

# Validity of Adult Psychopathology Model Using Psychiatric Patients Sample From a Developing Country: Confirmatory Factor Analysis

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## Research Article

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# Abstract

**Objectives:** This study aimed to test and validate the two-factors measurement model of the Millon Clinical Multiaxial Inventory (MCMI). Specifically, this paper reported construct, convergent and divergent validities of the internalizing-externalizing MCMI model of adult psychopathology using a psychiatric sample from a developing society, the Republic of Yemen.

**Methods:** MCMI was distributed among 232 outpatients from the Hospital of Taiz City and two private psychiatry clinics in Yemen; data were collected using structured interviews in four months. The Maximum Likelihood (ML) was used in Exploratory Factor Analysis (EFA) and the Confirmatory Factory Analysis (CFA) to explore and confirm the latent underlying MCMI and verifying evidence of convergent and discriminate validity.

**Results:** The CFA results indicated that MCMI was a good fit for the internalizing-externalizing model of adult psychopathology. The results of the CFA confirmed that evidence of convergent and discriminant validity characterized MCMI with the internalizing and externalizing model.

**Conclusion:** The adult psychopathology of internalizing and externalizing is a valid model by MCMI with ten personality disorders and eight clinical syndromes. Thus, practical clinical implications are suggested.

## 1. Introduction

Achenbach's original analyses on psychopathology assessment in childhood have empirically changed the way researchers, clinicians, and educators think about childhood behavioral problems [1, 2]. One of the fundamental aspects of the analyses is the hierarchical conceptualization of mental disorders in terms of two broad behavioral spectra, which Achenbach termed internalizing and externalizing. The spectra substantially accounted for the systematic covariation among more narrowly defined behavioral problems [3]. Internalizing problems in childhood include anxiety, depression, and somatization-based disorders while externalizing problems include behavioral misconduct, anger, and attentional difficulties [2].

Another contribution of Achenbach's work is its impact on approaches to conceptualizing adult psychopathology [4]. This internalizing-externalizing model has received substantial attention as a potential theoretical framework for organizing the structure of mental disorders in adults [4–6]. Internalization is the propensity to express distress inwards; common internalizing disorders include major depression, dysthymia, generalized anxiety disorder, agoraphobia, social phobia, simple phobia, and obsessive-compulsive disorder. Conversely, externalization describes the propensity to express distress outwards; commonly recognized externalizing disorders include conduct disorder, antisocial personality disorder, marijuana dependence, and alcohol dependence [7–20].

The externalizing–internalizing spectra have been proposed as an organizational system to be applied in DSM-V [5]. Regarding this change, several advantages have been highlighted, including the use of a more parsimonious and meaningful organizational model/schema, the ability to simplify problems caused by excessive comorbidity, aiding intervention and treatment development, and creating an important area for future research [6, 8, 21, 22].

This externalizing–internalizing framework has been demonstrated across multiple disorders [17, 23], genders [24, 25], ethnicities [25], cultures [10], and over time [7]. It has also been highly successful in accounting for the relationships between psychopathology and other constructs [26] in explaining the etiology of psychopathology in twins studies [27, 28], and in studying adult with attention-deficit/hyperactivity disorders (ADHD)[29]. Although there is growing recognition that comorbidity among individual mental disorders is better understood by the broad psychiatric dimensions of internalization and externalization, expanding the scope of this framework is still needed [12, 23].

# 1.1 Theoretical Gap

Both cluster analysis and exploratory/confirmatory factor analysis studies of mental disorders have found evidence that internalizing and externalizing dimensions underlying common psychopathology in adults [4, 9, 26]. There is also evidence that a limited number of mental disorders represent the internalizing-externalizing spectrum of psychopathology. In particular, the internalizing dimension in previous studies of adult samples was composed of few mental disorders. For example, Krueger and Markon [23] carried out a meta-analysis of relevant literature, applied a CFA to pool data on 11 common mental disorders, and replicated the two general dimensions. The externalizing cluster was composed of substance use disorders, conduct disorder, and adult antisocial behavior. However, the internalizing conditions were only all depressive and anxiety disorders. Although the internalizing and externalizing forms of adult psychopathology are now reasonably established, this 2-spectrum framework is still far from a comprehensive structure, including several mental disorders [7, 30]. Krueger and Markon [23] concluded that expanding the scope of the internalizing-externalizing model by covering a greater diversity of psychopathological symptoms and personality constructs is required and would be a novel step for this model. Therefore, the current study aimed to expand the internalizing dimension by covering several mental disorders, including personality disorders and clinical syndromes.

# 1.2 .Methodological Gap

In addition, the validity of the internalizing-externalizing model for psychopathology in adults has been replicated in population-based samples from several Western, industrialized nations [4, 9, 19, 26, 31]. However, the applicability of this model to mental disorders in non-Western countries remains unknown [10]. Hence, the application of the internalizing-externalizing model of psychopathology in a non-Western country is in order. Methodologically, robust evidence for the internalizing-externalizing model for psychopathology has been supported by investigations with diagnostic interviews and multi-dimensional self-report measures [4, 9, 10, 31, 32]. Krueger and Markon [23] indicated that advanced statistical methods (e.g., structural equation models, item-response models, and growth-curve models) had allowed the tremendous increases in sophistication in our confidence regarding conclusions from psychological theories that can be tested using those methods. These methods also hold great promise for understanding psychopathology because they allow empirical comparison of different classification paradigms. Such paradigms can be represented by different quantitative models and can be rigorously compared by comparing the fit of those models to psychological data (p.114, 2006).

However, the Millon Clinical Multiaxial Inventory[33] is a widely used measure of personality disorders and psychopathology; it is evaluated as a third international scale in the clinical population [34–36]. The scale has provided good evidence of convergent and discriminant validity [37, 38] with several versions. It has been used in limited studies to (i) examine Millon's four factors of psychopathology (11 clinical personality disorders, three severe personality disorders, seven clinical syndromes, and three severe clinical syndromes) and (ii) adequate fit of the internalizing-externalizing model using the maximum likelihood approach of CFA. One possibility of this advanced analysis is to provide powerful evidences of construct validity for the instrument [39].

Many researchers have employed exploratory techniques for MCMI [40–44], while few recent studies have used confirmatory methods with limited scales of MCMI. For example, Cuevas, Garcia, Aluja and Garcia [45] analyzed 14 personality disorders of MCMI using the maximum likelihood of confirmatory factor modelling among undergraduate students as the study sample. Another pioneering study by Rossi, Elklit, and Simonsen [46] used the confirmatory factor method to analyze 14 disorders of MCMI, obtaining a four-factor solution including the internalizing-externalizing model in clinical patients and forensic setting. Only Ruiz and Edens [47] utilized a CFA to analyze the complete 24 MCMI clinical scales. However, their model used a correlation matrix of MCMI, estimating the internalizing-externalizing dimensions and the general factor of personality disorders. Although their model demonstrated adequate fit, it did not

provide MCMI's construct validity evidence in convergent and discriminant validity. In summary, evidence of convergent and discriminant validity using the maximum likelihood of confirmatory factor modelling for MCMI have been limited; therefore, this research aimed to address this concern. Mainly, the current study aimed to examine the Millon Clinical Multi-axial Inventory- III (MCMI) fit with the internalizing-externalizing model of psychopathology and, secondly, evaluate evidence of convergent and discriminant validity of MCMI.

## **2. Methodology**

### **2.1 Sample Size Determination**

Hair and his colleague suggested for Covariance based on SEM (e.g., AMOS), the analysis needs a sample size of greater than 100 [48]. In this study, 212 sample size was considered an adequate size for employing structural equation modelling (SEM) to address the research objectives. Concisely, the determined sample size was satisfactory for conducting confirmatory factor analysis (CFA) [49].

### **2.2 Participants and Procedures**

Data were collected from 232 outpatients of the Hospital of Taiz City and two private psychiatry clinics in Yemen. The inclusion criteria for selecting the outpatients were (i) Yemeni nationality, (ii) getting medical treatment in a psychiatric clinic for more than one year, and (iii) being more than eighteen years old and above. The final eligible sample size of 212 was used, which was the optimal sample size for CFA[50].

The data were collected over a four-month duration. Twenty questionnaires were excluded based on the instruction of MCMI. The response contained males (86.3 %). The age of the outpatients ranged from 20 to > 50 years, with an average age of 30.81 years. The majority of the participants were married (56.63%), whereas 34% were single and 9.4% were divorced. About 28.3% of the sample had primary education (writing and reading skills), 23.1% had primary education, 35.4% held secondary school certificates, and 13.2% were degree holders.

The study received ethical approval from the academic committees of the Department of Educational Psychology and Counseling at International Islamic University Malaysia (IIUM), Malaysia. In addition, every patient gave their informed consent to participate in this research.

### **2.3 Research Design**

The research design of the current study was based on correlational structural equation modelling that was dependent on the analysis of covariance's matrix [39]. The list of observable variables of personality disorders and psychopathology in MCMI was endogenous/dependent variables, while latent constructs, namely externalizing and externalizing dimensions of psychopathology, were evaluated as exogenous variables. Subsequently, the structural model in the current study was under confirmatory factor modelling [39, 49, 51].

### **2.4 Patient and Public Involvement**

In this study, the data was collected using Millon Clinical Multi-axial Inventory after the consent had been taken from the outpatient to participate by answering the survey. However, no patient was involved in setting the research question or the outcome measures. Furthermore, the participants were also not involved in the design or conduct of the study. No patients were requested to provide advice on interpreting or reporting the results. The results of the study were not planned to be disseminated to the participants.

### **2.5 Millon Clinical Multi-axial Inventory (MCMI)**

Psychopathology was measured using the Millon Clinical Multiaxial Inventory- III (MCMI-III Millon, 1994). This self-report personality and diagnostic inventory consist of 175 true-false items addressing Axis I (10 clinical syndromes) and Axis II (14 personality disorders) based on the Diagnostic and Statistical Manual of Mental Disorders (4th ed. [DSM-IV] and DSM-5.

The MCMI has an adequate internal consistency (alphas ranging from 0.66 for the compulsive scale to .90 for the major depression scale) [38]. Moreover, the test-retest reliability of the MCMI scales was obtained by re-administering the scale between 5 to 14 days after the initial administration to .87 subjects. The validity ranged from .84 for the anxiety scale to .96 for the somatoform scale. The median stability coefficient was .91, suggesting that the MCMI results were highly stable over a short period [38].

## 2.6 Statistical Analysis

### 2.6.1 Exploratory Factor Analysis (EFA)

EFA in IBM SPSS was conducted to determine the number of the underlying factors in MCMI, using Maximum Likelihood as the best method for extraction. The Kaiser-Meyer-Olkin (KMO) measure should be more than .70. A value of more than .90 indicates a superb considerable level [52]. Bartlett's Test of Sphericity must be statistically significant. Next, anti-image correlation and communalities were set at  $\geq 0.50$  [53]. Both orthogonal and oblique methods of rotation were engaged. Furthermore, the number of extracted factors should meet several criteria, including theoretical justification, identical results across both orthogonal and oblique methods of ML-EFA, Kaiser's Eigenvalue  $\geq 1$ , total variance  $\geq .60$ , and Scree Plot. Next, the direction and proportion of factor loading should be  $\geq .55$ , and the corrected item-total correlation must be .30 at least and positive[54]. Finally, individual and overall reliability should be 0.70 at least[55].

### 2.6.2 Confirmatory Factor Analysis

CFA is a type of structural equation modelling (SEM) that deals specifically with measurement models. In other words, it deals with the relationships between observed measures or indicators (e.g., test items, test scores, and behavioral observation ratings) and latent variables or factors [39].

To evaluate fit of the hypothesized model for the data, multiple tests were used in this study. Kline [49] recommended a minimal set of four fit indexes, including Chi-Square Test ( $\chi^2$ ), the Comparative Fit Index (CFI; Bentler, 1990), Standardized Root Mean Residuals (SRMR) and the Root Mean Square Errors of Approximation (RMSEA), Chi-Square Model included chi-square Test, Degree of Freedom (DF), and non-significant P-value. However, it is well known that significant p-testing is greatly influenced by certain factors such as sample size, high correlations [49] and model complexity[56]. Both SRMR and RMSEA must be less than 0.08 [49, 57]. Additionally, normed chi-square ( $\chi^2/df$ ) and Incremental Fit Index (IFI; Bollen, 1989) were also used to evaluate the hypothesized model fit. The normed chi-square ( $\chi^2/df$ ) should be  $\leq 3$ . Both CFI and IFI must be .90 at least[49, 58].

Convergent and discriminant validity of MCMI as a component of construct validity was tested based on suggestions provided by several statisticians [39, 49, 54, 57, 59, 60]. It refers to how much each indicator (e.g., disorder) represents or relates to its construct, whether it is an internalizing or externalizing form of psychopathology. This was achieved by assessing the high factor loading, construct reliability (CR), and average variance extraction (VE). Several techniques and different meanings assess discriminant validity.

## 3. Results

## 3.1 CFA and Millon's Four Factors of Psychopathology

Millon et al. [38] hypothesized that four psychopathology factors underlie the MCMI. The results of the ML estimation confirm that the four-factor structure did not converge to an admissible solution. The result of the covariance matrix was not definite positive. Moreover, the four inter-correlation factors from the six relationships yielded offending estimates ( $r > 1$ ).

Subsequent attempts to solve this improper problem by eliminating the inter-correlations and fixing them at 1 also led to an inadmissible solution. Similarly, using the different methods of estimation such as generalized least squares, unweighted least squares, scale-free least squares, and asymptotically distribution-free produced an improper solution. Millon's classification for psychopathology in terms of the four-factor model did not fit the present data. Accordingly, to search for a more appropriate solution, we explored the number of factor structures underlying MCMI using EFA to obtain an initial validation is shown in Figure 1.

## 3.2 Exploratory Factor Analysis (EFA)

Kaiser-Meyer-Olkin Measure of Sampling Adequacy was .952, and Bartlett's Test of Sphericity was statistically significant ( $p \leq 0.001$ ). All results of Anti-Image Correlation for the twenty four factors of MCMI were above .90 as ideal standard criterion except for Narcissistic personality disorder (.533<sup>a</sup>), Histrionic personality disorder (.736<sup>a</sup>), and Compulsive personality disorder (.863<sup>a</sup>) as acceptable standard criteria (Table 1). Results of communalities in the same Table were almost above .50 as acceptable standard criteria except for histrionic personality disorder (.266) and Narcissistic personality disorder (.264). Thompson [61] advised researchers to keep the factors for following analysis procedures with low communalities if their factor loadings are above .33. The Eigenvalue of the ML of EFA produced an initial three-factor solution, which accounted for about 72.096% of the total variance, confirmed by the scree-plot (Fig. 1).

The first term, which explained 57.090% from the total variance is named "internalizing psychopathology", and its Eigenvalue  $\lambda$  13.697. This term consisted of the following eighteen factors with excellent ratio of loading ( $>.55$ ): Paranoid (.833/.916), Anxiety (.820/.869), Posttraumatic Stress (.803/.852), Depressive (.808/.856), Thought Disorder (.812/.838), Schizotypal (.803/.837), Dysthymia (.802/.839), Avoidant (.791/.846), Major Depression (.787/.825), Borderline (.752/.739), Somatoform (.730/.769), Delusional Disorder (.730/.756), Bipolar Manic (.707/.701), Masochistic (.707/.690), Negativistic (.708/.717), Dependent (.663/.677), Sadistic (.674/.637), and Schizoid (.591/.575). Both orthogonal and oblique rotation of ML confirmed the identical factors with positive pole of direction, exceeding loading .55.

Next, a corrected item-total correlation was high (above .30) as acceptable standard criteria for each disorder in the given factor. Similarly, each disorder was highly reliable and above .70 as a standard condition. The overall reliability for the whole factor was .971, which is above .70.

The second term, which modeled 7.488% from the total variance, is named "externalizing psychopathology" and Eigenvalue  $\lambda$  1.899. This term involved four factors with an excellent ratio of loading ( $>.55$ ) as follows: Antisocial personality disorder (.874/-.814), Drug Dependence (.810/-.777), Alcohol Dependence (.736/-.650), and Compulsive personality disorder (-.610/.649) (Table 1). It was noted that compulsive personality disorder was related in the opposite direction across the orthogonal and oblique rotation of ML with the other three disorders in the same term. Furthermore, the Corrected item-total Correlation for each disorder in the externalizing psychopathology factor displayed a high rate above 0.30 as acceptable standard criteria. The reliability analysis was conducted in SPSS, which suggested dropping the compulsive personality disorder from externalizing psychopathology, resulted in a highly rated

degree of reliability 0.70 and around 0.920. Additionally, the Corrected item-total Correlation for each disorder and its specific reliability were ideally rated degree. Similarly, each disorder was highly reliable and above 0.70 as a standard condition of reliability. Moreover, the overall reliability for the whole factor was 0.920 (above 0.70) after removing the compulsive personality disorder from the externalizing psychopathology factor.

The final term, which accounted for 4.399 % of the total variance, is known as “emotional disturbances” and Eigenvalue  $\lambda$  1.056. This term contained two factors with small loading ( $<0.55$ ), which are Narcissistic personality disorder (0.510/0.514) and Histrionic personality disorder (0.428/0.411) as identified by both orthogonal and oblique rotation of ML.

Table 1  
Result of ML-EFA and reliability of MCMI-III's subscales and their factor loading.

Variables/ Disorders	Anti-Image Correlation	Communalities	Maximum Likelihood (ML)		Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha <sup>a</sup>
			Varimax	Oblimin			
			(Rotated Factor Loadings)	(Pattern Matrix)			
			Term 1 : Internalizing Psychopathology				
Paranoid	.929 <sup>a</sup>	.781	.833	.916	.710	.971	
Anxiety	.963 <sup>a</sup>	.731	.820	.869	.835	.969	
Posttraumatic Stress	.954 <sup>a</sup>	.727	.803	.852	.827	.969	
Depressive	.972 <sup>a</sup>	.778	.808	.856	.851	.969	
Thought Disorder	.972 <sup>a</sup>	.817	.812	.838	.883	.968	
Schizotypal	.972 <sup>a</sup>	.724	.803	.837	.836	.969	
Dysthymia	.963 <sup>a</sup>	.794	.802	.839	.859	.969	
Avoidant	.959 <sup>a</sup>	.662	.791	.846	.795	.969	
Major Depression	.934 <sup>a</sup>	.767	.787	.825	.841	.969	
Borderline	.980 <sup>a</sup>	.804	.752	.739	.869	.968	
Somatoform	.958 <sup>a</sup>	.647	.730	.769	.774	.970	
Delusional Disorder	.943 <sup>a</sup>	.625	.730	.756	.712	.971	
Bipolar Manic	.977 <sup>a</sup>	.652	.707	.701	.786	.970	
Masochistic	.970 <sup>a</sup>	.738	.707	.690	.828	.969	
Negativistic	.951 <sup>a</sup>	.601	.708	.717	.748	.970	
Dependent	.964 <sup>a</sup>	.525	.663	.677	.718	.970	
Sadistic	.961 <sup>a</sup>	.732	.674	.637	.762	.970	
Schizoid	.947 <sup>a</sup>	.584	.591	.575	.712	.970	.971
<b>Term 2 : Externalizing Psychopathology</b>							
Antisocial	.920 <sup>a</sup>	.943	.874	-.814	.725/ <b>.871</b>	-.016 <sup>a</sup> / <b>.862</b>	

\* Values with Bold font in factor 2 are result of second run of Reliability analysis after removing the Compulsive Disorder Personality. (-) refers for unavailable Reliability.

Variables/ Disorders	Anti-Image Correlation	Communalities	Maximum Likelihood (ML)		Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha <sup>a</sup>
			Varimax	Oblimin			
			(Rotated Factor Loadings)	(Pattern Matrix)			
			Term 1 : Internalizing Psychopathology				
Drug Dependence	.908 <sup>a</sup>	.751	.810	-.777	.771/ <b>.854</b>	-.056 <sup>a</sup> / <b>.873</b>	
Alcohol Dependence	.964 <sup>a</sup>	.729	.736	-.650	.721/ <b>.818</b>	.115/ <b>.913</b>	
Compulsive	.863 <sup>a</sup>	.429	-.610	.649	-.510	.920	.533/ <b>.920</b>
<b>Term 3: Emotional Disturbances</b>							
Narcissistic	.533 <sup>a</sup>	.264	.510	.514	.354	-	
Histrionic	.736 <sup>a</sup>	.266	.428	.411	.354	-	.497
* Values with Bold font in factor 2 are result of second run of Reliability analysis after removing the Compulsive Disorder Personality. (-) refers for unavailable Reliability.							

Corrected Item-Total Correlation for narcissistic personality (0.354) and histrionic personality disorders (0.354) was above .30 as acceptable standard criteria. However, the overall reliability for the whole factor was 0.497 and less than 0.70. Although this factor loaded an acceptable ratio, it was not reliable either individually or collectively. Subsequently, it was not included for the next CFA.

### 3.3 Confirmatory Factor Analysis (CFA)

The skewness and kurtosis indices demonstrated no evidence of non-normality for the MCMI's 21 factors (largest skewness value = -.571 for paranoid; largest kurtosis value = -.882 for posttraumatic stress disorder; a value of +/- 1.0 is generally considered the cut-off for data non-normality). The value of Mardia's coefficient was 1.213, thus demonstrating evidence for multivariate normality. An estimate of  $\leq 2.0$  is usually reflected as the cut-off for data multivariate normality[62]. Given that every variable was normally distributed, the ML method was used to analyse the confirmatory factor modeling.

#### 3.3.1 Fit of MCMI with Two-Factor Model

ML of CFA revealed that the two-factor model of the MCMI (internalizing and externalizing forms of psychopathology) was free from any improper solution of CFA. There were no offending estimates, loading  $\geq 1.0$ , and no negative error variance value. The model converged to an admissible solution with all parameter estimations reaching a statistically significant level. However, its fit statistics was less satisfactory, thus suggesting the need for revising it. For instance, CFI = .888, IFI = .888 and RMSEA = .114 failed to be reasonably adequate. After allowing the errors to be correlated (not shown here), ML results of the revised measurement model of the two-factor model of MCMI indicated that its fit statistics seemed reasonably good and plausible (e.g.,  $\chi^2 = 383.655$ , DF = 175,  $\chi^2/df = 2.192$ ,  $p \leq 0.001$ , CFI = .954, IFI = .955, SRMR = .046, and RMSEA = .075) (Fig. 2).

The critical values indicate that the unstandardized factor loadings for all disorders were statistically significant ( $\geq 1.96$ ), ranging from 10.164 for paranoid personality disorder to 20.02 for drug dependence. More specifically, the

standardized factor loadings for each disorder in the internalizing psychopathology construct varied from very good (.68) for paranoid to excellent (0.90) for thought disorder. Similarly, the standardized factor loading for each indicator in the externalizing psychopathology construct was profound. Hence, the convergent validity for the two-factor model of MCMI seemed substantially credible.

The squared multiple correlations (SMC) represent the proportion of variance in each disorder, accounted for by its respective factor. Indicators with small SMC values represent potentially weak evidence of construct validity, while the squared multiple correlations (SMC) is .50 and above, which is an ideal value [49]. Except for the paranoid ( $R^2 = .46$  as a good value), the squared multiple correlations of all disorders had an ideal value of  $SMC \geq .50$ , showing that both internalizing and externalizing psychopathology constructs explained a high proportion of variance in their respective disorders is shown in Figure 2.

**Table 2.** Variance Extracted Computations.

<b>First Method</b>	
Variance Extracted	$= \frac{\text{Sum of Squared Factor Loadings}}{\text{Sum of Squared Factor Loadings} + \text{Sum of Indicator Measurement Error}}$
Variance Extracted for Internalizing Psychopathology	
Variance Extracted	$= \frac{11.70}{11.70 + 6.30} = \frac{11.70}{18} = 0.65$
Variance Extracted for Externalizing Psychopathology	
Variance Extracted	$= \frac{2.39}{2.39 + 0.61} = \frac{2.39}{3} = 0.80$
<b>Second Method</b>	
Variance Extracted	$= \frac{\text{Sum of Squared Factor Loadings}}{\text{Number of Indicators}}$
Variance Extracted for Internalizing Psychopathology	
Variance Extracted	$= \frac{11.70}{18} = 0.65$
Variance Extracted for Externalizing Psychopathology	
Variance Extracted	$= \frac{2.39}{3} = 0.80$

## 3.3.2 Convergent Validity

### 3.3.2.1 Average Variance-Extracted (AVE)

The average variance-extracted displayed that latent construct of internalizing psychopathology obtained a coefficient of .65, which fell above the recommended amount of the 50 percent (Table 2). Likewise, the average variance-extracted of externalizing psychopathology was .80, which reached the recommended threshold. This means that the large amounts of variance extracted for both internalizing and externalizing constructs indicated an adequate percentage or greater than half of the variance for each set of the specified disorders which were modeled by each representative construct.

### 3.3.2.2 Construct reliability

Cronbach's alpha coefficient (Table 3) for both internalizing and externalizing psychopathology constructs was .97 and .92, respectively. The values exceeded .70 as an acceptance level. Furthermore, the construct reliability based on standardized loading was .97 and .92 for internalizing and externalizing psychopathology constructs, which considerably exceeded the suggested threshold of 0.70 [49]. In conclusion, the construct reliability methods excellently

indicated that the observed measures of disorders all adequately and consistently represented the same latent construct (Internalizing and Externalizing Psychopathology).

**Table 3.** Construct Reliability Computations.

<b>Construct Reliability Computation</b>	
<i>Construct Reliability</i>	$= \frac{(\text{Sum of Standardized Loading})^2}{(\text{Sum of Standardized Loading})^2 + \text{Sum of Indicator Measurement Error}}$
	<i>Indicator Measurement Error calculated by 1 - SMC (Squared Multiple Correlation)</i>
<b>Construct Reliability for Internalizing Psychopathology</b>	
<i>Construct Reliability</i>	$= \frac{(14.54)^2}{(14.54)^2 + 6.30} = \frac{211.4116}{211.4116 + 6.30} = \frac{211.4116}{217.7116} = 0.97$
<b>Construct Reliability for Externalizing Psychopathology</b>	
<i>Construct Reliability</i>	$= \frac{(2.68)^2}{(2.68)^2 + 0.61} = \frac{7.1824}{7.1824 + 0.61} = \frac{7.1824}{7.7924} = 0.92$

### 3.3.3 Discriminant Validity

From the point of the construct level, the discriminant validity refers to the strength of correlation coefficient among the latent constructs [49]; that is, when two latent constructs are moderately correlated (not too high, e.g. .85), and the value of correlation coefficient is not too small (<.20)[63]. Inter-factor correlation between internalizing and externalizing constructs of psychopathology was statistically significant:  $r = .73$ ,  $b = 10.39$ ,  $S.E = 1.39$ ,  $C.R = 7.27$  ( $10.39/1.39$ ), and  $p \leq 0.001$  (Fig. 2). This correlation value is good evidence of the discriminant validity. Next, the discriminant validity was estimated by comparing the AVE to squared correlation ( $r^2$ ) or shared variance (SV) between internalizing psychopathology and externalizing psychopathology. The variance-extracted was expected to be greater than the squared correlation value[60]. Hair et al.[54] noted that a latent construct could explain its variable measures better than it explains another construct. Variance-extractions of internalizing psychopathology (.65) and externalizing psychopathology (.80) were more than squared correlation (.53) between these two constructs, thus providing good evidence of the discriminant validity (Table 4).

Table 4  
Tests of Discriminant Validity for Two-Factor Model of MCMI.

<b>Internalizing Psychopathology</b>		<b>Externalizing Psychopathology</b>	
AVE	$(r)^2$	AVE	$(r)^2$
.65	.53	.80	.53

At the factor /item level, discriminant validity is not a divergent validity, which means that individual measured variables should represent only one latent construct. The absence of cross-loading for two constructs indicates a discriminant validity (Hair et al., 2010). Factor Score Weights showed that antisocial, alcoholic, and drug disorders correlate highly with externalizing psychopathology. In contrast, all of the remaining disorders correlated highly with the internalizing psychopathology, except the paranoid.

At the model level, discriminant validity can also be tested using a series of chi-square difference tests. The unconstrained CFA model (with all factors freely correlated) was compared with a constrained model, and the correlation of two factors set equal to one. The discriminant validity is supported by a significant change [59]. Table 5 shows that the chi-square difference and the goodness of fit tests by Byrne [57] were due to the added constraint, all

getting significant (CFI and RMSEA) power, e.g. the constrained model fit is poorer than the unconstrained one. Thus, the two factors of internalizing and externalizing psychopathology exhibited a discriminant validity.

Next, the discriminant validity was determined by comparing the fit of the original model against the one-factor model [54]. Table 5 shows that internalizing-externalizing psychopathology, as a two-factor model of MCMI, was more significantly plausible than the one-factor model of MCMI. Hence, the two-factor model of MCMI was sufficiently characterized by good evidence of the discriminant validity.

Table 5  
Fit Statistics for Discriminant Validity.

Fit Statistics	Comparison 1		Comparison 2	
	Unconstrained Model	Constrained Model	Two-Factor Model	One-Factor Model
	383.655	499.421	383.655	655.350
<b>DF</b>	175	176	175	176
	2.192*	2.838*	2.192*	3.724
<b>CFI</b>	.954	.929	.954	.895
<b>IFI</b>	.955	.930	.955	.896
<b>SRMR</b>	.0462	.2229	.0462	.0587
<b>RMSEA</b>	.075	.093	.075	.114
* p < 0.001 * p < 0.05				

## 4. Discussion

The first research objective of the present study was to examine the construct validity of MCMI with IN-EX model of psychopathology using the collected data. The result of ML in CFA indicated the MCMI was an adequate scale with a two-factor model, including the internalizing-externalizing model of psychopathology. Fit statistics of CFA (CFI, IFI and RMSEA) showed that MCMI with the internalizing and externalizing model of psychopathology fitted with the data collected from a developing country. Psychopathology is ideally classified in terms of the internalizing and externalizing models. The eighteen disorders; schizoid, avoidant, depressive, dependent, sadistic, negativistic, masochistic, schizotypal, borderline, paranoid, anxiety, somatoform, bipolar manic, dysthymia, posttraumatic stress disorder, thought disorder, major depression, and delusional disorder were ideally loaded on the internalizing form of psychopathology. In all, ten disorders were classified under Axis II (personality disorders), whereas the rest (eight disorders) were related to Axis I (clinical syndromes). The three disorders, that is, antisocial, alcohol, and drug were excellently loaded on the externalizing form of psychopathology. These findings of the internalizing and externalizing are consistent with the results of previous studies [4, 7–19, 21, 22, 24, 29, 37, 46, 64].

However, it should be noted that these previous studies had found a small number of disorders (four to six disorders) representing and manifesting the internalizing model of psychopathology. The structure of internalizing psychopathology in this research was extended to ten personality disorders and eight clinical syndromes. It captured the DSM-V model of psychopathology: Axis II (personality disorders) and Axis I (clinical syndromes). Uniquely, the internalizing model in the current study validated more mental disorders used in previous researches on

psychopathology. This is congruent with Millon's theory, which considers the importance and dominance of the broad general maladjustment factor with loadings from many scales/disorders [38].

One plausible interpretation is that the expanded scope of internalizing disorders is justifiable since they are attributable to a shared set of genetic factors [4, 9]. Røysamb et al. [65] found that the internalizing factor contained six indicators from Axis I (clinical disorders), namely anxiety disorder, major depressive disorder, dysthymia, anorexia nervosa, and post-traumatic stress, and pain disorder. In addition, the two indicators from Axis II (personality disorders): depressive and borderline, were loaded partly on this factor.

The current study extends existing disorders of the internalizing psychopathology structure by including various Axis I and Axis II psychopathology. Theoretically, this expanded the conceptualization of internalizing psychopathology which is consistent with the ideas of Krueger and Markon [23], suggesting that the internalizing-model can be tested with many mental disorders. Empirically, the result of the study is similar to the results of a previous study [16] that analyzed the correlation matrix of MCMI [38]. The set of internalizing and externalizing in the current research and previous study [16] are somewhat harmonious because of the two studies in terms of instrument and analyses procedures.

Although the current study expands the model of internalizing-externalizing psychopathology, there are notable differences between the current model and previous models. For example, previous studies presented/delineated internalizing psychopathology with two underlying factors: fear and distress [4, 10, 17, 21, 24], whereas the internalizing model in the current study did not bifurcate into distinct distress and fear components of internalizing disorders.

The externalizing psychopathology in this research included antisocial, alcoholic and drug disorders. The results of the present study analysis are strongly consistent with the results of previous studies [4, 9, 12, 16, 17, 64, 65], which demonstrated that antisocial, alcoholic and drug disorders all reflect an externalizing dimension. Substance abuse (e.g. alcohol and drug) and antisocial behaviour are genetically linked to an impulsive personality style [66]. In addition, these are both externalizing disorders indicators as the emotional release is directed outward without any restriction [67], sharing the fact that the expression of the detachment from social values maybe from childhood.

The second research objective was to evaluate the evidence of convergent validity and discriminant validity of MCMI with internalizing-externalizing model of psychopathology. The result of ML in CFA indicated the MCMI with the two-factor model (internalizing-externalizing model of psychopathology) was evidently characterized by convergent and discriminant validity. Given the ideal factor loadings of MCMI and the large proportion of variance, excellent reliability, and high variance extracted, it is evident that the disorders within each construct of psychopathology measure consistently and sufficiently their respective construct: internalizing-externalizing of psychopathology. It can be concluded that a convergent validity adequately characterized MCMI with the internalizing-externalizing model of psychopathology. These findings are consistent with the results of the previous studies [16, 40, 44, 45]. Similar findings across five discriminant validity evidences confirmed that MCMI with the internalizing-externalizing model of psychopathology were characterized by discriminant validity.

The value of the latent correlation was .73 ( $p \leq 0.000$ ), which was consistent with previous studies [4, 19]. The squared correlation between two constructs of psychopathology was less than their average variance-extracted. These techniques of discriminant validity predict that each construct of psychopathology assesses distinct concepts and meanings in the hypothesized model. This finding supports some previous studies which verified the distinction between internalizing and externalizing psychopathology [23]. Therefore, it can be concluded that the two-factor model of MCMI was differently designed to be assessed, indicating that the internalizing psychopathology construct was distinct from the externalizing psychopathology construct; this was good evidence of discriminant validity. Next, the two factors for MCMI exhibited discriminant validity, which strongly confirmed that the two-factor model of

psychopathology for MCMI appeared to be the most favorable. Psychopathology with more than two-factor or single factors had unacceptable fit indices. These findings of the discriminant validity were consistent with a previous study that aimed to test the discriminant validity of MCMI regardless of the different methods of analysis [37].

## 4.1 Strengths and Limitations

The current research is the first study to verify psychometric evaluations of construct validity evidence of MCMI in a developing country using a sample of patients from outside Western culture.

This study is a novel attempt to offer evidence of the fit of the adult psychopathology model in terms of internalizing and externalizing forms using a psychiatric sample from a developing society.

The research expanded the structure of internalizing psychopathology to capture simultaneously ten personality disorders and eight clinical syndromes. It is consistent with the ideal vision that new research would expand the scope of the structure of internalizing and externalizing psychopathology (1-3). Subsequently, the organization of psychopathology in terms of internalizing and externalizing forms in the developing society is evaluated as a modern conceptual framework for adult psychopathology. The study provides original information on MCMI as a third clinical scale on clinical population using Maximum Likelihood (ML) in Exploratory Factor Analysis (EFA) and Structural Equation Modeling.

Although the results of this study are significant, certain limitations should be addressed for future research. The first limitation is that the important findings from this study were based on correlational analyses, relying on participants' self-report of psychopathology measures. Therefore, developmentally longitudinal studies are needed to verify the findings reported here. Moreover, although the MCMI with the two-factor model: internalizing and externalizing psychopathology was evident by its construct validation, replication of this study is needed, using different methodologies such as Multitrait-Multimethod [68](Campbell & Fiske, 1959)(Campbell & Fiske, 1959)[68][68][68][68] (Campbell and Fiske, 1959)[66]<sup>1</sup>(4) (e.g., self-reports, clinical observations, and interviews) and different samples (e.g., prisoners, patients, and community).

## 4.2 Implications and Recommendations

The results of the current study carry significant implications for clinical researchers and psychiatrists in hospitals. The MCMI is defined theoretically by internalizing and externalizing forms of psychopathology in clinical populations, which was significantly characterized by construct validity. Therefore, clinicians, clinical psychologists and researchers can assess psychopathology / mental disorders and personality disorders using MCMI in clinical and non-clinical populations with high confidence in terms of psychometric aspects (validity and reliability) in a developing society. Moreover, MCMI is a clinically accurate assessment for the diagnosis of mental disorders. It can be used in treatment to track changes over time by looking at patients' scores on MCMI's scales elevations.

## Conclusion

### 4.3 Conclusion

This study provides evidence of model-fit-data of the adult psychopathology two-factor internalizing - externalizing using psychiatric samples from a developing society. More significantly, this study expanded the structure of the internalizing psychopathology to identify ten personality disorders and eight clinical syndromes. It is consistent with the ideal vision that new research would expand the scope of the structure of internalizing and externalizing

psychopathology [8, 10, 11]. Subsequently, psychopathology is a novel conceptual framework for adult psychopathology in terms of internalizing and externalizing forms.

## Declarations

### Ethics approval and consent to participate

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Research Ethics and Supervisory Committee of the Kulliyah of Education, International Islamic University Malaysia (IIUM) (Date: 26/3/2018). All participants in this research gave their informed consent to participate in this research voluntarily.

### Consent for publication

Not applicable

### Availability of data and materials

The data used in the current study are confidential and cannot be publicly shared. This was also stated in the participants' consent. However, it is available from the first author or corresponding author on reasonable request.

### Competing interests

None declared

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### Authors' contributions

N.A.A., S.A.H., and M.S.N. have conceptualized the theoretical parts of the study, including theories and previous studies. N.A.A., S.A.H., N.M.A., and M.A.A. have been involved in formulating the section of Methodology. N.A.A., E.M.E.K., and M.S.N. participated in the analysis of the results and statistical analysis. N.A.A., S.A.H., and E.M.E.K. participated in the preparation of the discussion. N.A.A., S.A.H., and L.A.M. contributed to drafting the paper and revising it in a critical way to improve its important intellectual content. All authors read and approved the final manuscript.

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## Figures

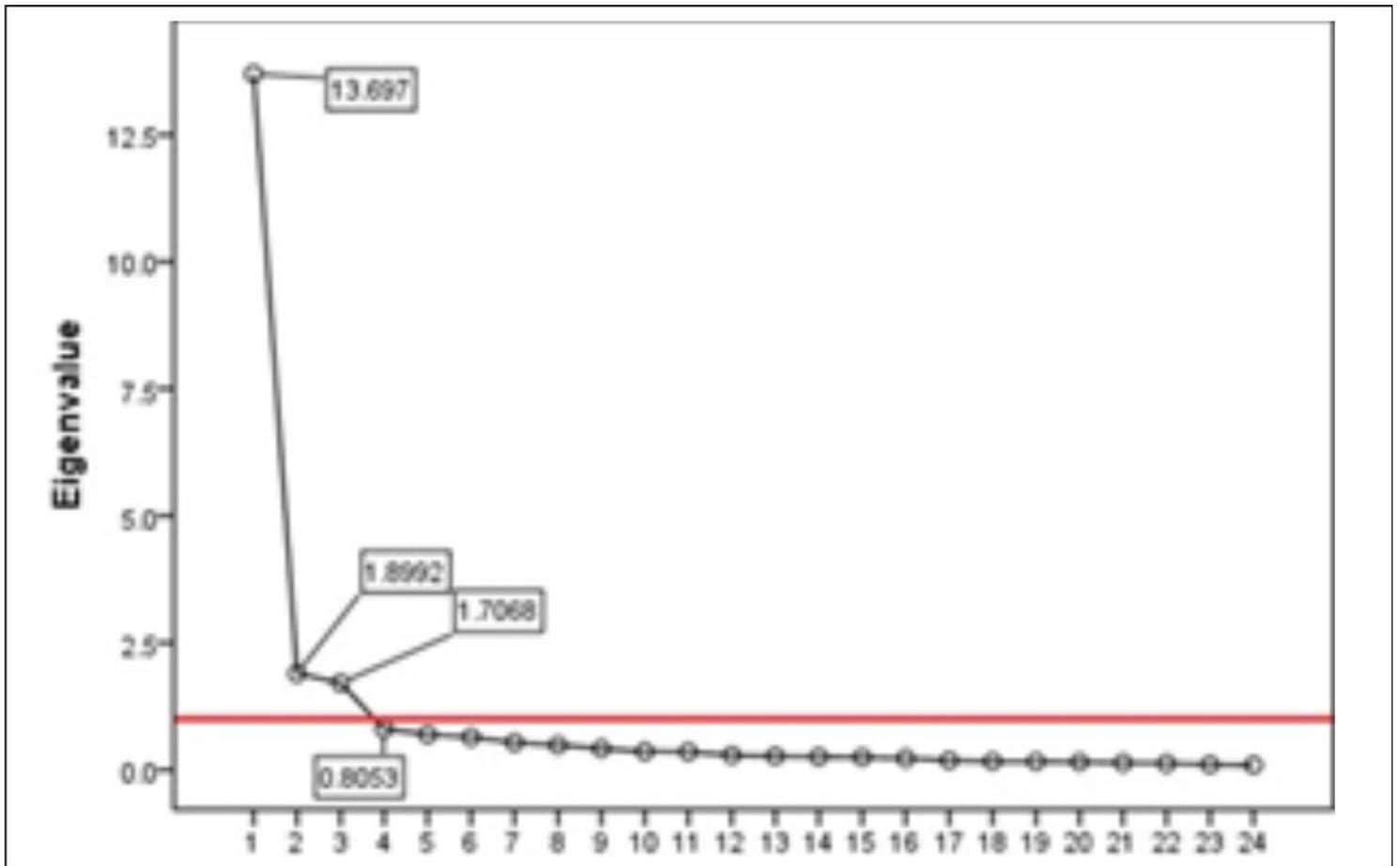


Figure 1

ML Scree Plot of MCM1

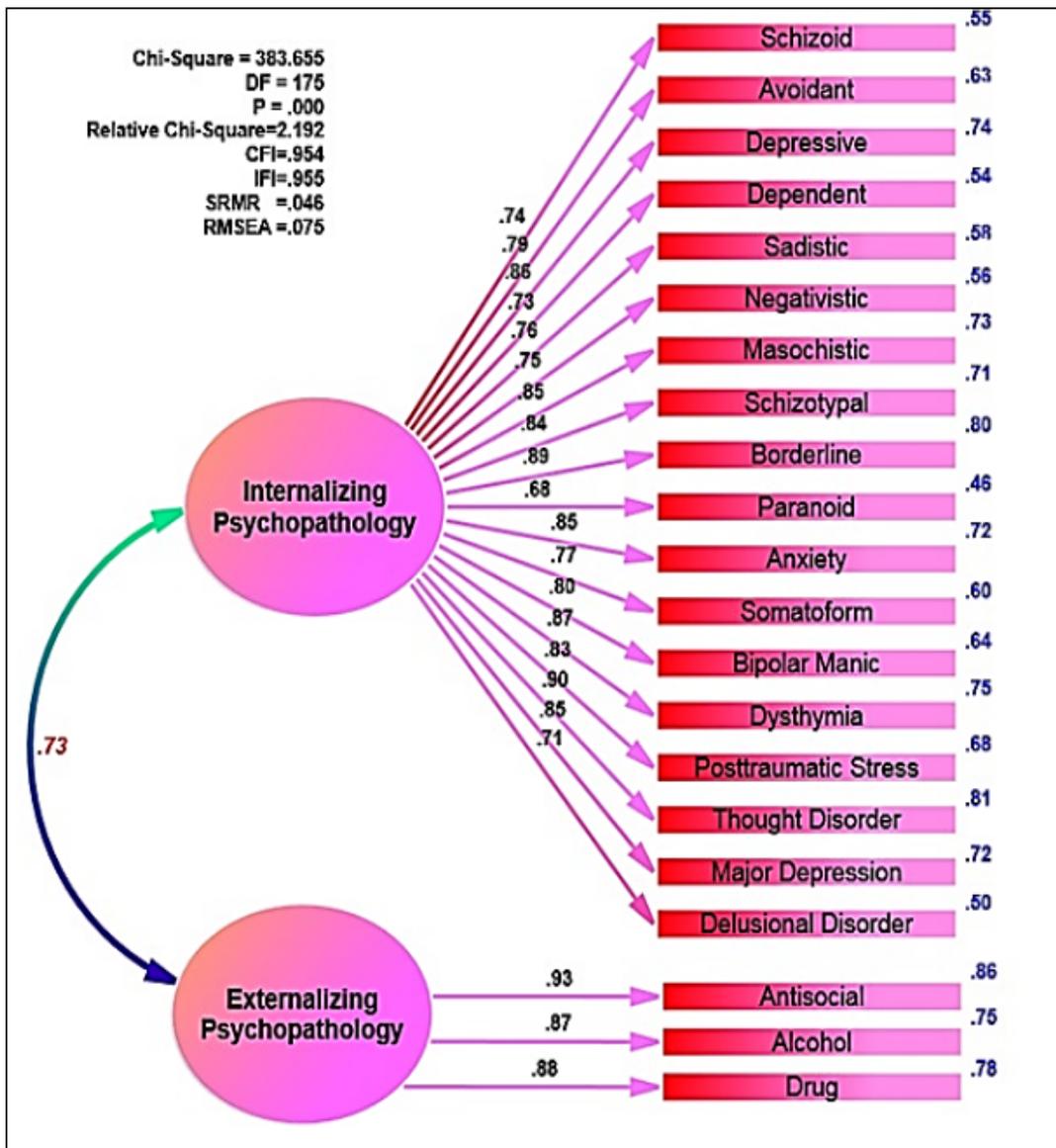


Figure 2

Hypothesized Measurement Model of Psychopathology using MCMI