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Supplementary Information for

# Students of color show health advantages when they attend schools that emphasize the value of diversity

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## Supplementary Information Text

### Sample

Participants were healthy 8th grade students who were part of a larger study on adolescents and cardiovascular disease risk. They were recruited from the Chicago area via advertisements in schools, public transportation, and mailings. Because the study was not specifically designed to test hypotheses about schools, schools were not sampled systematically.

Children were eligible to participate if they were in 8th grade and free of acute or chronic medical conditions and had no metal in their body (due to an fMRI component of the larger study that is not relevant to the current analyses). The full sample included 277 participants. Data on the relevant school characteristics were not available for 7 participants, due to the participants being homeschooled ($N = 2$), not reporting what school they attended ($N = 1$), or attending a school that did not have a mission statement available (i.e., did not have our measure of whether the school emphasized diversity; $N = 4$). Descriptive statistics on the demographics of the 270 participants in the analytic sample are provided in the results section and in Table 1 (in the text of the paper). Participants provided written assent, and their parents provided written consent. The research was approved by the Northwestern University Institutional Review Board.

### School Mission Statements

Our measure of whether schools emphasized diversity was whether diversity was mentioned in each school's mission statement. We developed a coding scheme in which mission statements were coded as emphasizing diversity if they mentioned the goal of students learning to live in a multicultural or global world; respecting or valuing diversity; serving a diverse student body or community; offering bilingual instruction; including racially or culturally diverse perspectives in the curriculum; teaching students to develop an awareness of or responsiveness to other racial, ethnic, or cultural groups; and meeting students' cultural needs. This was a dichotomous code (either emphasized or did not emphasize diversity).

In order to test whether this coding scheme captured meaningful differences in the school environments and experiences of students of color in the schools, we conducted a separate set of analyses with a separate sample to validate our coding scheme. Specifically, we collected mission statements for all schools in the Chicago Public School system that served grades K-8 and that were not included in our primary analyses (i.e., were not attended by participants in our sample). These mission statements were available on the schools' websites and on the Chicago Public Schools district website. Two independent coders then coded them as emphasizing diversity or not using the coding scheme described above and in the text of the paper (kappa = .91). We then tested whether the school's emphasis on diversity (i.e., whether the mission statement mentioned diversity) predicted differences in the academic performance of students of color in the school and in rates of discipline of students of color in the school. To test this, we obtained the following statistics from the U.S. Department of Education's Civil Rights Data Collection (https://www2.ed.gov/about/offices/list/ocr/data.html): the percentage of White students and students of color in each school who (1) were retained (i.e., did not advance to the next grade level because they did not pass enough classes or

receive enough credits), (2) received at least one in school suspension, and (3) received at least one out of school suspension (all data for the 2015-2016 school year). Of the 334 Chicago Public Schools that were eligible to be in these validation analyses (i.e., were not schools attended by participants in our sample), mission statements were not available for 14 schools. In almost all cases this was because the school did not have its own unique mission statement but rather shared its mission statement with other Chicago Public Schools run by the same charter management organization and, thus, could not be coded independently. In addition, the U.S. Department of Education Civil Rights Data Collection did not provide data for an additional 5 schools, typically because the school had only recently opened and, thus, data were not yet available. This left a sample of 315 schools for our analyses. The degrees of freedom are lower in the results reported below due to schools being dropped from analyses when there were not enough students in the relevant group (e.g., schools with a very small percentage of White students were not included in analyses relevant to White students because data for this group were not available).

We compared the schools that did and did not emphasize diversity on these academic and disciplinary metrics. First, looking at the student retention rates, schools that emphasized diversity had a lower percentage of students of color who were retained (i.e., did not advance to the next grade level due to not passing courses or receiving enough credits) ($M$ = 1.26, $SD$ = 1.28) than did schools that did not emphasize diversity ($M$ = 1.68, $SD$ = 1.50), $t(308) = 2.53$, $p = .012$. In contrast, there was no difference in the percentage of White students who were retained in schools that emphasized ($M$ = 2.26, $SD$ = 12.08) versus did not emphasize ($M$ = 2.07, $SD$ = 12.77) diversity, $t(224) = 0.11$, $p = .909$. Turning to the suspension rates, the percentage of students of color that received at least one in school suspension was marginally lower in schools that emphasized diversity ($M$ = 2.34, $SD$ = 2.95) than in schools that did not emphasize diversity ($M$ = 3.16, $SD$ = 4.94), $t(308) = 1.61$, $p = .109$. There was no difference in the percentage of White students who received at least one in school suspension in schools that emphasized ($M$ = 2.36, $SD$ = 11.31) versus did not emphasize ($M$ = 1.61, $SD$ = 9.04) diversity, $t(224) = 0.55$, $p = .583$. Finally, the percentage of students of color that received at least one out of school suspension was lower in schools that emphasized diversity ($M$ = 2.67, $SD$ = 2.72) than in schools that did not emphasize diversity ($M$ = 3.79, $SD$ = 3.66), $t(308) = 2.84$, $p = .005$. Again, there was no difference in the percentage of White students who received at least one out of school suspension in schools that emphasized ($M$ = 2.91, $SD$ = 12.26) versus did not emphasize ($M$ = 1.62, $SD$ = 9.17) diversity, $t(224) = 0.90$, $p = .370$.

Returning to our primary analyses testing the relationship between a school's emphasis on diversity and students' health, we obtained and coded the mission statements for the schools attended by participants in our sample. To do so, we asked participants to report the name of the school they attended, and we obtained each school's mission statement from the school or district website. Two independent coders who were blind to information about the participants who attended each school (i.e., to participants' race/ethnicity and health outcomes) coded the content of the mission statements for whether they mentioned diversity according to the coding scheme described above (kappa = .95). Students attended 124 different schools, and mission statements were available for 120 of these schools. Details about the characteristics of these schools, as

well as how schools whose mission statements did and did not mention diversity compared to each other, are available in the Results section and in Table S1 below.

**Cardiometabolic Risk**

To assess health risk, we examined the following outcomes: a composite of five inflammatory biomarkers, insulin resistance (HOMA-IR), β-cell function, and two metabolic syndrome indices (a count of the number of metabolic syndrome components for which participants met clinical risk cutoffs, and a sum of the standardized scores on each component).

**Inflammation.** Following an overnight fast, venous blood was drawn into a Serum Separator Tube (Becton-Dickinson) by antecubital venipuncture. Following the manufacturer's instructions, the tube was centrifuged at 1200 x g for 10 minutes, after which the serum was harvested, divided into aliquots, and frozen at −80 °C until the end of the study. At that time the samples were thawed, and five biomarkers of low-grade inflammation were measured: C-reactive protein (CRP), interleukin-6 (IL-6), interleukin-8 (IL-8), interleukin-10 (IL-10), and tumor necrosis factor-α (TNF-α). CRP was measured in duplicate by high-sensitivity immunoturbidimetric assay on a Roche/Hitachi cobas c502 analyzer. Average intra- and inter-assay coefficients of variation were 2.5% and 5.6%, respectively. This assay's lower limit of detection is 0.2 mg/L. The cytokines were measured in duplicate by electrochemiluminescence on a SECTOR Imager 2400A (MesoScale Discovery) with a Human Pro-Inflammatory 4-Plex Ultra-Sensitive assay (MesoScale Discovery), following instructions provided by the manufacturer (1). The kit's lower limits of detection range from 0.10 pg/mL (IL-8) to 0.80 pg/mL (IL-10). Across runs, the median intra-assay coefficients of variation were 3.71% (IL-6), 3.00% (IL-8), 3.42% (IL-10), and 3.57% (TNF-α). Raw values of each marker were log-10 transformed to correct for skew, and an inflammation composite was computed by standardizing these log-transformed scores and summing them, following previous research (2).

**Insulin Resistance and β-Cell Function.** From the same fasting blood samples, we also measured serum levels of glucose and insulin, which were used to estimate insulin resistance and β-cell function. Glucose was measured photometrically using a UV test on a Roche/Hitachi Cobas c502 instrument. This assay has a dynamic range of 2-750 mg/dL and intra-assay coefficient of variation of 0.7%. Serum insulin was measured in duplicate with an electrochemiluminescent immunoassay (Human Leptin/Insulin Kit K15164C; MesoScale Discovery) on a SECTOR Imager 2400A (MesoScale Discovery). This assay has an 8-point standard curve, a lower limit of detection of 25 pg/ml. The intra-assay coefficients of variation for duplicate pairs averaged 3.8%. Insulin resistance was estimated using the homeostasis model assessment (HOMA-IR) (3, 4), with the equation [[fasting glucose (mmol/L) x fasting insulin (mIU/L)] / 22.5]. β-cell function was estimated with software available from the Oxford Center for Diabetes, Endocrinology, and Metabolism (https://www.dtu.ox.ac.uk/homacalculator/). Two participants had insulin resistance scores that were extreme outliers (i.e., scores more than five standard deviations above the mean). These participants' scores were winsorized to the next highest value. In addition, five participants had insulin and/or

glucose levels that fell outside of the range for which the software will calculate β-cell function values (i.e., outside of what are typically considered clinically realistic values). These five participants are therefore excluded from the analyses in which β-cell function was the outcome.

**Metabolic Syndrome**. Metabolic syndrome was assessed using criteria that the International Diabetes Federation (IDF) developed for children and adolescents (5). According to the IDF definition, 11-16 year olds are diagnosed with metabolic syndrome if they have central adiposity (defined as a waist circumference ≥ 90th percentile for their age, gender, and race/ethnicity, or, if it is lower, the adult cutoff, which is ≥ 80 cm for women, ≥ 94 cm for men of European and African descent, and ≥ 90 cm for men of Asian descent) and have at least two of the following: HDL cholesterol < 40 mg/dL, triglycerides ≥ 150 mg/dL, fasting glucose ≥ 100 mg/dL, and systolic blood pressure ≥ 130 mm Hg and/or diastolic blood pressure ≥ 85 mm Hg.

Reflecting the fact that our sample was relatively young and healthy, only 8 participants met the criteria for a metabolic syndrome diagnosis. Therefore, we also calculated two continuous variables reflecting metabolic risk, which were the outcomes of interest in our analyses. The first was a sum of the number of components on which participants met the clinical cutoffs, which ranged from 0-5. Second, in acknowledgement of concerns about the validity of dichotomizing children into risk categories when variables are continuous (6), we also created a composite that was the sum of the z-scores of each component. Two participants were missing data on three metabolic syndrome components, due to blood not being drawn. For these participants, scores were divided by two (i.e., the number of components on which data were available) and multiplied by five to be equivalent to the values for other participants.

Waist circumference was measured at the narrowest point between the ribs and iliac crest. Resting systolic and diastolic blood pressure (SBP and DBP) were recorded continuously for ten minutes while participants sat quietly in a chair watching a nature video. We used a Continuous Non-invasive Arterial Pressure (CNAP) Monitor 500 (CNSystems, Graz, Austria). This monitor non-invasively records beat-to-beat arterial pressure using finger arterial sensors, which are automatically calibrated to brachial pressures via an upper arm-cuff. Blood pressure data were then scored using Mindware Technology software (BP 3.1, Gahanna, OH), which computed average SBP and DBP values across the ten-minute period.

HDL cholesterol, triglycerides, and glucose, were measured in serum harvested from the same fasting blood samples described above. HDL cholesterol and triglycerides were measured on a Roche/Hitachi cobas c701 instrument at the NorthShore University Health System's Core Laboratory. The average intra- and inter-assay coefficients of variation for these assays are 1.6% and 2.4%, respectively. Detection ranges are 8.85-885 mg/dL (triglycerides) and 3-120 mg/dL (HDL). Glucose was measured as described above (see Insulin Resistance and β-Cell Function section of this document).

**Covariates**

At the child level, covariates included child sex, child age in years and fractions of a year, family's savings (the amount of assets that their family could easily convert to liquid cash in an emergency, rated on a 9-point scale from "less than $500" to "$500,000

or higher," reported by children's parents), and pubertal stage (7). At the school level, covariates included whether the school was public or private/parochial, the percentage of students in the school that were White and African American (two variables), the student-teacher ratio, and the number of words in the mission statement. Data on these school characteristics were obtained from Illinois State Board of Education records (https://www.illinoisreportcard.com) and from the National Center for Education Statistics (https://nces.ed.gov/datatools/). Finally, as noted in the Results section of the main text of the paper, we conducted additional analyses controlling for the frequency of discrimination that participants reported. Discrimination was measured with a 10-item scale developed by Williams and colleagues (8). Participants rated how frequently (often, sometimes, rarely, never) they were treated with less courtesy than others, treated with less respect than others, seen as less smart than others, and experienced other types of discrimination. Responses were summed so that total scores could range from 10 (never experienced discrimination) to 40 (often experienced discrimination). As reported in Table 1, means were close to the midpoint of the scale (i.e., base rates of reported discrimination were not low), and students of color ($M$ = 18.22, $SD$ = 5.36) reported more frequent discrimination than did White students ($M$ = 16.53, $SD$ = 4.87), $t(267) = 2.37$, $p$ = .018, indicating that the scale was meaningfully capturing participants' experiences of discrimination.

**Analytic Approach**

To test our hypotheses, we used generalized estimating equations with exchangeable covariate structure to account for the nested structure of our data. Adolescents' race was dummy coded as 0 = students of color and 1 = White students. Participants who identified as White and another race were included in the former category. Whether schools acknowledged and valued diversity was also dummy coded as 0 = yes and 1 = no. All analyses controlled for the covariates of sex (0 = female, 1 = male), age, family's savings, and pubertal stage (7), number of words in the school's mission statement, whether the school was public (0 = private/parochial, 1 = public), the school's student-teacher ratio, the percentage of students in the school who are White and African American (two variables). Continuous covariates were standardized. The coefficient of interest was the interaction between child race and whether the school valued diversity. We conducted analyses separately for each outcome. For the insulin resistance outcome, we specified a gamma probability distribution with log-links, which is appropriate for skewed outcomes where all values are positive. For the outcome that was the count of metabolic syndrome signs, we specified a poisson loglinear distribution, which is appropriate for outcomes that are counts. For the remaining outcomes, we specified a linear distribution.

**Additional Analyses**

**Discrimination.** As noted in the text of the manuscript, we repeated the analyses, controlling for participants' self-reported experiences of discrimination. First, looking at the inflammation composite, the significant interaction between child race and whether the school emphasized diversity persisted even when controlling for discrimination ($b$ = -1.53, 95% CI [-2.82, -.24], $p$ = .020). The difference in inflammation levels between

students of color who attended schools that did and did not emphasize diversity also remained significant ($b$ = -1.04, 95% CI [-1.81, -.28], $p$ = .008, $d$ = .42). Next, turning to insulin resistance, again when controlling for discrimination, the interaction between child race and whether the school emphasized diversity remained significant ($b$ = -.52, 95% CI [-.90, -.14], $p$ = .007), with the students of color having lower insulin resistance when they attended schools that emphasize diversity ($b$ = -0.32, 95% CI [-.51, -.13], $p$ = .001, $d$ = .48). Next, the interaction between child race and whether the school emphasized diversity predicting β-cell function also remained nearly significant when controlling for discrimination ($b$ = -25.38, 95% CI [-50.82, .06], $p$ = .051). As with the analyses where discrimination was not a covariate, for the β-cell function outcome, neither the contrast for Whites nor students of color was significant ($p$s > .14). Finally, turning to the metabolic syndrome indices, when controlling for discrimination, the interaction between child race and whether the school emphasized diversity still significantly predicted the number of metabolic syndrome signs ($b$ = -1.17, 95% CI [-1.97, -.38], $p$ = 0.004) and the continuous metabolic syndrome composite ($b$ = -2.04, 95% CI [-3.31, -.76], $p$ = 0.002). Among students of color, the difference between those who attended schools that did and did not emphasize diversity became significant (having previously been marginal) for the number of metabolic syndrome signs ($b$ = -.52, 95% CI [-1.02, -.03], $p$ = .040, $d$ = .24) and remained significant for the continuous metabolic syndrome composite ($b$ = -1.24, 95% CI [-2.00, -.48], $p$ = 0.001, $d$ = .53).

**Multiracial Participants.** In the primary analyses reported in the paper, multiracial students were categorized as students of color. To test whether this choice affected our results, we also repeated our analyses excluding the 31 multiracial participants who identified as White and as another racial/ethnic group (but leaving the 11 multiracial participants who identified with two or more racial/ethnic groups that did not include White). First, looking at the inflammation composite, the interaction between child race and whether the school emphasized diversity became marginal ($b$ = -1.23, 95% CI [-2.59, .14], $p$ = .078). Next, turning to insulin resistance, the interaction between child race and whether the school emphasized diversity remained significant ($b$ = -.55, 95% CI [-.96, -.14], $p$ = .009), with the students of color having lower insulin resistance when they attended schools that emphasized diversity ($b$ = -0.39, 95% CI [-.62, -.16], $p$ = .001, $d$ = .59). With respect to the β-cell function outcome, the interaction between child race and whether the school emphasized diversity remained marginal ($b$ = -24.45, 95% CI [-50.65, 1.75], $p$ = .067). Finally, turning to the metabolic syndrome indices, the interaction between child race and whether the school emphasized diversity still significantly predicted the number of metabolic syndrome signs ($b$ = -1.20, 95% CI [-2.00, -.40], $p$ = 0.003) and the continuous metabolic syndrome composite ($b$ = -1.96, 95% CI [-3.32, -.61], $p$ = 0.005). Among students of color, the difference between those who attended schools that did and did not emphasize diversity became significant (having previously been marginal) for the number of metabolic syndrome signs ($b$ = -.69, 95% CI [-1.14, -.24], $p$ = .003, $d$ = .37) and remained significant for the continuous metabolic syndrome composite ($b$ = -1.36, 95% CI [-2.28, -.44], $p$ = 0.004, $d$ = .57).

**Table S1. Descriptive statistics for schools that do and do not emphasize diversity**

| | Emphasizes Diversity: No | | Emphasizes Diversity: Yes | | |
|---|---|---|---|---|---|
| | N | Mean (SD) or Percent | N | Mean (SD) or Percent | p-value for $\chi^2$ or t-test |
| Number of words in mission statement | 62 | 67.73 (45.48) | 58 | 96.05 (69.07) | 0.009 |
| School is private/parochial (vs. public) | 62 | 12.90 | 58 | 18.97 | 0.363 |
| School is selective public school (e.g., magnet, charter) | 62 | 25.81 | 58 | 29.31 | 0.668 |
| Student-teacher ratio | 52 | 15.47 (3.66) | 55 | 16.38 (5.50) | 0.290 |
| Percentage of students who are White | 62 | 29.74 (28.41) | 55 | 28.73 (28.20) | 0.847 |
| Percentage of students who are African American | 62 | 27.27 (34.11) | 55 | 27.53 (30.74) | 0.966 |
| Percentage of students who are "low income"[1,2] | 54 | 66.25 (29.94) | 46 | 62.50 (30.29) | .535 |
| Percentage of students who are English language learners[2] | 54 | 12.40 (13.24) | 46 | 16.21 (17.00) | .211 |
| Percentage of 8th graders in school meeting/ exceeding grade level expectations on standardized tests[2] | 53 | 33.09 (18.07) | 44 | 37.73 (19.56) | .228 |

[1]Low income students are defined as those eligible for free/reduced price lunch, receiving public assistance, and/or in alternative care.
[2]Data for these metrics are only available for public schools. Comparisons were conducted using public (but not private/parochial) schools in the sample because these data were only available for public schools.

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