Journal of Adolescent Health 77 (2025) 118–127

ELSEVIER

JOURNAL OF ADOLESCENT HEALTH

www.jahonline.org

Original article

Longitudinal and Geographic Trends in Perceived Racial Discrimination Among Adolescents in the United States: The Adolescent Brain Cognitive Development Study

Christopher T. Fields, Ph.D. [a,b,*], Carmen Black, M.D. [c,d,e], Amanda J. Calhoun, M.D. [d], Matthew Rosenblatt, Ph.D. [b], Raimundo Rodriguez [b], Joseph Aina [f], Jannat K. Thind [a], Jalen Grayson [g], Fahmi Khalifa, Ph.D. [f], Shervin Assari, M.D., M.P.H. [h], Xin Zhou, Ph.D. [i], Jason M. Nagata, M.D., M.Sc. [j], and Dylan G. Gee, Ph.D. [k]

[a] *Program for Recovery and Community Health, Department of Psychiatry, Yale School of Medicine, New Haven, Connecticut*
[b] *Department of Radiology, Magnetic Resonance Research Center, Yale School of Medicine, New Haven, Connecticut*
[c] *Institute of Living at Hartford Healthcare, Hartford, Connecticut*
[d] *Department of Psychiatry, Yale School of Medicine, New Haven, Connecticut*
[e] *Department of Psychiatry, University of Connecticut Health Center, Farmington, Connecticut*
[f] *Department of Electrical and Computer Engineering, Morgan State University, Baltimore, Maryland*
[g] *Semel Institute for Neuroscience and Human Behavior, University of California-Los Angeles, Los Angeles, California*
[h] *Department of Family Medicine, Charles R Drew University of Medicine and Science, Los Angeles, California*
[i] *Department of Biostatistics, Yale School of Medicine, New Haven, Connecticut*
[j] *Division of Adolescent and Young Adult Medicine, Department of Pediatrics, University of California San Francisco, San Francisco, California*
[k] *Department of Psychology, Yale University, New Haven, Connecticut*

Article history: Received October 26, 2024; Accepted March 21, 2025
Keywords: Racial discrimination; Racism; Intergroup relations; Public health; Interpersonal racism; Adolescent health; Social determinants of health; Racism-related stress; Health disparities

A B S T R A C T

Purpose: To assess longitudinal and geographic variation in perceived discrimination from ages 10–11 to 13–14 years in the Adolescent Brain Cognitive Development cohort, and to examine how these experiences are shaped by contextual factors such as neighborhood segregation and state-level racial bias.
Methods: Data were drawn from the longitudinal Adolescent Brain Cognitive Development Study (release 5.1), analyzing years 1, 2, and 4, corresponding to approximate ages 10–11, 11–12, and 13–14 years. Perceived discrimination was assessed using items adapted from the Perceived Discrimination Scale. Mixed-effects logistic regression models examined how perceived discrimination varied across time, demographic factors, and contextual variables, with models weighted using American Community Survey raked propensity scores to ensure national representativeness.
Results: Black, Asian American and Pacific Islander, and Other/Multiracial non-Hispanic youth showed increasing trajectories of perceived discrimination over time, while Native American and

IMPLICATIONS AND CONTRIBUTION

This longitudinal study documents how perceived racial discrimination changes during early adolescence, with Black, Asian American and Pacific Islander, and multiracial youth experiencing increasing discrimination while White and Native American youth show

Conflicts of interest: The authors have no conflicts of interest to disclose.
Disclaimer: The funding organizations had no role in the analysis and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication. This manuscript reflects the views of the authors and may not reflect the opinions or views of the NIH or Adolescent Brain Cognitive Development consortium investigators.

* Address correspondence to: Christopher T. Fields, Ph.D., Program for Recovery and Community Health, Department of Psychiatry, Yale School of Medicine, 319 Peck St, New Haven, CT 06513.
E-mail address: christopher.fields@yale.edu (C.T. Fields).

https://doi.org/10.1016/j.jadohealth.2025.03.014

White non-Hispanic youth exhibited decreasing trends. Significant geographic variation emerged, with Black youth reporting elevated discrimination across all regions, particularly in the West and South. Youth living in areas with concentrated poor Black households and in states with high anti-Black bias reported higher discrimination. Youth with immigrant backgrounds generally reported higher levels of perceived discrimination across most racial/ethnic groups.

Discussion: Perceived discrimination follows distinct developmental trajectories during early adolescence that vary significantly by race, ethnicity, geography, and structural context. These findings highlight the critical need for targeted interventions during this developmental period, particularly for Black, Asian American and Pacific Islander, and Other/Multiracial youth. Context-specific approaches to addressing racism are essential for mitigating its harmful effects on adolescent development.

declining patterns. Understanding these trajectories and their geographic/structural influences is critical for developing targeted interventions during this formative developmental period.

Racism is a ubiquitous force in US society, conveyed through interpersonal and structural dimensions, that impacts mental health in minoritized groups across the lifespan [1]. Perceived racial discrimination, a key manifestation of racism, has been consistently linked to adverse mental health outcomes, including depression, anxiety, and substance use, in adolescents [2–5]. While a growing body of literature documents the harmful effects of discrimination, less is known about the longitudinal trends of perceived discrimination during the critical developmental period of early adolescence, and how these experiences vary across geographic regions.

Early adolescence (ages 10–14) represents a particularly vulnerable period related to the development of racial identity and awareness of social inequalities [6–9]. During this time, youth are increasingly exposed to societal messages about race and begin to internalize racial biases, making them more susceptible to the negative impacts of discrimination [8,9]. Understanding the trajectory of perceived discrimination during this formative period is crucial for developing targeted interventions.

An analysis of the Adolescent Brain Cognitive Development (ABCD) Study found 4.8% of US children aged 10–11 reported racial/ethnic discrimination [10]. However, this initial analysis did not examine longitudinal changes or geographic variations. Furthermore, while discrimination is often studied within specific racial/ethnic groups, structural racism has broader community impacts. Leitner et al. [11] found that in communities where White residents harbored more explicit anti-Black bias, Black residents experienced worse health outcomes, suggesting community-level racial attitudes affect population health. Additionally, studies have shown that various dimensions of structural racism may create environments that foster discrimination across multiple racial and ethnic groups [12,13], though these patterns may differ substantially by group and context.

Therefore, the objective of this study was to assess longitudinal and geographic variation in perceived discrimination from ages 10–11 to 1314 years in the ABCD cohort, and to examine how these experiences are shaped by contextual factors such as neighborhood segregation and state-level racial bias. Such information is critical for identifying vulnerable developmental stages and high-risk communities to inform targeted interventions.

Methods

Data source and study population

Data were drawn from the ABCD Study (release 5.1), a longitudinal cohort following youth from ages 9 to 10 through early adulthood across the United States [14]. We analyzed data from years 1, 2, and 4 follow-up assessments (corresponding to approximate ages 10–11, 11–12, and 13–14 years), focusing on participants who had valid responses for the perceived discrimination measure. The analytical sample included 11,868 youth at baseline, 11,220 youth at follow-up year 1 (referred to as 'Year 1'), 10,909 youth at follow-up year 2 ('Year 2'), and 4,689 youth at follow-up year 4 ('Year 4'). The sample was racially diverse, with White participants comprising 64.5% and 69.3%, followed by Black (20.3% and 16.1%), Asian American and Pacific Islander (AAPI) (5.8% and 5.9%), Native American (2.3% and 2.5%), and Other/Multiracial (7.0% and 6.2%) youth in year 1 and year 4, respectively. Participants were enrolled from 22 sites across the country (Northeast: 5, Midwest: 4, South: 6, West: 7), listed in Table S12. The ABCD Study began recruitment in September 2016, with year 4 follow-up data (corresponding to ages 13–14) collected during 2020–2021, which coincided with the start of the COVID-19 pandemic. All participants provided assent with parents/guardians providing signed informed consent. Study procedures were approved by a centralized institutional review board at the University of California, San Diego, and by local sites' institutional review boards.

Outcome variable: Perceived discrimination

Perceived discrimination was assessed at years 1, 2, and 4 follow-up assessments using items adapted from the Perceived Discrimination Scale [15]. Data on perceived discrimination were not collected at baseline or year 3. The assessment included a yes/no question on whether participants had experienced discrimination based on race, ethnicity, or color in the past 12 months, along with 7 items rating the frequency of unfair treatment due to ethnic background on a 5-point Likert scale ("Almost Never" coded 1, "Rarely" coded 2, "Sometimes" coded 3, "Often" coded 4, "Very Often" coded 5). These frequency-based items, drawn from the scale's Daily Discrimination subscale,

captured experiences such as unfair treatment by teachers, adults outside school, or peers; perceptions of negative behavior toward one's ethnic group; feeling unwanted or unaccepted in American society; and the sense that other Americans hold something against them. The original scale has been validated across White, Black, Asian, Native American, and Latinx populations [15].

Given the zero-inflated data, we created a binary outcome variable. Participants were classified as perceiving discrimination if they answered "yes" to the general discrimination question or endorsed "Sometimes" or higher for any of the 7 frequency-based items. This more inclusive definition differs from Nagata et al.'s approach [10], which reported a 4.8% discrimination prevalence in Year 1 based solely on the yes/no discrimination question, explaining the higher prevalence rates in our study. The binary measure demonstrated good internal consistency across all assessment periods (Cronbach's α: year 1 = 0.81; year 2 = 0.84; year 4 = 0.84). Participants with only null responses ("null," "don't know," or "refuse to answer") across all 8 items were excluded from analysis.

Primary predictors

Race was categorized using parent-reported data on the child's racial identity. For single-race identification, categories included White, Black, AAPI (including Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Guamanian, Samoan, Native Hawaiian, and other Asian ethnicities), Native American (including American Indian and Alaska Native), and Other. For participants with multiple racial identifications, we applied a hierarchical coding approach. Black race took precedence in multiracial classification, reflecting the historical one-drop rule in US racial categorization [16]. If Black was not selected, individuals identifying with multiple Asian categories only were classified as AAPI, those identifying with multiple Native American categories only were classified as Native American, and those with other combinations of multiple racial identifications were categorized as "Other/Multiracial."

Ethnicity (Hispanic/Non-Hispanic) was combined with race categories for analysis (e.g., "White Non-Hispanic," "Black Hispanic"). Study year was coded numerically (year 1 = 1, year 2 = 2, year 4 = 4) to reflect temporal spacing. Geographic variables included US Census Bureau–defined regions (West, Northeast, Midwest, South) and 2 structural racism measures: the Index of Concentration at the Extremes (ICE), which is a census tract-level measure of racialized economic segregation [17], and a dichotomized state-level anti-Black bias measure [18]. Immigrant background was coded as a binary variable indicating whether the participant or any family member was born outside the United States. Detailed variable specifications are provided in the Supplementary Methods.

Covariates

Models adjusted for gender identity (male as reference), parental education (no 4-year college degree as reference), and household income (under $75,000 as reference) as main effect, individual-level factors. Missing demographic values were coded as null and excluded from analysis.

Data analysis approach

Analyses were conducted using R (v4.3.2) with data preprocessing via Microsoft Power Query. We used mixed-effects logistic regression models to account for nested data (observations within individuals within families), with random intercepts at individual and family levels and random slopes for time. Models were weighted using American Community Survey raked propensity scores for national representativeness [19]. Detailed model specifications and code are available in the Supplementary Methods.

We employed a progressive modeling approach examining how perceived discrimination varied across time, demographic factors, and contextual variables. Model 1 (base) included race/ethnicity, time, and their interaction, plus demographic covariates. Model 2 added geographic variables and region interactions. Model 3 introduced structural racism measures (ICE and state-level anti-Black bias). Model 4 incorporated immigrant background to identify how nativity status intersected with racial/ethnic identity. For all models, non-Hispanic White participants at year 1 served as the reference group.

Model fit was assessed using likelihood ratio tests, Akaike information criterion (AIC), and Bayesian information criterion criteria. We examined variance components to determine the proportion of unexplained variance at individual and family levels. All models were fitted to 23,252 observations across years 1, 2, and 4 to ensure valid comparisons.

Statistical analysis

Effect modification tests assessed whether time trends in perceived discrimination varied across racial/ethnic groups by evaluating Year*Race/Ethnicity interactions, with pairwise comparisons using Tukey-adjusted post-hoc tests (Table S2).

For geographic analyses, we tested regional differences using Region*Race/Ethnicity and Year*Region interactions to assess both cross-sectional regional variation and longitudinal patterns. State-level patterns were visualized using heatmaps, with states having insufficient data (n < 10 respondents) coded as missing.

To evaluate contextual factors, we tested interactions between structural measures (ICE and state-level anti-Black bias) and both race/ethnicity and time, with pairwise comparisons employing Tukey-adjusted p values (Tables S5 and S6). Similarly, immigrant background effects were tested within each racial/ethnic group (Table S7).

Statistical significance was defined as $p < .05$ ($^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$). Three sensitivity analyses addressed robustness concerns: (1) including "Rarely" responses in the discrimination threshold; (2) randomly selecting one member per family; and (3) reassigning 650 Black participants with multiple racial identifications to the Other/Multiracial category.

Results

Racial and ethnic differences in perceived discrimination across time

The American Community Survey weighted prevalence of perceived discrimination, specified by model 1, varied significantly across racial and ethnic groups and over time (Table 1, Figure 1). Table S1 reveals substantial unadjusted baseline

Table 1
Adjusted odds ratios for perceived discrimination by race/ethnicity over time

Variable	Year 1 AOR (95% CI)	Year 2 AOR (95% CI)	Year 4 AOR (95% CI)	Time Trend *p* value
Race/Ethnicity				
White non-Hispanic	1.00 (reference)	0.990 (0.984–0.995)	0.969 (0.951–0.986)	<.001***
White Hispanic	1.086 (1.051–1.121)	1.090 (1.055–1.125)	1.098 (1.059–1.136)	.5728
Black non-Hispanic	1.272 (1.237–1.308)	1.300 (1.264–1.337)	1.358 (1.318–1.398)	<.001***
Black Hispanic	1.197 (1.116–1.283)	1.204 (1.124–1.289)	1.218 (1.137–1.305)	.7166
AAPI non-Hispanic	1.132 (1.077–1.189)	1.182 (1.125–1.242)	1.289 (1.223–1.358)	<.001***
AAPI Hispanic	1.078 (0.940–1.235)	1.035 (0.902–1.186)	0.953 (0.830–1.094)	.2748
Native American non-Hispanic	1.038 (0.975–1.105)	0.981 (0.922–1.044)	0.875 (0.820–0.934)	.0016**
Native American Hispanic	1.092 (0.947–1.258)	1.087 (0.943–1.252)	1.077 (0.934–1.242)	.8753
Other/Multiracial non-Hispanic	1.182 (1.093–1.278)	1.250 (1.157–1.351)	1.396 (1.285–1.516)	.0075**
Other/Multiracial Hispanic	1.114 (1.062–1.168)	1.114 (1.061–1.168)	1.113 (1.060–1.167)	.964
Gender identity (Ref: nonmale)				
Male	0.994 (0.989–1.000)	0.984 (0.979–0.990)	0.964 (0.958–0.970)	.0439*
Parental education (Ref: college degree or higher)				
No 4-year college degree	0.973 (0.966–0.981)	0.963 (0.956–0.971)	0.944 (0.936–0.952)	<.001***
Household income (Ref: over $75,000)				
Under $75,000	0.982 (0.975–0.990)	0.972 (0.965–0.980)	0.953 (0.945–0.961)	<.001***
Effect modification test (are time slopes different between groups?)	$p = 8.854 \times 10^{-9}$ ***			

AORs and 95% confidence intervals are derived from a weighted mixed-effects model with individual- and family-level random intercepts and a random slope for time. The model accounts for gender identity, parental education, and household income. All AORs are referenced to Year 1 White non-Hispanic, allowing for direct comparison of both between-group differences and within-group changes over time. Gender identity is referenced to monmale, parental education to 4-year college degree or higher, and household income to over $75,000. The Time Trend *p* value tests whether perceived discrimination changed significantly within each racial/ethnic group from year 11 to year 4. Estimates are weighted using American Community Survey raked propensity scores for national representativeness. The Effect Modification Test ($p = 8.854 \times 10^{-9}$) assesses whether the time trend significantly differs between racial/ethnic groups, indicating that changes in perceived discrimination over time vary by group. AAPI refers to Asian American and Pacific Islander participants.
AAPI = Asian American and Pacific Islander; AOR = adjusted odds ratio; CI = confidence interval.
*$p < .05$. **$p < .01$. ***$p < .001$.

differences, with Black non-Hispanic youth reporting the highest rates of perceived discrimination (35.47% in year 1, increasing to 45.39% by year 4), compared to much lower rates among White non-Hispanic youth (11.78% in year 1, decreasing to 9.85% by year 4). Among non-Hispanic participants, Black, AAPI (13.95%–29.41%), and Other/Multiracial youth (22.94%–41.46%) showed increasing trajectories, while White youth (lowest overall levels) and Native American youth (27.42%–12.64%) exhibited decreasing trends, with Native American youth showing the most pronounced decline. Hispanic and non-Hispanic groups showed different patterns, with non-Hispanic participants demonstrating more dynamic trajectories compared to Hispanic participants, who exhibited relatively stable patterns across racial groups, with the exception of a modest decline for AAPI Hispanic youth (from 25.49% to 18.75%).

Compared to White non-Hispanic participants, Year 1 odds of perceived discrimination were higher for Black non-Hispanic (adjusted odds ratio [AOR] = 1.272), AAPI Non-Hispanic (AOR =

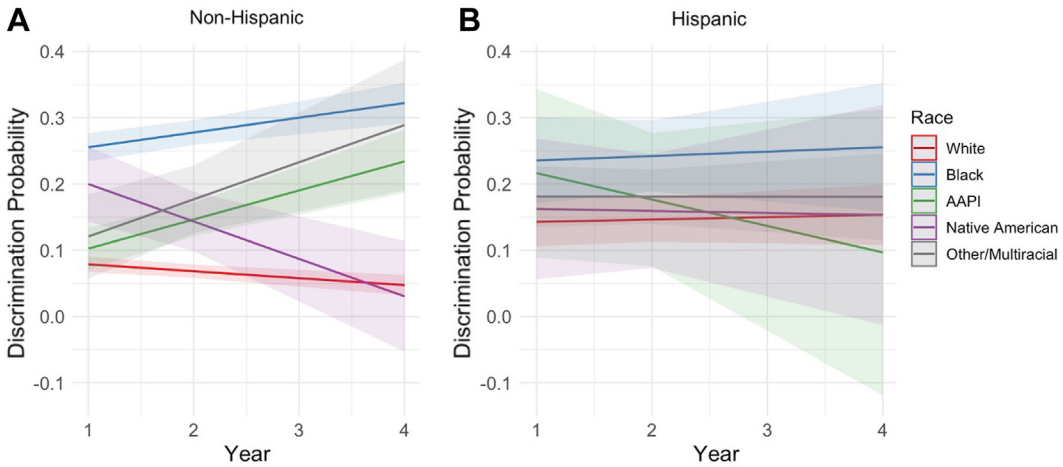

Figure 1. Longitudinal trends in perceived discrimination by race and Hispanic ethnicity. Predicted probability of reporting perceived discrimination over time by race, stratified by Hispanic ethnicity: (A) Non-Hispanic participants and (B) Hispanic participants. Predictions are derived from a weighted mixed-effects model adjusted for gender identity, parental education, and household income. Shaded areas represent 95% confidence intervals. Note the divergent trajectories among non-Hispanic participants (panel A), with significant increases among Black, AAPI, and Other/Multiracial youth, and significant decreases among White and Native American youth over time. In contrast, Hispanic participants (panel B) show more stable patterns across most racial groups, with the exception of AAPI Hispanic youth who demonstrated a modest, nonsignificant decline. AAPI = Asian American and Pacific Islander participants.

1.132), Other/Multiracial non-Hispanic (AOR = 1.182), and most Hispanic groups. By year 4, disparities widened for Black (AOR = 1.358), AAPI (AOR = 1.289), and Other/Multiracial non-Hispanic (AOR = 1.396) participants, while decreasing for Native American non-Hispanic (AOR = 0.875). Raw percentages show Black non-Hispanic youth had the largest increase (35.47%–45.39%), while Native American non-Hispanic youth showed the steepest decline (27.42%–12.64%).

Time trends differed significantly across racial/ethnic groups ($p = 8.854 \times 10^{-9}$). Demographic factors including male gender identity (AOR = 0.994, $p = .044$), parents not having a 4-year college degree (AOR = 0.973, $p < .001$), and lower household income (AOR = 0.982, $p < .001$) were all independently associated with slightly lower odds of perceived discrimination. Raw data in Table S1 show notable socioeconomic disparities, with youth from households without a 4-year college degree reporting higher unadjusted rates of discrimination (28.35% vs. 13.23% in year 1) as well as those from lower income households (27.05% vs. 12.43% in year 1), though these differences were attenuated in the adjusted models.

Table S2 presents pairwise comparisons of time trends, revealing significant differences between White non-Hispanic and both Black non-Hispanic and AAPI non-Hispanic youth (both $p < .001$), between Native American non-Hispanic and 3 groups of youth (Black non-Hispanic, AAPI non-Hispanic, and Other/Multiracial non-Hispanic; all $p < .01$), and between White Hispanic and AAPI non-Hispanic youth ($p = .048$). These findings align with the visual contrasts in Figure 1 and the raw prevalence patterns in Table S1, highlighting how perceived discrimination evolved differently across racial/ethnic groups during the study period.

Regional and state-level variations in perceived discrimination

Model 2 revealed significant geographic variation in perceived discrimination across racial/ethnic groups and time (Table 2, Figure 2). The Race/Ethnicity*Region interaction was statistically significant ($p = .004$), indicating that regional patterns differed substantially by racial/ethnic group.

Black non-Hispanic youth reported elevated discrimination across all regions, particularly in the West (AOR = 1.272 at year 1) and South (AOR = 1.207 at year 1), with disparities increasing over time (year 4 AORs: 1.273–1.344). In contrast, White non-Hispanic youth showed relatively consistent levels across regions.

AAPI non-Hispanic youth demonstrated pronounced increases over time across all regions (all $p < .01$), while Native American non-Hispanic youth experienced significant decreases (all $p < .05$), most substantially in the West (AOR from 1.091 to 0.924). Among Hispanic participants, Native American youth in the Northeast reported the highest regional disparity (AOR = 1.614 at year 1).

State-level heatmaps (Figure 2) revealed that Black youth faced elevated discrimination over time across most states, particularly in California, New York, Florida, and South Carolina, with noticeable increases between years 1 and 4. AAPI youth experienced substantial geographic heterogeneity, with sharp temporal increases in Florida and Western states. Native American youth showed generally decreasing trends in Western states, with Missouri as a notable exception. Other/Multiracial youth demonstrated the most pronounced geographic variability, with heightened discrimination in Northeastern states and South Carolina by year 4. These state-level patterns provide additional context for understanding how structural factors like neighborhood segregation and state-level racism, examined in Table 3, may intersect with geographic location to shape discrimination experiences.

Contextual effects of structural racism and nativity on perceived discrimination

Building on geographic trends, we added structural racism measures (Model 3) and immigrant background (Model 4) to examine nuanced contextual influences. Table 3 reveals how neighborhood segregation, state-level racism, and immigrant status shaped discrimination trajectories for Black youth beyond regional effects.

For Black non-Hispanic youth, discrimination increased significantly over time across all neighborhood contexts (all $p < .05$), with those in areas of concentrated poor Black households experiencing the sharpest increase (AOR = 1.288–1.415) (Table S3). In contrast, discrimination decreased for White non-Hispanic youth in highly segregated areas ($p < .001$), while AAPI non-Hispanic youth showed significant increases across all neighborhood types (all $p < .001$), and Native American non-Hispanic youth showed significant decreases in highly segregated areas ($p < .007$).

Youth with immigrant backgrounds generally reported higher discrimination levels, particularly among Hispanic groups (Table S4). Black youth with immigrant backgrounds consistently reported higher discrimination (Black non-Hispanic: AOR = 1.284 vs. 1.246; Black Hispanic: AOR = 1.198 vs. 1.136 at Year 1), with significant temporal increases for Black non-Hispanic youth regardless of immigrant status (both $p < .001$).

Neighborhood effects varied by group: Black non-Hispanic youth in low disparity–wealthy White areas reported significantly lower discrimination than those in high disparity–poor Black areas ($p = .022$) (Table S5), while AAPI Hispanic youth in low disparity–wealthy White areas consistently reported lower discrimination than their counterparts in low disparity–poor Black areas (all $p < .05$).

State-level anti-Black bias significantly increased discrimination for Other/Multiracial youth across all years (all $p < .05$) (Table S6). For Black Hispanic youth, the only significant temporal increase appeared in states with high anti-Black bias ($p = .042$), suggesting state-level racism had stronger longitudinal effects than neighborhood segregation for this group.

Developmental changes in immigrant background effects emerged: Native American Hispanic youth without immigrant background initially reported higher discrimination ($p = .026$) (Table S7), but this difference disappeared by year 4. Conversely, White youth showed no early immigrant status differences, but by year 4, those without immigrant background reported significantly lower discrimination ($p < .025$).

Model comparison

Each added model significantly improved fit (Table S8). Adding geographic variables (Model 2) improved fit over the base model ($\chi^2 = 127.82$, $p < .0001$; $\Delta AIC = -77.82$). Structural racism measures (Model 3) further improved fit ($\chi^2 = 129.60$, $p < .0001$) despite a slight AIC increase ($\Delta AIC = 4.40$). Including immigrant background (Model 4) led to another improvement ($\chi^2 = 64.64$, $p < .0001$; $\Delta AIC = -18.64$).

Table 2
Regional differences in perceived discrimination across time and racial/ethnic groups

Racial/Ethnic group	Region	Year 1 AOR (95% CI)	Year 2 AOR (95% CI)	Year 4 AOR (95% CI)	Time Trend *p* value
White non-Hispanic	West	1.00 (reference)	0.988 (0.982–0.994)	0.965 (0.946–0.984)	<.001***
	Northeast	1.024 (0.979–1.070)	1.013 (0.969–1.059)	0.991 (0.948–1.036)	.001**
	Midwest	1.018 (0.978–1.060)	1.009 (0.969–1.050)	0.992 (0.952–1.034)	.004**
	South	0.982 (0.944–1.023)	0.977 (0.939–1.017)	0.966 (0.928–1.006)	.062
Black non-Hispanic	West	1.272 (1.189–1.360)	1.296 (1.212–1.386)	1.344 (1.258–1.437)	<.001***
	Northeast	1.200 (1.148–1.254)	1.228 (1.175–1.283)	1.286 (1.230–1.344)	<.001***
	Midwest	1.200 (1.146–1.256)	1.224 (1.170–1.281)	1.273 (1.217–1.332)	.002**
	South	1.207 (1.167–1.249)	1.242 (1.201–1.284)	1.314 (1.271–1.359)	<.001***
AAPI non-Hispanic	West	1.051 (0.988–1.118)	1.096 (1.031–1.165)	1.191 (1.121–1.266)	<.001***
	Northeast	0.989 (0.910–1.075)	1.035 (0.953–1.123)	1.134 (1.045–1.231)	<.001***
	Midwest	1.020 (0.935–1.112)	1.063 (0.976–1.158)	1.155 (1.060–1.258)	.002**
	South	1.019 (0.947–1.097)	1.069 (0.995–1.149)	1.176 (1.095–1.264)	<.001***
Native American non-Hispanic	West	1.091 (0.954–1.249)	1.033 (0.902–1.183)	0.924 (0.807–1.059)	.007**
	Northeast	1.153 (0.998–1.333)	1.094 (0.947–1.263)	0.982 (0.850–1.135)	.023*
	Midwest	1.035 (0.893–1.200)	0.989 (0.853–1.147)	0.902 (0.778–1.046)	.021*
	South	1.117 (0.996–1.253)	1.069 (0.953–1.198)	0.979 (0.873–1.098)	.005**
Other/Multiracial non-Hispanic	West	1.061 (0.923–1.219)	1.123 (0.977–1.292)	1.260 (1.095–1.450)	.01*
	Northeast	0.995 (0.863–1.148)	1.059 (0.919–1.221)	1.197 (1.038–1.381)	.014*
	Midwest	0.932 (0.799–1.087)	0.993 (0.851–1.159)	1.124 (0.963–1.312)	.026*
	South	1.039 (0.916–1.178)	1.108 (0.977–1.256)	1.256 (1.108–1.425)	.004**
White Hispanic	West	1.072 (1.037–1.109)	1.078 (1.042–1.115)	1.089 (1.052–1.127)	.424
	Northeast	1.014 (0.949–1.082)	1.021 (0.956–1.091)	1.036 (0.969–1.108)	.276
	Midwest	1.041 (0.971–1.117)	1.045 (0.975–1.121)	1.054 (0.983–1.130)	.429
	South	1.007 (0.957–1.060)	1.019 (0.968–1.072)	1.043 (0.991–1.098)	.031*
Black Hispanic	West	1.154 (1.071–1.242)	1.162 (1.079–1.252)	1.178 (1.094–1.269)	.644
	Northeast	1.119 (1.023–1.224)	1.130 (1.033–1.236)	1.152 (1.054–1.259)	.558
	Midwest	1.118 (1.005–1.244)	1.125 (1.011–1.252)	1.139 (1.023–1.268)	.712
	South	1.183 (1.098–1.273)	1.199 (1.113–1.291)	1.230 (1.142–1.325)	.293
AAPI Hispanic	West	1.125 (0.981–1.291)	1.079 (0.941–1.238)	0.993 (0.866–1.138)	.234
	Northeast	1.214 (0.957–1.540)	1.159 (0.914–1.470)	1.056 (0.832–1.341)	.156
	Midwest	1.056 (0.814–1.371)	1.011 (0.779–1.311)	0.924 (0.712–1.199)	.183
	South	1.093 (0.857–1.393)	1.042 (0.817–1.329)	0.947 (0.743–1.207)	.207
Native American Hispanic	West	1.102 (0.955–1.271)	1.095 (0.950–1.263)	1.082 (0.938–1.249)	.836
	Northeast	1.614 (1.065–2.445)	1.600 (1.055–2.427)	1.573 (1.037–2.387)	.802
	Midwest	1.047 (0.812–1.350)	1.040 (0.806–1.341)	1.027 (0.796–1.325)	.868
	South	1.039 (0.890–1.214)	1.033 (0.885–1.206)	1.020 (0.874–1.190)	.78
Other/Multiracial Hispanic	West	1.053 (1.002–1.107)	1.049 (0.998–1.102)	1.041 (0.991–1.093)	.692
	Northeast	1.141 (1.052–1.237)	1.136 (1.048–1.231)	1.126 (1.039–1.221)	.547
	Midwest	1.079 (0.981–1.187)	1.075 (0.977–1.183)	1.066 (0.969–1.173)	.663
	South	1.206 (1.142–1.273)	1.206 (1.142–1.273)	1.207 (1.143–1.275)	.015*

Regional differences in perceived discrimination across racial/ethnic groups over time. All AORs and 95% CIs are referenced to White non-Hispanic youth in the West at year 1. AORs for years 2 and 4 reflect the temporal evolution of perceived discrimination for each race/ethnicity-region combination. Time trend *p* values indicate the statistical significance of changes in perceived discrimination over time for each subgroup. All estimates are adjusted for gender identity, parental education, and household income. The significant Race/Ethnicity *Region interaction ($p = .004$) indicates that regional patterns of discrimination vary by racial/ethnic group. Results are based on a weighted mixed-effects model with random effects for individual and family.
AAPI = Asian American and Pacific Islander; AOR = adjusted odds ratio; CI = confidence interval.
*$p < .05$. **$p < .01$. ***$p < .001$.

Unexplained individual variance declined from 72.28% (Model 1) to 69.72% (Model 4), while family-level variance increased (19.12%–21.52%), reinforcing that segregation, state-level racism, and immigrant background provide explanatory value beyond geographic and demographic factors.

Sensitivity analysis

Three sensitivity analyses confirmed result robustness. A less stringent discrimination threshold (Table S9) maintained a significant race/ethnicity-by-time interaction ($p = 3.36 \times 10^{-15}$). Using one randomly selected family member (Table S10) showed similar trends ($p = 1.28 \times 10^{-8}$), though with some instability in random effects. Reclassifying Black multiracial participants (Table S11) yielded consistent findings ($p = 6.32e\text{-}10$). Across all analyses, racial/ethnic disparities in perceived discrimination remained significant, affirming the developmental patterns in our primary analysis.

Discussion

This national, longitudinal analysis of the ABCD Study cohort reveals significant developmental changes in perceived discrimination across early adolescence, with pronounced differences by race, ethnicity, geographic location, and structural context. Black, AAPI, and Other/Multiracial non-Hispanic youth experienced increasing discrimination between ages 10–11 and 13–14, while White and Native American non-Hispanic youth showed declining trajectories. These divergent developmental patterns reflect distinct racial socialization processes during early adolescence, a period when cognitive capacities for social perspective-taking mature and awareness of systemic inequities increases [6,20,21].

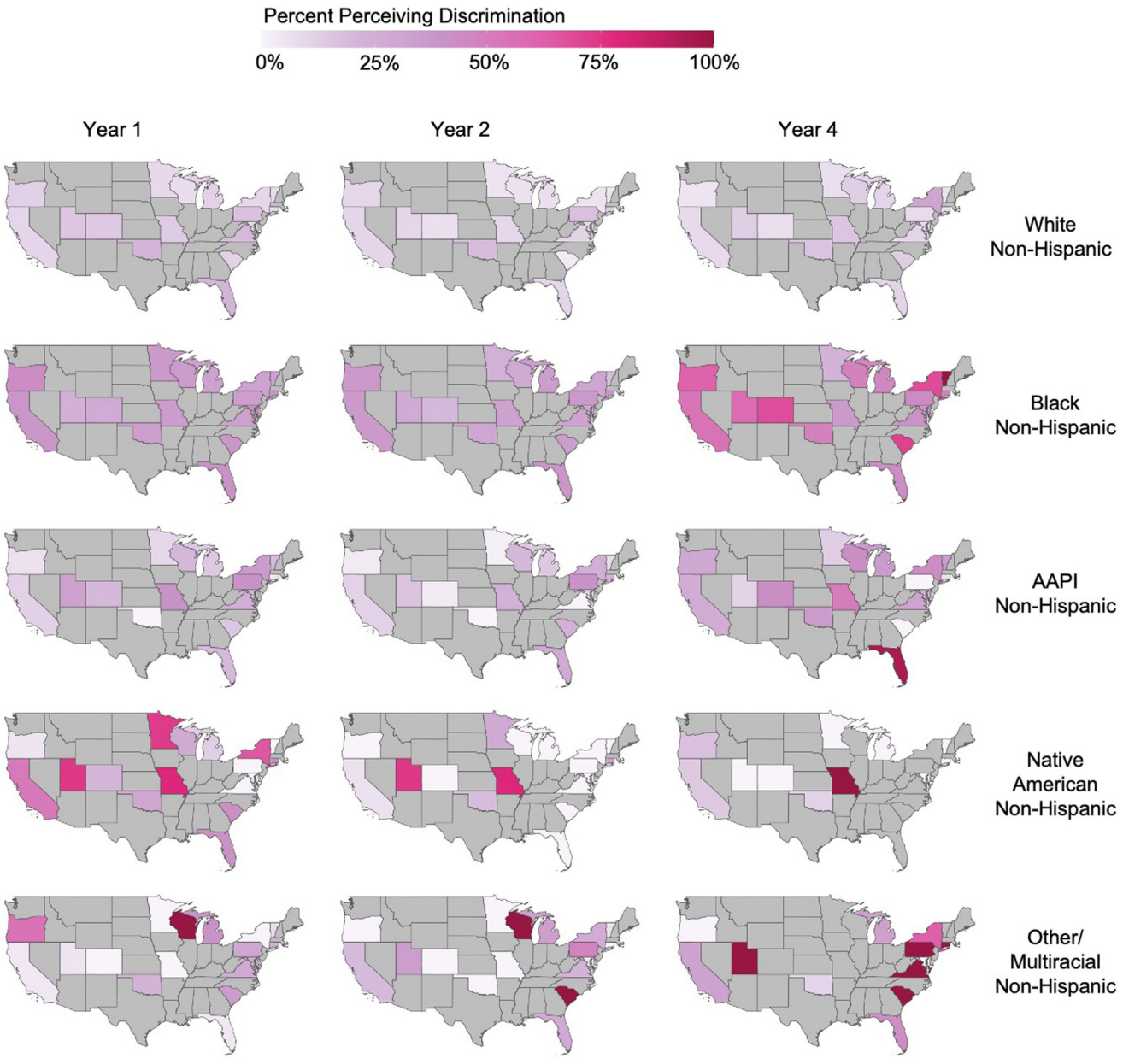

Figure 2. State-level variations in perceived discrimination by non-Hispanic race and time (years 1, 2, and 4). Geographic distribution of perceived discrimination across US states by racial group and study year. Each row represents a different non-Hispanic racial group (Asian or Pacific Islander, Black, Native American, Other/Multiracial, and White), while columns show temporal progression from year 11 to year 4. States are color-coded using a purple gradient, with darker shades indicating higher percentages of youth reporting discrimination (scale ranges from 0% to 100% as shown in the color bar). Gray states indicate that data was not available. Notable patterns include: (1) consistently higher rates of perceived discrimination among Black youth across most states, with increases over time particularly in Northeastern, Western, and Southern states; (2) substantial increases in perceived discrimination among Asian or Pacific Islander youth between years 1 and 4, especially in Florida and Western states; (3) changing patterns for Native American youth, with decreases in many Western states but pronounced increases in Missouri; (4) heightened discrimination for Other/Multiracial youth in Eastern states (including Pennsylvania and Connecticut) by year 4; and (5) relatively lower and stable rates for White youth across most states. These geographic variations align with the contextual findings in Table 3, highlighting how structural factors may contribute to spatial heterogeneity in youth experiences of discrimination. Percentages are weighted using American Community Survey raked propensity scores to ensure national representativeness across demographic characteristics.

The increased perceived discrimination for Black non-Hispanic youth (AOR from 1.272 to 1.358) is concerning. This may reflect heightened racial awareness during early adolescence when Black youth begin to recognize the pervasiveness of racism [20,22]. It may also reflect sociopolitical changes during the study period (2017–2022), which included increased national attention to racial injustice following high-profile police killings of Black Americans and the rise of the Black Lives Matter movement [23]. Seaton and colleagues [4] have documented how Black adolescents' racial identity development intersects

Table 3
Impact of structural racism and immigrant background on perceived discrimination among Black youth

Contextual factor	Year 1 AOR (95% CI)	Year 2 AOR (95% CI)	Year 4 AOR (95% CI)	Time Trend *p* value
Black non-Hispanic				
ICE Level				
High disparity—Wealthy White Biased	1.257 (1.169–1.352)	1.295 (1.204–1.393)	1.375 (1.279–1.478)	<.001***
High disparity—Poor Black Biased	1.281 (1.187–1.383)	1.317 (1.220–1.421)	1.392 (1.290–1.502)	<.001***
Low disparity—Wealthy White Biased	1.236 (1.159–1.319)	1.251 (1.173–1.334)	1.282 (1.201–1.367)	.026*
Low disparity—Poor Black Biased	1.288 (1.211–1.370)	1.329 (1.249–1.414)	1.415 (1.330–1.504)	<.001***
State anti-Black bias				
Low anti-Black bias	1.223 (1.171–1.277)	1.252 (1.199–1.308)	1.313 (1.257–1.371)	<.001***
High anti-Black bias	1.255 (1.195–1.318)	1.292 (1.230–1.356)	1.370 (1.304–1.439)	<.001***
Immigrant background				
No immigrant background	1.246 (1.192–1.303)	1.278 (1.222–1.336)	1.344 (1.285–1.407)	<.001***
Has immigrant background	1.284 (1.211–1.362)	1.317 (1.242–1.397)	1.385 (1.306–1.470)	<.001***
Black Hispanic				
ICE Level				
High disparity—wealthy White biased	1.122 (1.046–1.203)	1.128 (1.051–1.210)	1.140 (1.062–1.223)	.701
High disparity—poor Black biased	1.151 (1.067–1.242)	1.158 (1.073–1.251)	1.172 (1.085–1.267)	.526
Low disparity—wealthy White biased	1.211 (1.074–1.366)	1.218 (1.080–1.374)	1.233 (1.092–1.392)	.463
Low disparity—poor Black biased	1.225 (1.122–1.338)	1.240 (1.135–1.355)	1.272 (1.164–1.390)	.173
State anti-Black bias				
Low anti-Black bias	1.115 (1.049–1.184)	1.121 (1.056–1.191)	1.135 (1.069–1.206)	.294
High anti-Black bias	1.211 (1.132–1.295)	1.228 (1.148–1.314)	1.263 (1.180–1.352)	.042*
Immigrant background				
No immigrant background	1.136 (1.053–1.225)	1.143 (1.060–1.233)	1.158 (1.073–1.249)	.435
Has immigrant background	1.198 (1.114–1.288)	1.215 (1.130–1.307)	1.251 (1.163–1.346)	.068

Structural racism, racialized economic segregation, and immigrant background affect perceived discrimination among Black youth. All AORs are referenced to White non-Hispanic youth in year 11 within the most privileged areas (high disparity—wealthy White biased census tracts and low anti-Black bias states). The ICE measures (Model 3) local neighborhood segregation patterns: "High Disparity" indicates more extreme concentration (absolute value ≥0.3), while "Wealthy White Biased" areas have positive ICE scores (concentration of affluent White households) and "Poor Black Biased" areas have negative scores (concentration of poor Black households). State Anti-Black Bias (Model 3) is measured using a composite racism factor from multiple national surveys, with higher scores indicating greater anti-Black bias. Immigrant Background (Model 4) indicates whether the child or any family member was born outside the United States. Time Trend *p* values indicate whether perceived discrimination significantly changed over time within each contextual environment.
AOR = adjusted odds ratio; CI = confidence interval; ICE = Index of Concentration at the Extremes.
*$p < .05$. **$p < .01$. ***$p < .001$.

with their increasing perception of discrimination, creating a complex developmental challenge during this period.

The declining trajectories observed among Native American non-Hispanic youth (from AOR = 1.038 to 0.875) contrast sharply with the experiences of other racial minorities. This unexpected finding warrants further investigation, as it may reflect cultural protective factors, measurement issues specific to Indigenous populations, or community-specific resilience processes [24]. Previous research has documented how some Native American communities employ cultural teachings and practices that promote positive cultural identity development, potentially buffering youth against the psychological impacts of discrimination [25].

Geographic variations in perceived discrimination were substantial, with regional patterns differing markedly by racial and ethnic group. Higher rates of perceived discrimination among Black youth in the West and South align with previous studies documenting regional differences in expressions of racial bias [26,27]. Pronounced increases in discrimination reported by AAPI youth across all regions, but particularly in Western states and Florida, may reflect the rise in anti-Asian sentiment during the COVID-19 pandemic, which coincided with the later waves of data collection [28,29]. These findings underscore how geographical context shapes the lived experiences of racism and how regional sociopolitical climates create distinct environments for minority youth.

The significantly elevated discrimination among youth living in areas with concentrated poor Black households and in states with high anti-Black bias demonstrates how structural racism shapes individual experiences. Previous research has established that neighborhood-level segregation and resource inequities function as manifestations of structural racism that impact health and well-being [13,17,30–33]. Our findings extend this work by demonstrating how these structural factors also influence developmental trajectories of perceived discrimination during early adolescence. The complex relationship between state-level anti-Black bias and perceived discrimination across racial groups supports theories that community-level racial climates affect multiple minoritized populations, though through distinct pathways and with varying intensity [18].

Higher discrimination among youth with immigrant backgrounds aligns with literature on the "double jeopardy" of navigating both racial discrimination and xenophobia [34]. This increased vulnerability has been linked to poorer mental health outcomes and warrants particular attention in clinical and community interventions [35].

The pervasiveness of racism-related experiences among adolescents underscores the need for early prevention strategies in clinical and community settings. Evidence-based approaches include school-based antibias programs that promote positive intergroup contact [36], clinical screening for racism-related stress as part of routine adolescent health visits [37], and family-based interventions that support positive racial socialization and coping strategies [38]. Jones and colleagues [39] have developed a clinic-based assessment tool that healthcare

providers can use to identify youth experiencing discrimination and connect them with appropriate resources. Community-level interventions that address structural racism through policy change and institutional reform are also essential components of comprehensive prevention strategies [40].

Our study has several limitations. First, while our longitudinal design is a strength, the incomplete year 4 sample may limit generalizability of findings from this time point. Second, the measure of perceived discrimination in the ABCD Study relies on self-report, which while developmentally appropriate, maybe influenced by recall bias and cognitive developmental factors. Third, while we controlled for several individual-level characteristics, unmeasured factors such as racial identity development may influence perception and reporting of discrimination. Fourth, the structural racism measures were collected at baseline and may not capture changes in these contextual factors over time.

This study contributes by documenting how discrimination changes developmentally across racial/ethnic groups, varies geographically, and is shaped by structural factors. Future research, including studies leveraging the ABCD dataset, should examine how these trajectories continue into middle and late adolescence, explore protective factors that buffer youth from the negative effects of discrimination, and evaluate interventions aimed at reducing both interpersonal and structural racism.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the authors used a privately hosted large language model, Mistral 7B, to improve language clarity and coherence. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Funding Sources

The Adolescent Brain Cognitive Development Study was supported by the National Institutes of Health and additional federal partners under awards U01DA041022, U01DA041025, U01DA041028, U01DA041048, U01DA041089, U01DA041093, U01DA041106, U01DA041117, U01DA041120, U01DA041134, U01DA041148, U01DA041156, U01DA041174, U24DA041123, and U24DA041147. The Adolescent Brain Cognitive Development federal partners are the National Institute on Drug Abuse, National Institute on Alcohol Abuse and Alcoholism, National Cancer Institute, National Institute of Mental Health, Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Heart, Lung, and Blood Institute, National Institute of Neurological Disorders and Stroke, National Institute on Minority/Health and Health Disparities, National Institutes of Health (NIH) Office of Behavior and Social Sciences Research, NIH Office of Research on Women's Health, Centers for Disease Control and Prevention—Division of Violence Prevention, National Institute of Justice, Centers for Disease Control and Prevention—Division of Adolescent and School Health, National Science Foundation, and National Endowment for the Arts. This work was additionally supported by grant support to the authors: Yale ASCEND grant to Christopher T. Fields, Matthew Rosenblatt, and Joseph Aina, National Cancer Institute grant 5R03CA252808 to XZ, NIMH grant R01MH135492 to JN, and National Institutes of Health grant U01DA041174 to Dylan G. Gee. Shervin Assari is partially supported by funds provided by The Regents of the University of California, Tobacco-Related Diseases Research Program, Grant Number No. T32IR5355.

Supplementary Data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jadohealth.2025.03.014.

References

[1] Cogburn CD, Roberts SK, Ransome Y, et al. The impact of racism on Black American mental health. Lancet Psychiatry 2024;11:56–64.
[2] Pachter LM, Caldwell CH, Jackson JS, et al. Discrimination and mental health in a representative sample of African-American and Afro-Caribbean youth. J Racial Ethn Health Disparities 2018;5:831–7.
[3] Benner AD, Graham S. Latino adolescents' experiences of discrimination across the first 2 years of high school: Correlates and influences on educational outcomes. Child Dev 2011;82:508–19.
[4] Seaton EK, Yip T, Sellers RM. A longitudinal examination of racial identity and racial discrimination among African American adolescents. Child Dev 2009;80:406–17.
[5] Assari S. Racial differences in biopsychosocial pathways to tobacco and marijuana use among youth. J Racial Ethn Health Disparities 2024. https://doi.org/10.1007/s40615-024-02035-8.
[6] Umana-Taylor AJ, Quintana SM, Lee RM, et al. Ethnic and racial identity during adolescence and into young adulthood: An integrated conceptualization. Child Dev 2014;85:21–39.
[7] French SE, Seidman E, Allen L, et al. The development of ethnic identity during adolescence. Dev Psychol 2006;42:1–10.
[8] Perry SP, Abaied JL, Wu DJ, et al. Racial socialization in the United States. Annu Rev Psychol 2025;76:443–74.
[9] Hughes D, Rodriguez J, Smith EP, et al. Parents' ethnic-racial socialization practices: A review of research and directions for future study. Dev Psychol 2006;42:747–70.
[10] Nagata JM, Ganson KT, Sajjad OM, et al. Prevalence of perceived racism and discrimination among US children aged 10 and 11 years: The Adolescent Brain Cognitive Development (ABCD) study. JAMA Pediatr 2021;175:861–3.
[11] Leitner JB, Hehman E, Ayduk O, et al. Blacks' death rate due to circulatory diseases is positively related to whites' explicit racial bias. Psychol Sci 2016;27:1299–311.
[12] Colen CG, Ramey DM, Cooksey EC, et al. Racial disparities in health among nonpoor African Americans and Hispanics: The role of acute and chronic discrimination. Soc Sci Med 2018;199:167–80.
[13] Bailey ZD, Krieger N, Agenor M, et al. Structural racism and health inequities in the USA: Evidence and interventions. Lancet 2017;389:1453–63.
[14] Volkow ND, Koob GF, Croyle RT, et al. The conception of the ABCD study: From substance use to a broad NIH collaboration. Dev Cogn Neurosci 2018;32:4–7.
[15] Williams DR, Yan Y, Jackson JS, et al. Racial differences in physical and mental health: Socio-economic status, stress and discrimination. J Health Psychol 1997;2:335–51.
[16] Davis FJ. Who is black?: One nation's definition. 10th ed. University Park, Pa.: Pennsylvania State University Press; 2001.
[17] Krieger N, Kim R, Feldman J, et al. Using the index of concentration at the extremes at multiple geographical levels to monitor health inequities in an era of growing spatial social polarization: Massachusetts, USA (2010-14). Int J Epidemiol 2018;47:788–819.
[18] Hatzenbuehler ML, Weissman DG, McKetta S, et al. Smaller hippocampal volume among Black and Latinx youth living in high-stigma contexts. J Am Acad Child Adolesc Psychiatry 2022;61:809–19.
[19] Census US. American Community Survey (ACS). 2025. Available at: https://www.census.gov/programs-surveys/acs.html. Accessed March 12, 2025.
[20] Rivas-Drake D, Seaton EK, Markstrom C, et al. Ethnic and racial identity in adolescence: Implications for psychosocial, academic, and health outcomes. Child Dev 2014;85:40–57.
[21] Quintana SM. Racial and ethnic identity: Developmental perspectives and research. J Couns Psychol 2007;54:259–70.
[22] Hope EC, Skoog AB, Jagers RJ. "It'll never be the white kids, it'll always be us". J Adolesc Res 2014;30:83–112.
[23] English D, Lambert SF, Tynes BM, et al. Daily multidimensional racial discrimination among Black U.S. American adolescents. J Appl Dev Psychol 2020;66:101068.

[24] Whitbeck LB, Hoyt DR, McMorris BJ, et al. Perceived discrimination and early substance abuse among American Indian children. J Health Soc Behav 2001;42:405–24.
[25] Walls ML, Whitbeck LB. The intergenerational effects of relocation policies on indigenous families. J Fam Issues 2012;33:1272–93.
[26] Paradies Y, Ben J, Denson N, et al. Racism as a determinant of health: A systematic review and meta-analysis. PLoS One 2015;10:e0138511.
[27] Lewis TT, Cogburn CD, Williams DR. Self-reported experiences of discrimination and health: Scientific advances, ongoing controversies, and emerging issues. Annu Rev Clin Psychol 2015;11:407–40.
[28] Gover AR, Harper SB, Langton L. Anti-Asian hate crime during the COVID-19 pandemic: Exploring the reproduction of inequality. Am J Crim Justice 2020;45:647–67.
[29] Cheah CSL, Wang C, Ren H, et al. COVID-19 racism and mental health in Chinese American families. Pediatrics 2020;146.
[30] Williams DR, Lawrence JA, Davis BA. Racism and health: Evidence and needed research. Annu Rev Public Health 2019;40:105–25.
[31] Messer LC, Laraia BA, Kaufman JS, et al. The development of a standardized neighborhood deprivation index. J Urban Health 2006;83:1041–62.
[32] Singh GK. Area deprivation and widening inequalities in US mortality, 1969-1998. Am J Public Health 2003;93:1137–43.
[33] Lukachko A, Hatzenbuehler ML, Keyes KM. Structural racism and myocardial infarction in the United States. Soc Sci Med 2014;103:42–50.
[34] Tummala-Narra P, Claudius M. Perceived discrimination and depressive symptoms among immigrant-origin adolescents. Cultur Divers Ethnic Minor Psychol 2013;19:257–69.
[35] Gee GC, Walsemann KM, Brondolo E. A life course perspective on how racism may be related to health inequities. Am J Public Health 2012;102:967–74.
[36] Priest N, Alam O, Truong M, et al. Promoting proactive bystander responses to racism and racial discrimination in primary schools: A mixed methods evaluation of the 'speak out against racism' program pilot. BMC Public Health 2021;21:1434.
[37] Trent M, Dooley DG, Douge J, et al. The impact of racism on child and adolescent health. Pediatrics 2019;144:e20191765.
[38] Anderson RE, McKenny M, Mitchell A, et al. EMBRacing racial stress and trauma: Preliminary feasibility and coping responses of a racial socialization intervention. J Black Psychol 2017;44:25–46.
[39] Jones SCT, Anderson RE, Gaskin-Wasson AL, et al. From "crib to coffin": Navigating coping from racism-related stress throughout the lifespan of Black Americans. Am J Orthopsychiatry 2020;90:267–82.
[40] Ford CL, Airhihenbuwa CO. Critical race theory, race equity, and public health: Toward antiracism praxis. Am J Public Health 2010;100 Suppl 1:S30–5.