



Supportive Community Resources Are Associated with Lower Risk of Substance Use among Lesbian, Gay, Bisexual, and Questioning Adolescents in Minnesota

Marla E. Eisenberg ¹ · Darin J. Erickson ² · Amy L. Gower ¹ · Len Kne ³ · Ryan J. Watson ⁴ · Heather L. Corliss⁵ · Elizabeth M. Saewyc ⁶

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Abstract

Research has indicated that lesbian, gay, bisexual, and queer/questioning (LGBQ) adolescents have disproportionately high rates of substance use compared to heterosexual peers; yet certain features of schools and communities have been associated with lower substance use rates in this population. To advance this field, research examining multiple levels of influence using measures developed with youth input is needed. With community, school, and student data, this study tested hypotheses that LGBQ students attending high schools and living in communities with more LGBQ-supportive environments (assessed with a novel inventory tool) have lower odds of substance use behaviors (cigarette smoking, alcohol use, marijuana use, prescription drug misuse, and other drug use) than their peers in less supportive LGBQ environments. Multilevel models using data from 2454 LGBQ students (54.0% female, 63.9% non-Hispanic white) in 81 communities and adjusting for student and school covariates found that LGBQ adolescents who lived in areas with more community support had lower odds of frequent substance use, particularly among females. Expanding and strengthening community resources (e.g., LGBQ youth-serving organizations, LGBQ events such as a Pride parade, and LGBQ-friendly services) is recommended to further support LGBQ adolescents and reduce substance use disparities.

Keywords Adolescence · Sexual orientation · Community climate · School · Substance use

Introduction

Health disparities in adolescent substance use across sexual orientation groups are well-documented. Research has

indicated that lesbian, gay, bisexual, and queer/questioning (LGBQ) adolescents have disproportionately high rates of cigarette smoking, alcohol, marijuana, and other illicit drug use, compared to their heterosexual peers (Institute of Medicine 2011; Kann et al. 2016a, 2016b). Although some substance use is normative in adolescence, heavy or frequent use contributes to later substance use disorders and negative health and social consequences (e.g., school

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✉ Marla E. Eisenberg
eisen012@umn.edu

¹ Department of Pediatrics, Division of General Pediatrics and Adolescent Health, University of Minnesota, 717 Delaware St. SE, Minneapolis, MN 55414, USA

² Division of Epidemiology and Community Health, School of Public Health, University of Minnesota, 1300 South 2nd Street, Minneapolis, MN 55455, USA

³ U-Spatial, Research Computing, Office of Vice President for Research, University of Minnesota, 267 19th Avenue South, Minneapolis, MN 55455, USA

⁴ Department of Human Development and Family Studies, University of Connecticut, Storrs, CT, USA

⁵ School of Public Health and Institute for Behavioral and Community Health, San Diego State University, 9245 Sky Park Court, Suite 100, San Diego, CA 92123, USA

⁶ Stigma and Resilience Among Vulnerable Youth Centre, School of Nursing, University of British Columbia, T201-2211 Wesbrook Mall, Vancouver, BC V6T 2B5, Canada

failure); heavy use has also been disproportionately found among LGBQ groups (Boyd et al. 2019; Talley et al. 2014).

Bullying, peer harassment, and other experiences of stigma contribute to health disparities in LGBQ populations (Almeida et al. 2009; Hatzenbuehler et al. 2015; Kidd et al. 2018; Saewyc 2011). However, many LGBQ adolescents thrive in spite of this adversity. Research has turned to health-promoting protective factors that can support young people—even those in vulnerable, stigmatized groups—as they navigate their adolescence (Eisenberg and Resnick 2006; Gower et al. 2018; Hatzenbuehler et al. 2014; Saewyc et al. 2009). A supportive social climate (characterized by policies and values that support LGBQ individuals) and community resources (such as support groups and health services) may be particularly relevant protective factors for this population of adolescents (Eisenberg et al. 2017).

Theoretical Models of Influence on the Health of LGBQ Adolescents

Two related theoretical models articulate the role of social influences on well-being. The social ecological framework emphasizes multiple levels of influence—including interpersonal, organizational/institutional and community/societal factors—on individual health (Bronfenbrenner 1979; McLeroy et al. 1988; Sallis and Owen 2002). Ecological models are well-suited to health behavior research, as a wide range of environmental or system-wide variables may promote healthy behaviors and positive outcomes and are, themselves, amenable to action. A landmark report from the National Academy of Medicine (formerly the Institute of Medicine) highlighted the importance of multilevel social influences in the lives of LGBQ people, noting the role of social structures such as schools, workplaces, religious institutions and community organizations as critical subjects of study to expand collective understanding of the positive and negative determinants of health in this population (Institute of Medicine 2011).

Similar to social ecological frameworks, the Minority Stress Model also informs research on LGBQ populations by considering multiple levels of both stigma and protective supports that can act on individual well-being as well as act on other stigmatizing and protective factors. Specifically, it posits that LGBQ individuals experience stigmatization and stressors that are above and beyond common stressors (Brooks 1981; Meyer 1995, 2003). The model attributes the higher prevalence of mental health concerns found in LGBQ populations to the additive stress of stigmatization from interpersonal interactions, organizational and community factors, as well as intrapersonal stressors. Such stressors may contribute to unhealthy coping mechanisms (e.g., substance use), which exacerbate adverse effects.

Researchers in the field of stigma and LGBQ health have further honed this model, applied it to research examining a

variety of structural factors as influences on adolescent health, and called for further research into structural stigma using novel measures (Hatzenbuehler 2017). Based on these theoretical underpinnings, the present study examines stigma and support with an emphasis on the structural factors at the community and school levels (e.g., policies, public opinion, availability of support services), and their associations with substance use behaviors among LGBQ youth. Although not tested here, the proposed pathways, in keeping with Hatzenbuehler's application, is via internalized stressors and stigma (e.g., expectations of rejection, concealment of sexual orientation) and interpersonal stigma and supports (e.g., peer connections, microaggressions).

Social Environments and LGBQ Adolescent Substance Use

The relevance of structural stigma or supports in schools and communities has been borne out in existing research, as certain features of these contexts have been shown to be associated with substance use behaviors among LGBQ youth (Kidd et al. 2018). The importance of school-based supports and school climate to the well-being of LGBQ youth is relatively well known. Key measures include the presence of a gender and sexuality student organization (GSA), enumerated anti-bullying policies, and supportive school staff, which have been associated with lower levels of alcohol use (Coulter et al. 2016; Heck et al. 2013) and other substance use among LGBQ students (Poteat et al. 2012), with some of these protective associations identified for LBQ girls but not GBQ boys (Konishi et al. 2013). The presence of other LGBQ peers in school has also been associated with emotional well-being among LBQ girls but not GBQ boys (Eisenberg et al. 2016). More broadly, community factors such as a supportive religious climate, higher concentration of same-sex couples, supportive public opinion, and the presence of policies regarding hate crimes and employment discrimination have been used in combination with school-based measures and associated with lower levels of substance use behaviors among LGBQ adolescents (Hatzenbuehler et al. 2014; Hatzenbuehler et al. 2015; Hatzenbuehler et al. 2012).

Current Study

The body of research described above has established the importance of social environments for substance use behaviors among LGBQ youth. However, further research will advance previous work in two important ways. First, studies in this field typically focus on either school or community characteristics, but are rarely able to consider both simultaneously. Because supports in nested social or structural

contexts are likely to be correlated with each other (i.e., more supportive schools in more supportive communities), research that captures only a single social environment may be subject to undetected confounding. Combining these distinct social contexts in research may aid in understanding their unique contributions to well-being, in order to identify appropriate settings for intervention. Second, studies of community characteristics germane to LGBQ youth often draw measures only from existing data sources to piece together elements of a supportive environment. These indices are not informed by youth themselves, who may not be cognizant of features being measured such as the presence of same-sex couples or policies regarding employment discrimination, for example, but may be highly attuned to the presence of safe and welcoming spaces to spend time with friends. Broader and deeper assessment of school and community environments will advance the study of social and structural stigma and supports on the health of LGBQ adolescents and identify additional factors that contribute to positive adjustment and buffer the negative consequences of minority stress and stigma.

The current study addresses these gaps by examining three hypotheses, informed by literature indicating that structural supports can protect LGBQ youth from engaging in health-compromising behaviors: among LGBQ adolescents, (a) living in a more supportive community, (b) attending a school with more resources and supports, and (c) attending a school with a greater proportion of LGBQ peers will each be inversely associated with substance use behaviors. Based on existing literature, and recognizing that some experimental substance use among adolescents is common, additional hypotheses posit that associations will be strongest for more frequent use of each substance and stronger for girls than boys. Simultaneous testing of both community and school factors will account for potential cross-level confounding. Findings are expected to identify features of the community and school contexts that are amenable to programmatic and policy changes that may improve the social climate and ultimately reduce disparities and protect LGBQ adolescents from adverse outcomes.

Methods

Overview

Project RESPEQT (Research and Education on Supportive and Protective Environments for Queer Teens) is a cross-sectional study designed to extensively assess the social climate and availability of resources for LGBQ adolescents in numerous locations based on input from youth themselves (Gower et al. 2019), and link these new community data to existing school and student survey data. The present analysis merges data from three sources for multilevel

statistical analysis: (1) the 2013 Minnesota Student Survey (MSS; student-level data), (2) the CDC's 2014 School Profiles Survey (Profiles; school-level data), and (3) the Lesbian, Gay, Bisexual, Transgender and Queer (LGBTQ) Supportive Environments Inventory data (community-level data). The University of Minnesota's Institutional Review Board exempted this analysis from review due to use of existing anonymous student data and publicly available organizational and institutional (i.e., non-human) data.

Participants

One hundred fifty-four schools serving grades 9 and/or 11 had data from both the 2013 MSS and 2014 Profiles. Because school participation in the MSS was high statewide (84%) and Profiles schools are randomly selected (as described below), these schools approximate a representative sample from the state. Within this subset, 81 schools had at least 10 students who indicated that they were gay, lesbian, bisexual, or not sure (questioning their sexual orientation) and were selected as the school sample for analysis. A minimum number of LGBQ students per school was used in order to further protect participants' anonymity (a priority of the MSS program) and to ensure robustness of school-level variables aggregated from student data. Although this selection method required omitting small schools, the sample included adequate representation from all four location types (e.g., rural, small town), as described below.

The geographical space designated as the "community buffer" for purposes of this research was selected to be the area accessible within a 15-min drive from the index location of each school's physical address. This buffer was chosen to reflect a combination of access to resources and an area in which most young people conduct their daily lives (e.g., home, school, friends, activities), as well as a desire to have consistency across participants and locations. As described by Gower et al. (2019), community-level data were originally collected for a geographical space within a 30-min drive around each school location. However, these large community buffers resulted in considerable overlap of available resources and less variability in community-level variables across locations in Minnesota. Smaller 15-min buffers were able to distinguish communities and reflected the more immediate social environment. School addresses were geocoded using Environmental Systems Research Institute (Esri) ArcGIS Desktop 10.4.1 software. The 15-min community buffer was created using the "Create Drive-Time Areas" tool in ArcGIS Online (Esri). The tool uses a proprietary model to estimate how far an average vehicle can travel while obeying applicable traffic laws.

Students were the unit of analysis, and data came from the Minnesota Student Survey (MSS), an anonymous surveillance program conducted every three years in grades 5, 8, 9,

and 11 by the state Departments of Education, Health, Human Services, and Public Safety (Minnesota Center for Health Statistics (n.d.)). All public school districts are invited to participate; in 2013, 84% of districts had at least one eligible grade complete surveys and approximately 67% of all students enrolled in these grades statewide provided data in the full sample. Parental notification and student assent were used, in accordance with applicable federal laws. The survey was administered via paper/pencil (65%) or computer (35%) according to schools' preferences. In order to improve the validity of self-reported data, approximately 2% of surveys were discarded due to highly implausible (e.g., attended seven different after-school activities every day) or inconsistent responses (e.g., three or more instances of marking both yes and no to the same behavior, such as no alcohol use in the past 30 days but binge drinking in the past 30 days), or a response pattern suggesting exaggeration (e.g., used five kinds of tobacco products on all 30 days of the past month). Questions about sexual orientation were only included on the high school version of the survey (grades 9 and 11), so the current analysis is restricted to these grades.

In 2013, two measures of sexual orientation were included on the MSS, which were combined to identify the sample. Sexual orientation identity was assessed as: "Which of the following best describes you?" with response options of heterosexual (straight), bisexual, gay or lesbian, and not sure (questioning). Sexually active students also reported their number of male and female sexual partners in the past year (sexual orientation behavior). Because many in this age group are not yet sexually active with a partner and identity development is critical to both adolescent well-being and connection to resources and supports for LGBQ people, this widely used identity measure (Hatzenbuehler 2011; Kann et al. 2016a, 2016b) was given priority in defining groups. However, students who identified themselves as heterosexual but also reported past-year same-sex sexual experience were also included, based on previous research demonstrating that the health profile of this group is more similar to non-heterosexuals than to heterosexuals (Cochran and Mays 2009; Corliss et al. 2011; Eisenberg et al. 2015). Lesbian, gay, bisexual, questioning and heterosexual youth with same-sex experience are referred to here as LGBQ ($N = 2454$). The 2013 MSS did not include a measure of gender identity; transgender students could therefore not be explicitly included here.

Measures

Substance use

Six substance use variables were included in this analysis. Separate questions asked "During the last 30 days, on how many days did you (a) smoke a cigarette, (b) drink one or

more drinks of an alcoholic beverage, (c) have 5 or more drinks of alcohol in a row, that is, within a couple of hours, (d) use marijuana or hashish, (e) use prescription drugs not prescribed for you?" Seven response options for each ranged from 0 days to all 30 days. Because some substance use is common among adolescents, a three-level variable was created for each substance, reflecting no use, low/moderate use, and high-frequency use. Categories were 0, 1–9 days, and 10+ days for cigarette, alcohol, marijuana and prescription drug use; and 0, 1–5 days, and 6+ days for heavy episodic drinking (i.e., 5 or more drinks in a row), which is, by definition, higher intensity and more problematic use. A final question asked about other drugs "By 'other drugs' we mean drugs that are taken for NONMEDICAL REASONS such as cocaine and crack, heroin, prescription drugs, stimulants, methamphetamine, MDMA (ecstasy), or LSD (acid)/PCP. We also mean sniffing glue or breathing gases or contents of spray cans." Use was assessed in the past 12 months, and included a variety of club drugs, street drugs, and over the counter or non-drug products (e.g., aerosol sprays) used to get high (response options of 0–40+ times were dichotomized as none vs. any, as use of these substances is less common and frequently associated with more problematic use including polysubstance use (Su et al. 2018).

In-school resources and external resources

Seven policy and programmatic resources were used to create two School Support Indices (labeled "in-school resources" and "external resources") for each school in the sample. The Profiles survey assessed a variety of school practices around health education, physical education, school health policies, health services, school health coordination and family and community involvement in school health programs and is conducted biennially by all state Departments of Education in partnership with the Centers for Disease Control and Prevention (Demissie et al. 2014). Data were collected from principals and lead health education teachers at a random sample of schools with at least one of grades 6–12. In 2014 Minnesota received both completed principal and teacher surveys from approximately 250 schools (70% of 357 invited schools).

The Profiles questionnaires were developed by the Division of Adolescent and School Health, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, Centers for Disease Control and Prevention in collaboration with representatives of state, local, and territorial departments of health and education. The principal survey included six items about relevant school policies and programs (e.g., "Does your school have a student-led club that aims to create a safe, welcoming, and accepting school environment for all youth, regardless of sexual orientation or gender

identity? These clubs sometimes are called gay/straight alliances” [in-school resource] and “Does your school.... facilitate access to providers not on school property who have experience in providing health services, including HIV/STD testing and counseling, to LGBTQ youth” [external resource]) with yes/no responses for each. The lead health teacher survey included an item about school curricula relevant to LGBTQ youth (i.e., “Does your school provide curricula or supplementary materials that include HIV, STD, or pregnancy information that is relevant to lesbian, gay, bisexual, transgender, and questioning youth”) with a yes/no response.

Principal component analysis (PCA) was used to determine if variance in these items could be adequately described using a small number of indexes; this reduces the number of individual predictors in the models and potentially creates more meaningful constructs. PCA models showed that these seven school-level items loaded on two factors that explained 54% of the variance in items. Correlations for the four items measuring in-school resources ranged from 0.16 to 0.33, and the coefficient alpha was 0.55. The factor loadings were 0.80, 0.57, 0.57, and 0.52 (ordered by size). Correlations for the three items measuring external resources ranged from 0.27 to 0.70, and the coefficient alpha was 0.72. The factor loadings were 0.88, 0.84, and 0.55 (ordered by size). Since all indicators were binary yes/no items, simple sum scores of the binary items were used, ranging from 0 to 4 for in-school resources and 0 to 3 for external resources.

Percent of LGBQ students

Within each school, the proportion of students who were LGBQ was calculated by aggregating responses from all MSS participants within each school. This variable reflects the availability of LGBQ peers, as in previous research (Eisenberg et al. 2016).

Community support

As part of the LGBTQ Supportive Environments Inventory (Gower et al. 2019), study team members assessed numerous community-level variables within community buffers for each of the 81 schools in the sample. Inventory items operationalizing five constructs are included in the present study. First, availability of four LGBTQ-focused community events (i.e., Pride, Transgender Day of Remembrance, PFLAG meeting, and anti-LGBT bullying day) in each community buffer were cataloged, and the number of events across each buffer was summed. Second, the presence or absence of nine qualities of LGBTQ youth organizations providing at least one service or group specifically for LGBTQ youth were coded (e.g., weekend hours, on social

media, confidential services). Scores were summed across all LGBTQ Youth Organizations within a community buffer. Third, LGBTQ-friendly community resources (e.g., coffee shops, health care providers, places of worship) were collected. Each resource was coded based on whether it explicitly indicated LGBTQ friendliness on its website (2) or was included as LGBTQ friendly on a resource list or review with no such indication on the resource’s own website (1). These scores were then summed. Fourth, the percent of voters in precincts within the 15-min community buffer around each school voting against the proposed state constitutional amendment to limit marriage to one man and one woman in the 2012 election was calculated from data obtained from the Secretary of State’s website (Office of the Minnesota Secretary of State Steve Simon 2012). Fifth, the percent of households in the census tract of the school headed by same-sex couples was estimated using the American Community Survey five year average for 2010–2014 (Manson et al. 2017).

These five community-level constructs were highly correlated with each other ($r_s = 0.44–0.80$). Principal component analysis showed that a single factor (eigenvalue 3.6) explained 72% of the variance of these five variables, the factor loadings were 0.90, 0.88, 0.84, 0.84, and 0.76 (ordered by size) and the original items had very high correlations with the component score ($r_s = 0.76–0.90$). Because the community indicators were on different metrics (unlike the school indicators), the PCA-based Community Support factor score was used in analysis (standardized mean = 0, SD = 1, range –1.2 to 3.1), as described below.

Demographic characteristics

Several demographic characteristics were also assessed on the MSS and used as covariates in this analysis. Students self-reported whether they were male or female, their grade in school, receipt of free or reduced-price lunch (yes/no) (Domina et al. 2017), and race/ethnicity. Students were asked to mark all that applied of 5 race groups and separately indicate if they were of Hispanic/Latino ethnicity. Responses were combined into six racial/ethnic groups: non-Hispanic American Indian, non-Hispanic Asian/Hawaiian/Pacific Islander, non-Hispanic Black, non-Hispanic White, non-Hispanic multiple races and Hispanic. Location type was provided by the MSS team with categories reflecting the National Center for Education Statistics groupings of city (i.e., a principal city inside an urbanized area), suburb (i.e., outside a principal city and inside an urbanized area), town (i.e., inside an urban cluster that is separate from an urbanized area) and rural location (i.e., census-defined rural territory that is separate from an urbanized area and/or urban cluster; National Center for

Table 1 Demographic characteristics among LGBQ adolescents attending 81 schools, 2013 Minnesota Student Survey ($N = 2454$)

	<i>N</i>	%
Sexual orientation		
Heterosexual with same-sex experience	442	18.0
Bisexual	887	36.2
Lesbian/gay	278	11.3
Not sure (questioning)	847	34.5
Gender		
Male	1129	46.0
Female	1325	54.0
Grade		
9th	1359	55.4
11th	1095	44.6
Race/ethnicity		
American Indian/Alaskan Native, NH	42	1.7
Asian/PI, NH	177	7.3
Black, African or African American, NH	168	6.9
White, NH	1547	63.9
Multiple, NH	265	10.9
Hispanic or Latinx	224	9.2
Free/reduced-price lunch		
Yes	879	36.3
No	1541	63.7

PI Hawaiian/Pacific Islander, *NH* Non-Hispanic

Education Statistics (n.d.)), and was used as a school-level covariate.

Data Analysis

Descriptive statistics for all individual, school, and community variables were examined. A series of multilevel (level 1 = student, level 2 = community/school) logistic regression models was estimated for each of the substance use variables, generating odds ratios for moderate use vs. no use and for high-frequency use vs. no use. The first set of models included the four primary predictors (the two school resource scores, percent of LGBQ students, and community support factor score) entered in separate models (i.e., unadjusted). The second set of models included all four primary predictors entered simultaneously. The third set of models adjusted for all four primary predictors plus school- (location type) and individual-level confounders (sex, grade in school, race/ethnicity, free or reduced price lunch). Because previous research on the social environment has suggested associations with health-related outcomes differ by sex (Konishi et al. 2013; Poteat et al. 2012), interaction terms of each of the primary variables by sex were tested. These cross-level interactions (sex \times level 2 predictor) were tested using a model with sex also allowed to be random.

Where interactions were statistically significant, sex-stratified models are presented.

All multilevel regression models included a random intercept for community buffer to account for within-cluster correlation. There was a small amount of missing data across survey items, and models were estimated on the subset with complete data on all variables included in that model (analyzed sample sizes ranged from 2195 to 2246). All analyses were estimated using Stata version 15 (Stata Corp 2017).

Supplemental analyses used the same models to examine differences between those reporting high-frequency substance use vs. moderate use (Supplemental Table A). Fully adjusted and sex-stratified models were also tested among MSS participants who identified as heterosexual ($n = 31,285$; Supplemental Table B).

Results

Characteristics of the LGBQ student sample are shown in Table 1. Over half (54.0%) were female and 55.4% were in 9th grade. A majority were white, non-Hispanic (63.9%) and over one-third (36.3%) received free or reduced-price school lunch. Substance use was common in this sample, with approximately one-quarter to one-third of participants reporting cigarette smoking, alcohol use, and marijuana use in the 30 days preceding the survey. High-frequency use of these substances was reported by approximately 4–11% of the sample. Additional information about substance use behavior is shown in Table 2.

Community and school characteristics are shown in Table 3. On average, 1.7 LGBTQ-focused community events (e.g., Pride) were available within the 15-min community buffers; similarly the number of LGBTQ-focused youth organization were also low overall (mean = 1.7), due to a large proportion of communities with no LGBTQ youth-serving organizations within a 15 min drive. The availability of LGBTQ-friendly community resources (e.g., coffee shops, health care providers, places of worship) varied widely by community (range = 0–591) with a mean of 65.6. On average, approximately half of voters voted against the 2012 constitutional amendment banning same-sex marriage and approximately one half of one percent of households were headed by same-sex couples. On average, schools had 2.2 in-school resources and 1.6 external resources for LGBTQ students, and the presence of LGBQ students ranged from 3.1 to 19.2% with a mean of 8.7%. Approximately 9% of schools were in city locations with the rest nearly evenly divided between suburban, town, and rural locations.

As shown in Table 4, LGBQ adolescents who lived in areas with greater community support had lower odds of

Table 2 Substance use behaviors among LGBQ adolescents attending 81 schools, 2013 Minnesota Student Survey ($N = 2454$)

	Total		Boys		Girls	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
Cigarette smoking (past 30 day)						
None	1680	75.8	795	78.6	885	73.4
Moderate ^a	290	13.1	111	11.0	179	14.8
High-frequency ^a	247	11.1	105	10.4	142	11.8
Alcohol use (past 30 day)						
None	1479	67.3	654	65.2	825	69.0
Moderate ^a	599	27.3	276	27.5	323	27.0
High-frequency ^a	120	5.5	73	7.3	47	3.9
Heavy episodic drinking (past 30 day)						
None	1762	80.5	779	78.1	983	82.6
Moderate ^b	336	15.4	163	16.3	173	14.5
High-frequency ^b	90	4.1	56	5.6	34	2.9
Marijuana use (past 30 day)						
None	1606	73.4	705	70.6	901	75.7
Moderate ^a	336	15.4	147	14.7	189	15.9
High-frequency ^a	247	11.3	146	14.6	101	8.5
Prescription drug misuse (past 30 day)						
None	1821	83.5	839	84.7	982	82.5
Moderate ^a	259	11.9	92	9.3	167	14.0
High-frequency ^a	102	4.7	60	6.1	42	3.5
Other drug use (past 30 days)						
None	1852	86.5	851	87.7	1001	85.6
Any	288	13.5	119	12.3	169	14.4

^aModerate = 1–9 days; high frequency = 10+ days

^bModerate = 1–5 days; high frequency = 6+ days

cigarette smoking and alcohol use (including heavy episodic drinking) and higher odds of marijuana use in unadjusted models. In fully adjusted models, associations remained statistically significant for alcohol use and marginally significant for heavy episodic drinking ($p = 0.06$). For example, one standard deviation on the community support factor score was associated with significantly lower odds of high-frequency alcohol use ($OR = 0.59$, $p < 0.01$) compared to no use in fully adjusted models. Additional associations between school variables and substance use are shown in Table 4.

Significant interactions between the community support factor score and sex were noted for cigarette smoking, prescription drug use and other drug use, and stratified models showed associations for girls (Fig. 1). For example, a one standard deviation increase in the community support scale was significantly associated with 34% lower odds of frequent cigarette smoking in fully adjusted models for girls, but this association was not observed for boys. Similar

Table 3 Community and school characteristics within 81 Minnesota community buffers*

School location	<i>N</i>			%
City	7			8.6
Suburb	24			29.6
Town	23			28.4
Rural	27			33.3
Community resources	Mean	SD	Range	
LGBTQ focused community events ^a	1.7	1.7	0–6	
Youth organization quality ^b	1.7	4.3	0–20	
LGBTQ-friendly community resources ^c	65.6	111.8	0–591	
Percent voting against amendment to ban same-sex marriage	48.8	0.1	26.1–70.4	
Percent same-sex households	0.49%	0.3	0.03–0.91%	
Summary scores				
Community support component score	0	1.0	–1.2 to 3.1	
In-school resources	2.2	1.1	0–4	
External resources	1.6	1.2	0–3	
% LGBQ students in school	8.7	3.1	3.1–19.2	

*The 81 locations in the sample have 2013 Minnesota Student Survey data, 2014 Profiles data and at least 10 LGBQ students

^aIncluding Pride, Transgender Day of Remembrance, PFLAG meeting, and anti-LGBT bullying day

^bExamples include weekend hours, social media, confidential services

^cExamples include coffee shops, health care providers, places of worship

associations were found for prescription drug misuse and other drug use (any vs. none) for girls only.

To determine whether these associations were specific to LGBQ youth, supplemental analyses with heterosexual participants were conducted; these analyses did not show significant associations between LGBTQ community support and alcohol use in the fully adjusted models (Supplemental Table B). In sex-stratified models, LGBTQ community support was similarly protective against cigarette smoking and other drug use (but not prescription drug use) among heterosexual girls, and was associated with higher odds of marijuana use and prescription drug use among heterosexual boys.

Discussion

High rates of substance use among LGBQ adolescents may be mitigated by resources and supports in school and communities, yet studies have rarely examined school and community settings together, which may pinpoint appropriate settings for interventions. The goal of this research

Table 4 Odds ratios for each substance use behavior among LGBQ adolescents attending 81 schools, 2013 Minnesota Student Survey ($N = 2454$)

	Unadjusted		Adjusted for 4 variables		Fully adjusted ^a	
	Mod. vs. none	High vs. none	Mod. vs. none	High vs. none	Mod. vs. none	High vs. none
Days smoked cigarettes						
Community support	0.90	0.77**	0.93	0.78**	1.00	0.83
External resources	0.90	0.89	0.90	0.98	0.85*	0.94
In-school resources	0.99	0.90	1.06	0.93	1.07	0.96
% LGBQ in school	1.03	1.03	1.03	1.03	1.03	1.02
Days drank alcohol						
Community support	0.90*	0.80*	0.89*	0.79*	0.90	0.59**
In-school resources	0.94	1.14	0.92	1.18	0.94	1.12
External resources	1.00	0.99	1.06	0.97	1.03	0.95
% LGBQ in school	0.99	1.02	0.99	1.01	0.99	1.00
Heavy episodic drinking						
Community support	0.85*	0.84	0.86*	0.85	0.89	0.68****
In-school resources	1.03	1.08	1.06	1.11	1.06	1.08
External resources	0.96	0.97	0.97	0.97	0.94	0.97
% LGBQ in school	1.00	1.04	1.00	1.03	1.00	1.03
Days use marijuana						
Community support	1.15*	0.97	1.16*	0.99	1.10	0.95
In-school resources	0.97	0.98	0.97	1.02	0.98	0.99
External resources	0.99	0.94	0.98	0.94	0.95	0.92
% LGBQ in school	1.01	1.03	1.01	1.02	1.01	1.02
Days use prescription						
Community support	1.02	0.90	1.01	0.92	1.05	0.86
In-school resources	1.00	0.92	0.97	0.95	0.97	0.86
External resources	1.03	0.92	1.05	0.95	1.02	0.99
% LGBQ in school	1.01	0.95	1.01	0.95	1.01	0.94
Other drug use						
	Any vs. none		Any vs. none		Any vs. none	
Community support	1.03		1.03		0.86	
In-school resources	1.00		1.00		0.98	
External resources	1.01		1.00		1.00	
% LGBQ in school	0.97		0.97		0.97	

Mod = moderate

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, **** $p < 0.10$

^aAdjusted for gender, race/ethnicity, grade in school, free/reduced lunch and location type

was to build on existing literature regarding features of the social environment and their associations with substance use behavior among LGBQ adolescents, by measuring community variables identified by youth (Eisenberg et al. 2017) and simultaneously modeling both community and school characteristics. Results were, for the most part, supportive of hypotheses, suggesting that the availability of LGBTQ supportive resources in the community environment is inversely associated with substance use behaviors among LGBQ adolescents. In fully adjusted models, odds of alcohol use and heavy episodic drinking were lower among those living in communities with more supportive

resources; similarly lower odds of high-frequency cigarette use, prescription drug use, and other drug use were evident only for girls in fully adjusted sex-specific models. Findings are generally consistent with Social Ecological Models and the Minority Stress Theory, as well as previous literature showing that community characteristics (e.g., social policy, presence of same-sex couples) are associated with lower levels of substance use behaviors among LGBQ adolescents (Hatzenbuehler et al. 2014; Hatzenbuehler et al. 2012, 2015), and suggest that strengthening LGBTQ resources in the community may be beneficial for LGBQ youth.

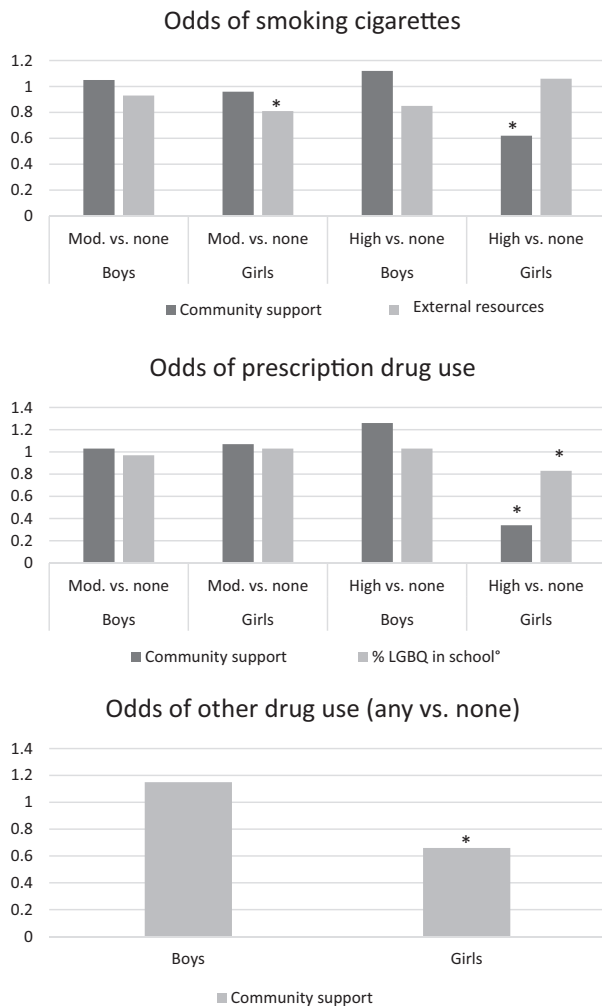


Fig. 1 Significant interactions by sex. * $p < 0.05$

Significant sex differences were evident in these findings, consistent with recent research showing that disparities in substance use behaviors have widened for LGBQ girls (compared to heterosexual girls) but not boys in the past 15 years (Fish et al. 2017; Watson et al. 2018a, 2018b). In the current study, out of five behaviors where associations between community supports and substance use were noted, three were only present for girls. Similar sex-specific associations with the social environment have been seen in previous work (Eisenberg et al. 2016; Konishi et al. 2013). For example, Konishi and colleagues found that the presence of an LGBTQ support group and anti-bullying policies in school were protective for high risk alcohol use for lesbian and bisexual girls but not gay or bisexual boys (Konishi et al. 2013). One might speculate that girls are encouraged to seek out social support more so than boys, and may therefore be aware of or make greater use of the resources available in the social environment. Generally speaking, it may also be that LBQ adolescent girls tend to use substances for different reasons than GBQ boys, for

example as a coping behavior to deal with minority stress rather than as part of socializing. These possible pathways could not be tested in the present study. Routinely exploring effect modification by sex in studies of social influences, including disaggregating by sex, is recommended (Heidari et al. 2016; Kidd et al. 2018).

The findings also differed by the type of substance; specifically, community support was not associated with marijuana use in adjusted models, but was associated with alcohol use in the full sample and with cigarette smoking, prescription drugs and other substances among girls. Prevalence of use among adolescents differs across substances (Kann et al. 2018), and social influences not measured here (such as peer norms, availability, public policy and enforcement) may overshadow the role of LGBTQ community characteristics. However the consistently protective nature of the association between community support and substance use suggests the general benefit of LGBTQ-specific resources for LGBQ adolescents.

Interestingly, the absence of associations between school-level supports and substance use (in almost all models) differs from previous research showing benefits of a supportive school climate and resources, with regards to substance use (Coulter et al. 2016; Heck et al. 2013; Potat et al. 2012). Supplemental analyses examining a single, theoretically driven school factor score (i.e., sum of twelve individual resources) as well as including only the presence of a GSA as a single school-level indicator (i.e., the most widely used single resource in literature regarding school-level protective factors for LGBQ youth) also failed to show the expected protective associations. One possible explanation is that the present study limited the sample to schools with at least ten LGBQ students completing the MSS, removing smaller schools. It may be that this sample selection limited the variability in school support, resulting in null associations with substance use. Further research is needed to investigate whether school characteristics such as size moderate established protective associations between school supports and substance use for LGBQ students. A second possibility is that although school supports may reduce or buffer stigmatizing experiences theorized in the Minority Stress Model to contribute to unhealthy coping behaviors such as substance use, school supports may also enhance social contacts for LGBQ students, which may in turn provide opportunities for substance use in social situations. A protective effect of school supports may therefore be canceled out, resulting in null findings as seen here. Research delving more deeply into substance use behaviors, including motivations and social context, would elucidate this issue.

The findings for heterosexual participants were both similar to (cigarette smoking and other drug use) and different from (alcohol use, marijuana use, prescription drug

use) main findings for LGBQ youth. A consistent pattern of no association between community support and substance use behaviors among heterosexual youth would strengthen the interpretation that LGBTQ-specific community support, as measured here, provide protection specific to LGBQ youth, as theorized. A pattern of findings showing protections for heterosexual youth, as seen previously (Gower et al. 2017; Konishi et al. 2013), might suggest that the LGBTQ-specific community support serves as a proxy for community environments that are more supportive of youth in general or are more progressive in general. Conversely, observing a more welcoming and inclusive climate for LGBQ peers might itself be beneficial for heterosexual youth as well. Future research assessing, and separately testing, both LGBTQ-specific resources and general community climate would help distinguish between these types of contextual variables.

Directionality is an important consideration in cross-sectional studies of influences on health behaviors. For example, in research about social influences, it is as easy to conclude that poor family connectedness contributes to substance use among LGBQ adolescents as it is to conclude that substance use contributes to withdrawal from family and feelings of low connectedness. This ambiguity arises in part because individual- and interpersonal-level factors can change at the same rate: substance use today can lead to family strife tomorrow, or vice versa. Moving outward through the levels of the social ecological model, however, factors become increasingly difficult and time-consuming to manipulate—development of LGBQ-focused community or school resources or social acceptance of same-sex marriage, for example, can take years or even decades. Institutional and social change typically occurs too slowly to be a response to the immediate needs of young people currently attending a school or living in a community. The theoretical models underlying this research therefore strongly suggest that the direction of influence moves from the broader school and community levels to the individual student behaviors, rather than the reverse.

This study's findings that LGBTQ supportive community resources appear to be associated with lower odds of high risk alcohol use among LGBQ adolescents and lower odds of frequent cigarette smoking, prescription drug use, and any other drug use among LGBQ girls in those settings have implications for both further research and practice. Longitudinal, experimental, and quasi-experimental research (for example, tracking LGBQ students who move into neighborhoods with greater or lower levels of support) is needed to confirm directionality and the causal nature of the relationships observed here. Further exploration of aspects of the social environment that protect LGBQ boys from high risk substance use are also needed. The programs, policies and other supports assessed in this study indicate

the importance of a positive social climate towards LGBTQ people, which can be enhanced in a variety of ways. Communities and schools wishing to support LGBQ adolescents can assess the resources they have in place to identify gaps. Based on existing evidence combined with current findings, expanding and strengthening community resources is recommended to further support LGBQ adolescent girls and reduce disparities in substance use behavior that have been observed in this population.

Several limitations must be noted in interpreting this study's findings. First, the colloquial definition of "community" differs both across and within locations, and the 15-min drive time buffer used here represents a middle ground. Resources, supports and norms may come from smaller or larger geographical areas and the 15-min buffer may not be the most relevant context for students' lives (which may also differ depending on urban/rural location). The geographical community may be experienced very differently by young people (e.g., the values of a faith community may be more salient than the neighborhood community), and no data were available to help discern the time spent in or relative importance of these different types of community. Second, the LGBTQ Supportive Environments Inventory was designed to use publicly available information. As a result, sources of support for LGBTQ people that are private or not publicized could not be included. These may be particularly important in locations where the overall climate towards LGBTQ people is hostile or unwelcoming. Third, because the school sample was restricted to schools that had at least 10 LGBQ students, small schools are under-represented in this study, and findings may not be generalizable to these settings. Fourth, this research does not include data on the extent to which young people take advantage of available resources and support, or are even aware of them. Measures of community, school and peer support may therefore be understood as markers of the social climate more broadly, and uncontrolled confounding by other school- and community-level factors cannot be ruled out as an explanation of these findings. Future research should examine the perceptions, experiences and participation of adolescents with these types of resources and supports. Likewise, certain items were not available on the MSS, such as parental education, which may further elucidate associations seen here. Finally, the 2013 MSS did not include a measure of gender identity; although community and school characteristics may be relevant to transgender and gender diverse students, the extent to which they were associated with emotional distress for this segment of the population could not be tested here.

However, this research also has several notable strengths. First, this study includes a large number of students and schools/communities, which provides adequate statistical power to test multilevel relationships. Second, multiple

sources (including students, principals, teachers, community organizations, websites and government sources) were used to gather information across levels of influence and individual behaviors; this is advantageous over research relying only on self-report. Third, inventory data were collected online, reflecting the way many young people access information about LGBTQ issues and resources in their communities (Wolowic et al. 2018). This approach increases the “real-world” relevance of the measures and findings, whether or not young people have disclosed their sexual orientation or are connected to support organizations. Fourth, the MSS included multiple measures of substance use behaviors that could be classified into moderate- and high-frequency use, and findings were fairly consistent across the dependent variables, which speaks to the robustness of this work.

Conclusion

LGBQ youth report substantially higher rates of substance use compared to their heterosexual peers, and hostile social environments may contribute to these disparities. This study addressed gaps in the literature by using a novel assessment of LGBTQ community resources and including both community and school resources in models of adolescent substance use. The results indicated significantly lower rates of use of a variety of substances among those in areas with greater community resources, particularly for girls; few associations were found between school resources and substance use. This work suggests that the development and expansion of LGBTQ supportive resources in communities may help support LGBQ youth and reduce well-established disparities in substance use behavior.

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Authors' Contributions MEE conceived of the study and drafted and revised the manuscript; DJE managed the data and conducted statistical analysis; ALG oversaw community-level data collection, aided in interpretation of data; LK created the spatial dataset and aided in interpretation of data; RJW participated in community-level data collection and aided in interpretation of data; HLC participated in the design of the study and aided in interpretation of data; EMS participated in the design of the study and aided in interpretation of data. All authors reviewed and critically revised multiple manuscript drafts and approved the final manuscript.

Data Sharing Declaration This manuscript's data will not be deposited.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval The University of Minnesota's Institutional Review Board exempted this analysis from review due to use of existing anonymous student data and publicly available organizational and institutional (i.e. non-human) data.

Informed Consent Parental notification and student assent were used for surveys, in accordance with applicable federal laws.

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Marla Eisenberg is a Professor in the Division of General Pediatrics and Adolescent Health, Department of Pediatrics, at the University of Minnesota. Her research focuses on social influences on high risk health behaviors among adolescents and young adults.

Darin Erickson is an Associate Professor in the Division of Epidemiology and Community Health at the University of

Minnesota. He uses advanced statistical modeling to better understand the role of the environment on health-related outcomes.

Amy Gower is a Research Associate in the Division of General Pediatrics and Adolescent Health, Department of Pediatrics, at the University of Minnesota. Her research interests include bullying prevention and the well-being of LGBQ youth.

Len Kne is the Director of U-Spatial at the University of Minnesota. He provides support for spatial research throughout the University.

Ryan Watson is an Assistant Professor in the Department of Human Development and Family Sciences at the University of Connecticut. His work focuses on sexual and gender identity development in relation to a variety of health outcomes for adolescents and young adults.

Heather Corliss is a Professor in the Division of Health Promotion and Behavioral Science at San Diego State University. Her research interests include LGBT health, adolescent health, substance use, and the effects of social stigma on health behaviors.

Elizabeth Saewyc is a Professor and Director of the School of Nursing at the University of British Columbia. Her research focuses on health issues of youth, with a particular emphasis on how stigma, violence and trauma affect adolescent health and risk behaviors.