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Parental Education or Household Income? Which Socioeconomic Status Indicator Can Better Reduce Body Mass Index Disparities among Latino Children?

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Abstract

Aim: *We compared the effects of parental education and household income on children's Body Mass Index (BMI) in Hispanic White (HW) and non-Hispanic White (NHW) families.* ***Methods:*** *In this cross-sectional study, we borrowed data from the Adolescent Brain Cognitive Development (ABCD) study and analyzed data of 5100 children between the ages of 9 and 10. The independent variables were parental education and household income. The primary outcome was BMI value. Ethnicity was the moderating variable. Confounders were age, sex, and family structure. Three mixed-effects regression models were used for data analysis.* ***Results:*** *Overall, higher parental education and household income were associated with lower BMI levels in children. While an interaction was reported between ethnicity and parental education, no relation was noted between ethnicity and household income regarding BMI. The interaction indicated weaker protective effects of high parental education on BMI in HW children than NHW children. Household income showed similar protective effects on children's BMI in HW and NHW families.* ***Conclusion:*** *Parental education but not household*

income loses some of its protective effects on childhood BMI among HW families compared to NHW families. Distal social determinants of health may be more vulnerable to the MDRs (minorities' diminished returns) than proximal ones. As a result, closing the income gap may be a good strategy towards closing the childhood BMI gap between highly educated HW and NHW families. Policies that raise the minimum wage and those that help HW families save money (e.g., earned income tax policies) maybe more promising strategies to eliminate the ethnic gap in BMI than increasing the education level of ethnic minority families.

Keywords

Body Mass Index (BMI), obesity, ethnicity, ethnicity, socioeconomic status, children

1. Introduction

High Body Mass Index (BMI), a risk factor for a wide range of cardiometabolic conditions in adulthood (Lloyd, Langley-Evans, & McMullen, 2010; Park, Falconer, Viner, & Kinra, 2012), is more common in ethnic minorities, such as Hispanic White (HW) children, compared to non-Hispanic White (NHW) children (Malina, 1993; Wallander, Taylor, Grunbaum et al., 2009; Staiano & Katzmarzyk, 2012; Albrecht & Gordon-Larsen, 2013). Research-based knowledge on social causes of ethnic inequalities in childhood's BMI is essential if we want to eliminate gaps like these, which have sustained and are growing (Komlos & Breitfelder, 2008; Nicosia, Shier, & Datar, 2016). Similarly, ethnic variation in social determinants of childhood BMI should be known (Freedman, Khan, Serdula, Ogden, & Dietz, 2006; Guerrero, Mao, Fuller, Bridges, Franke, & Kuo, 2016). Such a strategy may enhance various aspects of ethnic minorities' health and reduce the existing health inequalities in the next generations.

Two overlapping social determinants of childhood BMI are ethnicity (Malina, 1993; Wallander, Taylor, Grunbaum et al., 2009; Staiano & Katzmarzyk, 2012; Albrecht & Gordon-Larsen, 2013) and family socioeconomic status (SES). Compared to NHW children, HW children are more likely to be obese and have a higher BMI (Malina, 1993; Wallander, Taylor, Grunbaum et al., 2009; Staiano & Katzmarzyk, 2012; Albrecht & Gordon-Larsen, 2013). However, the effects of ethnicity and family SES are complex and inter-dependent (Assari, 2018; Assari, Boyce, Bazargan, Mincy, & Caldwell, 2019). As ethnicity and SES closely overlap (Williams, 1999; Chu, Moreira, Gerber et al., 2012; Chen, Kessler, Sadikova et al., 2019), SES may in part be responsible for ethnic variations in health (Kaufman, Cooper, & McGee, 1997). Thus, one of the best solutions to eliminate health inequality is believed to be closing the SES gap among ethnic groups (Williams, 1999; Lantz, House, Lepkowski, Williams, Mero, & Chen, 1998). However, the degree to which SES indicators (e.g., household income) reduce the risk of behavioral outcomes varies among diverse demographic groups (Assari, Preiser, & Kelly, 2018; Assari, 2019; Assari, 2020a; Assari, 2020b). As described by a pattern called Minorities' Diminished Returns (MDRs) (Assari, 2018a; Assari, 2017a), most SES indicators (Assari, 2019a), particularly the parental education (Assari, Caldwell, & Bazargan, 2019), generate unequal outcomes for population subgroups (Assari, 2018b; Assari, 2018c). The problem arises when we observe that populations' outcomes show less

response to economic resources for minority groups than the majority group (Assari, 2018a; Assari, 2018d; Assari, 2020c).

The MDRs theory (Assari, 2018a; Assari, 2017a) suggests that, due to stratification, racialization, discrimination, and social marginalization, ethnic minority groups do not have the same chance of using their SES to secure tangible health outcomes (Assari, 2018a; Assari, 2018d; Assari, 2020c). This means that the social structure reduces SES indicators' impact on health outcomes more for ethnic minority than majority groups. As a result of such MDRs, ethnic minority children who have a middle-class or a high SES background remain at risk of poor health. Regardless of the health outcome and the SES resource, we have observed systematically weaker effects of parental education (Assari, Boyce, Akhlaghipour, Bazargan, & Caldwell, 2020; Assari, Boyce, Bazargan, & Caldwell, 2020a; Assari, Boyce, Caldwell, & Bazargan, 2020) and household income (Assari, 2020d) on a wide range of health outcomes in high SES ethnic minority families (Assari, Farokhnia, & Mistry, 2019; Assari, Caldwell, & Bazargan, 2019; Shervin & Ritesh, 2019; Assari & Mistry, 2018; Assari, Caldwell, & Bazargan, 2020).

In the U.S., MDRs emerge because high SES minority groups are still racialized, marginalized, stigmatized, and discriminated against (Assari, 2018a; Assari, 2018d; Assari, 2020c). Due to marginalization processes like these, high SES ethnic minority groups face considerable structural and societal difficulties leveraging the resources. In the U.S., minority families are discriminated against on all SES levels. Considering that, the system hinders them from securing tangible, measurable, expected, and desirable behavioral outcomes. These MDRs emerge despite the availability of the SES indicators. Thus, we do not observe tangible outcomes in middle-class minorities (Assari, 2017a; Assari, 2018b; Assari, 2018e; Assari, Caldwell, & Mincy, 2018; Assari, Caldwell, & Zimmerman, 2018; Assari & Hani, 2018). In addition to that, these patterns are well documented for HW (Assari, Farokhnia, & Mistry, 2019; Shervin & Ritesh, 2019; Assari, 2019; Assari, 2018f), African American (Assari, 2018a; Assari, 2017a; Assari, Caldwell, & Mincy, 2018; Assari, Thomas, Caldwell, & Mincy, 2018), Asian American (Assari, Boyce, Bazargan, & Caldwell, 2020b), Native American (Assari & Bazargan, 2019c), lesbian, gay, and bisexual (LGB) (Assari, 2019b), immigrant (Assari, 2020b), and even marginalized NHW (Assari, Boyce, Bazargan, Caldwell, 2020b) groups. Although in theory, any deviation from social privileges may reduce the health effects of SES indicators, we are not aware of studies that have documented the relevance of MDRs in HW children's behavioral outcomes. As a result, it is essential to test whether MDRs hold for HW children or not.

1.1 Aims

In this investigation, we compared HW to NHW children in the U.S. regarding the effects of parental education and household income on childhood BMI. While high parental education and household income are expected to be associated with lower BMI levels in children, we simultaneously expect weaker protection in HW children than NHW children. Based on an extensive literature (Assari, Caldwell, & Bazargan, 2020; Assari, 2018f; Assari & Bazargan, 2019a; Assari, 2019c), we hypothesize that ethnicity and SES would show multiplicative rather than additive effects on children's BMI. To be

more specific, we expected weaker family SES effects, particularly parental education, on HW than NHW children's BMI. That is, we expect MDRs to contribute to economic and ethnic inequalities regarding childhood BMI. Stronger MDRs for parental education than household income is based on the knowledge that more social processes can hinder minority families from leveraging their education compared to their income. This is also in line with our past work showing stronger MDRs for education than income (Assari & Lankarani, 2016b).

2. Materials and Methods

2.1 ABCD Design

This cross-sectional study was a secondary analysis of existing data. We borrowed data from the Adolescent Brain Cognitive Development (ABCD) study (Alcohol Research: Current Reviews Editorial, 2018; Casey, Cannonier, Conley et al., 2018; Karcher, O'Brien, Kandala, & Barch, 2019; Lisdahl, Sher, Conway et al., 2018; Luciana, Bjork, Nagel et al., 2018). The ABCD is a national children's brain development study with a large diversity based on ethnicity, ethnicity, sex, and SES (Alcohol Research: Current Reviews Editorial, 2018; Auchter, Hernandez Mejia, Heyser et al., 2018).

2.2 ABCD Sample

The ABCD children were drawn from schools across multiple cities, nested to states in the U.S. The recruitment catchment area of the ABCD study sites is composed of 21 participating locations, encompasses over 20% of the entire United States population of 9/10-year-old children. The ABCD sampling and recruitment procedures were carefully designed, implemented, and evaluated across the 21 study sites. Although the ABCD sample is national, it is not random or representative. Even though this sample was not random, the final ABCD sample is a close approximation of the U.S. children across all demographic and sociodemographic factors as a result of careful sampling. Thus, the results are reliable regarding ethnicity, age, sex, SES, and urbanicity.

2.3 Analytical Sample

This study included 5100, 9/10-year-old U.S.-born White American children, who had data on age, sex, ethnicity, parental education, household income, family structure, and BMI. Our participants were either HW or NHW. Eligibility was being White and U.S.-born. Being from any ethnic background other than NHW or HW was the exclusion criteria. Thus, this study did not include any families identified as African American, Asian, Native American, Pacific Islander, or other/mixed ethnicity.

2.4 Measures

Body Mass Index (BMI). The ABCD measured height and weight, using a standard protocol between two or three times. Based on measured height and weight, the ABCD study has calculated the child's BMI value. In this study, BMI was treated as a continuous measure.

Parental Educational Attainment. Parental education was defined as a five-level categorical variable: (1) less than high school (reference category), (2) high school / GED, (3) some college, (4) college degree, and (5) graduate+ school.

Household Income. Household income was a nominal variable: Parents were asked, "What is your total highest income for the past 12 months? This should include income (before taxes and deductions) from all sources, wages, rent from properties, social security, disability and veteran's benefits, unemployment benefits, and workman". Responses included less than $50,000, $50,000- $100,000; and $100,000 +.

Family Structure. Family structure was a dichotomous variable: married = 1 and not- married = 0.

Ethnicity. Ethnicity was identified by the parent. Ethnicity was a categorical variable: 1 for HW and 0 for NHW (reference group).

Sex. Child sex was a categorical variable with 1 for boys and 0 for girls.

Age. Child age was a continuous variable, measured in months.

2.5 Data Analysis

The program Data Analysis and Exploration Portal (DEAP) was utilized for statistical analyses. DEAP is an online analytical tool, and it is based on the R program. To conduct our multivariable analysis, three mixed-effects model regressions were performed. As observation individuals were nested to families who were selected from study sites, we used mixed-effect models. This modeling strategy enabled us to have random effects and fixed effects that are needed when the sample is clustered and non-independent. The child's BMI was the outcome, while ethnicity was the moderator. Parental education and household income, both categorical variables, were the predictors. All regression models were estimated in the overall/pooled sample. *Model 1*, the main effect model, was estimated in the absence of interaction terms. *Model 2* added the interaction terms between ethnicity and parental education. *Model 3* added the interaction terms between ethnicity and household income. Our models controlled for age, sex, and family structure. Regression coefficients (b), standard errors (SE), and p-values were reported for each parameter. Appendix 1 summarized the model formulas. We tested several assumptions before we ran our models. These assumptions include ruling out collinearity between study variables (not shown) and distribution of our outcome, error terms, and quantiles, as shown in Appendix 2.

2.6 Ethics

For this study, we used a fully de-identified data set. Our analysis was exempted from a full review of the Institutional Review Board (IRB). The original ABCD study protocol was approved by the IRB at the University of California, San Diego (UCSD). Several other institutions also approved the ABCD study protocol. Children provided assent. Parents provided consent (Auchter, Hernandez Mejia, Heyser et al., 2018).

3. Results

Table 1 described the pooled sample and by ethnicity. The current analysis was performed on 5100, 9/10-year-old children, from which 4795 were NHW and 305 were HW.

Table 1. Baseline Data Overall and by Ethnicity (*n* = 5100)

Level	Overall	No	Yes	p
	5100	4795	305	
	Mean (SD)	Mean (SD)	Mean (SD)	
Age (month)	119.11 (7.49)	119.18 (7.48)	118.02 (7.58)	0.009
Body Mass Index (BMI)	17.95 (3.38)	17.86 (3.31)	19.39 (4.01)	< 0.001
	n (%)	n (%)	n (%)	
Parental Education				
< HS Diploma	41 (0.8)	23 (0.5)	18 (5.9)	< 0.001
HS Diploma/GED	202 (4.0)	156 (3.3)	46 (15.1)	
Some College	1049 (20.6)	950 (19.8)	99 (32.5)	
Bachelor	1617 (31.7)	1548 (32.3)	69 (22.6)	
Post Graduate Degree	2191 (43.0)	2118 (44.2)	73 (23.9)	
Household Income				
< 50K	748 (14.7)	633 (13.2)	115 (37.7)	< 0.001
> =50K& < 100K	1588 (31.1)	1499 (31.3)	89 (29.2)	
> =100K	2764 (54.2)	2663 (55.5)	101 (33.1)	
Hispanic				
No	4795 (94.0)	4795 (100.0)	0 (0.0)	< 0.001
Yes	305 (6.0)	0 (0.0)	305 (100.0)	
Sex				
Female	2392 (46.9)	2251 (46.9)	141 (46.2)	0.854
Male	2708 (53.1)	2544 (53.1)	164 (53.8)	

Table 2 summarizes our mixed-effects regression models' fit statistics, all performed in the overall (pooled) sample. Our models showed a better fit when there was an interaction between parental education and ethnicity. Interaction between income and ethnicity did not enhance the fit.

Table 2. Model Characteristics and Fit (*n* = 5100)

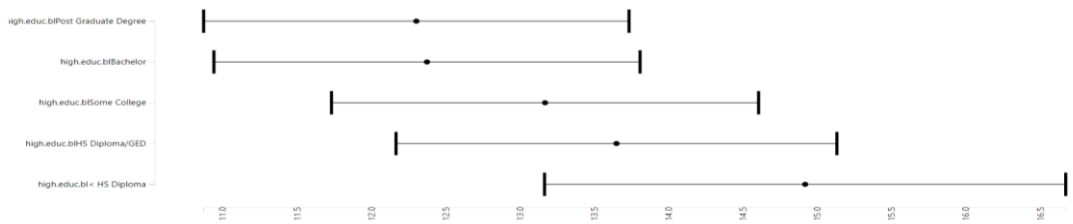
	Model 1	*Model 2*	*Model 3*
N	5100	5100	5100
R-squared	0.05113	0.05205	0.05126
ΔR-squared	0.01202	0.01828	0.00774
ΔR-squared (%)	1.2%	1.83%	0.77%

Table 3 summarizes the results of our three mixed-effects regression models in the overall (pooled) sample. As documented by our *Model 1* (Main Effect Model), parental education and household income showed protective effects on high childhood BMI. *Model 2* showed interactions between HW ethnicity and parental education on children's BMI. *Model 3* did not show interactions between HW ethnicity and household income on children's BMI. These findings suggested that the inverse association between parental education but not household income with BMI is weaker in HW children than NHW children (Figure 1 and Figure 2).

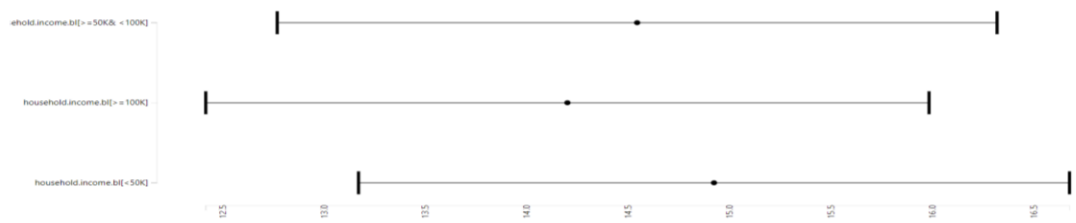
Table 3. Summary of Our Regressions without and with Interactions on the Association between Parental Education, Family Income, and Children's Body Mass Index (BMI) (*n* = 5100).

	b	SE	p	b	SE	p	b	SE	p
		Model 1			*Model 2*			*Model 3*	
Parental Education (HS Diploma/GED)	-1.27*	0.58	0.030	-1.01	0.77	0.188	-1.26*	0.59	0.032
Parental Education (Some College)	-1.75**	0.55	0.002	-1.24#	0.73	0.088	-1.74**	0.56	0.002
Parental Education (Bachelor)	-2.54***	0.56	0.000	-2.05**	0.73	0.005	-2.53***	0.56	0.000
Parental Education (Post Graduate Degree)	-2.62***	0.56	0.000	-2.13**	0.73	0.004	-2.60***	0.56	0.000
Household Income (> =50K& < 100K)	-0.38*	0.17	0.022	-0.37*	0.17	0.027	-0.39*	0.17	0.024
Household Income (> =100K)	-0.72***	0.17	0.000	-0.71***	0.17	0.000	-0.71***	0.18	0.000
Hispanic	0.88***	0.22	0.000	1.99#	1.07	0.063	0.91*	0.36	0.012
Age (Months)	0.05***	0.01	< 1e-6	0.05***	0.01	< 1e-6	0.05***	0.01	< 1e-6
Sex (Male)	-0.13	0.09	0.148	-0.13	0.09	0.145	-0.13	0.09	0.145
Parental Education (HS Diploma/GED) × Hispanic	-	-	-	-0.11	1.20	0.926	-	-	-
Parental Education (Some College) × Hispanic	-	-	-	-1.28	1.12	0.253	-	-	-
Parental Education (Bachelor) × Hispanic	-	-	-	-1.39	1.15	0.227	-	-	-
Parental Education (Post Graduate Degree) × Hispanic	-	-	-	-1.25	1.14	0.275	-	-	-
Household Income (> =50K& < 100K) × Hispanic	-	-	-	-	-	-	0.19	0.51	0.707
Household Income (> =100K) × Hispanic	-	-	-	-	-	-	-0.23	0.50	0.639

# p < 0.01 * p < 0.05 ** p < 0.01 *** p < 0.001

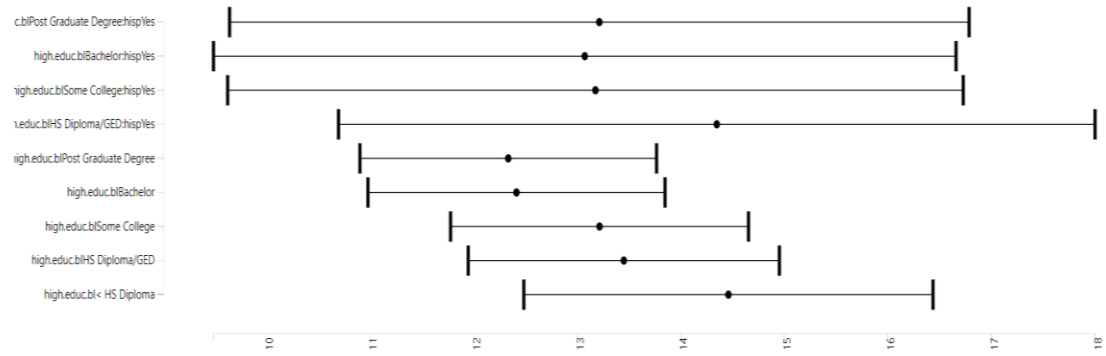


a) overall effects of parental education

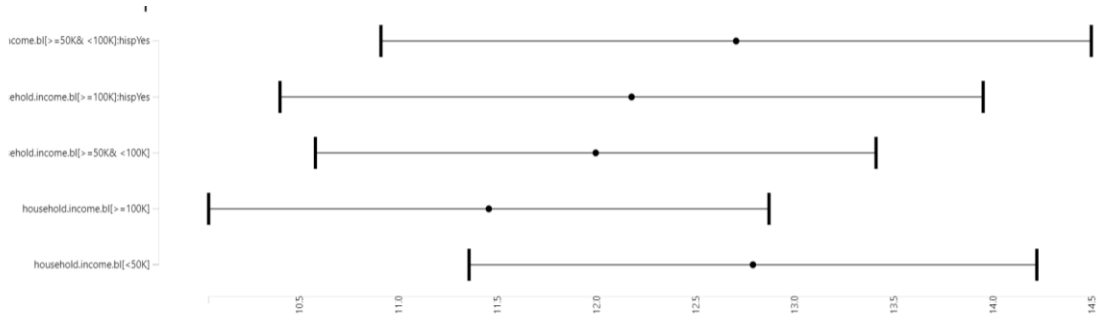


(b) overall effects of household income

Figure 1. Associations between Parental Education, Household Income, and Children's Body Mass Index (BMI) Overall (*n* = 5100).



a) differential effects of parental education by ethnicity



b) differential effects of household income by ethnicity

Figure 2. Associations between Parental Education, Household Income, and Children's Body Mass Index (BMI) by Ethnicity (*n* = 5100).

4. Discussion

Parental education and household income are inversely associated with BMI in 9- and 10-year-old American children. Ethnicity, however, alters the effects of parental education but not household income on children's BMI. That means, while we detected weaker effects of parental education on BMI in HW children than NHW children, household income may similarly lower BMI of NHW and HW children.

The inverse associations between parental education and household income with childhood BMI align with the literature on fundamental cause theory (Link & Phelan, 1995; Phelan, Link, Diez-Roux, Kawachi, & Levin, 2004) and social determinants of health (Marmot, 2004; Marmot, 2005; Dugravot,

Gueguen, Kivimaki et al., 2009). Higher parental education and household income mean better choices and options regarding diet, exercise, and higher food security (Cochrane, Leslie, & O'Hara, 1982; Davis-Kean, 2005; Chou, Liu, Grossman, & Joyce, 2010). Higher parental education and household income also mean lower proximity to fast food and better access to parks and green areas that protect families against obesity (Wen & Maloney, 2011; Schule, Fromme, & Bolte, 2016; Morgan Hughey, Kaczynski, Child, Moore, Porter, & Hibbert, 2017).

Our second result, diminished effects of parental education in reducing childhood BMI, can be seen as another example of MDRs of parental education for ethnic minority groups (Assari, Caldwell, & Bazargan, 2019). However, more research is done on these patterns for African American than HW children (Assari, Caldwell, & Bazargan, 2019). MDRs are well-documented for a wide range of SES sources, emotional and behavioral outcomes, age groups, and marginalization types (Assari, 2017a; Assari, 2018a). MDRs of parental education on children BMI are reported in other data sets (Assari, 2018; Assari, Thomas, Caldwell, & Mincy, 2018). The main contribution of this study is to establish MDRs like these for HW children.

The results are in line with what is already known about MDRs in HW (Assari, 2020e), African American (Assari, Mistry, Caldwell, & Bazargan, 2020), and Asian (Assari, Boyce, Bazargan, & Caldwell, 2020b) children. In the ABCD study, parental education (Assari, Boyce, Caldwell, & Bazargan, 2020) and income (Assari, 2020d) reduced the internalizing and externalizing behavioral problems in NHW better than in African American children. In several studies, children and adults from high SES African American (Assari, Gibbons, & Simons, 2018a; Assari, Gibbons, & Simons, 2018b; Assari & Caldwell, 2018; Assari, Lankarani, & Caldwell, 2018) families are reported to be at a very high risk of depression. In the PATH study, the effects of parental educational attainment on five health outcomes were weaker for HW than for NHW children (Assari, Caldwell, & Bazargan, 2019). In that study, among 12/17-year-old children, parental education showed weaker effects on psychological distress, aggression, tobacco dependence, poor school performance, and chronic disease for HW than NHW children. That study, however, did not report MDRs for obesity of BMI (Assari, Caldwell, & Bazargan, 2019).

NHW children gain the most health from their parental education (Assari, Caldwell, & Bazargan, 2019). In the Fragile Families and Child Wellbeing Study (FFCWS) data, parental education and household income at birth had stronger effects on various outcomes of NHW than in African American children 15 years later (Assari, 2019; Assari, Caldwell, Mincy, 2018a; Assari, Caldwell, & Mincy, 2018b; Assari, Thomas, Caldwell, & Mincy, 2018; Assari & Caldwell, 2019; Assari, Mardani, Maleki, & Bazargan, 2019). As a result of these MDRs, high SES ethnic minority children remain at risk, all across SES levels (Assari, 2019; Assari, Caldwell, Mincy, 2018a; Assari, Caldwell, & Mincy, 2018b; Assari, Thomas, Caldwell, & Mincy, 2018; Assari & Caldwell, 2019; Assari, Mardani, Maleki, & Bazargan, 2019). These diminishing returns start at childhood (Assari, Gibbons, & Simons, 2018a; Assari, Gibbons, & Simons, 2018b) and continue to adulthood (Assari, Lankarani, & Caldwell, 2018), and even to older adulthood (Assari & Lankarani, 2016a). Thus, these MDRs are robust across the whole life course.

This study showed MDRs for parental education but not for income. More MDRs are reported for parental educational attainment (Assari, Caldwell, & Bazargan, 2019), self-educational attainment (Assari, Farokhnia, & Mistry, 2019) that other SES indicators such as household income (Assari, Caldwell, & Mincy, 2018a). We observe larger MDRs for distal SES indicators than proximal SES indicators. This might be because social processes may easier confound translation of education than income to health. This is because by the time families access income, they have already skipped the inequalities that occur in the labor market and education system. That means segregation and many other aspects of racism may better interfere with the effects of education than income in communities of color. As a result, closing the income gap may be a more effective strategy to eliminate ethnic health inequalities compared to closing the educational gap. In one study, income could explain MDRs of education (Assari, 2018e). In another study (Assari & Lankarani, 2016b), education, but not income, better predicted mortality of African American than NHW adults. That study suggested that income may show more similar effects across groups than education (Assari & Lankarani, 2016b). This is partly because income explains some of the education effects (Assari, Boyce, Bazargan, & Caldwell, 2020a; Ross & Mirowsky, 1999; Mirowsky & Ross, 2015), and a higher number of societal processes can interfere with the utility of education than income for minority populations.

The weaker protection of family SES against depression and depressive symptoms are well known in African American children and adults. Some studies have shown that high SES may even operate as a risk factor for high internalization (Assari, 2020d) and depression (Assari, Boyce, Bazargan, & Caldwell, 2020a) among African American children.

As suggested by the MDRs theory (Assari, 2018a; Assari, 2017a), equal SES indicators, particularly educational attainment, generate unequal outcomes for the majority and minority groups. These differential effects of SES are documented among age groups, SES resources, and outcomes (Assari, 2018a; Assari, 2017a). As shown here, HW families also show similar MDRs. Due to the observed MDRs, HW children remained at risk of obesity, regardless of their SES. That means we see higher than expected BMI in high SES HW children.

Not only Hispanic (Assari, Farokhnia, & Mistry, 2019; Shervin & Ritesh, 2019; Assari, 2019a; Assari, 2018f), but also Native American (Assari & Bazargan, 2019c), African American (Assari, Thomas, Caldwell, & Mincy, 2018), Asian American (Assari, Boyce, Bazargan, & Caldwell, 2020b), LGB (Assari, 2019b), immigrant (Assari, 2020a; Assari, 2020f; Assari, Perez, Johnson et al., 2020), and even marginalized NHW (Assari, Boyce, Bazargan, Caldwell, & Zimmerman, 2020) individuals show MDRs. In U.S. society, any marginalizing social identity is associated with diminishing marginal returns of income, education, employment, marital status, parental education, and even coping (Assari, 2017b; Assari & Lankarani, 2016c). This universal and non-specific nature of the MDRs advocates for reducing social stratification, segregation, racism, and discrimination among marginalized people.

It is essential to emphasize that MDRs do not suggest that ethnic minority populations lack the knowledge of managing or leveraging their economic resources. These MDRs are also not indicative of

any biological inferiority of minority populations. Similarly, they do not indicate cultural preferences or low ambitions of the minority group. Instead, these MDRs suggest that despite access to resources, we observe inequalities beyond the access gap among groups due to the function and structure of society. Such social inequalities minimize the expected health gain that we should see for the marginalized group, while the majority group continues to maximize their gain. Thus, the observed differences are believed to be due to the differences in the daily living conditions between privileged and marginalized groups. In the U.S., HWs and other ethnic groups are treated differently than NHWs. These differential treatments are beyond individual-level discrimination and happen within institutions and structures of society. Some examples are structural inequalities in education, the labor market, and the correctional system. Brutal policing, mass incarceration, and police shooting against African American men in the U.S. have been well-publicized. In the U.S., NHWs occupy the more prestigious jobs and show a relative privilege compared to all other ethnic groups, including, but not limited to, HW people. HW people also experience high levels of discrimination and prejudice (Rosenbloom & Way, 2004). These social barriers, reflecting systemic marginal of populations of color, reduce the expected returns of their SES like parental education (Assari, 2019a; Assari, 2018f; Assari, 2019b; Assari & Bazargan, 2019b). To eliminate this gap, the living conditions of marginalized communities should be brought up, so their daily experiences become less different than the most socially privileged group: NHWs.

4.1 Implications for Research

Research in the field of childhood obesity should not reduce ethnicity to a factor that only directly affects childhood obesity. Thus, conceptual models should go beyond having ethnicity as merely as a control or a covariate. Similarly, policymakers and public health leaders should not assume that ethnic variation in health is all due to the SES differences among groups. This is also true for any studies investigating social correlations of SES, ethnicity, or BMI in American children. Children's BMI is not merely a function of families' ethnicity or SES but their intersection. Most of the research in this field takes an oversimplistic approach of merely "controlling" for the "main effects" of ethnicity and SES. Research, including this paper, shows that due to social stratification, ethnicity moderates the SES effects. As such, SES effects are not comparable among social groups that have qualitatively different daily experiences.

5. Conclusions

In the U.S., HW families show a weaker association between parental education but not household income on children's BMI when compared to NHW families. As a result of the diminishing returns of parental education, HW children show high BMI at all parental education levels. Household income can better equalize BMI between HW and NHW children, given the equal association between household income and childhood BMI among ethnic groups.

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Appendix 1. Model Formula

Model 1

anthro_bmi_calc ~ high.educ.bl + sex + age + household.income.bl + hisp +

Random: ~(1|abcd_site/rel_family_id)

Model 2

anthro_bmi_calc ~ high.educ.bl + sex + age + household.income.bl + hisp + high.educ.bl * hisp

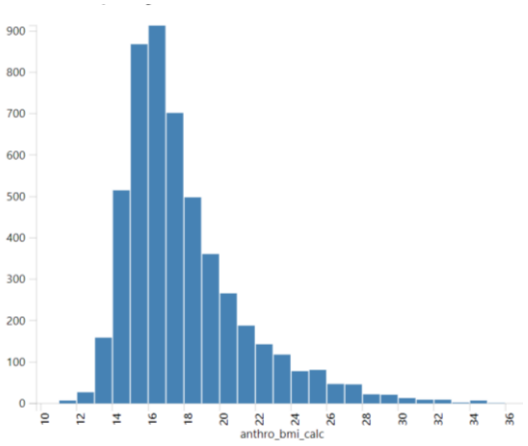
Random: ~(1|abcd_site/rel_family_id)

Model 3

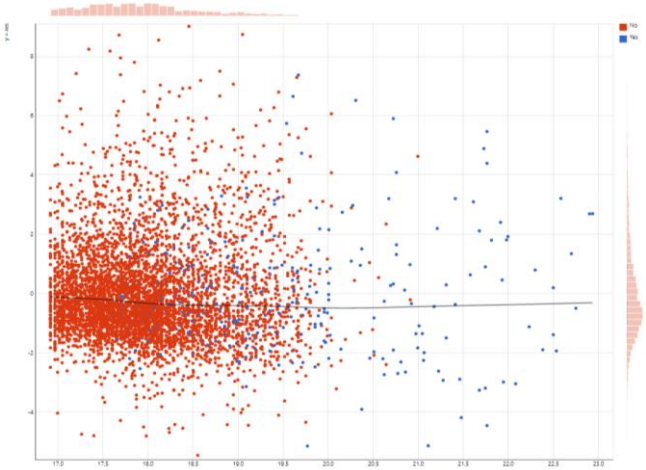
anthro_bmi_calc ~ high.educ.bl + sex + age + household.income.bl + hisp + household.income.bl * hisp

Random: ~(1|abcd_site/rel_family_id)

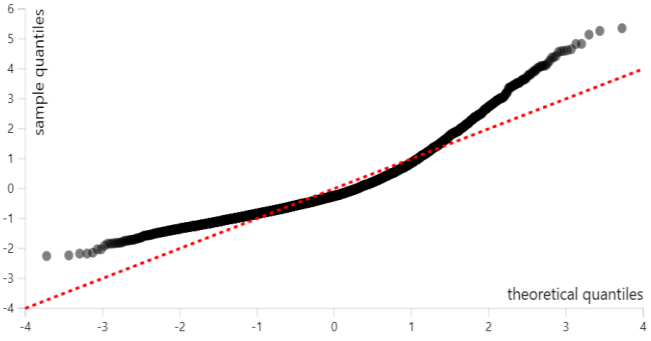
Appendix 2. Distribution of Our Outcome (a), Residuals (b), and Quantiles (c)



a) outcome



b) residuals



c) quantiles