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Racial/Ethnic Disparities in Longitudinal Emotional-Behavioral Functioning Among Youth Born to Women Living with HIV

Jemar R. Bather, MS¹, Paige L. Williams, PhD¹, Carly Broadwell, MS¹, Renee Smith, PhD², Kunjal Patel, DSc¹, Patricia A. Garvie, PhD³, Brad Karalius, MPH¹, Deborah Kacanek, ScD¹, Claude A. Mellins, PhD⁴, Kathleen Malee, PhD⁵ for the Pediatric HIV/AIDS Cohort Study (PHACS)

¹Harvard T.H. Chan School of Public Health, Boston, MA

²University of Illinois at Chicago, Chicago, IL

³Children's Diagnostic & Treatment Center, Fort Lauderdale, FL

⁴Columbia University Medical Center, New York, NY

⁵Northwestern University Feinberg School of Medicine, Chicago, IL

Abstract

Background: Youth with perinatal HIV exposure have demonstrated high rates of emotional-behavioral problems. Few studies have longitudinally examined racial/ethnic disparities in such functioning across adolescence, a critical time for targeting prevention/intervention efforts.

Setting: The PHACS Adolescent Master Protocol, one of the largest US-based cohort studies of youth with perinatal HIV infection (YPHIV) or HIV-exposed but uninfected (YPHEU).

Methods: Youth and caregivers individually completed the Behavior Assessment System for Children, 2nd edition every two years between ages 7–19. We used adjusted mixed effect models to evaluate whether mean youth-reported emotional concerns and caregiver-reported behavioral concerns differed by race/ethnicity. We used Group-based trajectory models (GBTMs) to identify groups having similar emotional-behavioral trajectories, followed by multinomial models to determine which factors predicted group membership.

Results: 391 YPHIV and 209 YPHEU (7% White non-Hispanic, 21% White Hispanic, 66% Black non-Hispanic, 6% Black Hispanic) completed a median of 4 assessments over follow-up. Adjusted models showed more caregiver-reported behavioral concerns for Black non-Hispanic YPHEU than Black non-Hispanic YPHIV, White Hispanic YPHIV, and White Hispanic YPHEU, particularly later in adolescence. Race/ethnicity did not predict membership in subgroups of youth-reported emotional or caregiver-reported behavioral functioning identified using GBTMs. However, factors predicting membership in vulnerable youth-reported emotional and caregiver-reported behavioral groups included experiencing a stressful life event and living with a caregiver who was married or screened positive for a psychiatric condition.

Corresponding Author: Jemar Bather, Department of Biostatistics, Harvard T.H. Chan School of Public Health, 655 Huntington Avenue, Boston, MA 02115; Phone: 617-432-3872; Fax: (617) 432-5619; jemar.bather@g.harvard.edu.

Conflicts of Interest: None reported.

Conclusion: Our study revealed that Black non-Hispanic YPHEU are a vulnerable subgroup. Contributing factors that could inform interventions include the caregiver's health, household characteristics, and psychiatric status.

Keywords

perinatal HIV; neurodevelopment; emotional-behavioral functioning; racial disparities; group-based trajectory model

Introduction

Youth born to women with HIV have demonstrated greater emotional-behavioral problems than the general US youth population.¹ Gadow et al. and others found that youth living with perinatal HIV infection (YPHIV) and youth perinatally HIV-exposed but uninfected (YPHEU) had higher rates of psychiatric disorders than the general population.¹⁻⁹ However, the role of PHIV has been mixed. Some studies observed higher risk of emotional-behavioral problems among YPHEU than YPHIV;^{4,7} others showed higher rates of psychiatric disorders in YPHIV than YPHEU;^{3,8} yet others found similar rates of psychiatric disorders among both groups.^{2,9} Regardless of mental health prevalence, several studies reported that YPHIV were more likely to receive psychotropic or non-pharmacological mental health treatment than YPHEU, likely because of closer monitoring within routine PHIV-related medical care.¹⁰⁻¹²

Social determinants of health (SDOH) may be associated with emotional-behavioral functioning among YPHIV and YPHEU. SDOH is defined as “conditions in the environments in which people are born, live, learn, work, play, worship, and age that affect health, functioning, and quality-of-life outcomes and risks.”¹³ Additionally, studies of YPHIV and YPHEU indicate that caregiver characteristics play a significant role in children's emotions and behavior. These characteristics include the caregiver relationship (i.e., biological mother or other), the caregiver's health (i.e., HIV status and psychiatric conditions), and life stressors within the family or household.^{3,4,6,11} Importantly, since youth in this population often live in low-income neighborhoods, with increased risk for stressful events in childhood and adolescence, SDOH may exacerbate emotional-behavioral challenges.^{3,14}

Additionally, underrepresented individuals from low-income neighborhoods may experience race-based discrimination.¹⁵⁻¹⁷ A meta-analysis by Williams and colleagues highlighted that race-based discrimination predicts adverse mental and physical outcomes. Specifically, marginalized racial groups experience elevated disease and mortality rates, race-based differences persist in health even after adjustment for socioeconomic status, and the general health of Hispanics is declining over time.¹⁵

In the US, YPHIV and YPHEU are now reaching adulthood, allowing examination of their emotional-behavioral functioning over time. To provide targeted interventions, it is crucial to understand how the lived experience of those in minority racial and ethnic groups contribute to the emotional-behavioral health of youth affected by HIV throughout adolescence.^{1,3-6,18-20} While a limited number of studies have evaluated behavior longitudinally in

YPHIV, none have specifically addressed racial/ethnic disparities in emotional-behavioral functioning.²¹

We used data from one of the largest prospective cohort studies of YPHIV and YPHEU in the US, providing a unique opportunity to examine racial/ethnic differences in emotional-behavioral trajectories from mid-childhood through late adolescence, spanning critical, dynamic periods of development. The availability of youth self- and caregiver reports about youth emotions and behavior provide unique perspectives on youth's psychological adjustment.²² We evaluated the impact of membership in particular racial/ethnic groups on trends in emotional-behavioral functioning during adolescence, identifying potentially vulnerable subgroups of youth with poorer functioning.

Methods

Study Population

The Pediatric HIV/AIDS Cohort Study (PHACS) (<https://phacsstudy.org>) Adolescent Master Protocol (AMP) was designed to evaluate the impact of perinatally acquired HIV and antiretroviral therapy on YPHIV. From March 2007 to October 2009, AMP enrolled 678 children and youth with perinatal HIV exposure (YPHIV and YPHEU) at fifteen sites in the US, including Puerto Rico. Eligibility criteria included perinatal HIV infection or exposure, age 7–16 at enrollment, engaged in care, and recorded antiretroviral history. AMP study visits occurred every six months until 2010, then annually thereafter. Data collection included physical examination, medical chart review, structured demographic and psychosocial interviews, and neurodevelopmental evaluations. Trained psychologists evaluated youth and caregiver mental health and psychosocial well-being through a biopsychosocial assessment protocol. Institutional Review Boards at participating sites and the Harvard T.H. Chan School of Public Health approved the study. Written informed consent and age-appropriate assent were obtained according to institutional guidelines. Given the epidemiology of HIV in women and children, analyses focused on youth with race reported as either Black/African American or White, ethnicity as either Hispanic or non-Hispanic, and at least one obtained emotional-behavioral assessment between the ages of 7 and 19 years.

Emotional-behavioral functioning

A standard in child and adolescent psychology and psychiatry, we utilized a multi-informant approach—youth and caregiver reports—to capture unique perspectives on youth psychological adjustment.²² Youth are likely to report more accurately on their internalizing states (i.e., depression and anxiety) while caregivers are considered more reliable reporters of youth externalizing behaviors.²³ In contrast, caregivers are considered more reliable reporters of youth's externalizing behaviors.²³ PHACS psychologists administered the Behavior Assessment System for Children-Second Edition (BASC-2) every two years through independent interviews with youth and caregivers at the same visit.²⁴ A standardized, validated and reliable multidimensional questionnaire, the BASC-2 contains two summary measures of interest. The Emotional Symptoms Index (ESI), a youth-reported summary measure, reflects emotional functioning by measuring social stress, anxiety,

depression, sense of inadequacy, self-esteem, and self-reliance domains. The Behavioral Symptoms Index (BSI), a caregiver-reported summary measure, reflects caregiver perceptions of the youth's behavior, including hyperactivity, aggression, depression, attention problems, atypicality, and withdrawal. Higher ESI and BSI scores indicate poorer emotional-behavioral functioning. T-score classifications are: <60 "Average Range," 60–69 "At-Risk," and >69 "Clinically Significant."²⁴ ESI or BSI assessments >85 were excluded as outliers.

Race/Ethnicity

Although race-based discrimination is not currently assessed, self-reported race was used as a proxy, allowing this analysis to inform future PHACS analyses on race-based discrimination. Caregivers reported their child's race as Black/African American, White, Asian, American Indian, Multiracial, or Unknown. The following racial groups were excluded due to small subsets: American Indian (0.4%), Asian (0.9%), Multiracial (1.9%), and Unknown/not reported (4.3%). Caregivers also reported their child's ethnicity (Hispanic/non-Hispanic). Four racial/ethnic subgroups were evaluated: White non-Hispanic, White Hispanic, Black non-Hispanic, and Black Hispanic.

Covariates and Potential Confounders

Demographic data were obtained through independently administered youth and caregiver interviews. Youth information included age at each study visit, biological sex, socioeconomic status (household income, caregiver education, and household density reported at study entry), and family structure (whether the biological mother was born in the US, whether the caregiver is the youth's biological mother, change in primary caregiver during study follow-up, caregiver's marital status, and geographic region of the enrollment site). Number of stressful life events experienced by the youth as measured by the Quality of Life Assessment²⁵ at baseline also was included (i.e., caregiver lost job, death of a family member, caregiver went to jail). Caregiver information included HIV status and positive screen from the initial Client Diagnostic Questionnaire (CDQ) for any psychiatric disorder including: depression, panic attacks, Generalized Anxiety Disorder (GAD), alcohol abuse, substance abuse, trauma, or any psychiatric condition, obtained from the earliest assessment.^{26,27} Of the 600 caregivers in the sample, 219 (37%) were biological mothers. These SDOH were considered as potential confounders. Less than 5% of youth were missing SDOH information except for family structure variables (16%) and caregiver health variables (14%, not evaluated); missing indicators were used for these measures.

Statistical Methods

To summarize emotional-behavioral functioning, two longitudinal approaches were implemented: a traditional mixed effects model, and a novel group-based trajectory model (GBTM). These two complimentary approaches allow a robust investigation of potential race-based disparities in emotional-behavioral functioning over time.

Mixed Effects Models

We fit mixed effects models to evaluate whether mean ESI and BSI T-scores differed across the 4 racial/ethnic groups as youth transitioned through adolescence. To allow a potential non-linear relationship of T-scores with age, we included squared terms for age. We also evaluated possible effect modification of racial/ethnic associations by HIV status using stratified analyses. Models included a random effect for each youth to account for correlation in repeated assessments. An exponential spatial correlation structure with a nugget effect,^{28–30} was utilized.

Initial ESI and BSI models were fit adjusting for youth age (centered at mean age at first assessment = 11.6 years), HIV status, and sex. We included interactions of racial/ethnic group with age, age², and HIV status. Final models additionally included any SDOH that changed any of the racial/ethnic group estimates by >10%. Mixed effects model results were used to generate predicted trajectories for mean emotional-behavioral functioning by racial/ethnic group and HIV status. Contrasts of least-square means were used to test pairwise differences in emotional-behavioral functioning across the four racial/ethnic groups at each age.

Group-Based Trajectory Models

GBTMs were fit to identify groups of youth following similar emotional-behavioral trajectories between ages 7 to 19 years. This approach uses multinomial density functions rather than continuous multivariate density functions to model variation in developmental trajectory parameters.³¹ The maximized function is a product of the probability of belonging to a specific group, and the conditional probability of the outcome as a function of age given group membership. The model selection process consisted of two iterative steps. First, we held the quadratic form constant and used the Bayesian information criterion (BIC) to identify the optimal number of groups.³² Then, keeping this number constant, we used the BIC to determine the optimal polynomial function of the model. This process yielded a predicted probability of belonging to each group for each youth, and assigned each youth to the group with maximum probability. Finally, we modeled the groups as dependent variables in a multinomial logistic regression model to determine which of the covariates described previously, including race and ethnicity, predicted group membership. GBTM results were summarized through plots of predicted trajectories with 95% confidence intervals (CIs). We summarized baseline characteristics by group membership. Statistical analyses were conducted using Stata (version 16, StataCorp LLC., College Station, TX) and R (R Core Team, 2019).

Results

Study Population

The AMP study enrolled 678 youth between 2007 and 2009, including 451 YPHIV and 227 YPHEU. Among these, 600 (88%) were included in the analysis of BSI scores and 588 (87%) in the analysis of ESI scores. Within the BSI sample, about half were male (49%), and the average age at first behavioral assessment was 11.6 years (Table 1). Overall, 72% identified as Black and 27% as Hispanic. Table 1 shows baseline characteristics of the four

racial/ethnic groups. Baseline youth characteristics of the ESI sample (n=588) were similar (Supp. Table 1), and characteristics of those included in each sample were similar to the AMP study as a whole (Supp. Table 2).³³ As of June 2019, AMP participants had up to eight youth and caregiver emotional-behavioral assessments (median = 4, IQR = 3–5), allowing for characterization of longitudinal trajectories. The median number of repeated measurements (4) was the same across racial/ethnic groups.

Differences in Emotional-Behavioral Functioning: Mixed Effect Model Results

The final adjusted mixed effects model for ESI (child-reported emotional functioning) controlled for youth HIV status, sex, age, site location, and caregiver psychiatric condition (Supp. Table 3). Predicted trajectories for mean emotional functioning for each cross-classification of racial/ethnic group and HIV status are shown in Figure 1 (upper panel). A Likelihood Ratio Test showed no overall racial/ethnic differences across age in ESI T-scores; pairwise contrast tests of least-square means showed no difference in ESI T-scores between racial/ethnic groups at each age. The final model for BSI (caregiver-reported behavioral functioning) controlled for youth HIV status, sex, age, household density, stressful life event, having a caregiver living with HIV, and any caregiver psychiatric condition. In contrast to the ESI model, there was greater evidence of overall racial/ethnic differences in BSI T-scores. Pairwise contrasts tests showed that Black non-Hispanic YPHEU had significantly more caregiver-reported behavioral concerns than three other groups at specific ages. Specifically, their mean scores were approximately five points higher (0.5 SD) than Black non-Hispanic YPHIV from age 7 to 19, five points higher than White Hispanic YPHIV from age 13 to 17, and five points higher than White Hispanic YPHEU from age 15 and 17 (Figure 1, lower panel).

Differences in Emotional-Behavioral Functioning: GBTM Results

Application of the GBTM approach for the ESI sample resulted in four groups, each with a quadratic trajectory (Supp. Table 4). We denoted Group 1 (43.8% of the population) as the ‘Best’ functioning group, having the lowest mean ESI T-scores at every age (Figure 2a). Group 2 (21.8%) was denoted as the ‘Average’ functioning group because ESI T-scores were higher than the ‘Best’ group, but within the Average range according to BASC-2 classifications. Group 3 (27.8%) was denoted as the ‘Improving’ group because their ESI T-scores showed a decreasing trend, reflecting fewer self-reported emotional concerns through adolescence. Group 4 (6.7%) was denoted as the ‘At-Risk’ group due to consistent mean ESI T-scores in the At-Risk range from ages 7 to 18. Both ‘Best’ and ‘Average’ groups, representing nearly 66% of the AMP population, had mean ESI T-scores within the Average range during follow-up. However, 63.9% of ‘Average’ youth had at least one ESI score in the At-Risk or Clinically Significant range during follow-up, as compared to only 4.7% of ‘Best’ youth.

The distribution of racial/ethnic groups was relatively similar across the emotional functioning groups (Supp. Table 5). Based on multinomial logistic regression models, we found no association of racial/ethnic group or HIV status with membership in any emotional functioning group compared to the ‘Best’ group. However, males were less likely than females to be in the ‘Average’ group than the ‘Best’ group (RR 0.52; 95% CI 0.34, 0.81).

After adjusting for SDOH, the lack of racial/ethnic differences remained, but youth who experienced a change in primary caregiver were nearly three times more likely to be in the 'At-Risk' group than the 'Best' group than those without a change (RR 2.85; 95% CI 1.08, 7.51) (Table 3). Youth with a married caregiver were more likely to be in the 'Improving' group than the 'Best' group (RR 1.60; 95% CI 1.05, 2.43). Youth who experienced a stressful life event vs. no stressful life event were three times more likely (RR 3.23; 95% CI 1.20, 8.68) to be in the 'Average' group than the 'Best' group. Lastly, youth whose caregiver screened positive for a psychiatric condition vs. not were more likely (RR 1.69; 95% CI 1.07, 2.68) to be in the 'Improving' group than the 'Best' group. When comparing each group to the 'At-Risk' group, no associations with racial/ethnic group or HIV status were observed.

The GBTM for the BSI sample resulted in five groups, again, each with a quadratic trajectory (Supp. Table 6). Similar to the ESI sample, we denoted Group 1 (40.3% of the population) as 'Best' (Figure 2b), Group 2 (38.2%) as 'Average', Group 3 (11.2%) as 'Improving', Group 4 (6.4%) as 'At-Risk', and Group 5 (3.9%) as 'Problematic'. Both 'Best' and 'Average' groups, representing nearly 80% of the AMP population, had mean T-scores that were within the Average range during adolescence. However, 41.6% of 'Average' youth had at least one BSI score in the At-Risk or Clinically Significant range during follow-up, as compared to only 1.7% of 'Best' youth. The distribution of racial/ethnic groups across the behavioral functioning groups are shown in Table 2.

Based on multinomial logistic regression models, we found no association between the racial/ethnic group and membership in any behavioral group relative to the 'Best' group. However, YPHIV were less likely than YPHEU (RR 0.47; 95% CI 0.26, 0.85) to be in the 'Improving' group than the 'Best' group. After adjusting for SDOH, these findings remained consistent (Table 3). Youth whose caregivers were married were four times more likely to be in the 'Problematic' group than the 'Best' group (RR. 4.34; 95% CI 1.72, 10.93). Youth who experienced a stressful life event were more likely to be in the 'Average' (RR 1.90; 95% CI 1.03, 3.50) and 'Improving' (RR 4.86; 95% CI 1.12, 21.06) groups than the 'Best' group. Lastly, youth whose caregiver screened positive for a psychiatric condition were at least twice more likely to be in each of the four other groups than the 'Best' group. We observed no racial/ethnic or HIV status associations when comparing any other group to the 'Problematic' group.

Discussion

We used two methods to assess the relationship between membership in racial/ethnic group and emotional-behavioral functioning among youth with perinatal HIV exposure. Using a mixed effects model approach that compared mean scores over time, caregivers of Black non-Hispanic YPHEU reported more behavioral concerns than caregivers of Black non-Hispanic YPHIV, White Hispanic YPHIV, and White Hispanic YPHEU, across various ages. The GBTM approach based on caregiver report identified clusters of youth with similar behavioral trajectories but did not suggest strong racial/ethnic differences given our sample size. Interestingly, neither approach demonstrated racial/ethnic differences based on youth self-report of emotional functioning. However, other factors predicted membership in

vulnerable youth-reported emotional and caregiver-reported behavioral functioning groups including youth experiencing a stressful life event, living with a married caregiver, experiencing a change in caregiver, and/or having a caregiver who screened positive for a psychiatric condition.

Some studies have indicated that YPHEU, experience higher rates of mental health problems compared to YPHIV.^{2,4,8,11} Given their chronic health condition, YPHIV have increased access to comprehensive care than YPHEU, given YPHIV are monitored every 3–4 months for HIV-specific care, while YPHEU may be seen only annually or less often for research purposes. As a result, emotional-behavioral problems in YPHIV may be identified earlier, given increased opportunities for monitoring and referral for intervention. Our results indicated that a change in caregiver contributed to more behavioral concerns, highlighting the important role of stability in home environment. Black non-Hispanic caregivers who may experience a higher prevalence of racial discrimination, including historical negative biases, intergenerational attitudes, and beliefs, may be more likely to observe and/or express concerns about their child's behaviors when asked.³⁴ However, due to stigma, cultural beliefs about psychiatry and mental health, and inconsistent access to health insurance, these caregivers may also be less likely to seek professional attention for their child's emotional-behavioral concerns.³⁵

There are several possible reasons why we did not identify strong evidence of racial/ethnic disparities in our study. The number of White non-Hispanic and Black Hispanics was small, reducing the power to detect subtle differences for these two specific subgroups. The existing literature provides substantial evidence of a relationship between racial inequality, environmental exposures, social conditions, and child behavior.^{36–40} Beginning in utero and throughout early childhood, children from disadvantaged backgrounds are vulnerable to neurodevelopmental and emotional impact of environmental injustice.^{38,41} Longitudinal studies are needed to examine the interrelation between environmental exposures, including social conditions, on developmental and behavioral health outcomes in adolescents from minority backgrounds in substandard environments that place them at increased risk.

This study is not without limitations. Although standardized measures were administered individually in an interview format, BASC-2 assessments may be subject to biases of social desirability, recall, and the mental/emotional state of the respondent.⁴² BASC-2 youth self-report and caregiver evaluations do not assess identical clinical constructs, thus prohibiting direct comparison across global functioning indicators. Some of our youth were lost to follow-up. These youth may have been at higher risk for emotional-behavioral problems or greater fluctuations in emotional-behavioral functioning over time than those who remained on study. Differing ages at enrollment and loss to follow up yielded varied numbers of assessments per participant; however, there was no evidence of imbalance in the number of repeated assessments across subgroups defined by race-ethnicity and HIV status. HIV disproportionately impacts people of color, particularly Blacks and Hispanics, who comprised our study.⁴³ Due to limited representation, other racial and ethnic groups could not be examined. Also, we did not have available a validated measure of race-based discrimination. Such measures are needed within this and similar cohort studies to better understand the impact of structural racism on health disparities.^{15,44} The GBTM approach

yielded low counts of racial and ethnic subgroups among the ‘At-Risk’ and ‘Problematic’ functioning groups, making it challenging to identify race and ethnicity as predictors of a group membership. Thus the GBTM model has inherent limitations for handling small samples and assumptions made about missing data.³¹

Despite these limitations, our study findings are noteworthy. This study utilized a novel application of GBTM, illustrating developmental trajectories among one of the largest cohorts of YPHIV and YPHEU in the US. This approach revealed underlying behavioral patterns, that while not highly dependent on race or ethnicity, did differ by other youth and caregiver characteristics. We examined emotional-behavioral including multiple factors that may influence youths’ emotional-behavioral trajectory over time. This study demonstrates utility of this method in life-course epidemiology to objectively identify population trajectories and determine predictors of trajectory membership.

Additionally, our analysis included sufficient sample sizes of racial and ethnic representation of Black non-Hispanics and White Hispanics, indicating high statistical power to detect smaller differences in emotional-behavioral functioning within these groups. Rather than a snapshot of mental health problems, we described unique groups of youth following similar emotional-behavioral trajectories over time. This study also highlights that the majority of adolescents affected by PHIV are resilient with respect to their emotional-behavioral functioning, despite living with a chronic illness. For those youth with emotional-behavioral challenges, especially when persistent over time, early identification and access to targeted intervention services are necessary. Identification of SDOH that predicted vulnerable subgroups illuminates opportunities for targeted prevention and intervention services for YPHIV and YPHEU.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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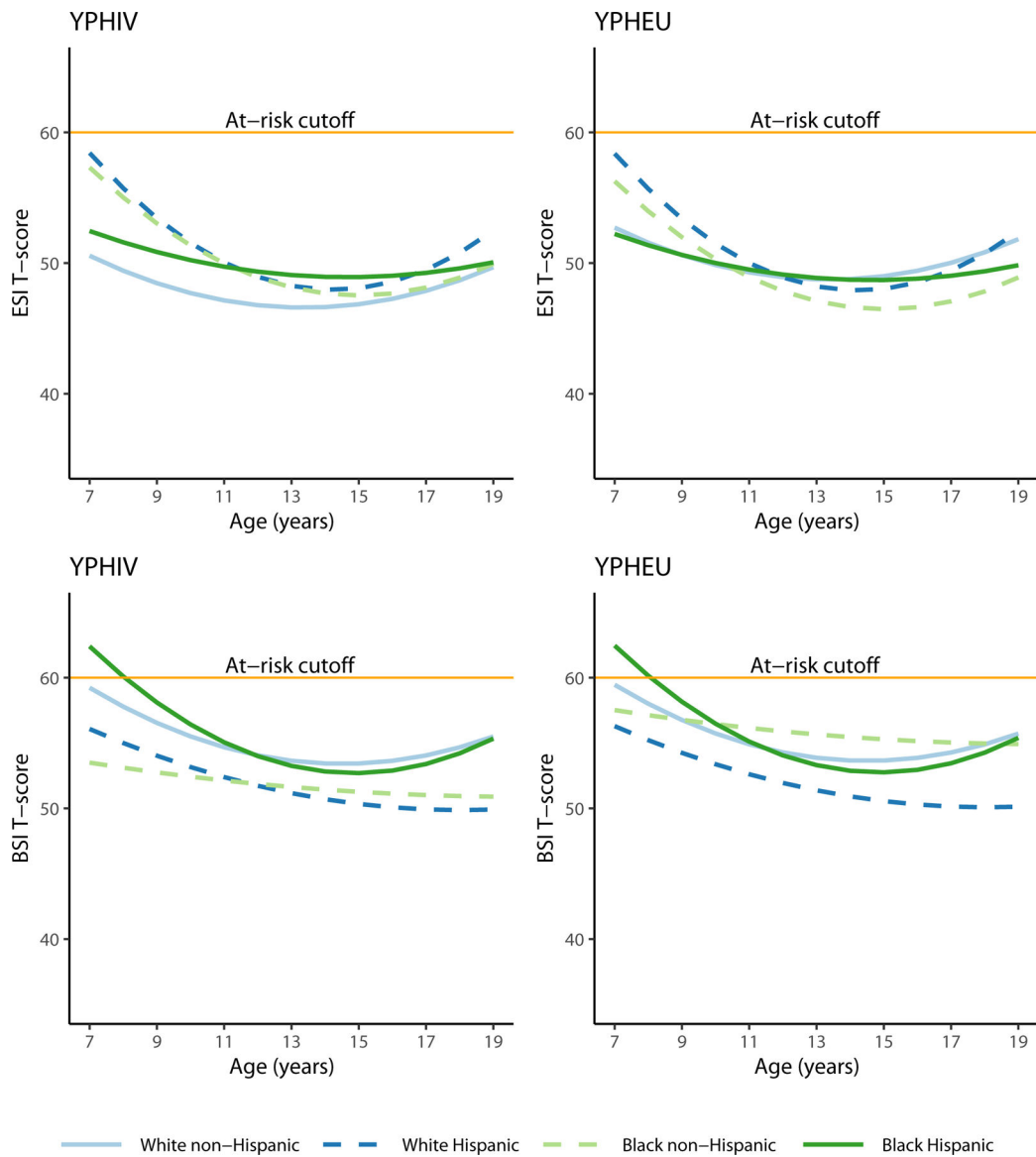


Figure 1. Predicted Mean ESI and BSI T-scores from Adjusted Mixed Effects Models
 YPHIV: Youth with perinatally-acquired HIV infection; YPHEU: Youth who are perinatally HIV-exposed but uninfected; ESI: Emotional Symptoms Index; BSI: Behavioral Symptoms Index

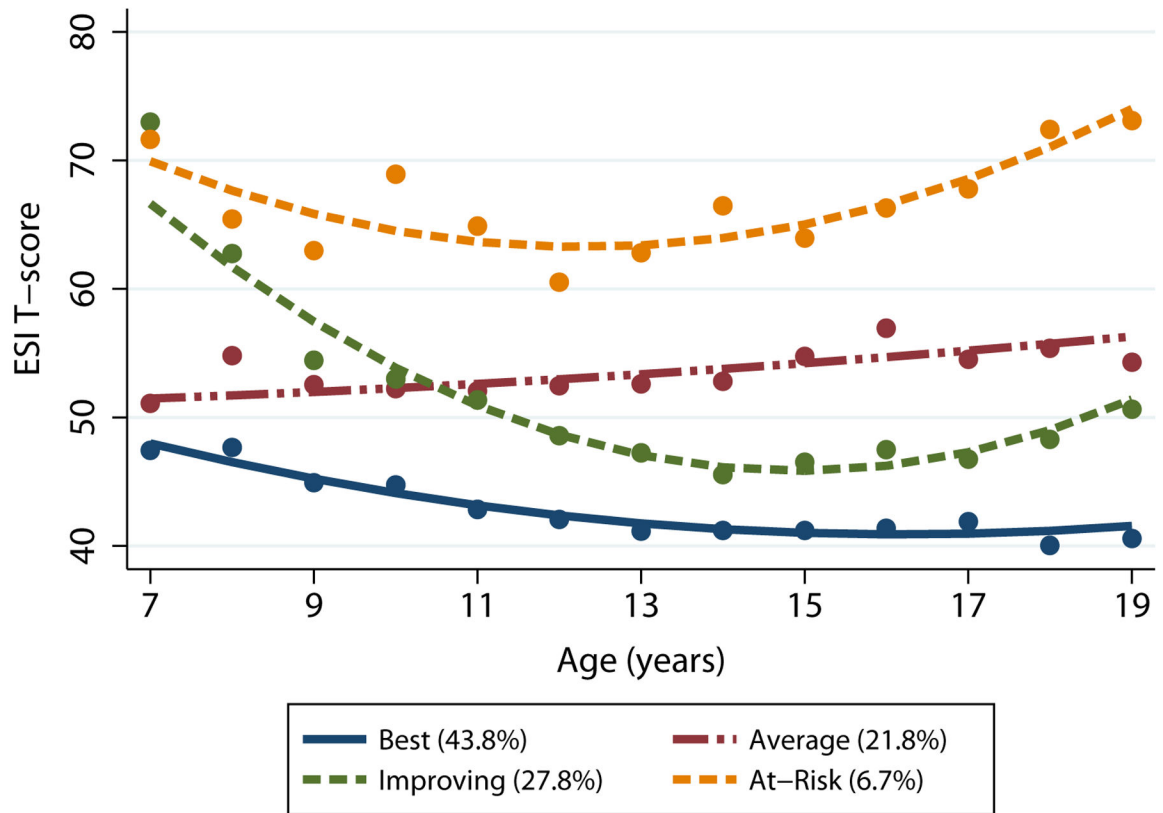


Figure 2a. Group-Based Trajectory Modeling Plot of ESI Trajectories over age.
 Higher ESI scores reflect worse emotional functioning (<60: Normal; 60–69: At-Risk, 70+: Clinically Significant). Points represent the observed mean score for each group at each age. Smooth curves represent fitted lines from the GBTM. Mean scores for groups 1 and 2 are considered within normal limits.

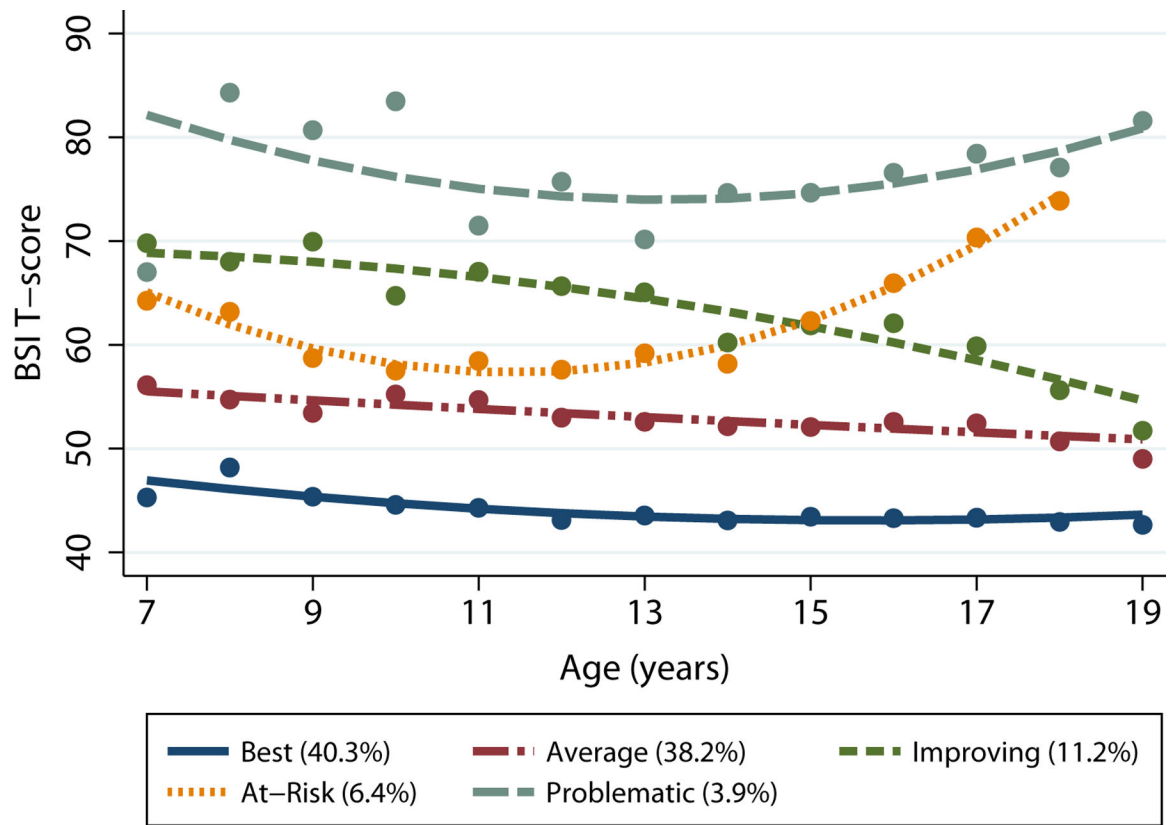


Figure 2b. Group-Based Trajectory Modeling Plot of BSI Trajectories over age. Higher BSI scores reflect worse behavioral functioning (<60: Normal; 60–69: At-Risk, 70+: Clinically Significant). Points represent the observed mean score for each group at each age. Smooth curves represent fitted lines from the GBTM. Mean scores for groups 1 and 2 are considered within normal limits.

Table 1.**Baseline Characteristics of Caregiver-reported BSI Study Population by Racial/ethnic Group**

Characteristic	Total (n=600)	Racial/ethnic Group			
		White non-Hispanic (n=44)	White Hispanic (n=127)	Black non-Hispanic (n=396)	Black Hispanic (n=33)
Median Assessments (IQR)	4 (3–5)	4 (2–5)	4 (3–5)	4 (3–5)	4 (3–4)
Mean Age (SD)	11.6 (2.7)	12.1 (2.8)	11.5 (2.7)	11.6 (2.7)	11.5 (2.7)
Male vs Female	296 (49.3%)	19 (43.2%)	70 (55.1%)	190 (48.0%)	17 (51.5%)
YPHIV vs YPHEU	391 (65.2%)	28 (63.6%)	69 (54.3%)	276 (69.7%)	18 (54.5%)
Socioeconomic Status					
Household income \$20,000	302 (50.3%)	10 (22.7%)	88 (69.3%)	185 (46.7%)	19 (57.6%)
Caregiver education <HS	166 (27.7%)	2 (4.5%)	59 (46.5%)	91 (23.0%)	14 (42.4%)
Household income supports 4 people	362 (60.3%)	35 (79.5%)	69 (54.3%)	236 (59.6%)	22 (66.7%)
Family Structure					
Mother born in US	459 (76.5%)	40 (90.9%)	80 (63.0%)	319 (80.6%)	20 (60.6%)
Caregiver is biological mother	219 (36.5%)	18 (40.9%)	58 (45.7%)	131 (33.1%)	12 (36.4%)
Primary caregiver change	58 (9.7%)	5 (11.4%)	15 (11.8%)	36 (9.1%)	2 (6.1%)
Caregiver is married	201 (33.5%)	21 (47.7%)	41 (32.3%)	132 (33.3%)	7 (21.2%)
Experienced stressful life event	442 (73.7%)	36 (81.8%)	90 (70.9%)	291 (73.5%)	25 (75.8%)
<i>Site location</i>					
South	209 (34.8%)	7 (15.9%)	16 (12.6%)	184 (46.5%)	2 (6.1%)
Northeast	193 (32.2%)	12 (27.3%)	35 (27.6%)	130 (32.8%)	16 (48.5%)
Midwest	87 (14.5%)	14 (31.8%)	5 (3.9%)	65 (16.4%)	3 (9.1%)
West	59 (9.8%)	11 (25.0%)	30 (23.6%)	17 (4.3%)	1 (3.0%)
Puerto Rico	52 (8.7%)	0 (0.0%)	41 (32.3%)	0 (0.0%)	11 (33.3%)
Caregiver Health					
Living with HIV	282 (47.0%)	22 (50.0%)	84 (66.1%)	160 (40.4%)	16 (48.5%)
<i>Positive CDQ screening for</i>					
Alcohol abuse	28 (4.7%)	1 (2.3%)	10 (7.9%)	15 (3.8%)	2 (6.1%)
Panic or GAD	62 (10.3%)	3 (6.8%)	13 (10.2%)	40 (10.1%)	6 (18.2%)
Major or other depression	66 (11.0%)	3 (6.8%)	11 (8.7%)	43 (10.9%)	9 (27.3%)
Drug abuse	15 (2.5%)	1 (2.3%)	3 (2.4%)	10 (2.5%)	1 (3.0%)
Any psychiatric condition	168 (28.0%)	11 (25.0%)	36 (28.3%)	106 (26.8%)	15 (45.5%)

BSI: Behavioral Symptoms Index; SD: Standard Deviation; YPHIV: Youth with perinatally-acquired HIV infection; YPHEU: Youth who are perinatally HIV-exposed but uninfected; HS: High School; CDQ: Client Diagnostic Questionnaire; GAD: Generalized Anxiety Disorder; Missingness for Socioeconomic Status (range: 0–5%), Family Structure (range: 0–16%), Caregiver Health (range: 10–14%)

Table 2.**Baseline Characteristics of Caregiver-reported BSI Study Population by Trajectory Group**

Characteristic	Trajectory Group				
	Best (n=243)	Average (n=243)	Improving (n=62)	At-Risk (n=28)	Problematic (n=24)
<i>Racial/ethnic Group</i>					
White non-Hispanic	12 (4.9%)	21 (8.6%)	6 (9.7%)	2 (7.1%)	3 (12.5%)
Black Hispanic	12 (4.9%)	10 (4.1%)	3 (4.8%)	3 (10.7%)	5 (20.8%)
White Hispanic	64 (26.3%)	47 (19.3%)	12 (19.4%)	0 (0.0%)	4 (16.7%)
Black non-Hispanic	155 (63.8%)	165 (67.9%)	41 (66.1%)	23 (82.1%)	12 (50.0%)
Male vs Female	121 (49.8%)	114 (46.9%)	35 (56.5%)	15 (53.6%)	11 (45.8%)
YPHIV vs YPHEU	167 (68.7%)	160 (65.8%)	31 (50.0%)	18 (64.3%)	15 (62.5%)
Socioeconomic Status					
Household income \$20,000	124 (51.0%)	122 (50.2%)	33 (53.2%)	14 (50.0%)	9 (37.5%)
Caregiver education <HS	65 (26.7%)	65 (26.7%)	22 (35.5%)	7 (25.0%)	7 (29.2%)
Household income supports 4 people	152 (62.6%)	148 (60.9%)	36 (58.1%)	13 (46.4%)	13 (54.2%)
Family Structure					
Mother born in US	180 (74.1%)	188 (77.4%)	51 (82.3%)	21 (75.0%)	19 (79.2%)
Caregiver is biological mother	89 (36.6%)	91 (37.4%)	24 (38.7%)	8 (28.6%)	7 (29.2%)
Primary caregiver change	21 (8.6%)	25 (10.3%)	6 (9.7%)	5 (17.9%)	1 (4.2%)
Caregiver is married	77 (31.7%)	80 (32.9%)	21 (33.9%)	9 (32.1%)	14 (58.3%)
Experienced stressful life event	171 (70.4%)	177 (72.8%)	52 (83.9%)	24 (85.7%)	18 (75.0%)
<i>Site location</i>					
South	76 (31.3%)	85 (35.0%)	26 (41.9%)	17 (60.7%)	5 (20.8%)
Northeast	77 (31.7%)	86 (35.4%)	15 (24.2%)	5 (17.9%)	10 (41.7%)
Midwest	34 (14.0%)	35 (14.4%)	8 (12.9%)	4 (14.3%)	6 (25.0%)
West	29 (11.9%)	19 (7.8%)	8 (12.9%)	1 (3.6%)	2 (8.3%)
Puerto Rico	27 (11.1%)	18 (7.4%)	5 (8.1%)	1 (3.6%)	1 (4.2%)
Caregiver Health					
Living with HIV	117 (48.1%)	117 (48.1%)	29 (46.8%)	9 (32.1%)	10 (41.7%)
<i>Positive CDQ screening for</i>					
Alcohol abuse	4 (1.6%)	14 (5.8%)	4 (6.5%)	3 (10.7%)	3 (12.5%)
Panic or GAD	20 (8.2%)	24 (9.9%)	8 (12.9%)	3 (10.7%)	7 (29.2%)
Major or other depression	22 (9.1%)	25 (10.3%)	9 (14.5%)	6 (21.4%)	4 (16.7%)
Drug abuse	4 (1.6%)	6 (2.5%)	3 (4.8%)	1 (3.6%)	1 (4.2%)
Any psychiatric condition	42 (17.3%)	83 (34.2%)	19 (30.6%)	10 (35.7%)	14 (58.3%)

BSI: Behavioral Symptoms Index; YPHIV: Youth with perinatally-acquired HIV infection; YPHEU: Youth who are perinatally HIV-exposed but uninfected; HS: High School; CDQ: Client Diagnostic Questionnaire; GAD: Generalized Anxiety Disorder

Table 3.

Multinomial Analysis of Youth-reported ESI and Caregiver-reported BSI Trajectory Groups Adjusting for Social Determinants of Health

<i>Characteristic</i>	ESI Trajectory Group (Ref = Best)			
	<i>Average RR (95% CI)</i>	<i>Improving RR (95% CI)</i>	<i>At-Risk RR (95% CI)</i>	
<i>Racial/ethnic Group (Ref. White non-Hispanic)</i>				
White Hispanic	1.48 (0.56, 3.89)	1.47 (0.61, 3.53)	1.00 (0.23, 4.41)	
Black non-Hispanic	1.24 (0.52, 2.96)	1.37 (0.62, 3.05)	0.78 (0.21, 2.91)	
Black Hispanic	2.20 (0.67, 7.17)	0.94 (0.27, 3.23)	0.54 (0.05, 5.93)	
YPHIV vs YPHEU	1.32 (0.82, 2.14)	0.96 (0.63, 1.46)	1.56 (0.65, 3.74)	
Male vs Female	0.50 (0.32, 0.79)	1.04 (0.69, 1.55)	0.48 (0.22, 1.06)	
Primary caregiver changed	0.96 (0.46, 2.03)	0.87 (0.43, 1.78)	2.85 (1.08, 7.51)	
Married caregiver	1.07 (0.66, 1.73)	1.60 (1.05, 2.43)	1.57 (0.70, 3.49)	
Experienced stressful life event	3.23 (1.20, 8.68)	1.20 (0.63, 2.28)	0.74 (0.25, 2.17)	
Positive psychiatric syndrome	1.42 (0.85, 2.35)	1.69 (1.07, 2.68)	1.76 (0.73, 4.20)	
<i>Characteristic</i>	BSI Trajectory Group (Ref = Best)			
	<i>Average RR (95% CI)</i>	<i>Improving RR (95% CI)</i>	<i>At-Risk RR (95% CI)</i>	<i>Problematic RR (95% CI)</i>
Black vs White	0.79 (0.45, 1.39)	0.81 (0.35, 1.89)	4.11 (0.73, 23.19)	1.99 (0.54, 7.38)
Hispanic vs non-Hispanic	0.55 (0.31, 0.98)	0.52 (0.21, 1.26)	0.52 (0.12, 2.31)	2.04 (0.58, 7.15)
YPHIV vs YPHEU	0.87 (0.58, 1.30)	0.47 (0.26, 0.85)	0.80 (0.34, 1.88)	0.82 (0.32, 2.08)
Male vs Female	0.90 (0.62, 1.31)	1.29 (0.72, 2.29)	1.23 (0.55, 2.76)	0.64 (0.26, 1.56)
Married caregiver	1.12 (0.75, 1.67)	1.17 (0.63, 2.17)	1.08 (0.45, 2.56)	4.34 (1.72, 10.93)
Experienced stressful life event	1.90 (1.03, 3.50)	4.86 (1.12, 21.06)	2.28 (0.51, 10.26)	1.07 (0.28, 4.10)
Positive psychiatric syndrome	2.62 (1.68, 4.10)	1.97 (1.01, 3.83)	2.49 (1.03, 6.04)	6.26 (2.51, 15.63)

RR: Relative Risk; CI: Confidence Interval; ESI: Emotional Symptoms Index; BSI: Behavioral Symptoms Index; YPHIV: Youth with perinatally-acquired HIV infection; YPHEU: Youth who are perinatally HIV-exposed but uninfected; Bold indicates statistical significance at the 0.05 level