

SPECIAL ARTICLE

Racial and Ethnic Health Disparities among Fifth-Graders in Three Cities

Mark A. Schuster, M.D., Ph.D., Marc N. Elliott, Ph.D., David E. Kanouse, Ph.D., Jan L. Wallander, Ph.D., Susan R. Tortolero, Ph.D., Jessica A. Ratner, B.A., David J. Klein, M.S., Paula M. Cuccaro, Ph.D., Susan L. Davies, Ph.D., and Stephen W. Banspach, Ph.D.

ABSTRACT

BACKGROUND

For many health-related behaviors and outcomes, racial and ethnic disparities among adolescents are well documented, but less is known about health-related disparities during preadolescence.

METHODS

We studied 5119 randomly selected public-school fifth-graders and their parents in three metropolitan areas in the United States. We examined differences among black, Latino, and white children on 16 measures, including witnessing of violence, peer victimization, perpetration of aggression, seat-belt use, bike-helmet use, substance use, discrimination, terrorism worries, vigorous exercise, obesity, and self-rated health status and psychological and physical quality of life. We tested potential mediators of racial and ethnic disparities (i.e., sociodemographic characteristics and the child's school) using partially adjusted models.

RESULTS

There were significant differences between black children and white children for all 16 measures and between Latino children and white children for 12 of 16 measures, although adjusted analyses reduced many of these disparities. For example, in unadjusted analysis, the rate of witnessing a threat or injury with a gun was higher among blacks (20%) and Latinos (11%) than among whites (5%), and the number of days per week on which the student performed vigorous exercise was lower among blacks (3.56 days) and Latinos (3.77 days) than among whites (4.33 days) ($P < 0.001$ for all comparisons). After statistical adjustment, these differences were reduced by about half between blacks and whites and were eliminated between Latinos and whites. Household income, household highest education level, and the child's school were the most substantial mediators of racial and ethnic disparities.

CONCLUSIONS

We found that harmful health behaviors, experiences, and outcomes were more common among black children and Latino children than among white children. Adjustment for socioeconomic status and the child's school substantially reduced most of these differences. Interventions that address potentially detrimental consequences of low socioeconomic status and adverse school environments may help reduce racial and ethnic differences in child health. (Funded by the Centers for Disease Control and Prevention.)

From the Division of General Pediatrics, Department of Medicine, Boston Children's Hospital (M.A.S., J.A.R., D.J.K.), and the Department of Pediatrics, Harvard Medical School (M.A.S.) — both in Boston; RAND, Santa Monica (M.A.S., M.N.E., D.E.K.), and Psychological Sciences, Center of Excellence on Health Disparities, and Health Sciences Research Institute, University of California, Merced, Merced (J.L.W.) — both in California; the Center for Health Promotion and Prevention Research, University of Texas Health Science Center, Houston (S.R.T., P.M.C.); the Department of Health Behavior, School of Public Health, University of Alabama at Birmingham, Birmingham (S.L.D.); and the National Center for Chronic Disease Prevention and Health Promotion, Division of Adolescent and School Health, Centers for Disease Control and Prevention, Atlanta (S.W.B.). Address reprint requests to Dr. Schuster at the Division of General Pediatrics, Boston Children's Hospital, 300 Longwood Ave., Boston, MA 02115, or at mark.schuster@childrens.harvard.edu.

N Engl J Med 2012;367:735-45.

DOI: 10.1056/NEJMsal114353

Copyright © 2012 Massachusetts Medical Society.

SUBSTANTIAL RACIAL AND ETHNIC DISPARITIES have been documented among adolescents across a range of health-related behaviors, experiences, and outcomes, including the use of bike helmets¹; witnessing of violence, experience of victimization, and perpetration of violence¹⁻⁶; experience of discrimination⁷; perceived health status^{8,9}; and obesity.^{1-3,8,10,11} In contrast, we know much less about similar health-related issues among preadolescents. Several studies in this age group, which generally have involved small numbers of participants, examined one or two health behaviors, or included only two racial and ethnic groups, suggest that disparities among these children may mirror those that have been found among adolescents.^{3,6,8-10,12,13}

We conducted a study of racial and ethnic disparities in a broad range of health-related measures among fifth-grade children. These issues matter because of childhood morbidity and mortality and because health-related problems during childhood may have lifelong implications, either by establishing patterns that can persist into adulthood (e.g., cigarette use^{14,15}) or by exerting long-term biologic influence (e.g., obesity^{16,17}). Moreover, although racial and ethnic disparities have been identified at early ages (e.g., in rates of preterm birth and low birth weight,¹⁸⁻²⁰ school readiness,^{18,21} and obesity²²), our study assessed whether disparities that are typically associated with adolescence (e.g., violence, peer victimization, and substance use) emerge during adolescence or are already present during preadolescence. Understanding the mediators of such disparities may identify the most promising policy levers for reducing them.

METHODS

STUDY PARTICIPANTS

We analyzed data from Healthy Passages, a study of fifth-graders and their parents, which was conducted from August 2004 through September 2006.²³ The participants were fifth-graders at public schools in districts in and around Birmingham, Alabama; Houston; and Los Angeles County. We then randomly sampled schools with probabilities designed to provide a balanced sample of children who were non-Latino black, Latino (regardless of race), and non-Latino white²³ and distributed letters in classrooms requesting permission to contact children's primary caregivers (henceforth called parents).

Among 11,532 students in the sampled schools, the parents of 6663 children permitted us to contact them; of these children, 5147 (77%) participated in the study. Each parent-child dyad completed computer-assisted personal interviews and audio-computer-assisted self-interviews (for sensitive questions) in English or Spanish. All parents provided written informed consent, and children provided written assent. A parental interview was lacking for 28 dyads, which left a sample of 5119. We included all dyads in adjusted analyses but report results for racial and ethnic groups with samples large enough for sufficiently precise estimation: black, Latino, and white (4612 dyads). Unadjusted rates were calculated for these 4612 dyads only. Relevant institutional review boards reviewed the research protocol.

HEALTH-RELATED AND OTHER MEASURES

We evaluated 16 health-related measures — witnessing of physical assault without a weapon, witnessing of threat or injury with a gun, victimization by peers, perpetration of nonphysical aggression, perpetration of physical aggression, cigarette smoking, alcohol use, seat-belt use, bike-helmet use, experience of discrimination, worrying about terrorism, obesity, vigorous exercise, health status, psychological quality of life, and physical quality of life — which are described in detail in Table S1 in the Supplementary Appendix (available with the full text of this article at NEJM.org). Parents reported sociodemographic characteristics; children reported all other measures (except obesity, which was derived from the body-mass index, as measured by researchers). For the children's evaluations of their psychological and physical quality of life, we used the Pediatric Quality of Life Inventory Psychological Health Summary Score and Physical Health Summary Score (www.pedsqol.org).

STATISTICAL ANALYSIS

To determine the extent to which blacks and Latinos differed statistically from whites, we used logistic and linear regressions, respectively, for dichotomous and continuous measures, with adjustment for sociodemographic characteristics (the child's age and sex, marital status of the responding parent, highest education level in household, and total household income) and the child's school and neighborhood.²³ Results from this model were presented as predictive margins,²⁴ in which the regression models predict means and proportions for each racial and ethnic group, holding

the distribution of all other respondent covariates constant across groups. We calculated differences from whites in these covariate-adjusted means and proportions to measure disparities. A “missing” category was included for income (8% missing) and education (1%); mean imputation was used for the marital status of the responding parent (<1%). We used Stata software, version 11, to account for design and nonresponse weights, clustering of children within schools, and site stratification.²³

We conducted an analysis to assess the relative importance of covariates in relation to disparities among racial and ethnic groups. To do so, we defined four factors (conceptual classes of covariates) that might mediate the relationship between racial and ethnic group and health-related measures: the child’s demographic characteristics (age and sex), parental marital status, socioeconomic status (household income and highest household education level), and the child’s school. We ran a series of four partially adjusted models that excluded one factor at a time.

We linked the residential addresses of participants to data from U.S. Census 2000 at the block-group level. To determine whether health-related measures were more correlated with the child’s school or characteristics of the child’s neighborhood, additional regression models predicted each measure from the aforementioned covariates plus seven neighborhood characteristics: proportion of households below the poverty level, proportion of adults 25 years of age or older with no more than a 12th-grade education, proportion of adults 25 years of age or older with at least a bachelor’s degree, median household income, and the proportions of residents who were Latino, non-Latino black, and non-Latino other races.

RESULTS

DISPARITIES IN HEALTH-RELATED MEASURES

The racial and ethnic groups varied widely in sociodemographic characteristics (Table 1). There were significant differences in all 16 health-related measures between black children and white children and significant differences in 12 of 16 measures between Latino children and white children (with similar rates of victimization by peers, perpetration of physical aggression, and use of tobacco and alcohol between Latino children and white children) (Table 2). For example, in unadjusted analyses, the rate of witnessing a threat or

injury with a gun was higher among blacks (20%) and Latinos (11%) than among whites (5%), and the number of days in the previous week during which the student had performed vigorous exercise was lower among blacks (3.56 days) and Latinos (3.77 days) than among whites (4.33 days) ($P<0.001$ for all comparisons). Additional disparities, as compared with whites, included lifetime cigarette use (5% higher for blacks), consistent seat-belt use (15% lower for blacks and 11% lower for Latinos), consistent bike-helmet use (36% lower for blacks and 32% lower for Latinos), and obesity (12% higher for blacks and 15% higher for Latinos) ($P<0.01$ for lifetime cigarette use and $P<0.001$ for all other comparisons).

Disparities in continuous measures, as compared with whites, included peer victimization (0.20 SD higher for blacks, $P<0.001$), discrimination (0.31 SD higher for blacks and 0.14 SD higher for Latinos; $P<0.001$ and $P<0.01$, respectively), and psychological and physical quality of life (0.28 SD lower for psychological quality of life and 0.24 SD lower for physical quality of life for blacks and 0.34 SD lower for psychological quality of life and 0.42 SD lower for physical quality of life for Latinos, $P<0.001$ for all comparisons).

EFFECTS OF ADJUSTMENT ON DISPARITIES

Table 3 provides unadjusted and adjusted differences in measures between black children and white children and between Latino children and white children, as well as the net change in these differences after adjustment. Overall, adjustment by the full set of covariates eliminated disparities between black children and white children for 6 of 16 health-related measures ($P>0.05$). Among the 10 differences that remained significant, 5 were reduced by at least 50%, and 5 were reduced by 35 to 48%. Of 12 disparities between Latino children and white children, 7 were eliminated by full adjustment, 2 were reduced by at least 50%, and 3 were reduced by 22 to 47%. For 3 measures (experiencing peer victimization and perpetrating physical and nonphysical aggression), Latino children had significantly better scores than white children after adjustment, even though in unadjusted analyses, Latino children had significantly worse scores than white children for one of these measures (perpetrating nonphysical aggression). Differences between black children and white children in witnessing a threat or injury with a gun and in performing vigorous exer-

Table 1. Characteristics of the Participants, According to the Child's Racial and Ethnic Group.*

Characteristics	No. of Participants	White Non-Latino (N=1249)	Black Non-Latino (N=1748)		Latino (N=1615)
			percent		
All participants	4612	24	32	44	
Female sex of child	2328	47	49	50	
Child's age					
<10 yr	17	<1	<1	<1	
10 yr	2017	38	40	45	
11 yr	2245	58	49	46	
>11 yr	333	4	11	9	
Child born outside the United States†	394	3	1‡	21§	
Responding parent female¶	4276	91	95§	93‡	
Highest educational level in household†					
Eighth grade or some high school	914	3	10	48	
High-school diploma or GED	976	9	31	25	
Some college	1209	17	37	19	
Four-year college degree or more	1459	71	23§	8§	
Annual household income†					
<\$25,000	1706	8	54	55	
\$25,000–\$49,999	1081	16	27	33	
\$50,000–\$99,999	827	35	14	10	
≥\$100,000	663	40	4§	2§	
Marital status of responding parent†					
Married	2613	80	36	62	
Living with a partner	326	1	5	14	
Widowed	81	1	3	1	
Divorced or separated	867	15	26	14	
Never married	712	2	31§	9§	

* All the listed characteristics were reported by the responding parent (i.e., the participating adult who is the child's parent or other primary caregiver). The numbers of participants do not total 4612 in some categories because of missing data. An additional 507 children were listed as being members of a racial and ethnic group described as "other"; their data were included in adjusted analyses but not unadjusted analyses. The reference group for comparisons among racial and ethnic groups is non-Latino white children. P values were calculated with the use of the Wald chi-square test from a logistic regression predicting each covariate with race or ethnic group. All covariates were treated as dichotomous or linearly coded with the exception of marital status, which was treated as an unordered categorical trait. GED denotes general equivalency diploma.

† P<0.001 for the overall comparison among groups.

‡ P<0.05 for the comparison of dichotomous or multilevel covariate with white children.

§ P<0.001 for the comparison of dichotomous or multilevel covariate with white children.

¶ P<0.01 for the overall comparison among groups.

cise remained significant after adjustment but were reduced by about half; disparities between Latino children and white children in both of these measures were eliminated after adjustment.

Figure 1 illustrates the relative importance of the four factors (i.e., child's demographic characteristics, parental marital status, socioeconomic

status, and school) in the adjustment of disparities. For example, the rate of witnessing a threat or injury with a gun was 15% higher among black children than among white children before adjustment, but full adjustment reduced this disparity to 8%, a reduction of 7 percentage points (Table 3).

Table 2. Unadjusted Health-Related Measures, According to the Child's Racial and Ethnic Group.*

Measure†	White Non-Latino (N=1249)	Black Non-Latino (N=1748)	Latino (N=1615)
Witnessed violence in past 12 mo (%)			
Saw physical assault without weapon "lots of times"	4	19‡	7§
Saw threat or injury with a gun	5	20‡	11‡
Victimized by peers in past 12 mo (z score)			
	-0.08	0.12‡	-0.02
Aggression in past 30 days (z score)			
Perpetrated nonphysical aggression	-0.17	0.25‡	-0.07§
Perpetrated physical aggression	-0.14	0.24‡	-0.08
Substance use (%)			
Smoked cigarette (ever)	5	10¶	6
Drank alcohol (past 12 mo)	5	7§	5
Injury prevention (%)			
Always wears seat belt	76	61‡	66‡
Always wears bike helmet	49	14‡	18‡
Social issues (z score)			
Experienced discrimination	-0.17	0.14‡	-0.02¶
Worried about terrorist attacks	-0.74	0.06‡	0.39‡
Exercise and obesity			
Classified as obese (%)	17	29‡	32‡
No. of days of performing vigorous exercise in past 7 days	4.33	3.56‡	3.77‡
Health status and quality of life			
Reported fair or poor health (%)	7	15‡	27‡
Psychological quality of life in past 30 days (z score)	0.23	-0.06‡	-0.11‡
Physical quality of life in past 30 days (z score)	0.26	0.02‡	-0.16‡

* All measures except for obesity were reported by the child. Complete data were available except for bike-helmet use (number of children who have ridden a bicycle: whites, 1106; blacks, 1481; and Latinos, 1306) and obesity (reliable height and weight available for 1192 whites, 1627 blacks, and 1476 Latinos). The reference group for comparisons among racial and ethnic groups is non-Latino white. P values were calculated with the use of a logistic or linear regression predicting each outcome with racial or ethnic group.

† Responses are reported as either percentages of participants (for dichotomous measures) or z scores with a mean of 0 and a standard deviation of 1 (for continuous measures). (Details about scoring and instruments of measurement are provided in Table S1 in the Supplementary Appendix.) Higher values indicate a greater level of response to each measure.

‡ P<0.001.

§ P<0.05.

¶ P<0.01.

The biggest independent contributors to reductions in disparities with adjustment were the child's school and socioeconomic status (i.e., household income and highest education), with the child's demographic characteristics and parental marital status having much smaller independent associations with racial and ethnic differences. The relative importance of each factor varied according to racial and ethnic group and the health-related measure. The child's school

was the most important mediator of disparities between black children and white children for 11 of 16 measures, whereas socioeconomic status was the largest mediator of disparities between Latino children and white children for 10 measures. For measures of witnessing a gun threat or injury and performing vigorous exercise, changes in disparities because of adjustment were driven almost entirely by the child's school and socioeconomic status, with school contributing more

Table 3. Effects of Adjustment on Disparities in Health-Related Measures, According to the Child's Racial and Ethnic Group.*

Measure†	Black Non-Latino (Difference from Whites)			Latino (Difference from Whites)		
	Unadjusted	Adjusted‡	Difference§	Unadjusted	Adjusted‡	Difference§
Witnessed violence in past 12 mo (%)						
Saw physical assault without weapon "lots of times"	14¶	5	-9	3	-2	-5
Saw threat or injury with a gun	15¶	8¶	-7	6¶	-1	-7
Victimized by peers in past 12 mo (z score)	0.20¶	-0.07	-0.28	0.06	-0.18**	-0.24
Aggression in past 30 days (z score)						
Perpetrated nonphysical aggression	0.42¶	0.19	-0.23	0.10	-0.22**	-0.32
Perpetrated physical aggression	0.38¶	0.23**	-0.15	0.05	-0.15	-0.20
Substance use (%)						
Smoked cigarette (ever)	5**	1	-4	1	-3	-4
Drank alcohol (past 12 mo)	2	0	-2	1	-1	-2
Injury prevention (%)						
Always wears seat belt	-15¶	-7	8	-11¶	-8	2
Always wears bike helmet	-36¶	-21¶	15	-32¶	-17¶	15
Social issues (z score)						
Experienced discrimination	0.31¶	0.20**	-0.11	0.14**	-0.10	-0.24
Worried about terrorist attacks	0.79¶	0.36¶	-0.43	1.12¶	0.50¶	-0.62
Exercise and obesity						
Classified as obese (%)	12¶	8**	-4	15¶	12¶	-4
No. of days of performing vigorous exercise in past 7 days	-0.77¶	-0.37	0.40	-0.56¶	-0.15	0.41
Health status and quality of life						
Reported fair or poor health (%)	7¶	3	-4	20¶	9**	-11
Psychological quality of life in past 30 days (z score)	-0.28¶	0.02	0.30	-0.34¶	0.08	0.42
Physical quality of life in past 30 days (z score)	-0.24¶	0.01	0.25	-0.42¶	-0.03	0.39

* All measures except obesity were reported by the child. Adjusted means and proportions are provided in Table S2 in the Supplementary Appendix.

† Responses are reported as either percentages of participants (for dichotomous measures) or z scores with a mean of 0 and a standard deviation of 1 (for continuous measures). Higher values indicate a greater level of response to each measure.

‡ Adjusted models include indicators of racial and ethnic group and additionally control for highest education in household (categorical), household income (categorical), parental marital status (married or living with a partner vs. other), age and sex of child, and child's school. Models include data from 507 children who were classified as "other" race or ethnic group; results for these children are not shown. Differences from whites in covariate-adjusted means and proportions were calculated to determine disparities. Adjusted means for each racial and ethnic group were calculated by fitting a model on observed data, setting the indicators for racial and ethnic group for all 5119 children in the sample to that racial and ethnic group, generating predicted values, and averaging the predicted values. The differences of these means between the children in each group and white children are the adjusted differences listed here.

§ Differences between unadjusted and adjusted values are measured in percentage points (for dichotomous measures) and in standard deviations (for continuous measures). Differences were rounded at the last stage of calculation.

¶ P<0.001.

|| P<0.05.

** P<0.01.

for disparities between black children and white children and socioeconomic status contributing more for disparities between Latino children and white children.

A sensitivity test showed that Census-linked

neighborhood characteristics were significantly associated with 10 of 16 measures when school was omitted from the analyses, although there was little evidence that neighborhood characteristics were significantly associated with measures inde-

pendently of school ($P < 0.05$ for 1 of 16 measures). However, school remained a significant predictor for all 16 measures ($P < 0.001$), even when neighborhood characteristics were included in the analysis.

DISCUSSION

Our study of fifth-graders attending public schools in the greater Birmingham, Houston, and Los Angeles areas showed striking disparities across racial and ethnic groups for a broad range of health-related behaviors, experiences, and outcomes, including obesity, vigorous exercise, witnessing of violence, seat-belt use, and self-reported health status and psychological and physical quality of life. Black children and Latino children fared worse than white children in almost every category. For nearly all health-related measures that we examined, adjustment for available sociodemographic characteristics and the child's school eliminated a sizable portion of these disparities and, in some cases, fully accounted for the disparities. In general, adjustment for these factors affected disparities between Latino children and white children more substantially than disparities between black children and white children. Fewer disparities between Latino children and white children persisted after adjustment, and significant differences emerged in a favorable direction for Latino children for several variables (experiencing peer victimization and perpetrating physical and nonphysical aggression). Although our study incorporated a wide variety of covariates, unavailable indicators of socioeconomic status, such as wealth and occupation, might have further narrowed adjusted disparities.

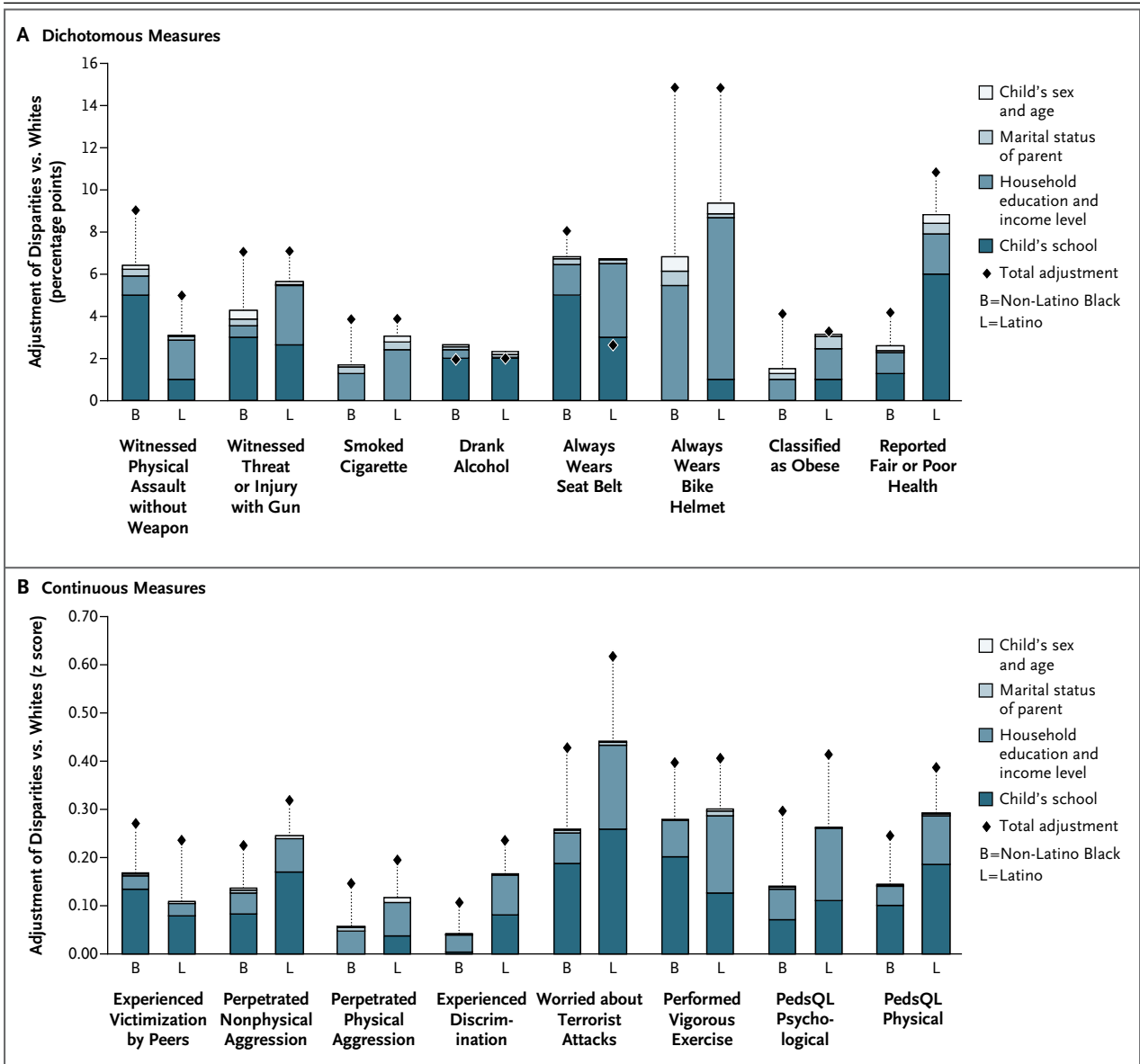
Previous research has documented that the prevalence of many health-related problems increases as children grow and that substantial racial and ethnic disparities exist by adolescence.^{1,2,4,6,25} Although some studies have included younger children (e.g., ≤ 18 years of age)^{6,8,9,26,27} and a few have focused exclusively on younger age groups,^{12,13,28-30} there is limited information on whether disparities in health-related problems that are often associated with adolescence appear earlier than adolescence. In our study, the prevalence rates of many problems were high and significant disparities already existed among preadolescents. The overall pattern of disparities in our preadolescent sample closely resembled that for older age groups, with black children having

the greatest number of disparities, followed by Latino children.²

Previous research among adults has identified socioeconomic status and neighborhood characteristics as important mediators of racial and ethnic health disparities.³¹⁻³⁴ We found that similar factors may influence preadolescent disparities. In particular, both the child's school and socioeconomic status independently mediated disparities. Whereas a child's school may reflect the neighborhood as well as school environment, since many children attend a school near their home, sensitivity analyses showed that school had an additional unique effect beyond neighborhood characteristics but not vice versa. In contrast, parental marital status appeared to have little independent association with racial and ethnic disparities in health-related problems. These patterns held for each racial and ethnic group for most of the health-related measures. Indicators of socioeconomic status more often mediated disparities between Latino children and white children, whereas the school or neighborhood environment was more often linked to disparities between black children and white children. These findings are consistent with studies among adults, which suggest both that socioeconomic status is an important mediator of racial and ethnic disparities and that, particularly for blacks, disparities are present even within income or education levels.³⁴⁻³⁶ Further research is necessary to explore factors influencing racial and ethnic disparities that are not fully captured by the sociodemographic and contextual measures used in our study. Such contributors might include additional factors involving socioeconomic status and neighborhood characteristics, discrimination, maturation level, and parenting (e.g., differences in bike-helmet use might reflect differences in parental monitoring).

Many of the health behaviors and experiences that we measured are major contributors to youth morbidity and mortality. For example, unintentional injuries are the leading cause of death among both children and adolescents.³⁷ In each racial and ethnic group, many children in our sample did not always wear a seat belt, and most did not always wear a bike helmet. Black children and Latino children were substantially less likely than white children to wear a seat belt or bike helmet.

Violence is the second largest cause of death



among adolescents and the leading cause of death for black male adolescents.³⁷ Peer victimization and exposure to community violence are linked to dysregulated physiologic stress responses³⁸⁻⁴¹ and are associated with substantial mental and physical health problems among youth.^{42,43} Among black children in our sample, exposure to violence was already prevalent, with 1 in 5 children witnessing physical assault without a weapon many times and 1 in 5 witnessing a threat or injury with a gun in the past year. Disparities between black children and white children were seen in measures of witnessing violence, being

victimized by peers, and perpetrating aggression. For most of these measures, about half of the disparity between black children and white children remained after adjustment. This suggests that there might be unmeasured factors putting black preadolescents at greater risk for these experiences and behaviors. In contrast, there might be unmeasured protective factors for these measures among Latinos. Although Latino children witnessed violence, were victimized by peers, and perpetrated aggression at levels similar to or greater than the levels among white children, after adjustment for sociodemographic

Figure 1 (facing page). Total Adjustment of Disparities between Black Fifth-Graders and Latino Fifth-Graders, as Compared with White Fifth-Graders, for 16 Measures of Health-Related Behaviors, Experiences, and Outcomes.

Shown are the differences between the disparities in responses among black fifth-graders and Latino fifth-graders, as compared with their white counterparts, and the values after adjustment for four factors: the child's sex and age, parental marital status, household education and income level, and the child's school. The differences are shown in percentage points for dichotomous measures (Panel A) and in z scores with a mean of 0 and a standard deviation of 1 for continuous measures (Panel B). The diamonds represent the total net adjustment for all four covariates, which, in general, is the sum of the single-factor adjustments and any adjustments from the combined effects of the multiple covariates. For example, the rate of witnessing a threat or injury with a gun was 15% higher among black children than among white children before adjustment, but full adjustment reduced this disparity to 8%, a reduction of 7 percentage points, as shown. The diamond above the column for this measure reflects a reduction of 7 percentage points owing to adjustment for all covariates in combination. The stacked segments show how much of this reduction can be uniquely attributed to each of the four covariates. About 3 of those 7 percentage points can be attributed uniquely to adjustment for the child's school, and less than 1 percentage point can be attributed uniquely to each of the other three covariates. The remaining 3 percentage points, represented by the vertical dashed line connecting the top of the column to the diamond above it, can be attributed jointly to a combination of the four covariates. The diamond symbol usually appears above the top of the column because of the adjustment jointly explained by multiple covariates. In three cases, however, the diamond is shown below the top of the column because one or more of the covariates reduced the overall adjustment, as represented by segments with zero height rather than negative height. Vigorous exercise is reported as the number of days in the past 7 days rather than as a z score. PedsQL denotes Pediatric Quality of Life Inventory.

characteristics and school, they had lower rates for several measures. Other studies have shown that black adolescents and young adults witness, perpetrate, and are victims of violence more commonly than whites; patterns among Latinos have been less consistent but are largely similar to those among blacks.^{1-6,44} Our finding that more black children and Latino children experienced discrimination is consistent with the results of studies involving older groups,⁷ and our finding that blacks and particularly Latinos worried more about terrorism corresponds with previous findings for both children⁴⁵ and adults.^{46,47}

The prevalence of obesity was high among the children in our study, ranging from 1 in 6 among whites to 1 in 3 among blacks and Latinos. Although these rates are somewhat higher than those found in previous research, the extent of the disparity is similar.^{10,48} Of note, in our study, disparities in obesity were less well explained by sociodemographic or contextual factors than were other problems.

Our data have implications for efforts to improve child health at both individual and community levels. First, our findings suggest that clinicians should recognize that some consequential health-related behaviors and experiences that are associated with adolescence have already begun in elementary school. Even when they have not, counseling and screening can reasonably begin in anticipation of what may soon emerge. Longitudinal research is needed to show whether disparities worsen or subside and what their consequences are.

Although the picture is complex and varies according to measure, our findings identified major correlates of disparities among preadolescents and thus potential pathways for reducing them. Disparities that are closely associated with socioeconomic status (e.g., bike-helmet use and cigarette smoking) might be ameliorated through educational interventions targeted at parental health literacy or subsidization of safety equipment. This type of approach might be particularly helpful for improving disparities between Latino children and white children. Disparities that are tied to school (e.g., peer victimization and perpetration of non-physical aggression) might be improved through efforts to change the school environment, such as school-based antibullying programs. Our finding that a child's school matters above and beyond his or her neighborhood suggests that school-based approaches might merit particular consideration. Such contextual approaches might be especially important for improving the health of black children. To make long-lasting improvements in disparities related to school and socioeconomic status, broader efforts in areas that affect health, such as education, employment, and housing, might be beneficial.^{31,33,34,36,49} Finally, given that substantial disparities sometimes remain after adjustment (e.g., for obesity), additional research is needed to identify remaining factors that might be associated with these disparities.

Our study has several limitations. First, the data

were obtained in only three metropolitan areas, so results might differ elsewhere, especially where differences in socioeconomic status are smaller among racial and ethnic groups. Second, all measures besides children's body-mass index were gathered through self-report by children and their parents. Finally, it is possible that school-related findings capture unmeasured aspects of the neighborhood beyond characteristics that were tested in our analysis.

In summary, our findings revealed marked racial and ethnic disparities among fifth-graders across a range of health-related experiences, behaviors, and outcomes, many of which were

strongly associated with the child's school and the socioeconomic status of the family. The fact that disparities are prevalent among preadolescents and, in many cases, mirror disparities found in older age groups suggests that intervention efforts may need to begin early.

Supported by cooperative agreements (CCU409679, CCU609653, CCU915773, U48DP000046, U48DP000057, U48DP000056, U19DP002663, U19DP002664, and U19DP002665) with the Centers for Disease Control and Prevention.

Disclosure forms provided by the authors are available with the full text of this article at NEJM.org.

We thank Jeremy Y. Feng and Katherine D. Vestal for research assistance, other Healthy Passages staff, and the study participants.

REFERENCES

1. High school youth risk behavior survey data. Atlanta: Centers for Disease Control and Prevention, 2009 (<http://apps.nccd.cdc.gov/youthonline>).
2. Harris KM, Gordon-Larsen P, Chantala K, Udry JR. Longitudinal trends in race/ethnic disparities in leading health indicators from adolescence to young adulthood. *Arch Pediatr Adolesc Med* 2006;160:74-81.
3. Oberg CN, Rinaldi M. Pediatric health disparities. *Curr Probl Pediatr Adolesc Health Care* 2006;36:251-68.
4. Mulye TP, Park MJ, Nelson CD, Adams SH, Irwin CE Jr, Brindis CD. Trends in adolescent and young adult health in the United States. *J Adolesc Health* 2009;45:8-24.
5. Crouch JL, Hanson RF, Saunders BE, Kilpatrick DG, Resnick HS. Income, race/ethnicity, and exposure to violence in youth: results from the national survey of adolescents. *J Commun Psychol* 2000;28:625-41.
6. Bernard SJ, Paulozzi LJ, Wallace DL. Fatal injuries among children by race and ethnicity — United States, 1999–2002. *MMWR Surveill Summ* 2007;56(SS-5):1-16.
7. Sanders-Phillips K, Settles-Reaves B, Walker D, Brownlow J. Social inequality and racial discrimination: risk factors for health disparities in children of color. *Pediatrics* 2009;124:Suppl 3:S176-S186.
8. Flores G. Technical report — racial and ethnic disparities in the health and health care of children. *Pediatrics* 2010;125(4):e979-e1020.
9. Wen M. Racial and ethnic differences in general health status and limiting health conditions among American children: parental reports in the 1999 national survey of America's families. *Ethn Health* 2007;12:401-22.
10. Hedley AA, Ogden CL, Johnson CL, Carroll MD, Curtin LR, Flegal KM. Prevalence of overweight and obesity among US children, adolescents, and adults, 1999–2002. *JAMA* 2004;291:2847-50.
11. Gordon-Larsen P, Adair LS, Popkin BM. The relationship of ethnicity, socioeconomic factors, and overweight in US adolescents. *Obes Res* 2003;11:121-9. [Erratum, *Obes Res* 2003;11:597.]
12. Campaigne BN, Morrison JA, Schumann BC, et al. Indexes of obesity and comparisons with previous national survey data in 9- and 10-year-old black and white girls: the National Heart, Lung, and Blood Institute Growth and Health Study. *J Pediatr* 1994;124:675-80.
13. Simons-Morton BG, Haynie DL. Psychosocial predictors of increased smoking stage among sixth graders. *Am J Health Behav* 2003;27:592-602.
14. Riggs NR, Chou CP, Li C, Pentz MA. Adolescent to emerging adulthood smoking trajectories: when do smoking trajectories diverge, and do they predict early adulthood nicotine dependence? *Nicotine Tob Res* 2007;9:1147-54.
15. Brook DW, Brook JS, Zhang C, Whiteman M, Cohen P, Finch SJ. Developmental trajectories of cigarette smoking from adolescence to the early thirties: personality and behavioral risk factors. *Nicotine Tob Res* 2008;10:1283-91.
16. Dietz WH. Health consequences of obesity in youth: childhood predictors of adult disease. *Pediatrics* 1998;101:518-25.
17. Biro FM, Wien M. Childhood obesity and adult morbidities. *Am J Clin Nutr* 2010;91:1499S-1505S.
18. Lynch JL. Infant health, race/ethnicity, and early educational outcomes using the ECLS-B. *Sociol Inq* 2011;81:499-526.
19. David RJ, Collins JW Jr. Differing birth weight among infants of U.S.-born blacks, African-born blacks, and U.S.-born whites. *N Engl J Med* 1997;337:1209-14.
20. Lu MC, Halfon N. Racial and ethnic disparities in birth outcomes: a life-course perspective. *Matern Child Health J* 2003;7:13-30.
21. Fiscella K, Kitzman H. Disparities in academic achievement and health: the intersection of child education and health policy. *Pediatrics* 2009;123:1073-80.
22. Anderson SE, Whitaker RC. Prevalence of obesity among US preschool children in different racial and ethnic groups. *Arch Pediatr Adolesc Med* 2009;163:344-8.
23. Windle M, Grunbaum JA, Elliott M, et al. Healthy passages: a multilevel, multi-method longitudinal study of adolescent health. *Am J Prev Med* 2004;27:164-72.
24. Graubard BI, Korn EL. Predictive margins with survey data. *Biometrics* 1999;55:652-9.
25. Singh GK, Kogan MD, Siahpush M, van Dyck PC. Independent and joint effects of socioeconomic, behavioral, and neighborhood characteristics on physical inactivity and activity levels among US children and adolescents. *J Community Health* 2008;33:206-16.
26. Chen E, Martin AD, Matthews KA. Understanding health disparities: the role of race and socioeconomic status in children's health. *Am J Public Health* 2006;96:702-8.
27. Flores G, Tomany-Korman SC. Racial and ethnic disparities in medical and dental health, access to care, and use of services in US children. *Pediatrics* 2008;121(2):e286-e298. [Erratum, *Pediatrics* 2009;124:999-1000.]
28. Harrell JS, Bangdiwala SI, Deng S, Webb JP, Bradley C. Smoking initiation in youth: the roles of gender, race, socioeconomic, and developmental status. *J Adolesc Health* 1998;23:271-9.
29. McDermott RJ, Clark-Alexander BJ, Westhoff WW, Eaton DK. Alcohol attitudes and beliefs related to actual alcohol experience in a fifth-grade cohort. *J Sch Health* 1999;69:356-61.
30. Vega WA, Zimmerman RS, Warheit GJ, Apospori E, Gil AG. Risk factors for early adolescent drug use in four ethnic and racial groups. *Am J Public Health* 1993;83:185-9.
31. Adler NE, Rehkopf DH. U.S. disparities in health: descriptions, causes, and mechanisms. *Annu Rev Public Health* 2008;29:235-52.
32. Williams DR, Jackson PB. Social

- sources of racial disparities in health. *Health Aff (Millwood)* 2005;24:325-34.
33. Laveist T, Pollack K, Thorpe R Jr, Fesahazion R, Gaskin D. Place, not race: disparities dissipate in southwest Baltimore when blacks and whites live under similar conditions. *Health Aff (Millwood)* 2011;30:1880-7.
34. Williams DR, Sternthal M. Understanding racial-ethnic disparities in health: sociological contributions. *J Health Soc Behav* 2010;51:Suppl:S15-S27.
35. Braveman PA, Cubbin C, Egerter S, Williams DR, Pamuk E. Socioeconomic disparities in health in the United States: what the patterns tell us. *Am J Public Health* 2010;100:Suppl 1:S186-S196.
36. Braveman PA, Egerter SA, Mockenhaupt RE. Broadening the focus: the need to address the social determinants of health. *Am J Prev Med* 2011;40:S4-18.
37. Heron HP, Hoyert DL, Xu J, Scott C, Tejada-Vera B. Death: preliminary data for 2006. Hyattsville, MD: National Center for Health Statistics, 2008.
38. Suggs SF, Staudenmayer J, Cohen S, Wright RJ. Posttraumatic stress symptoms related to community violence and children's diurnal cortisol response in an urban community-dwelling sample. *Int J Behav Med* 2010;17:43-50.
39. Vaillancourt T, Duku E, Becker S, et al. Peer victimization, depressive symptoms, and high salivary cortisol predict poorer memory in children. *Brain Cogn* 2011;77:191-9.
40. Knack JM, Jensen-Campbell LA, Baum A. Worse than sticks and stones? Bullying is associated with altered HPA axis functioning and poorer health. *Brain Cogn* 2011;77:183-90.
41. Cooley-Quille M, Boyd RC, Frantz E, Walsh J. Emotional and behavioral impact of exposure to community violence in inner-city adolescents. *J Clin Child Psychol* 2001;30:199-206.
42. Reijntjes A, Kamphuis JH, Prinzie P, Telch MJ. Peer victimization and internalizing problems in children: a meta-analysis of longitudinal studies. *Child Abuse Negl* 2010;34:244-52.
43. Rigby K. Consequences of bullying in schools. *Can J Psychiatry* 2003;48:583-90.
44. Sampson RJ, Morenoff JD, Raudenbush S. Social anatomy of racial and ethnic disparities in violence. *Am J Public Health* 2005;95:224-32. [Erratum, *Am J Public Health* 2006;96:591.]
45. Stein BD, Jaycox LH, Elliott MN, et al. The emotional and behavioral impact of terrorism on children: results from a national survey. *Appl Dev Sci* 2004;8:184-94.
46. Eisenman DP, Glik D, Ong M, et al. Terrorism-related fear and avoidance behavior in a multiethnic urban population. *Am J Public Health* 2009;99:168-74.
47. Stein BD, Elliott MN, Jaycox LH, et al. A national longitudinal study of the psychological consequences of the September 11, 2001 terrorist attacks: reactions, impairment, and help-seeking. *Psychiatry* 2004;67:105-17.
48. Singh GK, Siahpush M, Kogan MD. Rising social inequalities in US childhood obesity, 2003-2007. *Ann Epidemiol* 2010;20:40-52. [Erratum, *Ann Epidemiol* 2010;20:250.]
49. Woolf SH, Braveman P. Where health disparities begin: the role of social and economic determinants — and why current policies may make matters worse. *Health Aff (Millwood)* 2011;30:1852-9.

Copyright © 2012 Massachusetts Medical Society.

CLINICAL TRIAL REGISTRATION

The *Journal* requires investigators to register their clinical trials in a public trials registry. The members of the International Committee of Medical Journal Editors (ICMJE) will consider most reports of clinical trials for publication only if the trials have been registered. Current information on requirements and appropriate registries is available at www.icmje.org/faq_clinical.html.