Area-level Socioeconomic Environment and Cardiorespiratory Fitness in Youth

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ABSTRACT

CLENNIN, M. N., M. DOWDA, X. SUI, and R. R. PATE. Area-level Socioeconomic Environment and Cardiorespiratory Fitness in Youth. *Med. Sci. Sports Exerc.*, Vol. 51, No. 12, pp. 2474–2481, 2019. **Introduction:** Cardiorespiratory fitness is one of the most important markers of cardiometabolic health and is a strong predictor of cardiovascular disease and all-cause mortality across the lifespan. However, little is known regarding the relationship of area-level socioeconomic environment on cardiorespiratory fitness during childhood and adolescence. **Purpose:** To examine the relationship between area-level socioeconomic environment and cardiorespiratory fitness in a diverse sample of school-age youth; and to determine the extent to which grade level, sex, race/ethnicity, and student poverty status moderate this relationship. **Methods:** South Carolina FitnessGram data for school year 2015 to 2016 were obtained for 44,078 youth. Cardiorespiratory fitness was determined using Progressive Aerobic Cardiovascular Endurance Run or 1-mile run/walk test. Area-level socioeconomic environment was expressed as a composite index score at the census tract level using data from the American Community Survey. Multilevel logistic regression analyses were conducted, controlling for individual-level characteristics and nesting within schools and districts. Interaction terms were then introduced to the model to examine their effect of multiple sociodemographic moderators. **Results:** Approximately half of the sample had inadequate cardiorespiratory fitness for health. The odds of achieving the Healthy Fitness Zone for cardiorespiratory fitness decreased by approximately 25% to 34% with increasing deprivation of the area-level socioeconomic environment, after controlling for covariates. The association between area-level socioeconomic environment and cardiorespiratory fitness also varied significantly by sex, grade level, and race/ethnicity subgroups. **Conclusions:** Cardiorespiratory fitness was positively associated with area-level socioeconomic environment; however, the relationship varied by demographic characteristics. These results highlight the importance of examining the influence of area-level socioeconomic environment on health across the life span. Additional research is needed to explore how area-level socioeconomic environment may impact evidence-based efforts to improve youth cardiorespiratory fitness levels. **Key Words:** FITNESSGRAM, SCHOOL-AGE YOUTH, CARDIOVASCULAR DISEASE RISK FACTOR, DEPRIVATION

In the United States, drastic inequalities in health have been observed across neighborhoods, zip codes, and counties (1–4). These persistent differences in health often remain after controlling for individual-level characteristics, suggesting that environmental-level factors play a role in influencing health. Existing literature has identified numerous characteristics of the physical and social environment within homes, neighborhoods, schools, and communities that are associated with health-related outcomes and behaviors (5–7). Additionally, elements of the socioeconomic environment have also been recognized as influential determinants of health and potential contributors to health inequalities beyond individual-level factors. Existing evidence suggests that area-level socioeconomic environment is independently associated with multiple health outcomes, including cardiovascular disease, diabetes, and all-cause mortality (5,8–11).

Previous studies have consistently demonstrated a relationship between area-level socioeconomic environment and cardiovascular disease and related health outcomes (12–16). However, little is known regarding its association with indicators of cardiometabolic health, especially among younger populations. Among youth, cardiorespiratory fitness is regarded as one of the most important markers of cardiometabolic health and is a strong predictor of cardiovascular disease and all-cause mortality across the lifespan (17–20). Despite this evidence,

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there is a dearth of knowledge regarding the relationship of area-level socioeconomic environment on cardiorespiratory fitness during childhood and adolescence. Across the few studies that have examined this relationship, the findings have been inconsistent (12,14,21). One study examined the relationship between community social vulnerability and cardiorespiratory fitness and found that schools located in more socioeconomically deprived areas had a lower proportion of youth with adequate of cardiovascular fitness levels (12). However, another study reported no significant variation in students' cardiorespiratory fitness levels by area-level socioeconomic environment of the school (21).

To date, the independent relationship between area-level socioeconomic environment and cardiorespiratory fitness among youth remains relatively unexplored. Although previous studies have consistently reported an association between area-level socioeconomic environment and cardiovascular health among adults (9,10), it is unknown at what point during the life course the adverse impact of socioeconomic deprivation on cardiometabolic health emerges. Furthermore, the extent to which individual-level demographic characteristics moderate the relationship between area-level socioeconomic environment and cardiorespiratory fitness among youth has yet to be explored. Previous studies have shown individual-level characteristics are associated with cardiorespiratory fitness and associated health behaviors such as physical activity (6,13,19). As such, failure to account for these potential interactions may confound research findings and impede public health efforts to create supportive environments (3,11,12). Hence, the primary aim of this study was to examine the relationship between area-level socioeconomic environment and cardiorespiratory fitness in a diverse sample of school-age youth. A secondary aim was to determine the extent to which the relationship between area-level socioeconomic environment and cardiorespiratory fitness varies across grade level, sex, race/ethnicity, and socioeconomic subgroups.

METHODS

Data Source and Sample

Data were obtained from the South Carolina Department of Health and Environmental Control's (SC DHEC) FitnessGram project for school year 2015 to 2016. The SC DHEC FitnessGram project is a state-wide observational study to evaluate and ultimately improve health-related fitness among South Carolina students. All South Carolina public schools serving grades K-12 were eligible to participate. Participating schools conducted fitness testing and recorded health-related fitness data for students enrolled in physical education class. School staff received training support through the President's Youth Fitness Program before administering FitnessGram testing. All participating schools submitted data to the SC DHEC. The University of South Carolina received de-identified student-level data to assess health-related fitness among South Carolina students. Approximately 540 (38%) public schools across 47 (32%) school districts participated during school year 2015–216 (22). The analytic sample included 44,078 students in grades 5, 8, and 9 to 12. This study was approved by the University of South Carolina's Institutional Review Board.

Cardiorespiratory Fitness

Cardiorespiratory fitness was assessed using one of three field assessments: the Progressive Aerobic Cardiovascular Endurance Run (PACER) test, a 1-mile run test, or a 1-mile walk test. Additional information regarding the administration of the cardiorespiratory fitness field tests, validity and reliability of field tests, and the calculation of cardiorespiratory fitness are available in the FitnessGram manual (23). Briefly, the PACER test is a multistage, progressive fitness test that involves participants running at a specified pace for as long as possible. The 1-mile run and 1-mile walk tests are assessed using time to completion. For each test, cardiorespiratory fitness was estimated based on established protocols (23). Age- and sex-specific standards were then used to categorize cardiorespiratory fitness into one of three health zones: 1) healthy fitness zone, 2) needs improvement, and 3) needs improvement—health risk. For all analyses, achievement of Healthy Fitness Zone for cardiorespiratory fitness (yes/no) was modeled.

Area-level Socioeconomic Environment

Socioeconomic environment was expressed as a composite index score at the census tract level using data from the American Community Survey (5-yr estimates for 2011 to 2015 (24–26)). Because student's neighborhood of residence could not be determined in the current data set, school census tract was used as a proxy measure for area-level socioeconomic environment. Previous research has established an association between neighborhood of residence, school choice, and poverty such that the immediate and surrounding environment of the school reflects students' neighborhood environment (27,28).The index was calculated using 20 census tract variables representing six domains for all South Carolina census tracts (see Table, Supplemental Digital Content 1, which presents variables used to create the index and factor loadings, http://links.lww.com/MSS/B651) (24–26). Principal components analysis with varimax rotation was used to examine the data structure of the variables. The first common factor explained the greatest proportion of the total variance (43.1%) and included 11 variables with larger factor loadings (>0.25) on the first common factor (i.e., proportion of total population with less than a high school education, proportion of total population with a college degree, proportion female and male management occupations, proportion of population living below the federal poverty level income, proportion households with income US $150,000+, median household income, median value of all owner-occupied households, proportion of households with low income, proportion of households with dependents that are headed by females, and proportion of persons living in same residence since 2005). Next, selected variables were weighted and standardized based on their variable loading coefficients and a

composite index score was calculated by adding these values. Lower index scores indicate affluence or more favorable socioeconomic environments, whereas higher index scores indicate more unfavorable or deprived socioeconomic environment. For all analyses, the area-level socioeconomic environment index was categorized into quartiles (Q1, affluence [referent]; Q2, Q3, and Q4, deprivation).

Student Characteristics

Student sociodemographic characteristics were reported by school staff and/or were provided by the SC DHEC. Grade level was reported as 5th grade [referent], 8th grade, and high school (i.e., grades 9–12). Sex was reported as male [referent] or female. Race/ethnicity was expressed in the following groups: non-Hispanic white [referent], non-Hispanic black, Hispanic or Latinx, and other (including multiracial). Student poverty status (yes vs no) was determined using student's poverty status on the 135 d of the school year based on enrollment in Medicaid, Supplemental Nutrition Assistance Program, Temporary Assistance for Needy Families, or Foster Care Services within the past 3 yr; and/or student homelessness/migrant status during school year. Body mass index was calculated from objectively measured height and weight and classified into weight status categories using CDC growth charts: underweight/normal weight (<85th percentile [referent]), overweight (85th percentile to <95th percentile), and obese (≥95th percentile) (29).

Statistical analyses. Descriptive statistics and bivariate associations between variables were examined. Multilevel logistic regression was used to examine the association between area-level socioeconomic environment and cardiorespiratory fitness. Cardiorespiratory fitness was modeled as achievement of Healthy Fitness Zone (yes/no). Area-level socioeconomic environment consisted of four quartiles, as described above. All analyses accounted for the hierarchical structure of the data with students nested within schools and districts and controlled for grade level, sex, race/ethnicity, student poverty status, weight status and fitness field test (i.e., PACER, 1-mile run/walk test) as fixed effects. Next, interaction terms were introduced to the model to examine the potential moderating effect of grade level, sex, race/ethnicity, and student poverty status. To maintain a parsimonious model, only significant interactions were retained in the final model. Linear and quadradic trends in cardiorespiratory fitness were also examined across area-level socioeconomic environment quartiles. The presence of a significant linear trend indicates a statistically significant increase or decrease across area-level socioeconomic environment quartiles. A significant quadratic trend indicates a statistically significant nonlinear change (e.g., leveling off, change in direction). Significant linear and quadratic trends together indicate an overall linear increase/decrease; however, estimates also leveled off or began to increase/decrease across quartiles. Finally, stratified analyses were conducted by sociodemographic subgroups to interpret

TABLE 1. Student characteristics for the overall sample and by Healthy Fitness Zone for cardiorespiratory fitness.

		CRF		
	Total (N = 44,078)	Healthy Fitness Zone (n = 22,729; 51.6%)	Needs Improvement/Health Risk (n = 21,349; 48.4%)	P
Student Characteristics[a]				
Age (yr)	12.4 (2.0)	12.3 (1.9)	12.5 (2.0)	<0.0001
Grade				<0.0001
5th grade	52.2%	54.2%	50.2%	
8th grade	25.7%	25.3%	26.1%	
High school	22.1%	20.5%	23.7%	
Sex				<0.0001
Male	51.5%	58.8%	43.8%	
Female	48.5%	41.2%	56.2%	
Race/ethnicity				<0.0001
Non-Hispanic white	55.6%	59.3%	51.7%	
Non-Hispanic black	29.1%	25.3%	33.1%	
Hispanic	9.8%	9.6%	10.0%	
Other	5.5%	5.8%	5.2%	
Student poverty status				<0.0001
Yes	55.3%	47.8%	63.3%	
No	44.7%	52.2%	36.7%	
BMI	21.9 (5.5)	19.9 (3.7)	24.1 (6.3)	<0.0001
Weight status				<0.0001
Normal weight	60.3%	76.3%	43.3%	
Overweight	17.6%	15.1%	20.3%	
Obese	22.1%	8.7%	36.5%	
Estimated $\dot{V}O_{2max}$	42.0 (6.3)	46.4 (5.5)	37.1 (2.5)	<0.0001
CRF field test				<0.0001
PACER	94.8%	93.0%	96.9%	
1-Mile run/walk test	5.2%	7.0%	3.1%	
Area-level characteristics				
Socioeconomic environment[b]				<0.0001
Quartile 1 (affluence)	29.2%	34.0%	24.2%	
Quartile 2	28.1%	27.7%	28.5%	
Quartile 3	24.1%	21.5%	26.9%	
Quartile 4 (deprivation)	18.6%	16.7%	20.5%	

BMI, body mass index; CRF, cardiorespiratory fitness.
[a]Presented as mean (standard deviation) unless denoted by percent, %; reported as percentage of column total.
[b]Index score calculated using data from the American Community Survey 5-yr estimates from 2011 to 2015; quartiles based on distribution of index score across participating schools.

significant interactions. All significance levels were set to $P < 0.05$. Analyses were conducted in SAS 9.4 using PROC GLIMMIX.

RESULTS

Table 1 presents descriptive characteristics for the overall sample and by cardiorespiratory fitness Healthy Fitness Zone categories. The mean age for the overall sample was 12.4 yr (±2.0) and approximately half of the overall sample was enrolled in 5th grade. Sex was distributed equally between male and female students. The sample was racially/ethnically diverse with 55.6% non-Hispanic white, 29.1% non-Hispanic black, 9.8% Hispanic, and 5.5% identifying as other race/ethnicity group including multiracial. Just over half of the overall sample was classified as living in poverty. Finally, nearly 40% of the sample was overweight or obese and 52% achieved the Healthy Fitness Zone for cardiorespiratory fitness. Across sociodemographic categories, a greater proportion of students with the following characteristics achieved the Healthy Fitness Zone: 5th graders ($P < 0.0001$), males ($P < 0.0001$), non-Hispanic whites ($P < 0.0001$), higher family socioeconomic status (i.e., poverty = no) ($P < 0.0001$), normal weight ($P < 0.0001$), and attending school with more favorable area-level socioeconomic environments (Q1, affluent) ($P < 0.0001$).

Main effects. Table 2 depicts the results from multilevel logistic regression analyses that examined the association between area-level socioeconomic environment and cardiorespiratory fitness level, before and after adjusting for individual-level sociodemographic characteristics. Area-level socioeconomic environment was significantly associated with odds of achieving the Healthy Fitness Zone for cardiorespiratory fitness ($P < 0.05$). Specifically, the odds of achieving the Healthy Fitness Zone for cardiorespiratory fitness decreased by approximately 25% to 34% with increasing socioeconomic deprivation (Q2, Q3, Q4 compared with Q1), after controlling for covariates. Figure 1 visually presents the adjusted odds of achieving the Healthy Fitness Zone for cardiorespiratory fitness by area-level socioeconomic environment. A significant linear and quadratic trend was observed across area-level socioeconomic environment quartiles (Fig. 1). Although an overall decreasing trend was observed across area-level socioeconomic environment quartiles (linear trend: $P < 0.05$), a substantial decrease in the odds of achieving the Healthy Fitness Zone was observed from the first quartile to the second quartile followed by a leveling off of the effect across remaining quartiles (quadratic trend: $P < 0.01$). Further, the odds of achieving the Healthy Fitness Zone for cardiorespiratory fitness were significantly lower among females (odds ratio [OR], 0.43; 95% confidence interval [CI], 0.41–0.45), lower socioeconomic status (i.e., poverty, yes: OR, 0.59; 95% CI, 0.56–0.62), overweight (OR, 0.37; 95% CI, 0.35–0.39), obese (OR, 0.09; 95% CI, 0.08–0.10), and older students (8th grade: OR, 0.46; 95% CI, 0.39–0.55; high school: OR, 0.43; 95% CI, 0.34–0.54) (Table 2).

TABLE 2. Logistic regression models examining the odds of achieving the Healthy Fitness Zone for cardiorespiratory fitness by area-level socioeconomic environment.

	Unadjusted Model[a]	Adjusted Model[b]
Variables	**OR (95% CI)**	**OR (95% CI)**
Socioeconomic environment		
Quartile 1 (affluence)	1.0	1.0
Quartile 2	**0.65 (0.50–0.83)**	**0.75 (0.56–0.99)**
Quartile 3	**0.51 (0.40–0.64)**	**0.66 (0.51–0.87)**
Quartile 4 (deprivation)	**0.52 (0.40–0.67)**	0.75 (0.55–1.02)
Sex		
Male		1.0
Female		**0.43 (0.41–0.45)**
Race/ethnicity		
NH white		1.0
NH black		1.05 (0.99–1.1)
Hispanic		**1.42 (1.30–1.54)**
Other		**1.18 (1.07–1.31)**
Student poverty status		
No		1.0
Yes		**0.59 (0.56–0.62)**
Grade level		
5th Grade		1.0
8th Grade		**0.46 (0.39–0.55)**
High school		**0.43 (0.34–0.54)**
Weight status		
Normal		1.0
Overweight		**0.37 (0.35–0.39)**
Obese		**0.09 (0.08–0.10)**
Model fit		
Akaike information criterion	55,080	46,528
Socioeconomic environment (*P*)	<0.0001	<0.05

Bold emphasis indicates significant OR.
[a]Model accounts for nesting of students within schools and districts.
[b]Model adjusted for CRF field test (PACER, Walk, 1-Mile Run) and accounts for students nested within schools and districts.

Interactions. Next, interaction terms were introduced into the adjusted model to determine whether the relationship between area-level socioeconomic environment and cardiorespiratory fitness varied by the student's grade level, sex, race/ethnicity, and student poverty status. Significant interactions were found for sex ($P < 0.0001$), race/ethnicity ($P < 0.0001$), and grade level ($P < 0.0001$).

Stratified analyses. Lastly, for each significant interaction, the analytic data set was stratified by the sociodemographic characteristic of interest and the final adjusted model was rerun. For the stratified analyses by sex, the positive association between area-level socioeconomic environment and cardiorespiratory fitness held among males ($P < 0.05$); but not females ($P = 0.24$). Figure 2 depicts a significant quadratic trend across area-level socioeconomic environment quartiles for males ($P < 0.01$), with a substantial decrease observed from the first quartile to the second quartile followed by a leveling off or slight change in direction across remaining quartiles. For the stratified analyses by race/ethnicity, the association between area-level socioeconomic environment and cardiorespiratory fitness held for non-Hispanic white students ($P < 0.001$) and was marginally significant for non-Hispanic black students ($P = 0.07$) and students from other race/ethnicity subgroups ($P = 0.10$); but was not observed among Hispanic students ($P = 0.93$) (Fig. 3). Finally, the stratified analyses by grade level revealed that the influence of area-level socioeconomic environment was more pronounced among older students compared to younger students. More specifically, the association between area-level socioeconomic environment

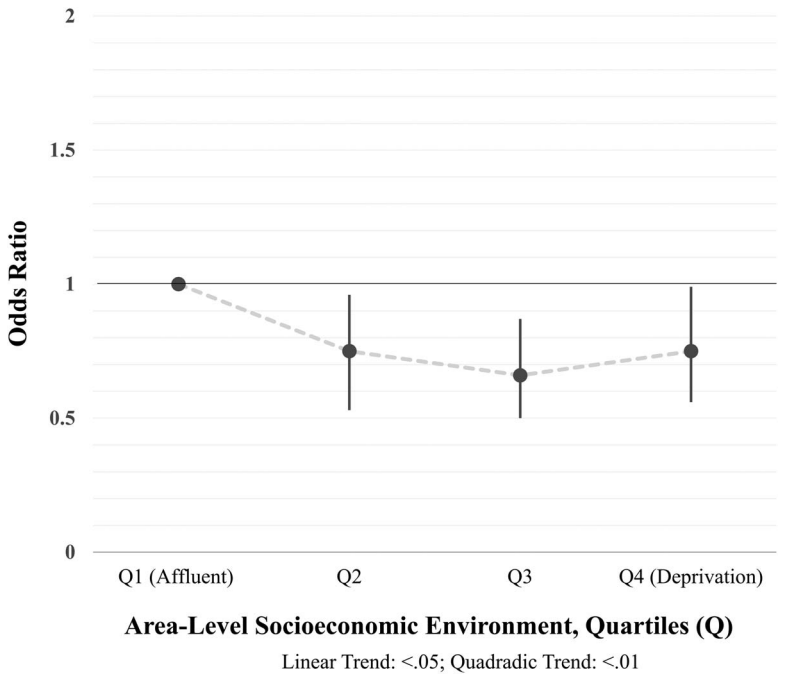

FIGURE 1—Adjusted odds of achieving the Healthy Fitness Zone for cardiorespiratory fitness by area-level socioeconomic environment (quartiles).

and cardiorespiratory fitness was observed among high school students ($P < 0.05$), but not among 5th graders ($P = 0.21$) and 8th graders ($P = 0.81$) (Fig. 4). Among high school students, cardiorespiratory fitness decreased across area-level socioeconomic environment quartiles (linear trend: $P < 0.01$, quadratic trend: $P < 0.05$) (Fig. 4). Additional results for the stratified analyses are presented in supplemental materials (see Table, Supplemental Digital Content 2, which presents OR for stratified analyses, http://links.lww.com/MSS/B652).

DISCUSSION

The main finding of this study was a significant relationship between area-level socioeconomic environment and cardiorespiratory fitness levels. Specifically, the odds of achieving the Healthy Fitness Zone for cardiorespiratory fitness were lower among youth attending schools located in socioeconomically deprived areas compared to more affluent areas. The relationship between area-level socioeconomic environment and cardiorespiratory fitness, though attenuated, remained significant after controlling for individual-level characteristics. Additionally, findings of this study demonstrated that the association between area-level socioeconomic environment and cardiorespiratory fitness varied significantly by sex, grade level, and race/ethnicity subgroups. Specifically, the relationship between cardiorespiratory fitness and area-level socioeconomic environment held among males, non-Hispanic whites, and high school students but was not significant in the remaining subgroups. A significant decreasing trend in cardiorespiratory fitness across area-level

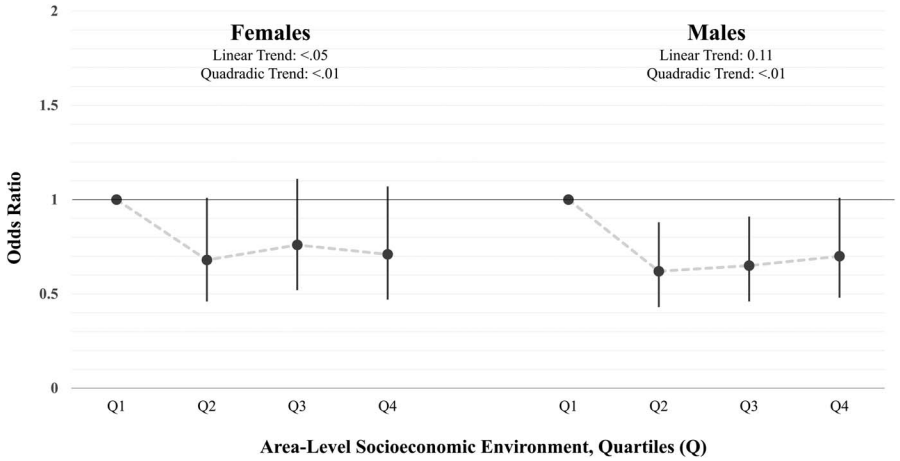

FIGURE 2—Sex stratified analysis: adjusted odds of achieving the Healthy Fitness Zone for cardiorespiratory fitness by area-level socioeconomic environment (quartiles) and sex.

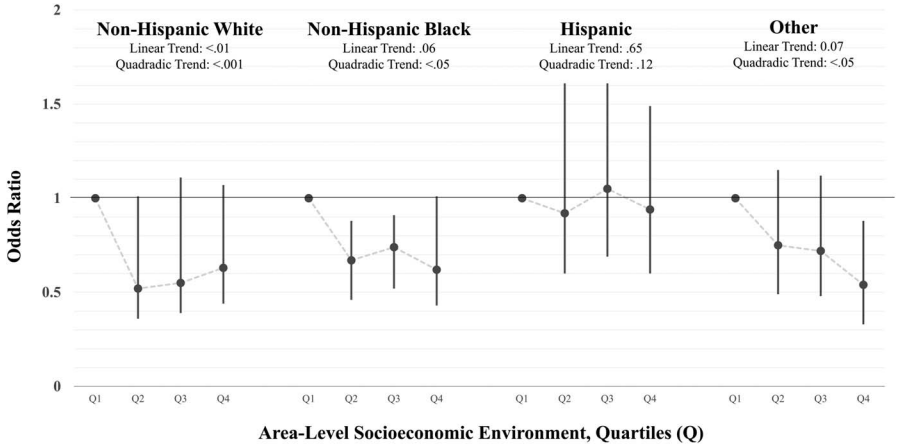

FIGURE 3—Race/ethnicity stratified analysis: adjusted odds of achieving the Healthy Fitness Zone for cardiorespiratory fitness by area-level socioeconomic environment (quartiles) and race/ethnicity.

socioeconomic environment quartiles was observed across the overall sample and across demographic subgroups Together, these findings suggest that area-level socioeconomic environment is independently associated with youth fitness levels and differs by individuals-level characteristics.

To date, few studies have examined the relationship between area-level socioeconomic environment and cardiorespiratory fitness, especially among younger populations. The findings of previous studies have been mixed. Some studies have reported a relationship between socioeconomic deprivation and lower levels of cardiorespiratory fitness among young adults and school-age youth (12,14). However, others have reported that cardiorespiratory fitness levels were significantly associated with school type (i.e., private vs public) but not the socioeconomic environment (21). Notably, the results of this study support previous research that has reported an association between area-level socioeconomic environment and cardiorespiratory fitness among younger populations (12,14). Further, the results of the present study suggest that area-level socioeconomic environment independently influences fitness levels among school-age youth.

Building from previous literature, there are several explanations that may describe the differences observed across demographic subgroups. With respect to sex, previous studies have reported that males may have increased independent mobility and thus may experience greater exposure to environmental factors compared to females (30–32). This may explain the stronger association observed among males compared to females in the current study. Concerning race/ethnicity, existing literature has well-documented the "Hispanic paradox," where individuals of Hispanic/Latino origin exhibit better cardiovascular health outcomes compared to non-Hispanic whites despite lower socioeconomic status and limited access to resources (33,34). Some have postulated that this paradoxical relationship may be attributed to higher levels of social support and/or prevalence of nuclear families (33,35). Although it cannot be confirmed in the current study, these factors may explain the absence of a significant relationship between area-level socioeconomic environment and cardiorespiratory fitness among Hispanic youth. Notably, the findings of this study do not align with those of a previous study that examined a sample of young adults and reported no significant interactions

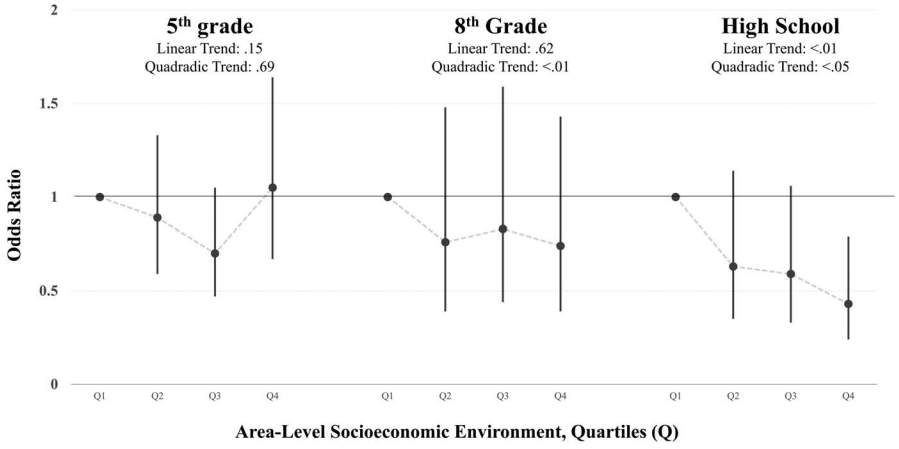

FIGURE 4—Grade stratified analysis: adjusted odds of achieving the Healthy Fitness Zone for cardiorespiratory fitness by area-level socioeconomic environment (quartiles) and grade.

between area-level socioeconomic environment and individual-level characteristics (14).

With respect to grade level, our findings demonstrated a significant association between area-level socioeconomic environment and cardiorespiratory fitness among high school students. Notably, the association was not significant among elementary and middle school students. There are several explanations that may explain why this relationship varied across grade levels. First, it is plausible that the influence of area-level socioeconomic environment on cardiorespiratory fitness levels (as measured by established field test) emerges during late adolescence. Previous evidence has reported that the influence of environmental factors on health and health-related behaviors may increase during adolescence as youth become increasingly independent and gain more responsibility (36,37). As such, older youth would have increased exposure to environmental factors that might influence their health. This may explain the stronger relationship observed among older youth. Alternatively, area-level socioeconomic environments may have a significant influence on cardiorespiratory fitness across all grade levels, but only be measurable among older age groups. This may be explained by the compounding effect that occurs across the life course. The potential emerging trend observed among 8th grade students may support this hypothesis (Fig. 4). Although the overall relationship was not significant among 8th graders, the significant quadradic trend indicates that cardiorespiratory fitness varied across area-level socioeconomic quartiles. This suggests that the influence of area-level socioeconomic environment may compound over time to produce measurable differences in cardiorespiratory fitness among older age groups. To better understand this complex relationship future longitudinal studies are needed to examine the influence of area-level socioeconomic deprivation on cardiorespiratory fitness across the life course.

Our study contributes to the growing body of knowledge and addresses several gaps in the literature. This is one of the first studies to examine the association between area-level socioeconomic environment and cardiorespiratory fitness among youth using individual-level data. Unlike previous studies, we also explored the potential moderating role of demographic characteristics, including sex, grade level, race/ethnicity, and student poverty status. However, some limitations should be noted. First, the study design was cross-sectional which does not allow for causality to be inferred. Second, the sample included a convenience sample of schools that self-selected to participate in the project. It is possible that participating schools differed from nonparticipating schools, which may have influenced our results. To reduce participation barriers, project staff provided free training, software, and technical assistance to all schools. Third, cardiorespiratory fitness was determined using established field tests delivered and reported by staff from participating schools. Although all staff received standard training before conducting FitnessGram tests, there was potentially variability in the measurement and reporting of cardiorespiratory fitness results. Finally, school census tract was used as a proxy because students' neighborhood of residence could not be determined. Although not a perfect proxy for neighborhood socioeconomic environment, student enrollment in a given school is often determined by the neighborhood in which the family resides. In most instances, students are designated to attend the school in closest proximity to their home of residence. Thus, the immediate and surrounding environment of the school is likely representative of students' neighborhood environment (27,28). Additionally, it is possible that area-level socioeconomic environment influences student's cardiorespiratory fitness by impacting the availability of resources and physical activity opportunities of schools (e.g., playgrounds, sport programs, quality of PE, etc.). Future research accounting for area-level socioeconomic environment of the school and neighborhood of residence are needed to better understand these complex relationships and the potential independent and synergistic interactions that may influence student fitness levels.

In summary, our findings detail the extent to which area-level socioeconomic environment is associated with cardiorespiratory fitness levels in a diverse sample of South Carolina youth. Unfortunately, nearly one out of every two youth in the study population had an inadequate level of cardiorespiratory fitness. Given the well-established relationship between cardiorespiratory fitness and cardiometabolic health, efforts to improve cardiorespiratory fitness levels among youth should be prioritized. Previous literature has identified several evidence-based strategies that have been shown to effectively improve youth fitness levels (38,39). Accordingly, studies are needed to examine the potential moderating effect of the socioeconomic environment on the effectiveness of evidence-based strategies to improve youth fitness levels. Results of such studies could provide information that would help tailor evidence-based approaches for improving youth cardiorespiratory fitness levels in specific demographic subgroups.

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