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Assessment of the Prodromal Questionnaire–Brief Child Version for Measurement of Self-reported Psychoticlike Experiences in Childhood

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IMPORTANCE Childhood psychoticlike experiences (PLEs) are associated with greater odds of a diagnosis of a psychotic disorder during adulthood. However, no known, well-validated self-report tools have been designed to measure childhood PLEs.

OBJECTIVE To examine the construct validity and psychometric properties of a measure of PLEs, the Prodromal Questionnaire–Brief Child Version (PQ-BC).

DESIGN, SETTING, AND PARTICIPANTS This validation study used data from the first wave of the Adolescent Brain and Cognitive Development (ABCD) Study, a prospective longitudinal study aimed at assessing risk factors associated with adverse physical and mental health outcomes from ages 9 to 10 years into late adolescence and early adulthood. The population-based sample of 3984 children within the ABCD data set was recruited from 20 research sites across the United States. Data for this study were collected from June 1, 2016, through August 31, 2017.

MAIN OUTCOMES AND MEASURES The PQ-BC Total and Distress scores were analyzed for measurement invariance across race/ethnicity and sex, their associations with measures of PLEs, and their associations with known correlates of PLEs, including internalizing and externalizing symptoms, neuropsychological test performance, and developmental milestones.

RESULTS The study analyses included 3984 participants (1885 girls [47.3%] and 2099 boys [52.7%]; mean [SE] age, 10.0 [0.01] years). The results demonstrated measurement invariance across race/ethnicity and sex. A family history of psychotic disorder was associated with higher mean (SE) PQ-BC Total (3.883 [0.352]; β = 0.061; 95% CI, 0.027-0.094) and Distress (10.210 [1.043]; β = 0.051; 95% CI, 0.018-0.084) scores, whereas a family history of depression or mania was not. Higher PQ-BC scores were associated with higher rates of child-rated internalizing symptoms (Total score: β range, 0.218 [95% CI, 0.189-0.246] to 0.273 [95% CI, 0.245-0.301]; Distress score: β range, 0.248 [95% CI, 0.220-0.277] to 0.310 [95% CI, 0.281-0.338]), neuropsychological test performance deficits such as working memory (Total score: β = −0.042 [95% CI, −0.077 to −0.008]; Distress score: β = −0.051 [95% CI, −0.086 to −0.017]), and motor and speech developmental milestone delays (Total score: β = 0.057 [95% CI, 0.026-0.086] for motor; β = 0.042 [95% CI, 0.010-0.073] for speech; Distress score: β = 0.048 [95% CI, 0.017-0.079] for motor; β = 0.049 [95% CI, 0.018-0.081] for speech).

CONCLUSIONS AND RELEVANCE These results provide support for the construct validity and demonstrate adequate psychometric properties of a self-report instrument designed to measure childhood PLEs, providing evidence that the PQ-BC may be a useful measure of early risk for psychotic disorders. Furthermore, these data suggest that PLEs at school age are associated with many of the same familial, cognitive, and emotional factors associated with psychotic symptoms in older populations, consistent with the dimensionality of psychosis across the lifespan.

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Supplemental content

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During the past several decades, research on psychotic disorders has increasingly focused on early identification of individuals potentially at risk.[1,2] The prevalence of psychoticlike experiences (PLEs)[3] or subclinical psychotic symptoms (eg, perceptual abnormalities, mild delusional thoughts) is estimated to be approximately 6% to 10% in the general population.[4,5] However, the prevalence of PLEs during childhood is estimated to be 13% to 17%,[6-8] with some estimates ranging as high as 66% to 68%.[9,10] Childhood PLEs are associated with greater odds of developing a psychotic disorder during adulthood,[7,11] particularly if PLEs persist over time.[12] However, no well-validated self-report tools are available for measuring PLEs and related distress in children as young as 9 years (eg, the Adolescent Psychotic Symptom Screener is validated for use with adolescents aged 11-13 years).[13] One self-report tool to identify PLEs, validated in adolescents and adults, is the Prodromal Questionnaire–Brief Version.[14] The present study is the first, to our knowledge, to examine the validity of this questionnaire modified for use in a childhood population.

Research exploring the characteristics of PLEs has indicated that rates can vary within demographic strata, such as race/ethnicity and sex.[15-18] This work often finds higher rates of PLEs in racial/ethnic minorities.[19,20] Consensus regarding sex differences in PLEs is lacking, with some evidence of higher levels of PLEs in males[16] and females,[21] as well as lack of sex differences.[22-24] However, before examining mean level differences in PLEs across various demographic strata, we must determine whether an instrument and its underlying construct behave similarly across groups, a concept termed *measurement invariance*. Without testing the assumption of measurement invariance, whether mean comparisons across groups are valid indications of variation in the construct of interest vs reflections of differential measurement performance across groups is unclear.[25] Research in young adult samples[17] found evidence that Prodromal Questionnaire–Brief Version scores appear to measure similar constructs across race/ethnicity and sex. Thus, one set of aims of the present study consisted of replicating these measurement invariance analyses and clarifying race/ethnicity and sex differences in childhood PLEs.

The present study also examined the construct validity of the Prodromal Questionnaire–Brief Child Version (PQ-BC). First, we examined whether, as expected, PQ-BC scores were positively associated with other measures of PLEs, including family history of psychotic disorder.[26] Next, we examined whether PQ-BC scores were significantly associated with constructs previously linked to childhood and adolescent PLEs, specifically greater internalizing and externalizing symptoms, cognitive impairment, and developmental milestone delays.[6,9,13,26-30] Childhood and adolescent PLEs are associated with a higher risk for internalizing and externalizing symptoms.[9,16,29-32] Additional evidence indicates that impaired cognition predates the development of psychotic disorders[33,34] and is associated with PLEs in childhood and adolescence.[16,35,36] Last, previous research indicates that the development of psychotic disorders is associated with delays in motor and speech developmental milestones[37,38] and movement abnormalities.[6,39]

Key Points

Question Is the Prodromal Questionnaire–Brief Child Version a valid measure of psychoticlike experiences in childhood?

Findings In this validation study of 3984 children aged 9 to 10 years, the instrument demonstrated adequate internal reliability and measurement invariance across race/ethnicity and sex. Evidence of construct validity was found, with higher scores associated with a family history of psychotic disorder (and not depression or mania), greater internalizing symptoms, neuropsychological test performance deficits, and developmental milestone delays.

Meaning The Prodromal Questionnaire–Brief Child Version may be a useful measure of early risk for psychotic disorders and is associated with several familial, cognitive, and emotional factors related to psychotic symptoms in older populations.

The present study is the first, to our knowledge, to examine the validity (ie, measurement invariance and construct validity) of the PQ-BC by using data collected from the Adolescent Brain and Cognitive Development (ABCD) study (https://abcdstudy.org). Our goals were to test whether PQ-BC scores (1) demonstrated measurement invariance across race/ethnicity and sex; (2) demonstrated mean level differences across race/ethnicity or sex; (3) were positively associated with other measures of PLEs, including family history of psychotic disorder and other measures of PLEs; and (4) were associated with higher rates of internalizing and externalizing symptoms, impaired cognition, or delays in motor and speech developmental milestones.

Methods

Participants

A sample of 4524 individuals was obtained from the ABCD study, a large-scale study tracking approximately 10 000 children aged 9 to 10 years recruited from 20 research sites across the United States (a list of sites is given and exclusionary criteria are described in eMethods in the Supplement).[40] These data were accessed from the National Institutes of Mental Health Data Archive from June 1, 2016, through August 31, 2017. The ABCD data repository grows and changes over time; data used in this report came from DOI 10.15154/1412097. We removed 540 participants from the analyses owing to missing data (eTable 1 in the Supplement). The final sample size was 3984 individuals. Institutional review board approval was obtained for each site before data collection. All parents provided written informed consent and all children provided assent.

Measures

Prodromal Questionnaire–Brief Child Version

Participants completed the PQ-BC,[14] a 21-item self-report questionnaire, modified for use with children aged 9 to 10 years based on a series of interviews assessing children's understanding of the items (eMethods and eTable 2 in the Supplement), with a visual response scale included as a Distress scale

Table 1. Fit Statistics for Measurement Invariance Models Across Race/Ethnicity

Model	χ^2 Value (*df*)	CFI[a]	RMSEA (95% CI)[b]	RMSEA *P* Value	Change in CFI[c]	Change in RMSEA[d]
Total Score						
Configural[e]	1297.679 (756)	0.979	0.025 (0.023-0.028)	>.99	NA	NA
Scalar[f,g]	1329.617 (813)	0.980	0.024 (0.021-0.026)	>.99	0.001	−0.001
Strict[h]	1327.455 (876)	0.982	0.021 (0.019-0.024)	>.99	0.002	−0.003
Distress Score						
Configural[e]	1330.999 (756)	0.978	0.026 (0.024-0.028)	>.99	NA	NA
Metric[f]	1251.681 (816)	0.983	0.022 (0.019-0.024)	>.99	0.005	−0.004
Scalar[g]	1395.764 (876)	0.980	0.023 (0.021-0.025)	>.99	−0.003	0.001
Strict[h]	1455.649 (939)	0.980	0.022 (0.020-0.024)	>.99	0.000	−0.001

Abbreviations: CFI, comparative fit index; NA, not applicable; RMSEA, root mean square error of approximation.

[a] Fit indices passing criteria for good fit are 0.950 or greater.

[b] Fit indices passing criteria for good fit are 0.060 or less.

[c] Calculated for each model minus the previous model; negative change indicates a decrement in fit. Change in fit indices passing criteria for good fit are −0.010 or greater.

[d] Calculated for each model minus the previous model; positive change indicates a decrement in fit. Change in fit indices passing criteria for good fit are 0.015 or less.

[e] The configural invariance models included all groups in a single model.

[f] The metric invariance model fixed factor loadings to be equal across groups. This model is not appropriate for dichotomous variables (ie, Total score).

[g] The scalar invariance model fixed factor loadings and item thresholds to be equal across groups.

[h] The strict invariance model fixed factor loadings, item thresholds, and unique/residual item variances to be equal across groups.

(eFigure in the Supplement).[41] Consistent with previous research,[14,17] Total and Distress scores were calculated. The Total score is the sum of endorsed questions (0 indicates no; 1, yes; possible scores range from 0 to 21). The Distress score is the total number of endorsed questions weighted by level of distress (0 indicates no; 1, yes [but no distress]; and 2-6, yes [≥1 on the Distress scale]; possible scores range from 0 to 126).

Internalizing and Externalizing Symptom Measures

The parent and youth versions of the validated and computerized Kiddie-Structured Assessment for Affective Disorders and Schizophrenia (KSADS) for *DSM-5*[42,43] were used as measures of psychopathology.[40] We examined internalizing symptoms using summations of current child- and parent-rated depression and generalized anxiety disorder symptoms, an internalizing symptoms composite (ie, summation of depression and generalized anxiety disorder symptoms), and bipolar symptoms. We examined externalizing symptoms using the child-rated UPPS-P (urgency, premeditation [lack of], perseverance [lack of], sensation seeking, positive urgency) for Children Short Form (UPPS-P-CSF; ABCD version),[44] a child-rated measure approximating externalizing symptoms (eMethods in the Supplement provides details and internal reliabilities).

Other PLE Measures

We measured PLEs[45,46] using (1) a parent-rated child PLE measure created from 4 items from the Child Behavior Checklist (CBCL) (eMethods in the Supplement)[46-49] and (2) a summation of parent-rated KSADS current psychotic symptoms (a child-rated psychosis module was not administered).[42,43] Last, a family history of psychosis, depression, and mania in first-degree relatives was assessed using the parent-rated Family History Assessment Module Screener,[50] with each diagnosis scored as present or absent.

Neuropsychological Test Battery

Participants completed all National Institutes of Health Toolbox Cognitive Battery (NIHTB-CB) tests.[51,52] The NIHTB-CB consists of 7 tests, grouped into 2 composite scores. The fluid composite consists of Flanker Inhibitory Control and Attention, List Sorting Working Memory, Dimensional Change Card Sort, Pattern Comparison Processing Speed, and Picture Sequence Memory. The crystallized composite consists of Picture Vocabulary and Oral Reading Recognition (eMethods in the Supplement and Weintraub et al[51] for descriptions of individual NIHTB-CB tests). The present study used uncorrected NIHTB-CB scores, but all analyses include age and sex as covariates.

Developmental Milestones

The parent assessment battery included questions about motor and speech development.[47,53-55] The motor delays composite was coded as the summation of delays in attaining motor milestones (ie, rolling over, sitting, and standing), parent-rated concern regarding motor development, and parent-rated current child clumsiness. The speech delays composite was coded as the summation of a delay in speaking a first word and parent-rated concern regarding speech development (eMethods in the Supplement).

Statistical Analysis

To examine measurement invariance, stepwise tests of invariance were conducted, first examining potential differences across the 4 racial/ethnic groups and then comparing boys and girls.[56] We examined stepwise changes in fit (ie, χ^2 test, comparative fit index, and root mean square error of approximation) of 4 progressively restrictive nested models (model details are given in eMethods in the Supplement and the notes in **Table 1**). If the stepwise tests indicated invariance across groups, mean comparisons could be meaningfully conducted across

Table 2. PQ-BC Scores by Race/Ethnicity and Sex

Variable	Sample Size, No. of Participants	PQ-BC Score, Mean (SE)	
		Total	Distress
Race/ethnicity			
White	2429	2.384 (0.215)	5.466 (0.553)
African American	364	3.138 (0.278)[a]	7.558 (0.761)[a]
Hispanic	726	2.886 (0.249)[b]	7.179 (0.668)[a]
Other[c]	465	2.623 (0.259)	5.998 (0.700)
Sex			
Male	2099	2.727 (0.214)	6.204 (0.551)
Female	1885	2.400 (0.215)[d]	5.839 (0.556)

Abbreviation: PQ-BC, Prodromal Questionnaire–Brief Child Version.

[a] $P < .01$ for the post hoc mean comparison with white race as the reference group.

[b] $P = .02$ for the post hoc mean comparison with white race as the reference group.

[c] Includes biracial (351 [75.4%]), Chinese (25 [5.3%]), Asian Indian (17 [3.7%]), Filipino (14 [2.9%]), and Native American (11 [2.4%]).

[d] $P < .01$ for the post hoc mean comparison with male as the reference group.

groups.[57] The remainder of the analyses used hierarchical linear models, with all multiple comparisons corrected for the false discovery rate. To account for nonindependence of observations due to familial relatedness, family members were treated as clustered observations, as were the 20 ABCD research sites. All analyses were conducted using the R lme4 package[58] (multcomp package for multiple comparison analyses),[59] with family unit and research site modeled as random intercepts and age, sex, income to needs (calculated as family income divided by the number of individuals in the household), family history of psychosis, and race/ethnicity included as covariates. Hierarchical linear models analyzed the associations between PQ-BC scores and (1) race/ethnicity (white, African American, Hispanic, or other); (2) sex; (3) family history of psychosis, depression, or mania; (4) other PLEs (ie, KSADS psychotic symptom domain and CBCL parent-rated child PLEs); (5) internalizing symptoms (ie, KSADS symptom domains and internalizing composite; comparable results are obtained using the CBCL internalizing measure[47]) and the UPPS-P-CSF child-rated externalizing symptoms (analyses were also conducted using the parent-rated KSADS and CBCL externalizing measures[42,43,47]) (see eMethods in the Supplement); (6) neuropsychological test performance (crystallized or fluid intelligence NIHTB-CB composites, then individual NIHTB-CB tests to examine the independent contributions of each test); and (7) motor and speech developmental milestone delays (as composites then individually to examine the independent contributions of each milestone). Results are expressed as standardized estimates (β statistics) with 95% bootstrapped CIs (5000 iterations). Analyses regarding basic PQ-BC properties are given in eResults in the Supplement.

Results

Measurement Invariance

Analyses for Ethnicity

The study analyses included 3984 participants (1885 girls [47.3%] and 2099 boys [52.7%]; mean [SE] age, 10.0 [0.01] years). Table 1 displays the results of the stepwise invariance tests comparing the race/ethnicity groups for the PQ-BC Total and Distress scores. The configural model showed good fit in terms of comparative fit index (0.979 for PQ-BC Total and 0.978 for PQ-BC Distress) and root mean square error of approximation scores (0.025 [95% CI, 0.023-0.028] for PQ-BC Total and 0.026 [95% CI, 0.024-0.028] for PQ-BC Distress), suggesting that a similar factor structure was present across groups for both PQ-BC scores. The change in fit from the configural to the metric invariance model passed invariance criteria for both PQ-BC scores, suggesting that the associations between PQ-BC scale items and the latent variable were similar across groups. Change in fit from the metric to scalar invariance model also passed invariance criteria for both PQ-BC scores, suggesting similar mean PQ-BC response profiles across groups. Last, change in fit from the scalar to strict model also passed invariance criteria for both PQ-BC scores, suggesting that PQ-BC scores measure the same construct across groups.

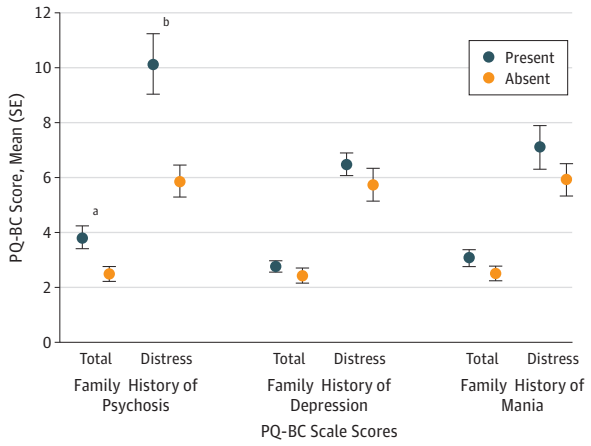
Analyses for Sex

As can be seen in eTable 3 in the Supplement, stepwise tests examining invariance across boys and girls showed good fit in terms of comparative fit index (range, 0.976-0.982) and root mean square error of approximation scores (range, 0.024 [95% CI, 0.022-0.026] to 0.028 [95% CI, 0.026-0.030]) and minimal decrement in fit at all steps. This model passed all criteria to indicate strict invariance (ie, similar loadings, thresholds, and unique/residual variance across boys and girls), suggesting that both PQ-BC scores measure the same construct across sex.

Mean Comparisons

We next examined whether race/ethnicity or sex showed mean level differences on PQ-BC scores (**Table 2**). Compared with the white group, the African American group had higher mean (SE) Total (3.138 [0.278]; β = 0.213; 95% CI, 0.094-0.332) and Distress (7.558 [0.761]; β = 0.201; 95% CI, 0.082-0.318) scores; similar results were found for the Hispanic group Total (2.886 [0.249]; β = 0.142; 95% CI, 0.043-0.241) and Distress (7.179 [0.668]; β = 0.164; 95% CI, 0.064-0.265) scores (additional analyses are given in eResults in the Supplement). Girls had

Figure. Mean Total and Distress Prodromal Questionnaire–Brief Child Version (PQ-BC) Scores for Family History of Psychosis, Depression, and Mania



Error bars reflect SEs. *P* values are corrected for false discovery rate.

[a] $P < .001$.

[b] $P < .01$.

lower PQ-BC Total scores (2.400 [0.215] vs 2.727 [0.214]; β = −0.092; 95% CI, −0.152 to −0.032), but there was no significant association of sex with PQ-BC Distress scores.

Associations With Other PLE Measures

Family history of psychotic disorder was associated with higher PQ-BC mean (SE) Total (3.883 [0.352]; β = 0.061; 95% CI, 0.027-0.094) and Distress (10.210 [1.043]; β = 0.051; 95% CI, 0.018-0.084) scores. Family history of depression was not significantly associated with PQ-BC Total (2.798 [0.121]; β = 0.022; 95% CI, −0.010 to 0.055) or Distress (6.536 [0.360]; β = 0.032 95% CI, −0.001 to 0.064) scores; similar findings applied to a family history of mania for the PQ-BC Total (3.102 [0.248]; β = 0.004; 95% CI, −0.029 to 0.036) and Distress (7.152 [0.735]; β = 0.014; 95% CI, −0.017 to 0.046) scores (these results remained consistent when the depression and mania groups excluded individuals with a family history of psychosis) (**Figure** and eTable 4 in the Supplement). Furthermore, weak but significant associations with greater parent-rated KSADS current psychotic symptoms were observed for PQ-BC Total (β = 0.065; 95% CI, 0.036-0.095) and Distress (β = 0.073; 95% CI, 0.043-0.103) scores. Similar associations were observed with greater CBCL parent-rated child PLEs and PQ-BC Total (β = 0.083; 95% CI, 0.054-0.113) and Distress (β = 0.082; 95% CI, 0.053-0.112) scores.

Associations With Internalizing and Externalizing Symptoms

Higher PQ-BC scores were associated with greater scores on the child-rated KSADS internalizing symptom composite (Total score: β = 0.311 [95% CI, 0.283-0.339]; Distress score: β = 0.353 [95% CI, 0.325-0.381]), and although child-rated UPPS-P-CSF symptoms were associated with PQ-BC scores (β range, 0.031 [95% CI, 0.004-0.059] to 0.151 [95% CI, 0.122-0.179]), the internalizing composite had a significantly greater association with PQ-BC scores than did externalizing symptoms ($z > -6.66$; $P < .001$). No significant difference was found between parent-rated KSADS internalizing symptoms and KSADS and CBCL externalizing measures ($z < 1.43$; $P > .23$). Small but significant associations were found between higher PQ-BC scores and greater scores on each of the child-rated internalizing symptom modules for Total (β range, 0.218 [95% CI, 0.189-0.246] to 0.273 [95% CI, 0.245-0.301]) and Distress (β range, 0.248 [95% CI, 0.220-0.277] to 0.310 [95% CI, 0.281-0.338]) scores as well as with bipolar symptoms (Total score: β = 0.200 [95% CI, 0.171-0.230]; Distress score: β = 0.197 [95% CI, 0.168-0.226]). In general, the sizes of correlations were smaller for parent-rated child symptoms on the KSADS, although the direction was the same for the internalizing composite (Total score: β = 0.077 [95% CI, 0.047-0.106]; Distress score: β = 0.088 [95% CI, 0.058-0.118]), internalizing symptom modules (Total score: β range, 0.047 [95% CI, 0.017-0.077] to 0.068 [95% CI, 0.039-0.097]; Distress score: β range, 0.064 [95% CI, 0.034-0.094] to 0.071 [95% CI, 0.042-0.101]), and bipolar symptoms (Total score: β = 0.046 [95% CI, 0.016-0.076]; Distress score: β = 0.040 [95% CI, 0.010-0.069]).

Neuropsychological Test Performance

As reported in **Table 3**, lower fluid and crystallized intelligence were independently associated with greater PQ-BC scores. Lower performance on List Sorting Working Memory was associated with higher PQ-BC Total (β = −0.042; 95% CI, −0.077 to −0.008) and Distress (β = −0.051; 95% CI, −0.086 to −0.017) scores. Lower performance on the Pattern Comparison Processing Speed and Oral Reading Recognition was also associated with higher Total scores (β = −0.041 [95% CI, −0.074 to −0.008] and β = −0.043 [95% CI, −0.080 to −0.007], respectively) (see eResults in the Supplement). Family history of psychosis continued to be associated with PQ-BC scores, even with the neuropsychological test measures included in the same model (eTable 5 in the Supplement).

Developmental Milestones

As reported in **Table 4**, delays in both motor and speech developmental milestones were associated with higher PQ-BC Total (β = 0.057 [95% CI, 0.026-0.086] for motor; β = 0.042 [95% CI, 0.010-0.073] for speech) and Distress (β = 0.048 [95% CI, 0.017-0.079] for motor; β = 0.049 [95% CI, 0.018-0.081] for speech) scores. Higher ratings of current child clumsiness were also significantly associated with greater PQ-BC scores (Total score: β = 0.055 [95% CI, 0.026-0.084]; Distress score: β = 0.055 [95% CI, 0.025-0.085]). However, clumsiness was additionally associated with higher child-rated KSADS depression scores, although not child-rated KSADS generalized anxiety disorder scores. Again, family history of psychosis continued to be associated with PQ-BC scores, even with the developmental delays in the same model (eTable 6 in the Supplement).

Discussion

The reliable and valid assessment of PLEs is critical for the screening and early detection of children at risk for psychotic

Table 3. Model Estimates for Neuropsychological Test Performance

Test	PQ-BC Total Scores				PQ-BC Distress Scores			
	Standardized Regression Coefficient, β (95% CI)	2-Tailed *t* Statistic	*P* Value	FDR *P* Value[a]	Standardized Regression Coefficient, β (95% CI)	2-Tailed *t* Statistic	*P* Value	FDR *P* Value[a]
NIHTB-CB composite scores								
Fluid	−0.056 (−0.090 to −0.023)	−3.221	.001	.001	−0.071 (−0.105 to −0.036)	−4.038	<.001	<.001
Crystallized	−0.061 (−0.098 to −0.024)	−3.307	.001	.001	−0.063 (−0.101 to −0.027)	−3.379	.001	.001
Individual NIHTB-CB tests								
Flanker Inhibitory Control and Attention	0.024 (−0.010 to 0.059)	1.398	.16	.23	0.011 (−0.023 to 0.045)	0.622	.53	.53
List Sorting Working Memory	−0.042 (−0.077 to −0.008)	−2.419	.02	.049	−0.051 (−0.086 to −0.017)	−2.907	.004	.03
Dimensional Change Card Sort	−0.015 (−0.050 to 0.020)	−0.811	.42	.49	−0.018 (−0.055 to 0.018)	−1.003	.32	.44
Pattern Comparison Processing Speed	−0.041 (−0.074 to −0.008)	−2.353	.02	.049	−0.037 (−0.071 to −0.003)	−2.129	.03	.12
Picture Sequence Memory	−0.008 (−0.041 to 0.024)	−0.516	.61	.61	−0.011 (−0.043 to 0.021)	−0.684	.49	.53
Picture Vocabulary	−0.028 (−0.066 to 0.011)	−1.414	.16	.23	−0.034 (−0.072 to 0.005)	−1.726	.08	.15
Oral Reading Recognition	−0.043 (−0.080 to −0.007)	−2.302	.02	.049	−0.036 (−0.074 to 0.001)	−1.922	.055	.13

Abbreviations: FDR, false discovery rate; NIHTB-CB, National Institutes of Health Toolbox Cognitive Battery; PQ-BC, Prodromal Questionnaire–Brief Child Version.

[a] Indicates corrected for multiple comparisons.

Table 4. Model Estimates for Motor and Speech Developmental Milestones

Milestone	PQ-BC Total Scores				PQ-BC Distress Scores			
	Standardized Regression Coefficient, β (95% CI)	2-Tailed *t* Statistic	*P* Value	FDR *P* Value[a]	Standardized Regression Coefficient, β (95% CI)	2-Tailed *t* Statistic	*P* Value	FDR *P* Value[a]
Composite								
Motor delays	0.057 (0.026 to 0.086)	3.627	<.001	<.001	0.048 (0.017 to 0.079)	3.064	.002	.002
Speech delays	0.042 (0.010 to 0.073)	2.625	.009	.009	0.049 (0.018 to 0.081)	3.097	.002	.002
Individual								
Motor delays								
Roll over	0.010 (−0.023 to 0.042)	0.582	.56	.71	0.020 (−0.013 to 0.052)	1.196	.23	.50
Sit	−0.009 (−0.043 to 0.025)	−0.510	.61	.71	−0.014 (−0.047 to 0.020)	−0.797	.43	.50
Walk	0.004 (−0.028 to 0.036)	0.261	.79	.79	−0.003 (−0.036 to 0.029)	−0.202	.84	.84
Subjective	0.023 (−0.012 to 0.059)	1.291	.20	.46	0.017 (−0.018 to 0.053)	0.941	.35	.50
Clumsiness	0.055 (0.026 to 0.084)	3.638	<.001	<.001	0.055 (0.025 to 0.085)	3.582	<.001	<.001
Speech delays								
Speak first word	0.031 (−0.002 to 0.065)	1.799	.07	.25	0.037 (0.003 to 0.071)	2.130	.03	.12
Subjective	0.015 (−0.019 to 0.048)	0.866	.39	.68	0.015 (−0.020 to 0.049)	0.825	.41	.50

Abbreviations: FDR, false discovery rate; PQ-BC, Prodromal Questionnaire–Brief Child Version.

[a] Indicates corrected for multiple comparisons.

disorders. The present study provides the first evidence, to our knowledge, of the validity of a self-report measure of PLEs in children. Results indicate that the PQ-BC shows adequate psychometric properties in terms of internal reliability, measurement invariance, and hypothesized associations with other measures of PLEs, internalizing symptoms, neuropsychological test performance, and developmental milestones.

One major finding of the present study is evidence of measurement invariance across race/ethnicity and sex, comparable to previous research using the Prodromal Questionnaire-Brief Version in a young adult population.[17] In follow-up analyses, African American and Hispanic participants had higher PQ-BC scores than did white participants. This finding is in line with extant research showing elevated rates of PLEs in nonwhite participants,[15,16] perhaps indicating that factors related to greater PLEs in nonwhite participants in adulthood (ie, discrimination, lower income to needs) (eResults in the Supplement)[19,20,60] may already be exerting an influence on PLEs in childhood.

Although the present study showed that the PQ-BC was associated with other PLE measures, the associations varied in strength. The current results replicate previous research showing that a history of psychotic disorder in first-degree relatives is associated with greater PLEs.[26] Of importance, this finding was specific to family history of psychosis and not family history of depression or mania. The weaker associations found between the PQ-BC and other PLE measures may be the consequence of using relatively limited measures of PLEs (ie, the CBCL has 4 questions, and the KSADS detects more severe psychotic symptoms), perhaps reducing the variability of re-

ported experiences. However, these weak associations are consistent with previous research examining parent-rated PLEs,[39] indicating potential differences between children and parents in the interpretation of PLEs or a lack of reporting these experiences to parents.

This study also replicated the associations between PLEs and internalizing symptoms,[16,27,28,31,32,37] supporting evidence that affective dysregulation occurs across the psychosis risk continuum.[61] Although externalizing symptoms were associated with PLEs,[29,31] associations between child-rated internalizing symptoms and PLEs were significantly stronger. Stronger associations between PQ-BC scores and internalizing symptoms may indicate some overlap between these constructs, consistent with research indicating the experience of PLEs as concerning and worrying.[3,62] Furthermore, conceptual similarity exists between internalizing symptoms and negative symptoms (ie, social withdrawal, affective flattening, and avolition), which are associated with psychosis risk.[63]

Despite the wealth of research indicating that cognitive deficits exist before the onset of psychosis (including in childhood),[11,37,64-66] research regarding the impaired cognitive domains associated with childhood PLEs is relatively scarce.[16,36] The present study found that PQ-BC scores were associated with deficits in fluid and crystalized IQ, but with greater evidence that impairments in some domains (eg, working memory) were associated with higher PQ-BC scores. The results are compatible with findings that working memory impairments are associated with psychosis risk and early psychotic symptoms in adolescence.[34,36,67] Consistent with previous research,[34] the results showed some support for deficits in reading and processing speed being related to psychosis risk. Furthermore, processing speed deficits in childhood are associated with psychotic experiences in adolescence,[66] and research indicates that processing speed deficits are a central deficit of psychosis risk.[36]

Last, this study also replicated the associations between PLEs and delays in developmental milestones. Of importance, the results suggest that clumsiness is associated with greater PQ-BC scores, consistent with previous research on associations between motor coordination and skills with schizophrenia spectrum disorders.[37,68] However, motor clumsiness was not specifically associated with psychosis risk and was associated with greater depressive symptoms, which may be reflective of construct overlap between negative symptoms and depression or nonspecific risk for later psychopathology conferred by early motor abnormalities.[63]

Limitations

Our results must be interpreted with consideration of limitations. First, although associations with other self-reports were in the small to moderate range, associations with behavioral measures tended to be small (β≤0.100), even if in line with the extant literature.[16,26,32,37] The generally small effects are expected, given that the sample was a non–help-seeking population without schizophrenia spectrum disorder diagnoses and was assessed years before the highest period of psychosis risk. Another limitation of the present study is that measures of PLEs other than the PQ-BC were obtained via parent report, which potentially limited the strength of associations between child-rated PQ-BC and other parent-rated measures. Furthermore, the choice to read questions to participants to ensure comprehension may have influenced disclosure willingness for some individuals. In addition, future research should examine trauma and its association with the PQ-BC when child-related trauma information is available in this sample (currently being collected as part of year 1 follow-up assessments),[69,70] develop cutoffs for specific clinical settings, and continue to compare the PQ-BC with additional developmentally appropriate PLE measures.

Conclusions

In addition to finding the first evidence, to our knowledge, of the potential validity of a self-report measure of PLEs in children, the current study also advances our understanding of PLEs in childhood, including the associations between self-reported PLEs and correlates of psychosis risk (eg, internalizing symptoms, cognitive deficits [eg, working memory], and developmental delays in motor coordination). Despite the study limitations, the present results demonstrate that PLEs in childhood may be associated with many of the same factors associated with psychotic symptoms in adolescence and adulthood. Psychoticlike experiences are associated with a specific array of deficits across domains, including impairments in internalizing symptoms,[37] cognitive deficits (eg, working memory),[35] and motor function.[35,37] Thus, higher scores on the PQ-BC may indicate risk for psychotic disorders[7] or may indicate placement on a nonclinical traitlike PLE continuum,[71] either of which has important clinical implications. These results also suggest that the PQ-BC may be valid assessment of childhood PLEs, and therefore follow-up studies, including longitudinal follow-up of these children, should explore how the combination of factors examined in the present study may be useful in predicting outcomes in at-risk children.

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Concept and design: Karcher, Barch, Avenevoli, Leckliter, Loewy.
Acquisition, analysis, or interpretation of data: Karcher, Barch, Savill, Huber, Simon, Sher, Loewy.
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