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Effects of a Comprehensive School Health Program on Elementary Student Academic Achievement

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ABSTRACT

BACKGROUND: Improving the academic achievement of youth in the U.S. has been an area of interest for many decades and has been a critical indicator of future success of youth. The purpose of this study was to examine the impact of a comprehensive school physical activity and healthy eating program on 5th grade students' academic achievement, specifically reading and math. **METHODS:** In total, 628 (intervention: 377, 54% female; comparison: 251, 49% female) 5th grade children participated across the six schools in a yearlong comprehensive health intervention, completing curriculum-based academic achievement measures at two-time points. **RESULTS:** Results showed that even after controlling for class clustering, age, sex, race, and T1 reading and math variables, students' T2 reading and math achievement were significantly higher in the intervention group than the comparison group. **CONCLUSIONS:** Comprehensive health programming can enhance the health and academic achievement of youth.

Key Words: Academic Achievement, Physical Activity, Healthy Eating, CSPAP, WSCC

Academic achievement is a critical indicator of future success, as poor life outcomes abound for those who perform poorly in academics,[1-2] including greater likelihood of high school dropout,[3-5] lower college attendance,[6] and lower wages across the lifespan.[6-7] Youth who drop out of school early have, on average, inferior long-term economic outcomes (eg, earn less money, more likely to be in jail, have poorer health, less likely to be married, and less happiness) than to those who graduate from high school.[8] In the U.S., youth achievement lags behind other countries in many ways,[9] and the transition from elementary school to middle school often yields a drop in achievement.[10-11] Given the known association between academic achievement and future livelihood it is imperative to understand the various factors contributing to achievement in youth, especially those facing major transitions such as entering middle school.

The ecological systems theory[12] posits that there are many systems that work together to impact behavior. Traditionally, this framework, or iterations of it, have been evident in helping to understand variables that individually and collectively impact student achievement. Broadly, literature suggests several levels of life contexts as key predictors of academic achievement in youth including family, school, and peers. At the family level specific aspects of parental and youth interactions including parental involvement, high academic expectations, and parental monitoring[13-15] are associated with better academic achievement. At the peer level, children who enjoy positive relationships with their peers and have high social competence have consistently shown higher levels of achievement.[16] Furthermore, these relationships have proven to be important outside of school with participation in sport teams also showing a positive relationship with achievement in the school setting.[17] At the school level, more frequent absences[14,18-19] as well as the type of school absence[20] (unexcused vs. excused), have been shown to predict elementary school achievement. Additionally teacher and student interactions including the

perception of conflict[21] and an established relationship[22] has been associated with academic achievement outcomes. As this literature base suggests, there are a host of factors related to academic achievement of youth, and while it is important to acknowledge them as contributory they do not fully explain the achievement gap and more so the contextual nature of student achievement.

In alignment with the educational arena's interest in academic achievement and associated struggles, public health and medical experts have raised the question of youth health and how it may contribute to student achievement. Research over the past several decades indicates a stark decline in youth health. Specifically, over 30% of youth are overweight and obese. Further, with a status of overweight and obesity comes an increased risk for comorbidities including diabetes, heart disease, stroke, hypertension, among many others.[23] Guided by the rationale that youth health is deteriorating, the National Academies of Medicine has called on the school environment to integrate healthy behaviors, such as physical activity and nutrition education, into the school day.[24] While evidence indicates that creating healthier school environments does improve and impact student health behaviors,[25] there is also a growing body of literature suggesting that healthier students are better learners.[26-27] Given the potential for an interrelationship between student health and academic achievement, a greater emphasis has been placed on comprehensively exploring these relationships.

Early school health intervention models laid the groundwork to explore the relationships between student health behavior and achievement. Some of these comprehensive interventions include, but are not limited to CATCH[28] (Child and Adolescent Trial for Cardiovascular Health), SPARK[29] (Sports, Play, and Active Recreation for Kids Curriculum), PAAC[30] (Physical Activity Across the Curriculum), and HOPS/OWG[31] (Healthier Options for Public Schoolchildren/Organ

Wise Guys). All of these early studies found relationships between health behaviors of students and success in the school setting. These early studies were influential in thinking about the intersection of student health and achievement. In 2014, educational and health scholars seemed to align in their thinking by releasing an updated version of the Coordinated School Health Model referred to as Whole School, Whole Community, Whole Child. This model, created by ASCD (formerly known as the Association for Supervision and Curriculum Development) and the Centers for Disease Control and Prevention encourages educators to embrace the whole child, which should include social, emotional, and behavioral health concepts.[32] This notion of addressing the "whole child" is thus most likely to lead to well-rounded educated students.[33] current authors sought to expand this body of literature around coordinated approaches and their relationship to academic achievement by conducting a holistic intervention, based on the ecological systems theory called the Building Healthy Communities program.

There are three health variables that have been commonly examined in the school setting in relation to academic achievement: (1) fitness, (2) physical activity, and (3) nutrition. Fitness is one aspect of student health that has been extensively examined in relation to academic achievement and has been shown to have the strongest correlational and directional relationship.[27,34-40] More specifically, researchers have shown that cardiovascular fitness has the strongest relationship to academic achievement, with some studies showing a direct relationship.[34, 39, 41-47] Aske et al[42] examined the relationship of academic achievement and cardiorespiratory fitness over time from 1200 youth enrolled in one school district in a northeastern state in the U.S. They found that students who were in the healthy fitness zone for cardiovascular endurance performed better on their math and language arts tests, as oppose to their non-fit counterparts.[42] The research also revealed that this relationship was less prominent

but still significant among minority and low socio-economic status youth. Similarly, Fair et al[47] found a small but positive association between cardiorespiratory fitness and writing, English/language arts, math, science, and social studies among 8641 fifth grade students, while controlling for BMI, sex, grade level, race/ethnicity, and income.

Although many studies examine fitness and physical activity together in the sense that increasing physical activity leads to improved fitness, physical activity alone has also been strongly correlated with academic achievement of youth.[48] Aisgbee et al[49] examined the relationship between physical activity and academic achievement in a longitudinal database that followed 9720 children through kindergarten, first grade, third grade, fifth grade, and eighth grade. Results showed that physical activity levels strongly predicted academic achievement, even while controlling for SES, age, and sex. Additionally, results from interventions which provided physical activity opportunities to students during the school day have also been associated with positive outcomes in academic achievement, specifically among 3rd grade reading.[50] In this particular study, 1279 elementary schools were surveyed and reported the amount of time per week that students were offered to participate in physical activity through physical education or recess. Results showed that the physical activity opportunities that were offered moderated the relationship between SES and third grade reading, with schools offering more than 225 minutes/week of physical activity having significantly higher reading achievement.[50] Finally, a study conducted by Authors et al[51] found that while controlling for level of fitness, physical activity was a significant predictor of rate of improvement for students' math achievement, but was not a unique predictor for their reading achievement. Although this latter study did not include a control group, it is promising as it is one of the first studies to parcel out physical activity while controlling for fitness and examining academic achievement.

Although we know youth fitness and physical activity are modifiable factors, they may not fully account for the variability in student health and achievement. Some scholars have also looked at nutrition and the role it plays in academic achievement. For example, Edwards et al[52] matched data from the Youth Risk Behavior Surveillance Survey to students' standardized state test scores. They found that there were significant relationships between positive nutritional, physical activity, and fitness behaviors and students' achievement. Specifically, math scores were associated with more milk and breakfast consumption and less consumption of fruit juice and sweetened beverages, while reading was associated with fewer sweetened beverages.[52] More recently, Asigbee et al[49] used a longitudinal dataset (ECELS) to better understand the relationships between nutrition, physical activity, and academic achievement. They found that physical activity, nutrition, and the interaction between physical activity and nutrition were all significant predictors of reading and math scores.[49]

Informed by evidence that student health behaviors including fitness, physical activity, and nutrition are associated with academic achievement, the authors sought to develop an intervention that included and measured factors that have been evidenced as contributory. Previous research on the Building Healthy Communities program, examined the intervention effect on rate of improvement in student achievement, specifically in math and reading.[51] The results of the initial pilot study indicated that the students who attended schools with high program fidelity (high implementation) had higher rates of improvement in reading comprehension than their peers. Additionally, students who had higher levels of fitness and physical activity had higher rates of improvement in math than their classmates. Although this study boasts a significant finding supporting the notion that a comprehensive health program

could lead to increased achievement, a lack of control group limits the interpretation of these prior findings.

Therefore, the aim in the current study was to extend the research beyond correlational relationships and into causal interpretations with an expanded iteration of the intervention that included a quasi-experimental design. The purpose of this current study, then, was to evaluate the impact of the comprehensive school physical activity and healthy eating program called Building Healthy Communities on 5th grade students' academic achievement, specifically reading and math. This comprehensive approach is purported by this research team as a notable improvement beyond prior research, which tended to parcel out individual predictors and intervention components for their unique impacts on achievement. However, in the complexity of the school setting, it is complicated to keep intervention components separate, especially when the goal of the program is to integrate a culture of health within the school setting. Therefore, in this study, although the components are presented with the intent to better understand the collective impact of the program, neither the components nor the outcomes of the components were examined individually. It was hypothesized that students in the intervention group would increase their academic achievement in both reading and math over one school year compared to students in comparison schools.

METHODS

Participants

Six schools (4 intervention, 2 comparison) were included in the study. All were located in the suburbs of a major Midwestern U.S. city (Table 1). Using a quasi-experimental design, four intervention schools were randomly selected from minimum inclusion criteria (ie, geographic region, size, Free/Reduced Lunch), while two additional schools were selected as waitlist

comparison schools and were chosen based on similar characteristics to the intervention schools. See consort diagram for more details (Figure 1). It is important to note that although the schools seem different in some of these areas, the schools chosen as comparison were closer than other options who had applied for the program. One of the schools was even in the same district as an intervention school. The schools chosen for the intervention did have similar offerings in their schools including amount of time spent in physical education, recess, lunch offerings, etc. In total, 628 (intervention: 377, 54% female; comparison: 251, 49% female) 5th grade children participated across the six schools, and 94% participated at both time points. Of those children in the intervention group 49% were Caucasian, 14.5% African American, 10.9% Asian, and 4.5% Arab American. The comparison group was made up of 30.3% Caucasian, 29% African American, 6.8% Asian, and 7.6% Arab American.

Instrumentation

Students' age, sex, and race were collected by survey to use as comparison variables within this study. The Academic Improvement Monitoring System (AIMSweb; www.aimsweb.com) and the Dynamic Indicators of Basic Early Literacy Skills (DIBELS) system are two different sets of brief, direct measures of academic skills commonly used in K-12 schools as universal screening tools to determine the attainment of grade level benchmark skills. Skills tested reflect generally consistent benchmarks across school buildings, districts, and states and are sensitive to change over time. At T1 and T2 of the intervention, math computation (using AIMSweb) and reading comprehension (using DIBELS) achievement tests were administered by trained research personnel. The test administration occurred during normal classroom time, under the supervision of the certified classroom teacher. Following final data collection, researchers calculated each participants' own rate of improvement (ROIs). Scores were

computed as T2 score minus T1 score divided by the number of weeks in the intervention (30 weeks). The purpose for calculated the rate of improvement was to be able to compare change that occurred within the schools (both intervention and control) beyond the sample in this study. Rate of improvement can be compared to schools across the nation and we thought this comparison could provide more information about the results and the students participating in the study. It is also important to understand that reliability and validity of Classroom Based Measures as been well established[53-55] and were specifically chosen given their common use in the school setting and their sensitivity to change in a short period of time.

The data represented in this paper are part of a larger study. Other data collected as part of this intervention have included healthy eating behavior as well as weight and obesity status.[56-57] Previous studies have reported the Building Healthy Communities intervention increasing children's levels of physical activity,[58] behaviors of healthy eating,[57] and decreased obesity.[56] Given the purpose of this paper only the student academic achievement data will be reported as it is the focused outcome of this manuscript. It is also important to note that fidelity measures were kept in order to track program implementation in each of the intervention schools, but fidelity data were not collected for the control schools due to lack of intervention related activities occurring and lack of resources. Additionally, given the nature of the analysis, differences in schools were controlled for during the analysis and the research question was based on collective change of the intervention versus control and not on differences between individual schools. This is reported as a limitation of the current study.

Procedure

Approval from the Institutional Review Board was received and all participants in the study were consented. Over a period of eight months, children in the intervention schools

participated in Building Healthy Communities, which was developed using a socio-ecological model and designed to change the culture of the school by increasing students' knowledge and behaviors for living healthy (Figure 2). The Building Healthy Communities program included six components: 1) principal engagement, 2) classroom nutrition lessons and physical activity breaks, 3) active recess, 4) quality physical education, 5) student leadership, and 6) after-school Healthy Kids Clubs. Each school was assigned a Building Healthy Communities coordinator who oversaw the six components within the school. The coordinator was there to support the school and the staff in creating a culture of health, but was not there to conduct the actual programming. Over the period of the school year the principal, teachers, the Building Healthy Communities coordinator, and the grant leadership team worked together to increase healthy eating and physical activity of students and create a culture of health within the school. This was not determined by a set number of requirements within a given component, but instead the intervention was designed to meet schools where they were at and in general increase the opportunities they were offering towards physical activity and healthy eating. Although this creates a limitation for the study that will be discussed later, it was in the best interest of the schools that were part of the project to ensure sustainability of programming and the creation of a true culture of health. No new or additional school physical activity or healthy eating interventions or programs were implemented in any of the intervention or comparison schools during the school year of this study. The six components that were focused on throughout the yearlong intervention are described below.

Principal engagement. Principals supported policies, systems, and environmental changes in their schools. They or their delegate read public announcements focusing on school wide healthy eating and physical activity health messaging ("healthy tips of the day"), distributed

healthy living newsletters to parents, and posted health messaging throughout the school and online.

Quality physical education. Certified physical education teachers received the evidence-based curriculum Exemplary Physical Education Curriculum (EPEC) and all physical activity equipment necessary to teach it. Additionally, teachers participated in a one-day professional development followed by site-based mentoring. Teachers were encouraged to use the curriculum to increase their opportunities for children to participate in moderate to vigorous physical activity. Building Healthy Communities coordinators observed classes and checked in with the physical education teachers on a monthly basis to ensure that they were implementing the curriculum and increasing opportunities for moderate to vigorous physical activity.

Classroom engagement. Classroom teachers integrated physical activity and healthy eating lessons into their classroom routines. Each was mentored by a healthy school coordinator to teach eight healthy eating lessons throughout the year developed from evidence-based USDA lessons. The Building Healthy Communities coordinator taught the first lesson, and then co-taught several lessons before transitioning to the classroom teacher implementing the remainder of the healthy eating lessons. Classroom physical activity break resources and mentoring were provided to help teachers implement physical activity into their classroom routines. Teachers were also encouraged to adopt a culture of health in their classrooms by encouraging physical activity homework, creating rules around healthy snacks and treats, and avoiding physical activity as punishment.

Active recess. Each school received a recess cart with equipment so that students had access to numerous options for physical activity during recess. Although this sounds simple, children having equipment and choice to be active during recess was a key component of the

grant. Existing recess monitors were trained to promote student activity and asked to role model physical activity during recess. Additionally, during physical education classes students learned games to play at recess to reinforce and encourage them to be active.

Healthy Kids Clubs. Healthy Kids Club took place after school to provide students with healthy snacks and fun physical activity opportunities. Weekly sessions lasted a total of 60 minutes and had three phases: (1) a healthy snack and nutrition education (10-15 minutes), (2) a walking/running club (20 minutes), followed by high-activity, non-elimination games (20 minutes), and (3) a review of the nutrition messaging (5 minutes). Schools were required to implement at least 30 sessions throughout the school year.

Student leadership team. Using *Fuel Up to Play 60*, schools assembled student leadership teams. consisting of 5-12 students charged with executing six-steps: (1) join the league, (2) build teams and draft key players, (3) hold a kickoff, (4) survey the field, (5) game time – host one healthy eating and one physical activity "play", and (6) light up the scoreboard by sharing success stories surrounding healthy eating and physical activity. The students worked collaboratively to implement at least two "plays," one geared toward increasing physical activity and the second focused on healthy eating. Plays varied considerably based on the school, due to the nature of allowing students to decide what they wanted and needed. Some student leadership teams decided to host onetime events such as a family fitness night or a fruit and vegetable tasting, while others created a 5k run that continued to occur past the life of the granting period.

As stated previously, the goal of this project was to understand how the totality of the Building Healthy Communities program could impact student achievement. Although some research aims to determine specific components and the impact they have on the outcome, it was the belief of this research team to try and understand the collective impact a culture of health

could have on the academic achievement of youth. Therefore, although these components are explained to understand the intervention, they were not looked at separately within the analysis.

Data Analysis

The missingness of the measures of interest in this study ranged from 2.2% (sex) to 20.4% (T2 AIMS). The data met univariate and multivariate values for normality. To reduce parameter estimate bias and improve generalizability and power,[60] T1-T2 dataset was imputed (m = 100). A principal component analysis (PCA) was conducted in SPSS, so that the saved PCA factors could be used to inform the imputation,[61] which was conducted in the R package mice.[62] The T2-DIBELS had a fraction missing information value of .291 and the relative efficiency of its parameter estimates was .997, while T2-AIMS was .124 and .999, respectively. Thus, supporting that the 100-imputed dataset approach was sufficient to recapture the missing information.[59-60] A supermatrix was then calculated to make a single, aggregated dataset for analysis.[63]

Two linear regression analyses were conducted in R to test the study hypotheses. Given there were significant differences between the two groups at T1 (pre), this analysis was chosen in order to control for T1 values on reading and math. T2 (post) reading comprehension (DIBELS) and math computation (AIMS) were used as the dependent variables, the intervention/comparison group variable was entered as a predictor. The students' age, sex, and race were entered as co-variates. Given, multiple schools were assigned to each group, the cluster option was used to adjust the standard errors to account for this nested structure. Cohen's *d* effect sizes were calculated with pooled variance (.20 = small, .50 = medium, .80 = large, 1.30 = very large).[64-65] Additionally, the ROIs for both the intervention and comparison groups'

AIMS and DIBELS was calculated. Then, the ROIs were compared between groups and to the national average DIBELS and AIMSweb ROIs.

RESULTS

The data showed significant correlations between T1 and T2 among the academic variables (Table 2). Regression analyses were run to determine differences in reading at T2 between the intervention and the comparison groups, controlling for age, sex, race, and T1 performance, while adjusting standard errors for students clustered within schools. The reading (DIBELS) regression revealed a significant difference between the intervention and comparison groups at T2, = 778.71, $p < .001$, Adj. $R^2 = .71$. The intervention group was significantly higher on reading (estimated marginal $M_{diff} = 2.84$, 95%CI [1.89, 3.78]) with a medium pooled Cohen's d effect size of .47 (T2intervention – T2comparison). Age ($p = .27$), sex ($p = .37$), and race ($p = .33$) were not significant covariates; T1 performance was significant ($p < .001$; Table 3).

A second regression was run to determine the differences in math at T2 between the intervention and the comparison groups. The math (AIMSweb) regression revealed a significant difference between the intervention and comparison groups at T2 for math, = 436.08, $p < 0.01$, Adj. $R^2 = 0.50$. The intervention group was significantly higher on math (estimated marginal $M_{diff} = 3.72$, 95%CI [1.14, 6.29]) with a medium pooled Cohen's d effect size of .40 ($T2_{intervention} – T2_{comparison}$). Again, age ($p = .67$), sex ($p = .92$), and race ($p = .16$) were not significant covariates; though the T1 performance was significant ($p < .001$; Table 3).

The AIMSweb national average math ROI is .50 correct per week increase. The average math ROI for the intervention group was .51, 95%CI [.45, .57], whereas the average for the comparison group was .42, 95%CI [.34, .50]. Therefore, the average math ROI was significantly ($p < .05$) higher for the intervention group in relation to the comparison group; however, neither

the intervention nor the comparison group's math ROIs were significantly different from the national average. The DIBELS national average reading ROI is .17 correct per week increase. The intervention group had a reading ROI of .25, 95%CI [.22, .27] and the comparison group had a ROI of .15, 95%CI [.12, .17]. Therefore, the average reading ROI for the intervention group was significantly ($p < .05$) higher than both the national and comparison group's average. The comparison group's average reading ROI was not significantly ($p > .05$) less than the national average

DISCUSSION

Academic achievement of youth in the U.S. is a top priority in schools. A major aim of this study was to better understand the relationship between the [INSERT NAME HERE] program, a comprehensive healthy eating and physical activity program, and its collective impact on academic achievement, specifically the core subjects of math and reading. Previous literature has investigated and indicated relationships between healthy eating, physical activity, fitness, and the academic achievement of students[29-32,41,51]; however, most research has siloed individual components of interventions such as physical activity, fitness, and nutrition. Few have examined the impact of a whole-of-school-approach and the overall impact that the intervention may have on student achievement. In the current study, we explored the collective impact of a comprehensive physical activity and healthy eating intervention on academic achievement in 5th grade youth. Results showed that even after controlling for class clustering effects, age, sex, race, and differences at T1, students' T2 reading and math achievement were significantly higher in the intervention group than the comparison group. This suggests that the comprehensive intervention approach proved successful in improving academic achievement for upper elementary aged students. This is further substantiated by the effect sizes, which were

moderately strong. This research is a contribution to the field as it begins to explore the collective impact that whole-of-school interventions may have on academic achievement.

Our study is timely and warranted given the push for schools to adopt comprehensive programming that fosters the whole child, and in the midst of a clear need to address health in our youth. By moving beyond measurement of individual intervention components this study begins to advance the consideration of additional factors and the variance they account for that may be missing in the current understanding of academic achievement. It is also important to note the rigor of the academic measures utilized in this study to understand change. Typically, comprehensive research that intermingles health and academic achievement uses measures of convenience such as grades and standardized test scores as proxies for academic factors. However, we assert that there are issues in using such measures. Grades are often subjective to the individual teachers and not a valid and reliable source,[66] while curriculum based measures are designed to show student growth and in a shorter period of time than traditional standardized tests.[67] Furthermore, curriculum based measures, like the ones used in this study are less susceptible to issues of bias based on race, sex, ethnicity and disability status because they rely on direct assessment of student performance.[68] We believe our use of formative and sensitive measurements of academic achievement may help to elucidate differences between prior and current inconsistent findings regarding the impact of such a comprehensive approach on achievement and encourage researchers to work alongside academic colleagues to administer and include more time sensitive assessment measures.

Perhaps most noteworthy and novel in this study was the expanded consideration beyond overall academic achievement scores to include an analysis of students' ROIs. This is important because many students start school behind their peers[69] and on many measures of achievement a

norm-referenced (compared to peers) standard score is utilized and growth is difficult to detect on such broad scores.[54] The current study accounted for this by analyzing students' individual differences as well as how they compared to the national average, rather than relying only on broad-based methods of detecting change over time. These expected rates of improvement have become increasingly important to track in K-12 schooling.[70] Guided by this rationale, it is compelling that when comparing the ROIs of students in the intervention group to national averages we saw positive findings. Specifically, the intervention group also had a significantly higher ROI than the national average in reading comprehension, but it was not significantly different in math. Additionally, the intervention group had a significantly higher ROI than the comparison group in both reading and math. That is, the intervention group at least kept pace with, and in some circumstances grew at a faster pace, than did their national norm group of peers. Coupled with our analyses that controlled for demographics, this is of principle interest seeing as though the national samples are not stratified by important demographics and are instead aggregated into one large national sample of tens and often hundreds of thousands of students.

Limitations

There are several limitations to be considered. First, this study focused on 5th grade students and, therefore, caution should be taken around drawing conclusions for students of different ages. Future research should be conducted to better understand generalizability across different elementary grades and ages. A second limitation is the quasi-experimental research design. Although a randomly designed intervention would be ideal, funding for this project was specified for intervention work that was embedded into and across the school day, which would not allow for randomized and matched controls. Nonetheless, the researchers worked within their

means to conduct the most robust quasi-experimental design as possible. Although precautions were taken within the analyses, future research should be designed within a randomized control trial design to examine if the design limitation could have effected results. Additionally, the focus of this study was not on the sustainability of the program and therefore did not track longitudinal changes in achievement. It was the desire of the researchers in this current study to understand the collective impact a comprehensive program had on the overall achievement of students. This is limited, as it does not lead interventionists to understand what specific part of the intervention is contributing to the overall change, nor does it allow differences to be examined between schools. Given in this specific situation we now know that the collective impact did, indeed, show improvements in achievement as compared to control schools, it is important for future studies to track changes in achievement and program fidelity to consider unique contributions of various components and youth behavior. Additionally, understanding the collective impact and tracking students beyond the initial intervention year to determine if program implementation and improvement in academic achievement continued after the initial intervention is warranted. Finally, given this study took place in [INSERT AREA] understanding the program's effects in other geographic regions should be undertaken.

Conclusions

Despite some limitations, this study has many strengths that we believe outweigh its limitations, including its sample size, the use of a treatment and comparison group, the academic achievement measurement methods, the analysis of ROI to compare to a national population in addition to the control group, and the comprehensive whole-of-school intervention approach. Furthermore, the effect sizes lend credibility to our findings and their applicability in other school settings. We believe that these results are robust enough to confidently conclude that this

whole-of-school approach will be replicable in other settings, even when considering its limitations. This is one of the few studies that begins to capture the effects of a whole-of-school intervention on the academic achievement levels of youth, and one of the only studies using curriculum-based measures in order to assess impact. Future studies should continue to evaluate the impact comprehensive programing has on youth achievement. Additional research is needed that examines the individual and additive contributions of program components to students' overall improvement in academic achievement.

IMPLICATIONS FOR SCHOOL HEALTH

Often times school personnel are investigating ways to increase academic achievement skills of students. Many of these efforts focus on time spent in curricular specific tasks. However, there is literature that suggests schools should look beyond curriculum in the academic arena and consider multifaceted approaches to increase academic achievement, including comprehensive school health programs. healthy eating, physical activity, and fitness have been linked to numerous cognitive processing variables that undoubtedly underlie academic achievement skills. We would acknowledge that there is a lot of pressure for administrators to actually minimize or even cut out from the school day anything that is not seemingly tied to academic gains. Although school personnel might be hesitant to increase time spent in "non-academic" activities, the results of this study allow us to advocate for administrators and educators alike to look beyond traditional conceptualizations of what drives academic success. Implementing school health programs that integrate opportunities for physical activity and healthy eating along with traditional academic preparation should be considered as a means to increase academic achievement in elementary school children. Comprehensive health

interventions could then be serving a dual purpose of increasing achievement and children's health outcomes.

Human Subjects Approval Statement

The study was approved by the [blinded peer review] Institutional Review Board (069012B3E).

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Figure 1. Consort diagram of schools included in the Building Healthy Communities Program

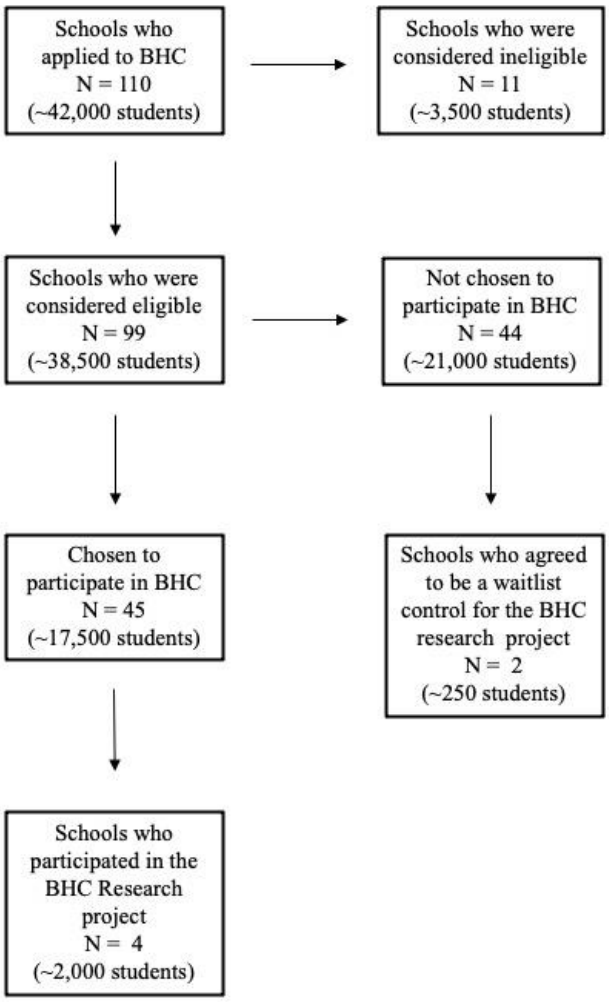

Table 1. School Information

	County	Free and Reduced Lunch Count	Number of Students	Number of Classrooms
Treatment Schools				
School 1	County A	23%	553	22
School 2	County A	22%	669	25
School 3	County A	20%	347	17
School 4	County B	12%	450	19
Comparison Schools				
School 5	County C	41%	455	17
School 6	County A	24%	580	21

Table 2.

Pooled Means and Correlations between control variables, pre and post reading and math by treatment and comparison group

	Age	Sex	Ethnicity	Pre-Reading	Pre-Math	Post-Reading	Post-Math
Age		-.02	.03	-.10	-.01	***-.11***	-.03
Sex	-.02		.06	.09	***-.13***	.08	-.10
Ethnicity	-.01	.03		.01	.10	-.01	.06
Pre-Reading	-.07	.09	.09		***.49***	***.82***	***.51***
Pre-Math	.01	-.04	.04	***.46***		***.50***	***.75***
Post-Reading	-.07	.12	.06	***.83***	***.43***		***.55***
Post-Math	.05	-.03	-.01	***.48***	***.65***	***.55***	
Treatment (M ± SD)	9.92 ± .36	1.54 ± .50	3.21 ± 2.34	20.45 ± 8.70	24.45 ± 19.12	27.94 ± 11.12	39.70 ± 21.93
Comparison (M ± SD)	10.02 ± .37	1.49 ± .50	3.47 ± 2.74	18.46 ± 7.74	18.75 ± 14.53	22.92 ± 9.82	31.22 ± 21.28

Note. The top right of the table represents the treatment group and the bottom left represents the comparison. The bold values are significant ($p \leq .05$). Bold and italics are significant ($p \leq .001$)

Table 3.

Regression Coefficient and Cohen's d values for each regression model

		Coefficient	S.E.	t-value	p-value	R-squared	Cohen's d
Reading	Treatment	2.84	0.52	29.92	< .001	.70	.47
	Age	-0.68	0.62	0.796	.37		
	Sex	0.32	0.36	0.792	.37		
	Race	-0.06	0.07	0.469	.49		
	Pre-Reading	1.05	0.02	46.29	< .001		
Math	Treatment	3.72	1.77	2.10	.04	.50	.40
	Age	0.91	2.16	0.42	.67		
	Sex	0.12	1.21	0.10	.92		
	Race	-0.28	0.20	-1.40	.16		
	Pre-Math	0.87	0.03	27.18	< .001		

Note. The covariates for each analysis were the students' age, sex, race, and pre-assessment values. The standard errors were corrected for the nested structure of data by using the cluster option with school. Regression coefficients are unstandardized. S.E. stands for Standard Error.