



School-based mental health services, suicide risk and substance use among at-risk adolescents in Oregon



Mallie J. Paschall*, Melina Bersamin

Prevention Research Center, Pacific Institute for Research and Evaluation, 180 Grand Avenue, Suite 1200, Oakland, CA 94612, United States

ARTICLE INFO

Keywords:

Adolescents
Mental health
Substance use
School-based health centers

ABSTRACT

This study examined whether an increase in the availability of mental health services at school-based health centers (SBHCs) in Oregon public schools was associated with the likelihood of suicidal ideation, suicide attempts and substance use behaviors among adolescents who experienced a depressive episode in the past year. The study sample included 168 Oregon public middle and high schools and 9073 students who participated in the Oregon Healthy Teens Survey (OHT) in 2013 and 2015. Twenty-five schools had an SBHC, and 14 of those schools increased availability of mental health services from 2013 to 2015. The OHT included questions about having a depressive episode, suicidal ideation, attempting suicide in the past year, and substance use behaviors in the past 30 days. Multi-level logistic regression analyses were conducted in 2017 to examine associations between increasing mental health services and the likelihood of these outcomes. Analysis results indicated that students at SBHC schools that increased mental health services were less likely to report any suicidal ideation [odds ratio (OR) (95% C.I.) = 0.66 (0.55, 0.81)], suicide attempts [OR (95% C.I.) = 0.71 (0.56, 0.89)] and cigarette smoking [OR (95% C.I.) = 0.77 (0.63, 0.94)] from 2013 to 2015 compared to students in all other schools. Lower frequencies of cigarette, marijuana and unauthorized prescription drug use were also observed in SBHC schools that increased mental health services relative to other schools with SBHCs. This study suggests that mental health services provided by SBHCs may help reduce suicide risk and substance use behaviors among at-risk adolescents.

1. Introduction

Depressive episodes are prevalent among adolescents in the U.S. The 2015 Youth Risk Behavior Survey (YRBS) indicated that 29.9% of high school students felt sad or hopeless every day for at least two weeks in the past 12 months, with a higher prevalence among females (39.8%) than males (20.3%) (Kann et al., 2016). Youth who experience depression are at elevated risk for attempting suicide and other risk behaviors, including alcohol, tobacco and other drug use (Brooks et al., 2002; Hallfors et al., 2004; Schilling et al., 2009). This led the U.S. Surgeon General and the World Health Organization to emphasize the need for accessible and effective services to prevent or reduce emotional health problems among adolescents (Murthy, 2015; World Health Organization, n.d.).

To identify and help adolescents who are at risk for depression, suicide and substance use, a growing number of schools offer mental health services through school-based health centers (SBHCs). SBHCs provide comprehensive, convenient health care services for school children and adolescents in all 50 states and the District of Columbia,

often serving disadvantaged students who have less access to health care services (Keeton et al., 2012; School-Based Health Alliance, 2013).

Although SBHCs represent a promising strategy for improving adolescents' emotional health, research on the effectiveness of SBHC mental health services is limited and equivocal (Bains and Diallo, 2016; Mason-Jones et al., 2012). The majority of studies to date have focused on utilization of SBHCs, and have found consistently higher levels of use among girls for reproductive and mental health services (Langille et al., 2008; Pastore and Techow, 2004; Soleimanpour et al., 2010; Szumilas et al., 2010). These studies support the premise that SBHCs can improve access to and utilization of mental health services needed by students, but leave questions about whether SBHCs contribute to improved mental health outcomes.

A prospective cohort study with 744 students in 16 middle and high schools in Michigan compared changes in emotional discomfort and other health indicators (e.g., satisfaction with health, physical activity, nutrition) at schools with SBHCs compared to demographically matched schools without SBHCs (McNall et al., 2010). No significant differences were observed in levels of emotional discomfort and other

* Corresponding author.

E-mail address: paschall@prev.org (M.J. Paschall).

health indicators between students who had access to an SBHC compared to those that did not, though utilization of SBHC services was positively related to overall satisfaction with health, physical activity, and eating healthy food.

Another prospective study in six Ohio school districts examined mental health care costs and mental health outcomes among students at schools with SBHCs compared to students at matched non-SBHC schools (Guo et al., 2008). Using Medicaid records from 1997 to 2003 for 109 students, the study found lower mental health care costs among students who utilized SBHC services than students who did not. There was also evidence of greater improvement in psychosocial health-related quality of life among students who utilized SBHC mental health services compared to students at non-SBHC schools. Although these results provide support for the effectiveness of SBHC mental health services, the study was limited by its reliance on Medicaid records for a cohort of students who represented only a small fraction of over 9000 students who were enrolled in the six school districts.

A study of over 300 students in 12 California schools with SBHCs found significant improvements in a number of mental health outcomes based on assessments conducted by mental health service providers (Soleimanpour et al., 2010). Students participated in at least three mental health visits and were asked about their level of anxiety or nervousness, depression or sadness, eating disorders, grief, loss or bereavement, self-injury, substance abuse, and suicidal ideation. Over a period of at least three months, students reported significant improvement for all of these mental health indicators. Students also reported improvements for a number of resiliency indicators, including school attendance and commitment, expressing feelings and emotions, expressing a sense of hope for the future, and involvement in recreational or vocational activities. While providing further evidence for the effectiveness of SBHC mental health services, this study was limited by absence of a comparison group. Thus, the observed improvements in mental health outcomes may have occurred regardless of students' exposure to mental health services.

A more recent study of 168 public schools and over 36,000 students in Oregon found that schools with SBHCs that increased availability of mental health services after 2013 had significant reductions in the prevalence of depressive episodes, suicidal ideation and suicide attempts from 2013 to 2015 compared to other public schools that did not increase mental health services (Paschall and Bersamin, 2017). This study also found significant reductions in the likelihood of depressive episodes and suicidal ideation among schools with SBHCs that increased mental health services after 2013 relative to other SBHC schools that did not increase mental health services. The large sample of public schools, use of comparison groups, and longitudinal design of this study represented an improvement on previous research on the effectiveness of SBHC mental health services.

The present study extends this recent study by examining associations between the increase in availability of mental health services at SBHC schools and suicidal ideation, suicide attempts and substance use behaviors among adolescents who experienced a depressive episode in the prior year. As prior studies show that adolescents who experience emotional health problems are more likely to utilize SBHC services than adolescents without emotional health problems (Amaral et al., 2011; Anyon et al., 2013; Pastore et al., 1998; Wade et al., 2008), this study focuses on at-risk adolescents who are most likely to use and potentially benefit from SBHC mental health services. We examine whether the likelihood of suicidal ideation, suicide attempts, and substance use behaviors in this subgroup of adolescents decreased from 2013 to 2015 at SBHC schools that increased mental health services after 2013 relative to other public schools, and relative to other schools with SBHCs that did not increase mental health services. We also examine possible moderating effects of student demographic characteristics, including gender, ethnicity, race, and socioeconomic status. We expected that females would benefit more from the increase in mental health services than males, as they are more likely than males to report depressive

episodes and utilize SBHC services (Juszczak et al., 2003; Langille et al., 2008; Pastore and Techow, 2004; Soleimanpour et al., 2010; Szumilas et al., 2010). We were also interested in possible ethnic, racial and socioeconomic differences as SBHCs may be more beneficial for disadvantaged youth who have limited access to health services (Keeton et al., 2012; School-Based Health Alliance, 2013).

2. Methods

2.1. School sample and study design

This study is based on 168 public schools in Oregon that participated in the Oregon Healthy Teens (OHT) Survey in both 2013 and 2015. Twenty-five of those 168 schools had SBHCs, and 14 of the schools with SBHCs increased mental health services between 2013 and 2015 with funds allocated by the Oregon Health Authority (OHA). Across the 14 SBHCs, there was an increase of 11.0 mental health service FTEs (mean = 0.8 FTE per SBHC). Available services included short- and long-term mental health therapy; several schools also hired behavioral health consultants to assist students with behavioral problems. The increased mental health provider time began by early 2014, after the administration of the 2013 OHT survey and before the 2015 OHT began. We compare changes in prevalence rates of having a depressive episode, suicidal ideation, and attempting suicide in the past year among students at schools with SBHCs that increased availability of mental health services after 2013 with all other schools in the sample, and with other schools with SBHCs that did not increase availability of mental health services after 2013. Prevalence rates of past-year suicidal ideation, suicide attempts and substance use behaviors in 2013 and 2015 are based on repeated cross-sectional samples of students.

2.2. School characteristics

School characteristics included having an SBHC, increasing SBHC mental health services after 2013, school type (middle, middle/high school, high school), total school enrollment, the percentage of students who were non-Hispanic and non-white, and the percentage of students receiving free or reduced price meals. These data were obtained from the OHA, Public Health Division, Adolescent and School Health Program.

2.3. Oregon Healthy Teens Survey

Survey data for 8th and 11th grade students were obtained from the statewide Oregon Healthy Teens (OHT) Survey, which was administered prior to increases in SBHC mental health services in 2013, and again in 2015 (Oregon Health Authority, Public Health Division, n.d.). The OHT is an anonymous, voluntary self-administered survey of 8th and 11th graders modeled after the Youth Risk Behavior Survey (YRBS). The OHT is conducted during the spring semester from February through May and is available either online or via paper-and-pencil, at the discretion of the school district. Students do not submit any personal information with their survey responses. The OHT survey is designed to be completed in a single class period.

The OHT sampling frame is based on the YRBS, and comprises public middle and high schools sampled within each county. The sample is intended to be representative of 8th and 11th graders in each county and the state. Post-hoc sample weights were developed for each county and the state based on the actual number of 8th and 11th graders in each school, county and the entire state (Oregon Health Authority, Public Health Division, n.d.). This study was limited to 168 schools that participated in both 2013 and 2015. The sample was further limited to students who reported experiencing a depressive episode in the past year ($n = 11,266$), and another 2193 were excluded because they did not provide responses to all study variables. This left a total of

9073 students in the final analytic dataset (4305 from 2013 and 4768 from 2015).

2.4. Survey measures

2.4.1. Mental health indicators

Students were asked, “During the past 12 months, did you ever feel so sad or hopeless almost every day for two weeks or more in a row that you stopped doing some usual activities?” Students who responded “yes” to this question were classified as having a depressive episode in the past year, constituting the study sample. Students were also asked, “During the past 12 months, did you ever seriously consider attempting suicide?” and “During the past 12 months, how many times did you actually attempt suicide?” Dichotomous variables were created to represent any suicidal ideation and any suicide attempts in the past year.

2.4.2. Substance use behaviors

Students were asked, “During the past 30 days, on how many days did you have... (a) at least one drink of alcohol? (b) 5 or more drinks of alcohol in a row, that is within a couple of hours? (c) smoke cigarettes? (d) use an e-cigarette or other vaping product? (e) use marijuana or hashish (weed, hash, pot)? and (f) use prescription drugs (such as Oxycontin, Percocet, Vicodin, Codeine, Adderall, Ritalin, or Xanax) without a doctor's orders?” Because of the skewed distributions of these past-30-day frequency measures, we created dichotomous versions to examine any use of these substances in the past 30 days, and logged versions to reduce skewness.

2.4.3. Demographic characteristics

Students reported their grade, age, gender, ethnicity, race, and whether they were receiving free or reduced price lunch at school. Hispanic ethnicity and race (white/non-white) were treated as dichotomous variables. Survey year was also a student-level variable.

2.5. Data analysis

Attrition analyses were first conducted to compare students who did and did not provide complete data for study variables. Descriptive statistics were then examined for the study sample, and characteristics of schools with and without SBHC services were compared. Multi-level logistic regression analyses were then conducted to test study hypotheses. Initial regression models included cross-level interaction terms (e.g., increase in SBHC mental health services \times year) to compare the likelihood (or frequency) of suicidal ideation, suicide attempts and substance use behaviors from 2013 to 2015 among students at schools with SBHCs that increased availability of mental health services relative all other schools and other schools with SBHCs. We then examined possible moderating effects of gender, ethnicity, race, and free/reduced price lunch status by including a three-way interaction term in the regression models (e.g., increase in SBHC mental health services \times year \times gender), recognizing that statistical power was limited for these analyses. All analyses were conducted with HLM version 7.01 software to adjust for variance attributable to observations nested within schools (Raudenbush et al., 2011).

3. Results

3.1. Attrition analyses

Analyses comparing students who did and did not have any missing data indicated no differences with respect to age and prevalence of suicide attempts in the past year. However, students with any missing data were less likely to be female and to report suicidal ideation in the past year. Students with any missing data were also more likely to report any past-30-day alcohol use and binge drinking, cigarette and e-cigarette use, marijuana use, and prescription drug use without a

Table 1

School and baseline student demographic characteristics^a by SBHC and mental health services status, mean (SD) or percent.

Variable	Total sample	Non-SBHC schools	SBHC schools (n = 25)	
			No change in mental health services	Increase in mental health services
<i>School level</i>	N = 168	n = 143	n = 11	n = 14
Middle school (%)	42.3	46.9	0.0	28.6
Middle/high school (%)	14.3	13.3	18.2	21.4
High school (%)	43.4	39.9	81.8	50.0
Student enrollment	704.6 (549.2)	672.3 (502.6)	961.8 (607.3)	831.9 (864.0)
Percent eligible for free/reduced price meals	55.5 (17.9)	55.3 (18.3)	54.9 (14.8)	58.6 (16.8)
Percent non-Hispanic, non-white	33.9 (18.5)	34.4 (18.8)	37.2 (10.0)	26.5 (19.3)
<i>Student level</i>	N = 4305	n = 3577	n = 339	n = 389
8th grade (%)	46.4	52.1	5.5	16.7
11th grade (%)	53.6	47.9	94.5	83.3
Age	15.3 (1.5)	15.1 (1.6)	16.4 (0.8)	16.2 (1.2)
Female (%)	66.6	66.7	65.8	66.5
Hispanic (%)	25.4	26.9	15.4	17.6
White (%)	72.8	72.2	78.5	74.4
Received free/reduce price lunch (%)	46.4	46.3	39.6	54.5

^a Student sample sizes are unweighted, while descriptive statistics for study variables were obtained with sample weights in 2017.

doctor's permission.

3.2. Sample characteristics

School and baseline student demographic characteristics are provided in Table 1, along with comparisons of schools with SBHCs that did and did not increase availability of mental health services after 2013, and schools without SBHCs. A higher percentage of schools with SBHCs (64%) were high schools, while a lower percentage (16%) were middle schools. Among SBHC schools, a higher percentage that increased availability of mental health services after 2013 were middle schools.

Prevalence rates of past-year suicidal ideation, suicide attempts, and past-30-day substance use behaviors in 2013 and 2015 are provided in Table 2. About two thirds of students who had experienced a depressive episode in 2013 were female. Among study participants, all of whom had reported experiencing a depressive episode in the past year, the overall prevalence rates for past-year suicidal ideation and suicide attempts were 45.1% and 20.3%, respectively, while past-30-day substance use prevalence rates ranged from 5.2% (e-cigarette use) to 32.4% (alcohol use). Prevalence rates for the total sample changed little from 2013 to 2015 except for past-30-day e-cigarette use, which increased substantially to 20.4% in 2015. Increases in prevalence rates of past-year suicidal ideation and suicide attempts were observed among students in non-SBHC schools, while decreases were observed in schools with SBHCs. Larger decreases in the prevalence of past-year suicidal ideation and attempts were observed at schools with SBHCs that increased mental health services after 2013. Past-30-day alcohol use, binge drinking and cigarette use changed little from 2013 to 2015 among students in non-SBHC schools, but decreased among students at schools with SBHCs. A somewhat larger decrease in the prevalence of cigarette use was observed at SBHC schools that increased mental health services after 2013. The prevalence of past-30-day e-cigarette use increased substantially from 2013 to 2015 among students at both

Table 2
Prevalence of past-year suicidal ideation, suicide attempts, and past-30-day substance use behaviors in 2013 and 2015.

Variable ^a	Total sample	Non-SBHC schools	SBHC schools	
			No change in mental health services	Increase in mental health services
Suicidal ideation, past year (%), 2013	45.1	44.9	43.1	49.0
2015	46.1	48.0	41.6	34.1
Suicide attempt, past year (%), 2013	20.3	20.3	18.5	21.2
2015	21.3	22.7	14.9	14.3
Alcohol use, past 30 days (%), 2013	32.4	31.6	37.8	35.6
2015	30.3	29.4	32.9	35.5
Binge drinking, past 30 days (%), 2013	16.7	16.0	23.5	19.2
2015	16.2	16.0	18.0	16.5
Cigarette smoking, past 30 days (%), 2013	12.6	12.2	15.4	15.4
2015	12.4	12.6	13.8	10.1
E-cigarette use, past 30 days (%), 2013	5.2	4.9	6.5	7.9
2015	20.4	20.0	25.1	20.1
Marijuana use, past 30 days (%), 2013	23.2	22.2	32.4	25.9
2015	22.6	22.2	26.9	22.4
Prescription drug use, past 30 days (%), 2013	9.6	9.2	10.6	12.7
2015	9.6	10.1	6.2	8.6

^a Student sample sizes are unweighted, while descriptive statistics for study variables were obtained with sample weights in 2017.

non-SBHC schools and schools with SBHCs. Prevalence rates for past-30-day marijuana use and prescription drug use changed little from 2013 to 2015 among students at non-SBHC schools, but decreased among students at schools with SBHCs.

3.3. Multi-level analyses

Results of multi-level logistic regression analyses indicate a significantly lower likelihood of suicidal ideation and suicide attempts in the past year among students at schools with SBHCs that increased availability of mental health services after 2013 compared to students at other public schools (Table 3). Odds ratios for the mental health services \times year terms indicate a significant relative reduction in the likelihood of suicidal ideation and a significant relative reduction in the likelihood of suicide attempts. These results are illustrated in Fig. 1. No moderating effects of gender, ethnicity, race or free-reduce price lunch were observed for these relationships.

Analyses also indicated a significantly lower likelihood of any past-30-day cigarette smoking and a marginally significant lower likelihood of any e-cigarette use in the past 30 days at schools with SBHCs that increased availability of mental health services. No associations were observed between increasing availability of mental health services at schools with SBHCs and any past-30-day alcohol use, binge drinking, marijuana use or prescription drug use without a doctor's order. However, additional multi-level linear regression analyses with past-30-day substance use frequency measures indicated significant inverse associations between increasing the availability of mental health services at schools with SBHCs and the frequency of cigarette smoking (beta [95% C.I.] = -0.05 [-0.03 , -0.07]), marijuana use (beta [95% C.I.] = -0.04 [-0.02 , -0.06]) and prescription drug use without a doctor's order (beta [95% C.I.] = -0.03 [-0.05 , -0.01]) among students after 2013. These results are illustrated in Fig. 2. No moderating effects of gender, ethnicity, race or free-reduce price lunch were observed for these relationships.

Within the subgroup of SBHC schools, there was a significantly lower likelihood of suicidal ideation among students at SBHC schools that increased availability of mental health services after 2013 compared to students at other schools with SBHCs (odds ratio [95% C.I.] = 0.75 [0.60 , 0.94]). However, no significant differences in the likelihood of past-year suicide attempts or past-30-day substance use behaviors were observed among students at SBHC schools that increased availability of mental health services after 2013 compared to students at other schools with SBHCs. There were also no significant differences in the frequency of past-30-day substance use behaviors among students

at SBHC schools that increased availability of mental health services after 2013 compared to students at other schools with SBHCs. We did not assess possible moderating effects of gender, ethnicity, race or free-reduce price lunch due to the smaller subsample size.

4. Discussion

Many communities across the U.S. have opened school-based health centers (SBHCs) to provide mental health services to prevent or reduce emotional health problems and related consequences among adolescents. However, research on the effectiveness of SBHC mental health services is limited. This study focused on adolescents in Oregon public schools who had experienced one or more depressive episodes in the past year to determine whether an increase in the availability of mental health services at some SBHC schools would be associated with the likelihood of suicidal ideation, suicide attempts and substance use behaviors in this at-risk population. Our findings suggest that the increase in availability of mental health services at 14 SBHC schools after 2013 was associated with a significantly lower likelihood of suicidal ideation and suicide attempts in the past year, and the frequency of cigarette, marijuana and prescription drug use without a doctor's order in the past 30 days relative to other public schools. Results also indicate a significantly lower likelihood of past-year suicidal ideation among students at SBHC schools that increased availability of mental health services after 2013 relative to other SBHC schools that did not increase availability of mental health services, though no differences were observed for past-year suicide attempts and past-30-day substance use behaviors.

Contrary to expectations, there were no differences in the associations between increasing availability of mental health services, past-year suicidal ideation and attempts and past-30-day substance use behaviors among student demographic subgroups. This is especially surprising for gender, given the greater utilization of SBHC mental health services by females (Juszczak et al., 2003; Langille et al., 2008; Pastore and Techow, 2004; Soleimanpour et al., 2010; Szumilas et al., 2010). The 2015 Oregon Healthy Teens Survey (OHT) also indicated that 35% of females reported using the SBHC at their school at least once in the past year compared to 28% of males. The mean frequency of SBHC visits in the prior year was 2.2 (SD = 1.7) for females compared to 1.8 (SD = 1.4) for males ($t = -7.2$, $p < 0.01$). The lack of any significant moderating effects of student demographic characteristics is also encouraging in that all demographic subgroups of Oregon students who experienced a depressive episode were likely to benefit from the increase in mental health services at schools with SBHCs.

Table 3
Associations for individual multi-level multivariate logistic regression models for the odds of eight different outcomes, including past-year suicidal ideation and suicidal attempts, and past-30-day alcohol use, binge drinking, cigarette use, e-cigarette use, marijuana use, and prescription drug use from 2013 to 2015, odds ratio (95% confidence interval).^a

Variable	Suicidal ideation	Suicide attempt	Alcohol use	Binge drinking
<i>School level</i>				
Middle school ^b	1.14 (0.88, 1.47)	1.62 (1.12, 2.37)	0.67 (0.47, 0.97)	0.61 (0.39, 0.93)
Middle/high school ^b	1.12 (0.91, 1.37)	1.21 (0.86, 1.71)	0.76 (0.56, 1.03)	0.81 (0.55, 1.21)
Student enrollment	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)
Percent eligible for free/reduced price meals	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)
Percent non-Hispanic, non-white	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	0.99 (0.98, 1.00)
Increase in MH services	0.86 (0.74, 1.00)	0.96 (0.75, 1.21)	1.00 (0.82, 1.23)	0.87 (0.71, 1.07)
<i>Cross-level</i>				
Increase in MH services × year	0.66 (0.55, 0.81)	0.71 (0.56, 0.89)	1.03 (0.83, 1.29)	0.93 (0.80, 1.07)
<i>Student level</i>				
Age	0.99 (0.92, 1.06)	0.99 (0.88, 1.11)	1.13 (1.02, 1.26)	1.16 (1.02, 1.32)
Female	1.39 (1.21, 1.60)	1.34 (1.17, 1.54)	1.13 (0.99, 1.29)	1.01 (0.86, 1.19)
Hispanic	0.87 (0.75, 1.01)	0.98 (0.86, 1.19)	0.99 (0.82, 1.20)	1.17 (0.92, 1.48)
White	1.17 (1.02, 1.35)	1.12 (0.98, 1.28)	1.23 (1.02, 1.48)	1.14 (0.92, 1.42)
Receive free/reduced price lunch	1.01 (0.91, 1.13)	1.19 (1.05, 1.35)	1.09 (0.97, 1.23)	1.16 (1.00, 1.34)
Year	1.01 (0.97, 1.06)	1.02 (0.95, 1.10)	0.93 (0.88, 0.99)	0.93 (0.80, 1.07)
Variable	Cigarette smoking	E-cigarette use	Marijuana use	Prescription drug use
<i>School level</i>				
Middle school ^a	0.85 (0.45, 1.59)	0.78 (0.51, 1.21)	0.73 (0.51, 1.06)	0.79 (0.44, 1.43)
Middle/high school ^a	0.90 (0.59, 1.37)	0.72 (0.49, 1.06)	0.83 (0.60, 1.15)	0.77 (0.52, 1.15)
Student enrollment	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)
Percent eligible for free/reduced price meals	1.01 (1.00, 1.02)	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)
Percent non-Hispanic, non-white	0.98 (0.98, 0.99)	0.99 (0.98, 1.02)	0.99 (0.98, 1.02)	0.99 (0.98, 1.02)
Increase in MH services	0.72 (0.54, 0.96)	1.00 (0.82, 1.23)	0.91 (0.71, 1.16)	1.03 (0.67, 1.58)
<i>Cross-level</i>				
Increase in MH services × year	0.77 (0.63, 0.94)	0.76 (0.58, 1.01)	0.94 (0.80, 1.10)	0.75 (0.52, 1.09)
<i>Student level</i>				
Age	1.25 (1.03, 1.51)	1.14 (1.00, 1.30)	1.11 (0.99, 1.24)	1.05 (0.87, 1.26)
Female	0.80 (0.65, 0.99)	0.85 (0.69, 1.07)	0.82 (0.72, 0.93)	0.97 (0.78, 1.22)
Hispanic	0.91 (0.70, 1.18)	1.00 (0.78, 1.28)	1.20 (0.99, 1.45)	0.94 (0.69, 1.26)
White	1.39 (1.08, 1.81)	1.23 (0.93, 1.62)	1.17 (0.97, 1.42)	1.05 (0.79, 1.39)
Receive free/reduced price lunch	1.59 (1.32, 1.92)	1.39 (1.18, 1.63)	1.44 (1.25, 1.65)	1.10 (0.88, 1.38)
Year	0.98 (0.89, 1.08)	2.17 (2.00, 2.35)	0.98 (0.92, 1.04)	0.99 (0.91, 1.08)

^a Analyses were conducted in 2017.

^b High schools are the referent group.

Similarities in the likelihood of suicide attempts and substance use behaviors within the subgroup SBHC schools may be attributable to similar levels of utilization of SBHC services among youth who experienced a depressive episode. Additional analyses indicated no significant difference in the likelihood or frequency of SBHC service utilization from 2013 to 2015 among at-risk youth at SBHC schools that increased availability of mental health services after 2013 relative to

SBHC schools that did not. These findings point to the potential benefits of all schools in Oregon with SBHCs with respect to students' emotional well-being.

Although this study advances prior research on the potential effectiveness of SBHC mental health services, findings of this study should be considered in light of several limitations. First, we cannot be certain that the observed associations between increasing availability of SBHC

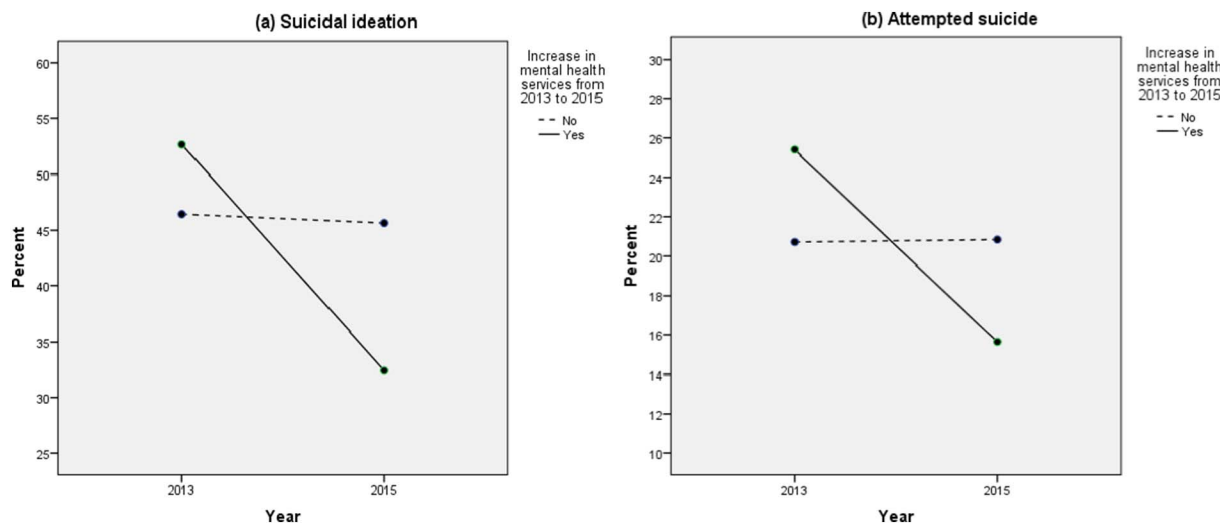


Fig. 1. Change in the prevalence of (a) past-year suicidal ideation and (b) past-year suicide attempts among at-risk students at schools with SBHCs that increased availability of mental health services after 2013 relative to other schools. Prevalence rates are adjusted for student and school demographic characteristics. Analyses were conducted in 2017.

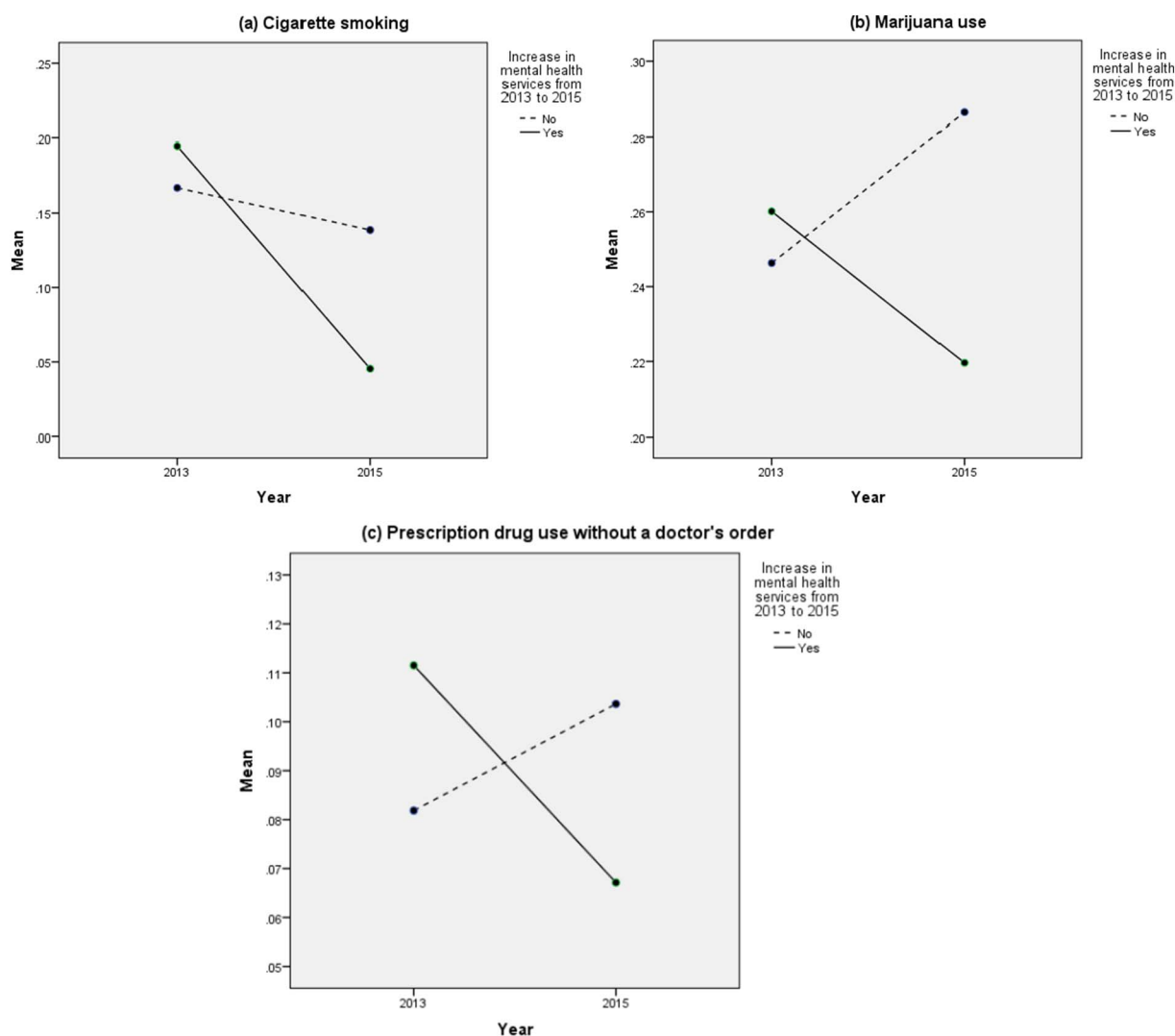


Fig. 2. Change in the frequency of (a) past-30-day cigarette smoking, (b) past-30-day marijuana use, and (c) past-30-day prescription drug use without a doctor's order among at-risk students at schools with SBHCs that increased availability of mental health services after 2013 relative to other schools. Means are based on logged frequency measures and are adjusted for student and school demographic characteristics. Analyses were conducted in 2017.

mental health services and past-year suicide risk and substance use behaviors were not attributable to some other unmeasured difference(s) between the Oregon schools. We also cannot account for any other changes to mental health services in schools or communities that may have impacted student mental health. Sample attrition due to missing survey data may have biased our results in unknown ways. Survey measures for past-year depressive episodes, suicidal ideation, suicide attempts and substance use behaviors may have been subject to social desirability and recall bias as students may have underreported these mental health indicators due to stigma or inaccurate memory. We also acknowledge that the single-item measures for past-year depressive episodes, suicidal ideation, suicide attempts and substance use behaviors are intended for population-based epidemiological surveys and do not meet standards for clinical diagnosis. Finally, some of our analyses may have been underpowered due to the number of schools and/or students in subgroups being compared.

In conclusion, this study suggests that SBHC mental health services may have a beneficial effect on the emotional health of adolescents. Natural experimental studies with longitudinal designs in other populations are needed, however, to determine whether these findings can be replicated. Existing data from school-based surveys in other states should be useful for that purpose. Additionally, more in depth research is needed to determine the level of utilization of SBHCs mental health

services among at-risk students, and the specific types of mental health services being provided, to better understand effects of such services on mental health outcomes.

Acknowledgments

This study was supported by grants from the National Institute on Child Health and Human Development (NICHD Grant No. R01 HD073386) and the National Institute on Alcohol Abuse and Alcoholism (NIAAA Grant No. R01 AA021726). The content is solely the responsibility of the authors and does not necessarily represent the official views of NICHD, NIAAA or the National Institutes of Health.

Conflicts of interest statement

The authors declare no conflicts of interest.

Ethical approval

All study procedures were approved by the Institutional Review Board of the Pacific Institute for Research and Evaluation.

References

- Amaral, G., Geierstanger, S., Soleimanpour, S., Brindis, C., 2011. Mental health characteristics and health-seeking behaviors of adolescent school-based health center users and non-users. *J. Sch. Health* 81 (3), 138–145.
- Anyon, Y., Moore, M., Horevitz, E., Whitaker, K., Stone, S., Shields, J.P., 2013. Health risks, race, and adolescents' use of school-based health centers: policy and service recommendations. *J. Behav. Health Serv. Res.* 40 (4), 457–468.
- Bains, R.M., Diallo, A.F., 2016. Mental health services in school-based health centers: systematic review. *J. Sch. Nurs.* 32 (1), 8–19.
- Brooks, T.L., Harris, S.K., Thrall, J.S., Woods, E.R., 2002. Association of adolescent risk behaviors with mental health symptoms in high school students. *J. Adolesc. Health* 31 (3), 240–246.
- Guo, J.J., Wade, T.J., Keller, K.N., 2008. Impact of school-based health centers on students with mental health problems. *Public Health Rep.* 123 (6), 768–780.
- Hallfors, D.D., Waller, M.W., Ford, C.A., Halpern, C.T., Brodish, P.H., Iritani, B., 2004. Adolescent depression and suicide risk: association with sex and drug behavior. *Am. J. Prev. Med.* 27 (3), 224–230.
- Juszczak, L., Melinkovich, P., Kaplan, D., 2003. Use of health and mental health services by adolescents across multiple delivery sites. *J. Adolesc. Health* 32 (6), 108–118.
- Kann, L., McManus, T., Harris, W.A., et al., 2016. Youth risk behavior surveillance — United States, 2015. *MMWR* 65 (6), 1–180.
- Keeton, V., Soleimanpour, S., Brindis, C.D., 2012. School-based health centers in an era of health care reform: building on history. *Curr. Probl. Pediatr. Adolesc. Health Care* 42 (6), 132–158.
- Langille, D., Asbridge, M., Kisely, S., Leblanc, M., Schaller, E., Lynk, A., Allen, M., 2008. The relationship of sex and risk behaviours to students' use of school-based health centres in Cape Breton, Nova Scotia. *Pediatr. Child Health* 13 (7), 605–609.
- Mason-Jones, A.J., Crisp, C., Momberg, M., Koech, J., De Koker, P., Mathews, C., 2012. A systematic review of the role of school-based healthcare in adolescent sexual, reproductive, and mental health. *BMC Syst. Rev.* 1, 49. Available at: <http://www.systematicreviewsjournal.com/content/1/1/49>, Accessed date: 6 March 2017.
- McNall, M.A., Lichty, L.F., Mavis, B., 2010. The impact of school-based health centers on the health outcomes of middle school and high school students. *Am. J. Public Health* 100 (9), 1604–1610.
- Murthy, V.H., 2015. Surgeon General's perspectives: improving the physical and mental health of adolescents to ensure success in adulthood. *Public Health Rep.* 130 (3), 193–195.
- Oregon Health Authority, Public Health Division Oregon Health Teens Survey. Available at: <https://public.health.oregon.gov/BirthDeathCertificates/Surveys/OregonHealthyTeens/Pages/index.aspx> Accessed on March 6, 2017. Documentation for Oregon Healthy Teens survey methodology was also provided by the Oregon Health Authority.
- Paschall, M.J., Bersamin, M., 2017. School-based mental health services, depressive episodes and suicide risk among adolescents. *Am. J. Prev. Med.* In press.
- Pastore, D.R., Techow, B., 2004. Adolescent school-based health care: a description of two sites in their 20th year of service. *Mt Sinai J. Med.* 71 (3), 191–196.
- Pastore, D.R., Juszczak, L., Fisher, M.M., et al., 1998. School-based health center utilization: a survey of users and non-users. *Arch. Pediatr. Adolesc. Med.* 152 (8), 763–767.
- Raudenbush, S., Bryk, A., Cheong, Y.F., Congdon, R., du Toit, M., 2011. *HLM 7: Hierarchical Linear and Nonlinear Modeling*. Scientific Software International, Lincolnwood, IL.
- Schilling, E.A., Asetline, R.H., Glanovsky, J.L., James, A., Jacobs, D., 2009. Adolescent alcohol use, suicidal ideation, and suicide attempts. *J. Adolesc. Health* 44 (4), 335–341.
- School-Based Health Alliance, 2013–2014. Digital census report on school-based health centers. Available at: <http://censusreport.sbh4all.org>, Accessed date: 6 March 2017.
- Soleimanpour, S., Geierstanger, S.P., Kaller, S., McCarter, V., Brindis, C.D., 2010. The role of school health centers in health care access and client outcomes. *Am. J. Public Health* 100 (9), 1597–1603.
- Szumilas, M., Kutcher, S., LeBlanc, J.C., Langille, D.B., 2010. Use of school-based health centres for mental health support in Cape Breton, Nova Scotia. *Can. J. Psychiatr.* 55 (5), 319–328.
- Wade, T.J., Mansour, M.E., Guo, J.J., Huentelman, T., Line, K., Keller, K.N., 2008. Access and utilization patterns of school-based health centers at urban and rural elementary and middle schools. *Public Health Rep.* 123 (6), 739–750.
- World Health Organization Health for the world's adolescents: a second chance for the second decade. Available at: <http://apps.who.int/adolescent/second-decade>, Accessed date: 6 March 2017.