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# Chaos, Hubbub, and Order Scale and Health Risk Behaviors in Adolescents in Los Angeles

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**Objective** To determine the relationship between household chaos and substance use, sexual activity, and violence-related risk behaviors in adolescents.

**Study design** We analyzed cross-sectional data among 929 high-school students in Los Angeles who completed a 90-minute interview that assessed health behaviors and household chaos with the 14-question Chaos, Hubbub, and Order Scale (CHAOS). Using the generalized estimating equation and adjusting for personal, parental, and family covariates, we examined associations of CHAOS score with substance use, sexual activity, and violent behavior outcome variables. We also examined the role of depression and school engagement as mediators.

**Results** Mean (SD) age of the 929 students was 16.4 (1.3) years, 516 (55%) were female, and 780 (84%) were Latino. After adjustment, compared with students with CHAOS score 0, those students with the greatest scores (5-14) had ORs of 3.1 (95% CI 1.1-8.7) for smoking, 2.6 (95% CI 1.6-4.4) for drinking, 6.1 (95% CI 1.8-21) for substance use at school, and 1.9 (95% CI 1.1-3.3) for fighting in the past 12 months. Associations between CHAOS score and sexual risk and other violent behaviors were not significant. Depression and school engagement attenuated the associations.

**Conclusions** In this group of adolescents, greatest CHAOS score was associated with increased odds of risky health behaviors, with depression and school engagement as potential mediators. In the future, CHAOS score could be measured to assess risk for such behaviors or be a target for intervention to reduce chances of engaging in these behaviors. (*J Pediatr* 2015;167:1415-21).

Chaos has been defined as the overall physical, social, and environmental disorder in a person's life<sup>1</sup> and may be an important but understudied determinant of health. The Chaos, Hubbub, and Order Scale (CHAOS) assesses the amount of disorder in the home environment<sup>1</sup> and has been linked longitudinally in children and adolescents to increased psychological distress,<sup>2</sup> learned helplessness,<sup>3</sup> and poor self-regulatory ability.<sup>4</sup> A chaotic home environment also has been shown to be longitudinally associated with more conduct problems and hyperactivity-inattention in childhood and early adolescence.<sup>5</sup> Despite the evidence that household chaos is associated with the aforementioned poor psychosocial outcomes in children, we are unaware of studies in which authors have examined the relationship between household chaos and health behaviors in adolescents.

Risky health behaviors—such as substance use, sexual risk behaviors, and violent behaviors—often are acquired during adolescence<sup>6</sup> and contribute significantly to morbidity and mortality.<sup>7,8</sup> According to Youth Risk Behavior Surveillance System (YRBSS) data from 2013, 16% of teens have smoked cigarettes in the past 30 days, 34% report having been sexually active, and 18% have carried weapons in the past 30 days.<sup>6</sup> Household chaos, through effects on self-regulatory ability, disruptive behaviors, or other mechanisms, could be a predisposing factor for risky health behaviors in adolescents, or could be an important downstream effect of risky behaviors, but has not been studied in this context. Understanding the association of chaos and adolescent health risk behaviors is an important first step in exploring the relationship.

The objective of our study was to determine whether household chaos is associated with self-reported engagement in health risk behaviors in a sample of low-income, minority high school students. We hypothesized that a greater CHAOS score, because it is associated with increased psychological distress and decreased self-regulatory ability in adolescents, ultimately would be associated with a greater risk of substance use, risky sexual behaviors, and violent behaviors.

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A-CASI	Audio-enhanced computer-assisted self-interview
CES-D	Center for Epidemiologic Studies Depression Scale
CHAOS	Chaos, Hubbub, and Order Scale
RISE	Reducing Health Inequalities through Social and Educational Change
YRBSS	Youth Risk Behavior Surveillance System

## Methods

The Reducing Health Inequalities through Social and Educational Change (RISE) study was a cross-sectional natural experimental study originally designed to examine the impact of exposure to high-performing school environments on risky behaviors among low-income adolescents.<sup>9</sup> In 2010 and 2011, the study sampled students who had applied to enter 1 of 3 high-performing charter high schools in Los Angeles between 2007 and 2010. Admission into these schools was determined by lottery. The RISE study compared those who were and were not accepted into these charter schools and thus included some students who attended traditional public schools. We examined data from all participants who completed the face-to-face survey. The RISE study received approval from the Medical Institutional Review Board of the University of California, Los Angeles, and this study was granted exemption from review by the Institutional Review Board of the Harvard Pilgrim Health Care Institute.

Investigators accessed lists of applicants to the 9th-grade lottery for the 3 charter schools in 2007-2010. Investigators randomly selected 2384 students from the list of applicants, 952 of whom had been accepted to attend charter schools by lottery, and 1432 of whom had not. Of the potential participants, 410 could not be contacted, and 736 were ineligible because they attended a private school, a charter school outside of the lottery, or received preference in the charter school lottery because they had a sibling at the charter school. Of the remaining students, 308 refused to participate (24.9% refusal rate). We excluded 1 subject who only answered the demographic questions, leaving 929 students who completed the interviews and whose data we analyzed.<sup>9</sup>

After receiving written consent, research assistants administered a 90-minute interview with students to assess their demographics, school information, depression (the 20-item Center for Epidemiologic Studies Depression Scale, CES-D),<sup>10</sup> school engagement,<sup>11</sup> and parenting style.<sup>12</sup> Investigators measured household chaos using the CHAOS questionnaire, 14 yes-no items such as—"we almost always seem to be rushed," and "it's a real zoo in our home" (Table I).<sup>1</sup> The CHAOS questionnaire was derived from

observations and parent interviews from hundreds of home visits during the Louisville Twin Study in the 1980s<sup>1,13</sup> and subsequently validated and used widely in children and adolescents.<sup>1,5,14</sup> In a sample of 123 families in the Louisville study, the CHAOS questions had a Cronbach alpha of 0.79, and when validated against direct observation in a sample of 52 families, had a high correlation with observer-reported measures of household chaos.<sup>1</sup> The CHAOS questionnaire also has been shown to be reliable and valid in Latino families. In a study of the CHAOS questionnaire in the families of 68 Latino children, the instrument was found to have similar reliability (Cronbach alpha of 0.79) and high convergent validity against other measures of parental stress and child behavior.<sup>15</sup>

Research assistants conducted interviews in as private a setting as possible, at the student's home, school, or in a public place without parents present. All participants were able to complete the interview in English. Subjects completed sensitive portions of the interview, including report of the health risk behaviors via audio-enhanced computer-assisted self-interview (A-CASI). A-CASI has been shown to be more sensitive than in-person interview for sensitive topics.<sup>16</sup> RISE Investigators drew questions about health risk behaviors from the Youth Risk Behavior Survey.<sup>17</sup> Using an iPad (Apple Inc, Cupertino, California), students could themselves read and then respond to the questions, or click a button to have the computer read the question to them, and then respond.

Primary outcomes included questions about substance use (tobacco use, alcohol use, or marijuana use in the past 30 days, or any substance use at school in the past 30 days), sexual activity (whether students had had sexual activity in the past 90 days, whether they had used contraception at their last sexual encounter, or whether they had used substances during sex in the past 90 days), and violent behaviors (whether students had carried a weapon in the past 30 days, whether the student had been involved in a gang in the past 12 months, or whether the student had been in a fight in the past 12 months).

## Data Analyses

We summed the 14 individual CHAOS items to create a composite score on a 0-14 scale. In preliminary bivariate analysis, we found the relationship between CHAOS and risk behavior outcomes to be nondichotomous and nonlinear, and given the sample size and prevalence of primary outcomes, we divided the subjects into 4 roughly equal groups by CHAOS score—score 0, 1-2, 3-4, and 5-14. We dichotomized responses to questions about risky health behaviors.

We used the generalized estimating equation to examine the relationship between chaos and risky health behaviors, accounting for clustering at the school level by adding terms for fixed effects of each school. We sequentially added sets of covariates to control for pre-specified individual, family history, parental socioeconomic factors, and school type (traditional public vs charter). We prespecified covariates on the basis of previous evidence of association with CHAOS score, health risk behavior or both—it is known, for example, that

**Table I. The CHAOS Questionnaire**<sup>14</sup>

For each of the following statements, please tell me whether you think it is true or false for you.

1. There are very few disturbances in our home.
2. We can usually find things when we need them.
3. We almost always seem to be rushed.
4. We are usually able to stay on top of things.
5. No matter how hard we try, we always seem to be running late.
6. It's a real zoo in our home.
7. At home we can talk to each other without being interrupted.
8. There is a lot of needless worrying going on in our home.
9. No matter what our family plans, it usually doesn't seem to work out.
10. It's so noisy, you can't hear yourself think in our home.
11. I often get drawn into other people's arguments at home.
12. Our home is a good place to relax.
13. The telephone takes up a lot of our time at home.
14. The atmosphere in our home is calm.

**Table II.** Characteristics of 929 high school students in Los Angeles, ages 13-19 years, in the RISE study

	Overall, N = 929	CHAOS score			
		0, n = 165	1-2, n = 303	3-4, n = 206	5-14, n = 255
Sex					
Male	413 (44)	74 (45)	443 (47)	96 (47)	100 (39)
Female	516 (56)	91 (55)	160 (53)	110 (53)	155 (61)
Race					
Latino	780 (84)	127 (77)	244 (81)	182 (88)	228 (89)
African-American	117 (13)	31 (19)	48 (16)	19 (9)	19 (7)
Other	32 (3)	7 (4)	11 (3)	5 (3)	8 (4)
CES-D 20 score					
<16	665 (72)	141 (85)	258 (85)	134 (65)	132 (52)
16-26	191 (21)	21 (13)	35 (12)	54 (26)	81 (31)
≥27	73 (8)	3 (2)	10 (3)	18 (9)	42 (16)
Parenting style					
Normal	584 (63)	113 (69)	206 (68)	134 (65)	131 (51)
Neglectful	146 (16)	5 (3)	23 (8)	31 (15)	87 (34)
Indulgent	55 (6)	12 (7)	22 (7)	12 (6)	9 (4)
Authoritative	88 (9)	30 (18)	39 (13)	14 (7)	5 (2)
Authoritarian	54 (6)	3 (2)	13 (4)	15 (7)	23 (9)
≥1 parent works full-time	852 (92)	152 (92)	287 (95)	184 (89)	229 (89)
Family history					
Parent smokes	247 (27)	41 (25)	74 (24)	62 (30)	70 (28)
Alcohol	121 (13)	4 (3)	27 (9)	31 (15)	59 (24)
Drugs	49 (5)	11 (4)	11 (4)	8 (4)	27 (11)
Smoking in past 30 d	87 (9)	5 (3)	21 (7)	23 (11)	38 (15)
Alcohol use in the past 30 d	308 (34)	32 (19)	93 (31)	68 (33)	115 (46)
Marijuana in the past 30 d	190 (21)	22 (13)	56 (19)	47 (23)	65 (26)
Sex in the past 90 d	247 (27)	41 (25)	67 (22)	54 (26)	85 (34)
No contraception at last encounter	109 (13)	18 (12)	28 (10)	25 (13)	38 (17)
Substance use with sex in the past 3 mo	66 (7)	6 (4)	14 (5)	13 (6)	33 (13)
Substance use at school in past 30 d	100 (11)	4 (2)	27 (9)	24 (12)	45 (18)
Fight in the past 12 mo	224 (24)	25 (15)	66 (22)	58 (28)	75 (29)
Gang involvement in past 12 mo	32 (3)	2 (1)	8 (3)	8 (4)	14 (6)
Carrying weapon in past 30 d	59 (6)	5 (3)	16 (3)	12 (6)	26 (10)

Values are n (%).

age and race/ethnicity are associated with substance use in adolescents,<sup>6</sup> as are socioeconomic status,<sup>18</sup> parenting style,<sup>19</sup> and family history.<sup>20</sup> Model 0 is unadjusted for any covariates. In Model 1, we added the individual-level covariates grade in school, sex, race/ethnicity, and school type. In Model 2, we included the parental-level covariates parenting style and student-report of whether at least one parent works. In Model 3, we included student report of whether at least one parent smoked or whether a family member had an alcohol or drug problem. In Model 4, we introduced the potential mediators of depression and school engagement to look for attenuation in the relationship between CHAOS score and risk behaviors.

Sixteen participants (1.7%) left 1 or more CHAOS questions unanswered, and outcome variables had 12 or fewer missing values (<2%). We imputed missing data by using multiple imputation methods developed by Rubin<sup>21</sup> and Schafer.<sup>22</sup> We used Stata version 11 for all analyses (Stata-Corp, College Station, Texas). Conducting the analyses with complete cases only did not change our findings.

## Results

The 929 participants had a mean (SD) age of 16.4 (1.3) years, and 44% were male. Eighty-four percent of students were Latino, 10% African-American, and 3% of other

race. On the CHAOS scale, 165 (17.7%) had a score of 0, 303 (32.6%) had a score of 1-2, 206 (22.2%) had a score of 3-4, and 255 (27.4%) had a score of 5-14. Cronbach alpha for the CHAOS scale in our sample is 0.78 compared with 0.79 in the original sample from which the measure was developed.<sup>1</sup> Twenty-seven percent of students reported having at least 1 parent who smoked, and 92% reported having at least 1 parent who worked. On the CES-D questionnaire, 21% of students had a score between 16 and 26, which is consistent with minor depression, and 7% had a score consistent with major depression. Nine percent reported smoking a cigarette in the past 30 days, 34% reported drinking alcohol in the past 30 days, 21% reported smoking marijuana in the past 30 days, and 11% reported using any substance at school in the past 30 days. Twenty-seven percent reported being sexually active in the past 90 days, 13% reported not using any contraception at their previous sexual encounter, and 7% reported using substances with sexual activity in the past 3 months. Twenty-four percent reported having been in a fight in the previous 12 months, 3% endorsed gang activity in the past 12 months, and 6% reported having carried a weapon in the past 30 days (Table II).

In unadjusted analysis, greater household chaos was associated with greater risk of engaging in substance use, sexual, and violent risk behaviors (Table III). The relationship between

**Table III.** Cross-sectional association of CHAOS with health risk behaviors among 929 adolescents in Los Angeles, ages 13-19 years

CHAOS score	Substance use risk behaviors					Sexual risk behaviors			Violence-related risk behaviors		
	Smoking in the past 30 d	Alcohol in the past 30 d	Marijuana in the past 30 d	Any substance use at school in the past 30 d	Sex in the past 90 d	No contraception at last sexual encounter	Substance use with sex in the past 30 d	Fight in the past 12 mo	Carrying a weapon in the past 30 d	Gang involvement in the past 12 mo	
<b>Model 0</b>	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	
0	2.2 (0.9-5.5)	1.9 (1.2-2.9)	1.5 (0.9-2.5)	3.3 (1.0-11)	0.8 (0.5-1.3)	0.9 (0.4-1.6)	1.2 (0.5-3.2)	1.5 (0.9-2.4)	1.8 (0.6-5.1)	2.2 (0.5-9.9)	
1-2	3.6 (1.4-9.1)	2.0 (1.2-3.3)	1.9 (1.1-3.3)	5.0 (1.5-16)	1.1 (0.7-1.7)	1.3 (0.7-2.6)	1.7 (0.5-4.6)	2.1 (1.3-3.5)	2.0 (0.7-6.0)	3.1 (0.7-14)	
3-4	4.9 (2.0-11.9)	3.4 (2.1-5.4)	2.1 (1.3-3.6)	8.2 (2.6-26)	1.5 (1.0-2.3)	1.7 (0.9-3.1)	3.7 (1.5-9.0)	2.2 (1.4-3.6)	3.7 (1.4-9.9)	4.5 (1.1-19)	
5-14	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	
<b>Model 1</b>	2.4 (0.9-6.6)	1.8 (1.1-2.9)	1.5 (0.8-2.5)	3.5 (1.0-12)	0.8 (0.5-1.3)	0.9 (0.4-1.7)	1.2 (0.5-3.2)	1.5 (0.9-2.6)	1.9 (0.7-5.3)	2.4 (0.5-12)	
0	4.2 (1.5-11.4)	2.1 (1.2-3.4)	2.2 (1.2-3.8)	5.7 (1.6-20)	1.2 (0.7-2.0)	1.5 (0.7-2.9)	1.8 (0.7-4.9)	2.2 (1.3-3.8)	2.0 (0.7-6.0)	3.8 (0.8-19)	
1-2	5.8 (2.2-15.2)	3.5 (2.1-5.6)	2.5 (1.4-4.2)	9.7 (2.9-32)	1.6 (1.0-2.6)	1.8 (0.9-3.5)	3.9 (1.6-9.8)	2.5 (1.5-4.2)	3.9 (1.5-11)	5.5 (1.2-25)	
3-4	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	
5-14	2.2 (0.8-6.0)	1.8 (1.1-2.9)	1.3 (0.8-2.4)	3.3 (1.0-11)	0.8 (0.5-1.3)	0.8 (0.4-1.6)	1.1 (0.4-2.9)	1.5 (0.9-2.5)	1.7 (0.6-5.1)	2.4 (0.5-12)	
<b>Model 2</b>	3.1 (1.1-8.7)	1.9 (1.1-3.1)	1.7 (1.0-3.1)	4.9 (1.4-17)	1.0 (0.6-1.8)	1.3 (0.7-2.8)	1.3 (0.5-3.7)	2.0 (1.2-3.5)	1.6 (0.5-5.0)	3.1 (0.6-16)	
0	3.2 (1.2-8.8)	2.9 (1.7-4.8)	1.5 (0.8-2.8)	7.3 (2.1-25)	1.3 (0.8-2.1)	1.6 (0.8-3.3)	2.4 (0.9-6.2)	1.9 (1.1-3.4)	2.3 (0.8-6.8)	4.1 (0.8-20)	
1-2	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	
3-4	2.2 (0.8-6.0)	1.8 (1.1-2.8)	1.3 (0.7-2.3)	3.1 (0.9-11)	0.8 (0.5-1.2)	0.8 (0.4-1.6)	1.0 (0.4-2.8)	1.5 (0.9-2.6)	1.7 (0.6-5.0)	2.2 (0.5-11)	
5-14	3.1 (1.1-8.7)	1.8 (1.1-3.0)	1.6 (0.9-2.9)	4.5 (1.3-16)	1.0 (0.6-1.7)	1.3 (0.6-2.7)	1.3 (0.5-3.6)	2.0 (1.1-3.3)	1.6 (0.5-5.0)	2.7 (0.5-14)	
<b>Fully adjusted model</b>	3.1 (1.1-8.7)	2.6 (1.6-4.4)	1.4 (0.8-2.5)	6.1 (1.8-21)	1.2 (0.7-2.0)	1.5 (0.7-3.0)	2.1 (0.8-5.5)	1.9 (1.1-3.3)	2.1 (0.7-6.2)	3.4 (0.7-17)	

Values are OR (95% CI). Bold values are statistically significant.

Model 0 is unadjusted for any covariates.

Model 1 is adjusted for the individual-level covariates grade in school, school type (charter vs traditional), sex, and race/ethnicity.

Model 2 is adjusted for the personal characteristics (grade in school, school type, sex, race/ethnicity), and the parental-level covariates of parenting style and student-report of whether at least one parent works.

The fully adjusted model is adjusted for personal characteristics (grade in school, school type, sex, race/ethnicity), parenting style and parental employment, and family substance abuse history (parent smoking, family history of drug or alcohol abuse).

chaos and risky health behaviors was strongest for substance use at school, with an unadjusted OR of 8.2 (95% CI 2.6-26) comparing those with the most vs least household chaos. The association was less strong for sexual risk behaviors—OR 3.7 (95% CI 1.5-9.0) for substance use with sex in the past 3 months and OR 1.5 (95% CI 1.0-2.3) for sexual activity in the past 90 days, for the greatest vs the lowest CHAOS group—and positive although not statistically significant for no contraception use at last encounter.

Furthermore, the relationship of chaos with risky behaviors was generally dose-dependent, with OR for engaging in the behavior increasing monotonically with greater levels of chaos. For example, regarding cigarette smoking in the past 30 days, compared with those with CHAOS score 0, the unadjusted OR of smoking was 2.2 for those with a CHAOS score 1-2, 3.6 for those with a score 3-4, and 4.9 for those with the greatest CHAOS score.

Adjustment for personal and family demographics, parenting style, and family history of substance use attenuated the relationship between chaos and risky health behaviors, but the relationship remained statistically significant for smoking and alcohol use in the past 30 days, any substance use at school, and having been in a fight in the past 12 months. In the final adjusted model, greater household chaos was associated most strongly with any substance use at school (OR 6.1, 95% CI 1.8-21), followed by cigarette use (OR 3.1, 95% CI 1.1-8.7), alcohol use (OR 2.6, 95% CI 1.6-4.4), and fighting in the past 12 months (OR 1.9, 95% CI 1.1-3.3). In addition, adjustment for potential mediators depression and school engagement further attenuated ORs (Table IV).

## Discussion

In this cross-sectional study of adolescents in Los Angeles from low socioeconomic backgrounds, we found greater household chaos to be associated with significantly greater odds of substance use and violent risk behaviors, providing insight into the relationship between this important and impactful psychosocial measure—household chaos—and risky health behaviors in adolescents.

Rates of health risk behaviors were comparable between our population and national data. According to YRBSS data from 2013, 16% of teens have smoked cigarettes in the past 30 days, 35% have used alcohol in the past 30 days, and 23% have smoked marijuana in the past 30 days,<sup>6</sup> comparable with our findings of 9%, 34%, and 21%, respectively. Approximately 27% of our students reported being sexually active, compared with 34% in the YRBSS nationally, with 6% of our students reporting carrying a weapon in the past 30 days, compared with 18% nationally.<sup>6</sup> Although our study population (84% Latino, in a large urban center) is otherwise different from the overall adolescent population in the US, comparable substance abuse rates suggest generalizability.

There was a strong relationship between CHAOS score and cigarette smoking and alcohol use among adolescents. There

**Table IV.** Cross-sectional association of CHAOS with health risk behaviors among 929 adolescents in Los Angeles, ages 13–19 years, adjusting for potential mediators

CHAOS score	Substance use risk behaviors			Sexual risk behaviors			Violence-related risk behaviors			
	Smoking in the past 30 d	Alcohol in the past 30 d	Marijuana in the past 30 d	Any substance use at school in the past 30 d	Sex in the past 90 d	No contraception at last sexual encounter	Substance use with sex in the past 30 d	Fight in the past 12 mo	Carrying a weapon in the past 30 d	Gang involvement in the past 12 mo
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Fully adjusted	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
5-14	<b>3.1 (1.1–8.7)</b>	<b>2.6 (1.6–4.4)</b>	1.4 (0.8–2.5)	<b>6.1 (1.8–21)</b>	1.2 (0.7–2.0)	1.5 (0.7–3.0)	2.1 (0.8–5.5)	<b>1.9 (1.1–3.3)</b>	2.1 (0.7–6.2)	3.4 (0.7–17)
+depression	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
5-14	<b>2.7 (1.0–7.5)</b>	<b>2.4 (1.4–4.1)</b>	1.1 (0.6–2.1)	<b>5.4 (1.5–19)</b>	1.0 (0.6–1.7)	1.2 (0.6–2.6)	1.8 (0.7–4.1)	1.6 (0.9–2.9)	2.0 (0.7–6)	3.0 (0.6–15)
+school engagement	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
5-14	2.6 (0.9–7.2)	<b>2.2 (1.3–3.8)</b>	1.0 (0.5–1.9)	<b>4.7 (1.3–17)</b>	1.1 (0.7–1.8)	1.3 (0.6–2.6)	1.8 (0.7–4.9)	1.6 (0.9–2.8)	1.9 (0.6–5.6)	3.2 (0.6–16)
+depression + school engagement	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
5-14	2.4 (0.8–6.7)	<b>2.2 (1.3–3.7)</b>	0.9 (0.5–1.7)	<b>4.5 (1.3–16)</b>	1.0 (0.6–1.7)	1.1 (0.5–2.3)	1.6 (0.6–4.4)	1.4 (0.8–2.6)	1.9 (0.6–5.6)	2.9 (0.6–15)

Values are OR (95% CI). Bold values are statistically significant. The fully adjusted model is adjusted for personal characteristics (grade in school, school type, sex, race/ethnicity), parenting style and parental employment, and family substance abuse history (parent smoking, family history of drug or alcohol abuse).

was also a strong relationship between CHAOS score and any substance use in school, although the CI was wide (as the result of low numbers of students engaging in those behaviors across CHAOS score groupings). Interestingly, in our study, marijuana was the one substance use behavior not associated with greater household chaos (drug use for drugs other than marijuana was, however). It is possible that the relationship between marijuana and household chaos is fundamentally different than the relationship for other health risk behaviors, with marijuana use being common and accepted enough (21%) among adolescents that marijuana use is not associated with household chaos. Recent legislation legalizing recreational use of marijuana in Washington and Colorado has raised concerns about these laws' impact on adolescent substance abuse behaviors,<sup>23</sup> and further study is warranted.

We did not find an association between CHAOS score and sexual activity or alcohol with last sexual encounter. It is possible that the nature of the relationship between CHAOS and sexual behaviors is different than for other risky behaviors. Furthermore, rates of sexual activity were lower in our population than in the general adolescent population, so there might be an unmeasured protective factor confounding the relationship between CHAOS and sexual behaviors in our population. The literature linking depression and sexual activity in adolescents is variable, with some studies suggesting that adolescent sexual risk behaviors may precede depression<sup>24</sup> and other studies suggesting that depression predisposes to sexual risk behaviors,<sup>25</sup> further complicating our ability to dissect these influences.

We did, on the other hand, find a relationship between CHAOS and behaviors related to violence. As CHAOS quartile increased, risk of having been in a fight, participated in a gang, or carried a gun increased, with the relationship for the latter 2 behaviors being particularly strong. A previous study linked household CHAOS scores to subsequent disruptive behaviors in 9- to 12-year-old children, as measured by the Strengths and Difficulties Questionnaire,<sup>5</sup> making the link between CHAOS score and violent behaviors in older adolescents seem plausible.

Although the cross-sectional nature of the data makes determining the direction of the association difficult, we speculate that household chaos likely precedes and influences initiation of these health risk behaviors in adolescents. As noted already, in previous studies, greater CHAOS score preceded disruptive behaviors in older adolescents,<sup>5</sup> indicating that CHAOS may similarly precede all 3 types of behaviors measured in our study. If risky behaviors were themselves causing household chaos, one might hypothesize that a riskier behavior such as marijuana use would be associated with more chaos than smoking, but the reverse is true.

On the other hand, risky health behaviors may cause increased household chaos—directly, or indirectly through decreased financial resources from using tobacco, alcohol, or drugs. Some of the downstream effects of household chaos are known and include significant negative psychosocial consequences in children.<sup>2–4</sup> Given the adverse effects of household chaos, if the aforementioned risky health behaviors

lead to greater chaos in a family, it would be reasonable to screen for high CHAOS score in adolescents with known substance use to try to mitigate downstream effects.

A third possible explanation for the link between chaos and substance use is that both household chaos and these behaviors are related to an underlying factor (either protective or risk-increasing) unmeasured in our study. Although we adjusted for parental employment, parenting style, and parent history of substance use, other unmeasured aspects of parents, families, and neighborhoods are likely to exist that could affect both household chaos in the home and a child's likelihood to participate in risky behaviors. Even though investigators also measured self-efficacy<sup>26</sup> and hopelessness,<sup>27</sup> they initially were not part of our causal model and in unadjusted bivariate analysis were not related to either CHAOS score or outcome variables.

Previous research suggests that age, sex, race,<sup>6</sup> socioeconomic status,<sup>18</sup> parenting style,<sup>19</sup> and family history of substance use<sup>20</sup> are risk factors for substance use in adolescents, and age, sex, and race are known to affect rates of sexual activity,<sup>28</sup> so we included these factors in the final models, as well as socioeconomic status, which seemed reasonable to include. The association between CHAOS score and smoking, alcohol use, any substance use at school, and fighting persisted after adjustment, indicating an independent relationship between household chaos and these risky behaviors.

Depression also has been found to predispose toward high-risk sexual behavior<sup>25</sup> and substance use disorder<sup>29</sup> in adolescents. Previous studies indicate that greater CHAOS increases risk for psychosocial distress and learned helplessness,<sup>14</sup> which may make students more susceptible to depression, which in turn increases the likelihood of engaging in health risk behaviors. We thus considered depression as a possible mediator between chaos and health risk behaviors. As described by Vanderweele and Vansteelandt,<sup>30</sup> formal mediation analysis is problematic for common dichotomous outcomes, such as those in our study, so we opted to introduce our potential mediators to the fully adjusted final model to look for attenuation of the relationship, which may suggest mediation. As expected, including these behaviors attenuated the relationship between chaos and risky behaviors, but the exact role of these behaviors—confounder or mediator—cannot be determined from this cross-sectional study (Table IV).

In our study, students with greater household chaos were less likely to be engaged in school. Students who are less engaged in school may be more likely to have the time and inclination to begin smoking cigarettes, drinking alcohol, using drugs, having sex, or participating in violent activities. In support of this hypothesized mechanism, we found that adjusting for depression and school engagement attenuated the relationship between household chaos and risky behaviors (Table IV). The relationship between CHAOS and alcohol use was the least attenuated by the mediators, indicating that household chaos might affect alcohol use via a unique path.

If future studies indicate a causal relationship between household chaos and health risk behaviors, interventions that decrease social and physical disorder in the lives of adolescents may help to decrease the risk of engaging in health risk behaviors. Although decreasing household chaos may seem like a challenging task, charter schools, which roughly one-half the participants in our study attended, have achieved success with academic achievement in part as the result of applications of strict routines and classroom-management systems. Indeed, schools may be an important place in which interventions to decrease health risk behaviors might be developed effectively, through understanding the roles of household chaos, depression, school engagement, and additional psychosocial factors.

The risky health behaviors we examined are important health disparities issues, with disparities in different directions based on the type of behaviors and group of interest. Black and Latino students are more likely to smoke marijuana than white students, and Latino students more likely to drink alcohol.<sup>6</sup> White youth are more likely to smoke tobacco.<sup>6</sup> For those black and Latino youth who do engage in substance abuse, morbidity and mortality from substance use is worse compared with white students.<sup>31,32</sup> In the national YRBSS survey, black students were more likely to report being sexually active.<sup>6</sup> White students were more likely to report having carried a weapon in the previous 30 days, and black and Latino students were more likely to report getting into fights.<sup>6</sup> Because our study population is mostly Latino, we cannot compare the impact of household chaos on health risk behaviors across racial/ethnic groups. Our study does, however, increase our understanding of risky health behaviors in a particularly vulnerable population.

Our study has several limitations. Causal inference cannot be made in cross-sectional studies, and there are limitations to generalizability posed by the racial/ethnic make-up and location of our study population. But given comparable rates of substance use<sup>6</sup> and a previous study confirming the reliability and validity of the CHAOS measure in Latino families,<sup>15</sup> we believe that our findings are generalizable to the broader adolescent populations. More than one-half of potential participants could not be contacted, were ineligible, or refused to participate, leading to potential selection bias. Our measures of health risk behaviors were also self-reported and, due to recall or reporting bias, may not accurately reflect risky behaviors among all participants, despite the use of A-CASI.

Understanding potential risk factors, such as household chaos on adolescent substance use, sexual activity, and violence may lead to interventions aimed at early intervention and risk reduction. ■

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