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Family Disadvantage, Education, and Health Outcomes Among Black Youths Over a 20-Year Period

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Abstract

IMPORTANCE Upward mobility (via educational attainment) is highly valued, but longitudinal associations with mental and physical health among Black youths are less understood.

OBJECTIVE To examine associations of childhood family disadvantage and college graduation with adult mental and physical health in Black youths followed up into adulthood.

DESIGN, SETTING, AND PARTICIPANTS This longitudinal, prospective cohort study of Black youths from the state of Georgia who were studied for 20 years (ages 11 to 31 years) was conducted between 2001 and 2022. Participants for this study were drawn from the Strong African American Healthy Adults Program. Data analysis was conducted from April 2023 to January 2024.

EXPOSURES Family economic disadvantage (measured during the adolescent years) and college graduation (indicating upward mobility).

MAIN OUTCOMES AND MEASURES Primary outcomes included mental health, substance use, and physical health. Mental health included a composite of internalizing and disruptive problems (anxiety, depression, anger, aggressive behaviors, and emotional reactivity). Substance use included a composite of smoking, drinking, and drug use. Physical health included metabolic syndrome (MetS) and proinflammatory phenotypes (immune cells mounting exaggerated cytokine responses to bacterial challenge and being insensitive to inhibitory signals from glucocorticoids). Mental and physical health measures were taken at age 31 and during the adolescent years. Linear and logistic regression analyses, as well as mediated moderation analyses, were conducted.

RESULTS The study population consisted of 329 Black youths (212 women [64%]; 117 men [36%]; mean [SD] age at follow-up, 31 [1] years). Compared with those who did not graduate college, those who graduated from college had 0.14 SD fewer mental health problems (b = −1.377; 95% CI, −2.529 to −0.226; β = −0.137; P = .02) and 0.13 SD lower levels of substance use (b = −0.114; 95% CI, −0.210 to −0.018; β = −0.131; P = .02). Residualized change scores revealed that college graduates showed greater decreases from age 16 to 31 years in mental health problems (b = −1.267; 95% CI, −2.360 to −0.174; β = −0.133; P = .02) and substance use problems (b = −0.116; 95% CI, −0.211 to −0.021; β = −0.136; P = .02). For physical health, significant interactions between childhood family disadvantage and college completion emerged in association with MetS (OR, 1.495; 95% CI, 1.111-2.012; P = .008) and proinflammatory phenotype (b = 0.051; 95% CI, 0.003 to 0.099; β = 0.131; P = .04). Among youths growing up in disadvantaged households, college completion was associated with a 32.6% greater likelihood of MetS (OR, 3.947; 95% CI, 1.003-15.502; P = .049) and 0.59 SD more proinflammatory phenotype (mean difference, 0.249, 95% CI, 0.001 to 0.497; P = .049). Conversely, among those from economically advantaged backgrounds, college completion was correlated with lower MetS and less proinflammatory phenotype. Findings held after controlling for body mass index at age 19 years.

(continued)

Key Points

Question Are there associations of childhood disadvantage and educational attainment with mental and physical health among Black youths?

Findings In this cohort study of 329 Black youths, those who grew up in economically disadvantaged households and graduated college displayed an adult profile of better mental health and less substance use but also a proinflammatory phenotype and greater likelihood of metabolic syndrome compared with those not graduating. College graduation was associated with better mental and physical health among those from economically advantaged households.

Meaning These findings suggest that understanding the health outcomes of college graduates across racial and income groups is important for developing interventions to maximize the benefits of striving for upward mobility.

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Abstract (continued)

CONCLUSIONS AND RELEVANCE In this longitudinal cohort study of Black youths, graduating from college was associated with an adult profile of better mental health but poorer physical health among those from economic disadvantage. These findings suggest that developing interventions that foster healthy outcomes across multiple life domains may be important for ensuring that striving for upward mobility is not accompanied by unintended cardiometabolic risk.

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Introduction

Upward mobility (eg, educational achievement) is viewed as desirable, opening doors to occupational and financial opportunities throughout life that will be beneficial to well-being, health, and happiness.[1-3] However, research[4-6] indicates that not everyone benefits equally from upward mobility; there are diminishing returns (ie, fewer benefits for a given educational or income level) for Black and Hispanic individuals compared with White individuals. Moreover, upward mobility may even sometimes come at a cost to physical health.[7-9]

For example, in 2 US national samples[10] with wide age ranges and varying races and ethnicities, adults were divided into life-course, socioeconomic-status (SES) trajectories based on income indicators. Those characterized by upward mobility (low childhood SES and high adult SES) had low levels of adult depression similar to those with high SES throughout their lives (high childhood SES and high adult SES group [high-high]). At the same time, however, this upwardly mobile group had higher rates of adult metabolic syndrome (MetS) than the high-high group.[10] In another study,[11] among Black and Hispanic individuals from low-SES backgrounds, completing college was associated with fewer adult depressive symptoms but a higher risk of MetS, whereas the same patterns were not found in White individuals. Additional evidence comes from analyses of low-SES families in France[12] after the required years of schooling was increased; adult blood pressure was higher in those born after the school mandate was implemented compared with those born before. This natural experiment[12] suggests that increasing years of schooling for those with low SES could have physical health costs. Taken together, these results suggest a pattern termed *skin-deep resilience*, whereby above the skin, upwardly mobile youths achieve successes by many external metrics (going to college, earning higher incomes, and having good mental health); however, below the skin, they appear to be struggling in terms of cardiometabolic health, suggesting resilience that is only skin-deep.[7,8]

These patterns are thought to exist because, for many individuals experiencing disadvantage, the path to success is paved with multiple challenges and hardships (eg, lack of resources, interpersonal discrimination, and structural racism). In turn, such stressors experienced earlier in life are associated with dysregulation of key biological processes, such as inflammation, which contribute to risk for cardiometabolic diseases in adult life.[13,14]

The present study reports on a 20-year longitudinal investigation focused on Black youths, given the excess mortality in this population[15] and given the importance of understanding the origins of health disparities by studying precursors to chronic diseases earlier in life.[16] This study tests the skin-deep resilience hypothesis, considering associations of upward mobility (educational attainment) with mental and physical health in adulthood. Mental health (internalizing symptoms and disruptive behaviors) and substance use outcomes were measured. Physical health outcomes included metabolic syndrome and inflammatory mechanisms, given the key role that inflammation plays in numerous chronic diseases of aging,[17,18] and the importance of identifying early warning signs (prior to disease onset) in younger people.[13,19] In line with skin-deep resilience theory, Black adolescents from low-SES households who graduated from college were hypothesized to have better adult mental health but poorer physical health compared with those without the same level of educational attainment or those with high SES.

Methods

This longitudinal cohort study, spanning 2001 to 2022, was drawn from the Strong African American Healthy Adults Program (SHAPE).[8] The University of Georgia's institutional review board approved the protocol. Written consent was obtained from participants and caregivers. The study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline. See the eMethods in Supplement 1 for more details.

Participants

In 2001, SHAPE enrolled 667 Black children in fifth grade and a primary caregiver from 9 rural counties in the US state of Georgia. Caregivers identified their children's race as Black, and families, on average, were characterized as working poor.[8] From 2009 to 2010 (age 19 years), a subgroup of 500 participants was randomly selected for a substudy of stress and health. From 2021 to 2022 (age 31 years), the substudy cohort was reassessed and blood samples were obtained from 346 participants.

Procedures

Data were collected primarily in participants' homes. A phlebotomist drew fasting blood and collected health measures. See the eMethods in Supplement 1 for more details.

Measures

Family Disadvantage (Ages 16-18 Years)

Parents completed a measure of Unmet Material Needs.[20] Three waves of assessments (ages 16, 17, and 18 years) were averaged to form a mean family unmet needs composite.

Bachelor's Degree Completion

At age 31 years, participants reported whether they had completed a bachelor's degree. Very few of the participants' caregivers had bachelor's degrees (18 of 329 caregivers [5.5%]), hence the use of this measure as an indicator of upward mobility.

Mental Health Composite (Ages 16 and 31 Years)

Mental health measures at age 31 covered both internalizing and disruptive problems, including anxiety,[21] depression,[22] anger,[21] aggressive behaviors,[23] and emotional reactivity.[24] Measures were standardized and summed to form an adult mental health composite.

Youth mental health measures were taken at age 16 years. Standardized mental health measures often differ in childhood vs adulthood, and, thus, this longitudinal study contained different measures at ages 16 and 31 years. Nonetheless, at age 16 years, comparable constructs were assessed for anxiety,[25] depression,[26] anger,[27] aggressive behaviors,[25] and impulsivity.[28] Measures were standardized and summed to form an age 16 mental health composite.

Substance Use Composite (Ages 16 and 31 Years)

At ages 16 and 31 years, participants reported their past-month cigarette, alcohol, and marijuana use (items from the Monitoring the Future Study[29]). Responses were summed to form a substance use composite consistent with prior research.[30] Composites were log-transformed because of skewed distribution.

Metabolic Syndrome Diagnosis (Age 31 Years)

Glucose, high-density lipoproteins, and triglycerides were measured in fasting serum. Resting blood pressure and waist circumference were measured. MetS was diagnosed via the International Diabetes Federation guidelines.[31]

Proinflammatory Phenotype (Age 31 Years)

Inflammation, particularly when ongoing and dysregulated, is a key pathway to the pathogenesis of many chronic degenerative diseases.[17,18,32] Because this study involved a longitudinal investigation of initially healthy Black children, measures of inflammatory processes were included as a potential early warning sign of chronic diseases later in life. Mechanistically, experiences of stress earlier in life are known to calibrate the response tendencies of innate immune cells so they mount excessive inflammatory responses to microbial challenges and become insensitive to glucocorticoid hormones that regulate these responses.[13,19] This response tendency has been termed a proinflammatory phenotype.[13]

To assess proinflammatory phenotypes, we used a portable cell culture protocol developed for field settings,[33] where immune cells are incubated ex vivo with a bacterial product (lipopolysaccharide [LPS]), and production of the proinflammatory cytokines interleukin-1β, interleukin-6, and tumor necrosis factor-α were measured. Hydrocortisone (3 concentrations) was added to separate cultures alongside LPS; because hydrocortisone inhibits cytokine production, this measures how sensitive cells are to the anti-inflammatory properties of glucocorticoids.

Analyses were conducted on 2 end points. The first was a stimulated cytokine production composite, formed by calculating a mean of the *z* scores of the 3 cytokines in the LPS well. Higher values represent larger cytokine responses to the bacterial product LPS. The second end point was a sensitivity to glucocorticoid inhibition composite, formed by estimating participant-specific sensitivity slopes for each cytokine at each hydrocortisone dose.[19,34] The mean of the *z*-scored values of slopes was calculated. Higher values represent greater sensitivity to the anti-inflammatory properties of glucocorticoids.

Body Mass Index (Age 19 Years)

Because this study did not begin as a health study, MetS and proinflammatory phenotypes were not measured during childhood. To represent earlier physical health, at age 19 years, height and weight were assessed and body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared.

Covariates

Child gender was included as a covariate. The SHAPE cohort[8] was initially recruited for a randomized clinical trial to prevent behavior problems and substance use. Participation in the intervention was included as a covariate.

Statistical Analysis

Study hypotheses were tested using linear regression equations (logistic regression for MetS) with sequentially entered blocks of variables including (1) covariates, (2) unmet material needs and bachelor's degree completion, and (3) the 2-way interaction of these variables. Outcome variables included mental health, substance use, proinflammatory phenotype, and MetS at age 31 years. Interaction analyses were conducted according to established guidelines.[35]

Given the longitudinal nature of the study, we tested whether there were associations with change in mental health and substance use outcomes from ages 16 to 31 years using residualized change scores. For physical health outcomes, we statically controlled for BMI at age 19 years in analyses with health at age 31 years. Mediated moderation analyses were conducted using a regression-based procedure.

All statistical tests were 2-tailed with alpha = .05 and $P < .05$ as statistically significant. Analyses were conducted using SPSS statistical software version 29.0 (IBM). Data analysis was conducted from April 2023 to January 2024. See the eMethods in Supplement 1 for additional details.

Results

The analytic sample consisted of 329 Black individuals (212 women [64%]; 117 men [36%]; mean [SD] age at follow-up, 31 [1] years) with complete data. The analytic sample did not differ from the sample of 500 participants from 2009 to 2010 who were missing data, except for being more likely to be a woman (eTable in Supplement 1). Of the 329 participants, 66 (20%) had completed a bachelor's degree, and 125 (38%) met criteria for MetS diagnosis. **Table 1** presents bivariate correlations. Compared with women, men had higher substance use, higher stimulated cytokine production, but lower BMI, and fewer MetS diagnoses. Family unmet needs were associated with more mental health problems (at age 16 years) and lower bachelor's degree completion rates. Bachelor's degree completion was associated with fewer mental health problems and less substance use (at age 31 years). Mental health and substance use problems were positively correlated. MetS and BMI were positively associated; proinflammatory phenotype and MetS were not correlated.

Mental Health and Substance Use Composites

Compared with youths who did not complete a bachelor's degree, those with a bachelor's degree reported 0.14 SD fewer mental health problems at age 31 years (b = −1.377; 95% CI, −2.529 to −0.226; β = −0.137; P = .02) (**Table 2**). Compared with youths who did not complete a bachelor's degree, those with a bachelor's degree reported 0.13 SD less substance use at age 31 years (b = −0.114; 95% CI, −0.210 to −0.018; β = −0.131; P = .02) (Table 2).

MetS

There was a significant interaction between unmet material needs and bachelor's degree completion associated with MetS (odds ratio [OR], 1.495; 95% CI, 1.111-2.012; P = .008) (**Table 3** and **Figure**). Below we report comparisons of those with and without a bachelor's degree among participants who grew up with low unmet material needs (1.5 SD below the mean) and those with high unmet needs (1.5 SD above the mean).

When participants experienced little financial hardship (low unmet material needs) as teenagers, those who completed their bachelor's degree had a 29.6% lower risk of adult MetS compared with those without a bachelor's degree (OR, 0.171; 95% CI, 0.048-0.608; P = .006). In contrast, when participants experienced high financial hardship as teenagers, those who completed their bachelor's degree had a 32.6% higher risk of adult MetS compared with those without a degree (OR, 3.947; 95% CI, 1.003-15.502; P = .049).

Proinflammatory Phenotype

There was a significant interaction between unmet material needs and bachelor's degree completion for stimulated cytokine production (b = 0.051 [95% CI, 0.003 to 0.099]; β = 0.131; P = .04) but no significant interaction for sensitivity to glucocorticoids (b = −0.009; 95% CI, −0.018 to 0.001; β = −0.125; P = .05) (Table 3 and Figure).

When participants experienced little financial hardship as teenagers, those with a bachelor's degree had cells with 0.42 SD higher sensitivity to glucocorticoids compared with those without a degree, although the result was not statistically significant (mean difference, 0.033; 95% CI, −0.003 to 0.069; P = .07). No differences were found for LPS-stimulated cytokine production (mean difference, 0.147; 95% CI, −0.341 to 0.047; P = .14).

In contrast, when participants experienced high financial hardship as teenagers, those who earned a bachelor's degree had a 0.59 SD higher level of LPS-stimulated cytokine production compared with those without a degree (mean difference, 0.249, 95% CI, 0.001 to 0.497; P = .049). No differences were found for sensitivity to glucocorticoids (mean difference, −0.037; 95% CI, −0.083 to 0.009; P = .12).

Table 1. Correlations Among Study Variables

Variable	Correlation coefficient[a]										
	Gender: man	Intervention	Mental health composite (age 16 y)	Substance use composite (age 16 y)	Unmet material needs (age 16-18 y)	BMI (age 19 y)	Bachelor's degree completion	Stimulated cytokine production (age 31 y)	Sensitivity to AIS (age 31 y)	MetS diagnosis (age 31 y)	Mental health composite (age 31)
Gender: man	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Intervention	−.008	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mental health composite (age 16 y)	−.021	.022	NA	NA	NA	NA	NA	NA	NA	NA	NA
Substance use composite (age 16 y)	.153[b]	−.008	.282[c]	NA	NA	NA	NA	NA	NA	NA	NA
Unmet material needs (ages 16-18 y)	−.026	.054	.151[b]	.106	NA	NA	NA	NA	NA	NA	NA
BMI (age 19)	−.183[c]	−.017	.019	−.082	.064	NA	NA	NA	NA	NA	NA
Bachelor's degree completion	−.087	−.042	−.078	−.028	−.167[c]	−.010	NA	NA	NA	NA	NA
Stimulated cytokine production (age 31 y)	.207[c]	−.051	.074	.043	.062	.014	.020	NA	NA	NA	NA
Sensitivity to AIS (age 31 y)	−.054	−.057	−.065	−.053	−.010	−.042	.014	−.179[b]	NA	NA	NA
MetS diagnosis (age 31y)	−.124[d]	−.055	.107	.004	.080	.340[c]	−.064	.007	−.027	NA	NA
Mental health composite (age 31 y)	−.086	.061	.317[c]	.081	.013	.049	−.111[b]	−.015	−.027	.090	NA
Substance use composite (age 31 y)	.252[c]	.028	.110[d]	.188[c]	.047	.015	−.124[d]	.034	−.043	−.024	.288[c]

Abbreviations: AIS, anti-inflammatory signaling; BMI, body mass index; MetS, metabolic syndrome; NA, not applicable.

[a] Pearson correlations were presented for continuous variables and Spearman correlations were presented for dichotomous variables.

[b] $P < .01$.

[c] $P < .001$.

[d] $P < .05$.

Table 2. Childhood Family Unmet Material Needs and Bachelor's Degree Completion and Their Association With Mental Health and Substance Use at Age 31 Years and Changes in Mental Health and Substance Use From Age 16 to 31 Years[a]

	Mental health composite		Change in mental health composite		Substance use		Change in substance use	
Factor	*b* (95% CI)[b]	β[c]	*b* (95% CI)[b]	β[c]	*b* (95% CI)[b]	β[c]	*b* (95% CI)[b]	β[c]
Gender: man	−0.498 (−1.415 to 0.418)	−0.059	−0.391 (−1.260 to 0.479)	−0.049	0.191 (0.114 to 0.267)[d]	0.262	0.169 (0.093 to 0.245)[d]	0.236
Intervention	0.565 (−0.320 to 1.451)	0.069	0.501 (−0.339 to 1.341)	0.065	0.015 (−0.059 to 0.089)	0.021	0.014 (−0.059 to 0.087)	0.020
Unmet material needs (ages 16-18 y)	0.003 (−0.184 to 0.190)	0.002	−0.055 (−0.232 to 0.122)	−0.037	0.009 (−0.006 to 0.025)	0.070	0.006 (−0.009 to 0.022)	0.047
Bachelor's degree completion	−1.377 (−2.529 to −0.226)[e]	−0.137	−1.267 (−2.360 to −0.174)[e]	−0.133	−0.114 (−0.210 to −0.018)[e]	−0.131	−0.116 (−0.211 to −0.021)[e]	−0.136
Unmet material needs × bachelor's degree completion	−0.162 (−0.623 to 0.300)	−0.044	−0.224 (−0.663 to 0.214)	−0.064	−0.025 (−0.063 to 0.014)	−0.077	−0.022 (−0.061 to 0.016)	−0.071

[a] Based on a total of 329 participants.

[b] Unstandardized regression coefficient.

[c] Standardized regression coefficient.

[d] $P < .001$.

[e] $P < .05$.

Earlier Health Measures

We tested whether the results held when using residualized change scores from age 16 to 31 years (Table 2). Compared with those without a bachelor's degree, those with a bachelor's degree displayed a 0.13 SD decrease in mental health problems (b = −1.267; 95% CI, −2.360 to −0.174; β = −0.133; P = .02) and a 0.14 SD decrease in substance use from age 16 to 31 years (b = −0.116; 95% CI, −0.211 to −0.021; β = −0.136; P = .02).

After controlling for BMI at age 19 years, the interactions at age 31 years between family unmet material needs and bachelor's degree completion remained for MetS (OR, 1.441; 95% CI, 1.061 to 1.956; P = .02) and measures of proinflammatory phenotype including LPS-stimulated cytokine production (b = 0.049; 95% CI 0.001 to 0.098; β = 0.127; P = .04) and sensitivity to glucocorticoids (b = −0.009; 95% CI, −0.017 to 0.000; β = −0.121; P = .06).

Additional Analyses: Moderation and Mediated Moderation

No significant moderation by participant gender or intervention status was found (race and age were the same in all participants and not tested as moderators). We tested whether stimulated cytokine production or sensitivity to glucocorticoids mediated the interaction between unmet material needs and bachelor's degree completion or MetS. Neither stimulated cytokine production (OR, 0.948; 95% CI, 0.541 to 1.662; P = .85) nor sensitivity to glucocorticoids (OR, 0.645; 95% CI, 0.034 to 12.393; P = .77) was significantly associated with MetS. The indirect effects of the unmet material needs and

Table 3. Childhood Family Unmet Material Needs and Bachelor's Degree Completion and Their Association With Physical Health Outcomes at Age 31 Years[a]

Factors	Stimulated cytokine production		Sensitivity to anti-inflammatory signaling		Metabolic syndrome diagnosis, OR (95% CI)
	b (95% CI)[b]	β[c]	b (95% CI)[b]	β[c]	
Gender: man	0.168 (0.073 to 0.263)[d]	0.189	−0.004 (−0.022 to 0.014)	−0.025	0.532 (0.325 to 0.870)[e]
Intervention	−0.048 (−0.140 to 0.044)	−0.055	−0.008 (−0.025 to 0.009)	−0.050	0.752 (0.473 to 1.195)
Unmet material needs (ages 16-18 y)	0.004 (−0.015 to 0.024)	0.025	0.001 (−0.002 to 0.005)	0.044	0.998 (0.906 to 1.098)
Bachelor's degree completion	0.051 (−0.068 to 0.171)	0.048	−0.002 (−0.024 to 0.020)	−0.010	1.216 (0.655 to 2.255)
Unmet material needs × bachelor's degree completion	0.051 (0.003 to 0.099)[e]	0.131	−0.009 (−0.018 to 0.000)	−0.125	1.495 (1.111 to 2.012)[f]

Abbreviation: OR, odds ratio.

[a] Based on a total of 329 participants.

[b] Unstandardized regression coefficient.

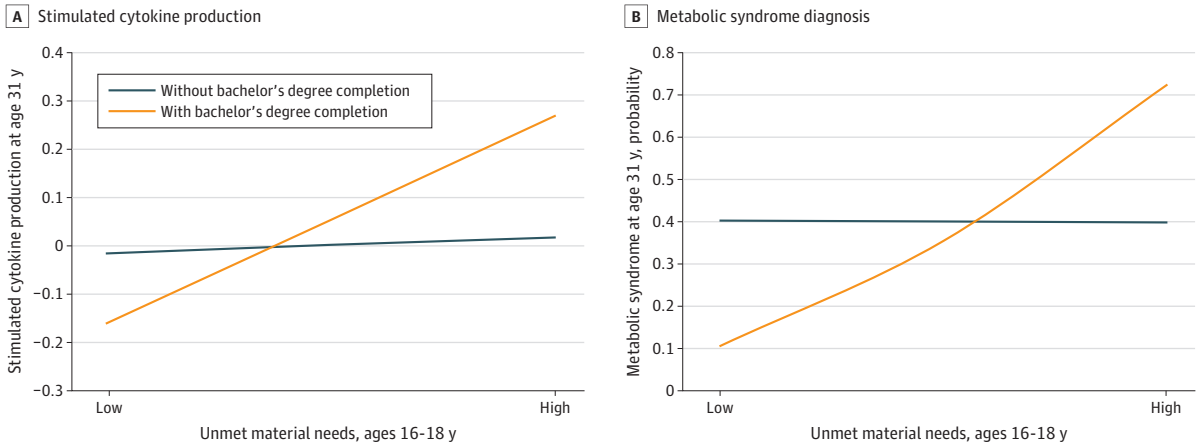
[c] Standardized regression coefficient.

[d] P < .001.

[e] P < .05.

[f] P < .01.

Figure. Childhood Family Unmet Material Needs, Bachelor's Degree Completion, and Health Outcomes



The figure shows stimulated cytokine production (A) and metabolic syndrome diagnosis (B) at age 31 years as a function of childhood family disadvantage (family's unmet material needs at ages 16-18 years) and bachelor's degree completion.

bachelor's degree interaction with MetS were not significant for LPS-stimulated cytokine production (indirect effect, −0.003; 95% CI, −0.053 to 0.031) or sensitivity to glucocorticoids (indirect effect, 0.004; 95% CI, −0.026 to 0.035).

Discussion

In this 20-year longitudinal cohort study of Black youths, upward mobility (defined as completing one's bachelor's degree) was associated with a skin-deep resilience profile of good mental health but worse physical health in adulthood, particularly among those growing up in low-SES households. That is, among Black teenagers living under economic disadvantage, going on to complete college was associated with better mental health profiles and less substance use, but also, a greater likelihood of MetS diagnosis and indications of a more pronounced proinflammatory phenotype in adulthood. Conversely, among Black teenagers from high-SES households, completing college was associated with good mental and physical health at age 31 years. Change analyses demonstrated that college completion was associated with greater decreases from age 16 to 31 years in mental health problems and substance use in all youths. Findings with MetS and proinflammatory phenotypes held after controlling for earlier BMI. These results suggest that striving for upward mobility, while associated with beneficial life outcomes such as good mental health, may at the same time set Black youths from low-SES households on a trajectory to dysregulated inflammatory signaling and cardiometabolic risk in adulthood.

Our findings are consistent with other studies[10,11] of upward mobility and mental vs physical health. The present study extends previous research by seeking to understand patterns solely within a Black population (other studies of upward mobility and mental and physical health contained approximately 60%-80% White participants[10,11]). The present study also focused on educational mobility in contrast with previous studies of income mobility.[10] In addition, the present study conducted a longer follow-up (20 years) than any previous skin-deep resilience study and accounted for earlier mental health and physical health, which was not possible in previous studies.[10,36]

There are numerous possible explanations for the study findings. One is that individuals seeking upward mobility frequently exert high levels of persistent striving in order to succeed. Such striving and hard work facilitate life successes; in turn, successes may be beneficial to mental health. At the same time, however, prolonged striving and hard work can be exhausting and may take a cumulative physiological toll on physical health.[8,37-41] A second explanation is that when faced with stress, particularly in environments with substantial constraints, some individuals may turn to coping strategies that help alleviate distress but are detrimental to physical health (eg, overeating of comfort foods).[42-44] Other explanations for why achieving higher SES might be associated with worse physical health among Black individuals include the increased discrimination experienced when individuals move into predominantly White spaces for higher education or work, the increased social isolation from the Black community,[4,45-47] and structural racism (eg, in employment opportunities and housing) that hinders the ability of Black individuals to take advantage of resources that supposedly come with moving into higher SES brackets.[4,47,48]

Evidence for skin-deep resilience was found both with MetS and immunologically in terms of cells exhibiting larger cytokine responses to bacterial challenge. Previous skin-deep resilience research assessed inflammatory biomarkers such as C-reactive protein,[49] but these markers are not necessarily a causal part of mechanistic pathways involving inflammation because they can sometimes be released in response to other signals without underlying injury or infection.[50] Thus, to our knowledge, this study provides the first empirical evidence in healthy young people of skin-deep resilience–related alterations to key processes in how immune cells function (eg, how aggressively cells produce cytokines in the face of bacterial challenges). Black individuals from low-SES households achieving upward mobility were prone to exhibiting a proinflammatory phenotype in their adult years. They also were more likely to experience clinical diagnoses such as MetS. However, no evidence for mediated moderation emerged; that is, the proinflammatory

phenotype did not mediate the unmet needs and bachelor's degree interaction associated with MetS. Perhaps it takes time for associations to emerge between dysregulated inflammatory signaling and cardiometabolic health, or perhaps mediation would appear with different cardiometabolic outcomes, such as atherosclerotic plaque development or symptomatic cardiovascular disease. It is also possible that associations with MetS are linked to other pathways, such as unhealthy eating behaviors.

Strengths and Limitations

Strengths of this study include the focus on an understudied and marginalized population, the prospective design including a 20-year follow-up of families starting when children were 11 years of age, with measures during the teenage years of mental and physical health, and the investigation of cellular mechanisms in addition to tracking physical health into the adult years. Limitations include the fact that the specific outcomes of MetS and immunologic processes were not assessed during adolescence. Continuing to track the emergence of chronic diseases in this sample through the adult years will be important. In addition, comparisons with other racial and ethnic groups were not available. Furthermore, because this study did not manipulate upward mobility, we cannot draw conclusions about causality. Additionally, study attrition may have limited the generalizability of conclusions.

Conclusions

In this 20-year longitudinal cohort study of 329 Black youths, among those from low-SES households, graduating from college was associated with an adult profile of better mental health and less substance use but worse immunologic profiles and greater risk of MetS. In contrast, among those with high-SES, graduating from college was associated with better mental and physical health in adulthood. Mechanistically, proinflammatory phenotypes (characterized by immune cells mounting larger cytokine responses to bacterial challenge) also followed a skin-deep resilience pattern. Together with other literature,[4,5] these findings suggest the need for interventions earlier in life aimed at addressing the health profiles of upward mobility, particularly among Black youths. For example, educational interventions that aim to increase student motivation and grit[51,52] may need to be modified to incorporate consideration of physical health as well. Interventions that consider youths holistically and focus on well-being across multiple life domains may help upward mobility become the key to positive life outcomes that we have always envisioned it to be in our society.

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SUPPLEMENT 1.

eMethods

eReferences

eTable. Comparisons of Analytic Sample With Participants Excluded Because of Missing Data at Age 31 (at 20 Year Follow-Up)

SUPPLEMENT 2.

Data Sharing Statement

JAMA Network Open

Original Investigation | Equity, Diversity, and Inclusion

Volunteering and Metabolic Syndrome and Diabetes in Black Adolescents From Low-Income Families

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Abstract

IMPORTANCE Disparities by race and socioeconomic status in cardiometabolic diseases are prevalent, and social determinants of health (SDOH) are significant contributors to these disparities. However, SDOH research often focuses on negative factors.

OBJECTIVE To examine associations of volunteering, a potentially positive SDOH, with metabolic syndrome and diabetes across 2 samples of Black adolescents from lower-income households, and to assess mediators of associations.

DESIGN, SETTING, AND PARTICIPANTS This cohort study used data from 2 studies. Study 1 was a cross-sectional study of Black adolescents (ages 14-19 years) in households with less than 2 times the poverty threshold from 2018 to 2022. Study 2 was a 14-year longitudinal study of Black adolescents (ages 11-20 years) from low-income families from 1994 to 2008. Data were analyzed from April 2024 to November 2025.

EXPOSURE Study 1 examined volunteering as a binary yes/no as well as volunteering frequency; study 2 examined volunteering from ages 12 to 18 years.

MAIN OUTCOMES AND MEASURES Study 1: metabolic syndrome (counts of the number of metabolic syndrome components above clinical cutoffs; composite z scores of each metabolic syndrome component). Study 2: diabetes diagnosis at age 29.

RESULTS Study 1 included 400 Black adolescents (256 [64.0%] female; mean [SD] age, 16.39 [1.56] years). Study 2 included 979 Black adolescents (570 [58.2%] female; mean [SD] age, 15.87 [1.71] years). In study 1, a higher frequency of volunteering was associated with a lower metabolic syndrome composite score (b = −0.06; SE, 0.03; P = .03). Purpose in life, but not physical activity or depressive symptoms, statistically mediated associations between volunteering and metabolic syndrome. In study 2, participants who volunteered during adolescence had lower odds of adult diabetes (odds ratio, 0.48; 95% CI, 0.24 to 0.94; P = .03).

CONCLUSIONS AND RELEVANCE These results suggest that encouraging adolescents to volunteer may represent a novel approach to improving cardiometabolic health earlier in life and in groups that have been historically marginalized. The notion that volunteering might help not only the recipients of volunteering efforts, but also the volunteers themselves, suggests the possibility of creating a 2-way street of benefits through a single activity that could promote health across groups while also strengthening the social fabric across communities.

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Key Points

Question Is volunteering associated with metabolic syndrome or diabetes among Black adolescents from lower-income households?

Findings In this cohort study including 1379 Black adolescents from 2 separate studies, those who volunteered, and who volunteered more frequently, had fewer indications of metabolic syndrome; higher purpose in life statistically mediated this association. Also, Black adolescents who volunteered had reduced odds of diabetes in adulthood.

Meaning These findings suggest that activities intended to benefit others may relate to better cardiometabolic health among volunteers themselves, suggesting that volunteering could be one positive component of the social determinants of health.

+ Supplemental content

Author affiliations and article information are listed at the end of this article.

Introduction

Social determinants of health (SDOH) have increasingly been recognized as important to address because of their role in health outcomes.[1-4] However, much of this literature has focused on negative factors (eg, racism, poverty, neighborhood conditions at the structural level,[5-7] social isolation, health-compromising behaviors at the individual or social network level[8-11]). In considering positive factors, one understudied behavior that may be helpful to understand is volunteering (eFigure in Supplement 1).

Volunteering is defined as behaviors intended to benefit others without an expectation of pay.[12] There are established psychosocial benefits of volunteering,[13-15] and more recently, research has demonstrated volunteering's associations with physical health as well. One meta-analysis documented a reliable reduction in mortality of approximately 25% associated with volunteering,[16] with more recent studies confirming these associations.[17,18] In addition, volunteering has been associated in observational studies with lower levels of hypertension,[19-21] incident cardiovascular disease (CVD),[18,22] metabolic syndrome,[21] and inflammation.[23,24]

These studies have focused predominantly on older adults. However, from a prevention perspective, health-relevant behaviors are important to initiate at younger ages to reduce rates of clinical diseases in adulthood.[25,26] Yet little is known about whether volunteering done earlier in life is associated with health outcomes. Two previous studies found no association between volunteering during the young adult years and metabolic risk or allostatic load measured in adulthood.[27,28] However, another study demonstrated that random assignment to volunteering during high school resulted in lower levels of obesity, cholesterol, and inflammation in students compared with a control group that did not volunteer.[29] To our knowledge, no other studies investigated links between volunteering and cardiometabolic health (CMH) in adolescents.

Additionally, previous studies used samples that included predominantly predominantly White participants and those with higher socioeconomic status (SES). These individuals are more likely to volunteer.[19,28,30] However, little is known about links between volunteering and CMH among marginalized groups. This is in spite of there being pronounced disparities in, and burdens resulting from, CVD by race and SES.[31-34] One study found that volunteering was associated with more favorable CMH in Hispanic adults.[35] However, another study found associations between volunteering and hypertension among White, but not Black, older adults.[36] To our knowledge, there are no studies on volunteering and CMH in adolescents from marginalized groups, such as Black individuals with low income.

This study addresses this gap by conducting an investigation of volunteering and CMH using 2 independent samples of Black adolescents from lower-income households. The first study (hereafter, *study 1*) was a cross-sectional study of Black adolescents investigating associations between volunteering and metabolic syndrome. In line with our theoretical model (eFigure in Supplement 1) of pathways between volunteering and health, this study tested explanations for volunteering and health associations, including individual-level cognitive (greater purpose in life[37,38]), emotional (fewer depressive symptoms[13,14]), and behavioral (greater physical activity[39,40]) pathways. We then tested whether associations could be replicated in a second longitudinal sample (hereafter, *study 2*), where we investigated associations over 14 years between adolescent volunteering and diabetes diagnosis in adulthood among Black adolescents in a national dataset. Across both studies, we hypothesized that adolescents who volunteered, and volunteered more frequently, would have better CMH (lower rates of metabolic syndrome, diabetes) compared to those who did not volunteer.

Methods

This cohort study used data from 2 separate studies. Study 1 was approved by Northwestern University's institutional review board. All participants provided written assent or consent, depending on age. All caregivers provided written consent. Study 2 was approved by the University

of North Carolin's institutional review board. Participants provided written informed consent. Data from this study are publicly available. Approval to conduct analyses on these data was obtained from the University of Georgia's institutional review board. This study is reported following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline.

Study 1

Design, Setting, and Participants

Study 1 was a cross-sectional study. Data collection spanned November 19, 2018, to December 16, 2022. Participants were youths who self-reported as Black race, ages 14 to 19 years, recruited from the greater Chicago, Illinois area. Families were from lower-income households (ie, <2 times the federal poverty threshold). Eligible youths completed psychosocial questionnaires and health measures including a fasting blood draw (eMethods 1 in Supplement 1).

Measures

Volunteering | Volunteering was defined as "unpaid work, e.g., community service, intended to help others," consistent with previous research recommendations.[41] The first question asked whether youths had volunteered in the past 6 months (yes or no). The second question asked how often they volunteered.

Metabolic Syndrome | Metabolic syndrome was diagnosed according to International Diabetes Federation guidelines,[42] based on clinical cutoff levels established for components of waist circumference, blood pressure, cholesterol, and glucose. Because of the young age of this sample, only 4% met criteria for metabolic syndrome diagnosis. Hence we focused analyses on 2 metabolic syndrome outcomes, consistent with previous research on younger samples.[43-45] One was a count of the number of metabolic syndrome components for which participants were above clinical cutoff levels, consistent with previous research.[44,46-49] Second, acknowledging concerns about the validity of dichotomizing youths into risk categories when metabolic functioning is distributed on a continuum,[50,51] a metabolic syndrome composite was calculated using the mean of *z* scores for each metabolic syndrome component, consistent with previous research[43-45,52,53].

Potential Mediators and Covariates

Possible pathways between volunteering and metabolic syndrome were probed, including physical activity (measured objectively via actigraphy), depressive symptoms,[54] and purpose in life.[55] Age, sex at birth, pubertal status, and family SES were included as covariates.

Study 2

Design, Setting, and Participants

Study 2 was a longitudinal cohort study, spanning 1994 to 2008. Data were drawn from the National Longitudinal Study of Adolescent Health (Add Health), a nationally representative sample of US adolescents in grades 7 to 12 in 1994 to 1995. For replicability purposes, the sample for this analysis was restricted to participants who self-reported as non-Hispanic Black, with family income $30 000 or less (ie, ≤2 times the federal poverty threshold for family of 4 in 1994), and complete data on study variables (eMethods 2 in Supplement 1).

Measures

Volunteering | At wave 3 (mean age, 22), participants were asked: "At any time during your adolescence, when you were between 12-18 years old, did you regularly participate in volunteer or community service work?" Response options were yes or no.

Diabetes | At wave 4 (mean age, 29), researchers collected whole blood spots for analysis of glycosylated hemoglobin and glucose. Criteria for diabetes are in eMethods 2 in Supplement 1 and consistent with previous Add Health studies.[56]

Covariates

Covariates included age, sex, body mass index, parent report of adolescent diabetes diagnosis, and family SES. All covariate variables were collected at wave 1.

Statistical Analysis

P values were 2-sided, and statistical significance was set at $P \leq .05$. Data were analyzed from April 2024 to November 2025.

Study 1

For analyses with metabolic syndrome composite score, univariate analyses of covariance were used to test differences between those who did vs did not volunteer. For associations between volunteering frequency and metabolic syndrome composite, hierarchical multiple linear regression analyses were conducted, with covariates entered in step 1, and volunteering frequency entered in step 2. Parallel analyses were conducted for associations with potential mediators.

Metabolic syndrome count score was a count dependent variable (mean [SD], 0.94 [0.90]; variance, 0.81). Hence, Poisson analyses of covariance were used to test differences between participants who did vs did not volunteer. To test associations of volunteering frequency and potential mediators with metabolic syndrome count, Poisson regression analyses were conducted.

For mediation analyses with metabolic syndrome composite, we used the Hayes PROCESS macro, a regression-based approach.[57] For mediation analyses with metabolic syndrome count, we used path analyses in Mplus version 8.2 (given Poisson regressions).

Study 2

Analyses were performed in Mplus version 8.2 with sampling weights from wave 4. Associations were tested using mixed-effect logistic regressions.

Results

Study 1

Descriptive Information and Preliminary Analyses

Study 1 included 400 Black adolescents (256 [64.0%] female; mean [SD] age, 16.39 [1.56] years), with 196 participants (49.0%) reporting volunteering in the past 6 months (**Table 1**). Univariate analyses (no covariates included) found that participants who volunteered had higher metabolic syndrome composites than those who did not ($t = 2.23$; $P = .03$) (Table 1). Volunteering more frequently was correlated with higher metabolic syndrome composites ($r = -0.10$; $P = .04$). No associations were found with metabolic syndrome counts (volunteering as binary variable: $b = -0.09$; SE, 0.10; $P = .37$; volunteering frequency: $b = -0.04$; se, 0.06; $P = .54$).

Volunteering and Metabolic Syndrome

After adjusting for covariates, adolescents who volunteered had a 0.11-SD lower score on the metabolic syndrome composite (estimated marginal mean [EMM], −0.08; SE, 0.04) compared with those who did not volunteer (EMM, 0.04; SE, 0.04) ($F = 4.51$; $P = .03$) (**Figure 1**). Regression analyses demonstrated that for every 1-SD increase in volunteering frequency, there was a 0.11-SD decrease in metabolic syndrome composite scores ($b = -0.06$; SE, 0.03; $P = .03$).

After adjusting for covariates, adolescents who volunteered (EMM, 0.87; SE, 0.07) vs those who did not (EMM, 0.97; SE, 0.07) did not differ on metabolic syndrome counts (Wald × 2 = 1.13;

P = .29). There was no association between volunteering frequency and metabolic syndrome counts (*b* = −0.04; SE, 0.06; *P* = .45).

Volunteering and Potential Mediator Variables

Adolescents who volunteered reported greater purpose in life (estimated marginal mean, 3.27; SE, 0.04) than those who did not (EMM, 3.10; SE, 0.04) (*F* = 10.17; *P* = .002) (Figure 1). A higher frequency of volunteering was associated with greater purpose in life (*b* = 0.08; SE, 0.03; *P* = .005).

Adolescents who volunteered had greater physical activity (log-transformed EMM, 1.23; SE, 0.04) than those who did not (EMM, 1.13; SE, 0.04) (*F* = 3.89; *P* = .049) (Figure 1). A higher frequency of volunteering was associated with greater physical activity (*b* = 0.06; SE, 0.03; *P* = .04). Volunteering was not associated with depressive symptoms (*F* = 0.27; *P* = .60; *b* = 0.38; SE, 0.32; *P* = .23).

Potential Mediator Variables and Metabolic Syndrome

Higher purpose in life was associated with lower metabolic syndrome composite (*b* = −0.16; SE, 0.05; *P* = .002) and with lower metabolic syndrome counts (*b* = −0.24; SE, 0.10; *P* = .01). There was no

Table 1. Descriptive Information for Study Samples

Characteristic	Participants, No. (%)	
	Volunteers	Nonvolunteers
Study 1		
No.	196	202
Age, mean (SD), y	16.45 (1.53)	16.34 (1.60)
Sex		
Female	130 (66.3)	126 (62.4)
Male	66 (33.7)	76 (37.6)
Pubertal status		
Early or midpuberty	30 (15.3)	31 (15.4)
Late puberty	94 (48.0)	104 (51.7)
Postpuberty	72 (36.7)	66 (32.8)
Log (Family SES), mean (SD)	0.47 (0.08)	0.46 (0.07)
Frequency of volunteering, mean (SD)	1.58 (0.70)	NA[a]
Log (MVPA), mean (SD), min/d	1.23 (0.42)	1.13 (0.54)
Depressive symptoms, mean (SD)	11.76 (5.58)	11.35 (6.15)
Purpose in life, mean (SD)	3.26 (0.48)	3.10 (0.57)[a]
Metabolic syndrome count, No.[b]		
0	81 (41.8)	73 (36.3)
1	58 (29.9)	70 (34.8)
2	49 (25.3)	46 (22.9)
3	6 (3.1)	12 (6.0)
Metabolic syndrome composite, mean (SD)[c]	−0.08 (0.56)	0.04 (0.52)[a]
Study 2		
No.	392	587
Age (wave 1), mean (SD), y	15.83 (1.76)	15.89 (1.67)
Sex		
Female	233 (59.4)	337 (57.4)
Male	159 (40.6)	250 (42.6)
Family SES (wave 1), mean (SD)	−0.74 (1.54)	−1.06 (1.41)
Log BMI (wave 1), mean (SD)	1.37 (0.09)	1.36 (0.08)
Diabetes status (wave 1)	1 (0.3)	4 (0.7)
Depressive symptoms (wave 4), mean (SD)	3.21 (2.59)	3.13 (2.88)
Physical activity (wave 4), mean (SD)	4.12 (5.26)	3.21 (4.70)[d]
Diabetes diagnosis (wave 4)	42 (10.7)	93 (15.8)[d]

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); MVPA, minutes per day of moderate to vigorous physical activity; NA, not applicable; SES, socioeconomic status (standardized composite of family income and savings, log transformed in study 1; standardized composite of parent education, parent occupation, and household income in study 2).

[a] *P* < .05.

[b] Defined as the number of metabolic syndrome components above clinical cutoff criteria.

[c] Defined as the mean *z* scores of each metabolic syndrome component.

[d] *P* < .01 for difference between groups.

association between physical activity and metabolic syndrome composite (b = −0.11; SE, 0.06; P = .08). No association was found between physical activity and metabolic syndrome counts (b = −0.18; SE, 0.12; P = .15). Depressive symptoms were not associated with metabolic syndrome (composite: b = 0.00; SE, 0.00; P = .69; counts: b = 0.00; SE, 0.01; P = .86).

Mediation Analyses

The indirect pathway of volunteering (yes or no) to purpose in life to metabolic syndrome composite was significant (b = −0.03; 95% CI, −0.06 to −0.004; proportion of mediation, 22.4%), as was the indirect path of volunteering frequency to purpose in life to metabolic syndrome composite (b = −0.01; 95% CI, −0.03 to −0.002; proportion of mediation, 19.0%) (**Figure 2**). The indirect pathway of volunteering (yes or no) to purpose in life to metabolic syndrome counts was significant (b = −0.04; 95% CI, −0.10 to −0.01; proportion of mediation, 36.7%), as was volunteering frequency to purpose in life to metabolic syndrome counts (b = −0.02; 95% CI, −0.05 to −0.004; proportion of mediation, 45.2%).

In contrast, there were no significant indirect associations through depressive symptoms or physical activity. There was also no support for alternative mediation models (purpose in life to volunteering to metabolic syndrome) (eResults 1 in Supplement 1).

Study 2

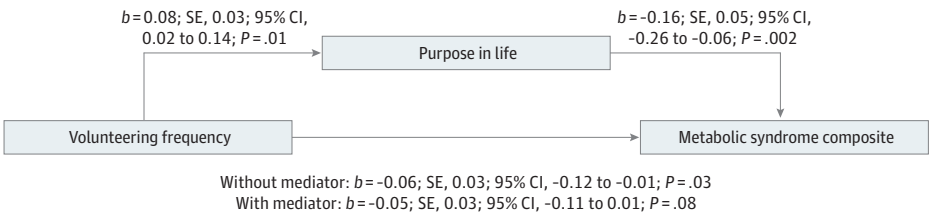
Descriptive Information

Study 2 included 979 Black adolescents (570 [58.2%] female; mean [SD] age, 15.87 [1.71] years), with 392 (40.0%) reported having volunteered regularly during adolescence. A total of 135 participants (13.8%) met criteria for diabetes at wave 4 (Table 1). eTable 1 in Supplement 1 presents differences between the study 2 sample and the larger Add Health sample.

Figure 1. Differences Between Youths Who Volunteered vs Those Who Did Not

Metabolic syndrome composite score is the mean of z scores of each metabolic syndrome component. Data are from study 1. Analyses control for age, sex, pubertal status, and family socioeconomic status. Estimated marginal means with standard error bars are depicted.

Figure 2. Psychological Pathway From Volunteering to Metabolic Syndrome



Metabolic syndrome composite score is the mean of z scores of each metabolic syndrome component, controlling for age, sex, pubertal status, and family socioeconomic status in study 1. Without purpose in life in the model, the association between volunteering and metabolic syndrome was significant; however, once purpose in life is included, there was no longer a significant direct association from volunteering to metabolic syndrome.

Volunteering and Diabetes

After controlling for covariates, youths who volunteered during adolescence had lower odds of adult diabetes diagnosis (EMM, 9%, SE, 0.03) compared with those who did not volunteer (EMM, 18%; SE, 0.02; odds ratio, 0.48; 95% CI, 0.24-0.94; $P = .03$) (**Table 2**). Including additional sociodemographic, health status, and health behavior covariates did not change the significance of this finding (eTable 2 in Supplement 1). Including wave 4 covariates did not change this finding (eTable 3 in Supplement 1).

Purpose in life was not measured in Add Health, so we were not able to test the replicability of mediation findings in study 1. However, consistent with study 1, no evidence for mediation was found for depressive symptoms or physical activity (eResults 2 in Supplement 1).

Discussion

To our knowledge, this cohort study is the first study to report—across 2 independent samples—that volunteering during adolescence was associated with better CMH (ie, lower adolescent metabolic syndrome composite, lower odds of adult diabetes). Patterns emerged in a group that experiences marginalization (Black adolescents from lower-income households). Dosage associations were found, such that those who volunteered more frequently had lower metabolic syndrome composite scores. Statistical mediation analyses revealed that higher purpose in life served as 1 pathway between volunteering and metabolic syndrome. In study 2, longitudinal analyses found that results held after controlling for wave 1 body mass index and adolescent diabetes diagnosis. Overall, our results suggest that positive aspects of SDOH are important to incorporate into health disparities models. One such component that merits further investigation is volunteering. Activities intended to benefit others may also be associated with better CMH in the helper.

Our findings are consistent with previous literature in adults showing associations between volunteering and metabolic syndrome, CVD, and mortality.[18,21,22] Findings are also consistent with previous literature showing dosage patterns of more hours of volunteering being associated with better health in adults.[18,23,58] We are aware of only 1 previous study documenting links between volunteering and biological outcomes during adolescence[29]; however, that study was not focused on clinical outcomes, unlike our study. Given that diseases, like CVD, involve physiological processes (eg, atherosclerosis) that begin during childhood and that track into adulthood,[26,59,60] it is important to identify factors associated with CMH during earlier periods of life. Two previous studies of young adults did not find associations of volunteering with health outcomes[27,28]; however those studies did not focus on marginalized populations. It is possible that the associations of volunteering with health in younger populations first appear in marginalized groups (that are already at risk for poorer health) and then emerge in the general population later in adulthood.

Most previous studies on volunteering included largely White participants and those higher in SES. Groups that have experienced economic and social marginalization may have less available time and resources to volunteer. Nonetheless, individuals with lower SES tend to place more importance on relationships with others and are more oriented toward helping others,[61-63] perhaps because connections between people are an important commodity when fewer material resources are

Table 2. Associations Between Volunteering in Adolescence and Diabetes at Ages 24-32 Years in Study 2 Cohort

Variable	OR (95% CI)	*P* value
Sex, male	1.01 (0.68-1.50)	.98
Age	1.08 (0.89-1.30)	.44
Family SES (ages 11-20 y)	0.95 (0.71-1.25)	.70
Log BMI (ages 11-20 y)	4.21 (0.95-18.68)	.06
Diabetes status (ages 11-20 y)	0.94 (0.07-11.97)	.96
Volunteering (ages 12-18 y)	0.48 (0.24-0.94)	.03

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); OR, odds ratio; SES, socioeconomic status.

present. While some might hypothesize that volunteering represents a burden for individuals with low SES, we found no evidence of this. On the contrary, we found beneficial associations between volunteering and health across 2 low-income samples. Given the striking disparities that exist by race and SES in CVD,[64-66] there is a need to better understand factors that could mitigate the burden of such diseases in groups experiencing disadvantage. While there are numerous structural causes of health inequalities, this study's findings nonetheless suggest that volunteering may be one beneficial activity that could be encouraged at the social network level, as our society simultaneously works toward structural solutions for health inequalities.

Why might volunteering be beneficial for CMH? We tested several pathways in study 1 and found that volunteering was associated with metabolic syndrome through a greater sense of purpose and meaning in life. Adolescence is a period when youths often develop a sense of purpose,[67] and volunteering may provide a structured way of finding meaning during this period. Previous research has found associations of volunteering with purpose in life in adults[17,19,68] and has found evidence for purpose in life as a pathway between volunteering and mental and physical health in adults.[37,38] Furthermore, associations of volunteering with adolescent development are only apparent when adolescents reflect on their volunteering experiences.[69] With respect to physical health, greater purpose in life has been associated with lower inflammation, CVD, and mortality in adults.[70-72]

In contrast, there was no support in study 1 or 2 for physical activity or depressive symptoms as mediators. Previous studies have found support for physical activity pathways between volunteering and mental or physical health in older adults.[17,18,21,39,40,73,74] It is possible that in older populations, volunteering allows opportunities for physical activity at a time in life when it is common to become more sedentary. In contrast, adolescents have structured opportunities for physical activities (eg, sports teams, gym class), and thus may not need volunteering to stay active.

Similarly while previous studies found support for depressive symptoms pathways linked to volunteering and mental or physical health,[13,14,75] these were also studies of older adults. It may be that in adolescents, other factors drive depressive symptoms more strongly, such as peer[76,77] and family relationships.[78,79]

In terms of clinical significance, our studies found that volunteering during adolescence was associated with a more than 50% reduction in the odds of adult diabetes, and furthermore, for each 1-SD increase in volunteering frequency, there was a 0.11-SD decrease in metabolic syndrome score. Additionally, purpose in life accounted for 19% to 45% of the variance in the volunteering-metabolic syndrome relationship, suggesting that these pathways to CMH may be important to address in SDOH and health disparities research.

Strengths and Limitations

Strengths of this study include the focus on a group experiencing marginalization, the emphasis on understanding CMH during earlier periods of life when prevention efforts can be implemented, and the use of 2 independent samples to replicate findings. Limitations include the cross-sectional nature of study 1, precluding conclusions about causality or directionality. Limitations of study 2 include not having measures of purpose in life to replicate study 1 findings. Additionally, study 2 is limited by a lack of repeated measures at every time point for volunteering, diabetes (objectively diagnosed), and covariates and by long intervals between assessments (when other factors linked to study outcomes might emerge). Other limitations more generally include volunteering being assessed retrospectively, the lack of details about volunteering (eg, type, length), and that other unmeasured variables may confound associations. Additionally, selection biases (eg, interest in research, time availability) may shape who agreed to participate. Future studies should test broader models situating volunteering within other social network (eg, work environments) and structural- or societal-level factors (eg, social service policies) that comprise SDOH and that contribute to health disparities. Furthermore, because casual conclusions cannot be reached without experimental designs, future research should conduct intervention trials of volunteering's effects on CMH.

Conclusions

In this cohort study of 2 independent samples of Black adolescents from lower-income households, a positive component of SDOH—volunteering—was associated with lower adolescent metabolic syndrome and lower odds of adult diabetes. Mediation analyses found that the association with volunteering operated via helping adolescents experience greater purpose in life. These findings suggest that encouraging adolescents to volunteer may represent one novel approach to improving CMH earlier in life. Volunteering may reflect one important, but largely unexplored, component of SDOH.[80] If so, the notion that volunteering could be beneficial not only for recipients of volunteering efforts, but also for volunteers themselves, suggests the possibility of creating a 2-way street of benefits through a single activity that could promote health across groups while also strengthening the social fabric across communities.

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SUPPLEMENT 1.

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SUPPLEMENT 2.

Data Sharing Statement