
Factorial validity and measurement invariance of the Bangla version of the Brief COPE

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✎ **ABSTRACT.** Lo scopo del presente studio è stato quello di misurare la struttura fattoriale e l'invarianza di misura del *Bangla Brief COPE*, nonché di misurarne l'affidabilità e la validità. Il *Bangla Brief COPE* tradotto è stato testato attraverso un questionario tra 778 cittadini del Bangladesh di età compresa tra i 18 e i 90 anni. Una analisi fattoriale esplorativa con il Sottocampione-1 ($n = 395$) ha prodotto una struttura a 6 fattori della scala che spiegava il 66.89% della varianza totale; una analisi fattoriale di conferma con il Sottocampione-2 ($n = 383$) ha confermato la struttura a 6 fattori della scala con un indice di adattamento del modello accettabile. I risultati complessivi dello studio indicano questa scala come uno strumento valido e affidabile per valutare le strategie di coping dei bengalesi.

✎ **SUMMARY.** There is no specific research history on the factorial validity and measurement invariance of the Bangla version of the Brief COPE. Although there is some research evidence of its reliability and validity measures, these are also insufficient. Therefore, the aim of the present study was to measure the factor structure and measurement invariance of the Bangla Brief COPE as well as to measure its reliability and validity. The translated Bangla Brief COPE was tested through a questionnaire survey among 778 Bangladeshi citizens aged 18 to 90 years. The participants of the study were selected through a convenience sampling method from different regions of the country who answered their questionnaire directly in front of the research assistant or indirectly through postal mail. An exploratory factor analysis with Subsample-1 ($n = 395$) yielded a 6-factor structure of the scale that explained 66.89% of the total variance. In addition, the minimum average partial test (i.e., a parallel analysis test) confirmed a total of 6 factors for this scale. A confirmatory factor analysis with Subsample-2 ($n = 383$) confirmed the 6-factor structure of the scale with an acceptable model fit index. The scale was found to be invariant across gender and education. Furthermore, the internal consistency reliability and convergent and discriminant validity of this scale were found to be acceptable. The overall findings of the study suggest that mental health professionals can adopt this scale as a valid and reliable tool to assess the coping strategies of Bangladeshis.

Keywords: Brief COPE, Factor structure, Reliability, Validity, Invariance analysis

INTRODUCTION

Coping is an ongoing behavioral, cognitive, and emotional process of managing stress (Blum, Brow & Silver, 2012); or a specialized category of adaptation in normal individuals to unusually taxing situations (Costa, Somerfield & McCrae, 1996); or attempts to manage demands that may exceed resources (Lazarus & Folkman, 1984). A coping strategy is an action or a thought process used to cope with a stressful situation. It can be of different types, for example, task-oriented versus defense-oriented (Carson, Butcher, Mineka & Hooley, 2007), problem-focused versus emotion-focused (Lazarus & Folkman, 1984), and approach versus avoidance (Eisenberg, Shen, Schwarz & Mallon, 2012). Some researchers have conceptualized problem-focused versus emotion-focused coping as adaptive versus non-adaptive coping or positive adjustment versus avoidance coping (e.g., Penley, Tomaka & Wiebe, 2002; Schnider, Elhai & Gray, 2007). People follow different coping strategies based on their perceived stress. Coping strategies are therefore not stable or the same over time and they may change in the context of different stressors (Schnider et al., 2007), or may vary in terms of gender (Eschenbeck, Kohlmann & Lohaus, 2007).

Existing scales measuring individuals' coping

Measuring an individual's coping behavior is challenging because it depends on a variety of factors, including personality traits, specific environments, support networks, and personal life experiences. Despite the challenges, there are many existing coping scales to measure people's coping that have been widely accepted around the world.

Carver, Scheier and Wientraub (1989) developed a 60-item multidimensional coping inventory called the *Coping Orientation to Problems Experienced (COPE)* to assess people's various coping strategies. It measures two basic components of coping: problem-focused coping and emotion-focused coping. This inventory also measures an additional measure called the 'coping response measure'. Hence, a statement of inventory falls under one of its three components. The *Brief COPE*, a 28-item brief version of the full COPE, was adapted by Carver in 1997. Chesney and colleagues (Chesney, Neilands, Chambers, Taylor &

Folkman, 2006) developed a 26-item coping scale, named the *Coping Self-Efficacy Scale (CSES)*, to measure an individual's confidence in performing their coping strategies. The *Brief Resilient Coping Scale (BRCS)* was designed by Sinclair and Wallston in 2004 to measure an individual's ability to cope with stress in highly adaptive ways. It is a 5-point Likert-type scale with only four statements. A score above 17 on the scale indicates a highly resilient coping individual and a score between 4 and 13 indicates a low resilient coping individual. A 55-item coping inventory, the *Proactive Coping Inventory (PCI)*, was developed by Greenglass and Schwarzer in 1998 to measure a variety of coping styles, including proactive coping, preventive coping, reflective coping, strategic planning, instrumental support seeking, emotional support seeking, and avoidant coping.

The *Ways of Coping Checklist (WCCL)*, a 68-item multidimensional coping scale, was developed by Folkman and Lazarus in 1980 to measure people's coping strategies. It consists of seven subscales. A 48-item *Coping Inventory in Stressful Situations (CISS)* developed by Endler and Parker (1990, 1994) is used to measure individuals' coping strategies in stressful situations. It consists of three subscales where each subscale consists of 16 items. A shortened version of the CISS (*CISS-21*) was also developed by Endler and Parker in 1994. A 37-item *Dyadic Coping Inventory (DCI)* developed by Bodenman (2008) is used to measure close relationships between partners, when one or both partners are experiencing stress.

Apart from the above-mentioned coping measurement scales, there are many other coping scales that have been developed or adopted to measure human coping strategies worldwide such as the *Ways of Coping Scale* (Lazarus & Folkman, 1984), the *Ways of Coping Questionnaire* (Folkman & Lazarus, 1988), the *Coping Responses Inventory-Youth* (Moos, 1993), the *Coping Schemas Inventory-Revised* (Wong, Reker & Peacock, 2006), and the *Measure of Affect Regulation Style* (Larsen & Prizmic, 2006). Among them, COPE (Carver et al., 1989) is one of the most popular coping scales, which consists of 15 subscales, with 4 items in each subscale. But a significant limitation of the aforementioned coping scales is their relatively extended length, ranging from 48 to 66 items, which may limit their long study protocols and widespread use in clinical settings. Consequently, the 28-item Brief COPE (Carver, 1997) was developed to reduce the time to completion of the scale as well as the burden on participants.

Literature reviews on the psychometrics of the Brief COPE

Based on factor loadings and field experience, Carver dropped two subscales from the original COPE and added a new subscale to the Br-COPE (Carver, 1997). In addition, he reduced the items from the original COPE to the Br-COPE from 4 to 2 in each subscale. The original English Br-COPE has already been translated into several languages such as French, Malay, Portuguese, Greek, Spanish, Turkish, Persian, Japanese, and Chinese. The scale has not only been translated into different languages but has also been validated in different countries around the world. The scale has shown good reliability and validity with good factor structure across its different language versions. Carver (1997) investigated the factor structure of the original English Br-COPE on a sample of 168 survivors of Hurricane Andrew. He found nine factors for this scale through EFA that explained 72.4% of the total variance.

To date, considerable research has been done to determine the number of factors of Br-COPE. In these studies, the total number of factors in the scale varied from a minimum of two (e.g., David & Knight, 2008) to a maximum of fourteen (e.g., Bacanlı, Surucu & Ilhan, 2013; Garcia, Barraza-Pena, Włodarczyk, Alvear-Carrasco & Reyes-Reyes, 2018; Monzani et al., 2015). Research has often identified two broad factors for the Br-COPE: (a) positive coping, which includes the positive reframing, proactive coping, and planning subscales (e.g., Carver, 1997; Miyazaki, Bodenhorn, Zalaquett & Ng, 2008; Snell, Siegert, Hay-Smith & Surgenor, 2011), and (b) social support-seeking, which included emotional and instrumental support (e.g., Carver, 1997; Kapsou, Panayiotou, Kokkinos & Demetriou, 2010; Yusoff, 2011). In some studies, however, some subscales of the Br-COPE were scattered, such as acceptance (Miyazaki et al., 2008), venting and self-distraction (Miyazaki et al., 2008), and positive reframing (Snell et al., 2011). Internal consistency reliability and content validity of the original English Br-COPE have been found in several studies (e.g., Carver, 1997; Cooper, Katona, & Livingston 2008; Monzani et al., 2015; Peters, Solberg, Templin & Cassidy-Bushrow, 2020). Some recent studies have attempted to test whether Br-COPE is invariant to various socio-demographic factors (e.g., Garcia et al., 2018; Nunes et al., 2021).

A summary of studies conducted on the translation, validation, and cultural adaptation of the Br-COPE is presented in Table 1.

The rationale of the study

Most of the coping scales mentioned above have been developed and adapted to a Western cultural context. Coping scales need to be culturally adapted before use because psychological patterns and culture can influence people's stressors, coping strategies, goals, and outcomes (Chun, Moos & Cronkite, 2006; Lam & Zane, 2004). Research findings have shown inconsistent results on the actual factors of the Br-COPE, which may limit its applicability to the study area, especially in cultural contexts. In addition, past studies have examined the factor structure of the Br-COPE considering only small and homogeneous samples. Therefore, coping strategies need to be validated in a large and heterogeneous sample across cultures. Thus, the present study aimed to validate the Br-COPE in a Bangladeshi culture with a large heterogeneous sample. Although there are some studies on the Bangla Brief COPE scale considering some psychometric properties, they are sparse, and there is no research on its measurement invariance (Hossain et al., 2021; Hossain et al., 2023; Islam & Sultana, 2020; Nguyen et al., 2022). Thus, the aim of the current study was to investigate the factorial validity and measurement invariance of the Br-COPE.

Research Question (RQ) and objectives of the study

A research question (RQ) is an attempt to answer or improve knowledge on a specific topic (Mattick, Johnston & de la Croix, 2018). A research question was considered in the present study: "Does the Bangla version of Br-COPE meet good psychometric properties?"

The main objective of the present study was to assess the basic psychometric properties of the Br-COPE in a Bangladeshi sample. In addition, we considered the following specific research objectives for the present study:

1. confirming a valid factor structure of the Br-COPE-B by EFA and CFA;
2. to know whether the scale is invariant with respect to gender and education;
3. to analyze and evaluate the reliability and validity of the scale.

Table 1 – Comparative summary of factor analytic results of the Br–COPE across languages and countries

Source	Scale's version	Sample	Analysis	Factors	Observations
Ashktorab et al. (2017)	Persian	Iranian women	CFA	14	14–factor structure by CFA, good content and face validity, and test–retest reliability
Bacanli et al. (2013)	Turkish	Turkish undergrad	PCA	14	PCA extracts 14 factors, good internal consistency reliability, and concurrent validity with self-esteem and life satisfaction
Baumstarck et al. (2017)	French	French people	PCA	4	4–factor structure by PCA, good internal consistency reliability, and construct validity
Doron et al. (2014)	French	French college students	CFA	5	5–factor structure by CFA, measurement invariance across gender, concurrent validity with anxiety and perceived stress
Garcia et al. (2018)	Spanish	Chilean people	CFA	14	CFA confirms a 14–factor structure, good internal consistency reliability, invariant across genders, and concurrent validity with scales
Kapsou et al. (2010)	Greek	Greek people	EFA and CFA	8 but broadly 4	8–factor structure with 4 broader factors, good internal consistency reliability, and concurrent validity with psychological scales
Muller & Spitz (2003)	French	French speaking people	EFA and SEM	14	Factor structure extracts 14 factors, good in both situational and dispositional context, and convergent and discriminant validity
Nunes et al. (2021)	Portuguese	Portuguese sample	CFA	14	CFA fits a 14–factor structure, good internal consistency reliability, and invariant across samples
Otsuka et al. (2008)	Japanese	Japanese school teachers	CFA	14	CFA confirms a 14–factor structure, acceptable internal consistency reliability, and construct, convergent and concurrent validity
Pavlova et al. (2022)	Russian	Russian school teachers	PCA and CFA	6	Both the PCA and CFA shows a revised 6–factor structure, and construct validity
Peters et al. (2020)	English	African–Americans	CFA and ESEM	13	The CFA proved 13 factors of the scale, ESEM resulted in three second–order factors: disengaged, active, and social support
Snell et al. (2011)	English	MTBI patients in NZ	EFA and CFA	9 but broadly 3	The EFA solution extracted 9 initial factors, and more reliably and meaningfully interpreted 3 factors rather than 9
Su et al. (2015)	Chinese	Chinese having HIV	EFA and CFA	6	The EFA identified 6 factors, significant correlation between subscales, and convergent and discriminant validity
Yousoff (2011)	Malay	Malaysian adolescents	EFA	14	Factors were loaded in their original 14 factors, good internal consistency reliability, and construct validity
Yuan et al. (2007)	Chinese	Chinese adolescents	EFA	3	3 higher order factors through factor analysis, adequate internal consistency reliability, and criterion validity with self–esteem

Legenda. EFA = Exploratory Factor Analysis; CFA = Confirmatory Factor Analysis; PCA = Principal Component Analysis; SEM = Structural Equation Modeling; MTBI = Mild Traumatic Brain Injury; ESEM = Exploratory Structural Equation Modeling.

METHODS

Participants

A total of 778 Bangladeshis aged 18 to 90 years ($M = 40.18$, $SD = 18.25$) were selected to conduct the present study. They were selected through a convenience sampling method from different areas of Bangladesh. Among them, males and females were 370 (47.56%) and 408 (52.44%) respectively. To conduct exploratory and confirmatory factor analyses with different data sets, we divided the total participants into two subsamples: Subsample-1 ($n = 395$) and Subsample-2 ($n = 383$). The division of the total sample was carried out in SPSS by the random sampling of

cases and about 50% of all cases functions. No significant differences were found between the two subsamples in terms of each socio-demographic considered in the study (see Table 2), meaning that the data in terms of each socio-demographic were equally distributed across the two subsamples.

Rationale for selection of total sample and subsample

We determined the total sample size of the study using the Raosoft calculator (Raosoft, 2004) considering four conditions: a) 5% margin of error, b) 99% confidence interval,

Table 2 – Number of respondents with percentage by specific socio-demographic

Variable	Levels	Total sample ($n = 778$)	Subsample-1 ($n = 395$)	Subsample-2 ($n = 383$)	Differences between two subsamples
Gender	Male	370 (47.56)	195 (49.40)	175 (45.70)	$\chi^2 (1) = 1.05, p = .305 (ns)$
	Female	408 (52.44)	200 (50.60)	208 (54.30)	
Residence	Rural	275 (35.30)	140 (35.44)	135 (35.25)	$\chi^2 (2) = 2.51, p = .284 (ns)$
	Suburban	235 (30.20)	128 (32.41)	107 (27.94)	
	Urban	268 (34.40)	127 (32.15)	141 (36.81)	
Education	Primary (Grade-5)	160 (20.60)	93 (23.50)	67 (17.50)	$\chi^2 (6) = 7.41, p = .285 (ns)$
	JS (Grade-8)	160 (20.60)	73 (18.50)	87 (22.70)	
	SSC (Grade-10)	180 (23.10)	85 (21.50)	95 (24.80)	
	HSC (Grade-12)	55 (7.10)	28 (7.10)	27 (7.00)	
	Under-graduation	142 (18.30)	70 (17.70)	72 (18.80)	
	Graduation	52 (6.70)	30 (7.60)	22 (5.70)	
	Others	29 (3.70)	16 (4.10)	13 (3.40)	
Age $M (SD)$		40.18 (18.25)	41.01 (19.15)	39.27 (17.26)	$t (775) = 1.33, p = .185 (ns)$

Legenda. JS = Junior School; SSC = Secondary School Certificate; HSC = Higher Secondary Certificate; *ns* = not significant.

c) population size, and d) 50% response distribution. The sample size recommended by this calculator was 664. The current study had an adequate sample size because the actual sample size ($n = 778$) was larger than the recommended sample size ($n = 664$).

The sample size for EFA ($n = 395$) was reasonably acceptable as it was based on a rule of thumb given by Tabachnick and Fidell (2013) who suggested an acceptable sample size of 300 for performing EFA. This sample size was good enough considering another rule of thumb, the $N:q$ ratio (5:1), where N is the number of participants and q is the variable considered in the analysis (Tanaka, 1987). Similarly, the sample size for the CFA ($n = 383$) was reasonably acceptable because it was based on a rule of thumb for ratios ($N:q$). A commonly recommended ratio (10:1 to 20:1) given by Schumacher and Lomax (2015) was used to calculate the sample size for CFA or SEM in the study.

Measures

- *Brief COPE (Br-COPE)*. The Br-COPE (Carver, 1997) consists of 28 items with 14 subscales with 2 items for each subscale. The subscales of the Br-COPE are: self-distraction (items 1 and 19), active coping (items 2 and 7), denial (items 3 and 8), substance use (items 4 and 11), emotional support (items 5 and 15), instrumental support (items 10 and 23), behavioral disengagement (items 6 and 16), venting (items 9 and 21), positive reframing (items 12 and 17), planning (items 14 and 25), humor (items 18 and 28), acceptance (items 20 and 24), religion (items 22 and 27), and self-blame (items 13 and 26). It is a 4-point Likert-type scale with answers ranging from 1 (I don't do it at all) to 4 (I do it a lot). There is no reverse scoring for any item on the scale, nor is there a total scale score for the scale. The total score on each subscale indicates an individual's coping strategies on that subscale.
- *Bangla version of the Brief COPE (Br-COPE-B)*. The Br-COPE was translated into Bangla from the original English version following a standard scale translation guideline provided by the International Test Commission (ITC, 2017). Before starting the translation of the scale, we asked permission from Carver (developer of the original scale) via email. A focus group discussion (FGD) was conducted with 8 adults to get feedback on the scale. We

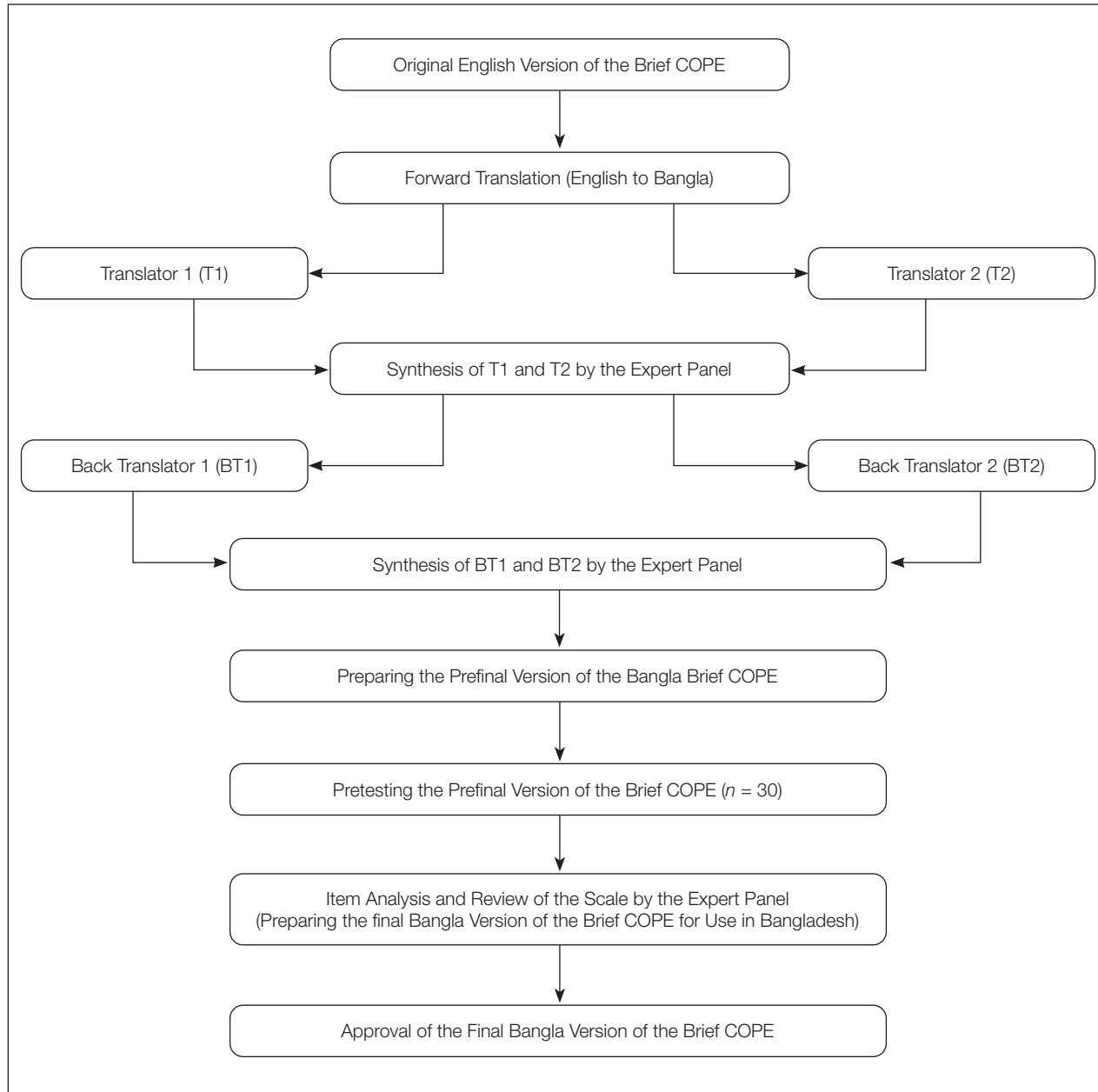
constituted an expert panel of 6 members (two researchers of the present study, two psychologists, one linguist and one English professor) to carry out the translation process of the study. Based on the data obtained from the FGD, the expert panel assessed the linguistic and cultural differences between the scale's source language (English) and target language (Bangla).

A forward translation (from English to Bengali) of the scale was done by two expert panel members who were proficient in the English language and also knew the assessment principles. They not only translated the scale items but also assessed the cultural equivalence of these items. The expert panel then evaluated the scale items to see if they were accurately translated from their original items. After that, a back translation of the scale (from Bangla to English) was done by two members of the expert panel (one a linguist and the other a professor of English). The expert panel, then, assessed whether the translated items were appropriate and standardized to the original English items. After judging both forward and backward translations, the expert panel developed a pre-final version of the Bengali Br-COPE. A pilot test ($n = 30$) was then conducted using this pre-final version of the Br-COPE-B. Positive corrected item-total correlations (value $\geq .30$) and significant positive correlations between items in each subscale suggested the appropriateness of inclusion of the items in the scale. The overall process of translation and cultural adaptation of Br-COPE-B is presented in Figure 1.

- *Personal Information Form (PIF)*. A separate PIF was used along with the questionnaire to collect some socio-demographic information including gender, age, residence, and education.

Procedure

We followed a standard survey method to ensure data collection and we did not follow any online survey method. The data collection process went through a smooth progression and no hiccups were encountered in the middle of the road. We collected data from people with the help of research assistants (psychology graduates). Data were collected in two ways. The first was the face-to-face method where participants answered their questionnaires in front of research assistants. A questionnaire was provided to

Figure 1 – Flowchart of the process of translation and cross-cultural adaptation of the Bangla Brief COPE

each individual along with instructions and an informed consent form (ICF). They were first requested to read the instructions and the ICF carefully and sign the informed consent form. After confirming their signature on the ICF they were requested to answer the questionnaire. They

were told that there was no option to mention their name, personal information, or contact address anywhere in the questionnaire which could hamper the reliability of the study. The research assistant thanked each participant who participated in the study.

The second method of data collection was postal method. As in the first method, each individual was provided with a questionnaire with instructions and an informed consent form (ICF). Furthermore, each of them was provided with a return envelope with a printed postal address of the principal researcher of the study and a revenue stamp, so that they could send their questionnaire back to the researcher confidentially. Before providing the questionnaire to the participants, the research assistant briefed the entire postal procedure of data collection. For any questions, they were requested to contact the research assistant via email or cell phone provided in the questionnaire.

Data analysis

We used two statistical programs for data analysis, namely Statistical Package Program for Social Sciences (SPSS v.26), and Analysis of Moment Structure (AMOS v.24). The cut-off values we considered to ensure CFA model fit were: $\chi^2/df \leq 5$, Goodness of Fit Index (GFI) $\geq .90$, Comparative Fit Index (CFI) $\geq .95$, and Root Mean Square Residual (RMSR) and Root Mean Square Error of Approximation (RMSEA) $\leq .08$ (Schermelleh-Engel, Moosbrugger & Muller, 2003).

RESULTS

Before conducting the final analysis, we checked whether there were any missing values or outliers in the total data set ($n = 778$). We found at least 1 missing value in the data of 8 participants. These missing values were imputed using a mean substitution method (i.e., the mean value of a particular subscale was used in place of the missing value of any item in that subscale). We found no outliers in the total data set ($n = 778$) by both Explorer and Mahalanobis distance tests.

Descriptive statistics

Initially, we performed some descriptive statistics for Br-COPE-B (see Table 3). The highest mean value ($M = 3.22$) was found for two items of the scale (e.g., items 8 and 15) and the lowest mean value ($M = 2.49$) was found for item 27 of the scale. Each item in the scale had an acceptable skewness and kurtosis value (values were between +1.96 and -1.96),

indicating that the scale items were individually normally distributed.

Exploratory Factor Analysis (EFA)

We conducted an exploratory factor analysis (EFA) on Subsample-1 ($n = 395$) to determine the number of factors for the Br-COPE-B. We found a 6-factor structure for Br-COPE-B based on the principal axis factoring method, direct oblimin rotation method, and eigenvalues greater than 1. Based on eigenvalues greater than 1, Figure 2 clearly showed 6 factors for Br-COPE-B.

The 6-factor structure of the Br-COPE-B explained 66.89% of the total variance with an acceptable KMO (Kaiser-Meyer-Olkin) value and a significant test of sphericity (see Table 4). The scale items loading into the six factors were as follows: F1 (items 5, 10, 12, 15, 17, 20, 23 and 24), F2 (items 4, 6, 11 and 16), F3 (items 9, 13, 21 and 26), F4 (items 18, 22, 27 and 28), F5 (items 2, 7, 14 and 25), and F6 (items 1, 3, 8 and 19). We conducted a Minimum Average Partial (MAP) test to determine whether the six factors of the Br-COPE-B derived by the EFA were true factors of the scale. Similar to the EFA, the MAP test (Velicer, 1976) showed six factors for the Br-COPE-B, indicating its actual six factors (see Table 4).

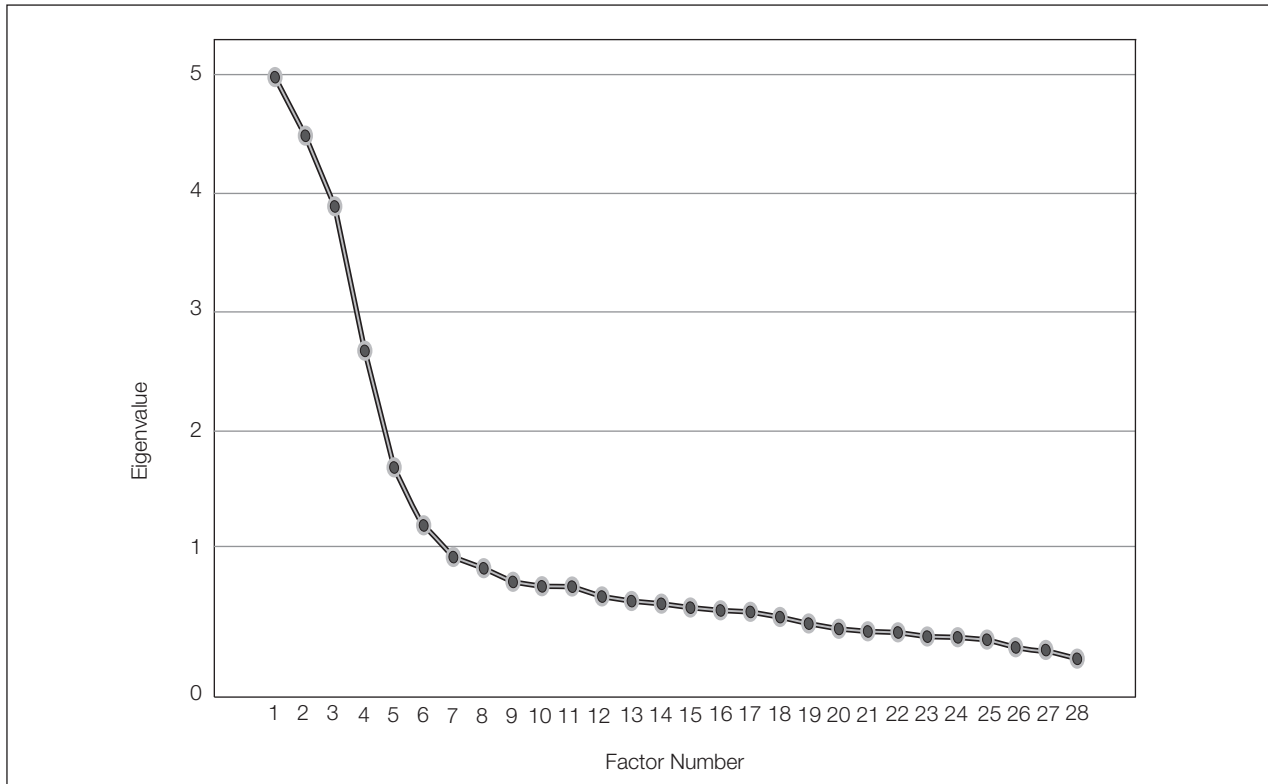
We named the six factors of the Br-COPE-B based on the structural fit of the scale items: F1 (Problem solving), F2 (Substance use and behavioral disengagement), F3 (Expression of negative emotions), F4 (Emotion-focused coping), F5 (Seeking support), and F6 (Avoidant coping). The naming of the new six factors of the Br-COPE-B was consistent with some previous studies (e.g., Baumstarck et al., 2017; Carver, 1997; Carver et al., 1989).

Confirmatory Factor Analysis (CFA)

We conducted a confirmatory factor analysis (CFA) on Subsample-2 ($n = 383$) to examine the structural fit of the Br-COPE-B. Before performing CFA, we created a model in AMOS for the scale's 6-factor structure. The CFA model showed an acceptable fit index for the Br-COPE-B ($\chi^2 = 457.11$; $df = 309$; $\chi^2/df = 1.48$; GFI = .922; CFI = .977; RMR = .034; RMSEA = .035). Additionally, all items on the scale had significant standardized regression weights ($p < .01$) (see Figure 3).

Table 3 – Descriptive statistics for items of Br-COPE-B ($n = 778$)

Item	M		SD	Skewness		Kurtosis	
	<i>Statistic</i>	<i>SE</i>	<i>Statistic</i>	<i>Statistic</i>	<i>SE</i>	<i>Statistic</i>	<i>SE</i>
c1	3.18	.030	.825	-.898	.088	.379	.175
c2	2.96	.034	.939	-.700	.088	-.329	.175
c3	2.95	.032	.903	-.670	.088	-.231	.175
c4	2.96	.034	.939	-.700	.088	-.329	.175
c5	3.18	.030	.825	-.898	.088	.379	.175
c6	2.80	.034	.947	-.479	.088	-.631	.175
c7	2.96	.034	.937	-.684	.088	-.351	.175
c8	3.22	.031	.852	-1.065	.088	.647	.175
c9	2.91	.034	.944	-.645	.088	-.416	.175
c10	3.00	.031	.863	-.749	.088	.083	.175
c11	2.82	.035	.971	-.479	.088	-.722	.175
c12	2.80	.034	.947	-.479	.088	-.631	.175
c13	2.82	.035	.971	-.479	.088	-.722	.175
c14	2.91	.034	.944	-.645	.088	-.416	.175
c15	3.22	.031	.852	-1.065	.088	.647	.175
c16	2.91	.034	.944	-.645	.088	-.416	.175
c17	2.80	.034	.951	-.473	.088	-.654	.175
c18	2.66	.033	.927	-.143	.088	-.840	.175
c19	3.00	.031	.863	-.749	.088	.083	.175
c20	2.82	.035	.976	-.473	.088	-.744	.175
c21	2.80	.034	.947	-.479	.088	-.631	.175
c22	2.59	.034	.958	-.106	.088	-.931	.175
c23	2.95	.032	.906	-.669	.088	-.244	.175
c24	2.82	.035	.971	-.479	.088	-.722	.175
c25	2.92	.034	.941	-.642	.088	-.412	.175
c26	2.96	.034	.939	-.700	.088	-.329	.175
c27	2.49	.033	.926	-.093	.088	-.851	.175
c28	2.64	.031	.862	-.211	.088	-.583	.175

Figure 2 – Scree plot for factor representation of Br-COPE-B (Subsample-1, $n = 395$)

Note. Six factors above the straight line with eigenvalues 1 indicate the true factors of the scale.

Reliability and validity analysis

Good internal consistency reliabilities ranging from .814 to .909 were found for the factors of the Br-COPE-B (see Table 5). We tested the convergent and discriminant validity of the scale based on standardized regression weights of the scale items. In line with the criteria proposed by many researchers, we considered the following criteria for convergent validity: Composite reliability (CR) $\geq .70$ and Average variance extraction (AVE) $\geq .50$; and the following criteria for discriminant validity: AVE \geq Average shared variance (ASV) and Maximum shared variance (MSV), and square root of AVE $\geq .70$ (Fornell & Larcker, 1981; Hair, Black, Babin & Anderson, 2010; Henseler, Ringle & Sinkovics, 2009). Convergent and discriminant validity of the Br-COPE-B was established as the observed values fully met the above-mentioned cut-off criteria (see Table 5).

Measurement invariance analysis

It is always an assumption that a good scale will be equally applicable in measuring its intended outcomes across different socio-demographics. In our study, we hypothesized that the Br-COPE-B would be invariant with respect to gender and education variables. So, we performed two multi-group CFAs separately to test whether the Br-COPE-B was invariant across gender and education. We considered four models to test measurement invariance in our study including unconstrained, measurement weights, structural covariance, and measurement residuals. The model fit indices we considered to verify a model fit was: χ^2/df , CFI, and RMSEA; and the criteria we considered to compare one model with another were: $\Delta CFI \leq .010$ and $\Delta RMSEA \leq .015$ (Chen, 2007).

We first performed an unconstrained model to examine whether the scale's latent factors had the same pattern of

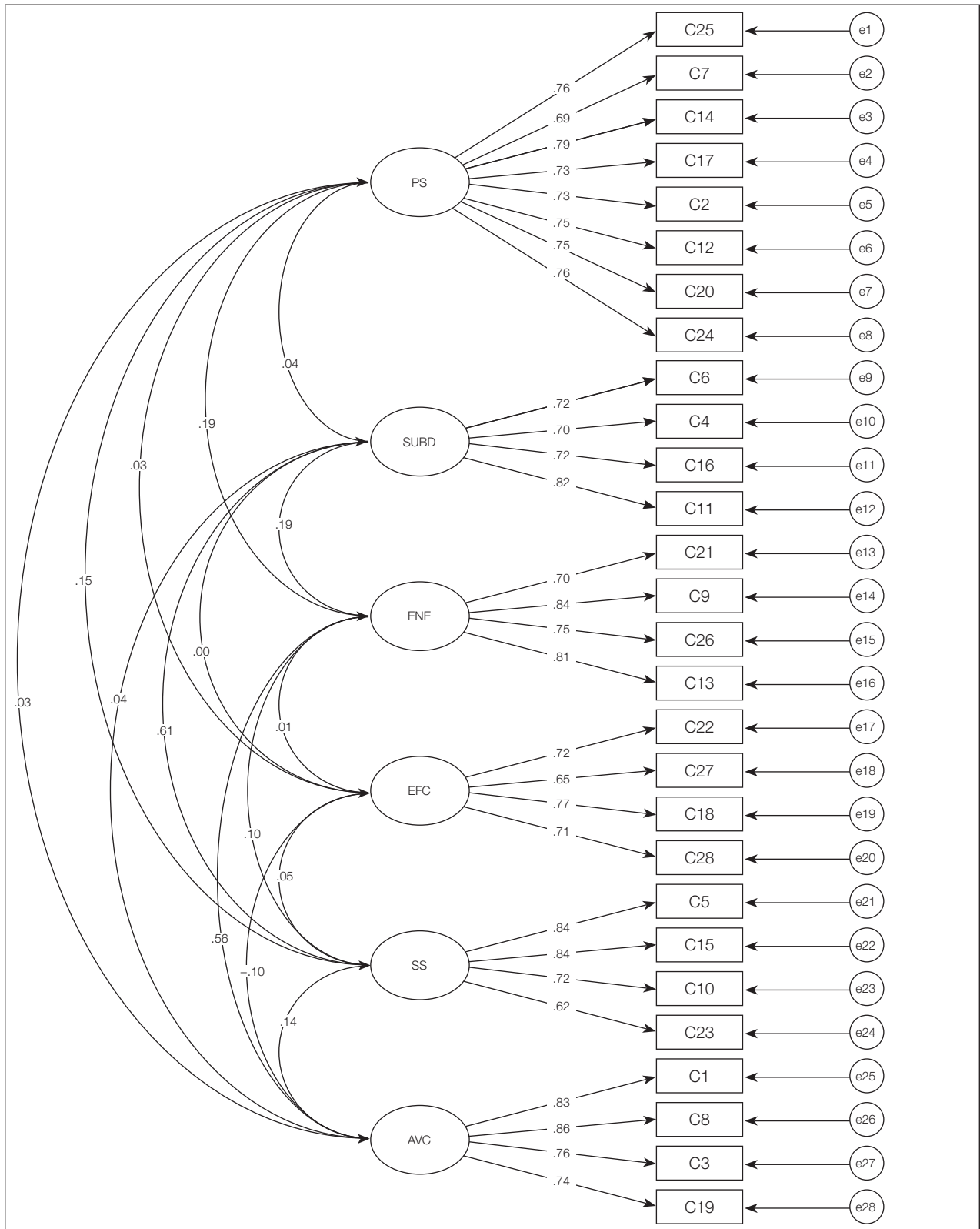
Table 4 – Factor structure of the Br-COPE-B by EFA and MAP Test (Subsample-1, $n = 395$)

Item	6-factor structure of the scale							MAP test	
	Communality (h^2)	F1	F2	F3	F4	F5	F6	Squared	
c25	.860	.792	.080	-.049	.005	.056	.050	.0000	.0626
c7	.802	.772	.140	-.003	-.114	-.171	.014	1.0000	.0505
c14	.863	.753	.014	-.019	.026	.129	.072	2.0000	.0475
c17	.737	.749	-.064	-.021	-.028	-.032	-.053	3.0000	.0290
c2	.798	.736	.125	-.013	-.060	-.123	.030	4.0000	.0260
c12	.711	.730	-.086	-.002	.030	.008	.011	5.0000	.0228
c20	.769	.695	-.089	.080	.066	.107	-.120	6.0000	.0221^a
c24	.752	.677	-.192	.077	.108	.129	-.079	7.0000	.0246
c6	.587	.031	.786	-.051	-.007	.005	.072	8.0000	.0279
c4	.613	-.007	.758	.037	-.016	.042	-.080	9.0000	.0307
c16	.688	-.038	.755	-.018	.034	.170	.067	10.0000	.0334
c11	.592	-.017	.696	.152	.065	.131	-.129	11.0000	.0382
c21	.576	-.022	-.030	.794	.003	.060	-.015	12.0000	.0423
c9	.640	.011	.007	.785	.002	-.017	.074	13.0000	.0475
c26	.578	-.025	.036	.727	-.043	.001	.023	14.0000	.0516
c13	.624	.073	.074	.700	.007	-.160	.120	15.0000	.0544
c22	.495	.003	.099	-.056	.785	-.072	.036	16.0000	.0611
c27	.465	.011	-.001	.063	.736	-.001	-.028	17.0000	.0734
c18	.453	-.028	-.021	.002	.729	.024	-.009	18.0000	.0933
c28	.419	.013	-.009	-.037	.688	-.030	.028	19.0000	.0932
c5	.602	.008	.029	.009	-.016	.805	-.047	20.0000	.1089
c15	.584	-.010	.050	-.013	.024	.769	.017	21.0000	.1363
c10	.503	.022	.099	.014	-.026	.667	.045	22.0000	.1838
c23	.516	.036	.095	-.074	-.087	.645	.062	23.0000	.2487
c1	.585	.013	.010	-.054	.037	-.021	.889	24.0000	.2931
c8	.548	-.022	-.103	.064	.037	.128	.706	25.0000	.3945
c3	.436	-.029	-.014	.075	-.037	.006	.605	26.0000	.5743
c19	.399	.011	.038	.091	-.010	-.037	.576	27.0000	1.0000
Eigenvalues by factor		4.95	4.46	3.86	2.64	1.66	1.17		
Variance extraction by factor (%)		17.66	15.91	13.79	9.44	5.91	4.18		
Total variance (%)		66.89%							
Kaiser-Meyer-Olkin (KMO) value		.746							
Bartlett's test of sphericity		$\chi^2 = 6519.17, df = 378, p < .01$							

Legenda. MAP = Minimum Average Partial; df = degree of freedom.

Note. ^a = the number of components according to the original MAP test (Velicer, 1976) is 6, as the smallest average squared partial correlation is .0221; Extraction method: Principal Axis Factoring; Rotation method: Direct Oblimin.

Figure 3 – Six-factor model of the Br-COPE-B (Subsample-2, $n = 383$)



Legenda. PS = Problem Solving; SUBD = Substance Use and Behavioral Disengagement; ENE = Expression of Negative Emotions; EFC = Emotion Focused Coping; SS = Seeking Support; AVC = Avoidance Coping.

Table 5 – Internal consistency reliability and convergent and discriminant validity of the Br-COPE-B

Factor	α	CR	AVE	ASV	MSV	PS	AVC	SS	EFC	ENE	SUBD
PS	.909	.909	.555	.012	.034	.745					
AVC	.831	.874	.635	.070	.316	.032	.797				
SS	.833	.844	.579	.085	.368	.152	.144	.761			
EFC	.814	.805	.509	.003	.010	.034	-.099	-.047	.714		
ENE	.860	.860	.608	.079	.316	.185	.562	.100	-.008	.780	
SUBD	.861	.830	.551	.082	.368	.043	.038	.607	-.001	.193	.742

Legenda. CR = Composite reliability; AVE = Average variance extraction; ASV = Average shared variance; MSV = Maximum shared variance; PS = Problem solving; AVC = Avoidance coping; SS = Seeking support; EFC = Emotion-focused coping; ENE = Expression of negative emotions; SUBD = Substance use and behavioral disengagement.

Note. Values presented in bolds are the square root of AVE.

free and fixed loadings. In the second step, we conducted a measurement weight invariance test (i.e., a metric model) by constraining the factor loadings (i.e., testing the equality of item loadings on the factors). The third step in our invariance test was a structural covariance model. This was a test to see if the latent factors had the same structural variance and covariance across groups. The fourth and final step of the study's measurement invariance test was the measurement residual invariance model. This model was considered to determine whether item-specific variances and error variances were similar across groups. In the analysis of invariance, each model had an acceptable model fit index as well as an acceptable invariance cut-off value that was not meaningfully different from the subsequent model (see Table 6). Thus, the Br-COPE-B was found to be invariant across gender and education.

DISCUSSION

The original Br-COPE has been tested empirically using various multivariate statistics worldwide. As a continuation of

this, the aim of the present study was to test its Bangla version through various multivariate statistics including factor structure, reliability, validity and measurement invariance. Factor structure is basic evidence of a translated scale, which adequately reflects the structure of the constructs measured in the scale (Eker, Arkar & Yaldiz, 2000). Many researchers recommend both EFA and CFA rather than EFA alone to explain the factor structure of a scale (e.g., Terwee et al., 2012). Therefore, we performed both EFA and CFA to explain the factor structure of the Br-COPE-B. Both EFA and CFA confirmed a 6-factor structure of the Br-COPE-B that was consistent with some past findings. For example, Amoyal and colleagues (Amoyal, Fernandez, Ng & Fehon, 2016) demonstrated a 6-factor structure of the Br-COPE through a construct validity analysis. Matsumoto et al. (2020) also confirmed a 6-factor structure of the Br-COPE by both EFA and CFA. The 6-factor structure of the Br-COPE-B was also consistent with the findings of Pavlova et al. (2022) and Su et al. (2015).

Because researchers claim that a 2-item factor rarely reflects its true factor structure in factor analysis (Eisinga, Grotenhuis & Pelzer, 2013), we obtained a 6-factor structure

Table 6 – Test of measurement invariance of the Br-COPE-B by gender and education ($n = 778$)

Variable	Model fit						Model comparison		
	Model	χ^2	df	χ^2/df	CFI	RMSEA		ΔCFI	$\Delta RMSEA$
Gender	M1	914.23	618	1.48	.977	.025			
	M2	914.23	640	1.43	.979	.024	M1–M2	–.002	.001
	M3	914.23	661	1.38	.981	.022	M2–M3	–.002	.002
	M4	914.23	715	1.28	.985	.019	M3–M4	–.004	.003
Education	M1	2276.56	1024	2.22	.911	.040			
	M2	2328.27	1046	2.23	.909	.040	M1–M2	.002	.000
	M3	2394.28	1067	2.24	.905	.040	M2–M3	.004	.000
	M4	2851.53	1121	2.54	.884	.045	M3–M4	.021	–.005

Legenda. *df* = degree of freedom; CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; M1 = unconstrained; M2 = measurement weights; M3 = structural covariances; M4 = measurement residuals.

instead of the original 14-factor structure of the Br-COPE. Even with reduced factor structure, the model fitness of the Br-COPE-B was comparable to that of the original Brief COPE. Acceptance, planning, active coping and positive reframing subscales were formed into the Problem-solving factor (Factor 1). These four subscales are relevant to problem-focused coping which explains all proactive efforts to manage stress. There are past studies that have found similar factor construct names to Factor 1 (e.g., Carver, 1997; Miyazaki et al., 2008; Snell et al., 2011). Although Carver made a conceptual distinction between emotional support and instrumental support, he claimed that they are primarily relevant to problem-focused coping and often work together. It would have been better if these two support subscales were included in the Problem solving factor instead of a separate

Support seeking factor (Factor 5). However, this factor was considered acceptable because it was not confounded with other avoidant coping factors. The Seeking support factor (Factor 5) was supported by some past findings (e.g., Carver, 1997; Kapsou et al., 2010; Perczek, Carver, Price, & Pozo-Kaderman, 2000; Yusoff, 2011).

Theoretically, four subscales of the original Brief COPE such as denial, behavioral disengagement, substance use, and self-distraction are relevant to avoidant coping. Theoretically as well as conceptually, it would have been better if these four subscales were extracted into a single factor structure. But they were extracted into two separate factors in the Br-COPE-B (Factor 2 and Factor 6), which did not mean that they were theoretically different. Furthermore, these two avoidant coping subscales were not confounded with the problem-focused or

emotion-focused coping subscales. Similar to the structural pattern of avoidant coping, factors relevant to emotion-focused coping in the original Brief COPE were structured into two factors instead of one factor in the Br-COPE-B (Factor 3 and Factor 4). It was clear that the approach-based (problem-focused and emotion-focused coping) and avoidance-based coping subscales formed separate factors in the factor structure of the Br-COPE-B which was supported by the findings of Eisenberg et al. (2012). Dias, Cruz, and Fonseca (2012) conceptualized the Brief COPE items within three basic factors including problem-focused coping, emotion-focused coping, and avoidant coping. The items of the Br-COPE-B were structured into three factors as noted by Dias et al. (2012), but each factor was structured into two sub-factors.

The Br-COPE-B showed both internal consistency reliability and composite reliability, which was consistent with previous findings (e.g., Bacanlı et al., 2013; Baumstarck et al., 2017; Garcia et al., 2018; Nunes et al., 2021; Otsuka, Takada, Suzuki, Tomotake & Nakata, 2008; Yusoff, 2011). The convergent and discriminant validity of the Br-COPE-B was adequately supported by past research conducted on the Br-COPE across cultures (e.g., Baumstarck et al., 2017; Muller & Spitz, 2003; Otsuka et al., 2008). This scale was invariant to gender, which was supported by some past research on it (e.g., Doron et al., 2014; Garcia et al., 2018; Nunes et al., 2021). Furthermore, it was invariant across education levels. There are almost no studies on the Br-COPE that have attempted to analyze its measurement invariance taking into account different educational groups. Thus, the invariance analysis of Br-COPE-B in terms of education revealed a new analysis in the field of Br-COPE research.

Limitations of the study

The current study had some limitations that should be addressed. First, the study was not free from sampling bias because it considered a convenience sampling method rather than a random sampling method. Second, the study did not consider a gold-standard Bangla coping scale to measure the concurrent validity of the Br-COPE-B. Finally, the study was unable to conclude that the Br-COPE-B is equally applicable to non-clinical and clinical samples because the study included only non-clinical samples.

Practical implications

Since we have proven the Br-COPE-B to be a valid and reliable scale for measuring the coping strategies of Bangladeshis, it is very clear that it will measure the actual coping behavior of Bangladeshis. The Br-COPE-B would be effective in measuring the coping strategies of Bangladeshis in a short period of time because it has no item loadings. Researchers around the world will not only be able to gain knowledge about the validation process and psychometric properties of the Br-COPE-B, but also will be able to compare this scale with other coping scales.

Future research directions

Although the Brief COPE is a globally accepted scale for measuring people's coping strategies, its original fourteen factors have not been supported with sufficient empirical evidence across cultures. Future research could be conducted on the Brief COPE to determine its underlying factor structure. If future studies could take into account the limitations of the current study (e.g., sampling bias, concurrent validity, invariance tests for different samples), they would be the most comprehensive studies in the field of coping research. It would be most appreciated if future studies could examine coping strategies in specific contexts such as situational, cultural, and economic.

CONCLUSION

The Br-COPE-B was structurally validated by both EFA and CFA and was found to be reliable and valid through reliability and validity analyses. Moreover, it was found to be invariant across gender and education. The overall results of the study strengthened the factorial validity of the Br-COPE-B and increased the robustness of its psychometric properties. Thus, a new Bangla 6-factor structure of Br-COPE can be recommended as a valid and reliable scale for assessing the coping strategies of Bangladeshi people. Future studies considering measurement invariance analysis across samples as well as across cultures would advance a new field of study of this scale.

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