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Title:

Understanding Suicide Risk and Eating Disorders in College Student Populations: Results from a National Study

Running title:

Suicide and Eating Disorders in College

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Abstract:

Objective: To examine suicide risk by eating disorder severity and symptom presentation in a nationwide sample of college students. Method: The Healthy Minds Study is the largest mental health survey of college populations in the U.S. We analyzed the most recent available data (2015-2017) with 71,712 randomly-selected students from 77 campuses. We estimated associations between two measures of suicidality (ideation and attempts) and three validated measures of eating disorder symptoms (the SCOFF, Weight Concerns Scale, and the Eating Disorder Examination Questionnaire binge and purge items). Importantly, we also controlled for cooccurring symptoms of depression and anxiety, based on validated screening tools. The large, diverse sample provided a unique opportunity to assess whether certain individual characteristics were associated with increased risk. Results: Eating disorder symptoms, even at sub-threshold

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levels, were highly predictive of suicidality. Relative to students with no apparent eating disorder symptoms, students with the highest symptom levels (a SCOFF score of 5) had 11 times higher odds of attempting suicide, while those with sub-threshold symptoms had 2 times higher odds.

We also observed a strong association between suicide attempts and eating disorder presentations that included purging. Students from marginalized backgrounds, particularly gender and sexual minorities, were at increased risk for suicide and eating disorders. Discussion: In the largest known study to date, findings suggest that eating disorders should be a priority within broader campus suicide prevention efforts, should be assessed along a continuum of severity and symptom presentation, and should focus on reaching vulnerable students.

Keywords: eating disorders, suicidal ideation, suicide attempted, psychiatric comorbidity, national survey, college students

INTRODUCTION

Eating disorders have the highest rate of mortality of any mental illness, and suicide risk is substantially elevated among individuals with eating disorders compared with the general population (Fitcher & Quadflieg, 2016; Pisetsky, Thornton, Lichtenstein, Pedersen, & Bulik, 2013; Suokas et al., 2013; Herzog et al., 2000). Suicide accounts for an estimated one-in-five deaths among individuals with anorexia nervosa, making it the second leading cause of mortality (Sullivan, 1995; Arcelus, Mitchell, Wales, & Nielsen, 2011). Numerous studies document high rates of attempted suicide in patients with anorexia and bulimia nervosa as well as binge eating disorder (Franko & Keel, 2006; Wade, Fairweather-Schmidt, Zhu, & Martin, 2015; Yao et al., 2016; Favaro & Santonastaso, 1997; Forrest, Zuromski, Dodd, & Smith, 2017; Conti et al., 2017). Suicide risk is further elevated among individuals with comorbid psychiatric conditions, such as depression and anxiety (Franko & Keel, 2006; Yao et al., 2016; Bodell, Joiner, & Keel, 2013).

While the relationship between eating disorders and suicidality is well documented in clinical samples (Sullivan, 1995; Arcelus et al., 2011; Franko & Keel, 2006; Wade et al., 2015; Yao et al., 2016; Favaro & Santonastaso, 1997; Forrest et al., 2017; Conti et al., 2017), considerably less is known about this relationship at a population level. Eating disorders are undertreated and underdiagnosed (Udo & Grilo, 2018), meaning that studies in clinical settings capture only a portion of the true burden of disease. Population-level data on eating pathology and suicide risk are sorely lacking, creating barriers to advancement in intervention and

prevention efforts. Furthermore, like all mental health conditions, eating disorders exist on a continuum of symptom severity from clinically-severe to sub-threshold. A small but consistent body of research shows a strong correlation between suicide risk and sub-threshold eating disorder symptoms (or “disordered eating”), such as overeating (Ackard, Neumark-Sztainer, Story, & Perry, 2003), dietary restriction (Rafiroiu, Sargent, Parra-Medina, Drane, & Valois, 2003), weight control behaviors (Crow, Eisenberg, Story, & Neumark-Sztainer, 2008a; Crow, Eisenberg, Story, & Neumark-Sztainer, 2008b), and body dissatisfaction (Crow et al., 2008a; Rodríguez-Cano, Beato-Fernández, & Llario, 2006). From a public health perspective, research is needed to examine suicide risk across the continuum of eating disorder severity and symptom presentation at a population-level. Such research is particularly important during the epidemiologically vulnerable adolescent and young adult years.

College students are an important population for prevention and early intervention of both eating disorders and suicide. The traditional college years (ages 18-25) directly coincide with the median age of onset for eating disorders (Franko & Keel, 2006), and more than 1,100 students die by suicide each year (Fernández Rodríguez & Huertas, 2013), making suicide the second leading cause of death in college populations nationwide (Schwartz, 2006). Public health research on college mental health has focused primarily on the prevalence and co-occurrence of suicide, depression, anxiety, and substance use. While important studies have examined the prevalence of eating disorders in specifically defined student sub-groups (e.g., sorority women, female athletes, students from certain academic departments such as nutrition, psychology, and

dance) (Wollenberg, Shriver, & Gates 2015; Allison & Park, 2004; Harris, Gee, D'Acquisto, Ogan, & Pritchett, 2015), these usually rely on non-random samples (Goel et al., 2018; Eichen et al., 2016) or are single-site studies with limited generalizability. Considering the full body of evidence on college student mental health, significantly less is known about eating disorders relative to other mental health problems common in college populations despite the importance of this time period for prevention and intervention efforts.

Large-scale studies with representative samples are needed in order to understand relationships between suicide risk and eating disorder symptoms in college student populations. Such knowledge is essential for understanding who is most at risk, the specific clustering of symptoms most strongly associated with suicidality, and how different pathologies present in combination with suicidal ideation and suicide attempts. The present study draws from a randomly selected, national sample of college students on over 75 campuses across the U.S. and uses validated measures to assess eating disorders and suicide risk. This is the largest known study to date and contributes new evidence to advance understanding and inform prevention and intervention efforts.

METHODS

Data

The Healthy Minds Study (HMS) is an annual, web-based survey focused on mental health and related factors in undergraduate and graduate student populations (Eisenberg & Lipson, 2019). We analyzed the most recently available years of data, collected from fall 2015

through spring 2017. Colleges and universities elected to enroll in HMS; there were no exclusion criteria for institutional enrollment. At each institution with $\geq 4,000$ students, the HMS team recruited a random sample of 4,000 degree-seeking students from the full population; at smaller institutions, all students were recruited. Recruitment was conducted by email. Students had to be at least 18 years old to participate; there were no other exclusion criteria. To incentivize participation, students were informed of their eligibility for one of several prizes totaling \$2,000 annually (10 \$100 and two \$500 gift cards per year). Upon clicking a personalized link in the email, students were presented with an informed consent page and had to agree to the terms of participation before entering the survey. HMS data were collected over a month-long period at each campus using Qualtrics software, and the survey took students approximately 15 minutes to complete.

HMS was administered as a series of modules (survey sections) focused on specific topics. At each institution, the survey was comprised of five total modules: three standard modules administered on all participating campuses (demographics, mental health status, and mental health service utilization) plus two elective modules chosen by the school from a menu of 13 options, including one eating disorder elective module. As described below, we took advantage of data from both the standard and elective modules to present the most comprehensive evidence to date around eating disorders and suicide risk. We analyzed data from the standard modules (henceforth, Study A) as well as data collected at campuses that administered the eating disorder module (Study B). The eating disorder measures examined in

Study B (see Measures) were not part of the standard modules and were only assessed for students on campuses that chose this elective. Thus, the analytic sample for Study B is a subset of the larger sample from Study A. Students in Study B were asked the same demographic questions as those in Study A.

All research was approved by the Institutional Review Boards at participating institutions. To further protect respondent privacy, the study was covered by a Certificate of Confidentiality from the National Institutes of Health.

Non-Response Analysis

HMS response rates were 27% in academic year 2015-2016 and 23% in 2016-2017. Though this is typical of online surveys in this population (Eisenberg et al., 2007), a potential concern is that respondents were not fully representative of the population from which they were drawn. To adjust for potential differences between respondents and non-respondents, we constructed sample probability weights. For all students in the initial random samples, the HMS team obtained administrative data from Registrars at participating institutions, including gender, academic level, race/ethnicity, and grade point average. We used these data to construct response weights, equal to 1 divided by the predicted probability of survey response, with a logistic regression estimating probability of response based on these variables. The following characteristics were associated with response propensity: female, higher GPA, and graduate student status. Thus, weights were larger for respondents with underrepresented characteristics,

ensuring that all estimates are representative of the full population in terms of basic demographic and other characteristics.

Measures

Eating disorder symptoms: In Study A, the eating disorder measure is the five-item SCOFF, a widely-used screening tool (Morgan, Reid, & Lacey, 1999). The items are as follows: (1) “Do you make yourself sick because you feel uncomfortably full?,” (2) “Do you worry that you have lost control over how much you eat?,” (3) “Have you recently lost more than 15 pounds in a three-month period?,” (4) “Do you believe yourself to be fat when others say you are too thin?,” and (5) “Would you say that food dominates your life?”. Response options are “yes” (1) or “no” (0). Scores range from 0-5, with ≥ 2 considered a positive screen. Prior studies have determined this cut-off to be both sensitive (72-100%) and specific (73-94%) for the diagnosis of anorexia and bulimia nervosa (Morgan et al., 1999; Luck et al., 2002). Recent research found the SCOFF to have 70% sensitivity and 78% specificity for binge eating disorder (Maguen et al., 2018).

In Study B, symptoms were based on two validated measures: (1) the Weight Concerns Scale (WCS) (Killen et al., 1994), and (2) the binge eating and purging items from the Eating Disorder Examination Questionnaire (EDE-Q) (Berg, Peterson, Frazier, & Crow, 2012). WCS scores range from 0-100 and were categorized in the present study as: low/no concerns (<47), moderate concerns (47-59), and high concerns (≥ 60). These cut-offs are based on prior research in college populations (Jacobi, Abascal, & Taylor, 2004; Taylor et al., 2006). From the EDE-Q,

binge eating in the past four weeks was categorized as: no binge eating, 1-3 times, and ≥ 4 times. Purging was defined as making “yourself sick (vomit) as a means of controlling your shape or weight,” taking “laxatives as a means of controlling your shape or weight,” taking “diuretics (water pills) or diet pills as a means of controlling your shape or weight,” and/or exercising “in a “driven” or “compulsive” way as a means of controlling your weight, shape or amount of fat, or to burn off calories” in the past four weeks, and was categorized as: no purging, 1-3 times, and ≥ 4 times. Together, the eating disorder measures capture a continuum of severity and symptom presentation.

Suicidality: In both Study A and Study B, we examined two binary measures of suicidality from the standard HMS mental health status module: (1) suicidal ideation (“In the past year, did you ever seriously think about attempting suicide?”); and (2) suicide attempt (“In the past year, did you attempt suicide?”). Response options were “yes” and “no,” and students were categorized accordingly. HMS measures of suicidality were taken from the National Comorbidity Survey (Kessler, Berglund, Borges, Nock, & Wang, 2005).

Statistical Analysis

Analyses were descriptive in nature, using the cross-sectional HMS survey data. We present results organized by study. In Study A, we estimated the prevalence of suicidal ideation and suicide attempts (weighted percentages) by eating disorder symptom count (number of “yes” answers on the SCOFF, ranging from 0 to 5). We then estimated unadjusted odds ratios (OR) using logistic regressions to examine relationships between suicidality and two

operationalizations from the SCOFF: (1) symptom count (reference category=0); and (2) each of the five items (yes/no). The large, diverse sample in Study A also provided a unique opportunity to assess whether certain individual characteristics captured in the demographics module (age, degree level, race/ethnicity, gender identity, sexual orientation) were associated with increased likelihood of having co-occurring suicidality and eating disorder symptoms. To do so, we estimated ORs for: (1) suicidal ideation with a positive screen for an eating disorder, and (2) suicide attempts with a positive screen for an eating disorder ($SCOFF \geq 2$). Reference groups were: 18-22 years (for age), graduate student (for degree level), White (for race/ethnicity), male (for gender identity), and heterosexual (for sexual orientation).

In Study B, we estimated ORs from unadjusted logistic regressions for suicidal ideation and suicide attempts with eating disorder symptoms (WCS, binge eating, purging) as the independent variable of interest. For suicidal ideation, we also estimated adjusted models controlling for the following covariates: (1) age (18-22, 23-25, 26-30, 31+ years); (2) race/ethnicity (White, Black, Asian, Latinx, multiracial, other race/ethnicity); (3) gender identity (female, male, transgender or other gender identity); (4) sexual orientation (heterosexual, bisexual, gay/lesbian, other sexual orientation); (5) weight status (body mass index (BMI), based on self-reported height/weight, in three standard categories: underweight (<18.5), healthy weight (18.5-24.9), overweight/obese (≥ 25)); (6) symptoms of depression; and (7) symptoms of anxiety. The age categories examined are consistent with extant research using HMS data (Lipson, Kern, Eisenberg, & Breland-Noble, 2018). Self-reported height and weight were measured in two

separate, stand-alone items that were not part of any other scale or screen. Symptoms of depression were measured using the Patient Health Questionnaire-9 (PHQ-9) (Kroenke, Spitzer, & Williams, 2001), operationalized as a binary measure based on the standard cut-off for a positive screen (≥ 10). The PHQ-9 has been validated as internally consistent and highly correlated with diagnosis (Kroenke et al., 2001; Lowe, Unutzer, Callahan, Perkins, & Kroenke, 2004). Symptoms of anxiety were measured by the Generalized Anxiety Disorder 7-item (GAD-7) scale, using the cut-off of ≥ 10 , which has been shown to have high sensitivity and specificity (Spitzer, Kroenke, Williams, & Lowe, 2006). Due to sample size, we were unable to conduct adjusted analyses for suicide attempt. Models were estimated separately for each of the three eating disorder measures (WCS, binge eating, purging), resulting in 6 models for suicidal ideation and 3 models for suicide attempts. Analyses were conducted using Stata 15 and weighted using the weights described above.

RESULTS

Study A

In Study A, the sample was 71,712 students at 77 U.S. colleges and universities. Just over two-thirds of students were between the ages of 18 and 22, and roughly three-quarters were undergraduates. In terms of race/ethnicity, 65% identified as White, 7% as Black, 12% as Asian, and 7% as Latinx. There was roughly equal representation of females and males, with 55% identifying as female. One-in-five students (21%) screened positive for an eating disorder

(SCOFF ≥ 2), 11% reported past-year suicidal ideation, and <1% of the full sample reported attempting suicide. Additional sample characteristics are listed in Table 1.

As presented in Table 2, each additional point on the SCOFF was associated with higher prevalence of past-year suicidality: among students with no symptoms (SCOFF=0), 7% reported seriously thinking about attempting suicide relative to 28% of students with the highest number of symptoms (SCOFF=5). Even among students with just one symptom of an eating disorder (SCOFF=1), the prevalence of suicidal ideation was 70% higher than among those with no symptoms (12% versus 7%). Similarly, <1% of students with no symptoms reported past-year suicide attempts compared to 5% of those with a score of 5.

In unadjusted logistic regressions, odds of suicidal ideation and suicide attempt also increased with each additional point on the SCOFF. Relative to a score of 0, having a score of 1 was associated with two times higher odds of suicidal ideation and suicide attempt, while a score of 2 was associated with three times higher odds of ideation and four times higher odds of attempt ($p < 0.001$). Having the highest symptom level was associated with five times higher odds of ideation and 11 times higher odds of attempting suicide ($p < 0.001$).

We also examined the five specific symptoms measured in the SCOFF, finding that items #3 (“Have you recently lost more than 15 pounds in a three-month period?”) and #4 (“Do you believe yourself to be fat when others say you are too thin?”) were most strongly correlated with past-year suicidality. Among students who answered “yes” to either of these items, nearly 20%

reported suicidal ideation, and a “yes” answer to either of these items was associated with three times higher odds of suicide attempt ($p<0.001$).

As presented in Table 3, 4% of the sample ($N=2,912$) reported both suicidal ideation and screened positive for an eating disorder, while 0.4% ($N=288$) reported making a suicide attempt and screened positive for an eating disorder. The following characteristics were associated with significantly higher odds of having co-occurring eating disorder symptoms and suicidality (both suicidal ideation and suicide attempt), all at $p<0.001$: undergraduate (relative to graduate student); female and transgender/other gender identity (relative to male); and bisexual, gay/lesbian, and other sexual orientation (relative to heterosexual). Relative to being ages 18-22, all other age groups had significantly lower odds for co-occurring eating disorder symptoms and suicidal ideation; this pattern remained the same for suicide attempt, though only age 31+ was statistically significant at the level of $p<0.001$. Having overweight/obesity (relative to healthy weight) was also associated with significantly higher odds of co-occurring suicidal ideation and eating disorder symptoms.

Study B

In Study B, the sample was 5,848 students at 7 colleges and universities that elected the eating disorder module. Roughly two-thirds of students were between ages 18-22 and three-quarters were undergraduates. Just over half identified as White, and the sample was 50% female. On the WCS, overall 71% were classified as having low/no weight and shape concerns (63% for females, 81% for males), 12% as having moderate concerns, and 17% as having high

concerns. The mean WCS score was 41 for females, 29 for males, and 35 for transgender students/students with another gender identity. For bingeing, 61% reported no binge eating in the past month, 24% reported 1-3 times, and 16% reported ≥ 4 times. For purging, 95% reported no purging, 3% reported 1-3 times, and 2% reported ≥ 4 times. One-in-ten students reported suicidal ideation and $< 1\%$ reported a suicide attempt. Additional sample characteristics are presented in Table 1.

In unadjusted logistic regressions, moderate weight and shape concerns were associated with 1.5 times higher odds of suicidal ideation ($p=0.005$) and high concerns with 2.1 times higher odds ($p<0.001$) (Table 4). Relative to no binge eating, ≥ 4 times binge eating was associated with 2.2 times higher odds of suicidal ideation ($p<0.001$). Relative to no purging, purging 1-3 times was associated with 1.9 times higher odds ($p=0.009$) and purging ≥ 4 times with 2.8 times higher odds ($p<0.001$) of suicidal ideation. In the adjusted models controlling for demographic characteristics and symptoms of depression and anxiety, high weight and shape concerns were associated with significantly increased odds of suicidal ideation. Other tested associations were no longer significant in the adjusted models once controlling for demographics, depression, and anxiety.

In the unadjusted models for past-year suicide attempt, high weight and shape concerns were associated with 3.0 times higher odds ($p=0.014$), while purging 1-3 times was associated with 4.1 times higher odds ($p=0.015$), and purging ≥ 4 times with 7.3 times higher odds ($p=0.003$).

DISCUSSION

Eating disorders have the highest rate of mortality of any mental illness (Pisetsky et al., 2013), and suicide is a leading cause of death for individuals with eating disorders (Sullivan, 1995; Arcelus et al., 2011). Despite a national dialogue about suicide on college campuses, little is known about the relationship between eating disorder symptoms and suicide risk. Echoing national trends in the high and rising prevalence of mental health problems among college students (Fernandez Rodriguez & Huertas, 2013; Schwartz, 2006; Eisenberg, Golberstein, & Gollust, 2007; Eisenberg, Hunt, & Speer, 2013; Lipson, Heinze, Gaddis, Beck, & Eisenberg, 2015; Kraft, 2011; Eisenberg, Nicklett, Roeder, & Kirz, 2011), this study underscores the population-level burden of both suicidality and eating disorder symptoms, with one-in-five students in our sample meeting criteria for indicated eating disorder risk and roughly one-in-ten reporting having seriously considered attempting suicide in the past year.

From a public health perspective, little is known about the relationship between suicide risk and symptoms of eating disorders, in the college setting or otherwise. This population-level study of a large, random sample of students is an important compliment to previous research, which has focused primarily on clinical samples or specific sub-sets of students, such as female athletes or sorority women (Wollenberg et al., 2015; Allison & Park, 2004; Harris et al., 2015). The present study drew from a large sample of college students on campuses across the U.S. to assess risk of suicidality along a continuum of eating disorder symptomatology, examining symptom severity, weight and shape concerns, and specific behaviors of bingeing and purging.

Consistent with extant research (Ackard et al., 2003; Rafiroiu et al., 2003; Crow et al., 2008a; Crow et al., 2008b; Rodríguez-Cano et al., 2006; Pompili, Girardi, Tatarelli, Ruberto, & Tatarelli, 2006; Preti, Rocchi, Sisti, Camboni, & Miotto, 2011), we saw a significant association between eating disorder symptoms and suicidality. In Study A, the prevalence of suicidal ideation and attempts increased with each additional symptom count on the SCOFF. Our findings suggest that endorsement of any symptoms of an eating disorder (i.e., SCOFF=1) could signal elevated risk of suicidality. Recent weight loss and body dysmorphia (believing “yourself to be fat when others say you are too thin”) were the most predictive symptoms of suicidal ideation and suicide attempts. In this diverse sample drawn from 77 campuses, we found that younger students, undergraduates, females, transgender students, queer students (bisexual, gay, lesbian, other sexuality), and students with overweight/obesity were at increased risk for having co-occurring eating disorders and suicidality.

In Study B, we found that weight and shape concerns were associated with higher rates of suicidality, even after controlling for individual characteristics and adjusting for psychiatric comorbidity. Consistent with other studies (Pisetsky et al., 2013; Franko & Keel, 2006; Favaro & Santonastaso, 1997; Goel et al., 2018), we observed a strong association between suicide attempts and eating disorder presentations that include purging behaviors.

Limitations

As noted, this is the largest known study to date examining associations between suicidality and eating disorder symptoms in college populations. Generalizability is strengthened

by the multi-site nature of our data and the use of a random sampling approach at the student-level. Though college students are an important population for this research due to epidemiological vulnerability, the findings may not be generalizable to same-aged non-college-attending peers, who tend to differ across numerous demographic and social dimensions. The study also provided a rare opportunity to examine eating disorder symptomatology using three validated measures (SCOFF, WCS, and EDE-Q binge-purge items). In addition to these strengths, there are several limitations to consider when interpreting results. First, campuses elected to participate in HMS and may not be representative of other institutions. In particular, campuses that selected the eating disorder elective module (Study B) may have done so out of a recognized need to address this particular issue in their student body. Though the SCOFF measure was analyzed only in Study A, these five questions were also asked of students in Study B. To address this potential limitation, we estimated separately the prevalence of positive SCOFF screens among students on the 70 campuses that did not elect the eating disorder module and compared this with the 7 campuses that elected that module. The prevalence of positive screens was actually slightly higher on the 70 campuses that did not administer the elective module (21.4%) than on the 7 campuses that did (18.8%), though this difference was not statistically significant. Third, the survey response rates was 27% in 2015-2016 and 23% in 2016-2017. While this is typical for an online survey of this nature (Eisenberg et al., 2007), it raises concerns of response bias. As described, we applied sample probability weights to address concerns related to systematic differences between respondents and non-respondents along known characteristics of the full

population, but there may be differences on unobserved characteristics, including eating disorder symptoms and suicidality. Finally, we were unable to examine temporal relationships due to the cross-sectional nature of the data. Future longitudinal studies are needed to explore the temporality of eating disorders and suicidality.

Conclusion

Findings from this study have important implications for prevention and early intervention, particularly in terms of screening and identification of both suicide risk and eating disorders. Given rising rates of student suicides, many colleges and universities are deeply concerned with suicide prevention (Schwartz, 2006). Findings from the present study suggest that screening for eating disorders should be a priority within broader suicide prevention efforts. Rather than assessing a single aspect of student mental health (e.g., depression), as is common in suicide prevention efforts on college campuses (Fernandez Rodriguez & Huertas, 2013; Eisenberg & Lipson, 2019) comprehensive mental health screenings are needed in order to collectively assess risk for suicide, eating disorders, and other prevalent mental health conditions. In our sample, younger students were at increased risk for co-occurring suicide and eating disorders. There is an urgent need and unique opportunity for screening efforts during the first undergraduate year, a time marked simultaneously by significant psychosocial transition and epidemiological vulnerability for eating disorders coupled with high and rising rates of suicidality (Schwartz, 2006).

Furthermore, this study points to a need for assessing eating disorders along a continuum of severity and symptom presentation. Eating disorder symptoms, even at what would be considered sub-threshold, were highly predictive of suicide risk in this national sample. Screening, prevention, and intervention efforts should recognize the particular relationship between suicide and purging behaviors, both of which have been linked to impulsivity (Claes, Nederkoorn, Vandereycken, Guerrieri, & Vertommen 2006).

Findings from this study also contribute to a growing understanding of mental health disparities in college populations. The present study provides the first known evidence of how eating disorder and suicide risk varies across student characteristics. In our sample, students from traditionally underrepresented, marginalized backgrounds had higher rates of co-occurring eating disorders and suicide risk. Targeted outreach and tailored prevention and intervention approaches are needed for vulnerable students on campus, including sexual and gender minority students who were between four and eight times more likely to have a positive eating disorder screen coupled with attempted suicide. Though it is still not well recognized, students with overweight and obesity are at increased risk not only for eating disorders and suicide, but are also less likely to be identified and treated due to weight bias in health systems (Lipson & Sonnevile, 2017).

Overall, results from this study add to a growing literature that underscores the critical need for the application of population-level approaches to suicide and eating disorder prevention (Austin, 2012), and provides support for integration of mental health prevention and early intervention efforts on college campuses.

Data Availability Statement: The data that support the findings of this study are available upon request from the Healthy Minds research team. Please visit www.healthymindsnetwork.org/research/data-for-researchers for more information.

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Table 1. Sample Characteristics

	<u>Study A</u> (N=71,712 on 77 campuses)	<u>Study B</u> (N=5,848 on 7 campuses)
Age		
18-22	66.70	69.00
23-25	12.21	12.89
26-30	10.25	11.08
31+	10.85	7.02
Degree level		
Undergraduate	78.57	73.99
Graduate	21.43	26.01
Race/ethnicity		
White	65.20	56.78
Black	7.20	5.12
Asian	12.26	16.90
Latinx	6.80	9.49
Multiracial	2.69	7.14
Other race/ethnicity	5.85	4.57
Gender identity		
Female	55.06	50.25
Male	43.02	48.53
Transgender/other gender identity	1.81	1.11
Sexual orientation		
Heterosexual	84.52	85.83
Bisexual	2.78	4.58
Gay/lesbian	3.14	3.86
Other sexual orientation	9.28	5.50
Weight status		
Underweight (BMI<18.5)	4.32	4.80
Healthy weight (BMI 18.5-24.9)	55.48	63.44
Overweight/obese (BMI≥25.0)	40.20	31.76
Eating disorder symptoms		
SCOFF positive (≥2)	21.17	
WCS low/no concerns (0-47)		71.43
WCS moderate concerns (47.01-59)		11.80
WCS high concerns (>59)		16.77
No binge eating, past month		60.67
1-3 times binge eating, past month		23.50
≥4 times binge eating, past month		15.83
No purging, past month		95.32
1-3 times purging, past month		2.73
≥4 times purging, past month		2.19
Suicidality, past year		
Suicidal ideation	10.78	9.61
Suicide attempt	0.86	0.59

Notes: Table values are weighted percentages. BMI is body mass index; WCS is Weight Concerns Scale.

Table 2. Past-Year Suicidality by Eating Disorder Symptoms, Study A

SCOFF symptom count	%	<u>Suicidal ideation</u>		%	<u>Suicide attempt</u>	
		OR (SE)	95% CI		OR (SE)	95% CI
0	6.95	REF		0.46	REF	
1	12.09	1.84 (0.08)***	1.70, 2.00	0.77	1.69 (0.26)**	1.24, 2.29
2	17.30	2.80 (0.13)***	2.56, 3.06	1.58	3.47 (0.53)***	2.56, 4.68
3	20.71	3.50 (0.19)***	3.15, 3.89	2.14	4.72 (0.80)***	3.39, 6.59
4	27.54	5.09 (0.41)***	4.35, 5.96	3.74	8.40 (1.77)***	5.55, 12.72
5	28.00	5.21 (0.85)***	3.79, 7.16	4.84	11.02 (4.43)***	5.01, 24.23
SCOFF items						
Item #1 (make yourself sick)	18.26	2.09 (0.08)***	1.94, 2.25	1.97	2.89 (0.34)***	2.29, 3.64
Item #2 (worry you have lost control over how much you eat)	17.21	2.27 (0.07)***	2.13, 2.42	1.50	2.44 (0.26)***	1.97, 3.01
Item #3 (recently lost more than 15 pounds)	19.88	2.24 (0.18)***	2.04, 2.46	2.21	3.03 (0.39)***	2.35, 3.91
Item #4 (believe to be fat when others say you are too thin)	19.22	2.29 (0.09)***	2.12, 2.46	2.11	3.26 (0.36)***	2.62, 4.05
Item #5 (food dominates your life)	16.28	1.78 (0.07)***	1.64, 1.92	1.56	2.11 (0.25)***	1.68, 2.65

Notes: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Table values are weighted percentages and odds ratios (OR) from unadjusted logistic regressions with standard errors (SE) in parentheses. 95% confidence intervals are presented in the far right column for each outcome. For SCOFF symptom count, the reference category (REF) was 0.

Table 3. Co-Occurring Suicidality and Eating Disorder Symptoms, Variations by Individual Characteristics, Study A

	<u>Suicidal ideation and SCOFF>2</u>		<u>Suicide attempt and SCOFF>2</u>	
Age				
18-22	REF		REF	
23-25	0.70 (0.06)***	0.60, 0.83	0.68 (0.17)	0.41, 1.13
26-30	0.58 (0.05)***	0.48, 0.69	0.50 (0.13)**	0.29, 0.84
31+	0.44 (0.04)***	0.36, 0.54	0.25 (0.09)***	0.12, 0.50
Degree level				
Undergraduate	1.99 (0.14)***	1.73, 2.29	2.87 (0.67)***	1.82, 4.55
Graduate	REF		REF	
Race/ethnicity				
White	REF		REF	
Black	0.80 (0.10)	0.62, 1.03	1.00 (0.30)	0.56, 1.80
Asian	0.97 (0.07)	0.84, 1.13	1.51 (0.31)*	1.02, 2.25
Latinx	1.18 (0.11)	0.99, 1.40	1.23 (0.34)	0.72, 2.10
Multiracial	1.51 (0.18)**	1.19, 1.91	2.38 (0.86)*	1.17, 4.84
Other race/ethnicity	1.30 (0.13)**	1.08, 1.58	1.56 (0.43)	0.90, 2.69
Gender identity				
Female	1.90 (0.12)***	1.69, 2.14	2.39 (0.45)***	1.65, 3.47
Male	REF		REF	
Transgender/other gender identity	7.37 (0.83)***	5.91, 9.19	8.25 (2.70)***	4.34, 15.69
Sexual orientation				
Heterosexual	REF		REF	
Bisexual	3.61 (0.34)***	3.01, 4.34	5.20 (1.57)***	2.88, 9.39
Gay/lesbian	2.56 (0.30)***	2.04, 3.20	4.05 (1.08)***	2.40, 6.85
Other sexual orientation	4.19 (0.24)***	3.74, 4.68	5.56 (0.91)***	4.02, 7.67
Weight status				
Underweight (BMI<18.5)	0.98 (0.13)	0.77, 1.27	1.75 (0.61)	0.88, 3.45
Healthy weight (BMI 18.5-24.9)	REF		REF	
Overweight/obese (BMI≥25.0)	1.48 (0.07)***	1.34, 1.62	1.50 (0.22)**	1.12, 2.01

Notes: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Table values are odds ratios (OR) from unadjusted logistic regressions with standard errors (SE) in parentheses. 95% confidence intervals are presented in the far right column for each outcome. The dependent variables were: (1) suicidal ideation with a positive screen for an eating disorder (SCOFF>2); and (2) suicide attempt with a positive screen for an eating disorder (SCOFF≥2). Reference groups (REF) were: 18-22 years (for age), graduate student (for degree level), white (for race/ethnicity), male (for gender identity), heterosexual (for sexual orientation), and healthy weight (for weight status). BMI is body mass index.

Table 4. Unadjusted and Adjusted Correlates of Past-Year Suicidality by Eating Disorder Symptoms, Study B

	<u>Suicidal ideation</u>				<u>Suicide attempt</u>	
	<u>Unadjusted</u>		<u>Adjusted</u>		<u>Unadjusted</u>	
WCS low/no concerns	REF		REF		REF	
WCS moderate concerns	1.54 (0.24)**	1.14, 2.09	1.36 (0.23)	0.98, 1.90	1.61 (0.88)	0.55, 4.71
WCS high concerns	2.12 (0.25)***	1.68, 2.68	1.46 (0.21)**	1.09, 1.93	3.01 (1.35)*	1.25, 7.25
No binge eating, past month	REF		REF		REF	
1-3 times binge eating, past month	1.11 (0.14)	0.86, 1.43	0.89 (0.13)	0.67, 1.17	1.14 (0.61)	0.40, 3.27
≥4 times binge eating, past month	2.15 (0.27)***	1.69, 2.75	1.16 (0.17)	0.87, 1.54	2.24 (1.00)	0.94, 5.37
No purging, past month	REF		REF		REF	
1-3 times purging, past month	1.93 (0.49)**	1.18, 3.17	1.39 (0.38)	0.82, 2.36	4.12 (2.39)*	1.32, 12.86
≥4 times purging, past month	2.81 (0.74)***	1.67, 4.71	1.65 (0.49)	0.92, 2.96	7.28 (4.82)**	1.99, 26.66

Notes: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Table values are odds ratios with standard errors in parentheses. 95% confidence intervals are presented in the far right column for each outcome (for both unadjusted and adjusted models for suicidal ideation). All models were estimated separately for each of the three eating disorder measures (WCS, binge eating, and purging), resulting in 6 models for suicidal ideation and 3 models for suicide attempts. Due to sample size, we were unable to conduct adjusted analyses for suicide attempt. The adjusted logistic regression models for past-year suicidal ideation controlled for age, race/ethnicity, gender identity, sexual orientation, weight status, depression (PHQ-9 \geq 10), and anxiety (GAD-7 \geq 10). Reference categories (REF) were: WCS low/no concerns; no binge eating; and no purging. WCS is Weight Concerns Scale; PHQ-9 is Patient Health Questionnaire-9; and GAD-7 is Generalized Anxiety Disorder Scale-7.