



Second-Hand Smoke Exposure at Home in the United States; Minorities' Diminished Returns

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Abstract

Introduction: Educational attainment and poverty status are two strong socioeconomic status (SES) indicators that protect individuals against exposure to second-hand smoke. *Minorities' Diminished Returns* (MDRs), however, refer to smaller protective effects of SES indicators among ethnic minority groups such as Hispanics and Blacks, compared to non-Hispanic Whites. This study explored ethnic differences in the effects of educational attainment and poverty status on second-hand smoke exposure in the homes of American adults.

Methods: This cross-sectional study included 18,274 non-smoking adults who had participated in the Population Assessment of Tobacco and Health (PATH; 2013). The independent variables were educational attainment and poverty status. The dependent variable was second-hand smoke exposure at home. Age and region of residence were the covariates. Ethnicity was the moderator.

Results: Overall, individuals with a higher educational attainment (odds ratio [OR] = 0.76, 95% CI = 0.74-0.79) and those who lived out of poverty (OR = 0.56, 95% CI = 0.51-0.62) had lower odds of second-hand smoke exposure at home. Hispanic ethnicity showed significant interactions with both SES indicators, suggesting that the protective effects of education and poverty on second-hand smoke exposure at home are smaller for Hispanics (ORs for interaction with education and poverty status = 1.30 and 1.26, $P < 0.05$) than for Non-Hispanics.

Conclusion: In the US, high SES Hispanics remain at high risk of exposure to second-hand smoke at home despite a high education and income. High SES better reduces environmental exposures for non-Hispanic than for Hispanic individuals.

Keywords: Population Groups, Ethnicity, Socioeconomic Status, Second Hand Exposure

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Introduction

Despite the recent decline in the prevalence of tobacco use in the US, active and passive exposure to tobacco remain the leading preventable causes of morbidity and mortality in the United States.¹⁻³ Annually, about half a million Americans die from tobacco-induced chronic illnesses.⁴ This is in addition to the 16 million Americans who suffer chronic diseases caused by tobacco.⁴ Tobacco-related illness in the United States costs more than \$300 billion a year, which is caused by lives lost, productivity losses, and health care costs.⁵

High socioeconomic status (SES) indicators such as high educational attainment and living out of poverty (high income) are among the strongest social determinants of tobacco use⁶⁻¹⁰ and exposure to second-hand smoke.^{11,12-14} Despite the success of the US in reducing the overall burden of tobacco, this burden has shifted from being a mainstream public health problem to being a concentrated one.¹⁵ Such social inequalities threaten the progress that the US has

already made regarding tobacco control.¹⁵ The SES tobacco use gap due to education widened drastically between 1966 to 2015.¹⁵ Less is known, however, for such trends in exposure to second-hand tobacco smoke. The increasing implications of SES indicators on tobacco disparities require more research.¹⁶⁻¹⁸

Partly because of their lower SES¹⁸⁻²⁰ and in part because of increased vulnerability likely due to reduced trust and access to the healthcare system,²¹ ethnic minorities are at an increased risk of tobacco-related illnesses.⁶⁻¹⁰ Although ethnic minorities such as Hispanics and Blacks are more likely to be impacted by the consequences of tobacco use,^{8,22,23} they do not have a higher prevalence of active tobacco exposure. This discrepancy between the low prevalence and the high burden of tobacco problems suggests that passive tobacco exposure may be higher in ethnic minorities such as Hispanics and Blacks. Such increasing vulnerability of ethnic minorities is characterized by a more rapid transition toward undesired

outcomes.^{8,22,23}

Some studies have recently introduced Minorities' Diminished Returns (MDRs)^{24,25} as a new mechanism for the ethnic disparities in the tobacco burden in US.²⁶⁻²⁸ MDRs refer to the "weaker than expected" protective effects of SES indicators on tangible and health outcomes for minority populations,^{24,25} which is also shown for tobacco use.²⁶⁻²⁸ Studying MDRs is very important, because they can explain how (a) ethnic inequalities in the tobacco burden emerge across SES levels, meaning that high tobacco burden and poor health are likely in high SES groups, and (b) why some of the ethnic gap remains or even widens as SES increases. Thus, MDRs provide a framework to study ethnic differences that are observable across all SES levels. The confirmation of MDRs through research would suggest that there is a need for policies and solutions that go beyond equal access and empower ethnic minority groups to effectively turn SES resources into health outcomes.²⁶⁻²⁸

Most of the literature on this issue, however, is focused on active rather than passive (second-hand smoke exposure) tobacco exposure.²⁶⁻²⁸ A single study that used data from the National Health Interview Survey (NHIS 2015) and focused on second-hand smoke exposure reported that highly educated Hispanic and Blacks were more likely to be exposed to workplace second-hand smoke, which was disproportionate to their educational level. In other words, the study showed that education had a smaller effect on reducing workplace exposure to second-hand smoke for Black and Hispanic individuals.²⁹ However, there is a need for more research on the topic for the following reasons. First, a single observation is almost never enough, and there is always a need for replication. This need is emphasized in the notion of replication crisis in psychological and sociological research. In addition, the mentioned study focused only on workplace smoke exposure and left a gap to be filled for second-hand smoke exposure at home. Finally, the mentioned study only included educational attainment and did not include other SES indicators (e.g., poverty status).²⁹

The current study tested ethnic variations in the effects of two important SES indicators (i.e. educational attainment and poverty status) on second-hand smoke exposure at home in a national sample of non-smoking American adults. A smaller protective effect of high educational attainment and living out of poverty was expected for Hispanic and Black than for Non-Hispanic White Americans. As MDRs are systemic, it was expected that similar patterns for educational attainment and poverty status would be observed, suggesting that MDRs are caused by the marginalization of ethnic minority populations.^{24,25}

Methods

Design and Settings

This is a secondary analysis of adult data from wave 1 of the Population Assessment of Tobacco and Health (PATH). Funded by NIH and FDA, PATH is a state-of-the art study on tobacco use among Americans. It has enrolled about 49,000 people 12 years or older who may or may not use tobacco at baseline. Wave 1 data was collected in 2013-2014. Although

PATH also has youth data, the current study investigated only adults.

Sample and Sampling

The PATH study adult sample was a civilian, non-institutionalized US population, 18+ years of age. The current study also limited the sample to non-smokers (current smoking = 0). The PATH study used a four-stage stratified area probability sample design. At the first stage, a stratified sample of geographical primary sampling units (PSUs, n=156) was selected. These PSUs were either a county or a group of counties. The second stage formed and sampled smaller geographical segments in each PSU. The third-stage sampled residential addresses using the US Postal Service Computerized Delivery Sequence files. The fourth stage was selection of one person from each sampled household. The final analytical sample was 18,274 non-smoking adults.

Analytical Sample

The current analysis is limited to adults who had valid data on the variables of interest in this study (see below).

Study variables

Effect Modifiers

Ethnicity. Ethnicity (Blacks and Hispanics) was self-identified and operationalized as two dichotomous variables: 1) Hispanics vs. Non-Hispanics, and 2) Blacks vs. Whites.

Confounders

Demographic Factors (Age and Gender). Gender was a dichotomous variable: male 1, female 0. Age was a 7-level ordinal variable: 1) 18 to 24 years old, 2) 25 to 34 years old, 3) 35 to 44 years old, 4) 45 to 54 years old, 5) 55 to 64 years old, 6) 65 to 74 years old, and 7) 75 years old or older.

Sexual Orientation. Lesbian, gay, bisexual, and transgender (LGBT) was self-identified and a dichotomous variable (LGBT=1, non-LGBT=0).

Outcome:

Second-hand smoke exposure at home. The outcome, second-hand smoke exposure at home, was a dichotomous variable measured by self-report.

Independent Variables

Educational attainment. Educational attainment was treated as a numerical variable which varied between 1 and 6: 1) Less than High School, 2) GED, 3) High school graduate, 4) Some college, no degree, or associate's degree, 5) bachelor's degree, and 6) any graduate level degree.

Poverty Status. Poverty status was a dichotomous variable: 0) below 100% federal poverty line, 1) above 100% federal poverty line.

Statistical Analysis

To handle the PATH design, SPSS 23.0 (IBM Corporation, Armonk, NY, USA) was used for data analysis. Given the complex survey design of the study, Taylor series linearization was applied to re-estimate the variance and SES. Given that

weights were applied, the current results are generalizable to the US general population of non-smokers. For data analysis, the distribution of the categorical and continuous variables was first examined. Frequency tables were used for univariate analysis; for continuous measures, means and SDs were reported. For multivariable analysis, binary logistic regression was applied. Two logistic regression models were run without (*Model 1*) and with (*Model 2*) two-by-two interaction terms between ethnicity and educational attainment and poverty status.

Results

Descriptive Statistics

The present study included 18,274 non-smoking American adults. Most individuals were Non-Hispanics (n = 14,856,

81.3%) and Whites (n = 14,989, 82.0%). [Table 1](#) shows the descriptive statistics of the sample. The participants were almost equally men and women. Second-hand smoke exposure at home was reported by 22.1% of all participants.

Bivariate Analysis

Race and ethnicity were correlated with educational attainment and poverty status. Gender, ethnicity, educational attainment, poverty status, and age were associated with second-hand smoke exposure at home ([Table 2](#)).

Multivariable Models in the Pooled Sample

[Table 3](#) presents a summary of the results of two logistic regression models with educational attainment and poverty status as the independent variables and second-hand smoke exposure at home as the dependent variable. Both models were estimated in the overall sample. *Model 1* only entered the main effects of educational attainment, poverty status, race, ethnicity, and covariates. *Model 2* also added four interaction terms between ethnic groups with educational attainment and poverty status.

Based on *Model 1*, high educational attainment and living out of poverty were associated with lower odds of second-hand smoke exposure at home. *Model 2* showed significant interactions between Hispanic ethnicity and the effects of educational attainment and poverty status on second-hand smoke exposure at home, suggesting that high educational attainment and living out of poverty have smaller protective effects on second-hand smoke exposure at home for Hispanics than for Non-Hispanics. The same interactions could not be found between the SES indicators and race (Blacks), suggesting that the protective effects of SES indicators were similar for Blacks and Whites ([Table 3](#)).

Discussion

In a nationally representative sample of American non-smoking adults, the current study showed two findings. Overall, higher educational attainment and living out of poverty were associated with lower exposure to second-hand smoke at home. Moreover, Hispanic ethnicity showed significant interactions with both SES indicators, suggesting that higher educational attainment and living out of poverty have smaller protective effects against passive smoke exposure for Hispanic than for non-Hispanic Americans. The same pattern, however, could not be found for the comparison of

Table 1. Descriptive Statistics of the Overall Sample (n = 18,274)

	No.	%
Race		
White	14989	82.0
Black	3285	18.0
Ethnicity		
Non-Hispanic	14856	81.3
Hispanic	3418	18.7
Sexual Orientation		
Non-LGBT	16781	94.1
LGBT	1049	5.9
Gender		
Women	9294	50.9
Men	8980	49.1
Region		
West	2898	15.9
Northeast	4199	23.0
Midwest	6903	37.8
South	4274	23.4
Poverty Status		
Living in poverty	8278	50.5
Living out of poverty	8101	49.5
Second-hand smoke exposure at home		
No	12628	77.9
Yes	3589	22.1
	Mean	SD
Age (1-7)	3.00	1.85
Educational Attainment (1-6)	3.73	1.36

LGBT: lesbian, gay, bisexual, and transgender.

Table 2. Bivariate Correlations

	1	2	3	4	5	6	7	8
1 Race (Blacks)	1	-.13**	.02*	-.05**	-.07**	-.12**	-.19**	.08**
2 Ethnicity (Hispanics)		1	.05**	-.02**	-.15**	-.25**	-.24**	.02**
3 Sexual orientation (LGBT)			1	-.07**	-.10**	-.04**	-.07**	.06**
4 Gender (male)				1	.02*	-.02**	.08**	-.03**
5 Age (1-7)					1	.05**	.19**	-.08**
6 Educational attainment (1-6)						1	.44**	-.19**
7 Poverty status (living out of poverty)							1	-.18**
8 Second-hand smoke exposure at home								1

* P < 0.05 ** P < 0.01 Pearson correlation test.

LGBT: Lesbian, gay, bisexual, and transgender.

Table 3. Summary of Logistic Regressions

	B	SE	OR	95% CI	P
Model 1 (All, No Interactions)					
Race (Blacks)	0.11	0.05	1.12	1.00 - 1.24	0.042
Ethnicity (Hispanics)	-0.27	0.06	0.77	0.69 - 0.86	< 0.001
LGBT	0.26	0.08	1.30	1.11 - 1.52	0.001
Gender (male)	-0.15	0.04	0.86	0.80 - 0.94	< 0.001
Country region					< 0.001
South	1.00				
West	-0.02	0.07	0.98	0.86 - 1.13	0.824
Northeast	-0.05	0.06	0.95	0.84 - 1.08	0.455
Midwest	-0.26	0.07	0.77	0.67 - 0.89	< 0.001
Age (1-7)	-0.06	0.01	0.94	0.92 - 0.96	< 0.001
Educational attainment (1-6)	-0.27	0.02	0.76	0.74 - 0.79	< 0.001
Living out of poverty	-0.58	0.05	0.56	0.51 - 0.62	< 0.001
Constant	0.31	0.09	1.36		0.001
Model 1 (All, M1 + 4 Interaction Terms)					
Race (Blacks)	0.05	0.14	1.05	0.79 - 1.40	0.722
Ethnicity (Hispanics)	-1.02	0.13	0.36	0.28 - 0.47	< 0.001
LGBT	0.28	0.08	1.32	1.13 - 1.55	0.001
Gender (male)	-0.15	0.04	0.86	0.80 - 0.94	< 0.001
Country region					0.001
South					
West	-0.02	0.07	0.98	0.86 - 1.12	0.804
Northeast	-0.06	0.06	0.94	0.83 - 1.07	0.370
Midwest	-0.25	0.07	0.78	0.68 - 0.90	< 0.001
Age (1-7)	-0.06	0.01	0.94	0.92 - 0.97	< 0.001
Educational attainment (1-6)	-0.33	0.02	0.72	0.69 - 0.75	< 0.001
Living out of poverty	-0.59	0.06	0.55	0.49 - 0.62	< 0.001
Black × educational attainment	-0.09	0.13	0.91	0.71 - 1.19	0.501
Hispanic × educational attainment	0.26	0.13	1.30	1.01 - 1.68	0.042
Black × living out of poverty	0.02	0.04	1.02	0.93 - 1.11	0.716
Hispanic × living out of poverty	0.23	0.04	1.26	1.16 - 1.36	< 0.001
Constant	0.52	0.10	1.68		< 0.001

Outcome: Second-hand smoke exposure at home.

CI: confidence interval; SE: standard error; OR: odds ratio; LGBT: lesbian, gay, bisexual, and transgender.

Blacks and Whites.

Previous research has shown that high SES Hispanics and Blacks may be at an increased risk of substance use such as smoking.^{27,28,30,31} This unexpected observation is due to the MDRs of SES indicators such as education, income, and employment on tobacco and alcohol use.^{27,28,30,31} These patterns go beyond tobacco use and can be seen for various SES indicators and many health outcomes.^{24,25} MDRs are shown for obesity,³² depression,³³ anxiety,³⁴ self-rated health,³⁵ and chronic disease,³⁶ increasing the rate of poor health among high SES ethnic minorities such as Hispanics and Blacks.

One possible explanation for the current findings is that smoke-free laws may be differently available and may differently influence diverse ethnic groups. Although the enforcement of such laws reduces exposure to second-hand smoke overall,^{37,38} these regulations may reach diverse sub-populations differently, depending on their likelihood to live, work, and play in contexts that have implemented such policies.^{39,40} As ethnic groups with the same educational attainment and income are likely to live in areas that differ

in SES, smoke-free laws, and retail tobacco stores, highly educated and high income ethnic minority people may be exposed to different levels of tobacco risk factors.⁴¹⁻⁴⁴ For example, Hispanics may be more likely to live in residential areas where smoke-free policies are not introduced or adhered to, so they may be less likely to benefit from them.⁴¹⁻⁴⁴ In this case, a well-intentioned policy may reduce overall tobacco use but also contribute to the generation of disparities by ethnicity and SES.⁴⁵⁻⁴⁸ Future research should test which policies generate and which ones reduce disparities by ethnicity and SES.

Another explanation is in ethnic variations in the quality of mates and partners. Given the existing discrimination, highly educated and high-income men and women of ethnic minorities may not have as high a chance as Whites to mate, partner, date, or marry a healthy individual who is also of high SES. Thus, high SES ethnic minorities may be at a higher risk of having a smoking housemate, which increases their risk of being exposed to second-hand smoke at home.

Implications

To eliminate ethnic disparities in the tobacco burden, reducing MDRs of SES for ethnic minorities may be required. The importance of eliminating MDRs as a solution to health disparities are well explained.^{25,27,28,31,32,34,35,49-51} There is, however, still a need to study how structural factors such as tobacco regulations and policies can be used to undo the MDRs of SES on tobacco use for high SES Black and Hispanic populations.^{27,28,30,31} Research should be conducted to find the best strategies for reducing MDRs of educational attainment and income on the health and wellbeing of ethnic minorities. Banning predatory marketing that specifically impacts areas of color may undo tobacco disparities among high SES ethnic minorities, also known as MDRs.^{27,28}

Limitations

The results of the current study should be interpreted with consideration of the methodological limitations. Given the cross-sectional design of the study, the results are only suggestive. A causal association is not inferred. Due to the sample size that was imbalanced across ethnic groups, models within ethnic groups were not run. Only the roles of education and poverty status were studied. Future research may study the roles of employment, occupation type, marital status, and area level SES. This study included only Blacks, Hispanics, and Whites. More research is needed on other marginalized groups, such as Asian Americans, Native Americans, immigrants, and LGBTs. Finally, this study was limited to non-smokers and did not separate married from single individuals. Despite these limitations, the results of this study still contribute to the literature.

Conclusion

In the United States, diverse ethnic groups with similar SES indicators have different environmental risk profiles, such as exposure to second-hand tobacco smoke. One of the mechanisms by which high SES protects individuals' health is by reducing environmental exposures. This protection, however, is diminished for ethnic minorities such as Hispanics. As a result, an additional tobacco risk should be expected in middle-class ethnic minorities (e.g., Hispanics). Policymakers should not take a minimalistic approach and reduce tobacco disparities to SES inequalities. Moreover, it should not be expected that high SES will show similar protective effects on exposure to smoke in diverse populations. As health disparities that influence ethnic minorities are beyond lack of SES, equalizing SES solves only some of the inequality problem.

Authors' Contributions

SA conceptualized the study, analyzed the data, prepared the first draft of the manuscript, and acquired the funding. He also approved the final draft. MB revised and approved the manuscript.

Conflict of Interest Disclosures

The authors declare no conflicts of interest.

Original Highlights

What Is Already Known?

In the US, high SES Blacks and Hispanics remain at high risk for tobacco-related diseases. That means that high SES better reduces the incidence of tobacco-related disease for Whites and Non-Hispanics than for Black and Hispanic individuals.

What This Study Adds?

In the US, high SES Hispanics remain at high risk of exposure to second-hand smoke at home despite having a high education and high income. High SES better reduces environmental exposures for non-Hispanic than Hispanic individuals.

Ethical Approval

All participants provided written informed consent. The Institutional Review Board (IRB) of Westat approved the PATH study protocol.

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