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Youth academic achievement, social context, and body mass index

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ABSTRACT

This study assesses the relationship between academic achievement and body mass index for age (BMI) trajectories across childhood and adolescence, and investigates how this relationship is moderated by social context. Specifically, we test the hypothesis that academic achievement is not associated with improved BMI among youth from disadvantaged social contexts. We test for differences by race/ethnicity, and examine the role of county-level economic mobility in shaping these patterns. We use data from the longitudinal Fragile Families and Child Wellbeing Study (FFCWS), an ongoing birth cohort study representative of children born in large US cities in 2000, and measure BMI, academic achievement, and social context at Years 5, 9, and 15. Estimating multilevel random effects linear regression models of BMI from childhood to adolescence, we find that youth who were exposed to social advantage displayed a negative association between academic achievement and BMI. In contrast, youth exposed to social disadvantage displayed no association between academic achievement and BMI. This difference was observed regardless of race/ethnicity. County-level economic mobility modified the observed relationship, such that youth living in places with low levels of mobility displayed higher BMI associated with high academic performance. The results suggest that the health costs of academic achievement among disadvantaged youth are concentrated in areas with low institutional support for upward mobility. The findings demonstrate that the unequal benefits of educational attainment begin early in life, while living in places that promote upward mobility can help individuals realize the health benefits of their own educational attainment.

Introduction

While health disparities are often observed in later life chronic conditions and mortality, the processes generating and sustaining such inequalities begin decades earlier (Colen, 2011; Jones et al., 2019; Shuey & Willson, 2008). Children born into and raised in disadvantaged social contexts already have worse health in childhood and adolescence relative to peers in more advantaged social contexts (Ferraro, Schafer, & Wilkinson, 2015; Pais, 2014; Poulton et al., 2002). The accumulation of health risks or benefits across youth follow individuals into adulthood, in part due to the life course trajectories on which early life conditions place individuals (Gruenewald, KarlamanglaHuStein-Merkin, Crandall, Koretz, & Seeman, 2012; Hayward & Gorman, 2004; Montez & Hayward, 2014). Indeed, the system of social stratification in the US is rigid and the likelihood of intergenerational mobility is low, meaning childhood social context strongly predicts adult circumstances (Chetty, Grusky, et al., 2017; Chetty, Hendren, Kline, & Saez, 2014; Chetty, Hendren, Kline, Saez, & Turner, 2014; Song et al., 2020). Research on mobility and health commonly rely on childhood and adulthood as starting and ending points, respectively, without interrogation of how health and status attainment processes unfold across the intervening period. Our analysis investigates the health of youth as they navigate the system of academic achievement, with a particular interest in children from conditions of adversity who are able to achieve success.

In this paper, we examined the relationship between social context, academic achievement, and body mass index from childhood to adolescence (ages 5 to 15) (Fig. 1). We examined three research questions. First, what is the relationship between academic achievement, social context, and body mass index in youth? We hypothesized that higher levels of achievement would be associated with lower BMI, but not for youth from disadvantaged social contexts. Second, does this relationship differ by race/ethnicity? Due to a legacy of institutionalized racism and discrimination, and consistent with previous research (Brody, YuMiller, & Chen, 2016; Gaydosh et al., 2018) we hypothesized that this pattern would be restricted to Black and Hispanic youth, and not observed among White youth. Third, how does contextual support

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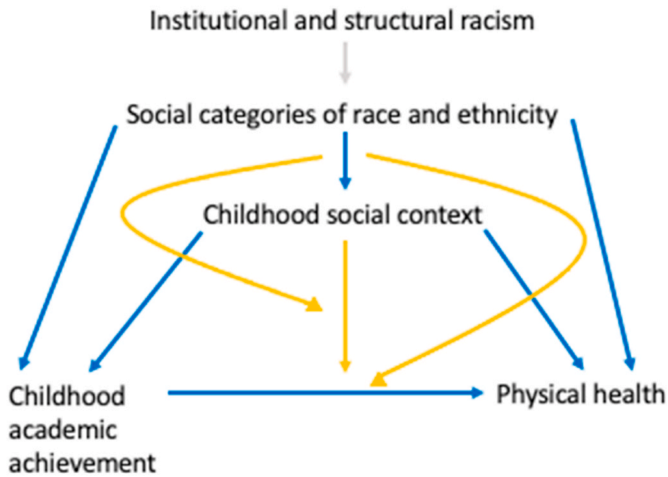

Fig. 1. Conceptual Diagram. Stylized representation of the hypothesized relationships between academic achievement, social context, and physical health. Arrows depicted in gray represent unobserved relationships, arrows depicted in blue represent direct relationships, and arrows depicted in yellow represent moderating relationships. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

for mobility shape the observed patterns? Specifically, we examined the role of county-level rates of upward mobility. We hypothesized that the absence of a health benefit associated with high levels of academic achievement among disadvantaged youth would be confined to, or amplified in, places where upward mobility is low. Next we outline the previous research from which these hypotheses are derived, followed by a description of the materials and methods, and a presentation of our results. We conclude with a discussion of our findings.

One route through which children from disadvantaged social contexts secure upward mobility is educational attainment. Greater educational attainment is generally associated with better health (Halpern-Manners, Helgertz, Warren, & Roberts, 2020; Warren, Muller, Hummer, Grodsky, & Humphries, 2020). Yet the benefits of such educational success are not enjoyed equally across all groups (Hummer & Hernandez, 2013; Montez, Hummer, Hayward, Woo, & Rogers, 2011; Sasson, 2016; Schafer, Wilkinson, & Ferraro, 2013). Specifically, college completion among highly disadvantaged and minoritized racial/ethnic groups is associated with elevated physical health risk in early adulthood (Chen, Miller, Brody, & Lei, 2015; Gaydosh et al., 2018). Exactly when this elevated health risk among upwardly mobile individuals appears is unknown, which limits the potential for interventions to address the possible health costs. In this paper, we examine the association between academic achievement, social context, and health across childhood and adolescence, from age 5 to 15. We used academic achievement as a proximal determinant of eventual educational attainment.

Children achieve academic success due to a variety of factors, including individual ability and effort; peer influence; familial and community support and investment; teacher expectations and behaviors; and school policies and characteristics (Altermatt & Ellen, 2011; Kenealy, Frude, & Shaw, 1991; Rydell; Stewart, 2006). From social contexts of disadvantage, academic achievement may require greater effort in order to overcome significant barriers to success. Indeed, much research in this area focuses on individual psychological characteristics such as self-control, striving, and "grit"(Duckworth, 2016; Duckworth & Gross, 2014; Oyserman, 2015). While high levels of self-control and perseverance may be necessary in order to overcome disadvantage and achieve higher status, self-control in the face of adversity may lead to repeated activation of the stress-response system, resulting in physiological wear and tear that manifests in elevated health risk (Brody et al, 2013, 2020; Miller, Yu, Chen, & Brody, 2015).

This area of research has developed from the foundational theories of John Henryism and Sojourner Syndrome. James and colleagues developed the theory of John Henryism to explain how a single-minded focus to achieve when faced with the repeated assaults of systemic oppression can cause poor health, particularly among African Americans (James, Hartnett, & Kalsbeek, 1983). Such effortful coping strategies may be psychologically protective but physiologically costly, a pattern referred to as skin-deep resilience, and observed among racial/ethnic minorities (Brody et al., 2016; Gaydosh et al., 2018). Soujourner Syndrome represents the health risks imposed by the intersecting identities of gender, race, and class, and the particular health consequences that African American women face by performing the labor necessary for community survival in the face of slavery, Jim Crow, and continued anti-Black racism and discrimination (Mullings, 2002). Both theories emphasize the health burden of effortful coping and resilience against the structural forces of racial oppression that are designed to restrain Black success.

In addition to the effort required, the status attainment of minoritized groups may be met with particular hostility, racism, and discrimination in predominantly White spaces where historical positions of privilege in the racial hierarchy are threatened (Anderson 2011, 2015; Ray, 2019). Students of marginalized racial/ethnic and class identities may experience added stress in educational settings that value and reinforce historically White and economically privileged norms and behaviors (Barry, JacksonWatkinsGoodwill, & Hunte, 2017; Bentley-Edwards & Chapman-Hilliard, 2015; Clayton, 2020; Jochman et al., 2019). There is evidence that Black students enrolled in predominantly White secondary schools experience poorer health (Goosby & Walsemann, 2012; Jochman et al., 2019; Walsemann, Bell, & Goosby, 2011). These results support the hypothesis that academic achievement, particularly for minoritized students – by race/ethnicity and class – may experience health deteriorating assaults associated with educational success.

As discussed, most research documenting the relationship between upward mobility and poor health focuses on individual or interpersonal behavior, specifically the effort required and stress accompanying the status attainment process for Black Americans (Chen et al., 2019; Jackson, Knight, & Rafferty, 2010; Jetten, Iyer, Tsivrikos, & Young, 2008; Miller et al., 2015). Individual psychosocial factors are certainly fundamental to our understanding of the mechanisms underlying these population health patterns, yet we also know that contextual factors shape individual experiences in ways that are crucial for understanding processes of health and stratification (Chetty and Hendren, 2018a, 2018b; Montez, Hayward, & Wolf, 2017; Zajacova & Lawrence, 2018). Less consideration has been given to contextual features that constrain or promote individual success (Gaydosh & Mullan Harris, 2020; Hargrove & Taylor, 2019). Research demonstrates that the communities in which children are raised and the schools that they attend influence their chances of upward mobility (Chetty, Friedman, Saez, Turner, & Yagan, 2017; Chetty, Hendren, & Katz, 2015; Donnelly et al., 2017). Certain community and school characteristics may make high achievement less physiologically taxing, either by reducing the level of effort required to achieve, or by mitigating the negative consequences of sustained high effort. Indeed, living or attending school in environments where institutional support for mobility is low, the cost of achievement will likely be high, as these environments do not have the institutional or structural resources needed to facilitate the pathway to success. Conversely, environments characterized by high institutional support for mobility are likely associated with a lower cost of achievement. Previous research has demonstrated associations between these measures of economic mobility and health behaviors and outcomes (O'Brien, Venkataramani, & Tsai, 2017; Venkataramani et al., 2016). We used data on the level of economic mobility in the county of residence to examine the role of institutional factors.

Material and methods

Study participants

This paper used data from the Fragile Families and Child Wellbeing Study (FFCWS), which follows a sample of 4,898 children representative of children born in large American cities between September 1998 and September 2000. The study design includes an oversample of children born to unmarried parents, making the data particularly well-suited to study disadvantaged populations. A baseline interview was conducted at the time of birth with the mother (and when possible, the father), and follow-up interviews have been conducted at ages 1, 3, 5, 9, and 15. We restricted the analytic sample to children who participated in the Year 5, 9, or 15 interview who identify as non-Hispanic White, non-Hispanic Black, or Hispanic (Table 1, n = 3,251).

Measures

Body mass index

Body mass index: We evaluated physical health at Years 5, 9, and 15 by constructing a measure of body mass index (BMI) from measured height and weight if the adolescent was evaluated at an in-home visit, and self-reported height and weight otherwise (Table 1). We then created BMI z-scores (hereafter BMI) by using the CDC growth chart, which standardizes height and weight by age and sex relative to the CDC reference (Kuczmarski, 2000). This is a standard approach to measuring BMI in children and adolescents, and the measure is considered a risk factor for poor cardiovascular and metabolic health in middle age (Berenson, Srinivasan, BaoNewmanTracy, & Wattigney, 1998; Must, Jacques, Dallal, Bajema, & Dietz, 1992). The average BMI z-score in the sample was 0.59 at Year 5, 0.75 at Year 9 and 0.67 at Year 15; values greater than 0 indicate BMI for age higher than average relative to the standard growth chart.

Academic achievement

We measured academic achievement from teacher report of school performance at Years 5 and 9, and adolescent self-reported course grades at Year 15. At Year 5, a subsample of children (n = 1,039) were selected for the teacher survey, while at Year 9 all children were eligible for the teacher survey. At Years 5 and 9, teachers rated the child's skills in three areas: 1) language and literacy; 2) science and social studies; and 3) mathematics. For each area, teachers rated the skills on a five-point scale ranging from far below average to far above average. We summed the teacher's rating to create a measure ranging from 3 to 15. At Year 15, adolescents reported the letter grade they received for the most recent grading period in four subjects: (1) English or language arts; (2) math; (3) history or social studies; and (4) science. We transformed each letter grade response option into its numerical equivalent (A = 4, B = 3, C = 2, D or lower = 1), and calculated academic achievement as the sum across the subjects, ranging from 4 to 16. We then rescaled this measure by subtracting one to make the scale consistent with Years 5 and 9.

Table 1
Descriptive statistics.

Variable	Year 5	Year 9	Year 15
Age	5.07 (0.20)	9.25 (0.34)	15.64 (0.70)
Male	47%	52%	51%
Black	45%	50%	52%
White	29%	25%	22%
Hispanic	26%	25%	26%
BMI z-score	0.59 (1.16)	0.75 (1.11)	0.67 (1.07)
Social context	−0.10 (1.01)	−0.03 (0.98)	−0.01 (0.99)
Academic achievement	9.09 (2.34)	8.66 (2.66)	11.55 (2.62)
County mobility	−0.48 (0.89)	−0.49 (0.89)	−0.50 (0.90)
N	886	2,026	2,601

Social context

Our current understanding of life course disparities in the health returns to educational achievement is limited by available data; many data sets that include both educational achievement and health do not include measures of childhood conditions, and those that do are retrospectively reported (Luo & Waite, 2005; Ross & Mirowsky, 2011). We use prospective measures of early life conditions to enrich our understanding of the life course patterns of educational health disparities. Rather than focusing on a single domain of childhood, we construct a measure to reflect childhood context across multiple domain (Ferraro et al., 2015; Pearlin, Scott, Fazio, & Meersman, 2005). This decision is motivated by our understanding that domains of disadvantage are overlapping and interconnected, and consideration of a single domain in isolation ignores these simultaneous and cumulative processes (Pearlin et al., 2005).

Our measure of social context captures conditions at the household, school, and neighborhood level across childhood. We used principal component analysis on sixteen measures of the social context at each included interview wave (Years 5, 9 and 15), and predicted the first principal component as a summary index. The first principal component captures ~38% of the variance across the measures at each measurement period (Appendix A). We mean standardized the measure for interpretability, with higher values indicating disadvantage, and lower values indicating advantage.

At the household level, we included measures of single parent family structure, primary caregiver education less than high school, household welfare receipt in the last year, and household income to poverty ratio <1.5 based on parent report. At the school level, we used data from the National Center for Education Statistics linked to the child's school. We included school type (public/private), percent of non-Hispanic Black students, percent of students receiving free or reduced price lunch, the pupil to teacher ratio, and whether school is eligible for Title I funding.

At the neighborhood level, we relied on the 2000 decennial Census data merged to the tract of residence for Years 5 and 9, and the 2015 American Community Survey for Year 15. We included neighborhood measures of percent of non-Hispanic Black residents, percent family households with kids <18 headed by females, percent of civilian labor force >16 unemployed, percent of 25+ population with less than a high school education, percent of housing units vacant, percent of households on public assistance, and percent of families below the poverty level. Results are robust to alternative strategies for constructing childhood disadvantage, such as combining dichotomous indicators for disadvantage to create a summed index. Moreover, results are not driven by any particular domain of disadvantage, although measures from the neighborhood and school domains are most strongly correlated with the first principal component.

Race/ethnicity

We considered racial/ethnic differences in the relationship between disadvantage, striving, and BMI by interacting the measures of interest with a categorical variable for racial/ethnic identification of the child. At Year 15, adolescents were asked to describe their race/ethnicity. We constructed categories of White non-Hispanic, Black non-Hispanic, Hispanic, and other. We exclude a small number of respondents categorized as "other" race/ethnicity.

County mobility rate

We tested the role of institutional support for upward mobility using a measure of intergenerational income mobility in the county of residence at Year 9. These county data were taken from the Equality of Opportunity project, which combines millions of tax records on parents and children to estimate the causal effect of growing up in each U.S. county on adult income at age 26 (Chetty, Hendren, Kline, Saez, et al., 2014). The estimate is defined as the "the percentage gain (or loss) in income at age 26 from spending one more year of childhood in a given county relative to the national mean" for an individual from a childhood household with income at the 25th percentile (Chetty, Hendren, Kline, & Saez, 2014). We transformed this estimate to a national z-score across all US counties weighted by county population. On average, FFCWS respondents lived in counties that are below the national average on mobility (Table 1). We restricted the measure to mobility in the county of residence at Year 9, given findings that childhood exposure has substantial effects across the life course (Chetty & Hendren, 2018a) and exposures at age 9 have the largest effects. Results are robust to including a time-varying measure of mobility at Years 5, 9, and 15.

Statistical analyses

We estimated multilevel random effects linear regression (or growth curve) models for BMI at Years 5, 9, and 15. This modeling approach allowed individuals with data missing at one or two of the three measurement periods to contribute to the estimation. All models included a random effect for the intercept to account for unobserved differences between individuals, and a city-level fixed effect. We first determined the most appropriate age pattern for BMI from Years 5–15 by comparing nested models with linear, quadratic, and cubic age trends using likelihood ratio tests and the Akaike information criterion to assess model fit. A quadratic age pattern best described the change in BMI. We estimated a quadratic age model predicting BMI:

$$BMI_{it} = (\beta_0 + b_{0i}) + (\beta_1 + b_{1i})age_{it} + \beta_2 age_{it}^2 + \beta_3 AA_{it} + \beta_4 SC_{it} + \beta_5 City_i + e_{it}$$

where BMI_{it} is body mass index for individual *i* at time *t*, age_{it} is age of the individual at time t, and the constant and linear age coefficients are random at the level of the child. The child-level residuals (b_{0i}, b_{1i}) are assumed to come from a bivariate normal distribution with mean zero and unstructured covariance matrix, and e_{it} the occasion-specific error term, normally distributed with mean 0 and variance σ_e^2. We include predictors of academic achievement (AA_{it}) and social context (SC_{it}) for individual *i* at time *t*, and time-invariant controls for sex and race/ethnicity. We tested the moderating relationship between academic achievement and disadvantage by including an interaction term AA_{it}* SC_{it}. We tested for evidence of racial/ethnic differences by including additional interaction terms (AA_{it} *SC_{it} *RE_i) where RE_i are indicators for Black, White, and Hispanic identity for individual *i*. We then added a measure of county mobility as well as allowed the effect of academic achievement and disadvantage to vary by level of mobility by including a three-way interaction (AA_{it}*SC_{it}*CM_i) where CM_i represents county mobility for individual *i*.

Results

We present results for multilevel random effects linear regression of BMI on academic achievement and social context in Model 1, Table 2. BMI increased 0.07 standard deviations on average with each year of advancing age, and at a decreasing pace as individuals age. Black and Hispanic youth had higher BMI on average compared to White youth. Academic achievement was associated with lower BMI, with one-point increase associated with 0.02 standard deviation decrease in BMI. Increasing disadvantage in social context was associated with higher BMI, with a one standard deviation increase in disadvantage associated with 0.06 standard deviation increase in BMI.

In Model 2, we tested the main hypothesis of interest: whether the association between academic achievement and BMI varies by social context, adding an interaction term between academic achievement and social context (Table 2). The results supported the hypothesis. Fig. 1 plots predicted BMI at ages 5 to 15 for low academic performance (score of 3; in blue solid line) and high academic performance (score of 16; in orange dashed line), separately at advantaged (2 SD below mean; on left) and disadvantaged (2 SD above mean; on right) social contexts. In contexts of social advantage, we found the expected negative association

Table 2
Multilevel random effects linear regression results for body mass index.

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Linear age	0.07***	0.07***	0.07***	0.07***	0.07***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Quadratic age	−0.00***	−0.00***	−0.00***	−0.00***	−0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Male	−0.05	−0.05	−0.04	−0.04	−0.04
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Race/ethnicity (White)					
Black	0.19***	0.18**	0.08	0.16**	0.15**
	(0.05)	(0.05)	(0.17)	(0.05)	(0.05)
Hispanic	0.30***	0.29***	0.41*	0.27***	0.27***
	(0.06)	(0.06)	(0.19)	(0.06)	(0.06)
Academic achievement	−0.02**	−0.01**	−0.01	−0.01**	−0.02**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Social context	0.06***	−0.07	0.05	−0.07	−0.01
	(0.02)	(0.05)	(0.14)	(0.05)	(0.06)
Academic achievement * social context		0.01**	0.01	0.01**	0.01
		(0.00)	(0.01)	(0.00)	(0.01)
Black * academic achievement			0.01		
			(0.02)		
Hispanic * academic achievement			−0.02		
			(0.02)		
Black * social context			−0.11		
			(0.16)		
Hispanic * social context			−0.13		
			(0.19)		
Black * academic achievement * social context			0.00		
			(0.01)		
Hispanic * academic achievement * social context			0.01		
			(0.02)		
County mobility				−0.04	−0.11
				(0.02)	(0.06)
Academic achievement * county mobility					0.01
					(0.01)
Social context* county mobility					0.16**
					(0.05)
Academic achievement * social context* county mobility					−0.01**
					(0.01)
Constant	0.41**	0.41**	0.44*	0.42**	0.44**
	(0.14)	(0.14)	(0.20)	(0.14)	(0.15)
Observations	5,430	5,430	5,430	5,426	5,426
Number of groups	3,251	3,251	3,251	3,248	3,248

Standard errors in parentheses. All models include city-level fixed effects. ***p < 0.001, **p < 0.01, *p < 0.05.

between academic achievement and BMI, where higher academic performance was associated with lower BMI; the orange line is consistently below the blue line at all ages, indicating lower BMI, or better health. In contrast, in contexts of social disadvantage we observed no association between academic achievement and BMI; the 95% confidence intervals for the orange and blue lines are overlapping, indicating no statistically significant difference. With exposure to high levels of disadvantage, youth had similar BMI at all ages regardless of their academic achievement.

We tested whether this pattern was restricted to Black and Hispanic youth in Model 3 by including additional interactions with a measure of race/ethnicity. We found no evidence of statistically significant differences in the relationship between social context, academic achievement, or their interaction, by race/ethnicity. Moreover, the magnitude of the interaction of interest between social context and academic achievement was relatively unchanged between models 2 and 3. We present these results in Fig. 2, with predicted BMI at ages 5 to 15 for low and high academic performance in advantaged and disadvantaged social contexts, for White, Black, and Hispanic youth. For all racial/ethnic groups in advantaged social contets, high academic achievement was associated with lower BMI, although the relationship was only statistically significant for Hispanics. For all racial/ethnic groups living in highly disadvantaged contexts, academic achievement was not associated with BMI.

In counties where upward economic mobility is common, childhood social context may exert less influence on the health returns to academic achievement. Specifically, academic achievement among youth from highly disadvantaged social contexts may be more supported and therefore less stressful or physiologically taxing in places that support upward mobility. Conversely, in counties where economic mobility is constrained, childhood social context may continue to modify the health returns to academic achievement. Specifically, academic achievement among youth from highly disadvantaged social contexts may require significant effortful coping in places that block opportunities for mobility. We investigated the mediating and moderating role of county rates of upward mobility in Models 4 and 5, respectively (Table 2). Residence in counties with higher mobility rates was marginally associated with lower BMI ($\beta = -0.04$, $p = 0.10$; Model 4, Table 2). Each standard deviation increase in the mobility rate of the county was associated with 0.04 standard deviation decrease in BMI. Controlling for the level of mobility in the county did not alter the observed association between disadvantage and academic achievement.

We also found suggestive evidence of further moderation in the relationship between BMI, academic achievement, and social context. The direction of the coefficient for the three-way interaction between social, academic achievement, and county mobility indicated that the positive association between academic achievement and BMI among individuals exposed to high disadvantage reduces as counties increase in rates of mobility ($\beta = -0.01$, $p = 0.009$; Model 5, Table 2). In other words, the increase in BMI associated with high academic achievement from social contexts of high disadvantage may be restricted to individuals living in lower mobility counties. We plot predicted BMI by county mobility for individuals exposed to advantaged and disadvantaged social contexts in Fig. 3. In low mobility counties (2 SD below the mean; on left) among individuals from advantaged social contexts, we observed the expected relationship where low academic performance (blue solid line) was associated with higher BMI at all ages compared to peers with high academic performance (orange dashed line). We observed the opposite in low mobility counties among individuals from disadvtranged social contexts; high academic performance was associated with higher BMI at all ages compared to peers with low academic performance. In contrast, in high mobility counties (2 SD above the mean; on right) BMI was statistically similar for individuals with low and high academic performance at all ages in both advantaged and disadvantaged social contexts. Our results suggest that the increase with BMI associated with high academic achievement among disadvantaged youth is concentrated among those living in counties where intergenerational upward mobility is rare (Fig. 4).

Discussion

This study found that greater academic achievement was associated with lower BMI across childhood and adolescence, consistent with a large literature on schooling and health. However, this relationship varied by social context. While youth from advantaged social contexts had lower BMI associated with higher academic achievement, there was no difference in BMI by academic achievement for youth from disadvantaged social contexts. In other words, academic achievement was not associated with a BMI benefit for highly disadvantaged youth. This pattern was true for all respondents regardless of race.

Contrary to previous research (Brody et al., 2016; Gaydosh et al., 2018), these findings suggest that the pattern of unequal returns to academic achievement by exposure to disadvantage may not be restricted to racial/ethnic minorities in the United States. There are several possible explanations for this finding. First, the Fragile Families cohort is more recent than previous studies, and conditions for disadvantaged Whites may have deteriorated. Second, the Fragile Families study was designed to over-represent disadvantaged families, and therefore contains a larger sample of disadvantaged Whites than is common in other nationally representative studies, providing greater power to detect the pattern in Whites. Third, it is possible that such racial differences may manifest later in the life course; this is the first study to examine the pattern of moderation between academic achievement and socioeconomic disadvantage among youth and adolescents. Previous studies document racial differences in young adulthood, when entry into educational and occupational settings may be met with racism and discrimination (Jochman et al., 2019; National Public Radio, RWJF

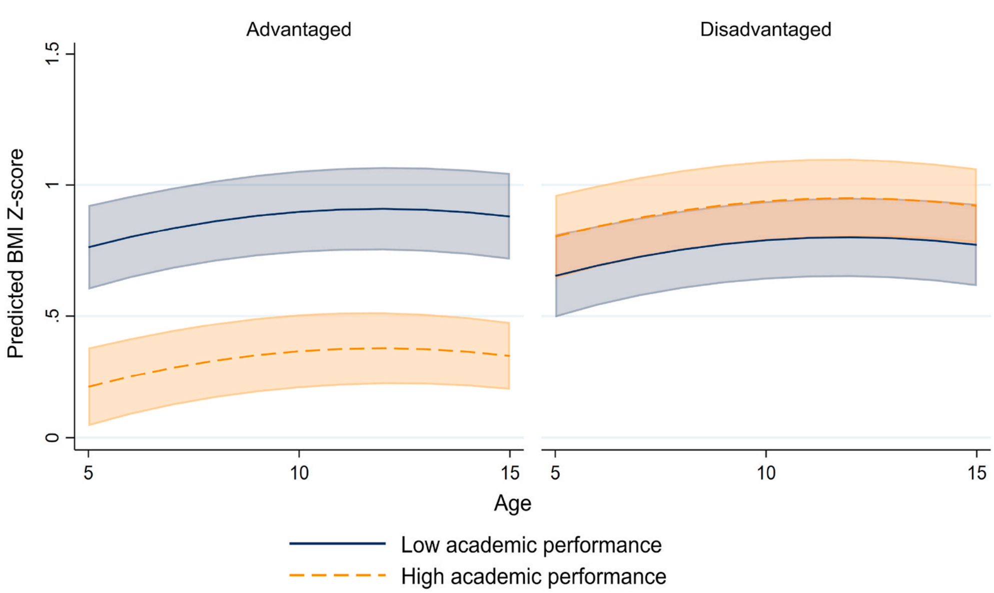

Fig. 2. Predicted body mass index z-score by age at advantaged and disadvantaged social contexts and low and high academic achievement. Results from multilevel random effects linear regression controlling for sex and race/ethnicity, with linear and quadratic age terms. Advantaged refers to two standard deviations below the sample mean. Disdvantanged refers to two standard deviations above the sample mean. Low academic performance refers to a value of 3, high academic performance refers to a value of 16. Full results presented in Model 2, Table 2.

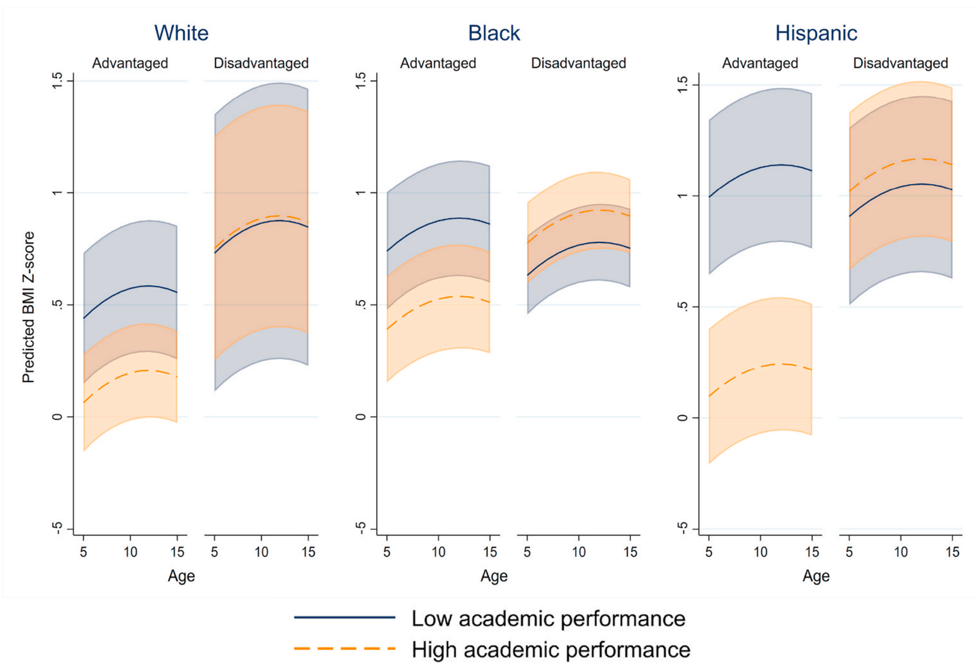

Fig. 3. Predicted body mass index z-score by age, race/ethnicity, and social context at low and high academic achievement. Results from multilevel random effects linear regression controlling for sex, with linear and quadratic age terms. Advantaged refers to two standard deviations below the sample mean. Disdavtanged refers to two standard deviations above the sample mean. Low academic performance refers to a value of 3, high academic performance refers to a value of 16. The association between academic achievement and disadvantage is permitted to vary by race/ethnicity. Full results presented in Model 3, Table 2.

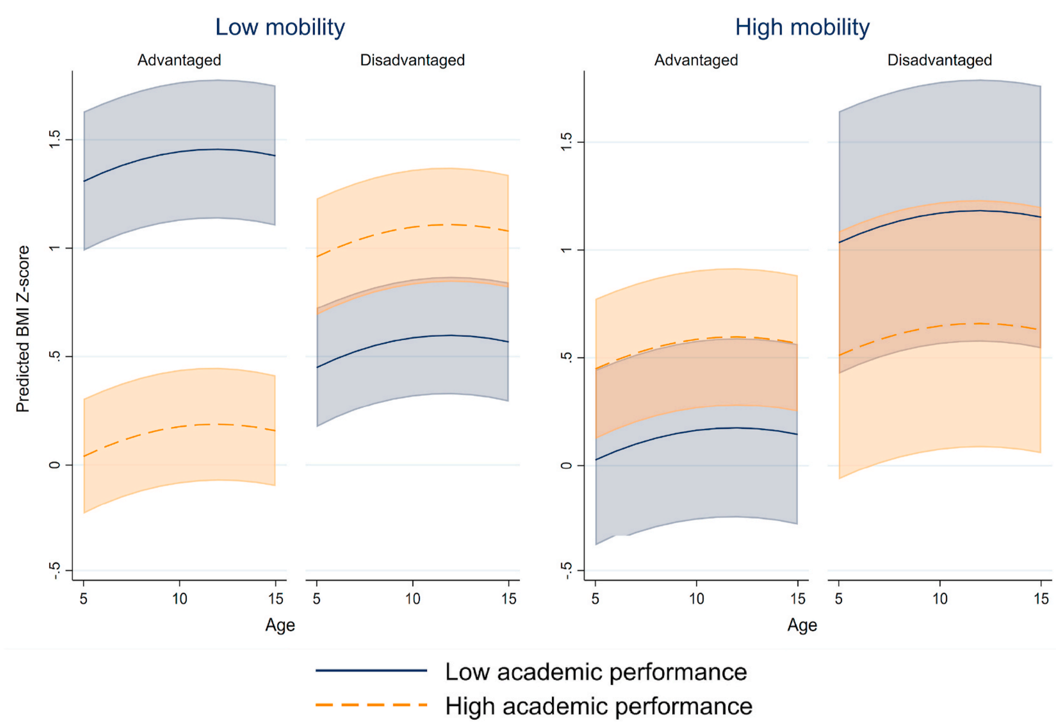

Fig. 4. Predicted body mass index z-score by age, social context, and county mobility, at low and high academic achievement. Results from multilevel random effects linear regression controlling for sex and race/ethnicity, with linear and quadratic age terms. Advantaged refers to two standard deviations below the sample mean. Disdavtanged refers to two standard deviations above the sample mean. Low academic performance refers to a value of 3, high academic performance refers to a value of 16. Low mobility refers to counties two standard deviations below the national average county mobility. High mobility refers to counties two standard deviations above the national average county mobility. Full results presented in Model 5, Table 2.

2017; Wingfield & Chavez, 2020). Further research is needed to better understand this finding and the life course manifestation of racial/ethnic and socioeconomic disparities in health.

To our knowledge, this study is the first to identify unequal returns to academic achievement in a youth (childhood to adolescence) sample. These findings have important implications for the health of this cohort, as BMI in youth is predictive of adult BMI, and BMI is associated with other health risks (Azar Mokdad et al., 2003; Roy et al., 2020; Sharabiani et al., 2011). Adolescence may be the start of a trajectory of worsening health among this group (Bauldry et al., 2016; Martin, Jennifer, Gandarvaka, Allison, & Harris, 2019). This finding is particularly concerning because it suggests that the suppressed health benefit of achievement occurs early, before upward socioeconomic mobility is actually achieved. However, this finding also suggests great potential for interventions early in the life course among high-achieving, low SES youth; intervening at this point could prevent upwardly mobile individuals from experiencing elevated health risk as they enter adulthood.

In place of the role of individual characteristics commonly considered such as self-control (Chen et al. 2019, 2020), we investigated contextual features of the neighborhood in which youth reside in an attempt to better understand the documented pattern of health risk associated with high academic performance among disadvantaged youth. The increase in BMI associated with higher academic achievement among disadvantaged youth appears to be concentrated among those growing up in counties with low rates of economic mobility. Perhaps youth in these communities experience greater levels of despair and perceive a lack of opportunity even for students who do well in school. It is also possible that academic success in these places is more difficult than for children from disadvantaged backgrounds in counties with high mobility, due to fewer resources, less support, and greater barriers. This finding is consistent with the large literature on John Henryism (Bonham, Sellers, & Neighbors, 2004; Brody et al., 2017; James, 1994; James et al., 1983), emphasizing the intersection of effortful coping in settings with barriers to opportunity as deleterious for health. Further research is needed to better understand characteristics of the places that promote or constrain upward mobility that may contribute to this pattern.

We acknowledge several limitations. Our sample includes an over-representation of youth from disadvantaged environments and low-mobility counties, which limits our power to examine the role of living in high-mobility counties. We used academic achievement as a proxy for potential educational attainment; while an imperfect predictor, this measure does capture the youth experience of the status attainment process. Moreover, at Year 5 the report of academic achievement was limited to a subsample of youth who were selected for a teacher survey. In supplementary analyses, we estimated linear regression models predicting BMI at Year 15, controlling for BMI at Year 9 and 5, with academic achievement and disadvantage measured at Year 15. Our results were substantively consistent with the findings presented above. Moreoever, the sample descriptives in Table 1 do not suggest differential participation in Year 5 compared to Years 9 and 15 along demographic characteristics. Finally, the measure of county mobility does not provide any insight into the mechanisms operating at the institutional and contextual level to help better understand the relationship between BMI, academic achievement, and exposure to socioeconomic disadvantage. This is a fruitful area for future research.

The results of this study demonstrate that academic achievement was associated with lower BMI in childhood and adolescence, but only among individuals from relatively advantaged social contexts. Among youth exposed to high levels of disadvantage, there was no BMI benefit associated with academic achievement. Residence in counties with high levels of upward mobility can allow all youth to realize the health benefits of academic achievement.

Conclusions

Academic achievement is a key avenue for upward mobility. While educational success generally promotes health, this benefit depends on the social context in which children are raised. We found that youth who grew up in disadvantaged childhood environments did not demonstrate any BMI benefit associated with better academic achievement, regardless of race/ethnicity. The study also highlights the importance of support for upward mobility; in counties where the likelihood of upward mobility is low, academic achievement among disadvantaged youth was associated with worse health.

Ethical statement

The data collection for this research was approved by the Institutional Review Board of Princeton University. The authors declare no conflict of interest.

CRediT authorship contribution statement

Lauren Gaydosh: Conceptualization, Formal analysis, Writing - original draft, Visualization. **Sara McLanahan:** Investigation, Resources, Conceptualization, Writing - review & editing, Funding acquisition.

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Appendix A. First Principal Component Loadings for Social Context by Survey Year

Variable	Year 5	Year 9	Year 15
Single parent family structure	0.09	0.12	0.00
PCG education < HS	0.10	0.08	0.08
Household welfare receipt in last year	0.14	0.11	0.08
Household income to poverty ratio <1.5	0.18	0.18	0.19
Neighborhood % NH Black	0.30	0.31	0.31
Neighborhood % female-headed	0.36	0.36	0.34
Neighborhood % adult unemployment	0.36	0.35	0.35
Neighborhood % education < HS	−0.31	−0.31	−0.24
Neighborhood % vacant households	0.23	0.22	0.26
Neighborhood % public assistance receipt	0.36	0.35	0.38
Neighborhood % poverty	0.37	0.37	0.38
School % NH Black	0.25	0.26	0.28
School % free-reduced lunch	0.27	0.29	0.30
School student-teacher ratio	0.01	−0.02	−0.01
School Title I eligible	−0.18	−0.20	−0.18
% variance explained by PC 1	38.5%	38.9%	37.7%

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