] to maintain consistency with the original EDE-Q. Then, the questionnaire was reviewed by an expert ethical committee before being administered on community samples. Participants completed the questionnaire under the supervision of the investigator within the classroom. Initially, a pilot test was conducted with 100 participants to assess cognitive understanding of the translated questionnaire. After obtaining satisfactory responses, the version was employed to target population. The data cleaning process involved the exclusion of incomplete questionnaires or items and cross-checking for inconsistencies.

3.6 Bias

Although there may be reporting bias in self-perception, recall, and willingness to disclose eating behaviors- several strategies were employed to minimize these risks. The researchers conducted face-to-face interviews, explained each question, and applied non-judgmental questioning techniques to observe detailed verbal expressions, remove ambiguities during responses, and encourage honest disclosure.

3.7 Sample size

The sample size was determined by methodological recommendations of multivariate statistical techniques. Based on a 20:1 sample-to-item ratio for Principal Component Analysis (PCA) (22 items), the required sample size was 440. Initially, 500 responses were collected. Among them, 8 participants left more than 20 questions (almost 10%) and those were eliminated under bias recommendations [19]. The missing responses were evaluated manually by cross-verification during data entry process. Finally, the final sample size was 472.

3.8 Quantitative/ordinal items

The item-scores of twenty-two items, recorded on a 7-point Likert scale, were treated as the ordinal measure.

3.9 Statistical methods

Statistical analysis were performed in three stages, such as-

3.9.1 Principal component analysis (PCA)

PCA was employed to reduce dimensionality and identify the components that explain the maximum variance (i.e., the most loading subscales) of the EDE-Q. Unlike exploratory factor analysis (EFA), PCA identifies the underlying structure of a tool by maximizing the total variance in the data, including common, unique, and error variance. In contrast, EFA focuses exclusively on shared (common) variance to model latent constructs that explain the relationships among observed variables. Since the instrument was translated into Bengali and applied in a new cultural context, PCA served as an appropriate initial step to explore its structure.

The first principal component (PC) represents the largest variance, followed by the subsequent components/dimensions in decreasing order of variance. Before conducting PCA, the sampling adequacy for each item and the suitability of the data for factor analysis were checked by Kaiser–Meyer–Olkin (KMO) and Bartlett's test of sphericity. Therefore, PCA ensures the cultural adaptation of the translated items into the local context and their grouping into specific dimensions, confirming that the translated version accurately measures the intended dimensions.

3.9.2 Reliability and validity testing

Following PCA, reliability test was conducted to ensure consistency or homogeneity of the items in the local scenario. Reliability was assessed in terms of internal consistency using Cronbach's α value for the entire questionnaire as well as each dimension score, considering its effectiveness in measuring Likert scale responses. Furthermore, it negates the issues that arise with multiple testing over an extended period. A score > 0.7 was considered reliable.

Validity test confirms that the items accurately measure the construct. Here, the extent of correlation between the items within each dimension was measured by convergent validity. A positive, significant, moderate-to-high correlation value for each item indicates validity.

3.9.3 Artificial neural network (ANN)

ANN modeling based on multilayer perceptron (MLP) architecture was used to evaluate the relative contribution of each dimension and item in predicting ED risk. It determines the nonlinear predictive relationships between extracted dimensions of PCA and ED risk classification. The extracted dimension scores were used as input items for the ANN model. The binary output was ED risk classification based on the established global EDE-Q cut-off score, i.e. 4 [6]. The contribution of the dimensions was calculated using normalized importance values derived from the ANN model. The dimension with the highest relative importance was then used as input in a second ANN model with its constituent items as inputs to examine the relative predictive importance of individual

Table 1 Kaiser–Meyer–Olkin (KMO) and Bartlett's Test (N = 472)

Kaiser–Meyer–Olkin (KMO) Measure of Sampling Adequacy		0.927
Bartlett's Test of Sphericity	Approx. Chi-Square	7075.29
	Df	231
	Sig	< 0.000

Table 2 Total Variance Explained (N = 472)

Components/Dimensions	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	10.18	46.27	46.27
2	1.67	7.61	53.88
3	1.39	6.33	**60.21**

Extraction Method: Principal Component Analysis

items associated with ED risk within that dimension. At both steps, the datasets were partitioned into different percentages (training and testing phases), and 20 independent trials were run per model configuration. The best results were obtained using training (75%) and testing (25%) subsets based on classification accuracy. To reduce overfitting risk, multiple trials were conducted and performance was assessed using accuracy, sensitivity, specificity, and area under the receiver-operating-control curve (AUC). A PCA-integrated MLP neural model enabled innovative methodological application and the identification of the most important dimensions influencing ED while minimizing the measurement errors.

ANN model was incorporated to complement PCA and conventional reliability and validity analyses. PCA identifies latent dimensional structure, including factor loadings, but it does not determine the relative predictive contribution of each dimension or item toward ED risk classification. ANN examines the nonlinear predictive relationships through normalized importance values between extracted dimensions and ED risk classification. Standard validation ensures that the items are related to the constructs, whereas the ANN model quantifies the contribution of each dimension (then items) to ED prediction.

4 Result

Table 1 represents an excellent KMO value, i.e., 0.927, which ensures adequacy of the sample size to proceed with PCA. The significant value in Bartlett's test ($p < 0.000$) indicates the presence of correlation between the items in the dataset.

Table 2 exhibits three dimensions and 60.21% variance, of which the maximum variance is exerted by dimension 1 (46.27%). So, it confirms the dimension reduction by PCA.

[1]This visual representation (Fig. 4) displays the dimensions (components) plotted on the X axis and their respective eigenvalues plotted on the Y axis. The elbow point is at 'dimension 3', suggesting that the first three dimensions have eigenvalue > 1 and they should be considered for further analysis. The maximum eigenvalue of this dataset reaches 10 points.

All the items were loaded into three PCs. Table 3 exhibits dimension reduction by PCA as it produces three dimensions (may be treated as subscales), while the original

[1] Bold value indicates cumulative percentage of the dimensions

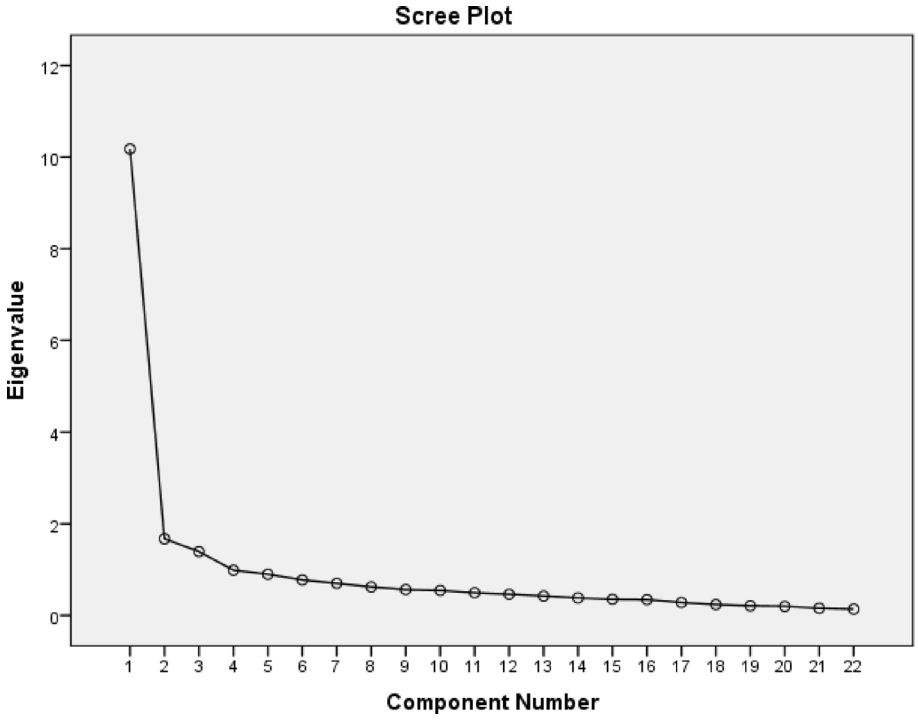


Fig. 4 Scree Plot

established version of EDE-Q contains four subscales. The three dimensions are termed as 'Cognitive-preoccupation and self-evaluation', 'Restrained-eating attitudes' and 'Weight and shape concerns'.

The internal consistency of all twenty-two items was evaluated using Cronbach's alpha value, which revealed a score of 0.941, indicating a relatively high internal consistency. The consistency of the items within each dimension was also checked. The alpha coefficient values were 0.868, 0.898, and 0.871, respectively. It suggests that the items grouped under each dimension are strongly interrelated and consistently measure the same underlying construct. The moderate-to-high and significant correlation coefficient between the items indicates an acceptable to good convergent validity.

The ability of the model to identify the presence of ED using the extracted PCs as input items was presented in Table 4. During the training phase, the model was highly able to correctly predict 99.1% cases. The prediction level was also quite high i.e., 97.7% during generalization (testing phase). This indicates the robustness of the model in correctly classifying ED cases even beyond training dataset.

[2]Figure 5 shows a feed-forward ANN model that produces one hidden layer with the help of four neurons (H:1, H:2, H:3, H:4) and predicts the presence or absence of ED based on the extracted three dimensions of EDE-Q. The three dimensions represent various aspects of ED. The figure exhibits the interconnected structure of the neurons within the hidden layer, which effectively processes the input data, identifies patterns, and predicts the occurrence of ED.

Figure 6 determines the relative contribution of each PC in the model's prediction. A higher value indicates a greater influence on the prediction. Here, PC 2 has the most

[2] Bold values indicate the overall percentage of predictions of both training and testing phases.

Table 3 Factor loadings (N = 472):

Items	PC 1	PC 2	PC 3
I1		0.731	
I2		0.527	
I3		0.685	
I4		0.582	
I5	0.549		
I6		0.697	
I7	0.713		
I8	0.727		
I9	0.549		
I10		0.696	
I11		0.685	
I12		0.736	
I19	0.597		
I20		0.535	
I21	0.664		
I22	0.531		
I23	0.588		
I24			0.532
I25			0.816
I26			0.824
I27			0.531
I28			0.527

Extraction method: PCA, Rotation method: Varimax rotation with Kaiser Normalization; # PC = Principal component

Table 4 Classification table (N = 472)

Sample	Observed	Cross-Entropy Error (% of Incorrect prediction)	Predicted		
			Present	Absent	% Correct
Training (75%)	Present	9.79 (0.9%)	297	1	79.7%
	Absent		2	47	95.9%
	Overall Percent		**86.2%**	**13.8%**	**99.1%**
Testing (25%)	Present	5.61 (2.3%)	105	2	98.1%
	Absent		1	25	96.2%
	Overall Percent		**79.7%**	**20.3%**	**97.7%**

Dependent Item: ED

influence, i.e., 100% on the output item ED. Therefore, the items included in PC 2 need to be primarily considered during the detection of ED.

The items included in PC 2 were further analyzed using a second ANN model, revealing 96.6% and 93.4% correct predictions during training and testing phases, respectively.

Among the seven items, item 2 has the largest contribution on this dimension for predicting the model, followed by item no. 11, 20 and 3, having variance more than 50%. The results highlight I2, I11, and I20 as the most influential factors in determining the outcome (Fig. 7).

5 Discussion

The study presents three dimensions of EDE-Q instead of four in the original version, retaining all the items that measure eating-related behaviors on Likert scale. It contradicts the findings of Smith et al. [3], who focused exclusively on urban adolescents in India and revealed two factors (dimensions) with 15 items. Such a contradiction

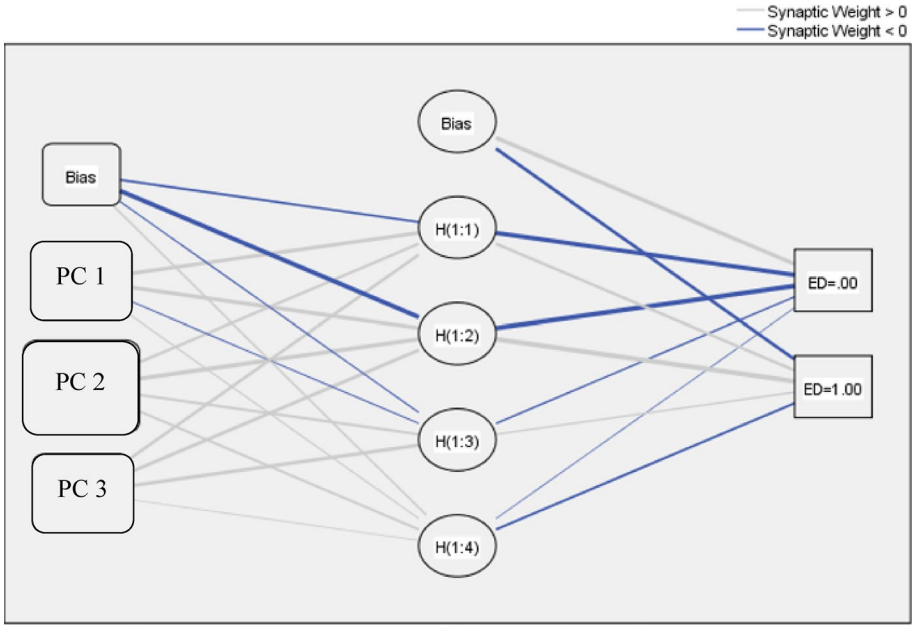


Fig. 5 Estimation of occurrence of ED by ANN model. # Input layer consists of three dimensions of EDE-Q and a bias layer, while the output layer has two nodes corresponding to ED absence and presence (ED = 0 or 1). A hidden layer comprises four neural structures, where grey and blue lines indicate positive and negative weights respectively. The line thickness indicates the relative magnitude of the weight

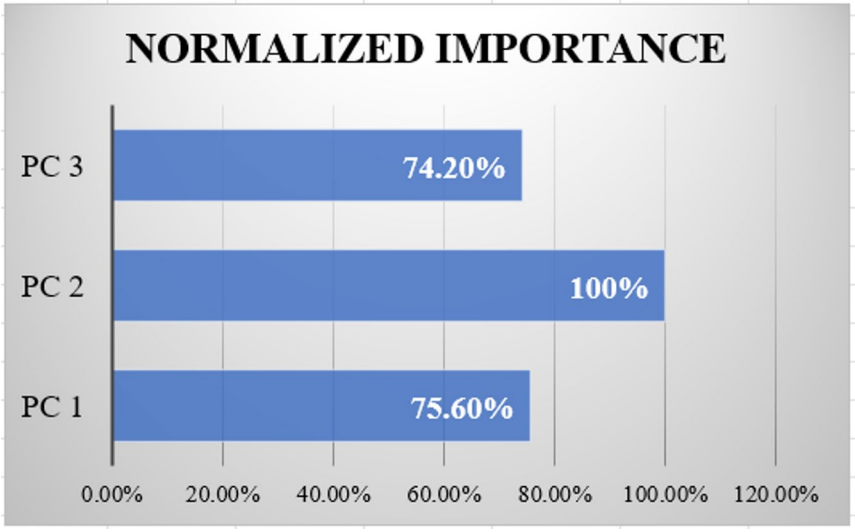


Fig. 6 Importance of three PCs in predicting ED cases

highlights potential regional differences in EDE-Q dimensional structure even across a nation. Administering the questionnaire in participants' native language may have facilitated more accessible responses, consistent with recommendations for cultural adaptation in ED assessment [20]. Additionally, conducting the survey with both rural and urban students may provide more valid and representative responses from the participants.

However, the three-dimensional structure observed in this study is consistent with the Saudi validation of the EDE-Q [21]. Among Asian countries, a three-factor structure

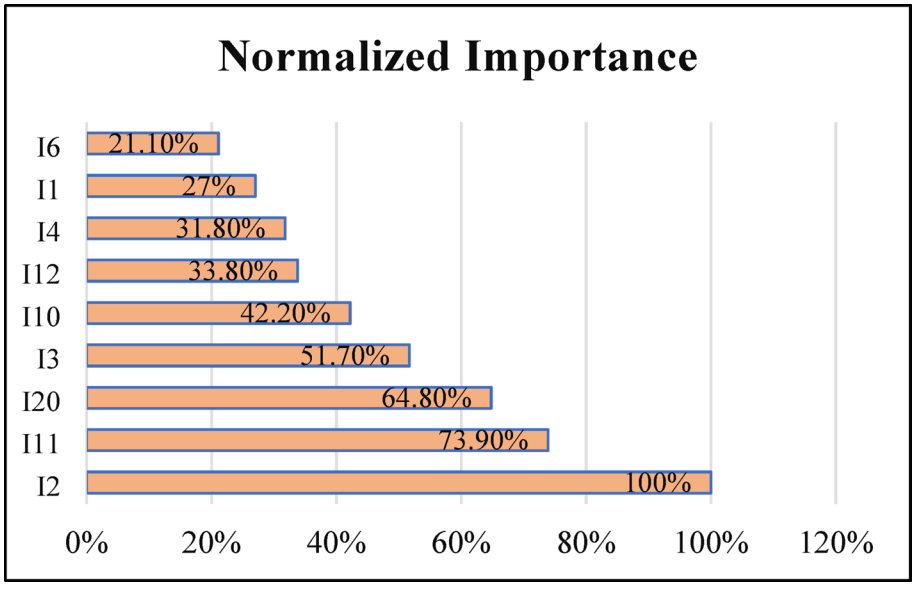


Fig. 7 Individual importance of items involved in dimension 2 in predicting ED cases

has been obtained in Iran [22] which combined weight and shape concerns into a single subscale. These variations suggest that while the core constructs of the EDE-Q remain stable, their dimensional representation may differ across populations. In our study, the loading of weight and shape-related items under the same dimension implies that Bengalee adolescent females may not necessarily perceive shape and weight as distinct concepts. It aligns with the theory of BD that encompasses issues with weight and shape in a single construct [23]. Such body image perception quantifies different dimensional scores within a population. In many contexts, the cultural ideals of female slimness elevate body image as a marker of personal worth [24]. However, Goel et al. reported that the original four-factor structure may not be suitable across different racial groups due to variations in psychopathology [25]. The difference in EDE-Q scores and its dimensional construct with cultural shifts has been evidenced in the findings of Song et al. [26]. These insights underscore the role of cultural and societal influences in shaping these perceptions and emphasize the need for a culturally adopted tool for ED screening in a specific community.

However, the study possesses some limitations. First, the study may limit the generalizability of EDE-Q to broader or more diverse groups because it is confined to a specific population. Second, the study was conducted only on female school students. This sample homogeneity overlooks key demographic diversities, such as age, gender, socioeconomic status, and ethnicity which limited the relevance of identified dimensions in this narrow cohort. Third, the cross-sectional design cannot explain the causal direction of associations between items and ED risk. Longitudinal research would be necessary to examine whether these dimensions consistently predict the development or progression ED symptoms over time. Finally, while PCA and ANN complement each other, integration of these comprehensive analytical frameworks may introduce methodological complexity, particularly in settings with limited statistical expertise.

Despite these few limitations, the study provides important practical implications. The strong predictive accuracy of the ANN model highlights the complex, non-linear associations among items. From a clinical perspective, this indicates that risk for ED may arise

from subtle interactions among symptoms rather than individual factor, which enhances the utility of the adapted scale. The integrated PCA and ANN approaches indicate that the adapted dimensions and their constituent items remain psychometrically robust within the studied population. Another strength of the study is the high internal consistency values observed across the identified dimensions, which confirm the reliability of the adapted scale in this population. This culturally adapted Bengali version of the EDE-Q can serve as a practical and reliable screening tool in Bengali school and community settings for public health screening.

6 Conclusion

This study demonstrates that the Bengali version of EDE-Q is a reliable tool for assessing ED risk among Bengalee adolescent females across rural and urban settings. The relevance of all items supports the utility of a culturally adapted questionnaire for screening in this population. This streamlined version facilitates easier administration and interpretation while retaining the fundamental aspects of original version of EDE-Q. The combined approach of PCA with ANN modeling is an analytical statistical measure for identifying the most influential contributors to ED risk. This hybrid approach highlights the novel contribution of the study in integrating statistical validation with predictive modelling, which could improve the practical utility of the tool. However, the establishment of an appropriate cut-off score is necessary to enhance its practical application. To improve the validation and model fit of the identified factor-structure, confirmatory factor analysis should be performed, as it would strengthen the psychometric evidence and support the generalizability of the tool across different populations and settings. Future investigations using larger and more diverse samples with longitudinal data would strengthen the findings regarding the predictive validity of the identified dimensions. By addressing cultural adaptation, the study offers a foundation for adapting the EDE-Q to other regional languages and contexts.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12982-026-02016-8.

Supplementary Material 1.

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Author contributions
S.S. contributed to data collection. S.S. and R.B. are involved in designing and drafting the manuscript. S.S. and B.P. worked on data analysis and interpretation. All the authors read and approved the final manuscript.

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Data availability
The datasets used and/or analyzed during the current study are not publicly available as this is a part of a research study, but are available from the corresponding author on reasonable request.

Declarations

Ethics approval
The study was conducted after getting ethical clearance from West Bengal State University Institutional Ethics Committee (IEC) for Research on Human Subjects (approval no. WBSU/IEC/30/05). The procedures performed were aligned with the 'Ethical Guidelines for Biomedical Research on Human Subjects' of Indian Council of Medical Research (ICMR), revised version of 2006.

Consent to participate
The objectives and procedure of the research were described to the participants in front of their guardians, and written informed consent was taken for participation in the research. Consent for publication is not applicable as the study does not disclose any personal information or photographs.

Generative artificial intelligence (AI)
We have used 'Grammarly' to check and correct grammatical issues. We used the 'Quillbot paraphrasing' tool for better delivery of sentences. All concepts and scientific contents were developed by authors.

Competing interests
The authors declare that they have no conflict of interest.

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