

Social Determinants of Change in Smoking Status over a 26-Year Follow up Period among Middle-Aged and Older Americans

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Abstract

Educational attainment and income are among major socioeconomic status (SES) indicators that are inversely associated with cigarette smoking. *Marginalization-related Diminished Returns* (MDRs), however, are weaker protective effects of SES indicators for racial and ethnic minority groups compared to non-Hispanic White people. The aim is to test whether racial and ethnic differences exist in the effects of educational attainment and income on cigarette smoking of middle-aged and older American adults. This is a 26-year longitudinal study using data from the Health and Retirement Study (HRS), a nationally representative study of middle-aged and older adults in the US. A total number of 11,316 middle-aged and older adults (age ≥ 50) were followed for up to 26 years. The independent variables were educational attainment and income. The dependent variables were always smoking and being quitters over the follow-up time. Age, gender, self-rated health, and chronic medical conditions were the covariates. Race/ethnicity was the moderator. Logistic regressions were used to analyze the data. Most participants were never smokers ($n = 7950$), followed by quitters ($n = 1765$), always smokers ($n = 1272$), and initiators ($n = 329$). Overall, high educational attainment (OR = 0.92, 95% CI = 0.90 - 0.95) and income (OR = 0.99, 95% CI = 0.99 - 0.99) reduced the odds of being always smoker. High educational attainment (OR = 1.05, 95% CI = 1.02 - 1.08) was associated with higher odds of being a quitter. Ethnicity, however, showed significant interactions with education on both outcomes suggesting that the effects of educational attainment on reducing the odds of always being a smoker (OR = 1.24, 95% CI = 1.14 - 1.35) and increasing the odds of quitting (OR = 0.84, 95% CI = 0.75 - 0.93) were smaller for Hispanics than non-Hispanics. In the United States, middle-aged and older Hispanic adults remain at high risk of smoking cigarettes despite high educational attainment. That is, high educational attainment may better help

non-Hispanic than Hispanic middle-aged and older adults to avoid cigarette smoking. As a result, we may observe a more than expected burden of tobacco use in middle class Hispanic middle-aged and older adults. Policymakers should not reduce racial and ethnic tobacco inequalities to SES gap, as ethnic tobacco disparities may persist in high SES levels as well.

Keywords

Smoking, Tobacco Use, Population Groups, Ethnic Groups, Race, Socioeconomic Position, Socioeconomic Status

1. Introduction

Although there has been some major decline in the prevalence of tobacco use in the US, cigarette smoking is still the leading preventable cause of morbidity and mortality in this country [1] [2] [3]. Each year, about 480,000 Americans die from illnesses that are due to tobacco use. In addition, more than 16 million Americans suffer from diseases that are caused by smoking [4]. As a result, tobacco costs the US about 300 billion USD each year, which is composed of \$170 and \$156 billion for direct and indirect costs, respectively [5].

The burden of tobacco use, however, is not randomly distributed in the US [6] [7] [8] [9] [10]. Despite the enormous progress that has been achieved in reducing the overall tobacco-related morbidity and mortality, tobacco use has shown a considerable shift from mainstream to a concentrated public health challenge that mainly affects marginalized populations defined by socioeconomic status (SES), race, and ethnicity [11]. Such social disparities threaten the progress that the US has already made in its tobacco control [11].

Racial and ethnic minorities [6] [7] [8] [9] [10] and low SES individuals [12] [13] [14] bear the vast majority of tobacco burden in the US. Some evidence suggests that SES disparities in tobacco use have increased [14] [15] [16]. Between 1966 and 2015, cigarette smoking declined by 83% in American adults with a college degree. At the same time, the decline was only 40% for Americans who did not have a high school diploma [11]. A large proportion of tobacco disparities are not all due to individuals' choices but social processes that place marginalized groups at higher risk of exposure to tobacco. For example, racial, ethnic, and low SES individuals are targets of predatory tobacco marketing [17] [18] [19]. Low SES individuals, as well as racial and ethnic minorities, are more frequently exposed to environmental risk factors of tobacco use including but not limited to retail display, coupon, discount, and point-of-sale advertisement [20]. The result is their increasing vulnerability of racial/ethnic and low SES individuals [21], which is characterized by a more rapid transition from initiation to undesired outcomes, in part due to low access to cessation programs [8] [22] [23].

Recent research on Marginalization-related Diminished Returns (MDRs) has

proposed a new mechanism for racial and ethnic health disparities in the US [24] [25]. That is, SES indicators do not similarly protect various ethnic groups, and racial and ethnic minorities tend to remain at a higher risk of poor health outcomes [24] [25]. This model proposes that: 1) racial/ethnic health inequalities in tobacco burden are not merely and exclusively due to SES gaps but also due to smaller effects of SES indicators for minority populations, and 2) the racial and ethnic health disparities persist and may even widen at high SES levels. This model emphasizes a need to explore the joint and multiplicative effects of race/ethnicity and SES indicators, which allows for the differential return of SES in terms of health outcomes. Finally, this model suggests that the elimination of racial and ethnic health disparities is beyond equalizing SES. The model suggests that a real solution to health disparities requires bold social and economic policies that affect qualitatively different life conditions of racial and ethnic groups [24] [25].

Research has shown that MDRs may also apply to tobacco use of youth [26] and adults [27] [28] [29]. According to this literature, at least some of the racial/ethnic tobacco use disparities are because of “weaker *than expected*” protective effects of SES indicators on tobacco use for racial, ethnic, and sexual minority populations [27] [28] [29]. Such MDRs are shown for education [30], employment [27], and parental education [26], and has been found for various products such as traditional cigarette as well as e-cigarette [30]. Although MDRs are shown to increase tobacco use of youth [26] and adults [27] [28] [29], the same is not shown for middle-aged and older American adults. Similar patterns (MDRs), however, are shown for other substances such as alcohol [28] [31] and even other behaviors such as diet [32] and exercise [33]. All these risk profiles result in a more than expected rate of chronic diseases [34], such as asthma [35] and COPD [36] and also hospitalization [37] and mortality in middle-class ethnic minority people. Given the systemic nature of the observed, MDRs are attributed to societal inequalities rather than groups’ or individuals’ characteristics or behaviors. MDRs are argued to be a side effect of the marginalization of racial and minority populations [34] [35].

2. Aim

This study tested racial and ethnic variation in the effects of two SES indicators, namely educational attainment, and income, on cigarette smoking in a nationally representative sample of middle-aged and older American adults. We expected smaller protective effects of educational attainment and income for Blacks and Hispanics than Non-Hispanic Whites.

3. Methods

3.1. Design and Setting

The Health and Retirement Study (HRS) is a state-of-the-art long-term longitudinal study with biannual observations from 1992 to 2016. The HRS has recruited a nationally representative sample of American middle-aged and older

adults over the age of 50. Detailed methodological information regarding the study design, measures, sample, and sampling is available elsewhere [38].

3.2. Ethics Statement

The HRS study protocol was evaluated and approved by the University of Michigan Institutional Review Board. Participants signed informed consent. All data were collected, restored, managed, and analyzed anonymously.

3.3. Participants and Sampling

This study only included the core primary sample of the HRS that was recruited in 1992. Participants were born between 1931 and 1941. The HRS sampling strategy was a national area probability sample of US households.

3.4. Analytical Sample

The current study included individuals who were 50+ years old and self-identified as White or Black. Both Hispanic and non-Hispanic people were enrolled in our analysis. This sample included 11,316. The entirety of this sample was included in our analysis regardless of the duration of the follow up.

3.5. Data Collection

Extensive data on demographic, SES, social, psychological, behavioral, and health information were collected. Data were collected from participants and their spouses. Data were collected on a biannual basis. Data collection was either through standard questionnaires that were completed wither in a telephone or a face-to-face interview. For the individuals who were not available, proxy interviews were used.

4. Measures

4.1. Demographic Factors

Age and gender were demographic factors. Age was a continuous measure recorded in years. Gender was a dichotomous variable: male = 1, female = 0. Age and gender were measured in 1992.

4.2. Socioeconomic Status (SES) Indicators

Educational attainment and income were the SES indicators. Education was a continuous measure recorded in years of schooling. Income was a continuous variable in USD 1000. Both SES indicators were measured at baseline (1992).

4.3. Depressive Symptoms

The eight-item Center for Epidemiologic Studies Depression scale (CES-D) was used to measure depressive symptoms. The CES-D scale is a reliable and validated measure of the level of depressive symptomatology over the past week [39] [40] [41]. We used the baseline CES-D score measured in 1992, with a higher

score indicating more depressive symptomatology.

4.4. Self-Rated Health (SRH)

A conventional single-item measure of SRH was used. Participants reported their health was excellent, very good, good, fair, or poor. SRH was operationalized as a continuous variable ranging between 1 and 5. A higher score indicated worse health. Research has repeatedly demonstrated high validity and reliability of SRH as a predictor of mortality risk [42]. We used the baseline SRH measured in 1992.

4.5. Chronic Medical Conditions (CMCs)

A single variable was used that reflected the number (count) of various chronic medical conditions, including diabetes mellitus, heart disease, emphysema/asthma, stroke, cancer, hypertension, arthritis, and psychiatric conditions. Participants were asked if they were ever told by a doctor that they have any of these conditions. This variable had a range of 0 to 8, with a higher score reflecting multi-morbidity.

4.6. Smoking Classes

Using data from smoking data across all waves, we generated four clusters of individuals. Always smokers, as people who reported current smoking status at all waves that they participated in. Never smokers, as individuals who reported non-smoking status at all waves that they participated. Quitters were composed of people who started the HRS cohort as a smoker but discontinued smoking at least at one future observation. Finally, initiators were composed of people who started the HRS as non-smokers but became a smoker at least in one observation in the next waves.

4.7. Data Analysis

We analyzed the HRS data using SPSS 23 (IBM Corp, Armonk, New York, USA). We used Taylor series estimation to calculate the variance of our study variables using survey design variables such as HRS survey weight and PSU that reflected clustering, stratification, and non-response. As a result of applying the HRS weight, the results of the current analysis are generalizable to the US general population of middle-aged and older adults. For our univariate analyses, we reported means and frequencies. We then ruled out the collinearities between race, ethnicity, educational attainment, income, and covariates. We did not have missing data simply because two waves were enough for the definition of our smoking trajectories. For multivariable analysis, we applied binary logistic regressions with smokers (vs. never smokers), initiators (vs. never smokers), and quitters (vs. always smokers) as outcomes. We ran three series of models without (Model 1) and with (Model 2) our four statistical interaction terms between race/ethnicity and SES indicators (educational attainment and income). As both

SES indicators were operationalized as a resource rather than risk, we expected their protective effects to be reflected by ORs less than 1. We, however, expected ORs larger than 1 for the interaction terms, suggesting that the associations between SES indicators and smoking outcomes would be smaller for Blacks and Hispanics.

5. Results

5.1. Descriptive Statistics

In this study, 25,654 American adults were followed overtime for up to 26 years. Participants were either Non-Hispanic, Hispanic, White, or Black. **Table 1** summarizes the descriptive statistics of the sample (**Table 1**).

Table 1 also compared the following study groups: 1) Always Smokers, 2) Initiators, 3) Quitters, and 4) Never Smokers. These groups differed in race, ethnicity, gender, education, income, SRH, CMCs, and depressive symptoms.

5.2. Multivariable Models

5.2.1. Outcome: Smoking

Table 2 summarizes the results of two pooled sample logistic regression models

Table 1. Descriptive statistics in the overall sample.

	Always Smokers		Initiators		Quitters		Never Smokers		All	
	N	%	n	%	n	%	n	%	n	%
Race*										
White	6377	83.4	254	80.4	1367	80.1	987	81.0	8985	82.5
Black	1268	16.6	62	19.6	339	19.9	232	19.0	1901	17.5
Ethnicity*										
Non-Hispanic	7181	90.4	290	88.1	1601	90.8	1186	93.5	10258	90.7
Hispanic	764	9.6	39	11.9	163	9.2	82	6.5	1048	9.3
Gender*										
Women	4060	51.1	122	37.1	863	48.9	557	43.8	5602	49.5
Men	3890	48.9	207	62.9	902	51.1	715	56.2	5714	50.5
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age	56.65	4.58	55.91	4.03	55.86	4.14	56.17	4.40	56.46	4.49
Education*	12.19	3.35	11.73	3.33	11.55	3.16	11.19	2.99	11.97	3.30
Income*	50.04	53.72	45.20	50.38	38.74	37.48	34.64	42.00	46.40	50.52
Self-Rated Health *	1.17	1.85	1.51	2.23	1.71	2.31	1.75	2.16	1.33	1.99
Chronic Medical Conditions*	2.52	1.19	2.83	1.23	2.71	1.18	3.01	1.26	2.62	1.21
Depressive Symptoms*	1.08	1.10	1.05	1.23	1.03	1.13	1.32	1.32	1.10	1.14

*P < 0.05 for comparison of always smokers, initiators, quitters, and never smokers.

Table 2. Summary of logistic regression of always smoking over the follow-up period.

	Model 1 (All, Main Effects)						Model 2 (All, Main Effects + Interactions)					
	B	S.E.	Exp(B) = OR	95% CI		p	B	S.E.	Exp(B) = OR	95% CI		p
Race (black)	-0.32	0.10	0.73	0.60	0.88	0.001	-0.94	0.33	0.39	0.20	0.75	0.005
Ethnicity (Hispanic)	-1.48	0.19	0.23	0.16	0.33	0.000	-3.39	0.46	0.03	0.01	0.08	0.000
Gender (male)	0.39	0.07	1.48	1.29	1.71	0.000	0.39	0.07	1.47	1.27	1.70	0.000
Age (years)	-0.05	0.01	0.95	0.94	0.96	0.000	-0.05	0.01	0.95	0.93	0.96	0.000
Education (years)	-0.08	0.01	0.92	0.90	0.95	0.000	-0.11	0.02	0.89	0.87	0.92	0.000
Income (USD 1000)	-0.01	0.00	0.99	0.99	0.99	0.000	-0.01	0.00	0.99	0.99	0.99	0.000
Depressive Symptoms	0.07	0.02	1.08	1.04	1.12	0.000	0.07	0.02	1.08	1.04	1.12	0.000
Self-Rated Health	0.20	0.04	1.22	1.14	1.31	0.000	0.20	0.04	1.22	1.13	1.31	0.000
Chronic Medical Conditions	-0.05	0.04	0.95	0.89	1.02	0.178	-0.05	0.04	0.95	0.89	1.02	0.155
Income × Race (black)	-	-	-	-	-	-	0.01	0.00	1.01	1.00	1.01	0.017
Income × Ethnicity (Hispanic)	-	-	-	-	-	-	0.00	0.01	1.00	0.98	1.02	0.987
Education × Race (black)	-	-	-	-	-	-	0.03	0.03	1.03	0.97	1.10	0.303
Education × Ethnicity (Hispanic)	-	-	-	-	-	-	0.21	0.04	1.24	1.14	1.35	0.000
Constant	1.74	0.41	5.72			0.000	2.19	0.42	8.90			0.000

Notes: CI: Confidence Interval; SE: Standard Error; OR: Odds Ratio.

with education and income as the predictor/independent variables and always smoking over the follow-up period as the outcome/dependent variable. Model 1 had the main effects of educational attainment, income, race, ethnicity, and covariates, while Model 2 also included four interaction terms between race/ethnicity and education and income.

Based on *Model 1*, overall, high education (OR = 0.92, 95% CI = 0.90 - 0.95) and income (OR = 0.99, 95% CI = 0.99 - 0.99) were associated with lower odds of always smoking. *Model 2* revealed an interaction between ethnicity with education (OR = 1.24, 95% CI = 1.14 - 1.35) on odds of always smoking, suggesting that the protective effect of high education against always smoking was smaller for Hispanics than Non-Hispanics (**Table 2**).

5.2.2. Outcome: Quitting

Table 3 presents the summary of the results of two pooled-sample logistic regression models with education and income as the independent variables and quitting over the follow up as the dependent variable. *Model 3* only entered the main effects, while *Model 4* also added four interaction terms. Based on *Model 1*, high education (OR = 1.05, 95% CI = 1.02 - 1.08) increased the odds of quitting. *Model 2* showed an interaction between ethnicity and education on odds of quitting (OR = 0.84, 95% CI = 0.75 - 0.93), suggesting that the effect of education on odds of quitting was smaller for Hispanics than Non-Hispanics (**Table 3**).

Table 3. Summary of logistic regression on the effect of education and income on quitting over the follow-up period.

	Model 3 (All, Main Effects)						Model 4 (All, Main Effects + Interactions)					
	B	S.E.	Exp(B) = OR	95% CI		p	B	S.E.	Exp(B) = OR	95% CI		p
Race (black)	0.29	0.11	1.34	1.08	1.65	0.007	0.41	0.39	1.51	0.69	3.26	0.300
Ethnicity (Hispanic)	0.90	0.20	2.45	1.66	3.61	0.000	2.39	0.56	10.88	3.64	32.51	0.000
Gender (male)	-0.14	0.08	0.87	0.74	1.02	0.089	-0.14	0.08	0.87	0.74	1.03	0.107
Age (years)	0.01	0.01	1.01	1.00	1.03	0.064	0.01	0.01	1.01	1.00	1.03	0.064
Education (years)	0.05	0.02	1.05	1.02	1.08	0.003	0.06	0.02	1.07	1.03	1.11	0.001
Income (USD 1000)	0.00	0.00	1.00	1.00	1.00	0.366	0.00	0.00	1.00	1.00	1.00	0.229
Depressive Symptoms	0.02	0.02	1.02	0.98	1.06	0.252	0.02	0.02	1.02	0.98	1.07	0.244
Self-Rated Health	-0.09	0.04	0.91	0.84	0.99	0.033	-0.09	0.04	0.91	0.84	0.99	0.028
Chronic Medical Conditions	-0.11	0.04	0.89	0.82	0.97	0.005	-0.11	0.04	0.90	0.83	0.97	0.007
Income × Race (black)	-	-	-	-	-	-	0.00	0.00	1.00	0.99	1.00	0.100
Income × Ethnicity (Hispanic)	-	-	-	-	-	-	0.01	0.01	1.01	0.99	1.02	0.382
Education × Race (black)	-	-	-	-	-	-	0.00	0.04	1.00	0.94	1.08	0.891
Education × Ethnicity (Hispanic)	-	-	-	-	-	-	-0.18	0.06	0.84	0.75	0.93	0.002
Constant	-0.53	0.48	0.59			0.271	-0.76	0.50	0.47			0.132

Notes: CI: Confidence Interval; SE: Standard Error; OR: Odds Ratio.

6. Discussion

Overall, high education and income were associated with lower odds of being a smoker, and high educational attainment was associated with increased odds of quitting smoking over the 26 years of follow up. We, however, found a significant interaction between race and educational attainment, suggesting that high education has a weaker inverse association with smoking for Hispanic than Non-Hispanic Whites. Similarly, education had a weaker positive association with the future chance of quitting for Hispanic than Non-Hispanic Whites.

Previous studies have shown that due to MDRs, high SES (e.g., education, income, and employment), Blacks and Hispanics remain at an increased risk of substance use [28] [29] [31] [43]. This is due to weaker than expected effects of education, income, and employment for Blacks compared to Whites [28] [29] [31] [43]. Similar patterns are shown for the effects of SES on obesity [44], depression [45], anxiety [46], self-rated health [47], and chronic disease [48] for Blacks and Hispanics.

One of the proposed mechanisms by which the risk of tobacco use stays high is a lower quality of education in predominantly Black and Hispanic areas. Another explanation may be structural factors such as residential segregation. Finally, predatory marketing practices may have a role. We already know that the tobacco industry specifically targets racial/ethnic and low SES areas, which creates disparity [17] [18] [19]. Future research is needed to understand the type of policies and practices that contribute to MDRs-related disparities. Predatory

marketing and advertising may increase the vulnerability of low SES, Blacks, and Hispanics for tobacco use, a pattern that may explain why smoking is more common among high Hispanic individuals, relative to high SES non-Hispanic Whites. If confirmed by future research, there is a need to introduce more restrictive marketing policies that reduce such predatory marketing. Such strategies would require banning point-of-sale advertisement and flavoring and specially focusing on disadvantaged areas that have a high concentration of Black and Hispanic populations. Research is also needed on the effects of restricting predatory marketing as a strategy to eliminate tobacco use disparities by race, ethnicity, and SES, at least those that are generated by MDRs of SES [49].

7. Implications

We argue that the high tobacco risk of highly educated ethnic minorities should be alarming for the FDA. Elimination of tobacco-related disparities in racial, ethnic, and marginalized people is a strategic priority for FDA and NIH. The results are relevant to the “understanding of why people become susceptible to using tobacco products,” which is one of the FDA’s research priorities.

The observation that highly educated Hispanic are at risk of tobacco use and have a lower chance of smoking than their White counterparts has some policy and public health implications and may help the FDA set priorities to tackle health disparities. Our finding is suggestive that tobacco regulation policies should consider the intersection of race, ethnicity, and SES. Effective policies that can reduce tobacco-related disparities are those that go beyond addressing racial/ethnic and SES gaps by addressing the MDRs-related disparities (those due to weaker effects of SES indicators for the members of the racial and ethnic minorities).

8. Limitations

The current study is not free of methodological limitations. As the sample size was different across race and ethnic groups, we did not perform race/ethnic-specific models. Such models would not be comparable, given the unequal size across race and ethnic groups. Other SES markers, such as wealth, employment, and area-level SES, were not included in this study. This study did not measure some health measured that could confound the link between SES and tobacco use. Mental health problems may have a major role. Finally, individuals lived under unequal tobacco policies that were not studied. Despite these limitations, we believe the results derived from this study still make a unique expansion of the existing literature on racial and ethnic tobacco disparities in middle-aged and older adults.

9. Conclusion

In the United States, Hispanic ethnicity may limit the health effect of an SES indicator such as education on smoking and quit. While education helps individu-

als to avoid high-risk behaviors such as smoking as well as increase their chance of quitting, these effects depend on ethnicity. While the more privileged groups (non-Hispanics) gain the most from their educational attainment, the least-privileged groups (Hispanics) gain the least.

Author Contributions

The paper only has one author.

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Conflicts of Interest

The author declares no conflict of interest.

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