

Longitudinal Trends in Race/Ethnic Disparities in Leading Health Indicators From Adolescence to Young Adulthood

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Objective: To use ethnically diverse, national data to examine longitudinal trends in race/ethnic disparities in 20 leading health indicators from *Healthy People 2010* across multiple domains from adolescence to young adulthood. Much of what is known about health disparities is based on cross-sectional measures collected at a single time point.

Design, Setting, and Participants: Nationally representative data for more than 14 000 adolescents enrolled in wave I (1994-1995) or wave II (1996) of the National Longitudinal Study of Adolescent Health (Add Health) and followed up into adulthood (wave III; 2001-2002). We fit longitudinal regression models to assess and contrast the trend in health indicators among racial/ethnic groups of adolescents as they transition into adulthood.

Main Outcome Measures: Diet, inactivity, obesity, tobacco use, substance use, binge drinking, violence, sexually transmitted diseases, mental health, and health care access.

Results: Diet, inactivity, obesity, health care access, substance use, and reproductive health worsened with age. Perceived health, mental health, and exposure to violence improved with age. On most health indicators, white and Asian subjects were at lowest and Native American subjects at highest risk. Although white subjects had more favorable health in adolescence, they experienced greatest declines by young adulthood. No single race/ethnic group consistently leads or falters in health across all indicators.

Conclusions: Longitudinal data indicate that, for 15 of 20 indicators, health risk increased and access to health care decreased from the teen and adult years for most US race/ethnic groups. Relative rankings on a diverse range of health indicators (and patterns of change over time) vary by sex and race/ethnicity, causing disparities to fluctuate over time.

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IN THE UNITED STATES, THERE ARE large and persistent racial, ethnic, and socioeconomic disparities in health across the life course,¹⁻³ with increasing economic and racial inequality.^{4,5} The reduction and ultimate elimination of health disparities has been identified as a major public health goal,^{6,7} exemplified by *Healthy People 2010*, the nation's promotion and disease prevention strategy for the first decade of the 21st century.⁸

McGuinness and Foege⁹ have described the major external (nongenetic) modifiable factors contributing to death in the United States. Tobacco use and poor diet/inactivity emerged as the 2 leading causes of preventable death in the United States, with alcohol abuse, motor vehicle crashes, sexually transmitted diseases (STDs), firearms, and illicit drug use also important.^{9,10} Leading health indicators from *Healthy People 2010* with known disparities in prevalence⁸ include sexually transmitted disease,¹⁰⁻¹² illicit drug use,^{10,13-15} asthma,^{16,17} lack of access to medical care,¹⁸⁻²⁰ and dental care.²¹

Health disparities research largely provides snapshots of health disparities at a single point in time or for a series of cross-sectional comparisons of different cohorts born at different times. The major contribution of our research is that we follow up the same cohort of ethnically diverse adolescents for 6 years into young adulthood to track change in disparities in health risk over time. We specifically examine 8 of 10 leading health indicators identified in *Healthy People 2010* that are particularly relevant to young people.^{7,8} Measures include health indicators related to diet and inactivity, obesity, tobacco use, substance use, STDs, mental health, violence, and access to health care.

METHODS

SURVEY DESIGN

The National Longitudinal Study of Adolescent Health (Add Health) cohort is a nationally representative school-based study of youths (grades 7-12), followed up with multiple interview waves into young adulthood. The study

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used a multistage, stratified, school-based, clustered sampling design. A stratified sample of 80 high schools (and feeder middle schools) was selected with probability proportional to size. Survey procedures were approved by the Institutional Review Board of The University of North Carolina at Chapel Hill and have been previously described.²² Wave I (1994-1995) included 20 745 adolescents (aged 12-19 years) and their parents. Wave II (1996) included 14 738 wave I adolescents (including school dropouts and excluding graduating seniors). Wave III (2001-2002) included 15 170 wave I adolescents, now aged 18 to 26 years and entering the transition to adulthood (76% response rate).²³ Total bias owing to attrition rarely exceeds 1%, which is small relative to the 20% to 80% prevalence rates for most of our measures.²³⁻²⁶

SAMPLE

We used repeated measures of health indicators, restricting the sample to respondents interviewed at wave I or wave II and at wave III (depending on the measure) with valid data at both time points. When race/ethnic disparity in each measure is tracked from waves I through III, more than 14 000 subjects (7538 females and 6725 males) participated; from waves II through III, more than 10 000 subjects (5719 females and 5069 males) participated. In all analyses, we used wave III sampling weights and survey analysis techniques to adjust for unequal probability of selection, clustered sampling design, and attrition to ensure national representation of US teens on enrollment rosters for grades 7 through 12 in 1994-1995.^{23,27,28}

MEASURES

To provide a comprehensive picture of the major health concerns of our nation, we include a range of measures that capture 8 of 10 leading health indicators of *Healthy People 2010*⁸ and that were particularly relevant to young people.

Health Habits

Diet indicators include the number of days the respondent ate breakfast and fast foods in the past 7 days (waves II and III). Physical activity is reported using a standard physical activity behavior recall that is similar, although not identical, to other self-report questionnaires that have been used and validated in other large-scale epidemiological studies.^{29,30} Wave III measures were scaled to be equivalent to those at wave II.³¹ Lack of exercise is defined by self-report of no bouts of moderate to vigorous physical activity (5-8 metabolic equivalents) per week (waves II and III).

Obesity is defined using body mass index (BMI; calculated as weight in kilograms divided by the square of height in meters) from the measured height and weight at waves II and III. To deal with the discrepant obesity definitions for adolescents and adults, the International Obesity Task Force reference is used. This reference links childhood and adolescent BMI centiles to the adult BMI cut point of 30 to determine obesity prevalence at wave II.³² For the young adult population at wave III (aged 19-26 years), we consistently use the adult BMI cut point. Measures have been described in detail elsewhere.³³

Health Care

The following health care measures (waves I and III) are dichotomous indicators reflecting lack of care: (1) whether the respondent had current health insurance; (2) whether the respondent needed but did not receive medical care in the last year; (3) whether the respondent needed but could not afford

dental or medical care last year; (4) whether the respondent visited a dentist in the last year; and (5) whether the respondent had a physical examination within 2 years.

General Health

Self-reported health is measured as a dichotomous indicator indicating fair or poor relative to good or excellent health. Asthma (parental report in wave I and self-reported asthma diagnosis in wave III) is measured as a dichotomous indicator.

Substance Abuse

All measures of substance abuse are self-reported from waves I and II and reflect (1) smoking at least 1 whole cigarette daily during the last 30 days; (2) any use of marijuana in the past 30 days; (3) any use of hard drugs such as cocaine, inhalants, or injected or other illegal drugs in the past 30 days in wave I, and any use of cocaine, injected or other illegal drugs, or crystal methamphetamine in wave III; and (4) binge drinking, defined as 5 or more drinks (ie, glass of wine, can of beer, wine cooler, shot glass of liquor, or mixed drink) on 1 occasion during the past year.

Reproductive Health

Our only measure of reproductive health is self-reported STD diagnosis (chlamydia, syphilis, gonorrhea, human immunodeficiency virus/AIDS, genital herpes, genital warts, and trichomoniasis for both sexes, and bacterial vaginosis and vaginitis for female subjects) at waves II and III.

Mental Health

We have the following 2 indicators of mental health at waves I and III: feelings of depression (feeling depressed a lot, most, or all of the time last week) and suicide ideation (the respondent has seriously thought about suicide in the past 12 months).

Violence

Exposure to violence in the past year is measured across the following items at waves I and III: (1) victim of violence who has been shot, stabbed, beat up, jumped, or threatened with a gun or a knife, and (2) perpetrator of a violent act who has pulled a knife or gun on someone or shot or stabbed someone.

Race/Ethnicity

Five race and ethnic groups were used based on self-identified race and Hispanic origin at wave III. In the largest sample, tracked from waves I through III, the sample includes non-Hispanic white (n=7728), non-Hispanic black (n=3038), non-Hispanic Asian (n=1021), Hispanic (n=2340), and Native American (n=136) subjects.

STATISTICAL ANALYSIS

We selected a marginal (or "population-average") longitudinal regression model to estimate temporal change in each health indicator; the hypotheses under investigation were best answered by examining the average experience of each race/ethnic group rather than by examining person-specific variables. Separate models were run for male and female subjects. Covariates used to predict each health indicator in the model included race/ethnic group, time, and the interaction between

race/ethnic group and time. Nonsignificant interaction terms were omitted from the final model. We hypothesized that (1) each race/ethnic group experienced no change in the health indicator over time, and (2) the rate of change in the health indicator for each nonwhite race/ethnic group was equal to the rate of change in the health indicator for the white group. To determine if the significant differences in the trend in health over time could be explained by socioeconomic status (SES), median tract income and maximum parental education were included in each of the final models, but had minimal influence on estimates of variables and made no difference in the tests of the hypotheses. Hence, we report results for the models that omitted these 2 covariates.

RESULTS

Across all sex and race/ethnic groups, there were significant increases in health risk and health disparities from adolescence into young adulthood. There were statistically significant increases over time in the proportion who get no exercise or report asthma, significant declines in breakfast consumption, and significant increases for almost every sex and race/ethnic group in the proportion of respondents who were obese, needed but could not afford medical care, used cigarettes and marijuana, had any STDs, or reported binge drinking, all indicating increasing health risk during the transition from adolescence to adulthood (**Table 1**). Reductions in risk were found in the significant declines over time across almost all sex and race/ethnic groups in the proportion who perceived their health as poor to fair, had feelings of depression or suicidal ideation, and were a victim of violence. All groups (except black and Native American male subjects) had significant declines in perpetrating violent acts.

The race/ethnic groups shift in their position as occupying the best or worst ranking across the various health indicators over time. No single race/ethnic group consistently occupies the best or worst ranking. The tendency was for Asian and non-Hispanic white subjects to generally rank best across time and across multiple domains of health risk, whereas the other minority groups ranked worst (**Table 2** and **Table 3**). However, white subjects lose their favored position more often than other groups as they age into adulthood. Native American subjects tended to appear in the worst rankings most often, followed by non-Hispanic black subjects, with Hispanic subjects in the middle range across most indicators.

Selected illustrative results are presented in **Figure 1** and **Figure 2** by category of health indicator. The full set of figures for male and female subjects in all 20 leading health indicators can be found at <http://www.cpc.unc.edu/projects/addhealth/findings>.

HEALTH HABITS AND HEALTH CARE

There was a significant increase in the proportion of overweight/obese adolescents and those engaging in no weekly physical activity (female subjects shown in Figure 1A and B). The trend lines fan out, indicating increasing disparity in young adulthood, highest among black vs white subjects. The proportion of respondents with no health insur-

ance coverage increased significantly for most groups (male subjects shown in Figure 1C). The proportion with the last physical examination more than 2 years ago (Figure 1D) also increased significantly for most male subjects, with increases for Hispanic and Native American subjects proportionately greater than those for white subjects.

GENERAL AND MENTAL HEALTH, SUBSTANCE USE, REPRODUCTIVE HEALTH, AND VIOLENCE

Self-reports of poor health (male subjects in Figure 2A) and feelings of depression (female subjects in Figure 2B) declined significantly as adolescents aged into young adulthood, and race/ethnic disparities decreased as well. Smoking (Figure 2C) and binge drinking (Figure 2D) increased significantly for all groups, with increasing disparity over time and greatest disadvantage among white subjects. Diagnosis of STDs increased significantly in the transition to adulthood for all groups, with increasing race/ethnic disparity over time (Figure 2E). Violence declined significantly over time for all groups, with decreasing race/ethnic disparity (Figure 2F).

The overall patterns of health disparities include significantly different trends for black relative to white female subjects across almost all domains. Among male subjects, the black-white disparity in trends is significant for more than half of the indicators. For both sexes, the white-Hispanic disparity in health trends is significant for 35% of the indicators. Patterns of change in health indicators are similar for white and Asian subjects, and greater among male than female Native American compared with white subjects.

COMMENT

To our knowledge, this research is the first to present longitudinal, nationally representative data on race/ethnic disparities in leading health indicators across the transition to adulthood. The fact that we can follow up the same individuals longitudinally to examine changes in these health risk behaviors, specifically the placement of these changes in the context of health disparities, is a major contribution of this research.

For 15 of 20 indicators, health risk increased across all race/ethnic groups during the transition to adulthood. Relative rankings on a diverse range of health indicators (and patterns of change over time) varied by sex and race/ethnicity, causing disparities to fluctuate over time. Asian and white subjects generally scored highest across the range of health indicators; Hispanic subjects scored within the moderate range; and Native American and non-Hispanic black subjects scored the lowest. Although white subjects had more favorable health risk in adolescence, they experienced the greatest decline by young adulthood.

For most of the health indicators showing increased health risk over time, race/ethnic disparities in these indicators also increased. Although the disparities increased, different race/ethnic groups occupied more and less favored positions over time, indicating that no single common approach to reduce disparities is possible given

Table 1. Estimated Change in Sample Reporting Health Risk Factors and Health Care Access From Adolescence to Young Adulthood Within Race/Ethnicity*

Indicator	Female Subjects				
	White	Black	Native American	Asian	Hispanic
Breakfast, d/wk†	0.79 (0.66 to 0.92)‡	0.79 (0.66 to 0.92)‡	0.79 (0.66 to 0.92)‡	0.79 (0.66 to 0.92)‡	0.79 (0.66 to 0.92)‡
Fast food, d/wk†	-0.05 (-0.21 to 0.11)	-0.55 (-0.77 to -0.33)‡	-0.36 (-0.97 to 0.25)	-0.23 (-0.60 to 0.13)	-0.40 (-0.62 to -0.17)‡
No exercise	-0.40 (-0.42 to -0.38)‡	-0.47 (-0.50 to -0.43)‡	-0.34 (-0.47 to -0.22)‡	-0.45 (-0.52 to -0.39)‡	-0.40 (-0.43 to -0.37)‡
Obese	-0.11 (-0.13 to -0.10)‡	-0.16 (-0.19 to -0.14)‡	-0.14 (-0.21 to -0.08)‡	-0.05 (-0.08 to -0.02)‡	-0.13 (-0.16 to -0.11)‡
No health insurance	-0.13 (-0.15 to -0.11)‡	-0.05 (-0.09 to -0.02)‡	-0.17 (-0.35 to 0.00)	-0.06 (-0.13 to 0.02)	0.03 (-0.03 to 0.09)
Need but did not get medical aid	-0.03 (-0.05 to -0.01)	0.02 (-0.02 to 0.06)	0.17 (0.08 to 0.26)‡	-0.04 (-0.15 to 0.07)	-0.06 (-0.12 to 0.00)
Need but could not afford medical aid	-0.16 (-0.18 to -0.14)‡	-0.12 (-0.14 to -0.10)‡	-0.22 (-0.32 to -0.13)‡	-0.11 (-0.16 to -0.06)‡	-0.17 (-0.19 to -0.14)‡
No dental examination last year	-0.39 (-0.44 to -0.35)‡	-0.07 (-0.13 to -0.01)	-0.20 (-0.46 to 0.05)	-0.33 (-0.44 to -0.22)‡	-0.07 (-0.15 to 0.02)
Last physical examination >2 y ago	-0.03 (-0.05 to -0.01)‡	0.05 (0.03 to 0.08)‡	0.04 (-0.18 to 0.26)	0.01 (-0.08 to 0.09)	0.04 (-0.02 to 0.10)
Health perceived as poor to fair	0.02 (0.01 to 0.03)‡	0.03 (0.01 to 0.05)‡	0.03 (0.08 to 0.05)‡	0.02 (0.01 to 0.04)‡	0.03 (0.01 to 0.04)‡
Asthma	-0.06 (-0.08 to -0.05)‡	-0.06 (-0.07 to -0.04)‡	-0.09 (-0.13 to -0.06)‡	-0.05 (-0.07 to -0.03)‡	-0.07 (-0.08 to -0.05)‡
Daily cigarette use	-0.14 (-0.71 to -0.12)‡	-0.07 (-0.09 to -0.05)‡	-0.13 (-0.35 to 0.08)‡	-0.06 (-0.10 to -0.02)‡	-0.09 (-0.12 to -0.06)‡
Marijuana use	-0.06 (-0.08 to -0.04)‡	-0.04 (-0.06 to -0.03)‡	-0.08 (-0.11 to -0.04)‡	-0.03 (-0.05 to -0.01)‡	-0.05 (-0.07 to -0.03)‡
Drug use	-0.00 (-0.02 to 0.01)	-0.00 (-0.01 to 0.00)	-0.00 (-0.02 to 0.02)	-0.00 (-0.01 to 0.01)	-0.00 (-0.01 to 0.01)
Binge drink	-0.25 (-0.28 to -0.21)‡	-0.02 (-0.06 to 0.01)	-0.20 (-0.43 to 0.02)	-0.11 (-0.19 to -0.06)‡	-0.12 (-0.16 to -0.06)‡
Any STD	-0.05 (-0.07 to -0.04)‡	-0.13 (-0.16 to -0.10)‡	-0.10 (-0.16 to -0.04)‡	-0.04 (-0.07 to -0.02)‡	-0.07 (-0.09 to -0.05)‡
Feelings of depression	0.05 (0.04 to 0.06)‡	0.06 (0.04 to 0.08)‡	0.06 (0.03 to 0.09)‡	0.04 (0.03 to 0.06)‡	0.06 (0.05 to 0.08)‡
Suicidal thoughts	0.10 (0.08 to 0.11)‡	0.08 (0.06 to 0.09)‡	0.17 (0.10 to 0.24)‡	0.09 (0.06 to 0.11)‡	0.09 (0.07 to 0.11)‡
Attack someone	0.01 (0.01 to 0.01)‡	0.04 (0.03 to 0.06)‡	0.05 (0.00 to 0.10)	0.02 (0.00 to 0.04)	0.04 (0.02 to 0.05)‡
Victim of violence	0.06 (0.05 to 0.07)‡	0.12 (0.09 to 0.14)‡	0.16 (0.07 to 0.24)‡	0.07 (0.04 to 0.09)‡	0.11 (0.09 to 0.14)‡

Indicator	Male Subjects				
	White	Black	Native American	Asian	Hispanic
Breakfast, d/wk†	1.56 (1.41 to 1.70)‡	1.56 (1.41 to 1.70)‡	1.56 (1.41 to 1.70)‡	1.56 (1.41 to 1.70)‡	1.56 (1.41 to 1.70)‡
Fast food, d/wk†	-0.35 (-0.50 to -0.20)‡	-0.98 (-1.25 to -0.71)‡	0.79 (-0.18 to 1.76)	-0.17 (-0.60 to 0.27)	-0.49 (-0.79 to -0.19)‡
No exercise	-0.30 (-0.32 to -0.28)‡	-0.30 (-0.33 to -0.26)‡	-0.27 (-0.38 to -0.17)‡	-0.26 (-0.35 to -0.18)‡	-0.26 (-0.30 to -0.23)‡
Obese	-0.05 (-0.06 to -0.03)‡	-0.08 (-0.12 to -0.05)‡	-0.03 (-0.10 to 0.05)‡	-0.12 (-0.18 to -0.06)‡	-0.07 (-0.10 to -0.04)‡
No health insurance	-0.17 (-0.19 to -0.14)‡	-0.16 (-0.21 to -0.11)‡	-0.19 (-0.46 to 0.09)	-0.03 (-0.13 to 0.06)	-0.11 (-0.19 to -0.04)‡
Need but did not get medical aid	-0.04 (-0.06 to -0.03)‡	-0.04 (-0.06 to -0.03)‡	-0.06 (-0.09 to -0.03)‡	-0.04 (-0.06 to -0.03)‡	-0.05 (-0.06 to -0.03)‡
Need but could not afford medical aid	-0.11 (-0.13 to -0.10)‡	-0.08 (-0.10 to -0.06)‡	-0.14 (-0.31 to 0.02)	-0.07 (-0.10 to -0.04)‡	-0.12 (-0.14 to -0.09)‡
No dental examination last year	-0.31 (-0.36 to -0.25)‡	0.01 (-0.06 to 0.08)	0.30 (0.10 to 0.49)‡	-0.32 (-0.42 to -0.22)‡	0.04 (-0.05 to 0.13)
Last physical examination >2 y ago	-0.24 (-0.27 to -0.21)‡	-0.11 (-0.15 to -0.07)‡	-0.08 (-0.21 to 0.04)	-0.21 (-0.29 to -0.13)‡	-0.13 (-0.17 to -0.08)‡
Health perceived as poor to fair	0.02 (0.01 to 0.03)‡	0.02 (0.01 to 0.04)‡	0.06 (0.03 to 0.10)‡	0.01 (0.00 to 0.02)‡	0.02 (0.01 to 0.03)‡
Asthma	-0.03 (-0.04 to -0.02)‡	-0.04 (-0.05 to -0.03)‡	-0.03 (-0.06 to -0.01)‡	-0.03 (-0.04 to -0.01)‡	-0.03 (-0.05 to -0.02)‡
Daily cigarette use	-0.19 (-0.21 to -0.17)‡	-0.09 (-0.11 to -0.06)‡	-0.15 (-0.22 to -0.07)‡	-0.12 (-0.16 to -0.08)‡	-0.10 (-0.13 to -0.07)‡
Marijuana use	-0.16 (-0.18 to -0.13)‡	-0.08 (-0.13 to -0.03)‡	-0.01 (-0.18 to 0.19)	-0.03 (-0.09 to 0.03)	-0.05 (-0.10 to -0.01)
Drug use	-0.04 (-0.06 to -0.02)‡	-0.02 (-0.03 to -0.01)‡	-0.05 (-0.08 to -0.02)‡	-0.03 (-0.04 to -0.01)‡	-0.03 (-0.04 to -0.01)‡
Binge drink	-0.35 (-0.40 to -0.32)‡	-0.12 (-0.17 to -0.07)‡	-0.28 (-0.42 to -0.13)‡	-0.32 (-0.42 to -0.22)‡	-0.23 (-0.30 to -0.16)‡
Any STD	-0.02 (-0.02 to -0.01)‡	-0.05 (-0.08 to -0.03)‡	-0.07 (-0.13 to -0.01)‡	-0.01 (-0.02 to 0.00)	-0.02 (-0.04 to -0.01)‡
Feelings of depression	0.02 (0.01 to 0.03)‡	0.03 (0.01 to 0.04)‡	0.03 (0.00 to 0.05)	0.02 (0.01 to 0.04)‡	0.03 (0.02 to 0.05)‡
Suicidal thoughts	0.04 (0.03 to 0.06)‡	0.03 (0.02 to 0.04)‡	0.05 (0.01 to 0.09)‡	0.05 (0.03 to 0.07)‡	0.04 (0.02 to 0.05)‡
Attack someone	0.03 (0.03 to 0.04)‡	0.08 (0.06 to 0.10)‡	0.12 (0.07 to 0.18)‡	0.05 (0.02 to 0.07)‡	0.05 (0.03 to 0.06)‡
Victim of violence	0.14 (0.12 to 0.16)‡	0.18 (0.16 to 0.21)‡	0.20 (0.14 to 0.26)‡	0.12 (0.08 to 0.16)‡	0.18 (0.15 to 0.21)‡

Abbreviation: STD, sexually transmitted disease.

*Unless otherwise indicated, data are expressed as proportions of the sample reporting select measures at time 1 (adolescence) minus the proportion reporting select measures at time 2 (young adulthood). Numbers in parentheses are 95% confidence intervals.

†Expressed as mean number at time 1 (adolescence) minus mean number at time 2 (young adulthood) (95% confidence interval).

‡Change over time (estimated time 1 level [wave I or II] minus estimated time 2 level [wave III]) was significantly different from 0 ($P < .01$).

the race/ethnic variation in change and rankings in health risk across time. Documenting race/ethnic disparities in health indicators is essential in understanding risk and formulating preventive strategies to tackle these important behavioral/health concerns.³⁴⁻³⁷ Furthermore, re-

search needs to move beyond race/ethnicity to understand the underlying causes of health disparities in the United States.³⁸

The extent to which socioeconomic differences may account for observed disparities in health outcomes across

Table 2. Prevalence of Leading Health Indicators in US Females*

Indicator	Subjects Participating in Adolescence (Waves I-II)					Subjects Participating in Young Adulthood (Wave III)				
	White	Black	Native American	Asian	Hispanic	White	Black	Native American	Asian	Hispanic
Breakfast, d/wk	4.18 (4.01 to 4.34)	<i>3.41</i> (3.21 to 3.61)	3.79 (3.17 to 4.41)	3.85 (3.33 to 4.37)	3.89 (3.66 to 4.12)	3.38 (3.25 to 3.52)	<i>2.62</i> (2.42 to 2.82)	3.00 (2.37 to 3.63)	3.06 (2.53 to 3.58)	3.10 (2.89 to 3.30)
Fast food, d/wk	2.04 (1.91 to 2.16)	<i>2.22</i> (2.04 to 2.39)	1.72 (1.29 to 2.15)	1.87 (1.48 to 2.25)	1.96 (1.79 to 2.13)	2.09 (1.95 to 2.22)	<i>2.77</i> (2.60 to 2.93)	2.08 (1.55 to 2.61)	2.10 (1.70 to 2.51)	2.36 (2.14 to 2.57)
No exercise	0.06 (0.05 to 0.07)	<i>0.08</i> (0.07 to 0.09)	0.04 (0.02 to 0.07)	0.08 (0.05 to 0.10)	0.06 (0.05 to 0.07)	0.46 (0.43 to 0.48)	<i>0.55</i> (0.51 to 0.59)	0.39 (0.23 to 0.54)	0.53 (0.44 to 0.62)	0.46 (0.42 to 0.50)
Obese	0.10 (0.09 to 0.12)	<i>0.18</i> (0.15 to 0.20)	0.14 (0.05 to 0.23)	0.04 (0.01 to 0.06)	0.13 (0.10 to 0.16)	0.21 (0.19 to 0.24)	<i>0.34</i> (0.30 to 0.38)	0.28 (0.13 to 0.44)	0.09 (0.03 to 0.14)	0.26 (0.22 to 0.31)
No health insurance	0.08 (0.07 to 0.10)	0.15 (0.11 to 0.18)	0.06 (0.00 to 0.11)	0.12 (0.04 to 0.21)	<i>0.33</i> (0.26 to 0.39)	0.21 (0.19 to 0.23)	0.20 (0.17 to 0.23)	0.23 (0.07 to 0.38)	0.18 (0.13 to 0.23)	<i>0.29</i> (0.25 to 0.33)
Need but did not get medical aid	0.18 (0.16 to 0.20)	0.25 (0.22 to 0.28)	<i>0.37</i> (0.24 to 0.49)	0.20 (0.13 to 0.26)	0.24 (0.19 to 0.28)	0.21 (0.19 to 0.22)	0.23 (0.19 to 0.25)	0.20 (0.09 to 0.30)	0.24 (0.16 to 0.31)	<i>0.29</i> (0.25 to 0.34)
Need but could not afford medical aid	0.04 (0.03 to 0.04)	0.03 (0.02 to 0.03)	<i>0.06</i> (0.02 to 0.10)	0.03 (0.01 to 0.04)	0.04 (0.03 to 0.05)	0.19 (0.17 to 0.21)	0.15 (0.12 to 0.17)	<i>0.28</i> (0.15 to 0.41)	0.14 (0.08 to 0.20)	0.21 (0.17 to 0.24)
No dental examination last year	0.24 (0.22 to 0.27)	0.43 (0.39 to 0.47)	0.38 (0.23 to 0.52)	0.31 (0.24 to 0.39)	<i>0.44</i> (0.39 to 0.49)	<i>0.64</i> (0.61 to 0.66)	0.50 (0.46 to 0.54)	0.58 (0.43 to 0.73)	0.64 (0.57 to 0.71)	0.50 (0.45 to 0.55)
Last physical examination >2 y ago	0.11 (0.09 to 0.13)	0.11 (0.09 to 0.14)	<i>0.20</i> (0.05 to 0.36)	0.17 (0.11 to 0.22)	0.17 (0.11 to 0.22)	0.14 (0.13 to 0.15)	0.06 (0.04 to 0.08)	<i>0.16</i> (0.05 to 0.27)	0.16 (0.10 to 0.21)	0.12 (0.10 to 0.15)
Health perceived as poor to fair	0.07 (0.06 to 0.09)	<i>0.11</i> (0.09 to 0.13)	0.09 (0.04 to 0.15)	0.09 (0.05 to 0.12)	0.10 (0.07 to 0.12)	0.05 (0.04 to 0.06)	<i>0.08</i> (0.06 to 0.09)	0.07 (0.02 to 0.11)	0.06 (0.03 to 0.09)	0.07 (0.05 to 0.08)
Asthma	0.12 (0.11 to 0.13)	0.10 (0.08 to 0.13)	<i>0.20</i> (0.09 to 0.32)	0.09 (0.05 to 0.12)	0.12 (0.10 to 0.15)	0.18 (0.17 to 0.20)	0.16 (0.13 to 0.19)	<i>0.30</i> (0.15 to 0.44)	0.13 (0.09 to 0.18)	0.19 (0.15 to 0.22)
Daily cigarette use	<i>0.14</i> (0.12 to 0.16)	0.01 (0.01 to 0.02)	0.08 (-0.05 to 0.21)	0.03 (0.00 to 0.05)	0.05 (0.02 to 0.07)	<i>0.28</i> (0.26 to 0.31)	0.08 (0.06 to 0.11)	0.22 (0.04 to 0.39)	0.09 (0.03 to 0.14)	0.14 (0.09 to 0.18)
Use marijuana	0.14 (0.12 to 0.16)	0.09 (0.07 to 0.12)	<i>0.21</i> (0.13 to 0.28)	0.07 (0.04 to 0.10)	0.12 (0.10 to 0.15)	0.20 (0.18 to 0.22)	0.13 (0.10 to 0.16)	<i>0.28</i> (0.19 to 0.38)	0.11 (0.06 to 0.15)	0.17 (0.14 to 0.20)
Take hard drugs	0.06 (0.05 to 0.07)	0.02 (0.01 to 0.02)	<i>0.08</i> (0.00 to 0.16)	0.04 (0.02 to 0.05)	0.05 (0.03 to 0.07)	0.06 (0.05 to 0.07)	0.02 (0.01 to 0.02)	<i>0.09</i> (0.00 to 0.17)	0.04 (0.02 to 0.06)	0.05 (0.04 to 0.07)
Binge drink	0.28 (0.25 to 0.30)	0.13 (0.10 to 0.16)	<i>0.33</i> (0.19 to 0.47)	0.17 (0.09 to 0.25)	0.24 (0.19 to 0.29)	0.52 (0.50 to 0.55)	0.15 (0.12 to 0.18)	<i>0.54</i> (0.39 to 0.68)	0.29 (0.21 to 0.37)	0.35 (0.30 to 0.40)
Any STD	0.03 (0.02 to 0.04)	<i>0.08</i> (0.06 to 0.10)	0.06 (0.02 to 0.10)	0.02 (0.01 to 0.04)	0.04 (0.02 to 0.05)	0.08 (0.07 to 0.09)	<i>0.21</i> (0.18 to 0.23)	0.16 (0.06 to 0.25)	0.07 (0.02 to 0.11)	0.11 (0.07 to 0.14)
Feelings of depression	0.12 (0.10 to 0.13)	0.15 (0.12 to 0.17)	0.15 (0.08 to 0.22)	0.10 (0.06 to 0.14)	<i>0.16</i> (0.13 to 0.18)	0.07 (0.06 to 0.08)	0.09 (0.07 to 0.10)	0.09 (0.05 to 0.14)	0.06 (0.03 to 0.08)	<i>0.09</i> (0.07 to 0.11)
Suicidal thoughts	0.17 (0.15 to 0.18)	0.13 (0.11 to 0.15)	<i>0.33</i> (0.16 to 0.51)	0.15 (0.11 to 0.19)	0.16 (0.12 to 0.19)	0.07 (0.06 to 0.08)	0.06 (0.04 to 0.07)	<i>0.16</i> (0.05 to 0.27)	0.06 (0.04 to 0.08)	0.07 (0.05 to 0.09)
Attack someone	0.01 (0.01 to 0.01)	0.06 (0.04 to 0.07)	<i>0.06</i> (0.00 to 0.12)	0.03 (0.01 to 0.05)	0.05 (0.03 to 0.06)	0.00 (0.00 to 0.00)	0.01 (0.01 to 0.02)	<i>0.01</i> (0.00 to 0.02)	0.01 (0.00 to 0.01)	0.01 (0.00 to 0.01)
Victim of violence	0.09 (0.08 to 0.10)	0.17 (0.14 to 0.21)	<i>0.24</i> (0.09 to 0.39)	0.09 (0.06 to 0.13)	0.17 (0.14 to 0.19)	0.03 (0.02 to 0.03)	0.06 (0.04 to 0.07)	<i>0.08</i> (0.02 to 0.15)	0.03 (0.02 to 0.04)	0.05 (0.04 to 0.06)

Abbreviation: STD, sexually transmitted disease.

*Unless otherwise indicated, data are expressed as proportions of the sample reporting select measures during adolescence (waves I and II) and young adulthood (wave III). Prevalence estimates are generated from predictions from the final interactive or main effects model for each outcome. Results were unchanged with socioeconomic status controls. Numbers in parentheses are 95% confidence intervals. Boldface indicates best and italic indicates worst ranks of health disparities.

race/ethnic groups varies across studies.^{2,39} Our analytical models suggest no changes in race/ethnic disparities over time with controls for SES. Thus, factors beyond income and education may play a role in the cause of these health trends. Furthermore, SES may be related to the starting point on our health indicators in adolescence, but not to the trends in these indicators over time. It is also possible that we do not capture the complexity of the SES-health relationship across the transition from adolescence to young adulthood. For example, as teens leave their parental homes, they are likely to lose health insurance coverage owing to aging out of Medicaid coverage or leaving their parents' health insurance coverage.

The top 3 leading actual causes of death in the year 2000 were (1) tobacco use, (2) poor diet and physical inactivity, and (3) alcohol consumption.¹⁰ We found dramatic increases in behaviors related to these 3 leading

causes of death. As adolescents become young adults, they are more likely to eat fast food, get no exercise, be obese, and smoke cigarettes. Binge drinking (the most common pattern of alcohol abuse⁴⁰) increased among male and female subjects (except black and Native American subjects). These findings underscore the importance of ongoing preventive efforts related to smoking, poor diet and physical inactivity, and alcohol consumption early in the life course.

As adolescents aged into young adulthood, an increasing proportion had no current health insurance, did not receive health care when they needed it, and did not get regular dental or physical examinations (male but not female subjects, likely due to the entrance into prime child-bearing age). Race/ethnic disparities increased in the need for but inability to afford medical care, further exacerbating race/ethnic disparities in health^{19,20} and potentially leading to increased mortality.¹⁸

Table 3. Prevalence of Leading Health Indicators in US Male Subjects*

Indicator	Subjects Participating in Adolescence (Wave I-II)					Subjects Participating in Young Adulthood (Wave III)				
	White	Black	Native American	Asian	Hispanic	White	Black	Native American	Asian	Hispanic
Breakfast, d/wk	4.62 (4.46 to 4.77)	4.37 (4.16 to 4.58)	<i>3.69</i> (<i>3.14 to 4.24</i>)	4.26 (3.81 to 4.70)	4.60 (4.39 to 4.82)	3.06 (2.95 to 3.16)	2.81 (2.61 to 3.02)	<i>2.13</i> (<i>1.57 to 2.69</i>)	2.70 (2.26 to 3.14)	3.05 (2.83 to 3.26)
Fast food, d/wk	2.27 (2.15 to 2.40)	2.18 (2.02 to 2.34)	<i>3.12</i> (<i>2.37 to 3.87</i>)	2.03 (1.62 to 2.44)	2.28 (2.04 to 2.52)	2.62 (2.49 to 2.75)	<i>3.16</i> (<i>2.90 to 3.42</i>)	2.33 (1.64 to 3.02)	2.20 (1.86 to 2.53)	2.77 (2.54 to 2.99)
No exercise	<i>0.05</i> (<i>0.04 to 0.06</i>)	0.05 (0.04 to 0.06)	0.04 (0.02 to 0.07)	0.04 (0.02 to 0.06)	0.04 (0.03 to 0.05)	<i>0.35</i> (<i>0.33 to 0.37</i>)	0.34 (0.30 to 0.39)	0.32 (0.18 to 0.45)	0.31 (0.20 to 0.41)	0.31 (0.26 to 0.35)
Obese	0.14 (0.12 to 0.16)	0.14 (0.11 to 0.17)	<i>0.39</i> (<i>0.11 to 0.66</i>)	0.10 (0.05 to 0.14)	0.15 (0.11 to 0.18)	0.19 (0.17 to 0.21)	0.22 (0.18 to 0.26)	<i>0.41</i> (<i>0.07 to 0.75</i>)	0.21 (0.13 to 0.30)	0.22 (0.18 to 0.26)
No health insurance	0.09 (0.08 to 0.11)	0.13 (0.10 to 0.15)	0.08 (0.02 to 0.14)	0.14 (0.06 to 0.22)	<i>0.27</i> (<i>0.20 to 0.34</i>)	0.26 (0.23 to 0.29)	0.29 (0.24 to 0.34)	0.27 (0.02 to 0.52)	0.17 (0.12 to 0.22)	<i>0.38</i> (<i>0.33 to 0.44</i>)
Need but did not get medical aid	0.18 (0.16 to 0.20)	0.19 (0.16 to 0.21)	<i>0.30</i> (<i>0.17 to 0.43</i>)	0.17 (0.12 to 0.21)	0.19 (0.16 to 0.22)	0.22 (0.21 to 0.24)	0.23 (0.20 to 0.26)	0.36 (0.21 to 0.50)	0.21 (0.16 to 0.25)	0.23 (0.19 to 0.27)
Need but could not afford medical aid	0.02 (0.02 to 0.03)	0.02 (0.01 to 0.02)	<i>0.03</i> (<i>0.01 to 0.07</i>)	0.01 (0.01 to 0.02)	0.02 (0.02 to 0.03)	0.13 (0.12 to 0.15)	0.10 (0.07 to 0.12)	<i>0.17</i> (<i>-0.03 to 0.38</i>)	0.08 (0.04 to 0.12)	0.14 (0.11 to 0.17)
No dental examination last year	0.28 (0.25 to 0.31)	0.47 (0.42 to 0.51)	<i>0.60</i> (<i>0.46 to 0.74</i>)	0.32 (0.23 to 0.40)	0.47 (0.41 to 0.54)	0.58 (0.55 to 0.61)	0.46 (0.41 to 0.50)	0.30 (0.18 to 0.42)	<i>0.63</i> (<i>0.58 to 0.69</i>)	0.44 (0.40 to 0.48)
Last physical examination >2 y ago	0.10 (0.08 to 0.11)	0.09 (0.06 to 0.11)	<i>0.19</i> (<i>0.08 to 0.30</i>)	0.09 (0.04 to 0.13)	0.18 (0.14 to 0.22)	<i>0.34</i> (<i>0.31 to 0.37</i>)	0.20 (0.17 to 0.23)	0.27 (0.15 to 0.39)	0.29 (0.21 to 0.38)	0.31 (0.25 to 0.36)
Health perceived as poor to fair	0.05 (0.04 to 0.06)	0.08 (0.06 to 0.10)	<i>0.21</i> (<i>0.13 to 0.30</i>)	0.04 (0.02 to 0.07)	0.05 (0.03 to 0.07)	0.04 (0.03 to 0.04)	0.05 (0.04 to 0.07)	<i>0.15</i> (<i>0.09 to 0.22</i>)	0.03 (0.01 to 0.04)	0.04 (0.02 to 0.05)
Asthma	0.12 (0.10 to 0.13)	<i>0.14</i> (<i>0.12 to 0.17</i>)	0.12 (0.03 to 0.21)	0.10 (0.05 to 0.15)	0.11 (0.08 to 0.14)	0.15 (0.14 to 0.17)	0.18 (0.15 to 0.22)	0.16 (0.05 to 0.27)	0.13 (0.07 to 0.19)	0.15 (0.11 to 0.18)
Daily cigarette use	<i>0.12</i> (<i>0.10 to 0.14</i>)	0.05 (0.03 to 0.06)	0.09 (0.02 to 0.15)	0.06 (0.04 to 0.09)	0.05 (0.03 to 0.07)	<i>0.31</i> (<i>0.29 to 0.33</i>)	0.13 (0.10 to 0.17)	0.23 (0.09 to 0.37)	0.18 (0.13 to 0.24)	0.56 (0.11 to 0.20)
Use marijuana	0.14 (0.12 to 0.16)	0.19 (0.15 to 0.23)	<i>0.28</i> (<i>0.15 to 0.40</i>)	0.14 (0.07 to 0.20)	0.15 (0.12 to 0.19)	<i>0.30</i> (<i>0.28 to 0.32</i>)	0.27 (0.23 to 0.32)	0.27 (0.13 to 0.41)	0.17 (0.11 to 0.22)	0.20 (0.16 to 0.24)
Use hard drugs	0.07 (0.05 to 0.08)	0.03 (0.02 to 0.04)	<i>0.08</i> (<i>0.04 to 0.13</i>)	0.04 (0.02 to 0.06)	0.05 (0.03 to 0.06)	0.11 (0.10 to 0.12)	0.05 (0.03 to 0.06)	<i>0.14</i> (<i>0.07 to 0.20</i>)	0.07 (0.03 to 0.10)	0.07 (0.05 to 0.10)
Binge drink	<i>0.32</i> (<i>0.28 to 0.35</i>)	0.21 (0.16 to 0.25)	0.30 (0.18 to 0.43)	0.17 (0.11 to 0.22)	0.31 (0.26 to 0.36)	<i>0.67</i> (<i>0.64 to 0.71</i>)	0.33 (0.27 to 0.38)	0.58 (0.44 to 0.72)	0.49 (0.41 to 0.57)	0.54 (0.50 to 0.58)
Any STD	0.01 (0.01 to 0.02)	0.04 (0.02 to 0.06)	<i>0.06</i> (<i>0.01 to 0.10</i>)	0.01 (0.00 to 0.01)	0.02 (0.01 to 0.03)	0.03 (0.02 to 0.03)	0.09 (0.07 to 0.11)	<i>0.13</i> (<i>0.03 to 0.22</i>)	0.01 (0.00 to 0.03)	0.04 (0.02 to 0.06)
Feelings of depression	0.06 (0.05 to 0.07)	0.08 (0.06 to 0.10)	0.07 (0.02 to 0.12)	0.06 (0.03 to 0.10)	<i>0.09</i> (<i>0.07 to 0.12</i>)	0.04 (0.03 to 0.05)	0.05 (0.04 to 0.06)	0.05 (0.01 to 0.08)	0.04 (0.02 to 0.06)	<i>0.06</i> (<i>0.04 to 0.08</i>)
Suicidal thoughts	0.11 (0.10 to 0.12)	0.08 (0.06 to 0.10)	<i>0.14</i> (<i>0.04 to 0.25</i>)	0.12 (0.08 to 0.16)	0.09 (0.07 to 0.11)	0.07 (0.06 to 0.08)	0.05 (0.03 to 0.06)	<i>0.09</i> (<i>0.02 to 0.16</i>)	0.07 (0.05 to 0.10)	0.06 (0.04 to 0.07)
Attack someone	0.05 (0.04 to 0.06)	0.13 (0.11 to 0.15)	<i>0.21</i> (<i>0.12 to 0.30</i>)	0.07 (0.03 to 0.11)	0.08 (0.05 to 0.10)	0.02 (0.01 to 0.02)	0.05 (0.04 to 0.06)	<i>0.08</i> (<i>0.04 to 0.13</i>)	0.03 (0.01 to 0.04)	0.03 (0.02 to 0.04)
Victim of violence	0.25 (0.23 to 0.27)	0.35 (0.31 to 0.38)	<i>0.40</i> (<i>0.23 to 0.56</i>)	0.21 (0.14 to 0.27)	0.34 (0.30 to 0.38)	0.11 (0.10 to 0.12)	0.16 (0.14 to 0.19)	<i>0.20</i> (<i>0.09 to 0.30</i>)	0.09 (0.06 to 0.12)	0.16 (0.14 to 0.19)

Abbreviation: STD, sexually transmitted disease.

*Numbers in parentheses are 95% confidence intervals.

†Unless otherwise indicated, data are expressed as proportions of the sample reporting select measures during adolescence (waves I and II) and young adulthood (wave III). Prevalence estimates are generated from predictions from the final interactive or main effects model for each outcome. Results were unchanged with socioeconomic status controls. Boldface indicates best and italic indicates worst ranks of health disparities.

Similarly, the levels and disparities in asthma increased from adolescence to young adulthood, affecting Native American and black subjects most and confirming research that shows increasing prevalence of asthma, particularly among minorities.^{16,17} Diagnosis of STDs increased over time with substantial race/ethnic disparity (highest for black subjects). Similarly, the proportion using marijuana and hard drugs (male subjects) increased over time, with increasing race/ethnic disparity in marijuana use (highest for white subjects). The trends in prevalence of STDs and illicit drug use prompts concern owing to the association of these health indicators with increased mortality risk.⁹

On the positive side, feelings of depression and suicidal ideation decreased over time (particularly for black subjects), and differences among the race/ethnic groups declined. It is possible that this co-occurrence could, as the literature shows, influence other health risk behaviors, such as a range of STD/human immunodeficiency virus-

associated sexual activity,⁴¹ substance abuse,¹⁵ tobacco use,⁴² and obesity.⁴³ Similarly positive was the reduction in victimization and perpetration of violence. The improvement in self-reported health indicates an interesting dichotomy as these young adults consider themselves to be in good health, despite engaging in a range of health risk behaviors with negative current (and future) health implications.

We included measures of 8 of the 10 leading health indicators highlighted in *Healthy People 2010*⁸ salient for young people (not included are measures of environmental quality and immunization). Although these are admittedly a broad array of health indicators that represent several different health constructs, they are important indicators reflecting major health concerns in the United States at the beginning of the 21st century.⁸ Furthermore, the meaning of health risk may change from adolescence to young adulthood (eg, sexual behavior may be considered more risky in adolescence than young adult-

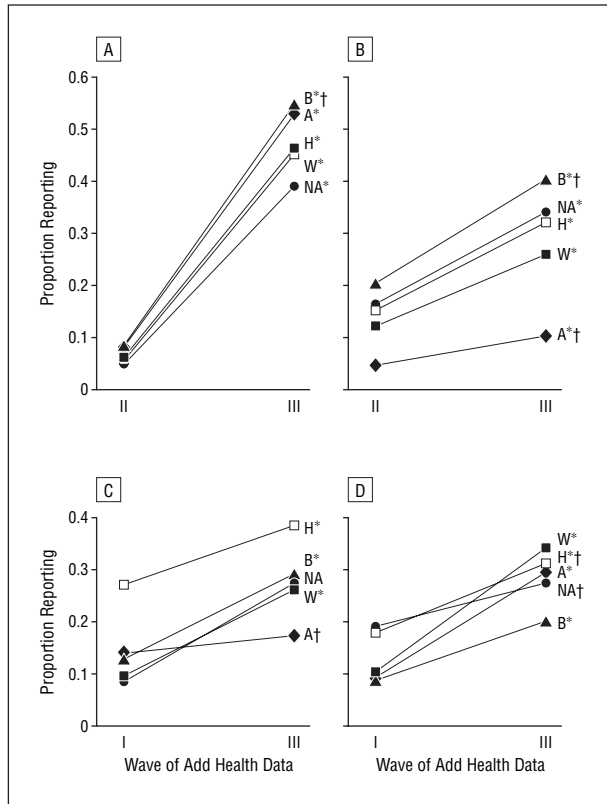


Figure 1. Graphs demonstrate trends over time in patterns of race/ethnic disparities in health habits and health care. A, Female subjects with no weekly exercise. B, Female subjects who are overweight or obese. C, Male subjects with no current health insurance. D, Male subjects whose last physical examination was more than 2 years ago. Asterisk indicates that the adolescent measure (wave I or II) differs significantly from the young adult measure (wave III) ($P < .05$); dagger, change over time differs significantly for the specified race/ethnic group relative to white subjects ($P < .05$); A, Asian; Add Health, National Longitudinal Study of Adolescent Health; B, black; H, Hispanic; NA, Native American; and W, white.

hood). Another limitation is our use of the standard race/ethnic categories, which may mask important race/ethnic heterogeneity within these groups.

Our findings indicate a strong and unprecedented decline in health during the transition to young adulthood in the current generation. Although we have no point of reference to compare these findings with those for other generations, the within-cohort trends indicate deterioration in health behaviors. As this cohort is followed up in adulthood, the assessment of morbidity and mortality outcomes associated with this increased health risk will be possible. Shifts in health profiles are part of our epidemiological history when, for example, during the demographic transition a mortality pattern of malnutrition and infectious disease shifted to one of high prevalence of chronic and degenerative diseases associated with urban-industrial lifestyles⁴⁴ and into a period of delayed degenerative diseases, a major shift in age-specific mortality patterns, and a consequent increase in life expectancy.⁴⁵ Furthermore, evidence suggests that life expectancy gains have dropped in recent decades.⁴⁶

One finding of major concern is the fact that young US adults are engaging in a range of health risk behaviors that puts them at increased risk of future adverse health outcomes. Our findings have serious implica-

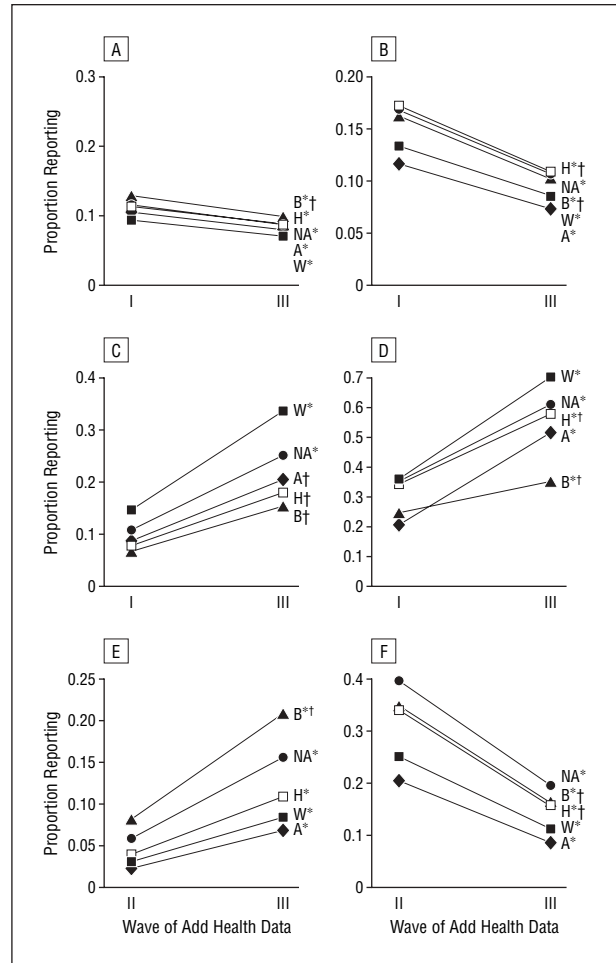


Figure 2. Graphs demonstrate trends over time in patterns of race/ethnic disparities in general and mental health, substance abuse, sexually transmitted disease (STD), self-reported health status, and violence. A, Female subjects with self-reported poor health. B, Female subjects with feelings of depression. C, Male subjects who smoke cigarettes daily. D, Male subjects who engage in binge drinking. E, Female subjects with a diagnosis of an STD in the past year. F, Female subjects who were victims of violence in the past year. Asterisk indicates that the adolescent measure (wave I or II) differs significantly from the young adult (wave III) measure ($P < .05$); dagger, change over time differs significantly for the specified race/ethnic group relative to white subjects ($P < .05$). Other abbreviations are described in the legend to Figure 1.

tions for the present and future health of this generation. We find substantial race/ethnic disparities in health that vary depending on the measure. Because our findings show great variability in the levels, relative rankings, and changes in race/ethnic disparities, policies to reduce race/ethnic disparities in health require completely different actions for each health indicator. Attention must be paid to national efforts to reduce and ameliorate these preventable conditions, particularly in light of national health objectives for reducing race/ethnic disparities in leading health indicators.

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