

Measurement Invariance of Commonly Used Psychosis-Screening Scales in U.S. Spanish- and English-Speaking Hispanic Participants

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Two of the most commonly used psychosis screening measures are the Prodromal Questionnaire–Brief (PQ-B) and the Youth Psychosis at Risk Questionnaire–Brief (YPARQ-B). Both scales have considerable support for the reliability and validity of their scores for use with English- and Spanish-speaking participants, with measurement equivalence established across a subset of demographic characteristics. However, measurement invariance has not been examined across several important demographic variables, including native language, language of the scales used with Hispanic participants, education, occupation, income, birth country, and generation status. In the present study, ($N = 1,191$) measurement invariance was examined for each of these variables across three samples ($n_s = 505, 714, \text{ and } 126$). The PQ-B total scores and YPARQ-B were found to demonstrate configural and scalar invariance, while PQ-B Distress scores displayed configural, metric, and scalar invariance across most tested demographic variables. Psychosis scores were associated with social determinants of health (SDoH) including major and everyday experiences of discrimination, food insecurity, financial insecurity, acculturation, and ethnic identity. The associations between psychosis and SDoH were mostly consistent across groups. Compared to White-non-Hispanic participants, Hispanic participants had higher scores on all psychosis measures and tended to have higher scores on discrimination, food and housing insecurity, affirmation aspects of ethnic identity, and acculturative stress. Despite differences in psychosis levels, the groups did not differ in history of treatment. Overall, these results provide strong evidence that the PQ-B and YPARQ provide equivalent, nonbiased, valid, and reliable scores in Hispanic and Non-Hispanic participants in both English and Spanish.

Public Significance Statement

Two commonly used psychosis measures displayed measurement invariance across a range of demographic variables including language, race, ethnicity, gender, age, and education. These scales can be used in both English- and Spanish-speaking Hispanic populations to screen for psychosis and yield equivalent scores.

Keywords: measurement invariance, psychosis screening, prodromal, Latinx, social determinants of health

Supplemental materials: <https://doi.org/10.1037/pas0001207.supp>

Psychosis incurs major cost to individuals, families, and communities (Cloutier et al., 2016). Early identification and treatment of people at risk for the development of psychosis may delay onset (Addington & Heinssen, 2012), reduce the duration of untreated

psychosis (Srihari et al., 2014), improve its course (Goff et al., 2020), and potentially prevent its onset altogether (Stafford et al., 2013). Streamlining pathways to care for people at risk is critical for mitigating impact (Csillag et al., 2016). Prodromal and first episode

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The authors have no conflicts of interest to disclose.

Thomas A. Bart played equal role in data curation, formal analysis, investigation, writing of original draft, and writing of review and editing. Charlie C. Su played supporting role in conceptualization, investigation, methodology, project administration, and writing of original draft. Deisy Gonzalez Zapata played supporting role in resources and writing of review and editing. Clare Alsup played supporting role in writing of original draft and writing of review and editing. Megan M. Hricovec played supporting role in investigation, validation, and writing of review and editing. Jennifer L. Callahan played supporting role in conceptualization and writing of review and editing. Camilo J. Ruggero played supporting role in supervision and equal role in conceptualization, investigation, methodology, resources, writing of

original draft, and writing of review and editing. David C. Cicero played lead role in conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, software, supervision, validation, visualization, writing of original draft, and writing of review and editing.

Materials and analysis code are available by emailing the corresponding author. This study was not preregistered. These data were presented as a poster at the 2022 annual meeting for the Association for Psychological Science. The authors' version of the article was posted to the Open Science Foundation following submission (at <https://osf.io/cztdm>).

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clinics struggle to identify those in need of care (Csillag et al., 2016), and many of the referrals they receive are not appropriate for their clinics (Johannessen et al., 2005; Power et al., 2007). Screening measures, such as the Prodromal Questionnaire–Brief (PQ-B; Loewy et al., 2011) and the Youth Psychosis at Risk Questionnaire (YPARQ; Ord et al., 2004) improve detection and access to care (Kline & Schiffman, 2014). However, the psychometric properties of these measures in the growing Hispanic/Latino/Latinx communities in the United States are unclear, and few studies have examined the measurement invariance of the scales in these groups.

Over 57 million people (>18% of the population) in the United States identify as Hispanic (or Latino/Latina/Latinx), representing the country's largest ethnic group as well as its fastest growing demographic (i.e., to 25% in the United States by midcentury; United States Census Bureau, 2018). Despite growing influence, their mental health needs are underserved. Rates of common mental illness (e.g., depression) are on par with non-Hispanic counterparts, yet rates of service utilization are far below expected (i.e., <50% of non-Hispanic Whites; Substance Abuse and Mental Health Services Administration, 2018). Several factors contribute to these mental health disparities, including discrimination (Caplan, 2007; Perreira et al., 2015), acculturative stress (Perreira et al., 2015), immigration and legal status (Perreira et al., 2015), language barriers (Hamp et al., 2016), and racial/ethnic identity (Anglin et al., 2018).

Psychosis in Hispanic Individuals

Mental health disparities for Hispanic individuals are especially pronounced for the assessment and treatment of psychosis. Rates of psychosis are higher in this group compared with non-Hispanic White counterparts. For example, Hispanic people are two to three times more likely to be diagnosed with schizophrenia than non-Hispanic Whites, especially among men (Hamilton et al., 2018; Schwartz & Blankenship, 2014). However, it is unclear if these differences reflect (a) real differences in rates of schizophrenia due to a number of social determinants of health (SDoH) related to systemic racism, (b) biases in clinical judgment of practitioners, or (c) differences in responses to interview questions related to cultural differences (i.e., a lack of measurement invariance). Similarly, racial and ethnic minorities also tend to have higher scores on psychosis and psychosis-risk measures (Anglin et al., 2018). One way to determine whether the disparity in scores represents a difference in psychosis or biases in the assessment is measurement invariance analyses (Chen, 2008).

Social Determinants of Health

Hispanic people also face unique SDoH that increase risk of psychosis in addition to risk for misdiagnosis. On a societal level, ethnic and racial minority status is associated with increased risk of psychosis (Veling, 2013). Psychosis has been associated with lower levels of educational attainment (Dickson et al., 2020), economic stress (Hakulinen et al., 2020), and linguistic proficiency (Hamilton et al., 2018). Community and interpersonal factors associated with psychosis include discrimination and institutional racism (Veling et al., 2008). Last, a number of social–cognitive–behavioral factors are associated with psychosis, including cultural and ethnic identity (Anglin et al., 2018). Theorists suggest that racial differences in prevalence and assessment biases are not necessarily attributable to

race per se, but are a result of these SDoHs that are closely associated with race and ethnicity. To our knowledge, all previous measurement invariance research with psychosis scales that has examined cultural factors has been limited to either self-reported race/ethnicity or country of residence. Much like race and ethnicity, associations between psychosis and SDoHs may be related to actual correlations of the underlying constructs or to measurement bias. If SDoHs are hypothesized to drive health disparities, then it is important to establish that scales assess psychosis consistently across SDoHs.

These factors likely contribute to how individuals interpret the items on psychological measures. For example, “Do people sometimes find it hard to understand what you are saying?” may be related to linguistic fluency rather than psychosis in individuals for which English is a second language. “Have you had the sense that some person or force is around you, although you couldn't see anyone?” may be reporting a culturally normative religious experience. “Do you hold beliefs that other people would find unusual or bizarre?” may tap the experience of acculturation in Hispanic individuals rather than “bizarre ideas” as it is intended. Finally, “Do you feel that other people are watching you or talking about you?” may measure experiences of racism rather than paranoia. Follow-up questions in an interview may clarify whether this affirmative answer represents psychosis if the interviewer has the necessary cultural competence, but this is not possible in a self-report format. At the same time, there are well-documented interviewer biases related to common heuristic clinical judgment errors that may perpetuate this overdiagnosis that may be more difficult to evaluate with measurement invariance analyses.

Psychosis-Risk Screening Scales

Two commonly used screening measures include the PQ-B (Loewy et al., 2011) and the Youth Psychosis at Risk Questionnaire–Brief (YPARQ-B; Ord et al., 2004). These measures have been shown to have excellent psychometric properties in majority participants. For example, the scales are strongly correlated with other measures of psychosis risk, including interview-rated attenuated psychosis symptoms (APS; see Kline & Schiffman, 2014, for a review). At the same time, some psychosis-risk screening scales have shown poor psychometric properties in racial and ethnic minorities. For example, the PRIME Screen has been shown to predict interview-rated psychosis risk in White individuals, but not in minority groups (Millman et al., 2019). Data from Hispanic participants is not available, but PRIME Screen scores were not correlated with Structured Interview for Psychosis-risk Syndromes ratings or psychosis risk categories in Black youth. Since the scores were not associated with psychosis risk in Black youth, adjusting to a more liberal cut score to increase identification of those at risk would not increase the accuracy of the measure but would increase misdiagnosis, a risk Hispanic youth may face as well. Similarly, the Psychosis-Screening Questionnaire produces unreliable scores in ethnic minority samples (Heuvelman et al., 2018). These and other screening scales have been shown to lack complete scalar invariance among minority groups (i.e., item responses differ based on group membership rather than latent level of psychosis) in nearly every study that has examined the issue (e.g., Cicero, 2016; Cicero et al., 2019; Fonseca-Pedrero et al., 2018; Li et al., 2020; Ortuño-Sierra et al., 2013). However, to our knowledge, no studies have examined the measurement invariance of the YPARQ and only two studies have

examined the measurement invariance of the PQ-B, both in undergraduate samples (Cicero et al., 2019; Lång et al., 2021). Nevertheless, this pattern holds across different races, ethnicities, countries, and language translations of the scales. The lack of scalar invariance suggests that scores represent different levels of risk for psychosis across groups, which is especially problematic for screening measures because categorical decisions are made based on these scores. Thus, the screening measures may select for different levels of psychosis risk in Hispanic samples compared with non-Hispanic samples. If the lack of scalar invariance holds true across the additional variables measured in this study, it may underscore the importance of refining cut scores to ensure individuals are not falsely identified as experiencing psychosis.

In particular, the PQ-B has been shown to lack complete scalar invariance across Hispanic, Asian, White, and Multiracial participants (Cicero et al., 2019). Mean Total, Distress, and the majority of individual item scores varied across races, suggesting potential racial differences in risk for psychosis. An item-level analysis looking closer at potential differences between White and Hispanic participants showed that five of the 21 items had differential item functioning (DIF) between the two groups. Moreover, 10 of the 21 items displayed DIF in a comparison of native and nonnative English speakers. Similarly, three distress items showed DIF across ethnicity, and 11 of 21 showed DIF between native and nonnative English-speakers. However, this study had a relatively small sample of nonnative English speakers whose native language was mostly Mandarin and Japanese. It is unclear if these findings would replicate to Spanish-speaking populations. The finding that the biases in the scale were associated with the distress scores is especially important for screening because the distress associated with APS may be what separates relatively common APS experiences from those at risk for psychosis and in need of treatment (Fusar-Poli et al., 2014).

These measures were chosen for three primary reasons: (a) They are both available within the public domain; (b) they have high quality Spanish versions (Fonseca-Pedrero et al., 2016, 2017); and (c) they are among the most commonly used Prodromal Questionnaires, with the PQ-B in particular having the most “real world” evidence for its screening utility (Kline & Schiffman, 2014).

Goals for Present Study

The first goal of the current research was to examine the measurement invariance of two commonly used psychosis-risk scales, the PQ-B (including Total and Distress scores) and the YPARQ-B. Since some Hispanic people in screening situations complete the scales in Spanish and others in English, the primary demographic for which to test measurement invariance was three groups: non-Hispanic White participants completing the study in English, Hispanic participants in English, and Hispanic participants in Spanish. The second goal was to examine the measurement invariance of the scales across 10 additional demographic variables hypothesized to contribute to differences in psychosis risk or measurement. The third goal of the present study was to test the hypothesized associations among scale scores and SDOHs. The fourth goal was to further examine measurement equivalence by testing whether the relations between psychosis and SDOHs were equivalent across groups. Finally, the last goal of the current research was to test for differences in psychosis and SDOH scores across groups. These analyses build on the extant literature by

testing for measurement invariance in community rather than exclusively undergraduate samples, combining race/ethnicity and language of administration, examining measurement invariance across the SDOHs purported to drive measurement biases, and testing whether the relations between psychosis-risk scores and SDOHs are consistent across race and ethnicity.

Method

Participants

A total of 1,372 participants consented to take part in the study including 505 recruited through Qualtrics Panels, 714 recruited through Amazon Mechanical Turk, and 153 undergraduates. One hundred eighty-one participants were removed due to failing more than two attention checks ($n = 78$) or finishing the entire study in less than 3 min ($n = 103$). An example attention check item is “I will select “disagree” because I am paying attention.”

This resulted in a total of 1,191 participants. Supplemental Table 1 describes the demographic characteristics for each sample, and Supplemental Figure 1 is a flowchart describing the recruitment of participants. Nearly half (49.4%) reported a history of mental health treatment. Missing data were treated with MPlus default settings, which use all available information to estimate the models (Muthén & Muthén, 1998–2022).

Measures

Demographics

Where possible, demographic questions were taken directly from the National Institutes of Health PhenX Toolkit (Hamilton et al., 2011) to facilitate comparison of results herein with previous research using similar demographic variables. Participants were asked to report their ethnicity, race, educational attainment, occupational prestige, birthplace, native language, and gender with the questions from the 2020 Census and American Community Survey (United States Census Bureau, 2020). Questions about food and housing insecurity were taken from the National Health and Nutrition Examination Survey (Centers for Disease Control and Prevention, 2020).

Psychosis Screening

The PQ-B (Loewy et al., 2011) is a 21-item questionnaire that was abbreviated from the original 92-item Prodromal Questionnaire. In the development of the PQ-B, Loewy et al. retained only the positive items of the PQ because the positive items are critical items for structured-interview “diagnoses” of psychosis risk. They then removed items that were endorsed by a high percentage of undergraduates and selected the items that were the most strongly correlated with Structured Interview for Psychosis-risk Syndromes diagnoses. Finally, they tested the items to see which best predicted Structured Interview for Psychosis-risk Syndromes diagnoses and ended with 21 total items. Participants answer each question either *yes* or *no*. For each affirmative answer, participants are instructed to answer a follow-up question: “When this happens, I feel frightened, concerned, or it causes problems for me” on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*). The scale yields two scores: (a) the total score, the sum of the affirmative answers (i.e., *no* = 0, *yes* = 1), and (b) a distress score, the total number of endorsed positive symptom items weighted by level of distress (i.e., *no* = 0, *yes*:

strongly disagree = 1, *disagree* = 2, *neutral* = 3, *agree* = 4, *strongly agree* = 5). The Spanish version of the scale has been shown to have a unidimensional factor structure and produce reliable and valid scores in Spanish-speaking populations (Fonseca-Pedrero et al., 2016). In the current research, the total scale had an internal consistency of $\alpha = 0.96$ and $\Omega = 0.96$ and the distress score had an internal consistency of $\alpha = 0.97$ and $\Omega = 0.98$. Supplemental Table 2 shows the means, standard deviations, and correlations among all the variables.

The YPARQ-B is a 28-item scale in which participants respond *yes*, *no*, or *unknown*. *Yes* responses are scored as “1” and *no* or *unknown* responses are coded as “0,” resulting in a binary scale. Like the PQ-B, the YPARQ-B measures the positive symptoms of psychosis and has been shown to have a unidimensional structure, be correlated with other psychosis screening measures including the PQ-B, be correlated with the gold-standard interview for psychosis risk, and to be effective in identifying individuals at risk for psychosis (Kline et al., 2012; Ord et al., 2004). The Spanish version of this scale has also been shown to have a unidimensional factor structure and produce reliable and valid scores in Spanish-speaking populations (Fonseca-Pedrero et al., 2017). In the current research, the total scale had an internal consistency of $\alpha = 0.96$ and $\Omega = 0.96$.

Discrimination

The Experience of Discrimination Questionnaire (EOD; Krieger et al., 2005) is a questionnaire in which participants are asked if they have experienced discrimination due to race or ethnicity in a variety of contexts (e.g., school, work, public setting, etc.). For each affirmative answer, participants are asked how many times the experience happened on a scale of *once*, *two or three times*, or *four or more times*. The EOD has been shown to be highly correlated with other measures of discrimination in Hispanic and African American samples (Krieger et al., 2005). In the present study, the EOD had an internal consistency of $\alpha = 0.92$ and $\Omega = 0.92$.

Additional measures of discrimination were the Major Experiences of Discrimination and Everyday Discrimination Scales (MED/EDS; Williams et al., 1997). The MED and EDS are part of the National Institutes of Health Phenx Toolkit and were created to assess different discriminatory experiences across participants' lifetimes in a variety of contexts. Participants are asked if they have been treated fairly in different contexts and are asked the main reason they were discriminated against (i.e., ancestry, gender, race, age, religion, height or weight, skin color, sexual orientation, education, or physical disability) for each affirmative answer. The scale is broken down into major experiences and everyday experiences of discrimination. In the current research, the MED and EDS had internal consistencies of $\alpha = 0.85$ and $\Omega = 0.85$, and $\alpha = 0.92$ and $\Omega = 0.86$, respectively.

Ethnic Identity

Ethnic identity was measured using the Multigroup Ethnic Identity Measure (MEIM; Phinney, 1992). The MEIM is a 12-item, self-report scale designed to measure the strength of ethnic identity and includes constructs of affirmation and belonging, ethnic identity achievement, and ethnic behaviors. Participants answer on a scale of 1 *strongly agree* to 5 *strongly disagree*. Many studies have found support for the two-factor structure of the MEIM including Ethnic Identity Search (i.e., Searching) and Affirmation, Belonging, and Commitment (i.e.,

Affirmation) factors (e.g., Ponterotto et al., 2003). The Searching subscale had an internal consistency of $\alpha = 0.79$ and $\Omega = 0.80$ and the Affirmation subscale had an internal consistency of $\alpha = 0.87$ and $\Omega = 0.87$.

Acculturation

Acculturation was measured with the Vancouver Index of Acculturation (VIA; Ryder et al., 2000). Participants respond to 20 questions on a scale from 1 *disagree* to 9 *agree* about participation, enjoyment, and interest in American/Mainstream Culture and their heritage culture. The VIA has been used to examine acculturation across diverse samples and has been adapted for use in Spanish (e.g., Bozdağ & Bilge, 2021). In this study, the Heritage Culture and Mainstream Culture acculturation subscales both had $\alpha = 0.93$ and $\Omega = 0.93$.

Procedure

Participants in all three samples completed the demographics questionnaire, PQ-B, YPARQ-B, VIA, EOD, MED/EDS, and MEIM as part of an online study taking approximately 45 min. Participants from MTurk and Qualtrics were minimally compensated for their time, with no other incentives provided. Undergraduates participated as a partial completion of a course requirement. All participants and their data were treated in compliance with the protocol approved by the institutional review board and the applicable professional code of ethics. Data and code are available from the corresponding author upon request. This study was not preregistered.

Analytic Plan

Single-Group Analyses

Prior to testing for measurement invariance, we first tested the hypothesized unidimensional structure of each of the three scales. Following previous research, root-mean-square error of approximation (RMSEA) and standardized root-mean-square residual (SRMR) < 0.05 and comparative fit index (CFI) and Tucker–Lewis index (TLI) > 0.95 were considered excellent fit (Hu & Bentler, 1998).

Measurement Invariance of Psychosis-Screening Scales

Primary analyses included measurement invariance analysis of the PQ-B Total, PQ-B Distress, and YPARQ-B scores across demographic and SDoH variables. This included measurement invariance analyses by (1) race, ethnicity, and language (i.e., (a) non-Hispanic White in English, (b) Hispanic in English, and (c) Hispanic in Spanish), (2) language (i.e., English vs. Spanish), (3) race/ethnicity (i.e., non-Hispanic White, Hispanic, and non-Hispanic/non-White), (4) education (high school or less, some college, college, and graduate degree), (5) occupation (professional vs. nonprofessional), (6) family income ($< \$45K$, $\$45K$ – $\$75K$, $> \$75K$), (7) birth country (United States vs. other), (8) generation status (first generation, second generation, third or more generation), (9) native language (English vs. Spanish), (10) sex (male and female), and (11) age (18–30, 31–40, 41+).

Measurement invariance was tested separately for the PQ-B Total, PQ-B Distress, and YPARQ-B scales. For each scale, and each of the 11 demographic variables, a series of measurement invariance models was tested incrementally. A configural invariance model was specified in which the factor loadings and intercepts were

free to vary across groups. If a configural invariance model were to fit the data well, then the scales would all have the same factor structure (i.e., unidimensional) across groups. Second, for the PQ-Distress scale, a metric invariance model was specified in which the factor loadings were constrained to be equal across groups, but the item intercepts were free to vary. If this model were to fit the data as well as the configural model, then it would suggest the strength of the items in indicating psychosis risk is the same across groups. Because the PQ-B and YPARQ-B are binary (i.e., yes/no), the metric invariance model is not appropriate to test for these scales; such a model is not identified (Muthén & Muthén, 1998–2022). For all three scales, a scalar invariance model was specified in which the factor loadings and item intercepts were constrained to be equal across groups. If the scalar invariance model were to fit the data as well as a configural model, it would suggest that scores represent the same latent level of psychosis/psychosis risk across groups and that mean comparisons can be made across groups.

Weighted least squares mean and variance adjusted (WLSMV) estimation was used for the two categorical scales (PQ-B Total and YPARQ) and maximum likelihood with robust standard errors (MLR) was used for the continuous PQ-B Distress scores. Consistent with previous reports (e.g., McDonald, 1989; Meade et al., 2008), models using WLSMV were compared using change in CFI ($\Delta\text{CFI} < .010$) and McDonald's noncentrality index (McD; $\text{Mc} < .020$). The MLR analyses were supplemented with Bayes information criterion (BIC), in which lower values represent better fit (e.g., Kim et al., 2017). Given the well-known limitations of chi-square significance testing in confirmatory factor analyses, the χ^2 difference test is reported but not interpreted as an index of measurement invariance (Cheung & Rensvold, 2002).

After establishing measurement invariance, we regressed each of the SDoH variables onto the latent variable representing the PQ-B Total, PQ-B Distress, and YPARQ-B scores in a single group analysis. We repeated these analyses in a multigroup standard error of the mean (SEM) across the main variable of interest: language/ethnicity (i.e., White non-Hispanic in English, Hispanic in English, and Hispanic in Spanish). In this model, the regression coefficients were free to vary across the three groups and represent the relations between the psychosis scales and SDoHs. Then, we ran the same models with the regression coefficients constrained to be equal across groups. If the constrained models were to fit the data as well as the unconstrained models, we could conclude that the relations among the variables are equivalent across groups. If models did not converge with WLSMV, we used MLR instead. Finally, we tested whether the groups differed in psychosis scores and levels of SDoHs with a one-way analysis of variance and planned follow-up *t* tests, with a Bonferroni correction for multiple comparisons.

Results

Measurement Invariance

Prior to testing the measurement invariance of the PQ-B total scores, YPARQ-B scores, and PQ-B Distress scores, we first verified that a unidimensional model fit the data well for each scale in a single group analysis. As can be seen in Table 1, all three unidimensional models fit the data well according to conventional fit statistics. Second, we tested the measurement invariance of the

PQ-B Total scores, YPARQ scores, and PQ-B Distress Scores. As can be seen in Table 2, the configural and scalar models for the PQ-B fit the data well across all 11 demographic variables that were tested. The scalar model fit the data just as well as the configural model for all 11 analyses according to both the ΔCFI (all $< .010$) and McD (all $< .020$). The PQ-B distress scores displayed a similar pattern of invariance, with the metric and scalar models fitting just as well as the configural models for ΔCFI and the scalar invariance models having the lowest BIC. However, the McD value exceeded 0.020 for four of the 11 analyses, including ethnicity/language, language, education, and income (see Supplemental Table 3). Thus, all three indicators showed invariance for 7 of the 11 analyses, and two of the three indicators showed invariance for the other four. The majority of these analyses indicate measurement invariance, but are somewhat equivocal for these four analyses, suggesting the conclusion of scalar invariance is warranted but should be interpreted with caution for these four demographic factors. Similarly, the YPARQ-B also showed configural and scalar invariance across all 11 analyses (see Supplemental Table 4).¹

Associations With SDoH

We tested the relations among the three psychosis scales and SDoH in a single group analysis. As can be seen in Table 3, PQ-B scores were associated with discrimination on the MED, EDS, and EOD, food and housing insecurity, heritage and mainstream acculturation, and the searching aspects of ethnic identity as measured with the MEIM. Higher psychosis scores were also associated with a history of psychological treatment. The same pattern of findings emerged for the PQ-B Distress scores (Supplemental Table 5) and YPARQ-B scores (Supplemental Table 6).

For the PQ-B Total score, six of the nine models with the paths constrained to be equal across the groups fit as well as the models where the paths were free to vary. The relation between major discrimination and PQ-B scores was stronger in the non-Hispanic White/English group and the Hispanic/English group than the Hispanic/Spanish group. Similarly, the searching factor of ethnic identity was more strongly associated with psychosis in the White-non-Hispanic English group than either Hispanic group and the affirmation score was only associated with psychosis in the Hispanic English group. Six of the nine constrained models fit as well as the free path models for the PQ-B Distress score. Everyday discrimination was more strongly associated with distress in the two groups completing the study in English than the group completing the study in Spanish. Both the searching and affiliation factors of ethnic identity were more strongly associated with PQ-B Distress in the non-Hispanic White group than the other two groups. Finally, the relations between SDoHs and YPARQ-B scores varied across the groups for three models including food insecurity and both subscales of the MEIM. Relations between YPARQ and food insecurity were higher in the English-speaking groups than the Spanish-speaking group. Moreover, the relation between YPARQ-B scores and both subscales of the MEIM scale were strongest in the Hispanic group completing the study in Spanish.

¹ The PQ-B total and YPARQ showed configural and scalar invariance between the Qualtrics and MTurk samples across ΔCFI , *Mc*, and BIC. The PQ-Distress scale showed configural and metric invariance across all three indices and scalar invariance for ΔCFI and BIC, but not *Mc*.

Table 1
Single-Group Unidimensional Model Fit

Psychosis-risk measure	$\chi^2(df)$	RMSEA (90% CI)	CFI	TLI	SRMR
Prodromal Questionnaire Brief Total	592.292 (189)	0.042 (0.038–0.046)	0.993	0.992	0.029
Prodromal Questionnaire Brief Distress	623.187 (189)	0.044 (0.040–0.048)	0.958	0.953	0.027
Youth Psychosis at Risk Questionnaire Brief	563.892 (350)	0.023 (0.019–0.026)	0.994	0.993	0.030

Note. RMSEA = root-mean-square error of approximation; CI = confidence interval; CFI = comparative fit index; TLI = Tucker–Lewis index; SRMR = standardized root-mean-square residual.

Finally, we compared the means of the psychosis scales and measures of SDOHs across groups. As can be seen in Table 4, the Hispanic group completing the study in Spanish had the highest scores on all three psychosis scales, followed by the Hispanic group completing the study in English and the non-Hispanic White group completing the study in English. Both Hispanic groups reported higher levels of discrimination on all three measures of discrimination, and the Hispanic group completing the study in Spanish reported higher levels of everyday experiences of discrimination than the

Hispanic group completing the study in English. Both Hispanic groups reported higher levels of food and housing insecurity than the White group. The White and Hispanic/English groups reported higher levels of mainstream acculturation than the Hispanic/Spanish group, and the Hispanic/English group reported higher levels of heritage acculturation. The White/English group reported lower levels of the searching factor of ethnic identity, while the Hispanic/English group had higher affirmation factor scores than the other two groups. Finally, the groups did not differ in history of mental health treatment.

Table 2
Measurement Invariance of the Prodromal Questionnaire Brief Across Demographic Variables

Invariance	χ^2	RMSEA (90% CI)	CFI	TLI	SRMR	χ^2 diff	Δ CFI	McD
Ethnicity and language: non-Hispanic White in English ($n = 321$), Hispanic in English ($n = 439$) Hispanic in Spanish ($n = 234$)								
Configural	815.119 (567)	0.036 (0.031–0.042)	0.995	0.977	0.041			
Scalar	895.490 (605)	0.038 (0.033–0.043)	0.994	0.994	0.042	116.681 (38)	0.001	0.019
Language: English ($n = 867$), Spanish ($n = 329$)								
Configural	712.290 (378)	0.038 (0.034–0.043)	0.994	0.994	0.033			
Scalar	761.667 (397)	0.039 (0.035–0.043)	0.994	0.994	0.033	73.042 (19)	0.000	0.011
Race/ethnicity: White/non-Hispanic ($n = 391$), Hispanic ($n = 673$), non-White/non-Hispanic ($n = 126$)								
Configural	838.588 (567)	0.038 (0.030–0.040)	0.996	0.995	0.038			
Scalar	898.560 (605)	0.035 (0.030–0.040)	0.995	0.995	0.039	83.372 (38)	0.001	0.008
Education: high school ($n = 336$), some college ($n = 164$), college ($n = 453$), graduate school ($n = 242$)								
Configural	1127.375 (759)	0.041 (0.036–0.045)	0.995	0.995	0.048			
Scalar	1208.346 (813)	0.040 (0.036–0.045)	0.995	0.995	0.490	105.659 (57)	0.000	0.010
Occupation: nonprofessional ($n = 351$), professional ($n = 571$)								
Configural	676.506 (378)	0.041 (0.036–0.046)	0.995	0.995	0.033			
Scalar	705.527 (397)	0.041 (0.036–0.046)	0.995	0.995	0.034	37.422 (19)	0.000	0.004
Family income: less than \$45K ($n = 358$), \$45K–\$75K ($n = 296$), \$75K+ ($n = 412$)								
Configural	864.124 (567)	0.038 (0.033–0.043)	0.996	0.995	0.036			
Scalar	916.382 (605)	0.038 (0.033–0.043)	0.995	0.995	0.037	64.902 (38)	0.001	0.006
Birth country: United States ($n = 903$), other ($n = 264$)								
Configural	713.442 (378)	0.039 (0.035–0.043)	0.994	0.994	0.034			
Scalar	750.880 (397)	0.039 (0.035–0.043)	0.994	0.994	0.035	52.874 (19)	0.000	0.007
Generation: first ($n = 264$), second ($n = 68$), third or more ($n = 834$)								
Configural	817.761 (567)	0.034 (0.028–0.039)	0.995	0.995	0.044			
Scalar	862.991 (605)	0.033 (0.028–0.038)	0.996	0.995	0.044	65.231 (38)	0.000	0.003
Native language: English ($n = 780$), Spanish ($n = 365$)								
Configural	702.505 (378)	0.039 (0.034–0.043)	0.995	0.994	0.032			
Scalar	731.326 (397)	0.038 (0.034–0.043)	0.994	0.994	0.033	35.502 (19)	0.001	0.004
Gender: male ($n = 618$), female ($n = 574$)								
Configural	756.393 (378)	0.041 (0.037–0.045)	0.994	0.993	0.034			
Scalar	782.747 (397)	0.040 (0.036–0.045)	0.994	0.994	0.034	29.540 (19)	0.000	0.003
Age: 18–30 ($n = 588$), 31–40 ($n = 471$), 41+ ($n = 124$)								
Configural	852.531 (567)	0.036 (0.031–0.041)	0.997	0.997	0.036			
Scalar	905.356 (605)	0.035 (0.031–0.040)	0.997	0.997	0.037	71.670 (38)	0.000	0.006
Setting: Qualtrics ($n = 505$), MTurk ($n = 561$), Undergrad ($n = 126$)								
Configural	877.882 (567)	0.037 (0.032–0.042)	0.997	0.996	0.049			
Scalar	949.116 (605)	0.038 (0.033–0.042)	0.996	0.996	0.050	99.415 (38)	0.001	0.012

Note. RMSEA = root-mean-square error of approximation; CI = confidence interval; CFI = comparative fit index; TLI = Tucker–Lewis index; SRMR = standardized root-mean-square residual; McD = McDonald’s noncentrality index.

Table 3*Relations Among the Prodromal Questionnaire Brief and Social Determinants of Health Across Groups*

Social determinants of health	Total	Non-Hispanic White/English	Hispanic/English	Hispanic/Spanish	χ^2 difference of SEM fit (<i>df</i>)
1. Major discrimination	0.47 (0.03) ^{***}	0.51 (0.5) [*]	0.47 (0.04) [*]	0.33 (0.07) [*]	7.471 (2) [*]
2. Everyday discrimination	0.74 (0.02) [*]	0.71 (0.05) [*]	0.76 (0.04) [*]	0.64 (0.06) [*]	2.927 (2)
3. Discrimination	0.58 (0.02) [*]	0.59 (0.04) [*]	0.50 (0.04) [*]	0.57 (0.05) [*]	5.102 (2)
3. Food insecurity	0.56 (0.07) [*]	0.40 (0.07) [*]	0.40 (0.06) [*]	0.20 (0.13)	5.857 (2)
4. Housing insecurity	0.53 (0.07) [*]	0.45 (0.07) [*]	0.30 (0.06) [*]	0.25 (0.13) [*]	4.891 (2)
5. Mainstream acculturation	0.10 (0.03) [*]	0.18 (0.06) [*]	0.03 (0.05)	0.02 (0.07)	4.134 (2)
6. Heritage acculturation	0.11 (0.03) [*]	0.18 (0.06) [*]	0.03 (0.05)	0.02 (0.07)	4.951 (2)
7. Treatment history	0.54 (0.02) [*]	0.66 (0.05) [*]	0.64 (0.05) [*]	0.60 (0.06) [*]	4.607 (2)
8. MEIM_S	0.15 (0.03) [*]	0.34 (0.05) [*]	0.02 (0.05) [*]	-0.04 (0.07)	15.062 (2) ^{***}
9. MEIM_A [†]	-0.02 (0.03)	0.14 (0.05) [*]	0.01 (0.05)	-0.15 (0.07) [*]	9.43 (2) ^{**}

Note. MEIM = multigroup ethnic identity measure; MLR = maximum likelihood with robust standard errors; SEM = standard error of the mean.

[†] MLR estimation. * $p < .05$. ** $p < .01$. *** $p < .001$.

Discussion

Most previous research has examined the measurement invariance of psychosis screening measures across basic demographic variables including gender, race, ethnicity, and age. The present study extends this research by examining the measurement invariance of two commonly used psychosis-risk measures across a variety of other demographic and psychosocial variables. The first goal of the present study was to examine whether the PQ-B Total score, PQ-B Distress, and YPARQ-B are invariant among Spanish-speaking Hispanic participants, English-speaking Hispanic participants, and English-speaking non-Hispanic participants. We found that all three scales were invariant across ethnicity and language of administration. To our knowledge, the present study is the first study to simultaneously examine the measurement invariance of these scales across both ethnicity and language of administration. This is consistent with some previous research that has found the PQ-B Total score and YPARQ-B are invariant with respect to race, ethnicity, and language (Cicero et al., 2019; Karcher et al., 2018). However, the PQ-B Distress scale displayed configural, metric, and scalar invariance in the present study across almost all indicators (with the exception of the McD for four of the 11 analyses). Previous studies have relatively consistently found that the PQ-B Distress scores lack complete scalar invariance across groups (Cicero et al., 2019; Lång et al., 2021). Given that the finding

of scalar invariance was somewhat equivocal for the PQ-B Distress analyses and is inconsistent with previous research, this finding should be interpreted with caution.

A strength of the present study is the comprehensive measurement of demographic variables and SDOHs. There are many different ways to conceptualize ethnic and racial identity, and many different SDOHs have been hypothesized to contribute to either differences in rates of psychosis or bias in its assessment. The expanded measurement in the present study enabled invariance analyses across not just self-reported ethnic and racial identity, but across other important SDOH variables that have been hypothesized to contribute to observed differences in psychopathology across groups. In addition to self-reported racial and ethnic identity, the present study found that the three scales were invariant across race, educational achievement, occupational prestige, income, birth country (i.e., immigrant status), generation status, native language (regardless of the language of administration), sex, and age. The findings that all three scales had configural, metric, and scalar invariance across all of these demographic and psychosocial variables suggests that the scales measure the same thing, and that scores represent the same latent level of psychosis risk across these diverse groups. Thus, the PQ-B total and YPARQ-B can be confidently used in these groups, and the same cutpoints can be used for screening purposes across these groups. The PQ-B Distress findings are less straightforward, but mostly indicate invariance as well.

Table 4*Mean Comparisons of Psychosis and Social Determinants of Health*

Measure	Non-Hispanic White/English	Hispanic/English	Hispanic/Spanish	<i>F</i> (2, 990)
Prodromal Questionnaire–Brief	6.57 (7.05)	7.92 (7.77)	9.21 (7.79)	8.33 ^{***}
Prodromal Questionnaire–Brief Distress	24.66 (29.89)	29.97 (32.21)	30.43 (28.35)	3.49 [*]
Youth Psychosis at Risk Questionnaire	7.13 (8.40)	8.02 (8.09)	9.29 (9.25)	4.31 [*]
Major discrimination	6.42 (2.51)	8.06 (2.31) ^b	7.81 (2.36) ^b	46.53 ^{***}
Everyday discrimination	11.25 (3.04)	12.10 (3.03)	14.18 (3.47)	16.19 ^{***}
Experiences of discrimination	20.19 (8.30)	23.10 (8.09) ^b	22.84 (7.22) ^b	13.42 ^{***}
Food insecurity	2.72 (1.36)	3.22 (1.24) ^b	3.26 (1.10) ^b	9.74 ^{***}
Housing insecurity	2.59 (1.33)	3.11 (1.24) ^b	3.38 (0.98) ^b	14.78 ^{***}
Mainstream acculturation	65.11 (17.98) ^a	66.77 (16.08) ^a	59.74 (18.61)	12.89 ^{***}
Heritage acculturation	62.48 (17.76) ^a	67.24 (16.88)	60.66 (18.61) ^a	12.64 ^{***}
Ethnic identity-searching	16.58 (5.11)	18.77 (4.23) ^b	17.99 (4.34) ^b	21.15 ^{***}
Ethnic identity-affirmation	26.06 (6.14) ^a	28.12 (5.21)	26.26 (6.05) ^a	14.655 ^{***}
History of mental health treatment	45.6%	47.4%	50%	0.975 [†]

Note. Groups that share a superscript letter do not differ significantly from each other.

[†] χ^2 , not significant. * $p < .05$. *** $p < .001$.

As expected, we found that the Hispanic groups had higher levels of psychosis on all three measures than did the non-Hispanic group. Since all three scales displayed configural and scalar invariance, these scores likely represent real differences in rate of psychosis presentation rather than biases in psychosis assessment. At the same time, the Hispanic groups also tended to have higher levels of SDoHs that may contribute to these differences including discrimination, food and housing insecurity, acculturation, and ethnic identity. These results should be interpreted with caution because it is unclear if these scales are also invariant across groups. The theory of SDoH suggests that these factors *cause* poor (mental) health outcomes (Allen et al., 2014). However, this is difficult to establish in empirical work because true experiments with manipulated SDoHs cannot be done for ethical and practical reasons. The present study was a cross-sectional study in which participants were assessed at a single time point and thus results cannot determine whether psychosis causes SDoHs, SDoHs cause psychosis, or a third variable causes both. These correlational findings are consistent with previous longitudinal studies showing that these factors precede the development of psychosis (Wiles et al., 2006). Future research may continue to elucidate the temporal and causal relations among these variables.

Implications for Minority Populations

The measurement invariance findings of the present study do not imply that the scales will necessarily have complete measurement invariance in other groups of people not adequately represented in the present study (e.g., Asian, African American, native speakers of languages other than Spanish and English). However, if there is a lack of measurement invariance in these groups, it is unlikely to be related to the SDoHs measured in the current research such as educational attainment, income, or occupational prestige. In addition to not implying that the PQ-B Total, PQ-B Distress, and YPARQ-B scores are invariant across other demographic variables not measured in the current research, the findings do not suggest that other psychosis scales are necessarily invariant across the demographic variables included in the present study. In fact, the scales in the present study performed better (i.e., more invariant) than other related scales have in previous studies (e.g., Cicero, 2016; Fonseca-Pedrero et al., 2018; Li et al., 2020; Ortuño-Sierra et al., 2013).

The results of the present study are somewhat inconsistent with previous research that has found that the PQ-B Distress score has configural and metric invariance but lacks scalar invariance across groups. However, these results are difficult to compare because both the conceptualization of race/ethnicity and demographic makeup of groups varies considerably from study to study. For example, a study that found a lack of complete scalar invariance for the PQ-B Distress scale included large samples of Asian and Multiracial participants (Cicero et al., 2019). This study found that the lack of invariance could be attributed primarily to the intercepts of three items in the Asian group. In the present study, there were too few Asian and Multiracial participants to form groups in the multigroup measurement invariance analyses. Similarly, other research has found a lack of complete measurement invariance with race defined as two groups including a White and a minority group (Lång et al., 2021). A measurement invariance analysis of an adapted version of the scale, the Prodromal Questionnaire Brief Child version (PQ-BC), with data from the Adolescent Brain and Cognitive Development

study included a similar conceptualization of race/ethnicity (i.e., White, African American, Hispanic, and Other) and also found that the PQ-BC had scalar invariance across race and sex (Karcher et al., 2018).

Strengths and Future Directions

Another strength of the current research is that we examined the equivalence of relations between the scales and SDoHs. Most measurement invariance analyses have focused more narrowly on examining invariance across one or more demographic variables, which potentially limits the implications of the research (Cicero & Ruggero, 2021; Stevanovic et al., 2017). The present study showed that, with a few exceptions, the relations between psychosis and SDoHs were consistent across groups, which is important for research exploring the mechanisms by which SDoHs are related to psychosis. Specifically, research may confidently use the scales in programs of research examining SDoHs and psychosis without the concern that findings are related to biases in the assessment of the constructs.

One unexpected finding in the present study was that perceived discrimination, measured with the MED, EDS, and EOD, was associated with increased levels of psychosis in Non-Hispanic White participants completing the study in English. In fact, these correlations were sometimes stronger in the non-Hispanic White group than the Hispanic groups. At the same time, the Hispanic groups were more likely to attribute the discrimination to ancestry/national origin, race, or skin color, while the White group was more likely to select “other” from the list of reasons for this experience. Future research may examine the measurement invariance of these scales as well as the equivalence of their relations with other variables in their nomological networks.

Like some measures of discrimination, the present study found nonequivalence for the associations among all three psychosis scales and the Searching factor of the Multiethnic Identity Measure (MEIM-S). These relations were stronger in the non-Hispanic White group than the two Hispanic groups. In previous research, the MEIM has been shown to lack measurement invariance (Yap et al., 2014), and this may account for the differences among groups. It is possible that the searching aspect of ethnic identity represents a normal and healthy developmental milestone in ethnic and racial minority groups, but detects the searching or exploration that is related to a lack of clear identity in majority participants. A large body of research suggests that psychotic-spectrum disorders are associated with a lack of a clear identity, a concept sometimes referred to as self-concept clarity and a part of anomalous self-experiences (Cicero et al., 2016).

In addition to the psychometric findings of equivalence, the current research also has implications for our understanding of the relations among psychosis and SDoHs. As mentioned, all three psychosis scale scores were associated with a variety of other SDoH including major and everyday experiences of discrimination, food and housing insecurity, acculturative stress, and strength of ethnic identity. These results are consistent with previous research finding increased rates of psychosis in racial and ethnic minorities (e.g., Schwartz & Blankenship, 2014). Moreover, these results are consistent with previous research finding that psychosis is associated with discrimination (Caplan, 2007; Perreira et al., 2015), food insecurity (Teasdale et al., 2021), housing insecurity (Misra et al., 2022), acculturative stress (Perreira et al., 2015), and

relatively weaker ethnic identity (Anglin et al., 2018). Coupled with the findings of measurement invariance, the present study provides evidence that increased rates of psychosis in Hispanic Americans may be related to actual differences in psychosis related to SDOHs, rather than biases in the assessment of psychosis.

Limitations

One limitation of the current research is that participants were drawn from nonclinical samples. However, nearly half reported a history of mental health treatment by a psychologist, psychiatrist, counselor, or other mental health professional, which suggests the results of the current research may generalize to outpatient clinics, where the YPARQ-B and PQ-B are commonly used. Nevertheless, future research may replicate these results in clinical samples of outpatients in general mental health and early intervention for psychosis clinics and determine whether the scales accurately identify people at risk for psychosis in community samples. Furthermore, a limitation of the present study is that the YPARQ-B was originally developed as a youth measure, though prior studies have used the YPARQ-B in college student samples (Kline et al., 2012; Phalen et al., 2018). Participants were recruited from three different settings including Qualtrics Panels, Amazon Mechanical Turk, and a public university. All reports of demographic variables were self-reported and were not independently verified, and there may be differences in participants recruited from these three settings. Similarly, no measures of overreporting or underreporting were given to participants, and it would likely be beneficial for future research to include measures of symptom validity. Finally, we relied on “one size fits all” recommendations for interpreting model fit. This may be problematic due to the differences in group sizes in the measurement invariance analyses. Analyses that may be problematic due to one group being relatively small include 41+ year olds ($n = 124$) in the age analyses, second generation ($n = 68$) in the generation analyses, non-White/non-Hispanic individuals ($n = 126$), in the race/ethnicity analyses, and undergraduates ($n = 126$) in the setting analyses. These analyses should be interpreted with caution due to small sample sizes for these groups.

Conclusion

In conclusion, the present study found that two commonly used psychosis screening scales, the PQ-B and YPARQ-B showed configural, metric, and scalar invariance across race, ethnicity, and a variety of other demographic factors. Moreover, scale scores were associated with SDOHs such that more difficult circumstances and variables were associated with higher rates of psychosis. Taken together, these results suggest that the disparities in psychosis rates between Hispanic and non-Hispanic participants may be due to differential exposure to SDOHs, rather than biases within the measure of psychosis itself.

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Received June 6, 2022

Revision received November 21, 2022

Accepted November 28, 2022 ■