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## INTERVENING AT THE RIGHT LEVEL TO IMPROVE STUDENT HEALTH: AN ANALYSIS OF LEVELS OF INFLUENCE ON SEXUAL BEHAVIOR OF HIGH SCHOOL STUDENTS

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### Abstract

This study adopts a socio-ecological framework and examines school- and district-level influences on sexual behaviors among high school students from 16 school districts that were federally funded to conduct a school-based, multilevel sexual health program. We drew cross-sectional data from the 2015 and 2017 Youth Risk Behavior Survey from funded school districts containing 648 schools and 101,728 students. We used multilevel modeling to determine the percentage of variance in sexual health outcomes explained at school and district levels, overall and by race/ethnicity and biological sex. We found protective behaviors such as using hormonal birth control had considerable district-level variance (10.1%) while sexual risk behaviors such as having multiple sex partners showed considerable school-level variance (12.7%). We also found significant subgroup heterogeneity in the variance. Findings indicate school-based interventions

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should address all levels of influences of the educational system to effectively improve a myriad of student sexual health outcomes.

### Keywords

HIV; STI; teen pregnancy; sexual risk behaviors; youth; adolescent; school-based intervention; school district; implementation science; multilevel analysis

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## INTRODUCTION

Youth experience extensive hormonal, behavioral, and psychological changes in transitioning from adolescence to adulthood (Spear, 2000). During adolescence, many young people engage in sexual risk behaviors (e.g., multiple sexual partners) that contribute to negative health outcomes that impact their life course (Anda et al., 1999; Bernat et al., 2012; Felitti et al., 1998; Norman et al., 2012; Whitfield et al., 2003). From a socio-ecological perspective, many factors influencing adolescent sexual behaviors operate at individual, interpersonal, and institutional levels and thus may be best addressed by multilevel and systemic interventions (Cordova et al., 2020; Ethier et al., 2011; Mayberry et al., 2009; Perrino et al., 2000; Wight et al., 2006; Yildiz et al., 2019).

From 2013 to 2018, the Centers for Disease Control and Prevention ([CDC], 2018)'s Division of Adolescent and School Health (DASH) funded school districts to provide resources and assistance to schools to implement evidence-based approaches through a number of multilevel, multicomponent approaches to prevent student risk behaviors, with a focus on sexual behaviors. The program centered on health education, health service continuum, and safe and supportive environments to address student health from all levels; from individual-level factors (such as teaching skills to help adolescents access health care providers) to policy-level factors (such as policies that govern which services are available and how youth may access them). Although core activities were required of school districts (see Supplemental Table S1 for detailed activities and levels of implementation), districts had broad discretion in which activities were implemented and how they were implemented based on local needs and resources.

Robin et al. (2022) evaluated the effectiveness of the CDC DASH program, and evidence indicated that exposure to the program was associated with significant decreases in ever having sex, having four or more lifetime sexual partners, and being currently sexually active. However, exposure to the program was also associated with decreases in the use of effective hormonal birth control and with no change in condom use, use of both effective hormonal birth control and condoms at last intercourse, and HIV testing. We also evaluated how levels of program implementation affected the program effects and found that implementing more activities to enhance safe and supportive school environments was associated with enhanced program effects in improving student sexual health outcomes (Li et al., 2022).

By design, the DASH multilevel health program aimed to impact student health through implementing the program at every level of the educational system (e.g., school districts, schools, students). Decisions regarding health programs, education, and services are often

made at these levels, and each of these levels of influence impacts individual student health behaviors significantly in the form of service and resource allocation. For the multilevel program to be successful, it is important for activities at all levels of the educational system to be coordinated to achieve maximum intervention effects.

To date, little evidence exists to examine the influence of each level of educational systems on student health behaviors (Acosta et al., 2019; Bohanon et al., 2016; Lindberg et al., 2020; Shackleton et al., 2016). As part of a broader evaluation of the CDC DASH program, our aim is to measure the amount of influence of the school and district levels on student sexual health behaviors. Understanding the influence of schools and school districts on student sexual behaviors may help develop or refine interventions for these settings. A secondary aim of this study is to examine any school or district level impacts on variance in these outcomes by racial/ethnic subgroups and by sex. Understanding differences in variance among these groups may allow tailoring of programs to better address their specific contexts.

Understanding the role of each level of the educational system in adolescent risk behaviors is key to effectively allocating intervention efforts and resources to affect risk behaviors at the appropriate levels.

## **METHODS**

### **DATA SOURCE**

Student-level health experiences and outcomes were collected through repeated cross-sectional data from the Youth Risk Behavior Survey (YRBS) in 2015 and 2017. The YRBS is a biennial survey that includes school-based national, state, tribal, and large urban school district surveys of high school students. The YRBS uses a two-stage cluster sample design to collect representative samples of 9th–12th grade students who attend public and private schools (Brener et al., 2013). More details about YRBS survey administration and data collection are described elsewhere (Underwood et al., 2020).

Between 2013 and 2018, CDC DASH funded 17 urban school districts in nine states (California, Florida, Ohio, Illinois, Massachusetts, Pennsylvania, New York, Tennessee, Texas) and Washington, DC. These funded school districts implemented a school-based, multilevel, multicomponent program to address student health and administered the YRBS in 2015 and 2017. For the current study, one school district was excluded from the sample due to a low response rate for the YRBS (an average of 20% response rate in this district). The sample further excluded students who had missing values in demographic data or selected “ungraded” as their grade in school. The final analytic sample included 16 school districts containing 648 schools and 101,728 students in both years combined.

### **MEASURES**

Student health outcomes, operationalized YRBS items, and their analytic coding are listed in Table 1. Primary outcomes of interest included (a) having ever had sex, (b) having had four or more lifetime sexual partners, (c) being currently sexually active, (d) use of effective hormonal birth control, (e) using a condom during last sexual intercourse, (f) using

a condom and effective hormonal birth control, and (g) having ever tested for HIV. Three outcomes were analyzed only for students who self-reported being currently sexually active (see Table 1). All variables were dichotomized.

## DATA ANALYSIS

Multilevel analysis can reveal whether individual outcomes are statistically dependent on the contexts of the respondents (Luke, 2004). When student data are clustered within schools and schools within the districts, this data structure may demonstrate a clustering/nesting effect upon the outcome and needs to be accounted for to obtain accurate regression estimates. Not only can multilevel analysis control for clustering effects, but it can also determine the amount of the variance in the outcomes attributable to school and school district levels (Luke, 2004; Merlo, Chaix et al., 2005a, 2005b). As such, we constructed three-level multilevel logistic regression models to account for nesting of 101,728 students (level 1) in 648 schools (level 2) within 16 school districts (level 3). We began by conducting a descriptive analysis of individual-level outcomes. As our goal was to determine the variances in the outcomes attributable to each level of the educational system, we then constructed an empty multilevel model for each outcome, which only included a random intercept (see Supplemental Figure S1 for Equation 1).

Based on the unconditional model's output, variance components for school- and district-levels were calculated (Merlo, Chaix, et al., 2005a; Merlo, Yang, et al., 2005). The variance component is the proportion of total variance in the outcomes resulting from the influence of the school level (see Supplemental Figure S1 for Equation 2) or district level (see Supplemental Figure S1 for Equation 3). Statistically, a variance component of 5% at school-level means that 5% of the variance in the odds of the outcome among students was apportioned to the school-level. Similarly, a variance component of 10% at district-level would mean that 10% of the variance in the odds of the outcome among students was apportioned to the district-level. The higher the variance percentage at a given level, the greater influence that level has on the outcome. For the race/ethnicity-specific or sex-specific variance component, we limited the samples to certain races/ethnicities or sexes and applied the same variance component equation. SAS 9.4 (SAS Institute, Cary, NC) was used for all statistical analyses.

## RESULTS

### DESCRIPTIVE STATISTICS

Table 2 shows descriptive statistics of the sample's demographic and outcome variables for both years combined. Overall, 50.6% of students were female, 39.1% were Hispanic/Latino, and students were evenly distributed by grade. Among all students, 36.5% reported ever having sex, 25.4% reported currently being sexually active, 21.0% had ever tested for HIV, and 10.4% had four or more lifetime sexual partners. Among students who were currently sexually active, 58.1% reported using a condom during last sexual intercourse, 18.9% used effective hormonal birth control, and 6.7% reported using both a condom during last sex and effective hormonal birth control.

## VARIANCE COMPONENTS

The results of the variance component analysis for outcomes for overall students, by race/ethnicity, and by sex are presented in Tables 3 and 4. We bolded variance percentages that are greater than 10% to better illustrate prominent findings.

Collectively, more than 10% of the variance in sexual risk behaviors (i.e., ever had sex, had four or more lifetime sexual partners, and currently sexually active) was attributable to levels of the educational system (i.e., school and district levels combined); and 13.3% and 14.6% of the variance in using hormonal birth control and ever tested for HIV were attributable to the educational system, respectively (Table 3 Total; Table 4 Total). In terms of district-level variance (Tables 3 and 4), 10.1% and 6.1% of the variance in the odds of using hormonal birth control and ever tested for HIV were apportioned to the district-level, respectively. In terms of school-level variance (Tables 3 and 4), 11.5% of the variance in the odds of ever had sex, 12.7% of the variance in the odds of having four or more lifetime sexual partners, and 9.2% of the variance in the odds of being currently sexually active were apportioned to school-level, respectively.

We also present the variance apportioned to school- and district-levels for each racial/ethnic group (Table 3, column W to column O) and for biological sex (Table 4, columns Male and Female). We observed racial/ethnic differences in the variance apportioned to school and district levels. For example, students in the other race category had the highest percentage of variance (18.4%) in the odds of having had four or more lifetime sexual partners that was apportioned to school level, followed by non-Hispanic Black (11.8%), non-Hispanic White (9.3%), and finally Hispanic/Latino (7.6%) students. In contrast, Hispanic/Latino students reported the highest percentage of variance (11.8%) in the odds of using hormonal birth control apportioned to the district level, followed by non-Hispanic Black (10.5%), other race (10.2%), and finally non-Hispanic White (5.8%) students.

Only a few outcome variables show notable differences in the variance composition by biological sex. These included having four or more sexual partners (14.5% school-level variance in male students vs. 9.8% in females) and the use of hormonal birth control (12.4% district-level variance in female students vs. 7.4% in males).

## DISCUSSION

Multilevel interventions are much more effective in achieving desired outcomes than single level interventions, particularly when there is coordinated design and implementation of programmatic elements across levels (Anderson & O'Donnell, 1994; Stokols, 1996). A prominent question when evaluating multilevel interventions is whether the intervention at one level facilitates or hinders the intervention at another level. Assessing this is important because without understanding the effect of each level on intervention outcomes, it is difficult to understand why the intended outcomes were or were not achieved. Additionally, a multilevel intervention is more likely to be transferred successfully to other settings when we know how each level of the intervention affects the intended outcomes. Hence, a major task when evaluating a multilevel intervention is researching multiple levels of influence of the intervention setting.

This study is a first step in understanding how district and school levels affect the CDC DASH program in addressing students' sexual health outcomes. We examined school- and district-level variance in students' sexual health outcomes among 16 urban school districts that received CDC DASH funding and found the use of hormonal birth control has considerable variance (10.1%) at the district level while ever having sex, having four or more lifetime sexual partners, and being currently sexually active show considerable variance (around 10%) at the school level. We also found noticeable heterogeneity in those variances across race/ethnic subgroups and sexes. These findings confirm the importance of multilevel interventions to attend to school- and district-level influences that may impact sexual health programming and sheds light on future intervention program design.

In our previous evaluation of the CDC DASH school-based adolescent health program, we found that exposure to the program was associated with reduced use of effective hormonal birth control and not associated with having ever tested for HIV (Robin et al., 2022). The current study provides the evidence that the district-level variance had considerable influence on these two student outcomes (10.1% and 6.1%, respectively). This finding indicates that district-level influences that may include district and community characteristics and state education and health policies and guidance (Guttmacher Institute, 2021; Westbrook et al., 2022) may impact students' uptake of these protective behaviors to a considerable degree. To date, little research has explored district-level influences on student-level outcomes and few school-based interventions address these influences. Future research is warranted to determine which specific district-level factors influence students' hormonal birth control use and HIV testing. Such research could provide insights to help strengthen the development of district-level strategies for a more effective school-based multilevel health program.

We also found notable school-level variance in having ever had sex (11.5%), having four or more lifetime sexual partners (12.7%), and being currently sexually active (9.2%). This finding is consistent with previous evidence that school environments are important influences on student sexual risk behaviors (Elkington et al., 2011; Holt et al., 2013; Marschall-Lévesque et al., 2014; Ramirez-Valles et al., 1998; Ritchwood et al., 2015; Teitelman et al., 2008). This finding reinforces the need to strengthen school-level activities including health education, health and mental health services, and increasing student connectedness to their schools to better address students' sexual risk behaviors (Boyer et al., 2000; Cordova et al., 2020; Fletcher et al., 2008; Li et al. 2022; Mayberry et al., 2009; Perrino et al., 2000; Poteat et al., 2013; Shackleton et al., 2016).

Our findings show noticeable racial/ethnic and between-sex differences in most outcomes, indicating that school and district levels differentially influence students' sexual health outcomes. For example, the district level had more influence on use of hormonal birth control among non-Hispanic Black, Hispanic/Latino, and other race students than on non-Hispanic White students. Similarly, the district level had more influence on female students' use of hormonal birth control than on male students' use. At the school level, there was some evidence of differential impact by race and gender. For example, the school level had more influence on non-Hispanic Black and other race students' likelihood of four or more sexual partners than for their White and Hispanic peers. Similarly, the school level

had more influence on male students' likelihood of having four or more sexual partners than for female students. Further research on these differential impacts by race and sex could facilitate the identification of effective intervention elements in schools, districts, communities, and state health and education agencies that could help to reduce health disparities by race, ethnicity, and sex.

## LIMITATIONS

This study has several limitations. We did not measure all ecological contexts such as classroom, home, or neighborhood that could simultaneously influence youth health. Additionally, although we were able to partition the variance at different levels, identifying specific mediating variables at the school and district levels was beyond the scope of this study. Therefore, future research needs to explore the extended characteristics of school and districts to explain the variation in youth health outcomes between schools and districts. Finally, this analysis included students in 16 DASH-funded school districts and our findings cannot be generalized beyond them.

## CONCLUSIONS

As part of a larger evaluation of the CDC DASH program, this study examined levels of influence of the educational system on student sexual health outcomes that might be overlooked in a single-level analysis. Specifically, students' use of effective hormonal birth control and HIV testing showed sizeable district-level variance and their sexual behaviors showed considerable school-level variation. We also found notable heterogeneity in these variances across racial/ethnic groups and sexes.

This study sheds new light on the findings of a previous evaluation of the CDC DASH program and has important implications for future intervention programming. It reveals the need to investigate the specific drivers of district-level influences on use of effective hormonal birth control and having ever tested for HIV and reinforces the needs to incorporate school-level activities to address school-level influences on student sexual risk behaviors. Additionally, depending on the outcome and depending on the racial/ethnic group, school and district administrators, teachers, and staff may need to consider the specific impact of school and district contexts on intended populations when tailoring program efforts.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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**TABLE 1.**

Outcome Variable, Youth Risk Behavior Survey (YRBS) Item, and Analytic Coding for Sexual Health Outcomes, 2015 and 2017

Outcome Variable	YRBS Item	Analytic Coding
Ever had sex	Have you ever had sexual intercourse?	0 = No; 1 = Yes
Had 4 or more lifetime sexual partners	During your life, with how many people have you had sexual intercourse?	0 3 people 1 4 people
Currently sexually active	During the past 3 months, with how many people did you have sexual intercourse?	0 = None 1 1 people
Effective hormonal birth control use <sup>a</sup>	The last time you had sexual intercourse, what one method did you or your partner use to prevent pregnancy? (Select only one response.) (Responses include birth control pills; an IUD; implant; shot; patch; or birth control ring)	0 = None of those responses 1 = One of those responses
Used a condom during last sexual intercourse <sup>a</sup>	The last time you had sexual intercourse, did you or your partner use a condom?	0 = No; 1 = Yes
Condom and effective hormonal birth control use <sup>a</sup>	“Yes” responses to one or more “used effective hormonal birth control” responses and “used a condom during last sex”	0 = Yes to one or none 1 = Yes to both
Ever tested for HIV	Have you ever been tested for HIV, the virus that causes AIDS? (Do not count tests done if you donated blood.)	0 = No; 1 = Yes

<sup>a</sup>This question was only asked if the participants self-reported being currently sexually active.

**TABLE 2.**

Individual-Level Characteristics Among All Students ( $N = 101,728$ ), Youth Risk Behavior Survey (YRBS), 2015 and 2017

Variable	<i>n</i> (%)
<b>Sex (<math>n = 100,485</math>)</b>	
Male	49,608 (49.4)
Female	50,850 (50.6)
<b>Race/ethnicity (<math>n = 95,911</math>)</b>	
Non-Hispanic White	11,396 (11.9)
Non-Hispanic Black	32,000 (33.4)
Hispanic/Latino	37,489 (39.1)
Other <sup>a</sup>	15,026 (15.7)
<b>Grade (<math>n = 101,728</math>)</b>	
9th	26,733 (26.3)
10th	26,774 (26.3)
11th	23,605 (23.2)
12th	22,684 (22.3)
<b>Ever had sex<sup>b</sup> (<math>n = 78,390</math>)</b>	28,623 (36.5)
<b>Had four or more lifetime sexual partners<sup>b</sup> (<math>n = 73,754</math>)</b>	7,695 (10.4)
<b>Were currently sexually active<sup>b</sup> (<math>n = 76,091</math>)</b>	19,338 (25.4)
<b>Used a condom during last sexual intercourse<sup>c</sup> (<math>n = 18,148</math>)</b>	10,539 (58.1)
<b>Used effective hormonal birth control<sup>c</sup> (<math>n = 19,656</math>)</b>	3,712 (18.9)
<b>Used a condom and effective hormonal birth control<sup>c</sup> (<math>n = 17,211</math>)</b>	1,159 (6.7)
<b>Ever tested for HIV<sup>b</sup> (<math>n = 84,876</math>)</b>	17,844 (21.0)

<sup>a</sup>“Other” includes American Indian or Alaska Native, Asian, Native Hawaiian or other Pacific Islander, and multiracial;

<sup>b</sup>The denominator of this variable is all students;

<sup>c</sup>The denominator of this variable is students who self-reported being currently sexually active.

**TABLE 3.**

Percentage Variance in the Odds of Outcomes at School and District Levels: By Race/Ethnicity, Youth Risk Behavior Survey (YRBS), 2015 and 2017

Variable	Percentage (%) variance in the outcome apportioned to school and district levels										
	School level						District level				
	Total <sup>a</sup>	All <sup>b</sup>	W <sup>c</sup>	B <sup>d</sup>	H <sup>e</sup>	O <sup>f</sup>	All <sup>b</sup>	W <sup>c</sup>	B <sup>d</sup>	H <sup>e</sup>	O <sup>f</sup>
Ever had sex <sup>1</sup>	<b>13.5</b>	<b>11.5</b>	7.2	9.2	7.1	<b>14.2</b>	2.1	2.9	7.0	1.7	3.3
Had 4 or more lifetime sexual partners <sup>1</sup>	<b>15.4</b>	<b>12.7</b>	9.3	<b>11.8</b>	7.6	<b>18.4</b>	2.7	1.0	1.7	1.9	3.4
Currently sexually active <sup>1</sup>	<b>10.9</b>	9.2	5.0	8.6	5.3	<b>12.6</b>	1.7	2.2	5.6	1.6	2.5
Used a condom during last sex <sup>2</sup>	1.3	0.7	2.5	1.0	0.3	0.0	0.6	0.8	0.8	0.6	0.8
Used hormonal birth control <sup>2</sup>	<b>13.3</b>	3.2	1.7	1.0	3.4	0.8	<b>10.1</b>	5.8	<b>10.5</b>	<b>11.8</b>	<b>10.2</b>
Used a condom & hormonal birth control <sup>2</sup>	3.7	1.6	NA	0.0	0.1	3.1	2.2	NA	4.0	3.6	1.5
Ever tested for HIV <sup>1</sup>	<b>14.6</b>	8.5	8.7	6.4	5.2	8.6	6.1	0.9	8.9	7.1	4.9

<sup>a</sup>Total variance = school-level variance + district-level variance regardless of race/ethnicity;

<sup>b</sup>All: variance apportioned to this level regardless of race/ethnicity;

<sup>c</sup>Non-Hispanic White;

<sup>d</sup>Non-Hispanic Black;

<sup>e</sup>Hispanic/Latino;

<sup>f</sup>Other races.

<sup>1</sup>Of all youth;

<sup>2</sup>Of currently sexually active youth.

NA: estimate approaching zero infinitely, thus there is no significant variance.

Bold values indicate variance greater than 10%.

**TABLE 4.**

Percentage Variance in the Odds of Outcomes at School and District Levels: By Biological Sex, Youth Risk Behavior Survey (YRBS), 2015 and 2017

Variable	Percentage (%) variance in the outcome apportioned to school and district levels						
	School level				District level		
	Total <sup>a</sup>	All <sup>b</sup>	Male	Female	All <sup>b</sup>	Male	Female
Ever had sex <sup>1</sup>	<b>13.5</b>	<b>11.5</b>	<b>11.2</b>	<b>10.6</b>	2.1	2.8	1.7
Had 4 or more lifetime sexual partners <sup>1</sup>	<b>15.4</b>	<b>12.7</b>	<b>14.5</b>	9.8	2.7	3.3	2.9
Currently sexually active <sup>1</sup>	<b>10.9</b>	9.2	8.7	9.0	1.7	1.9	1.5
Used a condom during last sex <sup>2</sup>	1.3	0.7	0.6	1.5	0.6	0.7	0.9
Used hormonal birth control <sup>2</sup>	<b>13.3</b>	3.2	3.3	2.4	<b>10.1</b>	7.4	<b>12.4</b>
Used a condom & hormonal birth control <sup>2</sup>	3.7	1.6	3.1	1.1	2.2	0.3	1.7
Ever tested for HIV <sup>1</sup>	<b>14.6</b>	8.5	6.5	9.9	6.1	6.1	6.5

<sup>a</sup>Total variance = school-level variance + district-level variance regardless of biological sex;

<sup>b</sup>All: variance apportioned to this level regardless of biological sex.

<sup>1</sup>Of all youth;

<sup>2</sup>Of currently sexually active youth.

Bold values indicate variance greater than 10%.