Cross-Cultural and Gender Invariance of Five Common Symptom and Cognitive Vulnerability
Measures in the United States and Singapore

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Abstract

Reliable and valid measurements of anxiety, chronic worry, depressive, and obsessive-compulsive symptoms is essential when seeking to draw cross-cultural and gender comparisons. Accordingly, the current study determined the psychometric properties of five widely used symptom measures in the United States (U.S.) and Singapore (SG) and across gender: Beck Anxiety Inventory (BAI), Beck Depression Inventory-II (BDI-II), Obsessive Beliefs Questionnaire (OBQ), Obsessive-Compulsive Inventory-Revised (OCI-R), and the Penn State Worry Questionnaire-Abbreviated (PSWQ-A). Participants comprised college students (U.S.: $n = 292$; SG: $n = 144$). Strict measurement invariance (equal factor loadings, item thresholds, residual variances) was observed for all measures across cultures and genders, except for the BAI, which met partial Level 1 strict cross-gender invariance. Overall, findings suggest a strong degree of cross-cultural and cross-gender construct compatibility, but also point to some notable exceptions, thereby providing ample material for theory-building and future research on transdiagnostic symptom and cognitive vulnerability measures across diverse groups.

Keywords: *depression, anxiety, obsessive-compulsive disorder, culture, gender differences, multi-group confirmatory factor analyses*

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Worry, depressed mood, obsessions, and compulsions are symptoms that cut across generalized anxiety disorder (GAD), obsessive-compulsive disorder (OCD), and other anxiety and depressive disorders (Drost et al., 2014; Gillan et al., 2017). These syndromes present as mental health problems commonly observed in the general population (Kessler & Wang, 2008). Further, these elevated common mental health symptoms have been consistently linked to myriad cardiovascular, autoimmune, and neurocognitive disorders (Zainal & Newman, 2018; Zainal & Newman, 2021; Zainal & Newman, in press), as well as poorer work functioning (Ford et al., 2011; Yohannes et al., 2010). Similarly, high levels of unwanted thought intrusions, perfectionism, inflated responsibility, and threat over-estimation have been related consistently to such symptom constellations (Egan et al., 2011; Rosser, 2019). Improving understanding of these symptom and cognitive vulnerability constructs is thus important.

The first step to enhance understanding of common mental health symptoms and cognitive vulnerability constructs via a cross-cultural and gender lens is to examine the applicability and universality of these constructs across unique cultures and gender. To date, there remains a paucity of cross-cultural and gender invariance studies for mental health symptoms and cognitive vulnerability factors (Van Doren et al., in press). Such endeavors are essential for estimating prevalence rates as well as assessing the wide array of interactions between environmental and neurobiological correlates and various treatment choices. Further, such efforts improve understanding of similarities and differences of certain features of psychopathology across unique cultures and gender. Viewed from a psychometric perspective,

these endeavors are more meaningful if measurement approaches work in an equal manner and latent constructs have equal theoretical structure for two or more groups (Dimitrov, 2010).

Earlier on, researchers assumed that if latent construct(s) of a measure designed in one culture was replicated in another, such an instrument was appropriate for juxtaposing observed average scores across groups (Byrne & Watkins, 2003). Increasingly, however, this assumption has been discredited (Borsboom, 2006). Instead, to establish invariance of an instrument, the theoretical construct needs to be assessed in each group in an identical way and measured concurrently across the groups. Accordingly, to juxtapose estimates across diverse groups, a major characteristic that must be shown is that the pattern of endorsements of the items in a measure and its factorial structure are equivalent across unique groups when assessed concurrently (i.e., construct compatibility). This means the factor structure, item loadings, item thresholds, and item residual variances function similarly across groups.

Specifically, before testing mean differences in a construct across unique groups (e.g., culture; gender) researchers should test for invariance across various levels to ensure such comparisons are psychometrically valid (Hong et al., 2003). There are four main steps for testing measurement invariance: *configural*, *weak* factorial invariance (also called metric invariance), *strong* factorial invariance (also called scalar invariance), and strict invariance (also called residual or invariant uniqueness; Putnick & Bornstein, 2016). It is not uncommon that full invariance (i.e., invariance for all items) does not hold. In this case, equality constraints may be relaxed for the noninvariant parameters, and partial invariance can subsequently be identified (Byrne et al., 1989; Steenkamp et al., 1998). Unbiased estimates of the latent mean differences between the countries can then be obtained from the final (partial) invariance model, provided there are relatively few noninvariant items compared to the number of invariant items (Guenole

& Brown, 2014). At least partial scalar invariance is required to proceed with testing group differences, while testing for residual or strict invariance (e.g., equivalence of factor variances, covariances, and means) is not a prerequisite for testing mean differences, because the residuals are not part of the latent factor, so invariance of the item residuals is inconsequential to interpretation of latent mean differences (Vandenberg & Lance, 2000). Nevertheless, it can be theoretically informative to examine the various levels of strict measurement invariance, as it can tell us about any group differences in the relationships among latent factors, as well as whether there are latent mean differences across groups.

A stringent way to test the generalizability of latent psychiatric symptom and cognitive vulnerability constructs is to investigate them in unique cultures, such as the United States (U.S.) and Singapore (SG). On balance, whereas the U.S. adopts individualistic cultural values, SG generally identifies with collectivistic values (Oyserman et al., 2002). Individualism refers to perceiving the self as independent from others by being primarily concerned about one's cognitions, emotions, and needs, as well as distinct personal attributes. On the other hand, in collectivism, the self is viewed as interdependent. Collectivistic features include the pressure to nurture in-group harmony, being deferential to authority, and putting aside personal preferences in favor of the most important consideration of the group (Triandis, 1995). Moreover, emphasis on hierarchical power structures has been shown to be higher in SG than the U.S. (Wasti et al., 2007). Also, because SG has adopted some European American cultural values and is a Southeast Asian country that uses English as the common language, research has shown a high degree of measurement invariance for various psychiatric assessments (e.g., Hong, Riskind, et al., 2017; Lowe & Ang, 2016). Collectively, cross-cultural and gender measurement invariance

studies facilitate adaptation of assessment and treatment to specific groups by accounting for observed similarities and differences.

Accordingly, testing cross-cultural and gender equivalence of widely used assessments of common mental health problems can contribute to the aforesaid endeavors. Of particular interest to the current study are the 21-item Beck Anxiety Inventory (BAI) (Beck, Epstein, et al., 1988), 21-item Beck Depression Inventory-II (BDI-II) (Beck, Steer, et al., 1988), 44-item Obsessive Beliefs Questionnaire (OBQ) (Obsessive Compulsive Cognitions Working Group, 2005), 18-item Obsessive-Compulsive Inventory-Revised (OCI-R) (Foa et al., 2002), and 8-item Penn State Worry Questionnaire-Abbreviated (PSWQ-A) (Hopko et al., 2003). Thus far, these measures have been cited a total of more than 15,000 times. It is therefore surprising that examination of cross-cultural and gender equivalence has been scarce despite their widespread use in diverse clinical and research settings.

To date, few studies have tested measurement equivalence of the BDI-II across cultures or gender. In one study, Whisman et al. (2013) collected data on American students from 11 U.S. universities. They observed that the three-factor BDI-II had similar item loadings, intercepts, and variances across gender as well as among Whites, African Americans, Latinos or Hispanics, and Asians in the U.S. However, it remains unknown if these findings would generalize to other ethnically diverse samples outside of the U.S.

For the PSWQ-A, an initial measurement invariance study found that the magnitude of item loadings on the latent worry factor were similar across American and Spanish older adults (Nuevo et al., 2007). At the same time, confirmatory factor analysis (CFA) in the study by Nuevo et al. (2007) revealed gender non-invariance such that women endorsed items related to situational or contingency-related worries higher than men. Extending these findings, DeLapp et

al. (2016) found strong PSWQ-A measurement equivalence between European Americans and African Americans. Also, in that study, European Americans tended to report greater symptom severity on items assessing uncontrollability of chronic worry. However, no study has tested measurement equivalence of the PSWQ-A between U.S. and Asian samples located in separate geopolitical contexts.

Although no studies conducting cross-cultural and gender invariance for the BAI, OCI-R and OBQ exists thus far, indirect evidence to date suggests high levels of invariance across unique cultures. Recently, seven out of nine social anxiety symptom scales had similar item loadings between Asian Americans and European Americans (Krieg et al., 2018). Relatedly, measurement properties of the Dimensional Obsessive-Compulsive Scale developed in the U.S. (Abramowitz et al., 2010) have been found consistently to be similar in China, Greece, Iceland, Italy, Spain, and Sweden (Melli et al., 2015; Sica et al., 2006). However, these studies did not carry out rigorous latent variable measurement equivalence analyses.

Thus, the current study examined the measurement invariance of five transdiagnostic symptom and cognitive vulnerability assessments (four-factor BAI, three-factor BDI-II, three-factor OBQ, six-factor OCI-R, one-factor PSWQ-A) between the U.S. and SG. As prior work has suggested that psychometric properties of five transdiagnostic process measures were largely equivalent between the two countries and across gender (Zainal et al., 2021), we hypothesized that these symptom and cognitive vulnerability assessments would exhibit a high degree of cross-cultural and gender measurement equivalence. In addition, as prior work has shown that undergraduates of primarily Asian, compared to European, heritage reported more social anxiety with moderate effect sizes ($d = 0.40\text{--}0.55$) (Woody et al., 2015), we predicted higher latent depressive, anxiety, and OCD symptom and cognitive vulnerability scores in the SG (vs. U.S.)

sample. Last, based on the gender difference literature (Asher et al., 2017; Bardhoshi et al., 2016; Girgus & Yang, 2015; Johnson & Whisman, 2013), we expected higher latent depressive, anxiety, and OCD symptom scores in women (vs. men).

Method

Participants

Undergraduates in two sizeable research-oriented state universities in the U.S. ($n = 292$) and SG ($n = 144$) participated in this study. Eligibility criteria included 18 years and above and enrollment in an introductory psychology class that required students to accrue research participation credits. Participants in the U.S. averaged 18.77 years ($SD = 1.85$), 79.79% were women, and 19.86 % were African American, Hispanic, or other. Participants in SG averaged 21.02 years ($SD = 1.96$), 69.44% were women, 16.67% were Indian, Malays, Eurasian, or other. Comparatively, the SG (vs. U.S.) sample was older on average by 2.25 years ($t(434) = 11.41, p < .001$) and comprised a higher proportion of men ($\chi^2(df = 1) = 5.72, p = .017$). Tables 1 and 2 display the descriptive and correlational statistics split by country and gender.

Measures

Beck Anxiety Inventory (BAI). This 21-item measure captures past-week anxiety severity on a 4-point Likert scale (1 = *not at all* to 4 = *a lot*) (Beck, Epstein, et al., 1988). Examples of items include feeling hot, nervousness, or scared. The BAI total score has good psychometric properties as reflected by strong retest reliability ($r = .65$) and internal consistency ($\alpha = .91$; Bardhoshi et al., 2016). Convergent ($r = .36-.69$ with anxiety scores) and discriminant validity ($r = .25-.56$ with depression scores) have been established (Osman et al., 1997). The BAI is comprised of four latent factors, reflecting various symptoms of anxiety: (1) subjective (6 items); (2) neurophysiological (7 items); (3) autonomic (4 items); (4) panic (4 items) (Beck &

Steer, 1991). Internal consistencies were satisfactory in the current study (U.S.: $\omega = .73-.88$; SG: $\omega = .74-.90$; Males: $\omega = .66-.86$; Females: $\omega = .76-.89$)¹.

Beck Depression Inventory-II (BDI-II). The 21-item BDI-II assesses past-week depressive symptom severity on a 4-point Likert scale of 0 to 3 (Beck, Steer, et al., 1988). The BDI-II consistently evidenced strong internal consistency ($\alpha = .83-.96$) and two-week retest reliability ($r = .73-.96$) across diverse cultures and samples (Wang & Gorenstein, 2013). Construct validity of BDI-II scores were evidenced by large correlations with another depression self-report score ($r = .78$) and weaker relation with another anxiety symptom measure ($r = .15$) (Hopko et al., 2003). The BDI-II comprises three latent factors: (1) negative attitude (10 items); (2) performance difficulty (7 items); (3) somatic elements (4 items) (Whisman et al., 2013). Internal consistencies herein were satisfactory (U.S.: $\omega = .70-.91$; SG: $\omega = .70-.88$; Males: $\omega = .61-.86$; Females: $\omega = .73-.90$).

Obsessive Beliefs Questionnaire (OBQ). The 44-item OBQ (Obsessive Compulsive Cognitions Working Group, 2005) captures three types of beliefs contributing to OCD symptom maintenance: (1) perception of the importance of cognitive intrusions and need for thought control (12 items); (2) views on uncertainty and perfectionism (16 items); (3) propensity to overestimate threat and exaggerate personal responsibility (16 items). Participants rated their extent of agreement on a 7-point Likert-scale (1 = *disagree very much* to 7 = *agree very much*). The OBQ showed strong internal consistency in the original study ($\alpha s = .89-.95$) and current study (U.S.: $\omega s = .88-.94$; SG: $\omega s = .90-.93$; Males: $\omega s = .90-.94$; Females: $\omega s = .90-.94$). Evidence of strong convergent ($r = .59$ with another thought intrusion scale score) and

¹ We used Macdonald's ω , instead of Cronbach's α when computing internal consistency as it produces unbiased estimates by relying on the latent factor structures derived from the CFA(s).

discriminant validity (e.g., $r_s = .02$ to $.48$ with scores on OCD symptom measures) (Obsessive Compulsive Cognitions Working Group, 2005) have also been found.

Obsessive Compulsive Inventory-Revised (OCI-R). The 18-item OCI-R (Foa et al., 2002) taps into past month OCD symptom presence and distress on a 5-point Likert scale (0 = *not at all disturbed* to 4 = *extremely disturbed*) for six factors (checking, hoarding, neutralizing, obsessing, ordering, washing). Each factor comprises 3 items. The OCI-R has strong retest reliability ($r = .70$) and internal consistency ($\alpha = .88$) for the global score, and good retest reliability ($r = .54-.75$) and internal consistency ($\alpha = .61-.84$) for the subscale scores (Hajcak et al., 2004). Internal consistency values in this study were good (U.S.: $\omega = .75-.84$; SG: $\omega = .77-.88$; Males: $\omega_s = .78-.86$; Females: $\omega_s = .74-.85$). It also has strong convergent (e.g., $r = .56-.65$ with other OCD measure scores) and discriminant validity (e.g., $r = .11-.42$ with chronic worry scale scores) (Hajcak et al., 2004).

Penn State Worry Questionnaire-Abbreviated (PSWQ-A). The 8-item PSWQ-A measures uncontrollability and excessiveness of worry (Hopko et al., 2003). It has shown moderate-to-large retest reliability ($r = .63-.87$) and internal consistency ($\alpha = .87-.94$) in European American and African American samples (DeLapp et al., 2016). Internal consistencies were also strong in the present sample (U.S.: $\omega = .93$; SG: $\omega = .92$; Males: $\omega = .93$; Females: $\omega = .93$). Also, the PSWQ-A has strong convergent validity with scores on other anxiety assessments (e.g., $r = .60$ with BAI score) and moderate relationship with scores on depression measures (e.g., $r = .47$ with BDI-II score) (Crittendon & Hopko, 2006).

Procedures

Participants completed the series of questionnaires within about 30 to 60 minutes in one sitting inside a laboratory setting to minimize extraneous variables. The average time taken to

complete the surveys was 47.03 minutes ($SD = 17.06$) with no outliers observed—accordingly, we could deduce that participants offered their undivided attention. Administration of questionnaires were counter-balanced using the randomization function in Qualtrics.

Data Analyses

All analyses were conducted using the *lavaan* R package (Rosseel, 2012). As the item indicators herein had ordinal properties, we used diagonally-weighted least squares (WLS) with means and variances adjusted (WLSMV). Compared to maximum likelihood approaches, WLSMV provides more precise and stable estimates for ordinal variables and small sample sizes (Flora & Curran, 2004; Kim & Yoon, 2011). WLSMV estimators use the theta parameterization that inputs the polychoric (vs. Pearson's product moment) correlation matrix to obtain unbiased estimates of the magnitude of relations among items and factors. Further, WLSMV (vs. WLS) estimators functioned well across a range of observed item indicators and sample sizes (Flora & Curran, 2004; Nussbeck et al., 2006). Collectively, WLSMV estimators are robust to multivariate non-normality, offer robust standard errors, and optimal weights. To assess goodness-of-fit for all models, we examined the pattern of statistical and practical fit indices: non-significance of WLSMV χ^2 value; confirmatory factor index (CFI; Bentler, 1990; $CFI \geq .95$); root mean square error of approximation (RMSEA; Steiger, 1990; $RMSEA \leq .08$); and square root mean residual (SRMR; Hu & Bentler, 1999; $\leq .08$).

Measurement invariance analyses progressed in the following sequence (Putnick & Bornstein, 2016). First, we tested for *configural* invariance (i.e., if hypothesized factor structures of the five measures displayed acceptable fit across separate cultural and gender groups). Next, we determined if the item loadings (λ) on each said factor were equal across groups (i.e., *metric* invariance). If metric invariance was met, we proceeded with testing for *scalar* invariance (equal

λ s and item thresholds (τ s)). Next, if *scalar* invariance was found, we tested for *strict* invariance across groups (i.e., equal λ s, τ s, and item residual variances (ϵ s)). If analyses revealed measurement equivalence for a specific assessment, we continued determining the degree of factorial invariance (i.e., equality of latent factor variances, latent covariances among the factors (if applicable), and latent means). Between-group effect sizes were calculated using the formula Cohen's $d = 2t/\sqrt{df}$ (Dunst et al., 2004). Cohen's d values of .20, .50, and .80 were considered small, moderate, and large, respectively (Cohen, 1988).

We conducted tests of measurement invariance by examining change in statistical and practical fit indices. At each step, significant change in the WLSMV χ^2 ($\Delta\chi^2$) signified that the unconstrained (vs. constrained) model was preferable, as with changes in $CFI \leq -.01$, $RMSEA > .015$, or $SRMR > .03$ (Cheung & Rensvold, 2002; A. W. Meade et al., 2008). Moreover, we checked that our models using the WLSMV estimators met the assumptions of structural equation modeling (e.g., all variance-covariance matrices were non-singular and positive definite; Sass et al., 2014).

Results

Multiple-group CFA across countries. Table 3 presents tests of each step of measurement invariance analyses for the five assessments in the U.S. and SG. First, we established baseline models with no equality constraints across both samples to test configural invariance. Based on the pattern of fit indices, all measures showed good configural model fit in both samples. Furthermore, on all of the measures, all standardized factor loadings exceeded .30 in both groups and all were statistically significant (all p values were $< .001$).

Table 4 displays the comparison of measurement invariance models shown in Table 3. Overall, complete cross-country strict invariance (equal λ s, τ s, ϵ s, latent factor variances and

covariances, latent factor means) was found for 3 measures: the BAI, BDI-II, and OCI-R. The remaining two measures, the OBQ and PSWQ-A, also exhibited a high degree of cross-country invariance—both met *scalar* invariance, and one or more level(s) of *strict* invariance, as detailed below.

Specifically, for the OBQ, latent means were higher in the SG than U.S. sample on each subscale (importance or control of thought: +0.70 units, $t = 5.47$, $d = 0.25$; perfectionism/certainty: 0.53 units, $t = 4.15$, $d = 0.19$; responsibility/ threat estimation: 0.73 units, $t = 6.51$, $d = 0.30$). Thus, the OBQ met up through Level 2 strict invariance (equal λ s, τ s, item residual variances (ϵ s), and latent factor variances), but failed to achieve Level 3 strict invariance (i.e., latent means were not equivalent). For PSWQ-A, the SG (vs. U.S.) sample had smaller latent factor variance (0.87 vs. 0.62), and higher latent factor mean by +0.26 units ($t = 2.86$, $d = 0.72$). Accordingly, the PSWQ-A met up through Level 1 strict cross-country invariance (equal λ s, τ s, item residual variances (ϵ s)), but failed to meet Levels 2 and 3 strict invariance (i.e., latent factor variances and means were not equal).

Multiple-group CFA across gender. Tables 5 and 6 refer to measurement invariance analysis steps for the five symptom assessments in men and women. All measures showed good configural fit across both genders (Table 4), and all λ s were significant (all p values were $< .001$). Complete cross-gender strict invariance (equal λ s, τ s, ϵ s, latent factor variances (and covariances if applicable), latent factor means) was found for the OCI-R and OBQ.

In addition, the BDI-II and PSWQ-A both met up through Level 2 strict invariance, but failed to achieve complete strict invariance—latent factor variances on the BDI-II were significantly larger in women than men, and women had significantly higher latent factor covariances than men (β s = 0.21–0.25 vs. β s = 0.14–0.19). Further, BDI-II latent factor means

were significantly lower in men than in women on negative attitude by -0.07 units, $t = -1.45$, $d = .14$; on performance difficulty by -0.04 units, $t = -0.60$, $d = .06$; and on somatic elements by -0.05 units, $t = -0.81$, $d = .08$. For the PSWQ-A, women had a significantly higher latent factor mean than men by 0.34 units ($t = 3.20$, $d = 0.81$).

The BAI showed good configural fit across genders, but there was evidence for a lack of metric invariance across gender. Compared to the configural invariance model, the weak invariance model produced a significant χ^2 difference test ($\chi^2(df = 17) = 240.27$, $p < .05$). Whereas the two models did not differ substantially on CFI ($\Delta = -.008$), RMSEA ($\Delta = .03$) and SRMR ($\Delta = .02$) were notably worse, indicating a poor model fit. Examination of λ s revealed that λ s were substantially stronger in women compared to men on BAI Item 20, Face flushed (.59 vs. .27). Accordingly, we fit a partial invariance model by freeing up the factor loadings for Item 20 and the resulting model fit the data well (Table 5) and did not differ substantially from the full configural model (Table 6), indicating partial metric (i.e., weak) invariance. With partial weak invariance satisfied, we proceeded to test subsequent levels of measurement invariance while leaving Item 20 unconstrained, and found that the model met strong partial invariance, and strict partial measurement invariance at Level 1 (equal error variances). However, the BAI with Item 20 unconstrained failed to meet the subsequent levels of strict invariance, indicating that latent factor variances, covariances, and means were substantially different across the two genders. Specifically, factor variances for subjective anxiety and panic factors were higher in women compared to men (subjective: .57 vs. .39; panic: .66 vs. .26), and latent factor means were significantly higher for women than men on subjective anxiety by +0.21 units ($t = 2.67$, $d = 0.26$) and on panic by +0.21 units ($t = 2.46$, $d = 0.24$). Finally, examination of factor covariances

revealed that the panic, neurophysiological, and autonomic factors were more strongly correlated with subjective anxiety in women than in men (women $r_s = .23-.57$ vs. men $r_s = .13-.22$).

Discussion

The present study investigated the cross-cultural and gender measurement invariance of five common symptom and cognitive vulnerability measures in the U.S. and SG. Establishing measurement equivalence across diverse samples is an often-neglected aspect of research, despite increasing efforts to test the efficacy of cognitive-behavioral and mindfulness-based therapies that track these symptom, cognitive vulnerability, and related constructs, in various Asian contexts (e.g., SG, Hong Kong; Sung et al., 2011; Wong et al., 2016). On the whole, and as hypothesized, the five measures exhibited a high degree of cross-cultural and gender measurement equivalence. In addition, the results revealed evidence of at least some degree of strict cross-cultural measurement invariance across all measures (BAI, BDI-II, OBQ, OCI-R, PSWQ-A), though measures varied in terms of degree of strict invariance achieved. Furthermore, across genders, all measures showed good configural fit, and four out of the five measures achieved at least one level of strict measurement invariance (BDI-II, PSWQ-A, OCI-R, OBQ), whereas the BAI met partial strict invariance across genders.

As noted previously, at least partial *scalar* (i.e., strong) invariance is required to proceed with testing group differences. Based on the present study findings, we can conclude that tests of group differences across SG and the U.S. on these assessment tools are valid, as the latent constructs measured therein can be said to have sufficient similarity in terms of their psychometric properties in order to draw such comparisons. The same can be said for cross-gender comparisons on the whole (though see further discussion of the BAI findings, below). However, even though strong and some level of strict invariance was met in most cases across

cultures and genders, the measures differed in terms of the degree of strict invariance achieved. Considering these cross-cultural and cross-gender differences can provide theoretically meaningful insights that could further aid ongoing research efforts and clinical practice, as detailed below.

Complete cross-cultural invariance was found for the BAI, BDI-II, and OCI-R. This result concurs with a recent CFA conducted in South Korean community-dwelling adults (Lee et al., 2016). This might be because Singaporeans and South Koreans generally uphold Confucian values that prioritize economic progress and community over self-interests (Chia et al., 2007). Additionally, findings extend recent psychometric validation efforts of OCD measures administered to undergraduate and clinical samples in Iceland (Sæmundsson et al., 2011) and Italy (Melli et al., 2015).

Interestingly, and in line with our hypotheses, students in SG endorsed more OCD beliefs related to perfectionism, threat over-estimation, and importance of control of thoughts than their U.S. counterparts. Findings corroborate a prior study that showed Asian (vs. White and African) Americans endorsed higher OC beliefs (Wu & Wyman, 2016), particularly maladaptive perfectionism (DiBartolo & Rendón, 2012). The fact that a large proportion of SG students displayed stable high levels or increased maladaptive perfectionism from childhood to adolescence (Hong, Lee, et al., 2017) fits with this data. Also, collectivistic ideas (i.e., interdependent values), such as enhanced family recognition via academic and career accomplishments, conformity, modesty, emotional suppression, and avoiding mistakes (Yoon & Lau, 2008) might contribute to these results. On that note, as Singaporean students tend to excel in mathematics and science (Provasnik et al., 2016), this might cultivate a competitive environment typified by high pressure to attain scholastic achievements and heightened parental

overprotection (Hong et al., 2015). However, we did not replicate the prior finding of Wu and Wyman (2016) of elevated OCI-R checking and washing in Asians. This might mean that Asian Americans differ from Asians situated in geographically different contexts (i.e., North America vs. Southeast Asia) in their OCD symptom expression. Subsequent cross-cultural psychometric investigations could evaluate these notions.

As predicted, higher latent worry severity was observed in SG compared to U.S. students on the PSWQ-A. This result aligns with prior work demonstrating a lower median age of onset for lifetime GAD in SG (around 20 years old; Vaingankar et al., 2013) compared to the U.S. (around 30 years old; Kessler et al., 2005) as well as recent work suggesting trends toward increased prevalence of lifetime GAD amongst Singaporeans (Chang et al., 2019). In addition, results dovetail with prior work that evidenced higher relations among scores on negative repetitive thinking measures in SG compared to the U.S. (Zainal et al., 2021). Another possibility is that high levels of stigmatizing attitudes in Asian cultures, such as viewing mental illness as a sign of weakness, and loss of social support that likely occur by disclosing psychological difficulties (Subramaniam et al., 2017), might partly explain the findings. Relatedly, compared to their European counterparts, Asians generally rely less on social support to cope with diverse stressors (Taylor et al., 2004). Future cross-cultural equivalence studies could include measures of mental health attitudes, social support, and cultural values to test these ideas.

Contrary to our predictions, we did not find any cross-cultural differences in latent BDI-II factor mean scores—instead, the BDI-II showed evidence of complete cross-cultural invariance. Thus, results differ from non-equivalence of BDI-II factor structures between U.S. and Sri Lankan samples (Jayawickreme et al., 2017). Unique sample characteristics (e.g., recruitment of mostly Sri Lankan women reeling from civil war and African Americans) might explain the

differences in findings across the current and prior study, further underscoring the need to study diverse Asian groups. It is important to note that results from one Asian country may not necessarily generalize to other Asian countries/cultures.

For the BAI, one item was not invariant across genders. Specifically, BAI item 20, which endorses face flushing, was higher in women than men, despite remaining items showing strong construct compatibility. Higher loadings for this item on the latent autonomic factor in women may suggest that facial flushing is a more common autonomic symptom of anxiety for women than for men. Findings align with prior work in socially anxious individuals, which has suggested that facial flushing during an embarrassing task was more pronounced in women than men (Drummond & Su, 2012). Future research could further investigate these findings in laboratory studies to examine whether self-reported gender differences in autonomic symptoms of facial flushing track with physiological measures of vasodilation, and whether this is driven by mean differences in anxiety across genders, for example. Despite this difference in factor loading for the BAI across gender, we were able to establish a partial invariance solution by leaving this item free to vary across groups. Results indicate that the remaining 20 items had good, if not excellent, cross-gender construct equivalence, having met through Level 1 strict invariance.

It is also worth noting that for the BAI, the latent inter-factor correlations indicated that the panic, neurophysiological, and autonomic factors were more strongly correlated with the subjective anxiety factor in women than in men. This result is particularly interesting considering findings that concordance between physiological and subjective components of emotional responding were more strongly linked in women than in men in laboratory studies (e.g., Rattel et al., 2020). The present findings add to this literature by suggesting that these gender differences

are reflected at the level of self-reported symptoms as well. In addition, similar to Whisman et al. (2013), BDI-II latent factor variances (i.e., spread of BDI-II scores) were unequal among men and women, as were BAI latent factor variances. Women also exhibited higher PSWQ-A and BAI latent scores relative to their male counterparts. Overall, this pattern of findings can be explained by the fact that compared to men, women tend to engage in more self-focused negative perseverative thinking, perceive less self-efficacy over life circumstances, and experience more acute traumas and chronic stressors (Nolen-Hoeksema & Jackson, 2001; Salk et al., 2017). We extend this research area by showing that gender differences in anxiety and depressive symptoms holds up across cultures.

Clinical implications deserve mention. Notably, findings herein contribute to culturally-informed functional analyses when delivering psychotherapy in Southeast Asia, a research topic replete with potential for growth (Keng et al., 2017). Since evaluating and challenging OCD-related beliefs form the crux of cognitive therapy, knowledge of these cultural differences is critical. Also, it is concerning that despite our pattern of findings, Singaporeans with OCD, GAD, and major depressive disorder delay seeking treatment by four to nine years (Chong et al., 2012). Heeding recent calls for public health campaigns and screening efforts to promote awareness, early identification, and treatment (Subramaniam et al., 2020) are thus essential. Mental health professionals treating these disorders in SG would need to address unhelpful core beliefs related to perfectionism and intrusive thoughts, and reduce attentional biases to threat.

Several study limitations are noteworthy. The college student nature of our sample limits generalizability to the general population. Thus, future work should attempt to replicate these findings in adult community samples. In addition, the relatively small sample size (292 Americans; 144 Singaporeans) hindered the ability to juxtapose across countries and gender

simultaneously. Nonetheless, simulation studies suggest that the high indicator-to-factor ratio per construct (i.e., 21-item BAI, 21-item BDI-II, 44-item OBQ, 18-item OCI-R and 8-item PSWQ-A), low differential item functioning, and sample size of > 100 participants per group, offer $\geq 80\%$ power to detect measurement invariance (Meade & Bauer, 2007; Adam W Meade et al., 2008). Further, the current study parameters provided 100% chance of attaining proper converging estimates (Marsh et al., 1998) and very low probability (0.7–5%) of Type I error (French & Finch, 2006). Thus, our final sample sizes were adequately powered to test for varying degrees of measurement invariance. Limitations notwithstanding, the present study provides the first investigation of these constructs across SG and the U.S., and therefore provides a novel contribution that future studies can expand upon in larger samples.

To conclude, results of the present investigation advance the study of common psychiatric symptom and cognitive vulnerability factors by enhancing our understanding of the generalizability and psychometric properties of five assessment tools used to measure these constructs across unique cultures and genders. On the whole, findings suggest a high degree of construct compatibility across cultures and genders, while also identifying key differences, thereby providing ample material for future cross-cultural and cross-gender investigations of these constructs. Such findings can further assist with efforts to facilitate nuanced ways of delivering empirically supported treatments to populations of diverse cultural and gender orientations.

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Table 1

Descriptive statistics and correlation matrix of observed study variables by country

	1	2	3	4	5	6	7	8	9	10	11	12
1. BAI	—	.74***	.17*	.37***	.39***	.26**	.42***	.37***	.36***	.46***	.29***	.29***
2. BDI-II	.77***	—	0.02	.45***	.39***	.36***	.45***	.35***	.39***	.51***	.28***	.34***
3. PSWQ-A	.40***	.24***	—	.17*	.18*	.18*	0.13	.22**	0.13	.35***	.46***	.45***
4. OCI-OB	.44***	.38***	.25***	—	.54***	.62***	.65***	.56***	.65***	.49***	.42***	.45***
5. OCI-CH	.50***	.39***	.29***	.62***	—	.54***	.60***	.66***	.64***	.48***	.45***	.40***
6. OCI-OR	.54***	.53***	.27***	.65***	.61***	—	.60***	.45***	.66***	.36***	.39***	.33***
7. OCI-WA	.47***	.49***	.29***	.64***	.60***	.63***	—	.56***	.79***	.46***	.39***	.39***
8. OCI-HO	.52***	.45***	.26***	.72***	.70***	.66***	.62***	—	.63***	.37***	.42***	.39***
9. OCI-NU	.45***	.50***	.20***	.70***	.64***	.65***	.63***	.68***	—	.48***	.39***	.39***
10. OBQ-ICT	.51***	.53***	.24***	.47***	.48***	.49***	.44***	.48***	.53***	—	.72***	.75***
11. OBQ-PT	.50***	.50***	.25***	.42***	.49***	.48***	.48***	.49***	.46***	.75***	—	.77***
12. OBQ-RT	.52***	.47***	.25***	.45***	.49***	.44***	.44***	.48***	.46***	.80***	.77***	—
US sample ($n = 292$)												
<i>M</i>	6.2	1.9	1.99	1.59	1.78	1.61	1.62	1.73	1.61	3.12	3.16	3.17
<i>SD</i>	4.57	0.96	0.58	0.81	0.78	0.71	0.76	0.74	0.77	1	0.82	0.85
Skewness	0.43	1.64	0.99	1.78	1.22	1.36	1.57	1.18	1.38	0.29	-0.15	0.03
Kurtosis	-0.86	3.08	3.28	3.25	1.52	1.63	2.62	1.47	1.55	0.4	0.32	0.15
Min	0	0.81	0.5	1	1	1	1	1	1	1	1	1
Max	17	5.71	4.88	5	5	4.67	5	5	4.67	6.58	5.81	5.94
SG sample ($n = 144$)												
<i>M</i>	7.96	2.24	2.08	1.82	2	1.86	1.81	1.93	1.82	3.63	3.72	3.75
<i>SD</i>	4.45	0.91	0.66	0.87	0.78	0.86	0.86	0.76	0.82	1.04	0.82	0.82

Skewness	-0.03	0.7	0.54	0.98	0.77	1.21	1.18	0.89	1.34	0.2	0.09	-0.15
Kurtosis	-1.18	0.13	0.18	0.03	-0.01	0.88	0.8	0.37	1.76	0.01	0.79	0.66
Min	0	0.71	1	1	1	1	1	1	1	1	1	1
Max	15.83	4.86	4	4.33	4.33	4.67	4.67	4.33	5	6.75	6.06	6.06

Note. $N = 436$. BAI = Beck anxiety inventory; BDI-II = Beck depression inventory – second version; OBQ = obsessive beliefs questionnaire; ICT = importance/ control of thought subscale; PC = perfectionism/ certainty subscale; RT = responsibility/ threat estimation; PSWQ-A = Penn State worry questionnaire-abbreviated version; OCIR = obsessive compulsive inventory – revised; OCIR-OB = obsessions; OCIR-CH = checking; OCIR-OR = ordering; OCIR-WA = washing; OCIR-HO = hoarding; OCIR-NU = neutralizing. Correlation values below the diagonal represents the relations between factors in the United States sample, whereas those above the diagonal depicts the factor correlations for the Singapore sample.

Table 2

Descriptive statistics and correlation matrix of observed study variables by gender

	1	2	3	4	5	6	7	8	9	10	11	12
1. BAI	—	.77***	.37***	.45***	.51***	.44***	.47***	.52***	.46***	.51***	.44***	.47***
2. BDI-II	.77***	—	.20***	.40***	.41***	.44***	.47***	.45***	.48***	.52***	.43***	.43***
3. PSWQ-A	.37***	.20***	—	.24***	.30***	.25***	.26***	.27***	.21***	.29***	.33***	.32***
4. OCI-OB	.45***	.40***	.24***	—	.62***	.65***	.65***	.67***	.69***	.52***	.46***	.48***
5. OCI-CH	.51***	.41***	.30***	.62***	—	.59***	.62***	.72***	.64***	.55***	.52***	.53***
6. OCI-OR	.44***	.44***	.25***	.65***	.59***	—	.60***	.58***	.67***	.44***	.47***	.43***
7. OCI-WA	.47***	.47***	.26***	.65***	.62***	.60***	—	.62***	.71***	.49***	.47***	.46***
8. OCI-HO	.52***	.45***	.27***	.67***	.72***	.58***	.62***	—	.68***	.51***	.50***	.50***
9. OCI-NU	.46***	.48***	.21***	.69***	.64***	.67***	.71***	.68***	—	.56***	.48***	.49***
10. OBQ-ICT	.51***	.52***	.29***	.52***	.55***	.44***	.49***	.51***	.57***	—	.76***	.80***
11. OBQ-PT	.44***	.43***	.33***	.46***	.52***	.47***	.47***	.50***	.48***	.76***	—	.81***
12. OBQ-RT	.47***	.43***	.32***	.48***	.53***	.43***	.46***	.50***	.49***	.80***	.81***	—
Male sample (n = 103)												
<i>M</i>	6.28	1.86	2.04	1.46	1.79	1.57	1.61	1.67	1.6	3.15	3.25	3.24
<i>SD</i>	4.5	0.83	0.56	0.7	0.73	0.74	0.7	0.68	0.67	1.04	0.84	0.87
Skewness	0.25	1.13	0.44	1.74	0.85	1.55	1.23	1.18	1.18	0.14	-0.29	-0.2
Kurtosis	-1.11	0.86	0.52	2.26	-0.03	1.99	0.75	0.97	0.76	-0.26	-0.01	-0.34
Min	0	0.81	1	1	1	1	1	1	1	1	1	1
Max	15.5	4.62	3.88	4	4	4.33	3.67	3.67	3.67	5.75	5.25	5.19
Female sample (n = 333)												
<i>M</i>	6.96	2.06	2.01	1.74	1.88	1.74	1.71	1.84	1.71	3.34	3.39	3.41
<i>SD</i>	4.62	0.99	0.63	0.86	0.8	0.78	0.83	0.77	0.83	1.04	0.87	0.89

Skewness	0.27	1.28	0.91	1.38	1.08	1.29	1.43	1.02	1.34	0.32	0.02	0
Kurtosis	-1.06	1.71	2.14	1.54	0.96	1.4	1.82	0.93	1.54	0.34	0.62	0.25
Min	0	0.71	0.5	1	1	1	1	1	1	1	1	1
Max	17	5.71	4.88	5	5	4.67	5	5	5	6.75	6.06	6.06

Note. $N = 436$. BAI = Beck anxiety inventory; BDI-II = Beck depression inventory – second version; OBQ = obsessive beliefs questionnaire; ICT = importance/ control of thought subscale; PC = perfectionism/ certainty subscale; RT = responsibility/ threat estimation; PSWQ-A = Penn State worry questionnaire-abbreviated version; OCIR = obsessive compulsive inventory – revised; OCIR-OB = obsessions; OCIR-CH = checking; OCIR-OR = ordering; OCIR-WA = washing; OCIR-HO = hoarding; OCIR-NU = neutralizing. Correlation values below the diagonal represents the relations between factors in males, whereas those above the diagonal depicts the factor correlations for the female sample.

Table 3

Configural, weak, strong, and strict invariance models for each of six symptom and cognitive vulnerability measures in the United States and Singapore

Model	WLSMV χ^2	df	p	RMSEA (90% CI)	CFI	SRMR
Beck Anxiety Inventory (21-item; 4-Factor Model)						
1a. BAI – Singapore	85.65	183	1	.000 (.000, .000)	1	0.07
1b. BAI – United States	70.61	183	1	.000 (.000, .000)	1	0.06
1. Configural: BAI across countries	156.26	366	1	.000 (.000, .000)	1	0.06
2. Weak (metric: loadings equal)	261.74	383	1	.000 (.000, .000)	1	0.07
3. Strong (scalar: thresholds equal)	298.54	400	1	.000 (.000, .000)	1	0.07
4. Error variances equal	324.46	421	1	.000 (.000, .000)	1	0.08
5. Factor variances equal	327.49	425	1	.000 (.000, .000)	1	0.08
6. Factor covariances equal	332.53	431	1	.000 (.000, .000)	1	0.08
7. Factor means equal	388.117	435	0.948	.000 (.000, .002)	1	0.08
Beck Depression Inventory-II (21-item; 3-Factor Model)						
1a. BDI-II – Singapore	84.9	186	1	.000 (.000, .000)	1	0.058
1b. BDI-II – United States	43.89	186	1	.000 (.000, .000)	1	0.044
1. Configural: BDI-II across countries	128.8	372	1	.000 (.000, .000)	1	0.047
2. Weak (metric: loadings equal)	231.96	390	1	.000 (.000, .000)	1	0.064
3. Strong (scalar: thresholds equal)	266.51	408	1	.000 (.000, .000)	1	0.066
4. Error variances equal	302.45	429	1	.000 (.000, .000)	1	0.077
5. Factor variances equal	310.5	432	1	.000 (.000, .000)	1	0.079
6. Factor means equal	336.76	435	1	.000 (.000, .000)	1	0.082
Penn State Worry Questionnaire - Abbreviated (8-item; 1-Factor Model)						
1a. PSWQ – Singapore	4.72	20	1	.000 (.000, .000)	1	0.031
1b. PSWQ – United States	7.46	20	1	.000 (.000, .000)	1	0.026

1. Configural: PSWQ across countries	12.18	20	1	.000 (.000, .000)	1	0.025
2. Weak (metric: loadings equal)	24.9	47	1	.000 (.000, .000)	1	0.035
3. Strong (scalar: thresholds equal)	36.65	54	0.966	.000 (.000, .000)	1	0.043
4. Error variances equal	47.56	62	0.912	.000 (.000, .017)	1	0.048
5. Factor variances equal	190.5	63	< .001	.097 (.082, .113)	0.972	0.099
Obsessive Compulsive Inventory-Revised (18-item; 6-Factor Model)						
1a. OCI-R – Singapore	42.83	120	1	.000 (.000, .000)	1	0.058
1b. OCI-R – United States	47.15	120	1	.000 (.000, .000)	1	0.048
1. Configural: OCI-R across countries	89.98	240	1	.000 (.000, .000)	1	0.049
2. Weak (metric: loadings equal)	128.39	252	1	.000 (.000, .000)	1	0.059
3. Strong (scalar: thresholds equal)	139.74	264	1	.000 (.000, .000)	1	0.06
4. Error variances equal	156.39	282	1	.000 (.000, .000)	1	0.067
5. Factor variances equal	165.53	288	1	.000 (.000, .000)	1	0.07
6. Factor covariances equal	204.33	303	1	.000 (.000, .000)	1	0.077
7. Factor means equal	276.45	309	0.908	.000 (.000, .012)	1	0.082
Obsessive Beliefs Questionnaire (44-item; 3-Factor Model)						
1a. OCI-R – Singapore	849.85	899	0.878	.000 (.000, .013)	1	0.087
1b. OCI-R – United States	1211.18	899	< .001	.035 (.030, .040)	0.988	0.075
1. Configural: OCI-R across countries	2061.03	1798	< .001	.026 (.020, .032)	0.993	0.077
2. Weak (metric: loadings equal)	2411.48	1839	< .001	.039 (.034, .043)	0.986	0.083
3. Strong (scalar: thresholds equal)	2526.26	1880	< .001	.041 (.036, .045)	0.984	0.084
4. Error variances equal	2614.43	1924	< .001	.041 (.037, .045)	0.983	0.086
5. Factor variances equal	2887.16	1927	< .001	.049 (.045, .052)	0.976	0.09
6. Factor covariances equal	2922.8	1930	< .001	.050 (.046, .053)	0.975	0.091
7. Factor means equal	3700.52	1933	< .001	.066 (.063, .069)	0.955	0.099

Note. $N = 436$. WLSMV = weighted least squares estimator with means and variances adjusted; RMSEA = root mean square error of approximation; CI = confidence interval; CFI = confirmatory factor analysis; SRMR = standardized root mean square residual.

Table 4

Tests of measurement invariance models for each of symptom and cognitive vulnerability measures across the United States and Singapore

Model Comparisons	$\Delta\text{WLSMV } \chi^2$	Δdf	p	ΔRMSEA	ΔCFI	ΔSRMR
Beck Anxiety Inventory (21-item; 1-Factor Model)						
Configural vs. Metric invariance	105.47	17	< .001	0.000	0.000	0.010
Metric invariance vs. Scalar invariance	36.81	17	< .001	0.000	0.002	0.000
Scalar invariance vs. Error variances equal	25.92	21	0.21	0.000	0.006	0.000
Factor variances equal vs. Error variances equal	3.02	4	0.55	0.000	0.000	0.000
Factor covariances equal vs. Factor variances equal	5.04	6	0.54	0.000	0.000	0.000
Factor means equal vs. Factor covariances equal	55.59	4	< .001	0.000	0.000	0.003
Beck Depression Inventory-II (21-item; 3-Factor Model)						
Configural vs. Metric invariance	103.16	18	< .001	0.000	0.000	0.017
Metric invariance vs. Scalar invariance	34.55	18	0.011	0.000	0.000	0.002
Scalar invariance vs. Error variances equal	35.94	21	0.022	0.000	0.000	0.011
Factor variances equal vs. Error variances equal	8.06	3	0.045	0.000	0.000	0.002
Factor means equal vs. Factor variances equal	26.25	3	< .001	0.000	0.000	0.003
Penn State Worry Questionnaire (8-item; 1-Factor Model)						
Configural vs. Metric invariance	12.72	7	0.079	0.000	0.000	0.01
Metric invariance vs. Scalar invariance	11.75	7	0.109	0.000	0.000	0.007
Scalar invariance vs. Error variances equal	10.91	8	0.207	0.000	0.000	0.006
Factor variances equal vs. Error variances equal	142.94	1	< .001	-0.028	0.097	0.05
Obsessive Compulsive Inventory-Revised (18-item; 6-Factor Model)						
Configural vs. Metric invariance	38.41	12	< .001	0.000	0.000	0.01
Metric invariance vs. Scalar invariance	11.35	12	0.499	0.000	0.000	0.001

Scalar invariance vs. Error variances equal	16.64	18	0.548	0.000	0.000	0.007
Factor variances equal vs. Error variances equal	9.15	6	0.165	0.000	0.000	0.003
Factor covariances equal vs. Factor variances equal	38.79	15	0.001	0.000	0.000	0.007
Factor means equal vs. Factor covariances equal	72.12	6	< .001	0.000	0.000	0.005

Obsessive Beliefs Questionnaire (44-item; 3-Factor Model)

Configural vs. Metric invariance	350.45	41	< .001	0.012	-0.008	0.005
Metric invariance vs. Scalar invariance	114.78	41	< .001	0.002	-0.002	0.001
Scalar invariance vs. Error variances equal	88.17	44	< .001	0.001	-0.001	0.002
Factor variances equal vs. Error variances equal	272.74	4	< .001	0.007	-0.007	0.004
Factor covariances equal vs. Factor variances equal	35.63	3	< .001	0.008	-0.001	0.001
Factor means equal vs. Factor covariances equal	777.72	3	< .001	0.017	-0.020	0.009

Note. $N = 436$. WLSMV = weighted least squares estimator with means and variances adjusted; RMSEA = root mean square error of approximation; CI = confidence interval; CFI = confirmatory fit index; SRMR = square root mean residual. Bold figures indicate significant changes in the practical fit indices (Δ CFI values of $\leq -.010$, Δ RMSEA values of $\geq +.015$, and Δ SRMR of $\geq +.030$ from the unconstrained to constrained model).

Table 5

Configural, weak, strong, and strict invariance models for each of symptom and cognitive vulnerability measures across gender

Model	WLSMV χ^2	df	p	RMSEA (90% CI)	CFI	SRMR
Beck Anxiety Inventory (21-item; 4-Factor Model)						
1a. BAI – Males	130.32	189	1	.000 (.000, .000)	1	0.11
1b. BAI – Females	136.1	189	1	.000 (.000, .000)	1	0.063
1. Configural: BAI across gender	266.42	378	1	.000 (.000, .000)	1	0.071
2. Weak (metric: loadings equal)*	342.50	382	0.93	.000 (.000, .008)	1	0.077
3. Strong (scalar: thresholds equal)*	355.84	398	0.94	.000 (.000, .006)	1	0.077
4. Error variances equal*	373.26	418	0.94	.000 (.000, .005)	1	0.081
5. Factor variances equal*	530.99	422	< .001	.035 (.025, .044)	0.985	0.104
6. Factor covariances equal*	1094.68	431	< .001	.085 (.079, .091)	0.909	0.154
7. Factor means equal*	1152.972	435	< .001	.088 (.082, .094)	0.901	0.156
Beck Depression Inventory-II (21-item; 3-Factor Model)						
1a. BDI-II – Males	79.72	186	1	.000 (.000, .000)	1	0.069
1b. BDI-II – Females	58.22	186	1	.000 (.000, .000)	1	0.041
1. Configural: BDI-II across gender	137.93	372	1	.000 (.000, .000)	1	0.046
2. Weak (metric: loadings equal)	284.86	390	1	.000 (.000, .000)	1	0.062
3. Strong (scalar: thresholds equal)	312.34	408	1	.000 (.000, .000)	1	0.064
4. Error variances equal	337.58	429	1	.000 (.000, .000)	1	0.071
5. Factor variances equal	428.1	432	0.544	.000 (.000, .023)	1	0.083
6. Factor means equal	547.52	435	< .001	.035 (.025, .044)	1	0.094
Penn State Worry Questionnaire - Abbreviated (8-item; 1-Factor Model)						
1a. PSWQ – Males	3.93	20	1	.000 (.000, .000)	1	0.034
1b. PSWQ – Females	7.75	20	1	.000 (.000, .000)	1	0.026
1. Configural: PSWQ across gender	11.68	40	1	.000 (.000, .000)	1	0.025
2. Weak (metric: loadings equal)	16.75	47	1	.000 (.000, .000)	1	0.029

3. Strong (scalar: thresholds equal)	24.07	54	1	.000 (.000, .000)	1	0.034
4. Error variances equal	28.91	62	1	.000 (.000, .000)	1	0.037
5. Factor variances equal	35.28	63	0.998	.000 (.000, .000)	1	0.041
6. Factor means equal	91.3	64	0.014	.045 (.021, .064)	0.994	0.062
Obsessive Compulsive Inventory-Revised (18-item; 6-Factor Model)						
1a. OCI-R – Males	37.14	120	1	.000 (.000, .000)	1	0.063
1b. OCI-R – Females	56.33	120	1	.000 (.000, .000)	1	0.047
1. Configural: OCI-R across gender	93.48	240	1	.000 (.000, .000)	1	0.048
2. Weak (metric: loadings equal)	162.81	252	1	.000 (.000, .000)	1	0.062
3. Strong (scalar: thresholds equal)	171.26	264	1	.000 (.000, .000)	1	0.063
4. Error variances equal	187.69	282	1	.000 (.000, .000)	1	0.068
5. Factor variances equal	196.92	288	1	.000 (.000, .000)	1	0.071
6. Factor covariances equal	239.96	303	0.997	.000 (.000, .000)	1	0.076
7. Factor means equal	247.47	309	0.996	.000 (.000, .000)	1	0.077
Obsessive Beliefs Questionnaire (44-item; 3-Factor Model)						
1a. OCI-R – Males	760.45	899	1	.000 (.000, .000)	1	0.096
1b. OCI-R – Females	1231.45	899	< .001	.034 (.029, .039)	0.99	0.069
1. Configural: OCI-R across gender	1991.9	1798	0.001	.023 (.015, .029)	0.996	0.074
2. Weak (metric: loadings equal)	2200.62	1839	< .001	.031 (.025, .035)	0.992	0.077
3. Strong (scalar: thresholds equal)	2229.72	1880	< .001	.030 (.024, .035)	0.992	0.077
4. Error variances equal	2261.06	1924	< .001	.029 (.023, .034)	0.992	0.078
5. Factor variances equal	2278.49	1927	< .001	.030 (.024, .034)	0.992	0.078
6. Factor covariances equal	2319.22	1930	< .001	.031 (.026, .036)	0.992	0.079
7. Factor means equal	2349.91	1933	< .001	.032 (.027, .037)	0.991	0.079

Note. $N = 436$. WLSMV = weighted least squares estimator with means and variances adjusted; RMSEA = root mean square error of approximation; CI = confidence interval; CFI = confirmatory factor analysis; SRMR = standardized root mean square residual. *Item 20 was left free to vary: “Face flushed”.

Table 6

Tests of measurement invariance models for each of symptom and cognitive vulnerability measures across gender (pooled sample)

Model Comparisons	ΔWLSMV χ^2	Δdf	p	ΔRMSEA	ΔCFI	ΔSRMR
Beck Anxiety Inventory (21-item; 4-Factor Model)						
Configural vs. Metric invariance	141.96	16	< .001	0.000	0.000	0.015
Metric invariance vs. Scalar invariance	13.35	16	.647	0.000	0.000	0.000
Scalar invariance vs. Error variances equal	17.41	20	0.626	0.000	0.000	0.004
Error variances equal vs. Factor variances equal	157.74	4	< .001	0.035	-0.015	0.023
Beck Depression Inventory-II (21-item; 3-Factor Model)						
Configural vs. Metric invariance	146.92	18	< .001	0.000	0.000	0.016
Metric invariance vs. Scalar invariance	27.48	18	0.07	0.000	0.000	0.015
Scalar invariance vs. Error variances equal	25.24	21	0.237	0.000	0.000	0.007
Error variances equal vs. Factor variances equal	90.53	3	< .001	0.000	0.000	0.012
Factor means equal vs. Factor variances equal	119.42	3	< .001	0.035	-0.014	0.011
Penn State Worry Questionnaire - Abbreviated (8-item; 1-Factor Model)						
Configural vs. Metric invariance	5.07	7	0.651	0.000	0.000	0.004
Metric invariance vs. Scalar invariance	7.32	7	0.396	0.000	0.000	0.005
Scalar invariance vs. Error variances equal	4.85	8	0.773	0.000	0.000	0.003
Factor variances equal vs. Error variances equal	6.37	1	0.012	0.000	0.000	0.004
Factor means equal vs. Factor variances equal	56.02	1	< .001	0.045	-0.006	0.021
Obsessive Compulsive Inventory-Revised (18-item; 6-Factor Model)						
Configural vs. Metric invariance	69.34	12	< .001	0.000	0.000	0.014
Metric invariance vs. Scalar invariance	8.45	12	0.749	0.000	0.000	0.008
Scalar invariance vs. Error variances equal	16.43	18	0.563	0.000	0.000	0.005
Factor variances equal vs. Error variances equal	9.23	6	0.161	0.000	0.000	0.002
Factor covariances equal vs. Factor variances equal	43.05	15	< .001	0.000	0.000	0.006

Factor means equal vs. Factor covariances equal	7.51	6	0.276	0.000	0.000	0.000
Obsessive Beliefs Questionnaire (44-item; 3-Factor Model)						
Configural vs. Metric invariance	208.72	41	< .001	0.008	-0.004	0.003
Metric invariance vs. Scalar invariance	29.1	41	0.918	-0.001	0.000	0.000
Scalar invariance vs. Error variances equal	31.33	44	0.924	-0.001	0.000	0.001
Factor variances equal vs. Error variances equal	17.43	3	0.001	0.001	0.000	0.000
Factor covariances equal vs. Factor variances equal	40.73	3	< .001	0.002	-0.001	0.001
Factor means equal vs. Factor covariances equal	30.7	3	< .001	0.001	-0.001	0.000

Note. $N = 436$. WLSMV = weighted least squares estimator with means and variances adjusted; RMSEA = root mean square error of approximation; CI = confidence interval; CFI = confirmatory fit index; SRMR = square root mean residual. Bold figures indicate significant changes in the practical fit indices (Δ CFI values of $\leq -.010$, Δ RMSEA values of $\geq +.015$, and Δ SRMR of $\geq +.030$ from the unconstrained to constrained model).