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Psychometric Evaluation of a Sinhalese Version of the Five Facet Mindfulness Questionnaire and Development of a Six-Facet Short Form in a Sri Lankan Buddhist Context

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Abstract

Objectives This study aimed to evaluate the psychometric properties of a Sinhalese version of the Five Facet Mindfulness Questionnaire (FFMQ), including its factor structure, internal consistency and convergent validity, in an exclusively Buddhist population.

Methods The FFMQ was translated to Sinhalese using forward and backward translation, expert consensus and pretesting. The translated questionnaire was administered to a sample of 415 nurses (90.8% female; mean age = 39 years; 100% Buddhists), from 4 hospitals in Sri Lanka. The Depression, Anxiety and Stress Scale (DASS)-21 was administered concurrently. A series of empirical factor models were tested for fit using confirmatory factor analysis (CFA). Exploratory factor analysis (EFA) was used to explore alternative factor structures. Internal consistency was measured using Cronbach α.

Results The original five-factor structure, either as first-order or hierarchical models, showed poor fit in the present population. EFA supported a six-factor structure, where the original *Actaware* facet splits into two facets, namely, *Distract* and *Autopilot*. A 20-item short form composed of 3–4 items from each of the six facets, selected based on factor loadings and item-total correlations, showed excellent CFA model fit. Internal consistencies of the 20-item scale ($\alpha = 0.7$) and the five subscales ($\alpha = 0.67$–0.72) were satisfactory. Overall mindfulness showed moderate negative correlations with depression, anxiety and stress; and all facets except *Observe* and *Describe* correlated negatively with psychological problems.

Conclusions Our findings endorse a six-factor structure of mindfulness, which had been proposed in a few previous studies. A modified 20-item short form with six facets shows satisfactory psychometric properties.

Keywords Mindfulness · Five Facet Mindfulness Questionnaire · Cross-cultural · Validation · Psychometric

Measurement of mindfulness has been an important requirement for both interventional and observational research on mindfulness and its related constructs. The development of the Mindful Attention Awareness Scale (MAAS) by Brown and Ryan (2003) and the Five Facet Mindfulness Questionnaire (FFMQ) by Baer et al. (2006) played pivotal roles in the advancement of mindfulness research, by enabling valid and reliable psychometric assessment of mindfulness. While many other scales attempting to quantify mindfulness have emerged over the last two decades, the FFMQ and MAAS probably remain, to date, the most widely used. In fact, in a recent bibliometric analysis, the MAAS and FFMQ were found to be the most cited empirical articles within the mindfulness literature (Baminiwatta & Solangaarachchi, 2021). Between the two scales, however, FFMQ encompasses a wider range of items covering multiple dimensions of mindfulness compared to MAAS, thus allowing a potentially more comprehensive assessment of this latent construct (Baer, 2019; Baer et al., 2006). However, the psychometric properties of the FFMQ, particularly its factor

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structure, have attracted some debate owing to the variations seen across studies conducted in different populations and using different methods.

Baer et al. (2006) developed the FFMQ by performing exploratory factor analysis (EFA) on a pool of 112 items extracted from five previously developed questionnaires assessing mindfulness, namely, the Cognitive and Affective Mindfulness Scale (Feldman et al., 2006); Freiburg Mindfulness Inventory (FMI; Buchheld et al., 2001); Kentucky Inventory of Mindfulness Skills (KIMS; Baer et al., 2004); MAAS (Brown & Ryan, 2003); and the Mindfulness Questionnaire (Chadwick et al., 2005). The five-factor structure which emerged from the EFA was then externally validated using confirmatory factor analysis (CFA). However, amongst non-meditators, a four-factor model that omits the *Observe* facet showed a better fit. Also, a higher order structure with an overarching mindfulness factor showed slightly better fit indices than first-order models in the original validation sample (Baer et al., 2006).

Cultural factors may also contribute to variations in the psychometric properties of the FFMQ (Karl et al., 2020). A study that tested the measurement invariance of the FFMQ factor structure across cultures, using data from 16 countries, demonstrated that the originally proposed dimensional structure has inadequate cross-cultural validity (Karl et al., 2020). This study also concluded that 'the fit of the FFMQ was substantially better in individualistic cultures and that further data from non-Western cultures is needed to develop a universal conceptualization and measurement of mindfulness' (Karl et al., 2020, p. 1).

Although the concept of mindfulness originated from Asian Buddhist cultures, there is a lack of research on the psychometric properties of the FFMQ in Buddhist populations (Haas & Akamatsu, 2019; Karl et al., 2020). Except for a few studies from China (Fong et al., 2021; Meng et al., 2020), Hong Kong (Hou et al., 2013), Japan (Sugiura et al., 2012), India (Pandey & Mandal, 2016) and Bhutan (Haas & Akamatsu, 2019), the literature on the FFMQ has been largely restricted to data from Western populations. Although Sri Lanka is a culturally diverse country, Buddhism, which was introduced to the island during the third century BCE, has remained the religion of the majority, shaping the thinking and behaviour of its population. The culture in many Asian countries including Sri Lanka is considered collectivistic (Della et al., 2021; Freeman, 1997), in contrast to the individualistic cultures whence most of the literature on mindfulness has originated (Karl et al., 2020). Sinhalese is the language spoken by most Buddhists in Sri Lanka, and since the majority of mindfulness-based interventions and educational programmes in Sri Lanka are delivered in Sinhalese, translating mindfulness measures into the local language is a necessity (De Zoysa, 2010, 2011). As the practice of psychotherapy in Asian countries should be culturally informed (Della et al., 2021), cultural adaptation of psychometric measures is important. Although mindfulness has been practiced for millennia in the country, only a handful of scientific publications have emerged thus far from Sri Lanka (Agampodi et al., 2018; De Zoysa, 2010). One barrier to the progress of research on mindfulness in Sri Lanka has been the lack of validated instruments in the local language to measure mindfulness (De Zoysa, 2010). Therefore, this study aimed to investigate the psychometric properties of a Sinhalese version of the FFMQ in a Buddhist population in Sri Lanka.

Methods

Participants

Participants consisted of nurses ($n = 415$) working in four tertiary care hospitals in Sri Lanka. These 4 hospitals were located in 4 different provinces of the country. One hospital was located in the Western province, close to the commercial centre of the country. The second hospital was located in the vicinity of the sacred city of Anuradhapura, in the North Central Province, a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site and a centre of Theravada Buddhism since the third century BCE. The third hospital was located in Kandy, in the hill country of Central Province, where another World Heritage Site—The Temple of Tooth Relic—is located. The fourth hospital was located in Galle, in the Southern Province, in the coastal zone, close to another World Heritage Site—old city of Galle and its fortifications (UNESCO, n.d.).

There was a preponderance of females in the sample ($n = 380$, 91.8%), likely a result of the general preponderance of females in nursing and the higher response rates of females generally observed in surveys. The age (years) ranged from 18 to 59, with a mean of 39 (SD = 9). Potential participants were inquired about their religion before obtaining consent for participation, and only those who self-identified as Buddhists were included, since this study aimed to validate the FFMQ for the Sri Lankan Buddhist cultural setting. Similarly, potential participants were asked whether they were able to read, understand and write in Sinhalese and only those who responded affirmatively were recruited, as this study intended to validate only the Sinhalese translation of the FFMQ.

Participants were asked to indicate whether they currently practice three Buddhist meditation techniques—*Anapanasati*, *Vipassana* or *Metta* meditation—on a regular basis. In the sample, 21% ($n = 87$) reported that they regularly practice at least one of these three meditation techniques; this included 70 participants (16.9%) who practiced *Metta*, 31 (7.5%) who practiced *Anapanasati*, and 8 (1.9%) who

practiced *Vipassana* meditation. *Anapanasati* is the practice of mindfulness of breathing (Analayo, 2019); *Vipassana* or insight meditation essentially consists of the four foundations of mindfulness: mindfulness of the body, feelings, state of mind and mind objects (Sayadaw); *Metta* or loving-kindness meditation is a widely practiced meditation in Sri Lanka, and its close relations to mindfulness have been described (Aspy & Proeve, 2017; Gunaratana, 2017; Rosenzweig, 2013).

Procedures

Procedure for questionnaire translation followed the recommendations of Beaton et al. (2000). The FFMQ was translated into Sinhalese by two independent bilingual experts (one with experience in mindfulness practice and one without), and a consensus version was created. This Sinhalese version was back-translated into English by two independent translators. The original and back-translated versions were compared and discussed by a panel that included all the translators, all investigators and a mindfulness expert; discrepancies were reconciled through discussion, and a pre-final version was prepared. This pre-final version was pretested on a small group of nurses ($n = 15$). A few minor issues related to the wording of certain items and difficulties in interpretation were identified from the pre-test, and these issues were discussed by the panel and appropriate amendments were made to the scale, before commencing the factor analytic validation stage.

The members of the research team visited wards and clinics in the four selected hospitals and invited nurses to participate in the validation study. Convenience sampling was used. Informed written consent was obtained from each participant. Participants were provided with self-administered questionnaires and were instructed to fill them out without interference to their clinical duties. Completed questionnaires were collected by the research team. Anonymity and confidentiality of the data were maintained.

Measures

Five Facet Mindfulness Questionnaire (FFMQ)

FFMQ is a self-report scale developed for the psychometric assessment of mindfulness. This 39-item questionnaire measures five facets of mindfulness: *Observe* (8 items), *Describe* (8 items), *Actaware* (8 items), *Nonjudge* (8 items) and *Nonreact* (7 items). Participants are asked to rate the degree to which each statement was true for them, on a 5-point Likert scale ranging from 1 (*never* or *very rarely true*) to 5 (*very often* or *always true*). Amongst the 39 items, 19 items are reverse-scored. Item scores in the entire scale and subscales may be either summed up or averaged, to indicate a person's overall level or different facets of mindfulness.

Depression, Anxiety and Stress Scale (DASS)-21

In order to test the relationship between mindfulness scores and psychological problems, DASS-21 was administered. DASS-21 is widely used for the assessment of depression, anxiety and stress in both clinical and non-clinical populations (Gunathilaka et al., 2018; Lovibond & Lovibond, 1995). This 21-item, self-administered scale includes three 7-item subscales assessing depression, anxiety and stress separately, as experienced during the past week. Responses are provided on a 4-point Likert scale, ranging from 0 (*Never*) to 3 (*Almost Always*). Subscale scores are generated by summing the item scores in each subscale, and multiplying by two. DASS-21 has been translated and validated into Sinhalese earlier (Rekha, 2012)). Validity statistics of the Sinhalese version, such as concurrent, criterion and construct validity, as well as reliability measures, have been reported to be comparable to the original English version.

Data Analyses

Confirmatory factor analysis (CFA) was used to ascertain whether a series of empirical models, including the original five-factor model proposed by Baer et al. (2006); the four-factor model (omitting the *Observe* facet) described amongst non-meditators (Baer et al., 2008); and a one-factor model consistent with the unidimensional conceptualizations of mindfulness (Bishop et al., 2004; Brown & Ryan, 2003), fitted with the present FFMQ data. CFA was performed using *lavaan* on RStudio. Likert items were considered ordinal data, and therefore, diagonally weighted least squares (DWLS) was used as the estimator. Since *lavaan* does not allow missing data imputation with DWLS, missing values were handled by listwise exclusion. Both first-order models and hierarchical models with an overarching mindfulness factor were tested. Model fit was assessed using five goodness-of-fit indices: the ratio of chi-square to degree of freedom (χ^2/df), comparative fit index (CFI), Tucker Lewis Index (TLI), standardized root mean square residual (SRMR) and root mean square error of approximation (RMSEA). A good model fit was indicated by a χ^2/df value smaller than 3. CFI or TLI values ≥ 0.90 and ≥ 0.95 were considered to indicate an acceptable and good model fit, respectively. SRMR values ≤ 0.10 and ≤ 0.08, and the RMSEA values ≤ 0.08 and ≤ 0.06 also indicated acceptable and good model fit respectively (Hu & Bentler, 1999). Modification indices were inspected to identify any constraints that could be freed to improve the model. Although item parcelling had been used by Baer et al. (2006) in the original

validation, some subsequent studies have performed CFA without item parcelling, citing disadvantages of this method such as the potential for spuriously high model fit (Aguado et al., 2015; Neuser, 2010; Tran et al., 2013); similarly, in the present study, we conducted CFA without item parcelling. Item-level analysis allows better identification of potential sources of poor model fit and reduce problems of model misspecification that can occur with item parcelling (Bandalos & Finney, 2001).

When CFA failed to accept above empirical models, we conducted exploratory factor analysis (EFA) using *psych* on RStudio, to explore the possibility of an alternative, better-fitting factor solution. Before performing EFA, the suitability of the dataset for factor analysis was tested using Bartlett's test of sphericity and Kaiser–Meyer–Olkin's (KMO) measure of sampling adequacy; a significant Bartlett's test ($p < 0.05$) and KMO > 0.7 generally indicate that the dataset is suitable for factor analysis. In EFA, principal axis factoring was used as the extraction method. In determining the number of factors to retain, Horn's parallel analysis method was used (Horn, 1965), as this method has been described to be more accurate than the traditional methods such as the Kaiser criterion and scree plot (Hayton et al., 2004): Polychoric correlations were used with the *fa.parallel* function in *psych* package as the data were ordinal. Rotation in EFA aims to achieve 'simple structure'; oblique rotation by the Promax approach was used as the factors were potentially inter-correlated. Factor loadings for individual items were examined to refine the scale structure, by excluding (1) items with factor loading < 0.3; (2) items with undue cross-loadings; and (3) items conceptually external to the emerging theoretical factors (Norman & Streiner, 2014; Raubenheimer, 2004). Item-total correlations were also inspected. CFA was performed on the EFA-derived modified scale and the fit indices are reported (Worthington & Whittaker, 2006). The internal consistencies of the modified scale and subscales were assessed using Cronbach's alpha and McDonald's omega; the minimum acceptable threshold of internal consistency was alpha ≥ 0.7 for the overall modified scale (Ponterotto & Ruckdeschel, 2007). However, taking into account the effect of the number of scale items on internal consistency measures and the less stringent criteria for internal consistency in research settings as opposed to individual high-stake decisions (Ponterotto & Ruckdeschel, 2007), alpha values ranging between 0.6 and 0.7 were also considered acceptable for individual subscales (Aiken, 2000).

In order to assess convergent validity, the correlations amongst overall mindfulness, facet scores (mean score of items in each facet) and the DASS-21 subscale scores (viz. depression, anxiety and stress scores) were tested using Pearson correlation. Incremental validity of each facet over the other facets was explored by running a hierarchical multiple linear regression, where in the first step, the facet scores were fitted as independent predictors of DASS-21 subscale scores; and in the second step, three other variables—age, gender and regular meditation—were added to the regression.

Results

CFA

The original five-factor model endorsed by Baer et al. (2006) did not show an acceptable fit in a CFA of the present data (see Table 1). A hierarchical model with a higher order mindfulness factor showed a poorer fit than the first-order model. A four-factor model without the *Observe* facet, supported in some studies amongst non-meditating samples (Baer et al., 2008), also failed to show adequate fit. The one-factor model also showed poor fit.

All items except three items in the Describe facet had factor loadings over 0.4 ($p < 0.001$) in the first-order, five-factor model. Exclusion of the 3 poorly loaded items (items 12, 16 and 22) from the model improved the model fit, but the fit indices including χ^2/df, SRMR and RMSEA did not reach the thresholds for acceptance. Modification indices did not suggest any theoretically meaningful modifications to improve the model fit. Therefore, to explore alternative

Table 1 Goodness-of-fit indices for empirically based confirmatory factor analysis models

Model	χ^2, *df*, *p* value	χ^2/df	CFI	TLI	RMSEA (90% CI)	SRMR	Decision
First-order, five factors	4348, 692, < 0.001	6.3	0.843	0.832	0.124 (0.120–0.127)	0.113	Reject
Hierarchical, five factors	5293, 697, < 0.001	7.6	0.803	0.790	0.138 (0.135–0.142)	0.125	Reject
First-order, five factors (3 items removed)	2309, 584, < 0.001	4.0	0.920	0.914	0.092 (0.088–0.096)	0.088	Reject
First-order, four factors	3455, 428, < 0.001	8.1	0.791	0.772	0.141 (0.137–0.146)	0.126	Reject
Hierarchical, four factors	4565, 430, < 0.001	10.6	0.714	0.691	0.165 (0.160–0.169)	0.145	Reject
One factor	8243, 702, < 0.001	11.7	0.676	0.658	0.176 (0.173–0.180)	0.151	Reject

factor structures which could better fit the present data, we performed EFA.

EFA

The FFMQ dataset was found to be suitable for factor analysis by Bartlett's test of sphericity ($\chi^2 = 4757$, $df = 741$, $p < 0.001$) and KMO measure of sampling adequacy (KMO = 0.87). EFA with principal axis factoring was performed, with Promax rotation. Horn's parallel analysis (with polychoric correlations) suggested a six-factor solution to be the most appropriate (Fig. 1). Hence, EFA was run with the number of factors set to six. This revealed a theoretically meaningful factor structure, where the original *Actaware* facet disaggregated into two separate factors, viz. *Autopilot* and *Distractibility* (shortened as *Distract*) facets. The factor loadings from this EFA are reported in Table 2. This model explained 39% of the variance in the FFMQ dataset. Two items (items 22 and 17) did not show significant loadings on any factor. EFA run by defining 4 or 5 factors showed less theoretically consistent clustering of items, with poorer EFA model fit indices.

Development of the Six-Facet Short Form

Factor loadings for items in the EFA were examined to refine the facet structure and develop a short form of the questionnaire. Initially, an 18-item scale composed of the 3 items with the highest factor loadings from each of the six facets was considered. Items which loaded inappropriately on theoretically incongruent facets were excluded; three items loading on the *Nonreact* facet (items 31, 36 and 37) and one item (item 12) on the *Distract* facet were thus excluded. Although the number of items with theoretical congruence and acceptable factor loadings under different facets ranged from 4 to 7, considering the minimum requirement of 3 items per factor in multidimensional scales (Raubenheimer, 2004) and the advantages of abbreviated scales (Hou et al., 2013; Tran et al., 2013), we decided to retain 3 items per facet in the initial short form. We also intended to have a similar number of items in each facet in order to maintain content coverage (Hou et al., 2013; Raubenheimer, 2004). CFA of this short form demonstrated excellent fit indices ($\chi^2 = 220$, $df = 120$, $p < 0.001$, $\chi^2/df = 1.8$, CFI = 0.98, TLI = 0.975, RMSEA = 0.047 (90% CI: 0.037–0.056), SRMR = 0.055). However, the internal consistency of this overall scale (Cronbach alpha = 0.688) did not reach the threshold for acceptance (alpha ≥ 0.7). The following approach was used to achieve the internal consistency threshold: Item-total correlations were examined to identify any items with poor correlation with the overall scale, and such items were replaced with another item from the same subscale with better item-total correlation; item 30 in the *Nonjudge* facet (item-total correlation = 0) was replaced with item 10 in this manner. Since the internal consistency was still inadequate after this modification, 2 items were added to the scale, one each from the two most prominent facets, *Nonreact* and *Distract*; this led to the scale reaching the acceptable threshold for internal consistency (Cronbach's alpha = 0.701; McDonald's omega = 0.726). Addition of any single item from facets other than *Nonreact* and *Distract* failed to improve alpha sufficiently, justifying the above choice. The resultant scale had an equal number of forward- and reverse-coded items. A first-order CFA was run again for this modified six-facet 20-item scale, resulting in an excellent model fit ($\chi^2 = 271$, $df = 155$, $p < 0.001$, $\chi^2/df = 1.74$, CFI = 0.980,

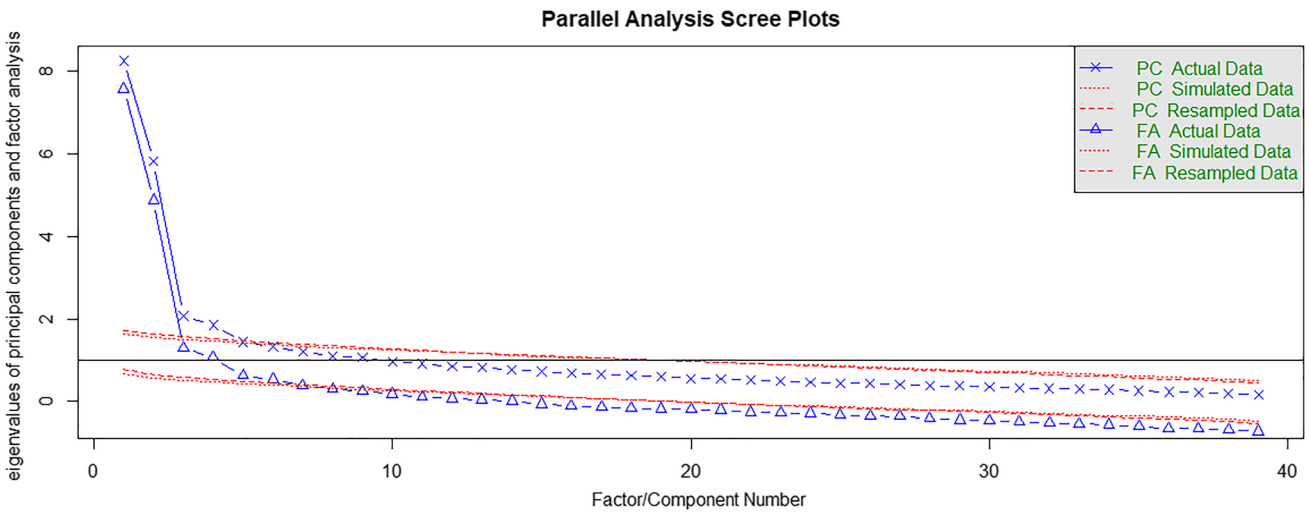

Fig. 1 Parallel analysis scree plot

Table 2 Factor loadings from an exploratory factor analysis of the Five Facet Mindfulness Questionnaire

Item no	Statement	Nonreact	Distract	Observe	Nonjudge	Describe	Autopilot
29	When I have distressing thoughts or images I am able just to notice them without reacting	0.680					
19	When I have distressing thoughts or images, I 'step back' and am aware of the thought or image without getting taken over by it	0.654					
36	I pay attention to how my emotions affect my thoughts and behaviour	0.608					
21	In difficult situations, I can pause without immediately reacting	0.577					
4	I perceive my feelings and emotions without having to react to them	0.567					
24	When I have distressing thoughts or images, I feel calm soon after	0.553					
33	When I have distressing thoughts or images, I just notice them and let them go	0.535					
9	I watch my feelings without getting lost in them	0.495					
37	I can usually describe how I feel at the moment in considerable detail	0.492					
31	I notice visual elements in art or nature, such as colours, shapes, textures, or patterns of light and shadow	0.475					
8	I don't pay attention to what I'm doing because I'm daydreaming, worrying, or otherwise distracted		0.778				
13	I am easily distracted		0.771				
5	When I do things, my mind wanders off and I'm easily distracted		0.569				
12	It's hard for me to find the words to describe what I'm thinking		0.552				
3	I criticise myself for having irrational or inappropriate emotions		0.387				
18	I find it difficult to stay focused on what's happening in the present		0.369				
16	I have trouble thinking of the right words to express how I feel about things		0.311				
15	I pay attention to sensations, such as the wind in my hair or sun on my face			0.638			
6	When I take a shower or bath, I stay alert to the sensations of water on my body			0.544			
20	I pay attention to sounds, such as clocks ticking, birds chirping, or cars passing			0.537			
1	When I'm walking, I deliberately notice the sensations of my body moving			0.413			
26	I notice the smells and aromas of things			0.382			
11	I notice how foods and drinks affect my thoughts, bodily sensations, and emotions			0.327			
30	I think some of my emotions are bad or inappropriate and I shouldn't feel them				0.715		
25	I tell myself that I shouldn't be thinking the way I'm thinking				0.714		
14	I believe some of my thoughts are abnormal or bad and I shouldn't think that way				0.603		
10	I tell myself I shouldn't be feeling the way I'm feeling				0.429		
39	I disapprove of myself when I have irrational ideas				0.379		
35	When I have distressing thoughts or images, I judge myself as good or bad, depending what the thought/image is about				0.302		
2	I'm good at finding words to describe my feelings					0.676	
7	I can easily put my beliefs, opinions, and expectations into words					0.674	
32	My natural tendency is to put my experiences into words					0.486	
27	Even when I'm feeling terribly upset, I can find a way to put it into words					0.433	
23	It seems I am 'running on automatic' without much awareness of what I'm doing						0.764
34	I do jobs or tasks automatically without being aware of what I'm doing						0.654
28	I rush through activities without being really attentive to them						0.521

Table 2 (continued)

Item no	Statement	Nonreact	Distract	Observe	Nonjudge	Describe	Autopilot
38	I find myself doing things without paying attention						0.450
22	When I have a sensation in my body, it's difficult for me to describe it because I can't find the right words						
17	I make judgments about whether my thoughts are good or bad						

Only factor loadings > 0.3 are displayed. Items within each factor are listed in the descending order of their factor loadings

TLI = 0.975, RMSEA = 0.045 (90% CI 0.036–0.054), SRMR = 0.056). Adding a second-order mindfulness factor to this model led to remarkable deterioration of fit (CFI = 0.811, TLI = 0.781); therefore, the first-order model was accepted. The items of the proposed six-facet short form with standardized factor loadings are illustrated in Fig. 2. The mean (SD) subscale scores and internal consistencies are reported in Table 3. Internal consistencies of the 6 subscales (Cronbach's alpha = 0.67 to 0.72; McDonald's omega = 0.67 to 0.73) were deemed acceptable considering the small number of items per subscale (Aiken, 2000; Raphiphatthana et al., 2019).

Relationship with Stress, Anxiety and Depression

Since psychological problems such as stress, anxiety and depression have been linked to lower levels of mindfulness, the correlations amongst these variables were explored. DASS-21 was completed by 295 participants (71.1% of the total sample). Table 4 shows the correlation matrix of the total

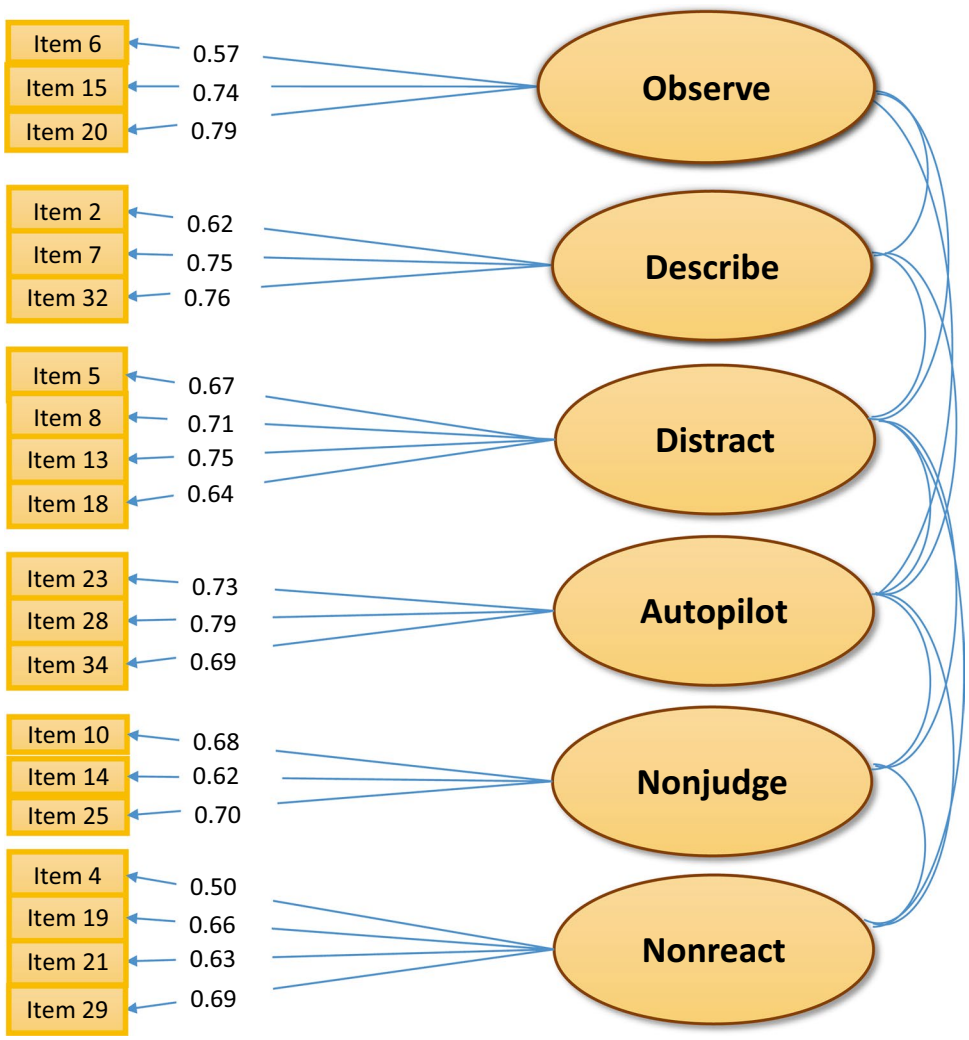

Fig. 2 The 20-item, six-facet mindfulness questionnaire (with standardized factor loadings from confirmatory factor analysis)

Table 3 Means, internal consistencies and inter-correlations of subscales in the modified six-facet mindfulness questionnaire

Scale	No. of items	Cronbach alpha	Alpha if item deleted	McDonald's omega	Mean per item	SD	Item-total correlations	Nonreact	Distract	Observe	Nonjudge	Describe	Autopilot
Nonreact	4	0.668	0.56–0.64	0.670	3.21	0.75	0.18–0.38	-					
Distract	4	0.724	0.61–0.72	0.733	3.75	0.74	0.38–0.42	0.148**	-				
Observe	3	0.691	0.54–0.67	0.697	2.80	0.99	0.19–0.28	0.418**	−0.005	-			
Nonjudge	3	0.684	0.53–0.63	0.691	3.44	0.94	0.05–0.14	−0.216**	0.340**	−0.266**	-		
Describe	3	0.665	0.49–0.63	0.675	3.47	0.75	0.22–0.31	0.312**	0.071	0.348**	−0.159**	-	
Autopilot	3	0.701	0.59–0.63	0.702	4.00	0.82	0.29–0.37	0.124*	0.462**	−0.074	0.249**	−0.032	-
Total	20	0.701	0.67–0.71	0.726	3.38	0.39	0.05–0.42	0.594**	0.668**	0.484**	0.328**	0.391**	0.542**

**Correlation is significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2-tailed)

Table 4 Correlations between mindfulness, depression, anxiety and stress

Scale/subscale	Depression	Anxiety	Stress
Overall mindfulness	−0.388**	−0.345**	−0.442**
Nonreact	−0.164**	−0.159**	−0.229**
Distract	−0.425**	−0.434**	−0.483**
Observe	−0.021	0.039	−0.012
Nonjudge	−0.190**	−0.175**	−0.229**
Describe	−0.046	−0.020	−0.025
Autopilot	−0.358**	−0.310**	−0.344**

**Correlation is significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2-tailed)

and subscale scores from the 20-item six-facet mindfulness scale with DASS-21 subscale scores. Overall mindfulness score showed a moderate negative correlation with depression ($r = -0.37$, $p < 0.001$), anxiety ($r = -0.34$, $p < 0.001$) and stress ($r = -0.43$, $p < 0.001$), demonstrating convergent validity of the scale. Amongst the subscales, *Distract* and *Autopilot* facets showed moderate negative correlations with depression, anxiety and stress ($r = -0.31$ to -0.48), whereas relatively small but significant negative correlations ($r = -0.16$ to -0.23) were observed for the *Nonjudge* and *Nonreact* facets with all 3 outcomes. *Observe* and *Describe* facets were not significantly associated with DASS-21 scores. Some subscales showed incremental validity over the others in a hierarchical multiple linear regression, conducted firstly with the six facets as independent predictors of depression, anxiety and stress; and in the next step, adjusting for age, gender and regular meditation practice (Table 5).

Meditators Versus Non-meditators

Eighty-seven participants (21%) reported that they regularly practice at least one of three Buddhist meditation techniques (*Anapanasati*, *Metta* or *Vipassana*). Mindfulness score (mean of 20 items) was significantly higher amongst meditators (mean = 3.46, SD = 0.39) compared to non-meditators (mean = 3.33, SD = 0.38; $t = 3.3$, $df = 406$, $p = 0.001$). Meditators scored higher on the *Observe* ($t = 3.3$, $df = 406$, $p = 0.001$), *Nonreact* ($t = 3.1$, $df = 406$, $p = 0.002$) and *Describe* ($t = 2.2$, $df = 406$, $p = 0.032$) facets, but not on the *Distract*, *Autopilot* and *Nonjudge* facets. Since the number of meditators in the sample was limited ($n = 87$) and measurement invariance testing is not recommended when the sample size is less than 100 per group (Meade & Bauer, 2007), measurement invariance across meditation practice was not tested.

Table 5 Results from multiple linear regression analyses showing prediction of depression, anxiety and stress from mindfulness facets ($n = 295$)

	Depression		Anxiety		Stress	
	β	p value	β	p value	β	value
Step 1						
Nonreact	−.095	.119	−.126	.038	−.200	.001
Distract	−.277	.000	−.325	.000	−.345	.000
Observe	−.022	.722	.052	.386	.005	.932
Nonjudge	−.073	.236	−.051	.407	−.135	.022
Describe	−.034	.562	−.016	.788	−.015	.788
Autopilot	−.187	.003	−.118	.055	−.110	.060
Adjusted R^2	0.200		0.197		0.267	
Step 2						
Nonreact	−.072	.244	−.112	0.053	−.177	.003
Distract	−.276	.000	−.317	<0.001	−.340	.000
Observe	−.033	.582	.042	0.342	.006	.919
Nonjudge	−.053	.392	−.032	0.859	−.113	.061
Describe	−.040	.505	−.021	0.854	−.014	.808
Autopilot	−.182	.003	−.105	0.042	−.111	.061
Adjusted R^2	0.216		0.213		0.277	

Discussion

This study examined the psychometric properties of the FFMQ in a Sri Lankan Buddhist population of nurses. Our findings add to the limited literature on the factor structure of the FFMQ in Buddhist populations. The original five-factor structure proposed by Baer et al. (2006) failed to demonstrate adequate fit in the present sample. Instead, we found, using EFA, that a six-factor structure, where the original *Actaware* facet splits into two, was the most statistically fitting and theoretically acceptable factor structure for this population. Based on this factor analysis, we present a 20-item six-facet mindfulness questionnaire. Overall mindfulness, measured using the refined 20-item scale, showed moderate negative correlations with psychological problems. Out of the six facets, four demonstrated significant negative correlations with psychological problems, and three of them showed incremental validity over the others.

Several previous studies have supported the presence of a higher order mindfulness factor (Baer et al., 2006, 2008; Christopher et al., 2012; Giovannini et al., 2014). However, our findings supported a correlated first-order factor structure, over hierarchical models. Similar observations where first-order correlated factors were favoured can be found in the literature (Fernandez et al., 2010; Hou et al., 2013; Sugiura et al., 2012; Van Dam et al., 2012). It has been argued that an overarching mindfulness factor may not be apparent amongst non-meditators and in such samples, first-order correlated models may be more appropriate; thus, an individual can be high on one facet of trait mindfulness and be low on another (Fernandez et al., 2010). Apart from meditation experience, cultural factors may have also contributed to these differences.

The splitting of the *Actaware* facet into two different dimensions has been observed earlier (Karl et al., 2020; Lecuona et al., 2021). Karl et al. (2020), in their study on cross-cultural validity of the FFMQ across 16 studies, found the five-facet structure to be unsatisfactory cross-culturally based on CFA; however, when they conducted EFA on the data, evidence for a six-facet structure, with two sub-facets of the *Actaware* facet, emerged. Karl et al. (2020) did not explicitly name the two new facets, but observed that the first sub-facet was characterised by items indicating awareness of one's behaviour, and the second sub-facet indicated items specific to one's mental processes. They also alluded to the distinction made by consciousness researchers between public cognitive spaces and private cognitive spaces, since the two sub-facets seem to resemble this distinction (Gray, 2004). Lecuona et al. (2021) have also proposed a similar six-factor structure, where they named the two sub-facets of *Actaware* as *Distractibility* and *Mindless actions*. Lecuona et al. (2021) also noted the resemblance of their *Mindless actions* facet to the recurring concept of 'Autopilot' that appears in mindfulness-based interventions. In the present study, we opted to name this facet *Autopilot* since the content of the 4 items in this facet is congruous with the concept of Autopilot. Although the items in the original *Actaware* subscale diverged into two dimensions, the inter-factor correlations show that the *Distract* and *Autopilot* were the two most closely correlated facets (Table 3), evidencing the conceptual overlap between the two.

Despite the instability of the *Observe* facet and the resultant better fit of a four-factor structure without the *Observe*

facet seen in non-meditating samples earlier (Baer et al., 2008), this four-facet solution fitted poorly in the present sample. However, comparison of the subscale scores between meditators and non-meditators in our study showed that a difference favouring meditators was most prominent for the *Observe* facet. This supports the notion that the *Observe* facet develops with meditation experience. Meditators scoring higher on *Observe* and *Describe* facets in the present study are similar to the findings of Hou et al. (2013).

Three items on the *Describe* facet showed non-significant factor loadings in the CFA. These items were (12) *It's hard for me to find the words to describe what I am feeling*, (16) *I have trouble thinking of the right words to express how I feel about things* and (22) *When I have a sensation in my body, it's difficult for me to describe it because I can't find the right words*. Fernandez et al. (2010) have also noted poor psychometric characteristics of the same three items amongst college students in the USA, and opted to omit them from the FFMQ. Hence, these three items seem to have a controversial place within the *Describe* facet. However, it is noteworthy that these three items are the only reverse-coded items amongst the eight items of this subscale. Therefore, it is possible that this discrepancy resulted from how the items were worded, rather than a conceptual incongruity with the subscale. The influence of method factors, particularly the positive and negative phrasing of items, on the factor structure of the FFMQ has been previously discussed (Aguado et al., 2015; Karl et al., 2020; Van Dam et al., 2012). However, in our analysis, we have not directly tested the influence of such method factors.

In the original validation study, Baer et al. (2006) used item parcelling for the CFA. This approach has been adopted by several subsequent researchers as well (Fernandez et al., 2010; Hou et al., 2013). However, some authors have argued against the use of item parcelling, opting to perform CFA on individual items, since item parcelling can lead to spuriously high model fit (Aguado et al., 2015; Christopher et al., 2012; Neuser, 2010; Tran et al., 2013). Additionally, conducting CFA on individual items allowed us to take a closer look at how each item was functioning within the tested models. These reasons justify our choice of conducting confirmatory analyses on individual items rather than on item parcels.

Higher trait mindfulness is known to be associated with lower levels of psychological problems such as depression, anxiety and stress. In a meta-analysis of the relationship between trait mindfulness (measured using FFMQ) and affective symptoms, Carpenter et al. (2019) reported the weighted mean correlation for affective symptoms and overall trait mindfulness to be $r = -0.53$. In our sample, significant correlations between overall mindfulness (assessed using the 20-item short form) and psychological problems, ranging from -0.34 to -0.43 ($p < 0.01$), were observed, indicating the convergent validity of the scale. In the foregoing meta-analysis, when mindfulness facets were considered, *Nonjudge* ($r = -0.48$) and *Actaware* ($r = -0.47$) had shown the largest correlations. In our study, similarly, the two sub-facets of *Actaware—Distract* and *Autopilot*—showed the strongest correlations, followed by *Nonjudge*. The comparatively lower correlation for *Nonjudge* is in line with findings from a moderator analysis performed by Carpenter et al. (2019) in their meta-analysis, where they observed that the correlation for *Nonjudge* was significantly influenced by culture; i.e. the correlation was lower in Eastern cultures (-0.32) compared to that in Western cultures (-0.49). Carpenter et al. (2019) also found *Nonreact* ($r = -0.33$) and *Describe* ($r = -0.29$) to be negatively correlated with affective symptoms, but noted that *Observe* was not significantly correlated. A separate meta-analysis on the correlates of mindfulness facets had shown similar results, with *Nonjudge* and *Actaware* facets showing the strongest correlations with mental health outcomes and *Observe* showing the smallest effects (Mattes, 2019). In comparison, in the present study, while *Nonreact* did show significant correlations, both *Observe* and *Describe* failed to correlate significantly with any of the psychological problems.

The non-significance of the *Describe* facet in predicting psychological problems amongst Sri Lankans contradicts the findings of Carpenter et al. (2019) who observed that *Describe* showed stronger correlations with affective symptoms in Eastern samples compared to Western samples. However, Carpenter et al. (2019) also noted differential effects of *Describe* on psychological outcomes, in that it showed a weaker correlation with generalised anxiety compared to depression. Worry, a common feature of anxiety, can involve verbal-linguistic processes characterised by articulating concerns about negative future events (Borkovec & Inz, 1990), thereby potentially rendering the *Describe* facet equivocal in predicting certain psychological outcomes. Worry has been shown to mediate the relationship between mindfulness and depression as well (Parmentier et al., 2019). Some studies have shown that Asian cultural values may predispose individuals to higher alexithymia (i.e. difficulty in reflecting on and articulating emotional states) than Western values (Lo, 2014); thus, the lower scores on the *Describe* facet seen amongst Eastern samples in previous studies (Raphiphatthana et al., 2019; Sugiura et al., 2012) may be a reflection of such cultural differences. On the other hand, some qualitative studies have contested the relevance of the *Describe* facet to the Buddhist conceptualization of mindfulness (Christopher et al., 2014).

Previous studies have shown that the *Observe* facet is negatively correlated with psychological problems amongst meditators, whereas it was positively correlated amongst non-meditators (Baer et al., 2008). In an attempt to illuminate on the anomalous function of the FFMQ *Observe* facet, Rudkin et al. (2018) conducted an EFA on a pool of

'observing' items from several mindfulness questionnaires and identified three sub-factors, viz. *Body Observing*, *Emotion Awareness* and *External Perception*. Amongst them, the *Emotion Awareness* factor was the only one to correlate with psychological symptoms, and it did so in the expected direction in both meditators and non-meditators. Of note, the FFMQ did not have any items which loaded on this factor, which led the authors to infer that the absence of items on awareness of emotions in the FFMQ may explain the problematic function of the FFMQ *Observe* facet.

Although each subscale was positively correlated with overall mindfulness, inter-subscale correlations showed both positive and negative correlations in our study. *Nonjudge* was negatively correlated with both *Observe* and *Nonreact* facets. This demonstrates the divergent validity of the subscales. *Nonjudge* being negatively correlated with *Observe* has been previously reported in studies validating several translations of the FFMQ, including Chinese, Japanese, Italian and Dutch versions (Arthur et al., 2017; Giovannini et al., 2014; Hou et al., 2013; Sugiura et al., 2012; Veehof et al., 2011). However, it has been observed that amongst experienced meditators, *Nonjudge* correlates positively with *Observe* (Baer et al., 2008). This suggests that in people with no experience in meditation, attending to experiences may be associated with judging them, whereas amongst meditators, the skill of non-judgmental observation of internal and external experiences would have developed. A negative correlation between *Nonjudge* and *Nonreact* has also been reported earlier (Hou et al., 2013), but some studies (Baer et al., 2006; Giovannini et al., 2014) have demonstrated a positive correlation between these two facets.

Possible reasons for differences in the psychometric properties of the FFMQ in the Sri Lankan Buddhist sample compared to Western literature would be manifold. Cultural contextual factors in a Buddhist setting may have played a significant role. In a study comparing the factor structure of the FFMQ amongst college students in Bhutan and the USA, a four-factor correlated model without the *Observe* facet showed the best fit in both samples, but the only model which showed both configural and metric invariance across the two samples was a hierarchical four-factor model (Haas & Akamatsu, 2019). In the hierarchical models, the *Observe* facet had loaded significantly on the mindfulness factor only in the Bhutanese sample, indicating a cultural difference in the functioning of this facet. Furthermore, *Nonjudge* and *Nonreact* were positively correlated with each other in the US sample, but negatively correlated in the Bhutanese sample; the latter is consistent with the Sri Lankan findings, and signifies a possible cultural difference between Western and Buddhist contexts. *Nonjudge* scores on the FFMQ in some Eastern cultures such as Thailand, Japan and Bhutan have been reported to be lower than in Western counterparts (Haas & Akamatsu, 2019; Raphiphatthana et al., 2019; Sugiura et al., 2012). It has been posited that a tendency for self-criticism and subsequent improvement of the self in collectivistic cultures, as opposed to a tendency for self-enhancement in individualistic cultures, may have contributed to these differences (Haas & Akamatsu, 2019; Kitayama et al., 1997). Also, it has been demonstrated that the factor structure of the FFMQ tends to differ between collectivistic and individualistic cultures (Karl et al., 2020). Since Sri Lanka is generally considered to be a collectivistic culture (Freeman, 1997), such cultural differences would have contributed, at least in part, to the psychometric differences observed in the present study compared to Western data.

The manner in which individual items in mindfulness scales are interpreted by the respondents would be influenced by meditation experience, and the knowledge and understanding of the concept of mindfulness. In Sri Lanka, virtually all Buddhists learn some theoretical and practical aspects of meditation and mindfulness (*sati*) during their formal school-based education (Tilakaratne, 2021). Sermons delivered by Buddhist monks on meditation are commonplace in the Sri Lankan cultural setting and provide informal education on this topic to Buddhist laypeople. Therefore, the way in which the present participants interpreted and responded to the FFMQ items would have been different from a Western sample with little or no exposure to mindfulness. Several qualitative studies on how Buddhist monks perceive the contents of different mindfulness scales have revealed a range of concerns about these scales (Christopher et al., 2014; Feng et al., 2018). In a study amongst Buddhists at a Zen monastery, the key concerns regarding the FFMQ were the questionable relevance of the *Describe* facet to the assessment of mindfulness; subjectivity of certain items, e.g. many *Actaware* and *Nonjudge* items designed to assess *mindlessness* were perceived as potentially valid statements of *mindfulness*, and level of practice was perceived as influencing item interpretation; repetitive items; and inability of the scale to capture certain elements of mindfulness, e.g. clear comprehension and right intention (Christopher et al., 2014). In another study which interviewed five senior Buddhist clergy representing three branches of Buddhism, several themes of Buddhist mindfulness that are not captured by mindfulness scales (MAAS, KIMS, FFMQ and FMI) were identified; these themes included attentional flexibility, skilfulness, purposefulness, wisdom and ethics (Feng et al., 2018).

Differences in the cross-cultural validity of different mindfulness measures have been observed. In a study that evaluated the factorial invariance of the MAAS and KIMS across Thai and American cultures, MAAS, but not KIMS, showed cultural invariance (Christopher et al., 2009). MAAS operationalized mindfulness as a unidimensional construct (Brown & Ryan, 2003), the contents of which correspond to the *Actaware* facet of the FFMQ. The one-factor structure

of the MAAS has been consistently replicated (Deng et al., 2011; Islam & Siddique, 2016; Jermann et al., 2009; Park et al., 2013). Therefore, a Sinhalese adaptation of the MAAS may show higher cross-cultural validity than the FFMQ, but this needs to be studied in future research. However, it should be noted that MAAS has its limitations; it does not capture many potentially important facets of mindfulness such as *Nonjudge* and *Nonreact*, both of which were significant predictors of psychological outcomes in the present study.

Limitations and Future Research

One of the chief limitations of this study is the preponderance of females in the sample. The small number of males in the sample precluded testing for gender invariance of the proposed six-factor structure. Similar gender imbalances have been noted in previous samples where the FFMQ was validated; e.g. 70 to 93% were women in Bohlmeijer et al. (2011); Christopher et al. (2012); and Veehof et al. (2011). Furthermore, the sample being composed solely of nurses also limits the generalizability of the findings, as nurses are a relatively homogeneous group especially in terms of educational background. Since Sri Lanka is a multi-ethnic, multicultural country, and the present sample consisted exclusively of Buddhists, our findings would not represent Sri Lanka in general. However, the sample being selected from four different provinces in the country would have improved the national representativeness of the sample to some extent.

Although a sizeable proportion of the present sample (21%) reported regular practice of Buddhist meditation, this number ($n = 87$) was considered inadequate to test the measurement invariance of the factor structure across meditation experience (Meade & Bauer, 2007). Moreover, those who were regularly practising at least one of three types of Buddhist meditations (*Vipassana/Anapanasati/Metta*) were considered as meditators, since these three meditations are closely related to mindfulness practice. Samples with a higher number of participants explicitly practising mindfulness meditation will be needed to test whether the proposed six-factor structure holds true for both meditators and non-meditators. Data on the duration of meditation experience were not recorded in our study, constituting a further limitation. As cultural differences between meditators and non-meditators were not investigated in this study, future research exploring such differences would provide useful information in disentangling the effects of meditation practice from potential confounding factors. In the present study, the 20-item scale developed using EFA was not cross-validated using CFA in an independent sample, due to the practical difficulty in recruiting a separate sample with an adequate number of participants. Cross-validation in a separate sample (Smith et al., 2000) in Sri Lanka as well as in other Buddhist cultural settings would be important future steps in further establishing its validity and reliability in the assessment of mindfulness.

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Author Contribution AB conceptualised and designed the study, contributed to data acquisition, conducted the data analysis and wrote the first draft of the manuscript. HA, TN, KK and NCH contributed to study design, and data acquisition. All authors read and approved the final manuscript.

Data Availability All data are available at the Open Science Framework (https://osf.io/bxufw).

Declarations

Ethics Approval Approval was obtained from the ethics review committee of Faculty of Medicine, University of Kelaniya. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Conflict of Interest The authors declare no competing interests.

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