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Race by Gender Differences in the Protective Effects of Education and Income Against Subsequent Changes in Self-rated Health, Physical Activity, and Body Mass Index Among Older Americans

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Abstract

Background: Educational attainment and income are central to maintenance of body mass index (BMI), physical activity, and self-rated health (SRH). However, less is known about how social groups differ in the role of educational attainment and income on subsequent changes in these health outcomes. This study compared race/ethnicity by gender groups of older Americans for the effects of baseline educational attainment and income on subsequent changes in BMI, physical activity, and SRH.

Methods: The Health and Retirement Study (HRS) followed 37,495 male and female White and African American people above age 50 for 6 years from 2004 to 2010. This number included 15,581 White women, 12,495 White men, 5,580 African American women, and 3,839 African American men. Physical activity, BMI, and SRH were measured every two years. Multi-group structural equation modeling (latent growth curve modeling) was used to compare race/ethnicity by gender groups for the protective effects of educational attainment and income in 2004 on a decline in physical activity, BMI, and SRH from 2004 to 2010.

Results: Major race/ethnicity by gender differences were observed in the effects of baseline educational attainment and income on changes in BMI, physical activity, and SRH. Educational attainment and income showed more salient roles for White men and women than African American men and women. To give some examples, baseline education (years) was associated with changes in physical activity of White women and changes in BMI of White men, while baseline income was associated with changes in SRH of White Women. We did not find evidence suggesting that baseline income fully mediates the effect of baseline educational attainment on health outcomes, as in many instances, educational attainment but not income was associated with health changes over time.

Conclusion: The intersection of race/ethnicity and gender alters how educational attainment and income protects against subsequent changes in physical activity, BMI, and SRH. Social groups may vary in operant mechanisms by which social determinants of health prevent health decline in the United States.

Keyword: Ethnic groups, Race, Ethnicity, Blacks, African Americans, Whites, Sex, Gender, Depression, Exercise, Activity, Body Mass Index, Obesity, Educational Attainment, Income
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1. Introduction

Educational attainment and income are two major socioeconomic position (SEP) indicators that reflect the relative position of an individual in the stratification system of society. While educational attainment and income are central to maintenance of health and well-being as well as prevention of illness, various SEP indicators may have specific influences on health (1) that are not universal but specific to SEP indicators and populations (14,16,17) who differ in their access to human and materialistic resources (e.g. prestige and composition of the social network) (1).

Educational attainment and income are linked to healthy behaviors (2), health, and psychosocial well-being (3). These SEP indicators also influence self-rated health (SRH), body mass index (BMI), chronic disease, psychosocial well-being, and mortality (3,4). Health behaviors such as physical activity, diet, and sleep may explain up to 70% of the effect of SEP indicators such as educational attainment and income on the mortality risk (5).

The protective effects of each SEP characteristic on each health outcome do not seem to be universal across settings and populations. Countries differ in the strength of the effect of SEP on health indicators. (6-11) Race/ethnicity (12), gender (13,15,16,59), place (17), and their intersections (14) shape how SEP factors influence health outcomes. For instance, for mortality as the outcome, SEP is a stronger determinant for men than women (13). How educational attainment determines health behaviors, chronic disease, depression, and mortality seem to differ between Whites and African American individuals (14,17).

Based on the "Marginalization-related Diminished Returns (MDRs) theory", the health returns of educational attainment and income might be smaller for African American individuals than Whites (17). Given they are differently treated by their society, populations can differently translate their SEP and available resources to health (17). Data from Americans Changing Lives (ACL) have documented a stronger protective effect of educational attainment for Whites than African American individual (17). In another study in 2016, Assari found a smaller effect of educational attainment on drinking patterns for African American individuals compared to Whites (12). In another ACL study, Assari found gender by race/ethnicity differences in the association between baseline educational attainment and change in depressive symptoms over 25 years. Contrary to our expectations, high educational credential was associated with a rise in depression for African American men over the course of the follow-up period. For White men and women, educational attainment had a protective effect against any increase in depression symptoms. Among African American men and women, we could observe an inverse association between years of schooling (education) at baseline and increased depression over time (14).

We conducted this study to compare race/ethnicity by gender groups for the protective effects of baseline educational attainment and income against changes in three physical health domains, namely BMI, physical activity, and SRH.

2. Methods

2.1. Study design

The Health and Retirement Study (HRS) is an ongoing longitudinal cohort study that started at 1992 which has collected data on SEP indicators and health behaviors, as well as mental and physical health. Data from 2004 to 2010 of the HRS were gathered and used in this study. The main goal of the HRS is to understand the changes in health status that follows the transition into retirement. The study has collected extensive psychosocial and health data associated with aging and retirement. For this analysis, data were limited to waves 7, 8, and 10 of the HRS. More detailed information is available on the HRS website, as well as previous publications (19-22).

2.2. Ethical Approval

The study received IRB approval from the University of Michigan. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) with the Helsinki Declaration of 1975, as revised in 2000.

2.3. Participants and sampling

The HRS sample is representative of Americans 50+ years old. The HRS enrolled its original sample in 1992. The original HRS cohort was comprised of Americans born 1931 -1941 and were between 51 and 61 years old. The HRS description of methods, sampling, and sample is available elsewhere (20-22).

2.4. Baseline and follow up interviews

The HRS baseline data were gathered in face-to-face interviews in the year 1992. Baseline interviews happened within the participants' homes. Since then the data collection was conducted every other year via phone interviews. We included 37,495 individuals who participated in 2004, 2006, and 2010.

2.5. Measures

Demographic factors. Gender and race/ethnicity were taken from the 1992 survey. Age was taken from the 2006 survey. Age was treated as a continuous variable. Gender was coded as 1 = female, 0 = male. Race / ethnicity was coded with White as the referent category. Individuals who were not White or African American were excluded.

Educational Attainment (SEP). Educational attainment was taken from the HRS 1992 (baseline). We treated years of educational attainment (schooling) as a continuous measure, with a higher score indicating more educational attainment.

Income (SEP). Income was taken from the HRS 2006 survey. Income was a continuous variable, calculated as household income divided by 10,000. As a result, the regression coefficient could be interpreted as the effect of each $10,000 change in household income.

Body Mass Index (BMI). The BMI level was measured based on self-reported weights and heights. Although some biases may exist, BMI based on self-reports strongly correlates with measured BMI (26,27,28).

Physical Activity. A single question was used to measure vigorous physical activity outside the work context, including but not limited to heavy housework (25). A higher score was indicative of more activity.

Self-Rated Health (SRH). Overall health varied between (1) excellent, (2) very good (3) fair, (4) good, and (5) poor. SRH was a continuous variable, ranging from 1 to 5. A higher SRH score indicated worse health (68-70).

2.6. Statistical Analysis

The current study used SPSS 20.0 for Windows (IBM Inc. Armonk, NY) for univariate and bivariate analysis. AMOS 20.0 (IBM Inc. Armonk, NY) was applied to perform our multivariable analysis (31,32). Structural equation modeling (SEM) was used for multi-variable analysis.

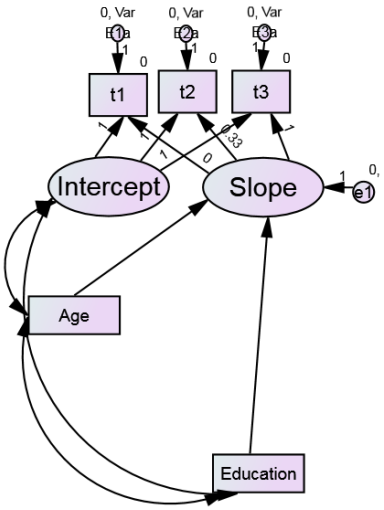
First, we ran our models in the pooled sample, then we ran multi-group SEMs (33). where groups were defined based on the intersection of race/ethnicity and gender. We used latent growth curve modeling (LGCM). The LGCM is a specific type of SEM to estimate baseline (intercept) and slope of three or more observed variables over time. We only included intercept and linear slope but not quadratic slope.

The first model was an unconditional model, which showed intercept and linear slope are significantly different from zero, and their variation can be modeled, in conditional models. We ran separate models for each health variable. In all our models, educational attainment and income were main predictors and age was the covariate, with covariance with the intercept. There were two primary paths of interest from educational attainment and income to the linear slope of the health outcome. There was also a path from age to the slope, which was considered as covariate. After we ran a model in the pooled sample, we ran a multi-group model for race/ethnicity by gender groups.

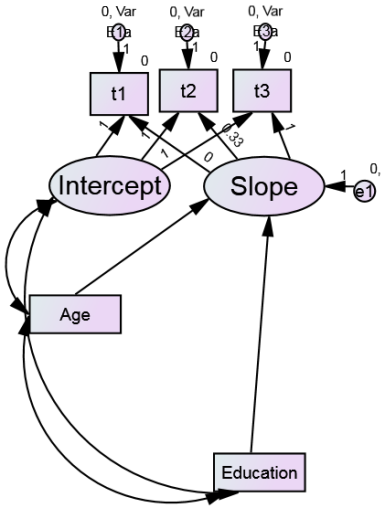
As Figure 1 shows, *Model 1* only included educational attainment (years), *Model 2* only included educational attainment (12 years), *Model 3* included educational attainment (years) and income, and *Model 4* included educational attainment (12 Years) and income. In all models, age was the only control variable, slope for the change of health over time was the only outcome, and educational attainment or/and income were the predictors.

We used full information maximum likelihood (FIML) to account for missing data. In our model, we defined sustained health problem as a latent factor which included three observed variables (years 2004,2006, and 2010). We assessed the goodness of

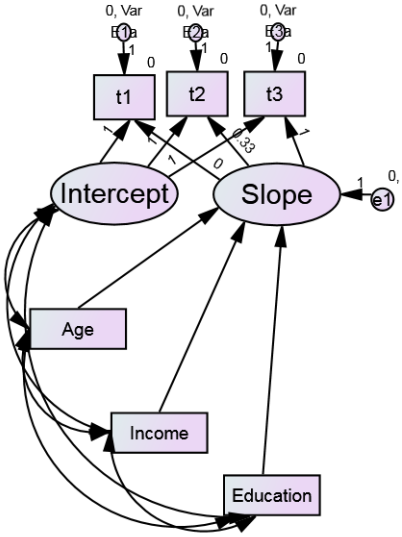
fit of our models using conventional fit statistics (34-37). These statistics included X^2 to degrees of freedom ratio, the comparative fit index, and the root mean squared error of approximation (RMSEA). From SEM paths, we reported the standardized regression coefficient, standard errors (SE), and p value.



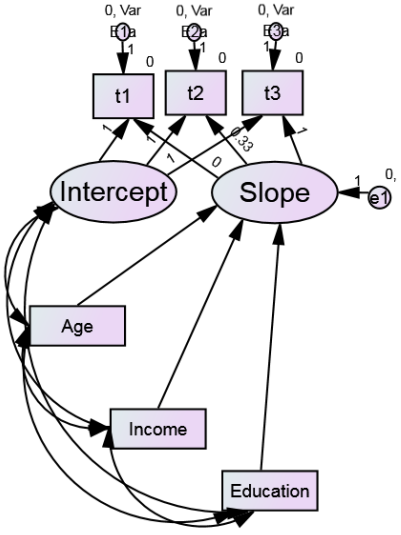
Model 1: Education (Years)



Model 2: Education (12 Years)



Model 3: Education (Years) and income



Model 4: Education (12 Years) and income

Figure 1: Effect of socioeconomic status on changes in BMI, physical activity, and SRH over 6 years

3. Results

This study was a successful follow up of 37,495 participants consisting of White men (n=12,495), White women (n=15,581), African American men (n=3,839), and African American women (n=5,580). (Table 1)

Table 1 shows that African American women had the highest BMI. African American men and African American women had the highest SRH (worst SRH).

Table 2 summarizes the pooled sample results. According to these models, educational attainment and income were associated with changes in physical activity, BMI, and SRH. (Table 2)

Table 3 shows the models with educational attainment (years) and health outcomes. Table 4 shows the results of the models with educational attainment (12 years) and health outcomes. These models show that educational attainment and income were more important for changes in SRH and BMI rather than physical activity. Major race/ethnicity by gender differences were found in the effects of baseline educational attainment and income on changes in physical activity, BMI, and SRH. More paths were missing for African American men and women than White men and women. To give some examples, educational attainment (years) was associated with the physical activity of White women and BMI of White men, while income was associated with SRH of White Women. We did not find evidence suggesting that income fully mediates the effect of educational attainment on health outcomes, as in many instances, educational attainment but not income was associated with changes in physical health outcomes. (Table 3 and Table 4)

Table 1: Socioeconomic position as well as physical health outcomes over time in the pooled sample and race/ethnicity by gender groups

	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
	Pooled sample		White men		White women		African American men		African American women	
	n=37,495		n=12,495		n=15,581		n=3,839		n=5,580	
Age	67.51	10.78	67.58	10.25	68.44	11.14	64.87	10.13	65.35	10.72
Education	12.05	3.46	12.47	3.41	12.20	3.14	11.00	4.08	11.39	3.71
Income($10,000)	6.05	10.35	7.33	12.39	5.89	10.02	4.86	6.24	3.78	5.84
BMI 2004	27.45	5.67	27.59	4.72	26.77	5.91	27.70	5.14	29.57	6.92
BMI 2006	6.05	10.35	7.33	12.39	5.89	10.02	4.86	6.24	3.78	5.84
BMI 2010	28.50	6.20	28.38	5.15	27.80	6.40	28.66	5.66	30.37	7.34
Physical Activity 2004	1.93	1.30	2.16	1.37	1.84	1.27	1.97	1.31	1.60	1.12
Physical Activity 2006	1.92	1.32	2.16	1.40	1.78	1.25	2.08	1.36	1.65	1.17
physical Activity 2010	2.04	1.32	2.25	1.36	1.92	1.29	2.27	1.36	1.83	1.24
SRH 2004	2.88	1.14	2.81	1.14	2.81	1.14	3.15	1.12	3.20	1.09
SRH 2006	2.88	1.13	2.80	1.11	2.82	1.14	3.10	1.13	3.24	1.08
SRH 2010	2.89	1.11	2.81	1.10	2.81	1.10	3.05	1.11	3.16	1.10

Body Mass Index; BMI, Self-Rated Health; SRH

Table 2: Effect of socioeconomic status on changes in BMI, physical activity, and SRH over 6 years in the pooled sample

			B (SE)	p	B (SE)	p	B (SE)	p
			BMI		Physical Activity		SRH	
Years of Education								
Model 1								
Education (Years)	→	Slope	0.06(0.01)	0.002	0.12(0.00)	0.057	0.28(0.00)	<0.001
Age	→	Slope	-0.27(0.00)	<0.001	0.21(0.00)	<0.001	0.29(0.00)	<0.001
Model 2								
Education (Years)	→	Slope	0.05(0.01)	0.011	0.12(0.00)	0.058	2.17(0.00)	<0.001
Income	→	Slope	0.03(0.00)	0.083	0.02(0.00)	0.792	0.85(0.00)	0.009
Age	→	Slope	-0.27(0.00)	<0.001	0.21(0.00)	<0.001	2.47(0.00)	<0.001
Education Credentials								
Model 1								
Education (12 Years)	→	Slope	0.08(0.07)	<0.001	0.16(0.03)	0.011	0.25(0.02)	<0.001
Age	→	Slope	-0.27(0.00)	<0.001	0.21(0.00)	<0.001	0.29(0.00)	<0.001
Model 2								
Education (12 Years)	→	Slope	0.07(0.07)	<0.001	0.16(0.03)	0.011	0.23(0.02)	<0.001
Income	→	Slope	0.03(0.00)	0.082	0.01(0.00)	0.866	0.12(0.00)	0.001
Age	→	Slope	-0.27(0.00)	<0.001	0.20(0.00)	<0.001	0.30(0.00)	<0.001

Body Mass Index; BMI, Self-Rated Health; SRH

4. Discussion

Overall, high education and income were linked to changes in BMI, physical activity, and SRH. Major race/ethnicity by gender differences were observed in the effects of baseline educational attainment and income on changes in three physical health domains. More paths were missing for African American men and women than White men and women. To give some examples, educational attainment (years) was associated with changes in physical activity of White women and BMI of White men, while income was associated with change of SRH of White Women. We did not find evidence suggesting that income fully mediates the effect of educational attainment on health outcomes, as in many instances educational attainment but not income was associated with changes in BMI, physical activity, and SRH. Our findings suggest that the associations were not consistent across SEP indicators, health outcomes, and populations. A recent study showed that although low educational attainment and income are associated with sustained health problems in all five domains namely insomnia, depressive symptoms, physical activity, BMI, and SRH, major race/ethnicity by gender group differences exist in these associations. For instance, the effect of educational attainment on insomnia, physical activity, and BMI were missing for African American men, and the effect of educational attainment on BMI was missing for African American women. The effect of income on high BMI was missing among White men and African American men (71).

Table 3: Effect of socioeconomic position on changes in BMI, physical activity, and SRH over 6 years by race/ethnicity and gender

			B (SE)	p	B (SE)	p	B (SE)	p	B (SE)	p	B (SE)	p
			All		African American Men		African American Women		White Men		White Women	
BMI												
Model 1												
Education (Years)	→	Slope	0.06(0.01)	0.002	0.00(0.03)	0.965	0.01(0.03)	0.701	0.13(0.01)	0.024	0.02(0.02)	0.369
Age	→	Slope	-0.27(0.00)	<0.001	-0.26(0.02)	<0.001	-0.17(0.01)	<0.001	-0.61(0.01)	<0.001	-0.21(0.01)	<0.001
Model 2												
Education (Years)	→	Slope	0.05(0.01)	0.011	-0.04(0.03)	0.598	0.01(0.04)	0.729	0.12(0.01)	0.046	0.01(0.02)	0.508
Income	→	Slope	0.03(0.00)	0.083	0.08(0.00)	0.201	0.00(0.00)	0.935	0.05(0.00)	0.374	0.02(0.00)	0.353
Age	→	Slope	-0.27(0.00)	<0.001	-0.24(0.02)	<0.001	-0.17(0.01)	<0.001	-0.61(0.01)	<0.001	-0.20(0.01)	<0.001
Activity												
Model 1												
Education (Years)	→	Slope	0.12(0.00)	0.057	0.00(0.01)	0.986	0.03(0.01)	0.824	-0.09(0.01)	0.140	0.62(0.01)	0.010
Age	→	Slope	0.21(0.00)	<0.001	0.09(0.01)	0.413	0.05(0.00)	0.669	0.09(0.00)	0.173	0.64(0.00)	0.008
Model 2												
Education (Years)	→	Slope	0.12(0.00)	0.058	-0.03(0.01)	0.824	-0.02(0.01)	0.859	-0.07(0.01)	0.269	0.49(0.01)	0.018
Income	→	Slope	0.02(0.00)	0.792	0.08(0.00)	0.483	0.18(0.00)	0.129	-0.08(0.00)	0.207	0.18(0.00)	0.393
Age	→	Slope	0.21(0.00)	<0.001	0.10(0.01)	0.361	0.09(0.00)	0.445	0.07(0.00)	0.238	0.56(0.00)	0.006
SRH												
Model 1												
Education (Years)	→	Slope	0.28(0.00)	<0.001	0.18(0.01)	0.042	0.26(0.01)	0.033	0.19(0.01)	<0.001	0.38(0.00)	<0.001
Age	→	Slope	0.29(0.00)	<0.001	0.03(0.01)	0.702	0.37(0.00)	0.003	0.15(0.00)	0.010	0.47(0.00)	<0.001
Model 2												
Education (Years)	→	Slope	2.17(0.00)	<0.001	0.19(0.01)	0.045	0.21(0.01)	0.085	0.18(0.01)	0.002	0.31(0.00)	<0.001
Income	→	Slope	0.85(0.00)	0.009	-0.01(0.00)	0.911	0.17(0.00)	0.179	0.05(0.00)	0.421	0.19(0.00)	0.006
Age	→	Slope	2.47(0.00)	<0.001	0.03(0.01)	0.767	0.38(0.00)	0.001	0.15(0.00)	0.008	0.48(0.00)	<0.001

Body Mass Index; BMI, Self-Rated Health; SRH

Table 4: Effect of socioeconomic position on changes in BMI, physical activity, and SRH over 6 years by race/ethnicity and gender

			B (SE)	p	B (SE)	p	B (SE)	p	B (SE)	p	B (SE)	p
			All		African American Men		African American Women		White Men		White Women	
BMI												
Model 1												
Education (12 Years)	→	Slope	0.08(0.07)	<0.001	0.01(0.25)	0.861	0.07(0.24)	0.034	0.12(0.10)	0.047	0.03(0.11)	0.181
Age	→	Slope	-0.27(0.00)	<0.001	-0.25(0.02)	<0.001	-0.16(0.01)	<0.001	-0.62(0.01)	<0.001	-0.20(0.01)	<0.001
Model 2												
Education (12 Years)	→	Slope	0.07(0.07)	<0.001	-0.01(0.26)	0.847	0.07(0.25)	0.030	0.11(0.10)	0.068	0.03(0.11)	0.231
Income	→	Slope	0.03(0.00)	0.082	0.08(0.00)	0.242	-0.01(0.00)	0.689	0.07(0.00)	0.270	0.02(0.00)	0.369
Age	→	Slope	-0.27(0.00)	<0.001	-0.24(0.02)	<0.001	-0.16(0.00)	<0.001	-0.61(0.01)	<0.001	-0.20(0.01)	<0.001
Activity												
Model 1												
Education (12 Years)	→	Slope	0.16(0.03)	0.011	-0.01(0.11)	0.913	0.11(0.08)	0.332	-0.13(0.05)	0.035	0.93(0.04)	<0.001
Age	→	Slope	0.21(0.00)	<0.001	0.08(0.01)	0.421	0.06(0.00)	0.586	0.07(0.00)	0.251	0.73(0.00)	0.007
Model 2												
Education (12 Years)	→	Slope	0.16(0.03)	0.011	-0.03(0.11)	0.771	0.07(0.08)	0.501	-0.12(0.05)	0.058	0.69(0.04)	0.001
Income	→	Slope	0.01(0.00)	0.866	0.08(0.00)	0.472	0.15(0.00)	0.195	-0.09(0.00)	0.169	0.18(0.00)	0.407
Age	→	Slope	0.20(0.00)	<0.001	0.10(0.01)	0.359	0.09(0.00)	0.398	0.06(0.00)	0.344	0.58(0.00)	0.006
SRH												
Model 1												
Education (12 Years)	→	Slope	0.25(0.02)	<0.001	0.07(0.08)	0.431	0.23(0.05)	0.072	0.14(0.04)	0.024	0.40(0.03)	<0.001
Age	→	Slope	0.29(0.00)	<0.001	0.00(0.01)	0.985	0.36(0.01)	0.005	0.15(0.00)	0.017	0.49(0.00)	<0.001
Model 2												
Education (12 Years)	→	Slope	0.23(0.02)	<0.001	0.06(0.08)	0.511	0.18(0.06)	0.154	0.13(0.04)	0.036	0.33(0.03)	<0.001
Income	→	Slope	0.12(0.00)	0.001	0.04(0.00)	0.677	0.19(0.00)	0.132	0.07(0.00)	0.266	0.21(0.00)	0.003
Age	→	Slope	0.30(0.00)	<0.001	0.00(0.01)	0.964	0.38(0.00)	0.002	0.15(0.00)	0.013	0.49(0.00)	<0.001

Body Mass Index; BMI, Self-Rated Health; SRH

Previous findings support the differential effect hypothesis. Based on this hypothesis, psychosocial determinants of health and illness are far from being universal as they vary across sections of the populations (38). Race/ethnicity, gender, and race/ethnicity by gender differences are well described across a wide range of health outcomes (39-44). Protective effects of educational attainment and income are also not universal and depend on a wide range of contextual factors. Thus, research may benefit from flexible theories, hypotheses, and conceptual models that can accommodate changes appropriate for each context.

In the U.S., employment opportunities are formed by race/ethnicity and gender, as the labor market may have a lower tendency to hire African American individuals (45-47). Some of this differential employment opportunities are because the labor market does not operate as color blind. As a result, African American individuals face more obstacles than Whites (45-47). Labor market's preferences toward Whites is illegal and is an indicator of structural racism in the U.S. (48). Another major problem is the wage gap based on race/ethnicity and gender, both well-described phenomena (49). Differential pay between African American individuals and Whites is highest at the highest levels of education (50). In 2006, among those who had a master's degree, African American men earned $27,000 less than White men (55).

The health effects of any resource such as educational attainment and income depend upon the availability of other resources and protective buffers such as wealth and employment (57-60). As a result, race/ethnicity, gender, and their intersection alter how SEP indicators translate to health outcomes (61-64).

The health effects of race/ethnicity, gender, and SEP indicators such as educational attainment and income are not additive but multiplicative (61). For instance, African American individuals and Whites differ in how educational attainment influences health (67). Thus, it is probably over-simplistic to assume that educational attainment and income are simply mediators of the effects of race/ethnicity on health, instead, race/ethnicity and SEP interact on health (61,57).

This paper extends our previous work on race/ethnicity by gender differences in the separate effects of education and income on sustained poor health outcomes (71). In that study, we took our previous findings one step further and showed that race and gender are also different in additive effects of race and gender, and whether income is why education impacts health. In our previous work, we focused on sustained health problems (poor health in all measurements) (71). In the current work, however, we tried to understand how education and income predicts a change in the health outcomes.

Limitations

Our study had a few limitations. To measure physical activity, we used a single item rather than a standard instrument. It is still not clear if the validity of health outcomes is similar among African American individuals and Whites. Thus, we cannot rule out the chance of differential under- or over- reporting based on race/ethnicity and gender.

Conclusion

Combined race/ethnicity and gender seem to alter how educational attainment and income are relevant to changes in BMI, physical activity, and SRH of American older adults. Sub-groups of older adults may vastly differ in how their social determinants (e.g. educational attainment and income) correlate with subsequent changes in SRH, BMI, and physical activity.

Ethics

University of Michigan Institutional Review Board (IRB) approved the study protocol. Informed consent was obtained from all participants included in the study.

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Authors Contribution

All authors contributed to the conceptualization of the paper. S.A. drafted the paper. All other authors revised the paper. All authors approved the final draft.

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Conflict of Interest

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest, or non-financial interest in the subject matter or materials discussed in this manuscript.

Informed Consent

Informed consent was obtained from all participants included in the study.

Animal Studies

No animal studies were carried out by the authors for this article.

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