Abstract

IMPORTANCE Associations of educational attainment with improved health outcomes have been found to be weaker among racial/ethnic minority groups compared with those among the racial/ethnic majority group. Recent research has also documented higher than expected prevalence of smoking in highly educated African American and Hispanic adults.

OBJECTIVE To compare the association of educational attainment with exposure to tobacco advertisements among racial/ethnic groups of US young adults.

DESIGN, SETTING, AND PARTICIPANTS This cross-sectional study included data from 6700 young adults who participated in wave 1 of the Population Assessment of Tobacco and Health Study, a nationally representative survey of US adults in 2013. Educational attainment was classified as less than high school diploma, high school graduate, or college graduate. Analysis was conducted between September 20 and October 4, 2019.

MAIN OUTCOMES AND MEASURES The independent variable was educational attainment (less than high school diploma, high school graduate, and college graduate). The dependent variable was any exposure to tobacco advertisements in the past 12 months. Race/ethnicity, age, sex, poverty status, unemployment, and region were the covariates. Binary logistic and Poisson regression were used to analyze the data.

RESULTS The study included 6700 participants (3366 [50.2%] men) between ages 18 and 24 years. Most participants were non-Hispanic (5257 participants [78.9%]) and white (5394 participants [80.5%]), while 1443 participants (21.5%) were Hispanic. Educational levels included 1167 participants (17.4%) with less than a high school diploma, 4812 participants (71.8%) who were high school graduates, and 4812 participants (10.8%) who were college graduates. A total of 4728 participants (70.6%) reported exposure to tobacco advertisements in the past 12 months. Exposure to tobacco advertising was reported by 383 participants (53.1%) who were college graduates, 3453 participants (71.8%) who were high school graduates, and 892 participants (76.4%) with less than high school educational attainment. In regression analysis, high school graduation (odds ratio, 0.79; 95% CI, 0.68-0.92) and college graduation (odds ratio, 0.46; 95% CI, 0.39-0.54) were associated with lower odds of exposure to tobacco advertisements compared with young adults with lower educational attainment. Compared with non-Hispanic participants, high school education had a weaker protective association for tobacco advertisement exposure among Hispanic participants (odds ratio, 1.44; 95% CI, 1.03-2.01; P = .03), suggesting that the association of high school graduation with lower exposure to tobacco advertisement is weaker among Hispanic young adults than non-Hispanic young adults.

CONCLUSIONS AND RELEVANCE This study found that high school graduation had a weaker inverse association with tobacco advertisement exposure among Hispanic than non-Hispanic young adults.

Key Points

Question What are the associations of educational attainment with exposure to tobacco advertisements among racial/ethnic groups of young adults?

Findings This cross-sectional study among 6700 US young adults found a weaker inverse association of educational attainment with exposure to tobacco advertisement among Hispanic young adults compared with non-Hispanic young adults.

 Meaning This finding suggests that elimination of racial/ethnic disparities in tobacco use may require more than equalizing educational attainment across racial/ethnic groups.
adults. Future research should explore the role of targeted marketing strategies of the tobacco industry that largely advertise tobacco in areas with high concentrations of racial/ethnic minority groups. Future research should also evaluate the efficacy of more restrictive marketing policies on racial/ethnic disparities in tobacco use.


Introduction

In the United States, considerable racial/ethnic disparities exist in the burden of tobacco use.\(^1\)\(^5\) Despite some racial/ethnic minority groups, such as Hispanic and African American people, having a lower prevalence of tobacco use compared with non-Hispanic white people, racial/ethnic minority groups continue to have higher rates of adverse tobacco outcomes—a paradox well known to tobacco researchers.\(^3\)\(^6\)\(^7\) Owing to low access to tobacco cessation programs\(^3\)\(^6\)\(^7\) combined with low acceptability and trust in the health care system overall and tobacco cessation services in particular, African American and Hispanic young adults remain at an increased risk of adverse tobacco-related outcomes, such as cancer, respiratory conditions, and heart disease.\(^8\)

Traditionally, some of the racial/ethnic differences in tobacco use have been associated with lower socioeconomic status of racial/ethnic minority groups.\(^9\)\(^12\) The role of socioeconomic status as a social determinant of tobacco disparities has recently increased in the United States, which can be seen as a challenge to the success of US policies in reducing tobacco use prevalence.\(^12\)\(^14\) From 1966 to 2015, cigarette smoking declined by 83% among people in the United States with college degrees. The same decline was less than half as strong (40%) among individuals who did not have a high school diploma.\(^15\) If the socioeconomic gap was solely responsible for racial/ethnic disparities in tobacco use, then policies aimed at the elimination of economic inequalities would have had some success in narrowing the tobacco gap across racial/ethnic and socioeconomic groups, which is clearly not the case.\(^12\)\(^14\) Thus, socioeconomic status does not seem to be the sole mediator of the racial/ethnic gap in tobacco burden. Therefore, to eliminate racial/ethnic and socioeconomic gaps, noneconomic interventions, such as restricting tobacco marketing, may be required.

Studies from 2018\(^16\) and 2019\(^17\) have shown that not all of the racial/ethnic differences in tobacco use are associated with socioeconomic status inequalities across such groups. The inverse association of educational attainment with substance use, particularly tobacco use, has been found to be smaller among racial/ethnic minority groups than among non-Hispanic white individuals.\(^16\)\(^17\) This is a phenomenon that I have labeled “minorities’ diminished returns.”\(^16\)\(^18\)\(^20\) This phenomenon refers to a weaker than expected association of educational attainment with health outcomes among racial/ethnic minority individuals, particularly Hispanic and African American individuals, compared with non-Hispanic white individuals.\(^18\)\(^20\) Similarly, prevalence of tobacco use would be higher than expected in highly educated Hispanic and African American individuals.\(^19\)\(^21\)\(^22\) Such greater-than-expected tobacco use imposes a considerable potential threat to middle-class Hispanic and African American individuals.\(^16\)\(^17\) Although similar patterns have been repeatedly shown for other outcomes in Hispanic\(^17\)\(^22\) and African American\(^21\)\(^23\)\(^24\) individuals, the exact mechanisms of a weaker association of educational attainment with tobacco use remain unknown, to my knowledge.

Despite replicability of studies showing diminished health outcomes associated with educational attainment among racial/ethnic minority groups,\(^16\)\(^17\) few studies have explored specific mechanisms for this phenomenon in the field of tobacco use.\(^25\) In a 2019 study,\(^26\) secondhand workplace exposure to cigarette smoke was higher in highly educated Hispanic and African American individuals, which was attributed to labor market discrimination, which often results in Hispanic and African American individuals working in occupations with higher stress and lower pay than non-Hispanic white individuals. Another 2019 study\(^27\) suggested that home smoke-free tobacco policies were associated with African American households at a lower rate than expected compared
with white households. One mechanism to be examined in this study is the differential role of higher educational attainment associated with risk of exposure to tobacco advertisement in Hispanic, African American, and white individuals.27

At least some of the disparities across racial/ethnic groups in the burden of tobacco-related health outcomes are not associated with individuals’ choices but with higher exposure to tobacco marketing among racial/ethnic minority groups and individuals with lower socioeconomic status compared with non-racial/ethnic minority groups and individuals with higher socioeconomic status.28-30 Previous studies have shown that individuals with lower socioeconomic status and in racial/ethnic minority groups are at increased risk for exposure to point-of-sale advertising, retail displays, and coupons or discounts.31,32 Tobacco coupons, discounts, and advertisement are widely recognized as marketing practices that the tobacco industry uses in communities at increased risk of harm secondary to tobacco use.33,34 Coupons or discounts are risk factors for tobacco use31,34-36 and may be associated with tobacco disparities, given that racial/ethnic minority groups and lower socioeconomic status communities may be more likely to be targeted by tobacco marketing.31,38,39

In theory, at least some of the weaker than expected association of educational attainment with tobacco use among Hispanic and African American individuals may be associated with the tobacco industry’s marketing practices that disproportionately target communities of color.31,40,41 One study by Sonej et al40 suggested that the tobacco industry may specifically target Hispanic and African American individuals. The exact marketing practices that are associated with influencing people of different races, ethnicities, and educational levels are unknown, to my knowledge. I argue that differential exposure to tobacco advertisements may be associated with tobacco use by Hispanic and African American individuals, even among those with high educational attainment.16,17 A study by Brock et al34 found that as educational attainment increases, exposure to cigarette advertisement and coupons decreases. However, in the presence of weaker associations of educational attainment with exposure to tobacco advertising,17,19,21,42 highly educated Hispanic and African American individuals would likely still be exposed to tobacco advertisements at higher rates than their white peers. This may be because educational attainment has been shown to be more weakly associated with improvements in life conditions among Hispanic and African American individuals compared with non-Hispanic white individuals. In addition, African American and Hispanic individuals have been shown to remain at risk of poverty despite high educational attainment.43 Educational attainment has also been shown to be more strongly associated with increased income and upward social mobility among non-Hispanic white individuals than among Hispanic and African American individuals.44-46 Similarly, educational attainment has been shown to be associated with improved mental health,23 happiness,47 and impulse control48 among non-Hispanic white individuals compared with Hispanic and African American individuals.45 This study was conducted to assess if Hispanic and African American race/ethnicity are associated with higher risk of exposure to tobacco marketing regardless of level of educational attainment in a national sample of US young adults.

I expected to find an inverse association of educational attainment with exposure to tobacco advertisements and a weaker negative association of higher educational attainment with exposure to tobacco advertisements among Hispanic and African American individuals compared with non-Hispanic white individuals.

Methods

Design and Settings

For this cross-sectional study, I analyzed wave 1 data from the Population Assessment of Tobacco and Health (PATH) Study,49,50 which was conducted from 2013 to 2014. This analysis was conducted between September 20 and October 4, 2019. Jointly funded by the National Institutes of Health and the US Food and Drug Administration, the PATH Study is the primary source of epidemiological information regarding tobacco use among US residents. The PATH Study enrolled adults 18 years or
This report follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline.

Ethics
All adult participants in the PATH Study provided written informed consent. The institutional review board of Westat approved the study protocol. Data were collected, stored, and analyzed anonymously. This was a secondary analysis of fully deidentified public data, and the Charles R. Drew University of Medicine and Science exempted this study from an institutional review as it was considered non-human subject research. Westat did not have any role in this study.

Sampling, Sample, and Analytical Sample
The PATH sample included civilian, noninstitutionalized, US adults 18 years or older. A multistage sampling design was used (ie, 4-stage probability sampling). First, a stratified sample of geographical primary sampling units were drawn. Second, smaller geographical segments in each primary sampling unit were selected. Third, residential addresses (ie, households) were selected using US Postal Service data files. Fourth, 1 individual was selected from each sampled household. The analysis included individuals who were aged 18 to 24 years (ie, young adults), had valid data on tobacco advertisement exposure, and were either white or African American and Hispanic or non-Hispanic. People with mixed (multiple) race/ethnicity, missing data on race/ethnicity, unknown race/ethnicity, or who identified as another race/ethnicity were excluded.

Variables
The study variables included demographic factors (ie, race/ethnicity, sex, and region), socioeconomic status (ie, educational attainment and poverty status), and tobacco advertisement exposures. Variables were all measured at an individual level.

Race/Ethnicity
Race/ethnicity was self-identified. For the purpose of this study, race and ethnicity were operationalized as 2 dichotomous variables: African American vs white and Hispanic vs non-Hispanic.

Confounders
Sex was treated as a dichotomous variable (male, 1; female, 0). Region was defined as a categorical variable: West, South, Midwest, and Northeast. West was used as the reference group. Poverty status was defined based on the federal poverty threshold based on the household income and household size. This variable was a dichotomous variable, with 1 indicating living out of poverty and 0, living in poverty.

Tobacco Advertisement Exposure
The outcome was the number of different tobacco advertisements that were seen by the participant in the year before the survey was conducted. A total of 20 advertisements were shown to the individuals. The advertisements were selected randomly and included Marlboro, Camel, Newport, Wave, American Spirit, Winston, American Gold, Pall Mall, L & M, Grizzly, Copenhagen, Blue Cig, Green Smoke, Swisher Sweets, Ploom, Triple Crown, General Swedish Snus, Apollo, and NJoy. After each advertisement was shown, the participant was asked “In the past 12 months, have you seen this advertisement before this study?” The 2 possible responses for each item were yes or no. The total score was calculated (range, 0-20), with a higher score indicating higher exposure to tobacco advertisement. Although the measure is highly reliant on recalling, it is unlikely that the person would recall an advertisement without being exposed to it. Tobacco advertisement exposure was treated as a binary outcome and as a count variable, with a higher score indicating more exposure to tobacco advertisements.
Educational Attainment

For the main analysis, educational attainment was operationalized as a 3-level variable: (1) less than high school or general educational development diploma; (2) high school graduate, some college (no degree), or associate's degree; and (3) bachelor's degree or advanced degree. A 6-level educational level variable was used for the sensitivity analysis: (1) less than high school, (2) general educational development diploma, (3) high school graduate, (4) some college (no degree) or associate's degree, (5) bachelor's degree, and (6) advanced degree. Education ranged from 1 to 6 as a continuous measure, with a higher score indicating higher educational attainment.

Statistical Analysis

Data were analyzed using SPSS statistical software version 23.0 (IBM Corp). The PATH Study data were adjusted for complex survey design, including examination of the distribution of variables and ruling out collinearity between variables, such as race/ethnicity, educational attainment, and poverty status, using Spearman correlation tests. For multivariable analysis, logistic regression models were fitted with any tobacco advertisement exposure as the outcome. For sensitivity analysis, a Poisson regression model was used, which also confirmed the observed interaction. Models in the pooled sample were performed without and with interaction terms between race/ethnicity and educational attainment (ie, African American × high school graduation, Hispanic × high school graduation, African American × college graduation, and Hispanic × college graduation). From the logistic regression model, odds ratios (ORs), SEs, 95% CIs, and P values were calculated. P values were 2-sided, and statistical significance was set at less than .05. None of the study variables had missing data.

Results

This study included 6700 young adults (3366 [50.2%] men) between ages 18 and 24 years who provided a valid answer about their tobacco advertisement exposure during the past 12 months. Most participants were non-Hispanic (5257 participants [78.9%]) and white (5394 participants [80.5%]); 1443 participants (21.5%) were Hispanic. Educational levels included 1167 participants (17.4%) with less than a high school diploma, 4812 participants (71.8%) who were high school graduates, and 721 participants (10.8%) who were college graduates. A total of 4728 participants (70.6%) reported exposure to tobacco advertisements (Table 1).

Advertisement Exposure

Table 2 provides frequency and percentage of exposure to tobacco advertisements during the past 12 months by the intersection of race/ethnicity and educational attainment. In the total sample, compared with individuals without high school education, those who had high school graduation, and those who were college graduates were associated with a stepwise reduction in exposure to tobacco advertisements (76.4% vs 71.8% vs 53.1%; P < .001). The same associated stepwise increase in exposure to tobacco advertisements was observed in white (75.7% vs 70.5% vs 51.8%; P < .001) and non-Hispanic (78.3% vs 71.8% vs 52.8%; P < .001) individuals. Although still statistically significant, this associated stepwise reduction was weaker and showed a different pattern in African American (78.9% vs 76.7% vs 63.8%; P = .005) and Hispanic (71.9% vs 71.6% vs 55.8%; P = .02) individuals. The rates of tobacco advertisement exposure were comparable between individuals with vs without high school graduation among African American (76.7% vs 78.9%) and Hispanic (71.6% vs 71.9%) individuals (Table 2).

Logistic Regression Models

Table 3 presents the summary of the results of 2 logistic regression models with categorical educational attainment as the independent variable and any exposure to tobacco advertisement during the past 12 months as the dependent variable. Both models were performed in the overall sample. Model 1 did not have any interaction term. Model 2 included 4 interaction terms: African American × high school graduation, Hispanic × high school graduation, African American × college graduation, and Hispanic × college graduation.
American race with high school graduation, Hispanic ethnicity with high school graduation, African American race with college graduation, and Hispanic ethnicity with college graduation.

Model 1 showed an inverse association of educational attainment with tobacco advertisement exposure for high school graduates (OR, 0.79; 95% CI, 0.68-0.92; \( P = .002 \)) and for college graduates (OR, 0.46; 95% CI, 0.39-0.54; \( P < .001 \)) after adjustment for all covariates. Based on model 2, Hispanic ethnicity showed a significant interaction association with high school graduation for increased exposure to tobacco advertisements (OR, 1.44; 95% CI, 1.03-2.01; \( P < .001 \)), suggesting that the inverse association of high school graduation with tobacco advertisement exposure is significantly weaker for Hispanic than for non-Hispanic individuals (Table 3).

**Sensitivity Analysis**

Table 4 presents the summary of the results of 2 Poisson regression models with continuous educational attainment as the independent variable and exposure to tobacco advertisement as the dependent variable. Both models were performed in the overall sample. Model 1 did not have any

| Table 1. Descriptive Statistics Summary of the Overall Sample |
|------------------|------------------|------------------|------------------|------------------|
| Characteristic   | Participants, No. (%) |
|                  | All (n = 6700)     | White (n = 5394)  | African American (n = 1306) | Non-Hispanic (n = 5257) | Hispanic (n = 1443) |
| Race             |                  |                  |                  |                  |
| White            | 5394 (80.5)      | 5394 (100.0)     | 4072 (77.5)       | 1322 (91.6)       |
| Black            | 1306 (19.5)      | NA               | 1306 (100.0)      | 121 (8.4)         |
| Ethnicity        |                  |                  |                  |                  |
| Non-Hispanic     | 5257 (78.5)      | 4072 (75.5)      | 1185 (90.7)       | 5257 (100.0)      |
| Hispanic         | 1443 (21.5)      | 1322 (24.5)      | 121 (9.3)         | NA               |
| Sex              |                  |                  |                  |                  |
| Women            | 3334 (49.8)      | 2605 (48.3)      | 729 (55.8)        | 2630 (50.0)       |
| Men              | 3366 (50.2)      | 2789 (51.7)      | 577 (44.2)        | 2627 (50.0)       |
| Region           |                  |                  |                  |                  |
| Northeast        | 959 (14.3)       | 777 (14.4)       | 182 (13.9)        | 813 (15.5)        |
| Midwest          | 1591 (23.7)      | 1335 (24.7)      | 256 (19.6)        | 1466 (27.9)       |
| South            | 2659 (39.7)      | 1909 (35.4)      | 750 (57.4)        | 2130 (40.5)       |
| West             | 1491 (22.3)      | 1373 (25.5)      | 118 (9.0)         | 848 (16.1)        |
| Poverty status   |                  |                  |                  |                  |
| In poverty       | 3326 (49.6)      | 2500 (46.3)      | 826 (63.2)        | 2469 (47.0)       |
| Out of poverty   | 3374 (50.4)      | 2894 (53.7)      | 480 (36.8)        | 2788 (53.0)       |
| Educational attainment |                  |                  |                  |                  |
| < High school graduate | 1167 (17.4)   | 901 (16.7)       | 266 (20.4)        | 831 (15.8)        |
| High school graduate | 4812 (71.8)   | 3852 (71.4)      | 960 (73.5)        | 3780 (71.9)       |
| College graduate | 721 (10.8)       | 641 (11.9)       | 80 (6.1)          | 644 (12.3)        |
| Tobacco advertisement exposure |                  |                  |                  |                  |
| No               | 1972 (29.4)      | 1663 (30.8)      | 309 (23.7)        | 1551 (29.5)       |
| Yes              | 4728 (70.6)      | 3731 (69.2)      | 997 (76.3)        | 3706 (70.5)       |

Abbreviation: NA, not applicable

| Table 2. Advertisement Exposure Based on the Intersection of Race/Ethnicity and Educational Attainment |
|------------------|------------------|------------------|------------------|------------------|
| Educational Attainment | Participants With Tobacco Advertisement Exposure, No. (%) |
|                   | All (n = 6700)   | White (n = 5394) | African American (n = 1306) | Non-Hispanic (n = 5257) | Hispanic (n = 1443) |
| < High school graduate | 892 (76.4)      | 682 (75.7)       | 210 (78.9)        | 652 (78.3)        | 240 (71.9)         |
| High school graduate | 3453 (71.8)     | 2717 (70.5)      | 736 (76.7)        | 2714 (71.8)       | 739 (71.6)         |
| College graduate   | 383 (53.1)      | 332 (51.8)       | 51 (63.8)         | 340 (52.8)        | 43 (55.8)          |
| \( P \) Value*     | < .001          | < .001           | .005              | < .001            | .02               |

* \( \chi^2 \) for comparisons across educational levels within group of race/ethnicity.
interaction terms. Model 2 also included 2 interaction terms: Hispanic ethnicity with educational attainment and African American race with educational attainment.

Model 1 showed an inverse association of educational attainment with tobacco advertisement exposure ($B = −0.17; 95\% CI, −0.21 to −0.14; P < .001$), after adjustment for all covariates. Based on model 2, there were significant interactions with educational attainment on tobacco advertisement exposure associated with African American ($B = 0.10; 95\% CI, 0.07-0.13; P < .001$) or Hispanic ($B = 0.06; 95\% CI, 0.03-0.09; P < .001$) race/ethnicity. This finding suggests that the inverse

Table 3. Logistic Regression on Tobacco Advertisement Exposure in the Pooled Sample

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1*</th>
<th>Model 2b</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B (SE)</td>
<td>OR (95% CI)</td>
</tr>
<tr>
<td>Hispanic ethnicity</td>
<td>−0.01 (0.07)</td>
<td>0.99 (0.86-1.14)</td>
</tr>
<tr>
<td>African American race</td>
<td>0.31 (0.07)</td>
<td>1.36 (1.18-1.58)</td>
</tr>
<tr>
<td>Men</td>
<td>0.06 (0.05)</td>
<td>1.06 (0.95-1.18)</td>
</tr>
<tr>
<td>Region</td>
<td></td>
<td>.89</td>
</tr>
<tr>
<td>South</td>
<td>−0.02 (0.09)</td>
<td>0.98 (0.82-1.17)</td>
</tr>
<tr>
<td>Midwest</td>
<td>−0.05 (0.08)</td>
<td>0.96 (0.81-1.13)</td>
</tr>
<tr>
<td>Northeast</td>
<td>−0.07 (0.09)</td>
<td>0.93 (0.78-1.12)</td>
</tr>
<tr>
<td>Living out of poverty</td>
<td>0 (0.06)</td>
<td>1.00 (0.90-1.12)</td>
</tr>
<tr>
<td>Educational Attainment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highschool graduate</td>
<td>−0.24 (0.08)</td>
<td>0.79 (0.68-0.92)</td>
</tr>
<tr>
<td>College graduate</td>
<td>−0.79 (0.08)</td>
<td>0.46 (0.39-0.54)</td>
</tr>
<tr>
<td>Interaction of Hispanic ethnicity with educational attainment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highschool graduate</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>College graduate</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Interaction of African American race with educational attainment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highschool graduate</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>College graduate</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Intercept</td>
<td>1.12 (0.11)</td>
<td>3.07</td>
</tr>
</tbody>
</table>

Abbreviations: B, regression coefficient; OR, odds ratio; NA, not applicable.  
* Examines main variables only.  
a Examines model 1 and interactions only.

Table 4. Poisson Regression on Tobacco Advertisement Exposure in the Pooled Sample

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1a</th>
<th>Model 2b</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B (SE) [95% CI]</td>
<td>P Value</td>
</tr>
<tr>
<td>Hispanic ethnicity</td>
<td>−0.02 (0.02) [−0.06 to 0.02]</td>
<td>.37</td>
</tr>
<tr>
<td>African American race</td>
<td>0.07 (0.02) [0.03 to 0.11]</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Men</td>
<td>0.03 (0.02) [0 to 0.06]</td>
<td>.03</td>
</tr>
<tr>
<td>Region</td>
<td></td>
<td></td>
</tr>
<tr>
<td>West</td>
<td>0.03 (0.03) [−0.02 to 0.09]</td>
<td>.22</td>
</tr>
<tr>
<td>South</td>
<td>0.13 (0.02) [0.08 to 0.18]</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Midwest</td>
<td>0.10 (0.03) [0.05 to 0.15]</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Northeast</td>
<td>−0.15 (0.01) [−0.16 to −0.14]</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Living out of poverty</td>
<td>−0.17 (0.02) [−0.21 to −0.14]</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Interaction of African American race × educational attainment</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Interaction of Hispanic ethnicity × educational attainment</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Intercept</td>
<td>1.42 (0.03) [1.36 to 1.48]</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Abbreviations: B, regression coefficient; NA, not applicable.  
* Examines main variables only.  
b Examines model 1 and interactions only.
Discussion

This cross-sectional study found that high school and college graduation were associated with a step-wise reduction in exposure to tobacco advertisement in the overall sample of young adults. However, the inverse association of high school graduation with tobacco advertisement exposure was weaker among Hispanic individuals than non-Hispanic individuals. Thus, in line with my hypothesis, the weaker inverse association of educational attainment with tobacco advertisement exposure meant that Hispanic high school graduates reported higher-than-expected exposure to tobacco advertisements.

At least some of the racial/ethnic tobacco burden disparities are not associated with individuals' choices but with higher exposure to tobacco marketing among communities of racial/ethnic minority groups and communities with lower socioeconomic status compared with communities of non-racial/ethnic minority groups and communities with higher socioeconomic status. People of color and individuals who live in lower socioeconomic status areas are at an increased risk for exposure to point-of-sale advertising, retail displays, and coupons or discounts. Tobacco coupons, discounts, and advertisements specifically target these communities. Advertisements and coupons or discounts are among the main risk factors of tobacco use and are potential contributors to tobacco use disparities.

Marketing practices may be associated with the higher tobacco risk associated with lower socioeconomic status and with African American and Hispanic race/ethnicity. One study in 6 neighborhoods in Boston, Massachusetts, found that people were heavily exposed to outdoor cigarette advertising, particularly people in areas with significant African American and Hispanic or Latino populations and with lower socioeconomic status. The results of this study provide some suggestive evidence for high exposure to tobacco advertisements in Hispanic and African American populations, regardless of socioeconomic status. Other studies have also suggested that the tobacco industry disproportionately targets these communities, which may increase the risk of tobacco use in their residents. Such place-based activity may also impose risk to high socioeconomic status African American and Hispanic individuals who live in communities that include predominantly African American and Hispanic populations.

Previous research has shown disproportionately high risk of tobacco use in highly educated and high-socioeconomic status Hispanic and African American individuals, across tobacco products. Highly educated Hispanic and African American individuals are also exposed to higher levels of secondhand tobacco smoke inside their homes and at work compared with white individuals. Thus, highly educated racial/ethnic minority groups remain at high risk of chronic medical conditions, such as chronic obstructive pulmonary disease, asthma, and hypertension.

Similarly, rates of hospitalization and mortality are higher in highly educated racial/ethnic minority groups than in racial/ethnic majority groups. This pattern of weaker-than-expected associations of educational attainment in the lives of people of color compared with their white peers has been described previously as 'minorities' diminished returns.' The findings of this study suggest a similar pattern in that highly educated racial/ethnic minority groups had higher-than-expected rates of exposure to tobacco advertisements, disproportionate to their education level.

Weaker-than-expected associations of health outcomes with socioeconomic status indicators are not limited to tobacco outcomes and have been documented for diet, exercise, obesity, depression, anxiety, self-rated health, and health care use and have been described in children, youths, adults, and older adults. Similar patterns are also shown for marginalizing social identities other than race/ethnicity, such as sexual orientation. The robust and systemic nature of the weaker than expected associations of health outcomes with education suggests that socioeconomic status may lose some of its protective associations among people marginalized by society, regardless of socioeconomic status, marginalizing identity, and outcome.
Given the existing weaker-than-expected associations of health outcomes with education for racial/ethnic minority groups, racial/ethnic gaps in tobacco exposure may increase, rather than decrease, as socioeconomic status increases. Rather than socioeconomic status per se, the major risk factors for tobacco disparities in middle-class racial/ethnic minority groups may be residual environmental exposures that continue regardless of socioeconomic status. The findings in this study suggest that at least some of the additional risk of tobacco use in highly educated racial/ethnic minority groups may be associated with environmental risk factors for tobacco use. Increased exposure to tobacco advertisement is a form of structural and place-based discrimination that is associated with worse health and well-being of people of color in the United States. Given existing residential segregation, people of color are more likely to live in proximity to tobacco retail stores, liquor shops, and tobacco outlets. Future research is needed on societal mechanisms that expose highly educated individuals from racial/ethnic minority groups to tobacco advertisement. If marketing is responsible for greater than expected tobacco use among highly educated racial/ethnic minority groups, then restricting marketing may be a solution to the tobacco burden disparities in racial/ethnic minority groups across socioeconomic levels, and more restrictive regulatory policies may be needed. However, even tobacco regulatory policies may be differently associated with outcomes across social groups.

**Implications**

These results have some policy and public health implications. The results may encourage the Food and Drug Administration and local authorities to consider more restrictive regulation of tobacco marketing that has traditionally targeted people of color. Tighter restrictions on tobacco marketing in communities of color may reduce some of the tobacco-related disparities that affect high socioeconomic status racial/ethnic minority groups. Reducing disparities is a strategic priority for the Food and Drug Administration and the National Institutes of Health. Further research is needed to identify interventions, including restrictive national and local regulations, such as banning advertisements that target racial/ethnic minority groups, and to implement evidence-backed policies. A 2019 study by Felito et al suggested that US residents favor restrictive tobacco regulations and do not consider such restrictions to be an imposition on their autonomy.

**Future Research**

Future studies should specifically explore how different types of advertisements affect populations based on the intersection of race/ethnicity and socioeconomic status. Researchers may also study differential associations of tobacco policies, such as banning certain marketing practices, point-of-sale advertisements, flavoring, and direct mailing, with tobacco outcomes across diverse racial/ethnic groups. As this study only focused on the role of educational attainment as a marker of socioeconomic status, future research should also explore associations of health outcomes with wealth, income, employment, occupational prestige, marital status, and area-level socioeconomic status. Additionally, this study only included African American, Hispanic, non-Hispanic, and white individuals. Future investigations may explore other minority groups, such as other racial/ethnic groups and immigrants. Future research may go beyond dichotomous outcomes and capture the frequency of exposure to advertisement.

This study was performed in the general population that included both tobacco users and nonusers. Although smoking status could alter the association of education with exposure to tobacco advertisement, this study did not perform models based on smoking status for statistical power concerns, given that very few individuals were highly educated, smokers, and black or Hispanic. Future research should use larger samples to test variation of exposure to tobacco advertisements among smoking and nonsmoking adults. Additionally, this study could not explore the association based on smoking status, as the estimates were unstable and CIs were wide. Still, future research may use larger samples to explore how these processes differ for smokers and nonsmokers.
Limitations
This study has some limitations. Given the cross-sectional design of this study, causation cannot be shown. The unbalanced sample size by ethnicity could generate differential statistical power across racial/ethnic groups. Thus, models were not performed within racial/ethnic groups. Instead, models with interaction terms in the pooled sample were performed, which is not affected by the unbalanced sample size distribution across racial/ethnic minority groups. This study did not measure all confounders, such as physical and mental health, tobacco use, and access to tobacco cessation programs. The PATH Study also did not have data on details of exposure to tobacco advertisement. These factors may explain why and how highly educated racial/ethnic minority groups may remain at high risk of exposure to tobacco marketing. Additionally, similar to any other study relying on self-reported measures, this study is prone to measurement bias. This problem is not limited to advertisement exposure, and any retrospective measurement would be accompanied by some degree of recall bias. Despite this limitation, many scholars have measured exposure by relying on self-report and recall as exposure to tobacco advertisement.\(^{51-58}\)

This reliance on self-report may become a problem if social groups differ in how they recall advertisements that they are exposed to. However, I am not aware of any previous study showing cross-racial/ethnic variation in the validity of this measure. Recognizing advertisements may not function as an exposure to marketing; however, prior research has used advertisement recall as a measure of exposure to advertisement.\(^{51-58}\) Interpretation of the results on recalls requires caution because the nature of the data are cross-sectional rather than longitudinal. This study could not rule out the likelihood of cultural or behavioral differences that may have contributed to differential recall despite equal exposure to advertisements. Additionally, this study did not measure frequency of exposure to tobacco advertisement but rather number of types of advertisements. If someone saw a particular advertisement every day for 12 months, this would be counted as yes with a score of 1, and if a person saw 3 different types of advertisements over the course of 12 months, the score would be 3. As a nationally representative sample was used, these results are likely generalizable to US young adults, but there is still a need to study geographic variation of exposure to tobacco advertisements by race/ethnicity and socioeconomic status.

Conclusions
In the United States, racial/ethnic minority status is associated with weakened inverse association of educational attainment with exposure to tobacco advertisement. While highly educated people are less likely to be exposed to tobacco advertisements, this pattern is less true for highly educated Hispanic and African American individuals than non-Hispanic white individuals. Additional exposure to tobacco advertisements may, in part, explain the results of previous studies on higher-than-expected tobacco risk among highly educated racial/ethnic minority groups.
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