

Article

Educational Attainment Promotes Fruit and Vegetable Intake for Whites but Not Blacks

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Abstract: *Background.* Although the protective effects of socioeconomic status (SES) on health behaviors are well-known, according to the minorities' diminished return theory, the health return of SES, particularly educational attainment, is systemically smaller for minorities than Whites. Aims. The current study explored Black–White differences in the effects of educational attainment and income on the consumption of fruits and vegetables. *Methods.* This cross-sectional study used the Health Information National Trends Survey (HINTS) 2017 ($n = 3217$). HINTS is a nationally representative survey of American adults. The current analysis included 2277 adults who were either non-Hispanic White ($n = 1868$; 82%) or non-Hispanic Black ($n = 409$; 18%). The independent variables in this study were SES (educational attainment and income). The dependent variable was consumption of fruits and vegetables. Race was the focal moderator. *Results.* In the overall sample, high educational attainment and income were associated with higher consumption of fruits and vegetables. Race moderated the effect of educational attainment but not income on the consumption of fruits and vegetables. *Conclusion.* In line with the past research in the United States, Whites constantly gain more health benefits from the very same educational attainment than Blacks. The health gain from income is more equal across races than the health gain from educational attainment. Such diminished returns may be due to racism across institutions in the United States.

Keywords: diet; nutrition; fruit and vegetable; population groups; race; Whites; Blacks; African-Americans; socioeconomics; education; income

1. Background

The Minorities' Diminished Return theory [1,2] suggests that the health effects of SES are not equal across races. Diminished health gain from equal resources among racial and ethnic minorities at least in part explains why racial health gaps persist despite enormous investments to achieve health equality [2]. Research has shown that educational attainment [3,4], employment [5,6], neighborhood quality [7], and social contacts [8] all have stronger health effects in White than Black Americans. Although most of the evidence behind Minorities' Diminished Return is for the comparison of Blacks and Whites [1,2], similar patterns are shown for other minority groups, such as Hispanics [9].

How educational attainment impacts population health depends on a wide range of sociodemographic factors, such as race, that shape access to other resources, the capacity to leverage education, the ability to navigate society, and the autonomy to take control of resources [1,2]. Differential health gains from

educational attainment by race have been attributed to institutional racism and historical oppression (legacy of slavery and Jim Crow laws) within the U.S. social system. Because American society does not treat racial groups equally, high SES Blacks are in a systemic disadvantage compared to high SES Whites in gaining and maintaining access to the opportunity structure. In addition, the pervasive racism and discrimination across levels and institutions of society increases the social, psychological, and physiological costs of upward social mobility for non-Whites. Residential and job segregation, lack of a universal health care system, and low availability of safety nets and welfare state in the U.S. all increase the challenges that are involved in the upward social mobility of minority groups [1]. Enormous gaps in wealth accumulation and childhood SES also exist across racial groups [1,2,10,11].

Several studies have shown that the health return of educational attainment is systemically smaller for Black than for White Americans. In a 15-year follow up study of an urban birth cohort, family structure and SES at birth had protective effects against future obesity among White but not Black families [12]. Similar results were found for the effects of educational attainment on alcohol consumption [3], self-rated health [13,14], physical activity and sleep quality [15], and breastfeeding and hunger [16]. Very few studies, if any, however, have ever explored racial variation on the effects of educational attainment on fruit and vegetable consumption.

Similar to other aspects of a healthy diet [17,18], fruit and vegetable intake is a function of race and SES [19,20]. Education and income are strong determinants of various aspects of diet quality, including breakfast eating, fast food eating, high calorie intake, and fruit and vegetable intake [17,19–21]. Individuals who have low educational attainment and low-income report a lower intake of fruit and vegetables [21]. As race is a proxy of SES (education and income) [22], compared to Whites, Blacks report a worse diet [23], including a lower intake of fruit and vegetables [24,25].

2. Aim

To extend the current knowledge on the Minorities' Diminished Return theory [1,2], and in continuation of previous work on the multiplicative effects of race and SES on health [26,27], this study investigates whether SES resources (educational attainment and income) have smaller effects on the consumption of fruits and vegetables in non-Hispanic Blacks compared to non-Hispanic Whites. In line with the Minorities' Diminished Return theory [1,2], we expected that economic resources would have a stronger association with the consumption of fruits and vegetables among non-Hispanic Whites than non-Hispanic Blacks.

3. Methods

3.1. Design and Setting

The Health Information National Trends Survey (HINTS), 2017, is the most updated version of HINTS, a nationally-representative survey. HINTS has been periodically administered by the National Cancer Institute (NCI) since 2003. The HINTS target population is non-institutionalized American adults (age ≥ 18) who reside in the United States. The current study is conducted on the most recent version of HINTS (also called HINTS 5, Cycle 1). HINTS 5, Cycle 1 was conducted between January and May 2017. The primary purpose of the HINTS study is to provide a comprehensive evaluation of Americans' access to and use of cancer information [28–30].

3.2. Ethics

All participants provided informed consent. HINTS 5 was approved by the Westat Institutional Review Board. According to the NIH Office of Human Subjects, HINTS was exempt from institutional review board (IRB) review.

3.3. Sampling

The HINTS 5, Cycle 1 sampling strategy consisted of a two-stage design. First, a stratified sample of addresses was derived from all residential addresses. Second, one adult was selected from each sampled household. As described more fully below, weights were applied to ensure representativeness. The list of addresses was provided by the Marketing Systems Group (MSG). All non-vacant residential addresses in the US were eligible for sampling. The sampling frame of addresses was stratified to the following two groups: (1) areas with a high concentration of minorities; and (2) areas with a low concentration of minorities. From each sampling stratum, an equal-probability sample of addresses was selected [31].

3.4. Survey

The survey was conducted exclusively by mail. To encourage participation, a pre-paid monetary incentive (\$2) was included in the mailing. Two toll-free telephone lines numbers were provided to participants: one for English interviews and one for Spanish interviews. The overall response rate was 32.4 percent [31].

3.5. Measures

3.5.1. Independent Variables

Educational Attainment. Educational attainment was one of the two main SES indicators in our study. Educational level was reported as: (1) less than high school; (2) high school graduate; (3) some college; (4) bachelor's degree; (5) post-baccalaureate degree. Educational attainment was operationalized as a continuous measure, with a higher score reflecting more education.

Income. Household income was recorded as: (1) 0–9999; (2) \$10,000 to \$14,999; (3) \$15,000 to \$19,999; (4) \$20,000 to \$34,999; (5) \$35,000 to \$49,999; (6) \$50,000 to \$74,999; (7) \$75,000 to \$99,999; (8) \$100,000 to \$199,999; and (9) \$200,000 or more. Income was operationalized as a continuous variable.

3.5.2. Dependent Variables

Consumption of Fruits and Vegetables. This study measured the fruit and vegetable intake using the following two items: (1) "About how many cups of fruits do you eat or drink each day?"; (2) "About how many cups of vegetables do you eat or drink each day?" Responses were (0) none; (1) half cup or less; (2) half cup to one cup; (3) one to two cups; (4) two to three cups, (5) three to four cups, and (6) five or more cups. The two items were positively correlated ($r = 0.49$ for all, $r = 0.49$ for Whites and $r = 0.50$ for Blacks). We calculated a sum score, with a potential range between 0 and 12. A higher score was indicative of a higher fruit and vegetable intake [32–36].

3.5.3. Covariates

Demographic Variables. Age, gender, and race were collected. Age was a continuous measure. Gender was operationalized as a dichotomous variable (men 0 [reference group] and women 1).

Self-Rated Health (SRH). Respondents were asked to rate their general health status, using a single item. Response options were: (1) excellent, (2) very good; (3) good; (4) fair; and (5) poor. The literature has mostly treated SRH as a categorical variable. In line with previous research, we defined the outcome as fair/poor health versus other levels (i.e., excellent, good, very good). Poor/fair SRH was coded as 1 [37]. SRH, which predicts the risk of mortality, is recommended as an outcome for the monitoring of the health of Americans by the Institute of Medicine (IOM) [38].

3.5.4. Moderator

Race, measured as self-identified, was a dichotomous variable (non-Hispanic Whites 0 [reference group], non-Hispanic Blacks 1).

3.6. Statistical Analysis

3.6.1. Survey Weights

To accommodate the HINTS multi-stage sample design, we applied the HINTS sampling weights due to stratification, clustering, and respondent non-response. We used Stata 13.0 (Stata Corp., College Station, TX, USA) for our data analysis. Jackknife standard errors were calculated.

3.6.2. Data Analysis

In terms of univariate statistics, we described the mean and proportions (frequencies). For the bivariate analysis, we used an independent sample t test and Pearson Chi square tests to compare Blacks and Whites. We tested the assumptions of multi-collinearity and the normal distribution of errors. All the ordinary least squares (OLS) regression assumptions, including linearity, multivariate normality, and auto-correlation, were successfully met. For the multivariable analysis, we estimated four sub-population linear regression models. In these linear regression models, we used educational attainment and income as the independent variables, the consumption of fruits and vegetables as the dependent variable, the demographics as covariates, and race as the focal moderator. First, two linear regressions were estimated in the pooled sample. The first model only included the main effects of race and SES (educational attainment and income) interactions. The next model included the following two interaction terms: race by income and race by education. Finally, we ran race-specific linear regressions (*Model 3* for Whites and *Model 4* for Blacks). Adjusted regression coefficients, 95% confidence intervals (CI), and *p* values were reported. A *p* value less than 0.05 was considered significant.

4. Results

4.1. Descriptive Statistics

This study included 2277 adults who were either non-Hispanic Whites ($n = 1868$, 82%) or non-Hispanic Blacks ($n = 409$; 18%), using 10 years of data. Table 1 provides descriptive statistics of the study variables in the overall sample and by race. Non-Hispanic Blacks had lower educational attainment and income than non-Hispanic Whites. Race was not associated with the consumption of fruits and vegetables (Table 1).

4.2. Multivariable Models

Table 2 summarizes the results of two linear regressions in the overall sample, with educational attainment and income as the independent variables, and the consumption of fruits and vegetables as the dependent variable. Based on *Model 1*, high educational attainment ($b = 0.25$, 95% CI = 0.10–0.39) and high income ($b = 0.13$, 95% CI = 0.04–0.23) were associated with higher fruit and vegetable intake above and beyond all of the covariates. *Model 2* showed an interaction between race and educational attainment for the consumption of fruits and vegetables ($b = -0.60$, 95% CI = -0.99 – 0.20), suggesting that the effect of educational attainment on the consumption of fruits and vegetables is smaller for non-Hispanic Blacks than non-Hispanic Whites. No interaction was found between race and income for the consumption of fruits and vegetables ($b = 0.05$, 95% CI = -0.15 – 0.25) (Table 2).

Table 3 presents the results of two linear regression models in non-Hispanic Whites and non-Hispanic Blacks. *Model 3* showed significant effects of educational attainment ($b = 0.35$, 95% CI = 0.20–0.50) and income ($b = 0.13$, 95% CI = 0.02–0.24) on consumption of fruits and vegetables for non-Hispanic Whites. *Model 4* among non-Hispanic Blacks did not show any effect of educational attainment ($b = -0.22$, 95% CI = -0.62 – 0.19) on fruit and vegetable intake, however, the association between income and the consumption of fruits and vegetables was marginally significant ($b = 0.18$, 95% CI = -0.01 – 0.37) (Table 3).

Table 1. Descriptive statistics in the overall sample and by race.

		All (n = 2277)		Non-Hispanic Whites (n = 1868)		Non-Hispanic Blacks (n = 409)	
		Mean	SE	Mean	SE	Mean	SE
	Age	48.80	0.34	50.10	0.46	47.72	1.22
	Education *	3.12	0.02	3.17	0.02	3.08	0.10
	Income (household) *	5.60	0.05	5.87	0.07	4.68	0.22
	Consumption of Fruits and Vegetables	4.99	0.06	4.99	0.07	5.26	0.18
		%	SE	%	SE	%	SE
Gender	Female	50.63	0.00	50.84	0.00	60.86	0.04
	Male	49.37	0.00	49.16	0.00	39.14	0.04
Education	Less than High School	8.37	0.01	5.54	0.01	13.69	0.03
	High School Graduate	22.67	0.01	20.16	0.01	24.01	0.03
	Some College	32.98	0.01	41.03	0.01	19.36	0.03
	Bachelor’s Degree	22.38	0.01	20.37	0.01	26.04	0.04
	Post-Baccalaureate Degree	13.60	0.01	12.91	0.01	16.91	0.04
Obese *	No	66.80	0.01	67.79	0.02	58.24	0.04
	Yes	33.20	0.01	32.21	0.02	41.76	0.04
Self-rated Health (SRH) *	Excellent-Good	83.07	0.01	85.15	0.02	80.41	0.02
	Fair/poor	16.93	0.01	14.85	0.02	19.59	0.02

* $p < 0.05$ for the comparison of Blacks and Whites.

Table 2. Estimated net effects of key predictor and control variables on fruit and vegetable intake in the pooled sample.

	All (n = 2277)		All (n = 2277)	
	Model 1		Model 2	
	b	95% CI.	b	95% CI.
Race (Non-Hispanic Blacks)	0.58 *	0.14–1.03	2.20 **	0.83–3.56
Gender (Male)	−0.28 *	−0.55–0.00	−0.29 *	−0.57–0.02
Age	−0.01 *	−0.02–0.00	−0.01 *	−0.02–0.00
Obese	−0.31 *	−0.62–0.01	−0.32 *	−0.62–0.01
SRH (Poor)	−0.31	−0.72–0.11	−0.25	−0.66–0.16
Education	0.25 ***	0.10–0.39	0.35 ***	0.20–0.51
Income	0.13 **	0.04–0.23	0.13 *	0.03–0.24
Race × Education	-	-	−0.60 **	−0.99–0.20
Race × Income	-	-	0.05	−0.15–0.25
Intercept	4.23 ***	3.31–5.15	3.89 ***	2.89–4.89
Adjusted R-square	0.10		0.11	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Source: Health Information National Trends Survey (HINTS) 2017.

Table 3. Estimated net effects of key predictor and control variables on fruit and vegetable intake across races.

	Non-Hispanic Whites (n = 1868)		Non-Hispanic Blacks (n = 409)	
	b	95% CI.	b	95% CI.
	<i>Model 3</i>		<i>Model 4</i>	
Gender (Male)	-0.34 *	-0.64-0.03	0.02	-0.69-0.74
Age	-0.01 *	-0.02-0.00	0.00	-0.03-0.02
Obese	-0.30 #	-0.65-0.06	-0.35	-1.08-0.39
SRH (Poor)	-0.29	-0.75-0.17	-0.02	-1.00-0.96
Education	0.35 ***	0.20-0.50	-0.22	-0.62-0.19
Income	0.13 *	0.02-0.24	0.18 #	-0.01-0.37
Intercept	3.95 ***	2.90-5.01	5.59 ***	3.80-7.37
Adjusted R-square		0.10		0.05

$p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Source: Health Information National Trends Survey (HINTS) 2017.

5. Discussion

In the pooled sample, higher educational attainment and income were associated with higher fruit and vegetable intake. While the effect of income was similar for non-Hispanic Whites and non-Hispanic Blacks, high educational attainment showed a stronger effect on the consumption of fruits and vegetables for non-Hispanic Whites than non-Hispanic Blacks. Although there are inequalities, such inequalities are seen for education but not income.

5.1. Results in Context

Although support for the Minorities’ Diminished Return theory was found, we only found a moderating effect of race for educational attainment but not income. One clear implication here is that educational institutions are not “the great equalizer” they are sometimes called [39]. In a study by Holmes and Zajacova, education was found to have a larger effect on the health of Whites than Blacks even after controlling for demographic, behavioral, and economic confounders. The authors attributed these racial differences to unmeasured variables such as childhood SES [39].

Our finding is in line with other studies that have documented stronger effects of educational attainment on other behaviors such as alcohol consumption [3] and smoking [40] among White than Black Americans. Educational attainment, employment, and income also better protect Whites than Blacks against premature mortality [4,6] and risk of depression [26,27,41]. Studies by Hayward et al. [42], Backlund et al. [43], Lewis et al. [44], Roelfs [45], and Everett et al. [46] have also shown larger effects of SES on mortality for Whites than Blacks. Marital status may also have stronger effects on hunger and breastfeeding for White than Black mothers [16].

The current study extends a well-established phenomenon to a new outcome. We are not aware of any previous studies on differential SES gains of Blacks and Whites on the consumption of fruits and vegetables. This study is among the first studies to provide evidence that the influence of educational attainment on diet is conditional on race. This result is in line with other outcomes that have previously shown (please see references [1] and [2] for a review).

Lower education quality in inner cities and scarcity of educational resources within majority Black areas may be responsible for the observed differential effect of educational attainment across races [47]. The magnitude of the effect of education credentials and years of schooling on health are conditional upon how educational attainment translates to income and wealth, which depends on race and ethnicity [48,49]. Populations’ abilities to translate their SES resources into tangible health outcomes are not equal across demographic and social groups [50]. Race, ethnicity, gender, and class mitigate the health gains that follow educational attainment in multiple ways [51].

Despite all the existing anti-discrimination regulations, the labor market continues to provide unequal employment opportunities for racial groups [52]. Labor market preferences and practices that constantly favor and promote Whites cause a relative disadvantage of the educational attainment of non-Whites. Labor market constantly discriminates against Blacks in hiring and wages [53]. Evidence indicates that applicants with Black or Hispanic names are less likely to be selected for job interviews [54–56]. In 2006, among men with a master's degree, Blacks earned \$27,000 less than Whites [4,57]. Dual market theory suggests that occupations are roughly divided into two categories: primary jobs that have high wages, good working conditions, and opportunities for advancement, and secondary jobs with minimum wages, poor working conditions, stressful and unstable conditions, and minimal opportunity for growth and promotion [58]. Blacks are more likely to work secondary jobs than Whites [59]. As a result, educational attainment shows a diminished economic return and generates smaller changes to the lifestyle, behaviors, social networks, and life conditions of Blacks than Whites [60].

The significant interaction between educational attainment and race is that among equally educated individuals, Blacks are at a disadvantage for diet; this may be due to Blacks' disadvantages in the job market. The disadvantage of Blacks in the job market may translate into Black's lower consumption of fruits and vegetables and other healthy behaviors. The effects of race and class are not additive but multiplicative. This supports the views of Navarro [61], Williams [62], and Mehta [63], who have argued that race and SES interact with health. That is, resources better serve the majority than minority groups. Health disparities should be seen as a consequence of complex, nonlinear, interrelated interactions between race and SES resources.

Due to residential segregation by race, high SES Blacks are still at a higher risk of living in majority Black neighborhoods, which reduces their access to healthy food [64]. The density of grocery stores and supermarkets that facilitate a healthy diet is lower for majority Black than majority White neighborhoods [64]. The environment negatively impacts highly educated Blacks who are interested in a healthy diet, as their physical environment may discourage them from purchasing fruit and vegetables that may not be easily available at nearby locations [65]. As a result, Blacks may replace fruits and vegetables with other types of food, resulting in the consumption of less fruits and vegetables [66–68]. Given the causal link between low levels of fruit and vegetable intake and the risk of cardio-metabolic problems and cancer [69], the results are a higher prevalence of obesity, diabetes, hypertension, stroke, heart disease, and some cancers in high SES Blacks compared to high SES Whites [23,70–76].

This study did not show an interaction between race and income on diet. In a study on the effects of SES on mortality, Blacks gained less from educational attainment but not income [4]. Thus, it is intuitive to expect larger gap in the effects of educational attainment than income. This is because the differential effect of education on income is one of the mechanisms behind the differential effect of educational attainment on health.

SES is best understood as a multi-dimensional construct composed of education, income, and occupational prestige [77,78]. The disparate findings of moderation for education and income further underscore the value of a multi-dimensional measurement of SES [77–79]. As a result, different measures of SES play a different moderating role, however, education seems to generate more differential gains than income [1,2].

5.2. Policy Implications

Policymakers should be aware of the systemic interaction between racial group membership and resources. Thus, policymakers should be aware of the systemic interaction between racial group membership and resources. Income redistribution policies may be an effective strategy for the elimination of health disparities in the U.S. Policies that increase the minimum income and reduce the Black–White gap in pay may reduce disparities in health [1,2]. This finding also has implications for decisions on the threshold of SES for the eligibility of food assistance programs such as Women,

Infants and Children (WIC) Temporary Assistance for Needy Families (TANF) for racial minority groups [80].

The results also have implications for clinical practice and public health programs. Highly educated Blacks may still require more health promotion programs that are focused on a healthy diet and the consumption of fruits and vegetables. High SES Blacks may require some advice to encourage an increase in their fruit and vegetable intake. In this regard, tailored messages may be an effective strategy to promote the health of Blacks [81,82].

The direction of moderation by race is to Blacks' disadvantage. Blacks experience several social and economic disadvantages [62,83]. As a result, closing the gap between White and Black health would not simply be possible by eliminating the racial gap in SES. Racial differences in health reaches beyond SES differences in the distribution of resources. Blacks are constantly exposed to a wide range of societal barriers that hinder their ability to take advantage of the resources that they access. A single SES resource may have a smaller protective effect in the presence of several other risk factors [84–89]. Despite high education, Blacks have low employment opportunities [42] and earn less if employed [90,91]. The Black–White pay gap is larger than the Black–White gap in educational attainment [92]. High paying jobs are more accessible by Whites than Blacks, and Blacks may have difficulty with commuting to jobs and competing to securing a high-paying job [93]. The education system also discriminates against Blacks [94], which reduces the gain that follows education. Highly educated Blacks do not enjoy equal access to the opportunity structure compared to their White counterparts [95,96].

5.3. Limitations

This study had a few methodological limitations. First, with a cross-sectional design, our study does not allow any causal inferences. Longitudinal studies are needed to observe how change in SES impacts changes in dietary behavior over time. Thus, there is a need to replicate these findings using longitudinal data. Second, potential underlying mechanisms beneath the observed differential effects were not investigated. Family structure, childhood SES, wealth, and employment may be some explanatory factors. In addition, we did not study the types of fruits and vegetables. As some fruit show paradoxical health effects [97], more attention to the specific types of fruit consumed is needed. Furthermore, as we measured fruit and vegetable intake using two items, we did not run separate models for fruit consumption and vegetable consumption. Measurement bias was also a threat, as the response categories for fruit and vegetable use were not mutually exclusive. This study was limited to Whites and Blacks. Future research should also include Latino or Hispanic respondents. We recommend that future research uses food diaries as a follow-up to self-reported survey data on fruit and vegetable intake. Our study is prone to non-random reporting differences by race and class that may impact the validity of the results. In addition, the lower sample size of Blacks than Whites may have resulted in different statistical power across racial groups. Lastly, although MDR should be considered as a theory, the evidence supporting it is limited to the US, and we do not know if the same pattern would hold in Europe, Asia, and Africa. More research is needed to test how this theory holds in settings other than US. Despite the above limitations, this study extends the existing literature on the interactive effects of race and SES on healthy diet.

6. Conclusions

To conclude, race modifies the health gains that follow educational attainment, and the consumption of fruits and vegetables is not an exception to this rule. That is, in America, educational attainment consistently generates a greater benefit for the majority than for minority groups. There is a need for policies and programs that have the potential to minimize minorities' diminished returns of educational attainment and other SES resources. Policies should go beyond increasing minorities' access to educational attainment and identify ways to increase Blacks' capacity to translate their educational attainment into tangible health outcomes. There is a need to reduce discrimination across

levels, such as the labor market and education system, that cause inequalities in gains from education. Without reducing structural and institutional racism in the U.S., merely eliminating the racial gap in access to SES resources will not be enough to eliminate the racial gap in health.

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Conflicts of Interest: The authors declare no conflict of interest.

Ethics: All participants provided informed consent. HINTS 5 was approved by the Westat's Institutional Review Board. HINTS was deemed exempt from IRB review by the NIH Office of Human Subjects.

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