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Factor structure and measurement invariance of the Perceived Ethnic Discrimination Questionnaire-Community Version Brief

Brian TaeHyuk Keum, Christina J. Thai, Nancy N. Truong, Harim Lydia Ahn and Yun Lu

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ABSTRACT
The Perceived Ethnic Discrimination Questionnaire-Community Version Brief (PEDQ-CVB) is a widely used brief multidimensional measure of general racial discrimination for both students and community populations. We evaluated the factor structure and measurement equivalency of the PEDQ-CVB across diverse racial/ethnic and gender groups. The groups in the current study were Black (N = 306), Asian (N = 310), Latinx (N = 163), multiracial (N = 108), women (N = 555), and men (N = 372). Confirmatory factor analysis (CFA) and test of competing models suggested that the four-factor and bifactor (with four specific factors and one general factor) models were best fitting and most conceptually meaningful. Based on the bifactor model, the PEDQ-CVB could be represented unidimensionally (total scale score) for applied measurement. Multi-group CFAs found evidence of measurement invariance for configural, metric, and scalar models across racial/ethnic and gender groups, suggesting that men and women, and individuals self-identifying as Black, Asian, Latinx and multiracial, interpreted PEDQ-CVB items in a similar fashion. Our findings substantiate the utility of the PEDQ-CVB as a brief general measure of racial/ethnic discrimination and the validity of results from prior studies that used the PEDQ-CVB. Study limitations and future directions for research are discussed.

ARTICLE HISTORY
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KEYWORDS
Racism; perceived racial/ethnic discrimination; factor analysis; measurement invariance; PEDQ-CVB

Racism, rooted in a system of dominance and power that creates White societal privilege, is a social and political reality for racial/ethnic minorities in the USA (Lewis, Cogburn, & Williams, 2015). Racial discrimination refers to unfair treatment due to racial/ethnic affiliation that disadvantages racial/ethnic minority individuals based on beliefs of racial superiority of the dominant members of society (e.g. White individuals). Racial/ethnic minority individuals grapple with persistent experiences of racial discrimination in their daily social encounters. Some of the major practices of racial discrimination include: social exclusion (Hagendoorn, 1993), racial/ethnic stereotyping (oversimplified and distorted image or label of racial/ethnic traits; Steele & Aronson, 1995), and stigmatization (mark of disgrace or shame associated with racial/ethnic stereotypes or traits; Link & Phelan, 2001). These discriminatory activities serve as vehicles in constituting the overarching presence of persistent racism in society (Feagin, 2013). The costs associated with racism have been overwhelmingly negative for racial/ethnic minority individuals. Researchers have proposed that racism should be considered as a form of trauma (Carter, 2007; Helms, Nicolas, & Green, 2010) given its significant links to depression, anxiety, somatization, and posttraumatic stress symptomatology. For example, a meta-analysis of 66 studies found that there was a significant correlation between perceived racism and psychological distress for Black
Americans (Pieterse, Todd, Neville, & Carter, 2012). Further, Black Americans who reported greater exposure to discrimination or who appraised the situations as more stressful were more likely to report mental distress such as depression and anxiety. Likewise, racial discrimination has been consistently linked to a host of negative effects for other ethnic racial minority groups, such as lower social competence, social connectedness and sense of coherence, and greater substance abuse for Asian Americans (Lam, 2007; Lee, 2005), and higher psychological distress, suicidal ideation, and anxiety for Latinx Americans (Hwang & Goto, 2008; Yosso, Smith, Ceja, & Solórzano, 2009).

In the past couple of decades, general measures of perceived racial discrimination have been useful in assessing the pervasive nature of racism across racial/ethnic minority groups. Although group-specific measures allow examination of the unique experiences of racism that individual racial groups encounter, general measures of racism allow both within-group and between-group evaluations of perceived racism across racial/ethnic groups (Landrine, Klonoff, Corral, Fernandez, & Roesch, 2006). For instance, greater generalizability across racial/ethnic groups provides opportunities for researchers to conveniently examine the effectiveness of interventions or factors that can mitigate the impact of racism across various racial/ethnic groups and interpret differential outcomes among these groups (Brondolo et al., 2005).

The Perceived Ethnic Discrimination Questionnaire-Community Version Brief (PEDQ-CVB; Brondolo et al., 2005) is one general measure of perceived racial/ethnic discrimination that has received wide utility due to its brevity and multidimensionality. However, a glaring limitation of the PEDQ-CVB as a general measure is that no studies have confirmed its measurement equivalency across race/ethnicity and other pertinent demographic categories (e.g. gender). Both race/ethnicity and gender have been found to contribute to people’s differential perceptions and experiences of racism in the literature (Paradies, 2006). Without evidence of measurement equivalence, it would be difficult for researchers to meaningfully evaluate the differences of PEDQ-CVB scores across racial/ethnic groups and gender. The lack of such evidence also undermines the validity and interpretability of previous studies that used PEDQ-CVB. Thus, the current study examined the factor structure and measurement invariance of the PEDQ-CVB across diverse racial/ethnic and gender groups.

**Perceived Ethnic Discrimination Questionnaire-Community Version Brief (PEDQ-CVB)**

The PEDQ-CVB (Brondolo et al., 2005) is a shortened version of the full 34-item Perceived Ethnic Discrimination Questionnaire-Community Version (PEDQ-CV), and was created for use in research procedures requiring a shorter administration time. The PEDQ-CV is a modification of the Perceived Ethnic Discrimination Questionnaire (PEDQ; Contrada et al., 2001), a measure developed to assess perceived exposure to ethnic discrimination in college students from varying ethnic/racial backgrounds. In the community version (PEDQ-CV), items were revised to be more inclusive of the life experiences of community-dwelling adults across ethnic groups at varying levels of literacy. This was necessary, as community members’ discrimination experiences may not be captured solely by student experiences. For example, the duration of exposure and the types of discrimination may be different for community and college populations. Thus, the PEDQ-CVB was developed for use with both students and community adults from diverse age ranges and educational levels.

The 17-item PEDQ-CVB has four subscales: (1) Exclusion/Rejection, (2) Stigmatization/Discrimination, (3) Discrimination at Work/School, and (4) Threat/Aggression (Table 1). Participants are asked to indicate how often they had these racial discrimination experiences during their lifetime on a 5-point Likert-type scale ranging from 1 (never happened) to 5 (happened very often). The first 16 items were items with the highest factor loadings on each of the four subscales of the full PEDQ-CV. All items begin with the statement, ‘Because of your ethnicity/race … ’ A sample item on the Exclusion/Rejection subscale is ‘How often … have people been nice to your face, but said bad things about you behind your back?’ A sample item on the Stigmatization/Discrimination subscale is ‘How
often... has it been hinted that you must be lazy’. A sample item on the Discrimination at Work/School subscale is ‘How often... have you been treated unfairly by co-workers?’ A sample item on the Threat/Aggression subscale is ‘How often... have others actually hurt you?’ An additional item was added to include exposure to discrimination from police (e.g. ‘How often... have police-man or security officers been unfair to you?’), an important source of ethnicity-related stress for people of colour. Scale scores are calculated by averaging participants’ responses with higher scores indicating a higher perception of racial/ethnic discrimination experiences.

In the original development study (Brondolo et al., 2005), the PEDQ-CVB has produced reliable scores both with students and community members (the majority of the sample identified as Black and Latinx), with Cronbach’s coefficients of 0.88 and 0.87, respectively. Subscale scores have yielded poor to adequate Cronbach’s alpha coefficients ranging from 0.65 to 0.88 for student and community populations. Regarding construct validity, the PEDQ-CVB scores were associated with scores of the Perceived Racism Scale (PRS; McNeilly et al., 1996) for convergent evidence. Criterion evidence has been established by correlating scores on the PEDQ-CVB with scores on measures of primary appraisals of racist interactions and relevant personality characteristics (Brondolo et al., 2005). Some discriminant evidence has been established as PEDQ-CVB scores were not significantly correlated with primary appraisals of challenge and were weakly correlated with perceptions of benefit (Brondolo et al., 2005).

The PEDQ-CVB has demonstrated adequate reliability and validity with students and community members from varying ethnic/racial backgrounds in subsequent studies (e.g. Atkins, 2014; Ghaffari & Çiftçi, 2010; Kwok et al., 2011), suggesting the utility of the measure with diverse populations. The four-factor model has been validated with the parent PEDQ-CV with a multiethnic Asian sample (Kwok et al., 2011) and the brief version with a large representative Latinx sample (Arellano-Morales et al., 2015). In sum, the PEDQ-CVB has several features in that it (a) is intended for use with any racial/ethnic group, (b) is appropriate for both student and community samples, (c) captures a range

<table>
<thead>
<tr>
<th>Items</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>G1234</th>
<th>G1</th>
<th>G2</th>
<th>G3</th>
<th>G4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work/School</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1. Treated unfairly by teachers, principals, or other staff at school?</td>
<td>0.77</td>
<td>0.73</td>
<td>0.94</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2. Thought you couldn’t do things or handle a job?</td>
<td>0.77</td>
<td>0.74</td>
<td>0.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>3. Treated unfairly by co-workers or classmates?</td>
<td>0.84</td>
<td>0.84</td>
<td>0.03ns</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>4. Hinted that you are dishonest or can’t be trusted?</td>
<td>0.80</td>
<td>0.73</td>
<td>0.30</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>5. Hinted that you must not be clean?</td>
<td>0.73</td>
<td>0.62</td>
<td>0.37</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Hinted that you must be lazy?</td>
<td>0.73</td>
<td>0.62</td>
<td>0.41</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Threat/Aggression</td>
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<tr>
<td>3. Actually hurt you and tried to hurt you (e.g. kicked or hit you)?</td>
<td>0.88</td>
<td>0.55</td>
<td>0.60</td>
<td></td>
<td></td>
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<tr>
<td>4. Actually damaged your property?</td>
<td>0.83</td>
<td>0.56</td>
<td>0.69</td>
<td></td>
<td></td>
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<tr>
<td>5. Exclusion/Rejection</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Feel like an outsider who doesn’t fit in because of your dress, speech, or other characteristics related to your ethnicity?</td>
<td>0.73</td>
<td>0.71</td>
<td>0.10ns</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. People been nice to you to your face, but said bad things about you behind your back?</td>
<td>0.78</td>
<td>0.75</td>
<td>0.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>12. People who speak a different language made you feel like an outsider?</td>
<td>0.52</td>
<td>0.49</td>
<td>0.20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Ignored you or not paid attention to you?</td>
<td>0.79</td>
<td>0.74</td>
<td>0.43</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Stigmatization/Discrimination</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Hinted that you are dishonest or can’t be trusted?</td>
<td>0.80</td>
<td>0.73</td>
<td>0.30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Hinted that you must not be clean?</td>
<td>0.73</td>
<td>0.62</td>
<td>0.37</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. People not trusted you?</td>
<td>0.82</td>
<td>0.71</td>
<td>0.46</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Hinted that you must be lazy?</td>
<td>0.73</td>
<td>0.62</td>
<td>0.41</td>
<td></td>
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<td></td>
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</table>

Note: ns = non-significant; N = 927.
of racial discrimination experiences through its four subscales, and (d) is a practical assessment of general perceived ethnic discrimination due to its brief nature compared to the full scale and may be advantageous regarding fatigue in the survey-taking experience.

**The present study**

Despite the wide utility and features of the PEDQ-CVB with specific racial/ethnic groups, its psychometric properties remain to be validated across racial/ethnic groups. Thus, the aim of this study was to (a) evaluate the factor structure of PEDQ-CVB, and (b) provide evidence of measurement equivalency across racial/ethnic groups and gender. There are several reasons that warrant evaluation of the factor structure of the PEDQ-CVB. First, Brondolo et al. (2005) created the PEDQ-CVB from the full scale and assumed equal psychometric properties for the brief version. However, the factor structure of the brief version has not been evaluated using a diverse sample (Bastos, Celeste, Faerstein, & Barros, 2010). Brondolo and colleagues used both the four subscales and the full scale in development, leading to a scoring scheme that assumed a second-order model (i.e. four factors representing a single higher order factor). However, it is equally possible that a one-factor model or a four-factor first-order model could represent the structure of the PEDQ-CVB. In fact, most studies have used only the total scale score (e.g. Atkins, 2014; Ghaffari & Ciftci, 2010). Regarding the use of a total scale score, a unidimensional representation of the PEDQ-CVB also seems plausible given that the items for the four factors were developed theorized as part of the overall discrimination experience (Brondolo et al., 2005) and some of the subscales display overlapping content. For example, the Stigma/Discrimination subscale and the Discrimination at Work/School both focus on the discriminatory events. Hence, the validity of the PEDQ-CVB and its utility is unclear without confirmatory tests of the underlying factor structure. Second, although the authors hypothesized that the four factors of the PEDQ would be correlated, the authors developed the measure using principal components analysis with varimax rotation, which specified an uncorrelated relationship among the subscales. Factor correlations thus remain to be evaluated using a correlated factor structure.

Against this backdrop, we set out to first evaluate the factor structure of the PEDQ-CVB based on the original oblique four-factor model, a one-factor model (i.e. all items loading onto a single factor), a second-order model (i.e. four specific factors representing a single higher order factor of perceived ethnic discrimination), and a bifactor model (Reise, 2012). The bifactor model assumes that a conceptually meaningful general factor accounts for variance in all items and that the subsets of the items share unique variance in representing their respective specific factors. For the PEDQ-CVB, the general factor would represent a general level of exposure to ethnic discrimination in addition to the unique experiences represented by the four subscales.

Following the factor structure evaluation, we conducted measurement invariance tests of the PEDQ-CVB across racial/ethnic groups and gender. Potential differences in racism experiences due to racial/ethnic group membership have been found with general measures of racism. For example, Forrest-Bank, Jenson, and Trecartin (2015) examined the factor structure of the Racial and Ethnic Microaggression Scale for Black, Latinx/Hispanic, and Asian young adults. They found that items in several subscales (e.g. Second-Class Citizen, Assumption of Criminality, and Assumptions of Similarity) loaded in a similar fashion for Latinx/Hispanic participants and Black participants, but were non-invariant for Asian participants. Specifically, certain items loaded differently for Asian participants (e.g. ‘someone told me that I was “articulate” after she/he assumed I wouldn’t be’ and ‘Someone acted surprised at my scholastic or professional success’). These items seem to represent the unique racism experience of Asians due to the model minority stereotype, which fuels perceptions that they were intelligent, successful, and oblivious to racial discrimination (Yoo, Burrola, & Steger, 2010).

Additionally, many racially marginalized groups, such as Asian, Middle Eastern, and Latinx/Hispanic individuals with immigrant roots are perceived to be foreigners (Devos & Ma, 2008; Sue et al., 2007), and this may influence their perceptions of racism and common racial discrimination.
experiences. Indeed, perceived foreigner objectification has been associated with negative psychological outcomes in Asian Americans and Latinx Americans (Guendelman, Cheryan, & Monin, 2011; Huynh, Devos, & Smalarz, 2011). Brondolo et al. (2015) also found that place of birth for Asian and Black immigrants led to differential ratings on the items in the PEDQ-CVB, such that US-born and younger age immigration statuses were associated with greater perceived discrimination, particularly on race-related stigmatization and exclusion. Furthermore, discrimination has also been linked to psychological distress and low life satisfaction for multiracial individuals (Giamo, Schmitt, & Robert Outten, 2012; Jackson, Yoo, Harrington, & Guevarra, 2012). Of note, whether PEDQ-CVB is generalizable to multiracial individuals is an interesting and important question since these individuals may acquire wider variety of ways to define their ethnic identity (Giamo et al., 2012) and hence variability in their perception of discrimination. Thus, testing measurement equivalency of the PEDQ-CVB as a general measure is crucial because items may be interpreted differently due to unique perception and experiences of racism across racial/ethnic groups.

Experiences of racial discriminations may also differ based on gender. The magnitude, directionality, nature and the context of gender-based differences of perceived racial discrimination are discrepant in the literature. More studies have found that men reported greater prevalence of racial discrimination than women in settings related to work and social services, whereas in service-oriented positions, studies have found that women reported greater prevalence (for a review, see Paradies, 2006). Researchers have suggested that men may be more willing than women to respond affirmatively to questions about racism experiences even with equivalent experience, or that measures may have been developed to overemphasize racial experiences pertaining to men (Kwate & Goodman, 2015). Greene, Way, and Pahl (2006) hypothesized that there may be differential racial discrimination experiences for Black men compared to Black women because men are perceived to be more threatening. For example, Black men may be more likely to be stereotyped as criminals, physically dangerous, and may experience more police searches (Kwate & Goodman, 2015; Sue et al., 2007). However, there have been inconsistent findings in the literature on whether men perceive more discrimination than women. Cassidy, O’Connor, Howe, and Warden (2004) found that male participants were more likely to perceive high levels of discrimination, and Goff and Kahn (2013) showed that Black men were typically perceived as the targets of discrimination. Conversely, Broman (1997) found that there were no gender differences. Yet, regardless of the trends in the literature, most racism measures may not account for gendered experiences. Gendered frameworks have been central to understanding the oppression that Black women (Collins, 2000) and Asian women (Sue et al., 2007) face – and potentially other women of colour. Given these discrepancies, testing measurement equivalence of PEDQ-CVB across gender would be important.

**Method**

**Participants and procedure**

Data for the current study was a subset from a previous study (Keum & Miller, 2017) and was conducted in compliance with the institutional review board of the host institution. Data were collected via an online survey consisting of study variable measures and demographic items hosted by Qualtrics. The survey was advertised through multiple online communication platforms such as listservs and social network sites (e.g., Facebook), and participants were compensated via Amazon MTurk. MTurk allows researchers to conduct targeted recruitment and grant greater access to some underrepresented populations (Huff & Tingley, 2015).

The average age of the participants was 27.42 (SD = 9.77) and ranged from 18 to 67. There were 372 men and 555 women in our sample. In terms of race, there were 108 multiracial, 163 Latinx, 310 Asian, and 306 Black adults in our sample. Majority of the sample were heterosexual (85%; 803), followed by 6% (55) bisexual, 3% (30) gay, and 2% (23) lesbian.
Analytic approach

No cases were missing more than 10% of the data. We handled missing data with full-information maximum likelihood in Mplus (Enders, 2010). We used Mplus 7.11 to conduct our analyses. Prior to testing invariance, we first conducted confirmatory factor analyses (CFA) to evaluate the fit of several competing models for the PEDQ-CVB in order to determine the best fitting model for our sample. Model fit was evaluated by the following fit indices (Fabrigar, Wegener, MacCallum, & Strahan, 1999; Hu & Bentler, 1999): (a) comparative fit index (CFI; > 0.95 for good fit; 0.92–0.94 for adequate fit); (b) the standardized root mean square residual (SRMR; close to < 0.08 for acceptable fit); and (c) the root mean square error of approximation (RMSEA; close to < 0.08 for acceptable fit). The competing models with at least acceptable fit indices were compared based on (a) Satorra–Bentler scaled chi-square difference test (S-B chi-square difference test) and (b) Bayesian and Akaike information criterion (BIC, AIC) values. Smaller values of BIC suggest better fit, with higher values of more than 10 units suggesting lack of empirical support for goodness of fit (Burnham & Anderson, 2004).

We used the best-fitting model to conduct multi-group CFAs to evaluate measurement invariance of the PEDQ-CVB. We tested whether the measures operated in an equivalent manner across race (Black, Asian, Latinx, multiracial) and gender (men and women) in our sample. Invariance testing was conducted via comparison of a series of models with increasing constraints: baseline configural model (no constraints), metric model (factor loadings constrained to be equivalent across the groups), and scalar model (factor loadings and item intercepts constrained to be equivalent across the groups). Evaluation of the invariance was conducted by assessment of changes in the fit index. A change in CFI (ΔCFI) less than 0.01, change in RMSEA (ΔRMSEA) less than 0.015, and change in SRMR (ΔSRMR) less than 0.03 suggests no significant decrease in model fit and supports measurement invariance (Chen, 2007). We did not consult the likelihood-ratio tests to determine measurement invariance because chi-square tests are known to be sensitive to sample size and even a small chi-square difference may be found to be statistically significant with increasing sample sizes (Cheung & Rensvold, 2002). Finally, we conducted latent mean comparisons based on evidence of measurement invariance.

Results

Fit statistics for invariance models and CFA tests are displayed in Table 2. Descriptives and Cronbach’s alphas are presented in Table 3. The Cronbach’s alpha values of the PEDQ-CVB subscale and total scores ranged from 0.76 to 0.95 among our racial and gender groups.

Confirmatory factor analysis (CFA)

Factor structure

The omnibus test of multivariate normality (Small, 1980) suggested that the data were not normal, $\chi^2$ (34) $= 1302.12$, $p < 0.001$. Thus, we employed a maximum likelihood estimation with standard errors and chi-square test statistic that are robust to non-normality. CFA suggested that the four-factor model had a good fit to the data. All of the items loaded significantly ($p < 0.01$) to their intended subscales and ranged from 0.52 to 0.88 (Table 1). The one-factor model had a poor fit to the data and was removed from further consideration. The second-order model had an adequate fit to the data (Table 1). We also found that the bifactor model had a good fit to the data with equal CFI values (0.946) as with the four-factor model. Both the bifactor and the four-factor models were deemed good fitting models, although the latter had slightly better fit indices as it had lower RMSEA (0.062), SRMR (0.037) values, and a lower BIC value (33941.25) that was empirically significant.
Test of competing models
Given that the four-factor, bifactor, and the second-order models had adequate to good fit, we conducted S-B chi square difference tests for comparison. The S-B chi-square difference test indicated that the four-factor model had a significantly better fit to the data than the second-order model, S-B $\chi^2(2) = 93.912, p < 0.001$. The S-B chi-square difference test indicated that the bifactor model had a significantly better fit to the data than the second-order model, S-B $\chi^2(11) = 84.331, p < 0.001$. Between the bifactor and four-factor models, the four-factor model demonstrated slightly better fit indices. However, we decided that further assessment was necessary to ascertain the multidimensionality of the PEDQ-CVB given the substantially high latent correlations among the four subscales ($r_{work\text{-}threat} = 0.630, p < 0.001; r_{work\text{-}exclusion} = 0.951, p < 0.001; r_{threat\text{-}exclusion} = 0.564, p < 0.001; r_{stigma\text{-}work} = 0.831, p < 0.001; r_{threat\text{-}stigma} = 0.725, p < 0.001; r_{stigma\text{-}exclusion} = 0.818, p < 0.001$). The high correlations suggested that the subscales may not be meaningfully distinguishing conceptually and statistically different dimensions. Using these subscales together in data analyses would likely yield issues of multicollinearity and reduction of power (Grewal, Cote, & Baumgartner, 2004). This led us to question whether the subscales are providing unique information, and whether a total scale score may be more useful. Literature suggests that subscale scores are often unreliable than total scale scores (Rodriguez, Reise, & Haviland, 2016). Thus, we conducted a closer examination of the bifactor model, as it had comparably good model fit and since the model’s simultaneous estimation of the general factor and the group factors would allow assessment of whether the group factors (subscale scores) account for unique variance above and beyond the general factor (total scale score).

Bifactor and multidimensionality
Bifactor models provide one useful solution to resolving dimensionality issues in measures, particularly with the distortion that may occur when unidimensional models are forced into multidimensional data (Reise, Morizot, & Hays, 2007). Although the data may be multidimensional, bifactor models provide an empirical assessment of whether the subscale scores reflect a single common factor (Reise, 2012). The bifactor model specifies unique variance in all items for the general factor and the unique variances in items for their respective group factors (Reise, 2012). For the PEDQ-CVB, all of the items significantly loaded onto the general factor from 0.49 to 0.84 (Table 1). Item loadings for the Threat/Aggression (0.55 to 0.69) and Exclusion/Rejection (0.30 to 0.46) factors were all significant (Table 1). For the Discrimination at Work/School subscale, three out of the four items (0.01 to 0.94) loaded below 0.20, and two of them had non-significant loadings (Table 1). Likewise, three out of the four items (0.10 to 0.43) for the Exclusion/Rejection subscale loaded at 0.20 or below and one of them had non-significant loadings (Table 1). The item loadings suggested that a significant portion of the variance in the Work/School and Exclusion/Rejection subscales were accounted by the general factor, suggesting that these two subscales provide little unique information and measurement precision (Stenling, Ivarsson, Hassmen, & Lindwall, 2015).

We also calculated model-based internal consistency estimates (omegaH and omegaHS) to interpret the utility of the total and subscale scores for the PEDQ-CVB. OmegaH estimates the proportion of variance in total scores attributed to a single general factor and values above 0.80 suggest significant unidimensionality (Rodriguez et al., 2016). OmegaHS is a reliability index of subscale scores extracted after controlling for the variance due to the general factor (Reise, Bonifay, & Haviland, 2013). OmegaH for the general factor was 0.87, suggesting that 87% of the total variance of the total scores were attributed to the individual differences on the general factor. OmegaHS for the subscales were 0.01, 0.05, 0.01, and 0.02, suggesting that subscale reliabilities were substantially reduced and very little common variance remained after controlling for the general factor.

Given that the omega values point to a strong general factor for the PEDQ-CVB, we also examined explained common variance (ECV) and percentage of uncontaminated correlations (PUC) indices to ascertain whether representation of the data as a unidimensional model is ‘good enough’ compared to a bifactor measurement model (Reise et al., 2013; Rodriguez et al., 2016). ECV is used to
Table 2. Goodness-of-fit indicators for structural equation modelling analyses.

<table>
<thead>
<tr>
<th>Models/samples</th>
<th>df</th>
<th>$\chi^2$</th>
<th>RMSEA</th>
<th>90% CI</th>
<th>CFI</th>
<th>SRMR</th>
<th>BIC</th>
<th>AIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-factor</td>
<td>104</td>
<td>1547.896**</td>
<td>0.121</td>
<td>[0.116, 0.127]</td>
<td>0.782</td>
<td>0.079</td>
<td>35,788.89</td>
<td>35,555.98</td>
</tr>
<tr>
<td>Four-factor</td>
<td>98</td>
<td>455.539**</td>
<td>0.062</td>
<td>[0.056, 0.068]</td>
<td>0.946</td>
<td>0.037</td>
<td>33,941.25</td>
<td>33,941.25</td>
</tr>
<tr>
<td>Second-order</td>
<td>100</td>
<td>534.021**</td>
<td>0.068</td>
<td>[0.062, 0.073]</td>
<td>0.935</td>
<td>0.050</td>
<td>34,301.01</td>
<td>34,048.69</td>
</tr>
<tr>
<td>Bifactor</td>
<td>89</td>
<td>449.513**</td>
<td>0.065</td>
<td>[0.059, 0.072]</td>
<td>0.946</td>
<td>0.048</td>
<td>34,053.16</td>
<td>33,947.56</td>
</tr>
<tr>
<td><strong>Racial groups</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Configural model</td>
<td>360</td>
<td>1061.067**</td>
<td>0.094</td>
<td>[0.087, 0.100]</td>
<td>0.919</td>
<td>0.061</td>
<td>32,729.94</td>
<td>31,542.56</td>
</tr>
<tr>
<td>Metric model</td>
<td>425</td>
<td>1201.801**</td>
<td>0.089</td>
<td>[0.083, 0.095]</td>
<td>0.911</td>
<td>0.082</td>
<td>32,361.59</td>
<td>31,533.29</td>
</tr>
<tr>
<td>Scalar model</td>
<td>468</td>
<td>1275.767**</td>
<td>0.088</td>
<td>[0.082, 0.094]</td>
<td>0.910</td>
<td>0.082</td>
<td>32,211.56</td>
<td>31,541.26</td>
</tr>
<tr>
<td><strong>Gender groups</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Configural model</td>
<td>178</td>
<td>727.125**</td>
<td>0.082</td>
<td>[0.075, 0.088]</td>
<td>0.943</td>
<td>0.046</td>
<td>33,613.89</td>
<td>33,005.06</td>
</tr>
<tr>
<td>Metric model</td>
<td>204</td>
<td>825.392**</td>
<td>0.081</td>
<td>[0.075, 0.087]</td>
<td>0.935</td>
<td>0.069</td>
<td>33,534.52</td>
<td>33,051.33</td>
</tr>
<tr>
<td>Scalar model</td>
<td>215</td>
<td>849.34**</td>
<td>0.080</td>
<td>[0.074, 0.085]</td>
<td>0.934</td>
<td>0.070</td>
<td>33,483.30</td>
<td>33,053.26</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MI model comparison</th>
<th>$\Delta \chi^2$(df)</th>
<th>$p$</th>
<th>$\Delta$CFI</th>
<th>$\Delta$RMSEA</th>
<th>$\Delta$SRMR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Racial groups</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Configural vs. metric</td>
<td>140.734(75)**</td>
<td>&lt;0.001</td>
<td>-0.008</td>
<td>-0.005</td>
<td>0.021</td>
</tr>
<tr>
<td>Metric vs. scalar</td>
<td>214.700(108)**</td>
<td>&lt;0.001</td>
<td>-0.001</td>
<td>-0.001</td>
<td>0</td>
</tr>
<tr>
<td>Scalar vs. configural</td>
<td>73.966(33)**</td>
<td>&lt;0.001</td>
<td>-0.009</td>
<td>-0.006</td>
<td>0.021</td>
</tr>
<tr>
<td><strong>Gender groups</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Configural vs. metric</td>
<td>98.267(26)**</td>
<td>&lt;0.001</td>
<td>-0.008</td>
<td>-0.001</td>
<td>0.023</td>
</tr>
<tr>
<td>Metric vs. Scalar</td>
<td>122.198(37)**</td>
<td>&lt;0.001</td>
<td>-0.001</td>
<td>-0.001</td>
<td>0.001</td>
</tr>
<tr>
<td>Scalar vs. Configural</td>
<td>23.930(11)*</td>
<td>0.013</td>
<td>-0.009</td>
<td>-0.002</td>
<td>0.024</td>
</tr>
</tbody>
</table>

Note: RMSEA = root-mean-square error of approximation; CI = confidence interval for RMSEA; CFI = comparative fit index; SRMR = standardized root-mean-square residual; BIC = Bayesian information criterion; MI = measurement invariance.

*p < 0.05.

**p < 0.01.
Table 3. Latent means, standard deviations, and Cronbach’s alphas.

<table>
<thead>
<tr>
<th>Sample group</th>
<th>Work/School</th>
<th>Threat/Aggression</th>
<th>Exclusion/Rejection</th>
<th>Stigmatization/Discrimination</th>
<th>PEDQ-CVB total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
<td>$\alpha$</td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Women</td>
<td>0</td>
<td>1</td>
<td>0.86</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Men</td>
<td>0.04</td>
<td>0.74</td>
<td>0.86</td>
<td>1.03</td>
<td>0.92</td>
</tr>
<tr>
<td>Black</td>
<td>0</td>
<td>1</td>
<td>0.86</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Asian</td>
<td>0.00</td>
<td>0.93</td>
<td>0.81</td>
<td>-0.19*</td>
<td>0.64</td>
</tr>
<tr>
<td>Latino/a</td>
<td>-0.10</td>
<td>1.00</td>
<td>0.87</td>
<td>-0.16</td>
<td>0.78</td>
</tr>
<tr>
<td>Multiracial</td>
<td>-0.11</td>
<td>0.66</td>
<td>0.86</td>
<td>-0.17</td>
<td>0.73</td>
</tr>
</tbody>
</table>

Note. PEDQ-CVB = Perceived Ethnic Discrimination Questionnaire-Community Version Brief; SD = standard deviation

*p < 0.05.

**p < 0.01.
assess the degree of essential unidimensionality by examining the percent of common variance attributable to a general dimension (Rodriguez et al., 2016). PUC is considered in conjunction to ECV, and is used to assess the degree to which parameter estimates may be biased when forcing a multidimensional data into a unidimensional structure (Rodriguez et al., 2016). ECV was 0.75, suggesting that the general factor explained 75% of the common variance extracted with just 15% of the common variance spread across group factors. PUC was 96, suggesting that an overwhelming majority of 96 correlations inform directly on the general factor and that the general factor appears to be the main trait that PEDQ-CVB is assessing.

Taken together, the results suggested a presence of a strong general factor and that a single factor specification with expectation of minimal bias in factor loadings was preferred as a measurement model of the PEDQ-CVB (Reise et al., 2013; Rodriguez et al., 2016). This led us to proceed to invariance testing with the bifactor model, given its applied measurement utility.

**Test of invariance across racial groups**

The baseline bifactor had an adequate fit to the data across the four racial/ethnic groups (Table 2). The configural model was compared to the metric model. The metric model had an adequate fit to the data and the changes in the fit index indicated no significant decrement in fit from configural to the metric model ($\Delta$CFI = 0.008, $\Delta$RMSEA = 0.005, $\Delta$SRMR = 0.021). The metric model was then compared to the scalar model. The scalar model had an adequate fit to the data and the changes in fit index indicated no significant decrement in fit from metric to the scalar model ($\Delta$CFI = 0.001, $\Delta$RMSEA = 0.001, $\Delta$SRMR = 0). We decided to accept our results as evidence for measurement invariance as the changes in CFI, RMSEA, and SRMR across the increasingly constrained models did not indicate significant decrement in model fit (Chen, 2007; Cheung & Rensvold, 2002).

**Test of invariance across gender**

The baseline four-factor model had a good fit to the data across men and women (Table 2). The configural model was compared to the metric model. The metric model had a good fit to the data and the changes in the fit index indicated no significant decrement in fit from configural to the metric model ($\Delta$CFI = 0.008, $\Delta$RMSEA = 0.001, $\Delta$SRMR = 0.023). The metric model was then compared to the scalar model. The scalar model had a good fit to the data and the changes in fit index indicated no significant decrement in fit from metric to the scalar model ($\Delta$CFI = 0.001, $\Delta$RMSEA = 0.001, $\Delta$SRMR = 0.001). We decided to accept our results as evidence for measurement invariance as the changes in CFI, RMSEA, and SRMR across the increasingly constrained models did not indicate significant decrement in model fit (Chen, 2007; Cheung & Rensvold, 2002).

**Latent mean comparisons**

Results of latent mean comparisons are listed in Table 3. For gender, factor means were set at 0 for women. Compared to women, men reported significantly higher scores for the Threat/Aggression and Stigmatization/Discrimination subscales, but lower scores for the total scale. For racial/ethnic groups, factor means were set at 0 for Black individuals. Compared to the Black individuals: (a) Asians reported significantly lower scores in Threat/Aggression, Stigmatization/Discrimination, and the total scale, (b) Latinx individuals reported significantly lower total scale scores, and (c) multiracial individuals had significantly lower Stigmatization/Discrimination scores.

**Discussion**

The current study is the first to examine the factor structure and measurement invariance of the PEDQ-CVB across multiple racial/ethnic groups and across men and women. Our results confirmed
and extended the multidimensional model of the PEDQ-CVB, with four specific factors and one general factor. The four-factor representation was consistent with previous studies that validated the measure with specific ethnic groups (Arellano-Morales et al., 2015; Kwok et al., 2011). We also found evidence of measurement invariance for PEDQ-CVB suggesting that differences in scores across these groups are likely to be true differences rather than measurement error or response bias. The internal consistency estimates of the four subscales and the total scale across the groups were adequate and ranged from 0.76 to 0.95; they were better than some of the acceptable values (0.65) found in the original development (Brondolo et al., 2005). Our findings substantiate the utility of the PEDQ-CVB as a brief general measure of racial/ethnic discrimination and the validity of prior studies that used the PEDQ-CVB.

One major goal for the current study was to ascertain the utility and structural model of the PEDQ-CVB given the lack of psychometric examinations in the literature. We propose two separate recommendations in using the PEDQ-CVB. Given the best fit of the four-factor model, the PEDQ-CVB may be conceptualized as a four-factor correlated model, with each of the subscales assessing unique domains of perceived ethnic discrimination. Such use may be especially applicable and helpful to clinicians and professionals in conceptualizing and assessing the breadth of ethnic discrimination that people may experience.

On the other hand, our test of the bifactor model of the PEDQ-CVB supported the use of a total scale score representing a single general construct of perceived ethnic discrimination. We recommend that researchers use structural equation modelling (SEM) to specify a bifactor structure to estimate the general factor for this purpose. For non-SEM users, the general factor score may be calculated by summing up the observed scores of all the items. For researchers wishing to use the subscale scores with their respective samples, first, the subscales must be assessed for the significance of the factor loadings and the unique variance accounted by the subscales in the bifactor model prior to conducting the analyses, since our results found that subscales appeared unreliable; notably, the variance in Work/School and Exclusion/Rejection subscales were mostly accounted by the general factor. Second, the subscale scores cannot merely be calculated by summing up the respective observed subscale item scores because doing so would confound the total and subscale scores as the variance accounted by the general or subscale factors would not be teased apart. For this reason, it is recommended that researchers use SEM to specify a bifactor structure to assess the subscales independent from each other and the general factor. For non-SEM users, although less recommended, ipsative scoring may be used (Tracey, 2012). In this procedure, the total mean score should be subtracted from each subscale score to address the overall mean elevation due to the effects of the general factor.

Regarding latent mean comparisons, we found differences in the total and subscale scores among the different groups. Although the literature is mixed (Paradies, 2006), the men in our sample reported significantly lower scores for the general factor (full scale). Yet at the subscale level with the general factor variance parcelled out, the men in our sample reported significantly higher scores in Threat/Aggression and Stigmatization/Discrimination domains. As researchers have indicated (Collins, 2000; Greene et al., 2006; Kwate & Goodman, 2015), the greater scores for men may be due to the overrepresentation of items focused on criminality or being perceived and stigmatized as a threat, which may be more likely to be associated with men in general. In conjunction, the greater mean overall scores for women may have to do with the sexism compounded in the items such as, 'Treated unfairly by coworkers,' and 'Boss or supervisor been unfair'. Further, items such as 'Made you feel like an outsider because of appearance' or 'Been nice to face, but said things behind back' may be more salient to women than men. These items are from the Work/School and Exclusion/Rejection subscales, both of which had more of the variance accounted for by the general factor; this may have been reflected in the lower general factor scores for men. Additionally, we found that Asian, Latinx, and multiracial individuals in our sample generally reported significantly lower overall and subscale scores when compared to Black individuals, who often experience racism at greater levels in the USA (Pieterse et al., 2012). Asians reported significantly lower (lowest among the groups compared to Blacks) total scores in Threat/Aggression, Stigmatization/Discrimination and total
scores. Asians in the USA are perceived to be the ‘model minority’ who pose little threat and may be assumed as intelligent and successful (Yoo et al., 2010) rather than being stigmatized with negative qualities (e.g. dishonest, lazy). Internalization of such stereotypes have been suggested to influence underreporting and denial of racial discrimination among Asians in the USA (Yoo et al., 2010). Overall, these differences highlight the possibility of nuanced assessment of racial discrimination through the use of the subscales.

Although our findings indicate invariance across racial and gender groups, there are a number of limitations to the current study. This study focused on the experiences of Asian, Latinx, Black, and multiracial individuals and cannot be generalized to the experiences of other people of colour. In addition, there was substantial unequal representation of racial groups in the sample; for example, only 17% of our participants identified as Latinx compared to those who identified as Black (33%). It would be ideal for future studies to conduct additional confirmatory tests of the PEDQ-CVB with larger Latinx and multiracial samples as well as other racial/ethnic minority groups (e.g. Native American). Further, although studies have shown that MTurk allows researchers to collect large amounts of data efficiently from a diverse sample of population with comparable data reliability and quality compared to traditional methods (Huff & Tingley, 2015), the current results should be interpreted with caution. Finally, the current study provides no external validity evidence. The utility of the subscales would need to be tested with external validity variables (e.g. psychological distress) especially given that the meaningfulness of the Work/School and Stigma/Discrimination subscales seem to diminish once the general factor is parcelled out.

Additionally, although our study examined the validity of PEDQ-CVB across race/ethnicity and gender, the results do not speak to the nuanced experiences of discrimination based on the intersection of these two demographic categories. Researchers choosing to use the PEDQ-CVB must take into account this limitation of a general measure of racism (Lewis et al., 2015). There are also other major demographic categories that may differentiate the experiences of racial discrimination and should be studied further. For example, although the average age of our participants was 27.42, the ages ranged greatly from 18 to 67. Future studies should examine whether there may be differences in exposure to racial discrimination across various age groups given that the existing trend on the perception of racism based on age appears to be mixed (Paradies, 2006). Socioeconomic and immigration status has also been found to differentiate the racial discrimination experiences (Brodolo et al., 2009) and it seems necessary to validate the PEDQ-CVB across these sociodemographic dimensions. These factors may help explain some of the differences in the level of perceived racial discrimination among various racial/ethnic and gender groups. Future research should also examine the PEDQ-CVB for subgroup variability. For example, prior research has validated the PEDQ-CV across multiethnic Asian sample (e.g. Japanese, Korean, Chinese; Kwok et al., 2011) and the PEDQ-CVB across nationally representative Latinx sample in the USA (Arellano-Morales et al., 2015). Researchers should consider validating the PEDQ-CVB in light of subgroup variability in other racial/ethnic categories.

Disclosure statement
No potential conflict of interest was reported by the authors.

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