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Household Income and Children Exercise Frequency: Blacks' Diminished Returns

Shervin Assari[1]*, Shanika Boyce[2], Mohsen Bazargan[1,3] and Cleopatra H Caldwell[4,5]

[1]*Department of Family Medicine, Charles R. Drew University, Los Angeles, CA 90059, USA*
[2]*Department of Pediatrics, Charles R. Drew University, Los Angeles, CA 90059, USA*
[3]*Department of Family Medicine, University of California Los Angeles (UCLA), Los Angeles, CA 90095, USA*
[4]*Department of Health Behavior and Health Education, University of Michigan, Ann Arbor, MI USA*
[5]*Center for Research on Ethnicity, Culture, and Health (CRECH), School of Public Health, University of Michigan, Ann Arbor, MI 48104, USA*

Abstract

Background: Based on the Marginalization-related Diminished Returns (MDRs) framework, a wide array of socioeconomic status (SES) indicators including but not limited to household income tend to show weaker effects for members of marginalized social groups. Limited knowledge exists on MDRs of household income on children exercise frequency.

Aims: Built on the MDRs framework, we tested the hypothesis of whether the effect of household income on exercise frequency differs for Black than White children. We hypothesized that: 1) there is a positive association between household income and exercise frequency for American households.

Methods: In this cross-sectional study, data came from wave one of the Adolescent Brain Cognitive Development (ABCD) study which included 8027 non-Hispanic Black or White American children between ages 9 and 10 years old. The predictor was household income. The outcome was children exercise frequency. Linear regression was used for data analysis.

Results: According to our pooled sample regression, household income was positively associated with children exercise frequency. We found a significant interaction between household income and race, suggesting that the positive association between household income and exercise frequency was weaker for Black than White children.

Conclusions: Diminished returns of household income on children's exercise may explain poor health of high SES Black children. That is, a smaller boosting effect of household income on changing health behaviors for Blacks than Whites may be one of many mechanisms that deteriorate health of high SES Black children. Not all racial disparities in health are due to SES but also diminished marginal returns of socioeconomic status indicators such as household income for the members of marginalized and racialized communities. Research should study how the context in which Black families live, play, and work contributes to low exercise frequency of high SES Black children.

Keywords: African Americans • Blacks • Maternal health • Socioeconomic status • Income • Exercise

Introduction

A wide range of socioeconomic status (SES) indicators such as household income are strong determinants of health behaviors such as exercise frequency [1-5]. Children and adults with higher SES show higher level of exercise [6-9]. The health effect of household income is frequently shown, suggesting that household income may be among the most robust and salient determinants of health and health behaviors [10,11]. Income may in fact be one of the reasons some other SES indicators such as education promote exercise and health [12,13].

How SES indicators such as income impact health behaviors such as exercise, however, may depend on social context and demographic factors [14]. In other terms, the effects of SES indicators such as income on exercise and other health behaviors depend on race and place, suggesting that race, resources, place, and context may interact in how they shape populations' and individuals' health behaviors [15]. This may be particularly true for the effects of income, because what people can purchase and what families can do with their income differ across populations and places [16,17]. In other words, if because of residential segregation high income people would still be less able to walk and exercise, then income would show diminished effects on exercise frequency of certain populations living under residential segregation [18].

As shown recently by a growing body of research [19,20], SES indicators such household income may not similarly impact health and behaviors of Black and White families [21]. For parents themselves, SES indicators such as household income better promote exercise of Whites than Blacks [22]. Similarly, SES shows diminished effects on delaying childbearing [23], place of living [24], stress [25], living conditions [26], economic well-being [27], and health [28] for Blacks than Whites. In one study, high-SES Black women in predominantly White areas had the highest rate of low birth weight (LBW) deliveries (14.5%), while high-SES Black women who were residing in predominantly Black neighborhoods had the lowest rate of LBW deliveries (4.0%) [15]. Thus, whether a SES indicator serve as a risk or protective factor depends on many intertwined social factors such as race and social context [29]. Any social identity that can be a proxy of how individuals or groups are treated by the society, and how they can navigate their resources, can be a source of marginalization, and any form of marginalization can potentially hinder the marginalized group against leveraging their available resources to secure measurable and tangible health outcomes [23].

Research has recently proposed Marginalization-related Diminished Returns (MDRs) as a neglected cause of racial inequalities in high SES families [19,20]. According to the MDRs literature, SES resources such as household income, show weaker effects for Black than White families [19,20]. As a result of these MDRs, SES generates fewer positive health outcomes for children who are Black than White [19,20]. Thus, we observe worse than expected economic, behavioral, and health outcomes for children from highly educated Black families; a pattern not seen for White families [30-32]. While household income generates fewer health outcomes across domains for Black than White individuals [33,34], we are unaware of any studies on racial variation in the effects of household income (e.g., MDRs) on exercise

***Address for Correspondence:** Shervin Assari, Department of Family Medicine, Charles R. Drew University, Los Angeles, CA 90059, USA, Tel: +1-734-858-8333; E-mail: assari@umich.edu*

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frequency. In multiple studies in adults, SES indictors such as household income and education showed weaker effects on exercise [22], tobacco use [28], alcohol use [35,36], and diet [37] for Black than White adults. However, all these studies have had a focus on adults not children. Thus, additional studies on MDRs of household income on exercise frequency of children would be a unique contribution to the literature. These MDRs hold for a wide range of marginalizing identities [38-40], however, they are best described for Black people [41].

Aims: With MDRs being historically neglected, the research community has only recently begun to acknowledge that SES indictors may also become a source of inequalities and disparities [19,20]. To expand the past work on differential effects of SES on physical activity of Black and White adults [22], this study was performed with two aims: First, to test the effect of household income on children exercise frequency, and second, to compare this effect between Black and White children. We hypothesized a positive association between household income and exercise frequency (hypothesis 1), however, we expected weaker effects of household income on children exercise frequency for Blacks than Whites (hypothesis 2). Support for our hypothesis 2 would propose that Black children would have a poor physical activity, regardless of their household income, which would partially explain why high SES and middle-class Black children still suffer poor health.

Methods

Design and settings

This was an analysis of the existing data from the Adolescent Brain Cognitive Development (ABCD) study [42-46]. This was a cross-sectional analysis of the ABCD data. ABCD is a national, state-of-the-art brain imaging study of children's brain development [42,47].

Participants and Sampling

In the ABCD, participants were selected across multiple cities across various states in the US. This sample was predominantly from US school systems. The recruitment catchment area of the ABCD, which was composed of 21 participating sites, encompasses over 20% of the entire United States population of 9-10-year-old children. The ABCD applied a closely monitored sampling and recruitment process, which is described here [42,47], to ensure that the sample is random and representative. Such efforts of local randomization yielded a final overall ABCD sample that is a close approximation of the US national sociodemographic factors. These sociodemographic factors include race and ethnicity, age, sex, SES, and urbanicity. The SES target in the ABCD has two sources: 1) the American Community Survey (ACS) and 2) annual 3rd and 4th-grade school enrollment. The ABCD sample and sampling are well described here [48]. The first is a large-scale survey of about 3.5 million households conducted annually by the US Census. The second data are maintained by the National Center for Education Statistics (NCES), affiliated with the US Department of Education.

Analytical sample

Our analysis included 8027 non-Hispanic Black or White 9-10 children who had data on exercise frequency. We needed all our participants to have data on race, household income, family marital status, and exercise frequency.

Variables

The study variables included demographic factors (age and sex), SES indicators (household income), family marital status, as well as exercise frequency (a three-item measure).

Outcome

Exercise frequency. The following three items were used to measure exercise frequency [49]. (1) "During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day? Add up all the time you spent in any kind of physical activity that increased your heart rate and made you breathe hard some of the time", (2) "On how many of the past 7 days did you do exercises to strengthen or tone your muscles, such as push-ups, sit-ups, or weight lifting?", and (3) "In an average week when you are in school, on how many days do you go to physical education (PE) class?" All responses were all on 0/7 scale. A score was calculated as the sum of the exercise engagement. The total score ranged from 0 to 7, with a higher score indicative of higher exercise frequency.

Moderator

Race. A self-identified variable, race was a categorical variable: 1 for Black and 0 for White (reference category).

Independent Variable

Household income: Household income, a continuous measure, ranged from 1 to 10, where a higher score indicated a higher level of household income. The item read as "What is your total combined household 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, workman". Responses included 1 = Less than $5,000; 2 = $5,000; 3 = $12,000; 4 = $16,000; 5 = $25,000; 6 = $35,000; 7 = $50,000; 8 = $75,000; 9 = $100,000; 10 = $200,000.

Confounders

Age, sex, and family structure were the covariates. Parents reported children's age. Sex was 1 for male and 0 for female. Family structure was 1 for married and 0 for other.

Data Analysis

The SPSS statistical package 23.0 (IBM Corporation, Armonk, NY, USA) was used for our data analysis. Mean, standard deviation (SD), frequency, and relative frequency (%) were reported at the first step. To perform multivariable analyses, four multiple linear regressions were performed. Our first two models were performed in the pooled sample. Model 1 was performed without our interaction term. Model 2 also included an interaction term between race and household income. Model 3 and Model 4 were performed in Whites and Blacks, respectively. In all models, exercise frequency was the outcome. These models controlled for age, sex, and marital status. Regression coefficient (b), standard error, 95% CI, and p-value, and were reported for each model. To test our moderation hypothesis, we applied a regression model with the pooled sample with an interaction term as suggested by Aiken, West, and Reno [50]. We also split the sample by race and ran regressions separately in both groups. Both these approaches were used to test if the b coefficients were significantly different in White and Black children.

Ethical Aspect

Although the ABCD study protocol was approved by the Institutional Review Board (IRB) of the University of California, San Diego (UCSD) and many other institutions [47], and while children and parents gave assent and consent, our study was exempt from a full review.

Results

Descriptive data

Table 1 described the children both overall and by race. The current analysis included an overall sample of 8027, 9-10 years old children who were either White (n=5927; 73.8%) or Black (n=2100; 26.2%).

Table 1 also presents the summary of comparison of Black and White participants. As shown in this table, Black and White participants did not differ in age or sex, however, they did differ in marital status and household income. Compared to White children, Black children were less likely to be from married families and had lower levels of household income. Exercise was not different between Black and White children.

Multivariate analysis

Table 2 shows the results of two linear regression models in the overall (pooled) sample. Model 1 (Main Effect Model) showed a boosting effect of household income on children exercise frequency. Model 2 (Interaction Model) showed an interaction term between race with household income on psychosis spectrum symptoms, suggesting that the positive association between household income and exercise frequency is weaker for Black children relative to their White counterparts.

Multivariate analysis

Table 3 summarizes the results of two linear regression models by race/ethnicity. Model 3 showed positive association between household income and exercise frequency in White children. Model 4 showed no association between household income and children exercise frequency in Black families.

Discussion

We showed that: (a) overall, high household income increases children exercise frequency, and (b) high household income better increases children's exercise frequency in White than Black families.

This is the first paper that documents MDRs of household income on exercise frequency of Black children in the US. Thus, while similar results are reported for other health outcomes, the unique contribution of this paper is to expand MDRs as a mechanism behind low physical activity and sedentary lifestyle of high-income Black children in the US.

We found that while children from high-income families more frequently engage in exercise, this effect is less robust for Black than White families. That means, while high income White children report the highest levels of physical activity, Black children from high- and low- income families report low exercise frequency. This result is an indicator of MDRs of household income on children exercise frequency.

The existing research has shown MDRs of household income and parental education. MDRs of household income is reported for impulse control [51], school function [34], and school bonding [52]. Similarly, Black children from high SES families remain at high risk of chronic diseases [17] such as ADHD

Table 1. Descriptive data overall and by race (*n* = 8027).

	All		***Whites***		***Blacks***	
	n	**%**	***n***	**%**	***n***	**%**
Race						
White	5927	73.8	5927	100.0	-	-
Black	2100	26.2	-	-	2100	100.0
Sex						
Female	3815	47.5	2786	47.0	1029	49.0
Male	4212	52.5	3141	53.0	1071	51.0
Age						
9	4302	53.6	3175	53.6	1127	53.7
10	3725	46.4	2752	46.4	973	46.3
Family Marital Status* b						
Other	2488	31.0	1058	17.9	1430	68.1
Married	5539	69.0	4869	82.1	670	31.9
	Mean	SD	Mean	SD	Mean	SD
Household income (1-10) * a	7.43	2.37	8.14	1.72	5.19	2.71
Exercise frequency (0-7)*	2.85	1.26	2.84	1.22	2.87	1.35

SD= Standard Deviation;

*p < 0.05 for Black - White comparisons;

a independent sample t test;

b Chi Square test

Table 2. Linear regressions overall (*n* =8027).

				Model 3 Main Effects							**Model 4 Interactions**			
	beta	**b**	**SE**	**CI**		**t**	**p**	**beta**	**b**	**SE**	**CI**		**t**	**p**
Race (Black)	0.04	0.12	0.04	0.04	0.20	2.87	.004	0.11	0.33	0.10	0.12	0.53	3.18	.001
Sex (Male)	0.06	0.14	0.03	0.09	0.20	4.91	.000	0.06	0.14	0.03	0.09	0.20	4.93	.000
Age	0.05	0.13	0.03	0.07	0.19	4.54	.000	0.05	0.13	0.03	0.07	0.19	4.54	.000
Marital Status (Married)	0.01	0.03	0.04	-0.05	0.11	0.80	.423	0.01	0.03	0.04	-0.05	0.11	0.74	.457
Household income	0.03	0.02	0.01	0.00	0.03	1.93	.053	0.06	0.03	0.01	0.01	0.05	2.89	.004
Household income x Race								-0.07	-0.03	0.01	0.06	0.00	-2.21	.027
Intercept		1.37	0.28	0.82	1.91	4.89	.000		1.25	0.28	0.69	1.81	4.40	.000

b= Unstandardized Regression Coefficient; CI= Confidence Interval

SE= Standard Error

Table 3. Linear regressions across groups defined by race (*n* = 8027).

	Model 3 White							Model 4 Black						
	beta	b	SE	CI		t	p	beta	b	SE	CI		t	p
Sex (Male)	0.05	0.12	0.03	0.06	0.19	3.79	.000	0.08	0.21	0.06	0.08	0.33	3.25	.001
Age	0.06	0.14	0.03	0.08	0.21	4.43	.000	0.03	0.09	0.06	-0.03	0.22	1.48	.140
Marital Status (Married)	0.01	0.02	0.05	-0.07	0.11	0.43	.664	0.02	0.05	0.08	-0.10	0.20	0.67	.504
Household income	0.04	0.03	0.01	0.01	0.05	2.95	.003	-0.01	0.00	0.01	-0.03	0.02	-0.28	.778
Intercept		1.15	0.32	0.53	1.77	3.65	.000		1.91	0.60	0.73	3.09	3.17	.002

b= Unstandardized Regression Coefficient; CI= Confidence Interval

SE= Standard Error

[53], asthma [54], obesity [55], anxiety [56], and depression [57]. Similar MDRs are observed for children [54], and adolescents [51,55,58]. Black and White children are not equally protected from their family SES, which is in line with the MDRs.

Research on MDRs suggests that diminished returns are not specific to any specific health or behavioral outcomes. This observation suggests that marginalization and social stratification, which accompanies race, may result in a systemic Black- White differences in the health gain from their SES resources [19,20]. These patterns hold for many visible and non-visible marginalizing identities such as race [28], ethnicity [35,59,60], sexual orientation [38,40], immigration [61], and even place-based marginalization [29]. That is racism and all forms of marginalization of populations result in a reduced health gain that follows SES.

MDRs have also been reported by Navarro [62-64], Farmer and Ferraro [65], Hamilton and Darity [66], Hudson et al. [67-69], Shapiro and Oliver [70,71], and other scholars [72]. Farmer and Ferraro documented MDRs of education on self-rated health. They showed that Whites gained more than Blacks from an increase in their educational attainment [65]. Shapiro and Oliver have documented the extensive and pervasive inequalities in wealth distribution between Black and White families [70,71]. Hamilton and Darity have described the same type of wealth gap in other studies and reports [66]. Other investigators have also published on MDRs [72]. Hudson et al. have shown a reduced gain of SES in the lives of Black than White adults [67-69]. Navarro has argued that health is not a function of race or SES but race and SES [62-64]. Others have shown that income better reduces discrimination for Whites than Blacks [73].

This study shows that health behaviors of high SES Black children is not optimal. This disadvantage may explain why high SES Black people remain at risk of chronic diseases [54], obesity [55,74], blood pressure [60]. This may also explain why high SES Black people remain at risk of chronic disease [75], hospitalization [31,76], and mortality [77].

MDRs have been explained through multiple mechanisms [19,20]. Structural and environmental inequalities due to social stratification may play a role [19,20]. Highly educated Black people work in worse occupations than highly educated White people [30] and report lower levels physical activity [37], and are at a higher risk of smoke cigarettes[32], drinking [35], and depression [57].

A mechanism that may cause MDRs is the high psychosocial tax that Black families pay in the US for their social mobility status [78]. Black people report higher levels of stress across all mobility statuses, compared to Whites [78]. Simultaneously, highly educated Blacks report more stress associated with race and discrimination [79]. At each level of education, Blacks have less income and wealth than Whites, and we know that income and wealth can buffer stress when they occur [70,71]. While highly educated Whites have lowest risk of poverty, highly educated Black families remain at risk of poverty [80].

Implications

There is a need for policy solutions that can undo health disparities across all SES levels in the United States. Previously, most policies have tried to eliminate racial inequalities in health through increasing minorities' access to resources or reducing their exposure to risk factors. We argue that another type of policy is also needed. Elimination of racial inequalities is not possible unless we equalize the return of SES for all groups. Not only unequal access but also unequal return of resources should be a priority for policymakers. To equalize return of resources, we need to similarly treat all racial and ethnic groups and Blacks and other ethnic groups in the society. Unless we effectively address the observe MDRs, merely promoting SES resources of racial and ethnic minority groups would not be sufficient for elimination of racial health disparities in the US. Thus, understanding MDRs extend our tools on how we can reduce health disparities [81-85].

Future Research

Future research should investigate the differences in the operant mechanisms by which social determinants and SES indicators impact health behaviors of social sub-groups in the US. That means we need to explore differences in the additive and multiplicative effects of race, SES, sex, and place on pro-health behaviors such as physical activity. Exercise frequency is not the only important aspect of health behaviors, and it is not only shaped by parental SES by a wide range of social, interpersonal, and individual factors. While this study only focused on exercise engagement of American children based on their household income and race, literature shows that several other factors may contribute to the physical activity of children. These include attitudes and expectations, availability of green areas and walkability, education in school and family, body mass index and chronic disease, mental health, and other health behaviors of the self as well as family members and peers. While we only studied income, future research should also test if other SES indicators such as parental education, wealth, parental occupation also show similar results. Future studies may also focus on the influences of peers and family members on health behaviors of White and Black children from middle-class families. There is also a need to study how these diminished returns change over time. It is also important to study contextual factors that reduce health behaviors of middle-class Black families. In addition, we need to understand modifiable factors that influence health behaviors in children. Studying mediators and moderators of the interplay between class, race, parenting, and health behaviors such as physical activity may propose intervention plans that can be utilized to undo health inequities across all SES levels. Such research is able to recommend novel and effective plans for action by local and federal government to enhance physical activity practices of the children. Longitudinal data and cohort studies are needed to study trajectories of engagement in physical activity form childhood to adulthood. Such research may go beyond relying on self-reported data and use wearables and meta data that can track individual movements.

Limitations

The study has a few limitations. First, most surveys do not have a balanced sample size of Black and White participants. The sample was also not random. As a result, the results are not generalizable to all White and Black US families. Other risk factors of low exercise frequency such as availability of green areas and physical activity of peers and parents were not measured. Our exercise frequency questionnaire was a simple three-item measure. There was also no information on other related behaviors such as sleep or diet. In addition, in this study, SES was not matched between Black and White participants. White families have higher levels of education and higher household income and are more likely to be married than Black families. In addition, these data are only tested for the differences between White and Black families and should not be generalized to other race and ethnic groups. This study only used 9-10 years old children and other developmental groups of White and Black children may show different patterns. Despite all these limitations are important, none of them are fatal flaws. As such, we need more replication studies on the results reported here.

Conclusion

In a national sample in the U.S, Black and White families show difference in the effect of their household income on children exercise frequency. While for White children, exercise frequency is a function of household income, meaning that and exercise frequency is highest for high income White children, for Blacks, exercise frequency remains always low, regardless of their income level. This new insight may help researchers, clinicians, policymakers, and others to tackle health inequalities in American children.

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