A Threshold Effect? The Association Between Educational Attainment and Resting Pulse Rate

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Abstract

Increased socioeconomic attainment is associated with better cardiovascular disease outcomes. The modifying effect of citizenship on this relationship is less studied. This analysis used cross—sectional data from the 2013—2014 National Health and Nutrition Examination Survey to consider the association between educational attainment and resting pulse rate using ordinary least squares regression. Resting pulse rate is a noninvasive measure of cardiovascular disease. Models control for age, gender, race/ethnicity, federal poverty level, health insurance, medication use, citizenship, and modification by citizenship. People with a 9th to 11th grade education ($\beta = 2.05$, $p < .05$), those who graduated high school/obtained a GED ($\beta = 2.25$, $p < .05$), or those with some college/associate's degree ($\beta = 2.69$, $p < .01$) had higher resting pulse rate compared to people with less than a 9th grade education. People with a college degree and above were not significantly different from people with less than a 9th grade education. These effects disappeared with the inclusion of control variables. Additionally, the effect of educational attainment on resting pulse rate differed by citizenship status. Specifically, noncitizens with some college/associate's degree had significantly lower resting pulse rates than all citizenship groups with a 9th to 11th grade education and U.S.—born citizens with a high school/GED education. The protective effect of educational attainment on resting pulse rate may differ by the type of education attained and citizenship status, specifically for noncitizens with some college education. Although these results might support a healthy immigrant hypothesis, the observed associations could be reflective of immigrant selection effects.

Introduction

Accounting for nearly 24% of all deaths, cardiovascular disease (CVD) remains the leading cause of mortality in the United States (U.S.) [1]. Although CVD mortality has declined since 1969, disparities by socioeconomic status (SES) and race remain [2]. In addition to medical advancements, interventions focused on the social determinants of CVD can have important preventative effects [3]. SES, which is often operationalized as educational attainment, income, occupation, and prestige, is one determinant [4].

The Role of Socioeconomic Status on Cardiovascular Disease

Increased SES is often associated with lower rates of infectious and chronic diseases [5—7]. The considerable evidence supporting this association led to Link and Phelan's [7] Fundamental Causes of Disease Theory. In this theory, SES functions as a "fundamental cause" because it allows access to flexible resources (e.g., healthcare and technology) that improve health. Regardless of the disease or condition in question, higher SES individuals often receive health improvements and treatments first because of their greater purchasing power to access resources, greater knowledge of how to use innovative technology, and greater likelihood of becoming early adopters of new treatments.

Previous work has found significant independent and joint effects of education, income, and occupation on CVD [4]. Of these measures, education had the strongest association [4]. Analysis of longitudinal data also revealed that increased educational attainment is associated with decreased CVD risk [8].

Educational attainment is strongly associated with other SES measures, including employment, income, job satisfaction, and perceived control [9]. Additionally, more educated individuals are less likely to engage in unhealthy behaviors, due in part to their greater access to more health promoting resources [9]. Therefore, educational attainment can serve as a distal determinant of health and engender other forms of social stratification.

Citizenship as Social Stratification

Fundamental Causes Theory highlights the importance of social stratification on health disparities. There are, however, exceptions to the generalizability of an SES advantage. One such exception is the Immigrant Health Paradox, or the phenomenon where immigrants tend to have better health than U.S.—born individuals despite having lower socioeconomic attainment [10, 11]. This

paradigm often places individual or cultural practices as the reason for immigrants' health advantage and ignores the institutional and structural barriers that may ultimately lead to selection for healthy migrants [12—14].

It is important to consider other forms of social stratification and adopt an intersectional approach [14]. Citizenship status embodies these perspectives of institutional and structural barriers. Citizenship status is an indicator of formal membership in a country. Citizenship status can be granted by birth within a country (jus soli) or by fulfilling criteria such as living in the U.S. for five or more years (e.g. naturalized citizenship). Those who choose not to pursue citizenship are classified as non—citizens. As a benefit of citizenship, members have greater access to health and socioeconomic resources than nonmembers (non—citizens) [15, 16]. The barriers to education are especially relevant; noncitizens have worse educational outcomes compared to citizens [15, 17]. Stratification by citizenship places institutional barriers on access to goods, which can lead to poorer health [12, 13, 16, 18].

Study Rationale: The Association Between Educational Attainment and Resting Pulse Rate

It is important to consider noninvasive measures of CVD. While outcomes like hypertension are often predictive of more severe cardiovascular events, measurement often requires medical equipment. Resting pulse rate is a simpler, noninvasive alternative. Increased resting pulse rate has been associated with an increased risk of CVD [19—22]. Specifically, Fox et al. found that a resting pulse rate past 60 beats per minute (BPM) was associated with increased risk for a cardiovascular event. A resting pulse rate between 60 BPM to 90 BPM, however, is considered normal, while clinical tachycardia is classified as having a resting pulse rate of at least 90 to 100 BPM [20, 22].

This study uses perspectives from the Theory of Fundamental Causes to examine the relationship between educational attainment and resting pulse rate. First, this analysis will interrogate the relationship between educational attainment and resting pulse rate. I hypothesize that compared to individuals with less than a high school education, higher educational attainment will be associated with lower resting pulse rate. This analysis will also examine whether or not the association between educational attainment and resting pulse rate is moderated by citizenship status. I hypothesize that the protective effect of educational attainment will be greatest among U.S.—born citizens and have less of an effect among naturalized citizens and noncitizens, given the health promoting privileges of citizenship.

Methods

Dataset and Study Design

The data for this study were taken from the 2013—2014 administration of the National Health and Nutrition Examination Survey (NHANES). NHANES is a comprehensive, cross—sectional survey intended to provide nationally representative profiles of U.S. demographics, health, dietary and health behaviors, and socioeconomic factors [23]. Some limitations of NHANES are that it excludes people who are incarcerated or institutionalized and has limited categorizations for certain variables (e.g. gender).

For 2013—2014, NHANES collected data from the noninstitutionalized civilian population through a four—stage nested sampling design: county, census block, dwelling, and person [24]. NHANES staff visited each household and chose a subsample of individuals based on sex, age, race, Hispanic origin, and income for the interview portion. NHANES also oversampled Hispanic, non—Hispanic Black, Asian/Asian American people in addition to older adults and low—income white people [24, 25]. The interview consisted of personal demographics, health, nutrition, and household information. Interviewed participants were then invited to complete a physical examination and laboratory assessment at the NHANES Mobile Examination Center (MEC). The 2013—2014 NHANES had a 71.0% unweighted response rate for the interview portion and a 68.5% unweighted response rate for the physical and laboratory examination [26]. In total, 14,332 individuals were screened, 10,175 completed the interview, and 9,813 of the interviewed participants also completed the examination. This study limits the NHANES population to people ages 20 and older, allowing for a starting sample size of 5,769 individuals.

Variables

To explore the relationship between educational attainment and pulse rate, this study considers the following covariates: age, gender, race/ethnicity, citizenship status, federal poverty level (FPL), health insurance type, and use of anti—hypertensive medication, which are all known to influence pulse rate [2, 3, 8, 19]. All variables except for resting pulse rate were measured during the initial screening and home interview portions of the survey. Resting pulse rate was measured at the MEC.

Educational Attainment. Educational attainment was determined using a single question: "What is the highest grade or grade level you have completed or the highest degree you have received?" NHANES presents

educational attainment data with five categories: less than 9th grade, 9th to 11th grade, high school graduate or General Education Diploma (GED) or equivalent, some college/associate's degree, and college graduate or above [27].

Resting Pulse Rate. The resting pulse rate was determined at the MEC. After resting quietly and seated for approximately 5 minutes, trained staff measured individuals' radial pulse rates by counting for 30 seconds using a stopwatch. The total resting pulse rate (measured in BPM) was calculated by doubling the 30—second resting pulse rate [28].

Age and Gender. Age was determined at the time of screening; individuals over 80 years old were top—coded. Gender was coded as either being male or female.

Race/Ethnicity. Hispanic ethnicity was determined by asking individuals whether they were of Hispanic origin. Individuals who identified as Hispanic were then classified as either Mexican American or "Other Hispanic." After determining Hispanic ethnic origin, participants were then asked which races they identify with. NHANES provides seven categories of race/ethnicity: Mexican American, other Hispanic, non—Hispanic white, non—Hispanic Black, non—Hispanic Asian, and Other Race/Multi—Racial [27].

Citizenship Status. Citizenship status was defined using three levels: U.S.—born citizen, naturalized citizen, and noncitizen. This variable was created based on two items: 1) "Are you a citizen of the United States?" (1— Citizen by birth or naturalization, 2 – Not a citizen, 7 – refused, 9 – missing) and 2) "In what country was the respondent born?" (1— Born in U.S., 2 – Others). Individuals who identified as citizens but were born outside of the U.S. were considered naturalized. Those who responded otherwise were categorized as noncitizens.

Poverty Index Ratio and Federal Poverty Level. Poverty Index Ratio (PIR) was calculated by dividing an individual's reported total family income (in U.S. dollars) by the U.S. federal poverty guidelines for the survey cycle [27]. PIR values range from 0 to 5.00. Respondents with a PIR greater than 5.00 were top—coded to have a PIR equal to 5.00 [27]. The Federal Poverty Level (FPL) categories were calculated using the PIR values by determining whether PIR values were above or below 1.00. PIR values below 1.00 were '0% to 99% FPL'. PIR values ranging between 1.00 to 1.99 were '100% to 199% FPL', with equivalent 100—point categories up to '400 to 499% FPL'. Any PIR value of 5.00 or above was classified as '500% + FPL'.

Health Insurance Status. Health insurance was operationalized by asking if individuals had health insurance and discerning the health insurance type (i.e. private or public) [27].

Use of Anti—Hypertensive Medication. The use of anti—hypertensive medication was determined by examining whether individuals used particular anti—hypertensive medications or not [29].

Analytical Sample

Of the 5,769 individuals within the adult sample, 5,399 individuals had complete data on educational attainment and resting pulse rate. Considering completeness of all variables, a complete case analysis would have a total of 4,594 individuals, or 79.63%. Other than individuals who did not complete the physical examination, most missing data was due to PIR. Therefore, PIR was imputed from the mean (PIR = 2.50). These PIR imputed individuals were placed in the appropriate FPL category. Although mean imputation may bias variance and covariance estimates, this technique was done to allow the analysis to be replicable.

Analysis

This analysis presents five linear regression models to examine the relationship between educational attainment and resting pulse rate. Model 1 examines the gross bivariate relationship between educational attainment and resting pulse rate. Model 2 incorporates demographic covariates (i.e., age, gender, race/ethnicity, and citizenship status) as potential controls. Age, gender, and race/ethnicity are included as covariate controls in this model, given their association both with educational attainment [9,15] and resting pulse rate/CVD [3]. Model 3 considers the mediating effects of PIR and health insurance type, two types of flexible resources that fit the context of the Theory of Fundamental Causes. Model 4 considers the potential confounding effects of the use of anti—hypertensive medication as a nuisance covariate. Finally, Model 5 formally tests for effect modification by citizenship status.

All univariate, bivariate, and multivariate analyses were done using Stata Version 15 [30]. Given the complexity of the sample design and to provide nationally representative estimates, I used the "svy" command with Mobile Examination (MEC) weights. A p—value of .05 was also used as the critical cutoff level to identify statistically significant findings.

Results

Sample Characteristics

Table 1 displays the weighted univariate distribution of educational attainment, resting pulse rate, and key covariates in the study population. Nearly 85% of the sample attained at least a high school education, GED, or higher. Individuals with some college/associate degree comprised nearly 33% of the sample and were the majority educational attainment category.

The mean resting pulse rate for the sample was 72.68 BPM, which is within the normal clinical range for resting pulse rate [22]. This pulse rate is elevated from the suggested resting heart rate of 60 BPM, however, possibly indicating an elevated risk of cardiovascular events within this population. Over 22% of the sample reported that they did use anti—hypertensive medication.

Exploration of demographic covariates reveals that the sample was primarily middle—aged (mean age = 47.47 years). Over half of the sample identified as female, and nearly two—thirds of the sample were Non—Hispanic White. Moreover, over 80% of the sample identified as U.S.—born citizens. Similar proportions of individuals were classified as naturalized citizens (8.99%) or noncitizens (8.30%).

Examining the univariate distributions of variables representing flexible resources (FPL and health insurance) revealed that nearly 13% of the sample was below the FPL (i.e., 0% to 99%). In comparison, the proportion of individuals with 500%+ FPL, the largest group, was nearly two times the proportion of individuals within the 0% to 99% category. Finally, over 80% of the sample had either public or private insurance.

Bivariate Analysis Between Study Variables and Mean Resting Pulse Rate

Table 2 displays the weighted bivariate distribution of resting pulse rate by educational attainment and key study variables. Overall, there is a significant difference in resting pulse rate by educational attainment ($p < .001$). Surprisingly, compared to individuals with less than a 9th—grade education, increased educational attainment is associated with increased resting pulse rate for all attainment categories except individuals with a college degree or above. Individuals with some college/associate degrees had the highest mean resting pulse rate (73.84 BPM), while individuals with a college degree or above had the lowest mean resting pulse rate (70.99 BPM).

Exploration of the demographic covariates revealed significant differences in resting pulse rate by age and gender, but not by race/ethnicity and citizenship status. Increased age was associated with decreased resting pulse rate and there were significant differences by age group ($p < .001$), such that the older groups had significantly lower resting pulse rates than the youngest group. Individuals aged 20 to 29 had the highest mean resting pulse rate (75.03 BPM), whereas individuals who were at least 80 years old had the lowest resting pulse rate (68.33 BPM). Females had a significantly higher mean resting pulse rate when compared to males ($p < .001$).

Exploration of differences in resting pulse rate between race/ethnic group and by citizenship status did not indicate any statistically significant differences (race/ethnicity: $p = .974$, citizenship: $p = .463$). Given the conceptual model for this study, however, these variables were still included in the multivariate analysis.

The examination of flexible resources revealed further significant differences. There was a gradient of increasing FPL with decreasing resting pulse rate, and an overall difference by group ($p = .002$). Individuals who were 0% to 99% of the FPL had the highest mean resting pulse rate (74.19 BPM), whereas individuals who were at least 500% of the FPL had the lowest resting pulse rate (71.58%). Examining the bivariate relationship between insurance type and resting pulse rate revealed significant differences by group ($p = .006$). People with private insurance had the lowest mean resting pulse rate (72.06 BPM) while people with no insurance (73.64 BPM) and public insurance (73.71 BPM) had similar mean resting pulse rates.

Finally, those who used anti—hypertensive medication had significantly lower mean resting pulse rates (71.50 BPM) than individuals who did not use anti—hypertensive medications (73.03 BPM).

Regression of Resting Pulse Rate on Educational Attainment

Table 3 displays the weighted ordinary least squares regression of resting pulse rate on educational attainment and additional covariates. The simple linear regression of resting pulse rate on educational attainment reveals significant differences with most of the higher attainment categories compared to individuals with less than a 9th—grade education (Model 1). Specifically, individuals with a 9th to 11th—grade education ($\beta = 2.05$, $p < .05$), a high school/GED education ($\beta = 2.25$, $p < .05$), or some college/associate degree ($\beta = 2.69$, $p < .01$) had higher resting BPM compared to individuals with less than a 9th—grade education. Individuals with a college degree or above had similar mean resting pulse rates to individuals with less than a 9th—grade education.

Despite this initial significant bivariate relationship, after the inclusion of demographic covariates, the effect of educational attainment became insignificant (Model 2). Individuals of all educational attainment categories had similar mean resting pulse rates compared to individuals with less than a 9th—grade education. The variance in the resting pulse rate explained solely by educational attainment categories could better be explained by differences in age and gender. Increasing age was associated with decreasing resting pulse rate ($p < .001$) and females had higher resting BPM compared to males ($p < .001$).

As expected from the initial bivariate analysis of race/ethnicity and citizenship status on resting pulse rate, the inclusion of these variables in the multivariate model did not reveal any significant main effects. Every race/ethnic category had similar mean resting pulse rates when compared to non—Hispanic Whites, after controlling for education, age, gender, and citizenship status. For citizenship status, naturalized citizens and noncitizens both had lower resting pulse rates than U.S.—born citizens. However, the differences of these groups when compared to U.S.—born citizens were not statistically significant.

The inclusion of flexible resources as mediators revealed significant main effects for insurance type, but not for FPL. Individuals with public insurance had higher pulse rates ($p < .05$) than individuals without insurance (Model 3). This elevated BPM among individuals with public insurance remained significant with anti—hypertensive medication use and the interaction of citizenship status on educational attainment. Inclusion of anti—hypertensive medication use (Model 4) did not yield any statistically significant results.

Finally, the overall interaction between educational attainment and citizenship was significant ($p = .035$). Figure 1 shows the predicted margins of citizenship status on the relationship between educational attainment and health. Resting BPM within the same educational group does not differ by the citizenship status group except for those with some college or an associate degree. Noncitizens had lower resting BPMs compared to U.S.—born citizens. Noncitizens with some college/associate degrees also had significantly lower resting BPMs compared to all groups in the '9th to 11th grade' category and U.S.—born citizens in the 'high school/GED' group.

Discussion and Greater Significance

This study investigated the relationship between educational attainment and resting pulse rate and explored how this relationship differs by citizenship status. Overall, compared to individuals with less than a 9th—grade education, there was a significant bivariate relationship between educational attainment and increasing resting pulse rate for all categories except for college—educated individuals. While the differences between higher educational attainment groups and individuals with less than a 9th—grade education disappeared with the inclusion of covariates, the association between educational attainment and resting pulse rate was indeed modified by citizenship status. Noncitizens drove this moderation effect with some college or an associate's degree and had a lower resting BPM.

These findings provide nuanced insight into the potential role of educational attainment on health. Rather than the assumed graded relationship of SES on health [5, 6], these findings show that lower resting BPM was present for those in the lowest and highest educational attainment groups.

This analysis also found that citizenship status significantly modified the relationship between educational attainment and resting pulse rate for noncitizens. U.S.—born and naturalized citizens saw a similar effect in the role of educational attainment on health. While the protective effect among noncitizens was consistent with the healthy immigrant hypothesis, the observed effect may instead be indicative of selection effects for immigrants. Despite their disadvantaged social status in the U.S. context, noncitizens may have a lower mean resting pulse rate because they may be selected to be healthier or have greater socioeconomic attainment relative to people of their country of origin [31, 32].

This study has several limitations. While there were significant relationships between educational attainment and resting pulse rate, educational attainment groups may not be entirely comparable given the NHANES' cross—sectional design. Though individuals of lower socioeconomic attainment were oversampled, lower educational attainment groups made up a small proportion of the sample. This lack of comparability limits our ability to make causal inferences about the association between educational attainment and resting pulse rate. The use of a longitudinal design would alleviate issues of non—exchangeability and allow for a more concrete causal assumption by establishing temporality. Nevertheless, the results provide a foundation for exploring why individuals

with increased educational attainment would have higher resting pulse rates rather than lower pulse rates.

Additionally, while this analysis found modification by citizenship, it cannot immediately distinguish individuals within the noncitizen category. The noncitizen category is a heterogeneous group comprising both documented immigrants (e.g., Lawful Permanent Residents) and undocumented immigrants. Thus, different groups within the noncitizen category have different degrees of legal privileges entitled to them. While the results presented provide a foundation from which to explore the role of citizenship as a marker of social stratification, future work should disaggregate the noncitizen category.

Despite these limitations, this analysis provides greater nuance on the relationship between SES and cardiovascular health. Specifically, the results show a protective effect on resting BPM among college educated individuals, but not among other levels of educational attainment. Additionally, this study is one of the few to explore the association between citizenship and a biomarker like resting pulse rate. Previous studies have used self—rated measures for health [13, 18]. Finally, placing this analysis in context, citizenship provides greater specificity of the Theory of Fundamental Causes. Overall, this study emphasizes that the effect of SES on health may be significant only at the highest educational attainment levels, rather than being a graded relationship. This effect may also differ by levels of citizenship.

Table 1. Study Sample Characteristics, National Health and Nutrition Examination Survey (NHANES) 2013-2014, n = 5,389

Characteristic	Weighted Percent or Mean (95% Confidence Interval)
Educational Attainment	
< 9th Grade	4.46 (3.52, 5.64)
9th- 11th grade	10.62 (8.44, 13.30)
High School/GED	21.66 (19.29, 24.23)
Some College/AA	32.78 (30.74, 34.89)
College and Above	30.47 (26.50, 34.75)
Mean Resting Pulse Rate	72.68 (71.67, 73.70)
Mean Age	47.47 (46.60, 48.34)
Gender	
Male	48.26 (46.73, 49.79)
Female	51.74 (50.21, 53.27)
Race/Ethnicity	
Non-Hispanic White	65.84 (58.72, 72.31)
Other Hispanic	5.59 (3.74, 8.27)
Mexican American	9.11 (6.02, 13.57)
Non-Hispanic Black	11.45 (8.42, 15.39)
Non-Hispanic Asian	5.32 (4.12, 6.87)
Other Race/Ethnicity or Multiracial	2.68 (1.87, 3.82)
Citizenship Status	
U.S.-Born Citizen	82.71 (78.86, 85.99)
Naturalized Citizen	8.99 (7.47, 10.78)
Noncitizen	8.30 (6.46, 10.61)
Federal Poverty Level (FPL)	
0% - 99% FPL	12.56 (11.52, 18.22)
100% - 199% FPL	20.01(17.76, 22.48)
200% - 299% FPL	19.83 (18.27, 21.49)
300% - 399% FPL	13.13 (11.73, 14.67)
400% - 499% FPL	8.15 (6.81, 9.73)

500%+ FPL	24.31 (20.00, 29.20)
Insurance Type	
No Insurance	17.94 (15.57, 20.59)
Public Insurance	20.60 (18.32, 23.10)
Private Insurance	61.47 (57.11, 65.61)
Anti-hypertensive Medication Use	
Yes	22.57 (20.66, 24.60)
No	77.43 (75.40, 79.34)

Note. AA = Associate's degree; GED = General Education Diploma. Data were weighted using Mobile Examination Center (MEC) weights. Total sample size (n = 5,389) reflects unweighted sample size.

Table 2. Mean Pulse Rate by Sample Characteristics, National Health and Nutrition Examination Survey (NHANES) 2013-2014, n = 5,389

Characteristic	**Mean Resting Pulse Rate (95% CI)**	**P - Value**
Educational Attainment		
< 9th Grade	71.14 (69.44, 72.85)	< .001
9th- 11th grade	73.19 (71.92, 74.46)	
High School/GED	73.39 (72.05, 74.74)	
Some College/AA	73.84 (72.64, 75.03)	
College and Above	70.99 (69.89, 72.10)	
Age Category		
20 – 29 years old	75.03 (73.74, 76.33)	< .001
30 – 39 years old	74.18 (72.48, 75.88)	
40 – 49 years old	73.01 (71.59, 74.42)	
50 – 59 years old	72.90 (71.47, 74.32)	
60 – 69 years old	70.34 (69.22, 71.46)	
70 – 79 years old	69.23 (68.27, 70.20)	
80+ years old	68.33 (66.92, 69.74)	
Gender		
Male	71.46 (70.50, 72.42)	< .001
Female	73.83 (72.65, 75.01)	
Race/Ethnicity		
Non-Hispanic White	72.54 (71.36, 73.72)	.974
Other Hispanic	73.10 (71.52, 74.67)	
Mexican American	73.13 (71.98, 74.29)	
Non-Hispanic Black	72.64 (70.69, 74.58)	
Non-Hispanic Asian	72.92 (71.49, 74.36)	
Other Race/Ethnicity or Multiracial	73.59 (71.09, 76.08)	
Citizenship Status		
U.S.-Born Citizen	72.76 (71.61, 73.91)	.463
Naturalized Citizen	72.18 (71.25, 73.10)	
Noncitizen	72.47 (71.31, 73.64)	

Federal Poverty Level (FPL)		
0% - 99% FPL	74.19 (72.80, 75.59)	.002
100% - 199% FPL	73.24 (71.95, 74.52)	
200% - 299% FPL	73.27 (72.12, 74.41)	
300% - 399% FPL	71.68 (69.88, 73.49)	
400% - 499% FPL	72.14 (70.90, 73.37)	
500%+ FPL	71.58 (70.42, 72.73)	
Insurance Type		
No Insurance	73.64 (72.07, 75.22)	.006
Public Insurance	73.71 (72.52, 74.91)	
Private Insurance	72.06 (71.02, 73.10)	
Anti-hypertensive Medication Use		
Yes	71.50 (70.08, 72.93)	.006
No	73.03 (72.03, 74.03)	

Note. AA = Associate's degree; GED = General Education Diploma, P-values were obtained by running simple linear regressions with selected variable and resting pulse rate. Data were weighted using Mobile Examination Center (MEC) weights. Total sample size (n = 5,389) reflects unweighted sample size.

Table 3. Weighted Multiple Linear Regression of Educational Attainment on Resting Pulse Rate, National Health and Nutrition Examination Survey (NHANES) 2013-2014, n = 5389

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variables	B	95% CI	B	95% CI	B	95% CI	B	95% CI	B	95% CI
Educational Attainment (Ref. = < 9th grade)										
9th- 11th grade	2.05*	.07, 4.02	.82	-1.28, 2.91	.91	-1.11, 2.92	.90	-1.12, 2.91	2.60	-1.05, 6.25
High School/GED	2.25*	.28, 4.22	.99	-1.22, 3.20	1.32	-.74, 3.38	1.32	-.75, 3.38	2.66	-.81, 6.14
Some College/AA	2.69**	.76, 4.62	.99	-1.26, 3.25	1.45	-.56, 3.46	1.45	-.56, 3.46	2.76	-.57, 6.10
College and Above	-.15	-1.94, 1.64	-1.48	-3.50, .55	-0.73	-2.56, 1.10	-.70	-2.54, 1.13	.47	-2.83, 3.76
Age			-.12***	-.14, -.09	-.12***	-.15, -.10	-.13***	-.15, -.10	-.13***	-.15, -.10
Female Gender (Ref. = Male)			2.42***	1.66, 3.18	2.35***	1.57, 3.14	2.35***	1.57, 3.13	2.36***	1.56, 3.17
Race/Ethnicity (Ref. = Non-Hispanic Whites)										
Other Hispanic			-.40	-2.17, 1.37	-.65	-2.49, 1.19	-.65	-2.48, 1.19	-.65	-2.56, 1.25
Mexican American			-.27	-1.88, 1.34	-.34	-2.11, 1.43	-.34	-2.10, 1.43	-.22	-1.94, 1.50
Non-Hispanic Black			-.91	-2.08, .26	-1.16	-2.52, .19	-1.19	-2.55, .16	-1.25	-2.62, .12
Non-Hispanic Asian			.87	-1.07, 2.80	.75	-1.22, 2.73	.74	-1.25, 2.73	.38	-1.53, 2.30
Other Race/Ethnicity or Multiracial			.01	-2.74, 2.76	-.10	-2.85, 2.64	-.09	-2.83, 2.64	-.11	-2.83, 2.61
Citizenship Status (Ref = U.S.-Born)										
Naturalized Citizen			-.44	-1.51, .63	-.41	-1.43, .62	-.39	-1.43, .66	.89	-4.27, 6.04
Noncitizen			-1.13	-2.69, .42	-1.09	-2.60 .42	-1.06	-2.55, .43	1.14	-3.28, 5.56
Poverty Income Ratio (Ref. = 0% - 99%)										
100% - 199%					-.17	-1.24, .90	-.17	-1.25, .90	-.17	-1.27, .94
200% - 299%					.18	-1.04, 1.40	.17	-1.05, 1.39	.15	-1.05, 1.36
300% - 399%					-.93	-2.08, .22	-.93	-2.07, .21	-.90	-2.02, .22
400% - 499%					-.42	-2.14, 1.30	-.40	-2.14, 1.33	-.37	-2.13, 1.39
500%+					-.31	-1.93, 1.31	-.31	-1.93, 1.31	-.27	-1.91, 1.37
Insurance Type (Ref. = No Insurance)										
Public Insurance					1.37*	.167, 2.57	1.34*	.13, 2.55	1.28*	.05, 2.51
Private Insurance					-0.41	-1.81, .99	-.43	-1.82, .95	-0.50	-1.89, .90

Anti-hypertensive Medication Use (Ref. = No)							.37	-.73, 1.46	.38	-.70, 1.45
Educational Attainment x Citizenship Status										
9th - 11th Grade x U.S. – Born (Ref.)										
9th - 11th Grade x Naturalized Citizen									-.60	-6.60, 5.40
9th - 11th Grade x Noncitizen									-5.38*	-9.77, -.99
High School/GED x U.S.-Born (Ref)										
High School/GED x Naturalized Citizen									-1.42	-7.57, 4.74
High School/GED x Noncitizen									-2.71	-7.89, 2.46
Some College/AA x U.S.-Born (Ref.)										
Some College/AA x Naturalized Citizen									-2.04	-6.75, 2.67
Some College/AA x Noncitizen									-1.01	-5.29, 3.26
College and Above x U.S. Born (Ref.)										
College and Above x Naturalized Citizen									-.57	-6.65, 5.51
College and Above x Noncitizen									-.90	-5.52, 3.72
Constant	71.14***	69.44, 72.85	77.06***	74.18, 79.93	77.09***	73.76, 80.43	77.22***	73.83, 80.61	75.96***	71.59, 80.32
R-squared	.011		.048		.053		.053		.055	
AIC	41943.79		41755.19		41735.25		41736.95		41742.97	
BIC	41976.75		41847.48		41873.69		41881.97		41940.74	
-2 Log Likelihood	-20967		-20864		-20847		-20846		-20841	
Adjusted R—squared	.00401		.0399		.0446		.0445		.0449	

Note. *** p < 0.001, ** p < 0.01, * p < 0.05; Ref. = reference category; AA = Associate's degree; GED = General Education Diploma, AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion. Model 1 examines the bivariate relationship between educational attainment and resting pulse rate. Model 2 includes the main effects of age, gender, race/ethnicity, and citizenship. Model 3 includes the effects of poverty income ratio and health insurance type (i.e. flexible resources). Model 4 accounts for the use of anti—hypertensive medication. Model 5 formally tests the modification effects of citizenship on the relationship between educational attainment and resting pulse rate. Data were weighted using Mobile Examination Center (MEC) weights. Total sample size (n = 5,389) reflects unweighted sample size.

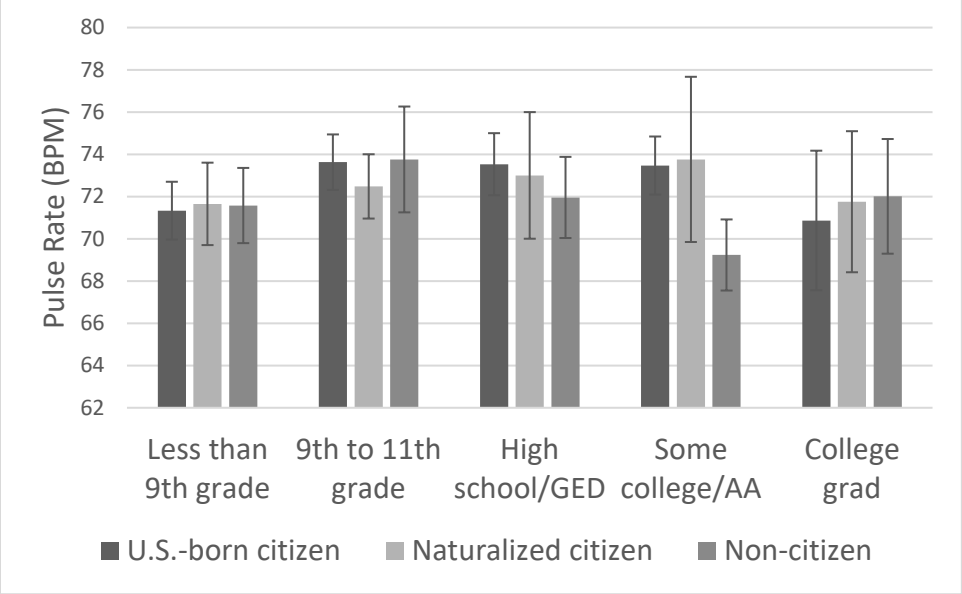

Figure 1. *Predictive Margins of Citizenship Status on the Relationship Between Educational Attainment and Resting Pulse Rate*
Note. Predictive margin values control for age, gender, race/ethnicity, Federal Poverty Level, health insurance type, and use of anti—hypertensive medication

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