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Screening and Offering Online Programs for Eating Disorders: Reach, Pathology, and Differences Across Eating Disorder Status Groups at 28 U.S. Universities

Ellen E. Fitzsimmons-Craft, PhD^a, Katherine N. Balantekin, PhD, RD^b, Dawn M. Eichen, PhD^c, Andrea K. Graham, PhD^d, Grace E. Monterubio, MA^a, Shiri Sadeh-Sharvit, PhD^{e,f,g}, Neha J. Goel, BA^{h,i}, Rachael E. Flatt, BS^{e,f}, Kristina Saffran, BA^e, Anna M. Karam, MA^a, Marie-Laure Firebaugh, LMSW^a, Mickey Trockel, MD, PhD^e, C. Barr Taylor, MD^{e,f}, Denise E. Wilfley, PhD^a

^aDepartment of Psychiatry, Washington University School of Medicine, St. Louis, MO, USA

^bDepartment of Exercise and Nutrition Sciences, University at Buffalo, Buffalo, NY, USA

^cDepartment of Pediatrics, University of California, San Diego, San Diego, CA, USA

^dDepartment of Medical Social Sciences, Northwestern University, Chicago, IL, USA

^eDepartment of Psychiatry and Behavioral Sciences, Stanford University School of Medicine, Stanford, CA, USA

^fCenter for m²Health, Palo Alto University, Palo Alto, CA, USA

^gBaruch Ivcher School of Psychology, Interdisciplinary Center, Herzliya, Israel

^hDepartment of Psychology, Virginia Commonwealth University, Richmond, VA, USA

ⁱInstitute for Inclusion, Inquiry and Innovation (iCubed), Virginia Commonwealth University, Richmond, VA, USA

Abstract

Objective: The Internet-based Healthy Body Image (HBI) Program, which uses online screening to identify individuals at low risk for, high risk for, or with an eating disorder (ED) and then directs users to tailored, evidence-based online or in-person interventions to address individuals' risk or clinical status, was deployed at 28 U.S. universities as part of a randomized controlled trial. The purpose of this study is to report on: 1) reach of HBI; 2) screen results; and 3) differences across ED status groups.

Method: All students on participating campuses ages 18 years or older were eligible, although recruitment primarily targeted undergraduate females.

Correspondence concerning this article should be addressed to Ellen E. Fitzsimmons-Craft, Department of Psychiatry, Washington University School of Medicine, Mailstop 8134-29-2100, 660 S. Euclid Ave., St. Louis, MO 63110. Phone: 314.286.2074. Fax: 314.286.2091. fitzsimmonse@wustl.edu.

Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Results: The screen was completed 4,894 times, with an average of 1.9% of the undergraduate female student body on each campus taking the screen. ED risk in participating students was high—nearly 60% of students screened were identified as being at high risk for ED onset or having an ED. Key differences emerged across ED status groups on demographics, recruitment method, ED pathology, psychiatric comorbidity, and ED risk factors, highlighting increasing pathology and impairment in the high-risk group.

Discussion: Findings suggest efforts are needed to increase reach of programs like HBI. Results also highlight the increasing pathology and impairment in the high-risk group and the importance of programs such as HBI, which provide access to timely screening and intervention to prevent onset of clinical EDs.

Keywords

eating disorders; college students; prevention; screening; guided self-help; digital technologies

Eating disorders (EDs) are serious mental illnesses (Klump, Bulik, Kay, Treasure, & Tyson, 2009) common in college-age women; however, fewer than 20% of students who screen positive for an ED report receiving treatment, indicating a wide treatment gap (Eisenberg, Nicklett, Roeder, & Kirz, 2011; Kazdin, Fitzsimmons-Craft, & Wilfley, 2017). Along with challenges in accessing treatment, ED screening on college campuses is lacking—only 22% of colleges offer year-round ED screening opportunities and 45% offer ED screenings once per year or semester (National Eating Disorders Association, 2013). Hence, opportunities for improved screening, prevention, and treatment of EDs on college campuses are necessary.

Internet-based technologies may improve care for EDs on college campuses by overcoming barriers to treatment, offsetting in-person clinical demands, increasing access, and reducing costs (Kumar et al., 2013). Internet technologies are efficacious for screening, prevention, and treatment of EDs, including among college students (e.g., Bauer & Moessner, 2013; Beintner, Jacobi, & Taylor, 2012; Jones et al., 2014; Melioli et al., 2016; Saekow et al., 2015). However, a key challenge is effectively delivering these promising technologies to populations, including directly linking screening results to prevention and treatment programs. To address this need, we developed the Healthy Body Image Program (HBI)—an online platform for screening and delivering tailored interventions (Fitzsimmons-Craft et al., 2019b; Jones et al., 2014; Wilfley, Agras, & Taylor, 2013). HBI, which was developed based on programmatic research evaluating tailored online preventive ED interventions (Beintner et al., 2012; Wilfley et al., 2013), identifies individuals at low risk for, high risk for, or with a possible clinical/subclinical ED and offers tailored, evidence-based online interventions or referral to in-person care to address students' risk or clinical status. We recently reported on the first state-wide deployment of HBI over the course of 3 years in 8 public universities in Missouri (Fitzsimmons-Craft et al., 2019b). Notable findings include: 1) an average of 2.5% of the undergraduate student body on each participating campus took the screen; 2) ED risk level in participating students was high—over 56% of students screened were identified as being at high risk for or having an ED; and 3) uptake for the online interventions ranged from 44-51%, with higher uptake in the high-risk compared to the low-risk group (Fitzsimmons-Craft et al., 2019b).

In the current study, HBI was deployed at 28 universities across the U.S. as part of a randomized controlled trial (RCT). A major strength of this trial is increasing our understanding of the reach of HBI among a large, geographically diverse population of U.S. students, which has critical implications for informing large-scale implementation efforts and designing more targeted engagement strategies. The aims of this paper are to report on: 1) reach of HBI over the course of three years of recruitment (i.e., number of online screens completed and proportion of undergraduate female student body reached [given that recruitment efforts primarily targeted female undergraduate students]); 2) results of the screen (i.e., percent low risk for an ED, high risk for an ED, positive screen for anorexia nervosa [AN], positive screen for other clinical/subclinical ED); and 3) differences across the four ED status groups on demographics, recruitment method, ED pathology, psychiatric comorbidity, and ED risk factors, including social comparison, idealization of thinness, and body talk, providing further validation for the screening algorithm. In reporting on reach, we also provide information on the relative reach to individuals from racial/ethnic minority backgrounds and on the relationship between reach and key campus characteristics (i.e., school size, acceptance rate, percent engaged in Greek life [i.e., percent participating in fraternities and sororities, which are social organizations common on many U.S. college campuses], percent living on campus, public vs. private). All of these characteristics were included in the analysis given that they could influence uptake of online mental health screening such as that offered through HBI. We note that our primary aim for reporting these data was to describe the epidemiological outcomes relating to widely implementing an online screen for EDs versus describing the outcomes of the RCT, which will be presented in another paper. Given that the ultimate goal of HBI is to reduce the incidence and prevalence of EDs on college campuses, understanding program reach, level of pathology, and differences across ED status groups in a sample of students from a wide range of U.S. universities is imperative.

Method

Participants and Procedure

All students on the 28 participating university campuses ages 18 years or older were eligible for participation. Recruitment efforts primarily targeted undergraduate female students, but individuals of other genders, graduate students, and postdoctoral fellows were also eligible. This project received institutional review board (IRB) approval and acknowledgment from all cooperating universities. All participants provided informed consent.

Recruitment occurred over three years. Students were recruited using campus-specific recruitment strategies, developed collaboratively with campus stakeholders (e.g., identified HBI liaison in the counseling/health center—typically a counselor), which typically included a combination of use of electronic media (e.g., email), printed materials (e.g., flyers, which included pull tabs with study information), presentations, social media (e.g., postings on Facebook and Twitter), and peer health educators/counselors in the counseling/health center offering HBI to individuals in need. Recruitment emails specifically referred to the program as the “Healthy Body Image Program.” Students were informed that upon completion of the screen, they would be provided with “online/mobile programs and resources to help [them]

integrate both healthy eating and activity into [their] life for an overall more positive body image and improved health and wellness.” We note that the recruitment materials never referred explicitly to EDs. The materials themselves were not designed to specifically target females but were often distributed to female-centric groups (e.g., through sorority listservs). The materials always provided the URL for accessing the online informed consent and online screen, in order to ensure ease of access to the program for students.

HBI Platform

HBI uses online screening to identify individuals' ED status level and offers tailored, evidence-based digital interventions or referral to in-person care. Students at low risk for an ED were offered *StayingFit*, an online, universal prevention intervention (Jones et al., 2008; Taylor et al., 2012). Women at high risk for an ED were offered *Student Bodies-Classic*, an online, targeted ED preventive intervention (Beintner et al., 2012; Kass et al., 2014; Taylor et al., 2006, 2016). Given that this program was specifically developed for females and was not developed for individuals identifying with other genders, respondents screening as high risk and identifying as a gender other than female were offered *StayingFit*. Based on randomized condition (at the school level), female students who screened positive for a clinical/subclinical ED other than AN were randomized to referral to usual care at their school's respective counseling/health center or to receive *StudentBodies-EDs* (SB-ED), an online, guided self-help cognitive-behavioral therapy intervention. Students of other genders were offered use of SB-ED, given that the program itself was designed to be somewhat more gender neutral, but were not included in the trial. Pilot data show SB-ED reduces ED symptoms and symptom progression (Fitzsimmons-Craft et al., 2019b; Jacobi, Völker, Trockel, & Taylor, 2012; Ohlmer, Jacobi, & Taylor, 2013; Saekow et al., 2015). Students who screened positive for possible AN were provided a referral to their school's respective counseling/health center. For additional information on HBI and the online programs, see Wilfley et al. (2013) and Fitzsimmons-Craft et al. (2019b).

Measures

Demographics.—Participants self-reported their age, gender, race, ethnicity, and height and weight, which were used to calculate body mass index (BMI).

Stanford-Washington University Eating Disorder Screen (SWED).—The SWED is a brief screening tool that assesses ED behaviors, pathology, and impairment (Graham et al., 2019). The SWED includes 17 questions, which come from the Weight Concerns Scale (WCS; Killen et al., 1994) and items adapted from the Eating Disorder Examination-Questionnaire (EDE-Q; Fairburn & Beglin, 1994), Eating Disorder Diagnostic Scale (EDDS; Stice, Telch, & Rizvi, 2000), and Clinical Impairment Assessment (CIA; Bohn & Fairburn, 2008). Responses are used to sort individuals into one of four categories, based on available data: 1) possible AN, based on BMI (lowest past year or current BMI < 18.5 kg/m²) and elevated weight/shape concerns; 2) possible clinical/subclinical ED other than AN, based on endorsing 6 or more episodes of binge eating, vomiting, and/or laxative/diuretic use in the past 3 months; 3) high risk for an ED, based on elevated weight/shape concerns; and 4) low risk for an ED, based on not screening into one of the above categories. The SWED screening algorithm has been validated and used in past research, with

sensitivity and specificity being high for cases of DSM-5 EDs compared to the Eating Disorder Examination (EDE; Fairburn & Cooper, 1993) diagnostic interview (0.78 for AN, bulimia nervosa, and binge eating disorder; see Graham et al., 2019). The SWED also provides a continuous measure of weight/shape concerns (i.e., WCS scores), frequencies of ED behaviors in the past 3 months (i.e., binge eating, vomiting, diuretics/laxative use, excessive exercise, and fasting), and continuous measures of ED-related clinical impairment in the areas of school work, relationships, and self-evaluation, rated on a 1 (*never*) to 5 (*always*) scale.

Psychiatric Comorbidity.—To assess comorbidity, four questions were used: 1) to assess binge drinking: “In the past two weeks, have you had at least four drinks if you are female or five drinks if you are male, on one occasion?” (yes/no); 2) to assess depression: “On average, during the past two weeks have you felt depressed or hopeless?”; 3) to assess anxiety: “On average, during the past two weeks have you felt anxious or tense?”; and 4) to assess sleep problems: “On average, during the past two weeks, has it been difficult for you to fall asleep or stay asleep at night?” The latter three questions were rated on a 1 (*not at all*) to 5 (*extremely*) scale. Research has demonstrated the reliability and validity of single-item measures assessing psychiatric comorbidities (e.g., Davey, Barratt, Butow, & Deeks, 2007; King, Taylor, Haskell, & DeBusk, 1989; Zimmerman et al., 2006).

The following measures were added after the study’s inception and were only administered to participants in Years 2 and 3.

Recruitment.—Participants were asked to select one of the following options indicating how they heard about the screen: flyer; email; website; counseling center or student health; peer/friend; in class/professor; and other.

ED Risk Factors

Social Comparison.—Social comparison behavior relevant to ED pathology, including body, eating, and exercise social comparison tendencies, was assessed using a short-form of the Body, Eating, and Exercise Comparison Orientation Measure (BEECOM; Fitzsimmons-Craft, Bardone-Cone, & Harney, 2012). Nine items (which loaded most highly onto the three factors [i.e., body, eating, and exercise comparisons] in Fitzsimmons-Craft et al. [2012]) were administered. Items were rated on a 1 (*never*) to 7 (*always*) scale and summed to create a total score. In this study, Cronbach’s alpha was .95.

Idealization of Thinness.—Idealization of thinness was assessed using a 12-item measure created for this study—the Idealization of Thinness Scale (ITS). Participants were asked to respond to items regarding positive expectations for “being thinner than I am now” on a 1 (*no chance*) to 6 (*certain to happen*) scale. Example items include: “increase my satisfaction with life” and “increase others’ interest in me.” Items were averaged to form a total score. In a sample of 78 young adult women, the ITS had a large significant correlation ($r = .54, p < .001$) with an established measure of thin-ideal internalization (i.e., Sociocultural Attitudes Towards Appearance Questionnaire-R-Revised Internalization: Thin/Low Body Fat subscale; Schaefer, Harriger, Heinberg, Soderberg, & Thompson, 2017)

(Flatt et al., 2019). In two studies, the ITS has shown high 2-week (Flatt et al., 2019) and 8-week (Trochel & Mazina, 2018) test-retest reliability among young adult women ($r_s = .83-.84$, $p_s < .001$). In this study, Cronbach's alpha was .97.

Body Talk.—Body talk was assessed using a 10-item measure created for this study—the Body Talk Scale (BTS). Participants were asked to rate how likely body talk-related scenarios were to happen in their peer group on a 1 (*not at all likely*) to 5 (*certain to happen*) scale. Example items include: “When my peers have dessert or ‘junk’ food, they say they are ‘being bad’ or ‘cheating’” and “When my peers haven’t exercised in a while, they talk about how ‘lazy’ they are being.” Items were summed to form a total score. In samples of young adult women, the BTS had a large significant correlation ($r = .71$, $p < .001$) with an established measure of fat talk (i.e., Fat Talk Scale [Clarke, Murnan, & Smolak, 2010] as modified by Becker, Diedrichs, Jankowski, & Werchan [2013]) and demonstrated good 2-week test-retest reliability ($r = .76$, $p < .001$) (Karam et al., 2019). In this study, Cronbach's alpha was .93.

Analytic Strategy

First, reach of HBI was examined descriptively based on previous methods (Fitzsimmons-Craft et al., 2019b). To examine reach to undergraduate female students relative to the size of the undergraduate female student body (i.e., number of screens completed at a particular college by undergraduate females divided by size of the undergraduate female student body), we used data (Fall 2015) from the National Center for Education Statistics (NCES) (“NCES College Navigator,” n.d.; i.e., undergraduate enrollment data) and Peterson's (“Find a college,” n.d.; i.e., proportion of student body that is female). This generated an estimate of the proportion of the undergraduate female student body reached by the program. Given that schools participated in the study across varying academic years, undergraduate female enrollment numbers were adjusted to account for one (for schools that participated two years; $n = 12$) or two additional incoming classes of female freshmen (for schools that participated three years; $n = 15$) (assuming the number of incoming female freshmen was equivalent to 25% of female undergraduate enrollment). In addition, we compared the number of screens completed by White non-Hispanic individuals on each campus relative to the expected number of White non-Hispanic screens by multiplying total number of screens at each school by the percent of the student body that is White non-Hispanic using data from the NCES (“NCES College Navigator,” n.d.). We also utilized correlation analyses and independent samples t-tests to analyze the relationship between proportion of the undergraduate female student body on each campus reached and key campus characteristics, including school size, acceptance rate, percent engaged in Greek life, percent living on campus, and public vs. private using data from the NCES (“NCES College Navigator,” n.d.) and individual university websites.

Second, screen results were examined descriptively, and then statistically, analyzing differences across ED status groups. Differences in ED status groups on demographics and recruitment method were examined using analyses of variance (ANOVAs) for continuous measures and chi-square tests for categorical variables. Differences in ED status groups on ED pathology, psychiatric comorbidity, and ED risk factors were examined using analyses of

covariance (ANCOVAs) for continuous measures and chi-square tests for categorical variables, controlling for any significant demographic differences found across groups. To correct for the use of multiple tests, $p < .01$ was used as the threshold for significance given that the Bonferroni correction has been criticized for being overly conservative (e.g., Perneger, 1998). Significant results ($p < .01$) were followed up with post hoc tests (Tukey or chi-square).

Results

Descriptive Statistics and Reach

Over the three years, 4,894 individuals completed the screen. Participants ranged in age from 18 to 67 years, with a mean age of 22.28 years ($SD = 5.75$). Participants were primarily female (87.4%), with fewer identifying as male (11.4%), transgender (0.3%), gender non-conforming (0.6%), or preferring not to answer/feeling as though none of the above applied (0.3%). Most participants identified as White (61.5%), 14.2% as Asian or South Asian, 6.5% as Black or African American, 0.6% as Native Hawaiian or Pacific Islander, 0.3% as American Indian or Alaskan Native, 7.9% as multiracial, and 7.3% as other races (1.9% missing). Regarding ethnicity, 16.2% identified as Hispanic. Current mean BMI was 24.33 kg/m^2 ($SD = 5.14$). In terms of student status, 76.7% were undergraduate students, 21.7% were graduate students, 0.2% were postdoctoral fellows, and 1.3% other. The median time for screen completion in Years 2 and 3 (which included the additional ED risk factor measures) was 11.9 minutes. As seen in Table 1, the total estimated undergraduate female student population that could have been reached was 300,613. Among participating schools, an average of 1.9% of the undergraduate female student body on each campus took the screen; the greatest reach was 8.4% at one campus and the lowest was <1% (0.08%). We note that one school of the 28 randomized schools never officially launched the initiative (i.e., no participants were recruited due to IRB delays and university requirements for recruiting participants that could not be met by the research team) and thus is not included in the reach estimates.

Regarding comparing the number of screens completed by White non-Hispanic individuals on each campus relative to the expected number of White non-Hispanic screens, in all but four instances (85.2%), we obtained more screens from White non-Hispanic individuals than was expected. There were two instances in which the number of screens from White non-Hispanic individuals was lower than expected and two instances in which there was alignment between the number of expected and obtained screens from White non-Hispanic individuals.

When examining the correlation between percent of the undergraduate female student body on each campus who took the screen and key campus characteristics, we found that it was significantly negatively correlated with school size ($r = -.52$, $p = .005$) and significantly positively correlated with percent living on campus ($r = .60$, $p = .001$). It was not significantly correlated with acceptance rate or percent in Greek life ($ps > .073$). Average percent of the undergraduate female student body reached differed in public versus private schools ($t(25) = -2.94$, $p = .007$), whereby reach was higher at private institutions.

Screen Results

ED status of the participating students was as follows: 40.3% ($n = 1,972$) screened as low risk for an ED; 35.7% ($n = 1,748$) screened as high risk for an ED; 20.3% ($n = 992$) screened positive for a possible clinical/subclinical ED (with the exception of AN) (hereafter referred to as the ED group); and 3.7% ($n = 182$) screened positive for possible AN (hereafter referred to as the pAN group).

ED Status Group Differences

Demographics.—As depicted in Table 2, ED status groups did not differ in terms of race or ethnicity ($p > .209$) but did differ in terms of age, gender, and BMI ($p < .002$). Follow-up tests revealed that individuals in the pAN group were significantly younger than individuals in the other groups. Relative to the low-risk group, greater proportions of individuals in the other groups were female. A significantly greater proportion of individuals in the ED group was female relative to the high-risk group. The low-risk group had a significantly lower mean BMI than the high-risk or ED groups. As anticipated, the pAN group had a significantly lower mean BMI than the other groups.

Recruitment Method.—As depicted in Table 2, ED status groups differed by recruitment method ($p < .001$). Email was the highest yielding method across all groups, particularly for the low- and high-risk groups for whom greater proportions were recruited via email compared to the ED group. More individuals in the low- and high-risk groups were also recruited in class/by a professor compared to the ED group. Greater proportions of individuals in the ED and pAN groups were recruited via website (e.g., link to HBI on counseling center website) compared to the low- and high-risk groups. Recruitment via referral from the counseling/student health center was also more common for individuals in the ED and pAN groups compared to the low- and high-risk groups. Proportions of individuals recruited through flyers and peers/friends did not differ across groups ($p > .057$).

ED Symptoms.—As depicted in Table 3, all ED symptoms significantly differed across the ED status groups ($p < .001$), controlling for the demographic variables on which the groups differed (i.e., age, gender, BMI). Follow-up tests revealed that weight/shape concerns increased incrementally by ED status level (considering the pAN group as the highest risk group), with significant differences emerging for each pairwise comparison. Low- and high-risk groups exhibited similarly low levels of binge eating, vomiting, and diuretics/laxative use in the past three months, while the high-risk group exhibited significantly greater levels of excessive exercise and fasting compared to the low-risk group. As anticipated, for all ED symptoms, the high-risk group reported lower frequencies than the ED or pAN groups. The ED and pAN groups did not differ on vomiting or diuretics/laxative frequencies but did significantly differ on binge eating (more frequent in the ED group) and fasting frequencies (more frequent in the pAN group).

ED-Related Clinical Impairment.—ED-related clinical impairment in all areas significantly differed across the ED status groups ($p < .001$), controlling for age, gender, and BMI. Follow-up tests revealed that for all areas, the ED and pAN groups reported

similarly high levels of impairment, which were significantly greater than the levels of impairment reported by the low- or high-risk groups. The high-risk group reported significantly greater levels of impairment than the low-risk group (see Table 3).

Psychiatric Comorbidity.—Depression, anxiety, and sleep problems significantly differed across the ED status groups ($ps < .001$), controlling for age, gender, and BMI. The low-risk group reported significantly lower levels of these problems than all other groups, and the high-risk group reported significantly lower levels of these problems compared to the ED and pAN groups. The ED and pAN groups reported similar levels these psychiatric comorbidities. Binge drinking was not found to significantly differ across the groups ($p = .035$) (see Table 3).

ED Risk Factors.—All ED risk factor variables (i.e., social comparison, idealization of thinness, body talk) significantly differed across the ED status groups ($ps < .001$), controlling for age, gender, and BMI. Follow-up tests revealed that the low-risk group reported significantly lower levels of all ED risk factors than all other groups, and the high-risk group reported significantly lower levels compared to the ED and pAN groups in the case of social comparison and idealization of thinness and significantly lower levels than the ED group in the case of body talk. The ED group reported significantly lower levels of social comparison than the pAN group. The ED and pAN groups did not differ on idealization of thinness or body talk (see Table 3).

Discussion

As part of an RCT, we screened and offered tailored online interventions for preventing and treating EDs at 28 U.S. universities. The current study reported on screening reach, level of pathology observed, and differences across ED status groups in this large, geographically diverse population of U.S. students, which will inform future large-scale implementation efforts. Results highlight several key findings.

First, we screened nearly 5,000 students for an ED at participating universities over three years. An average of 1.9% of the undergraduate female student body on each campus took the screen, with the greatest reach being 8.4% at one campus. This average reach is similar to results from HBI deployment in Missouri public universities (Fitzsimmons-Craft et al., 2019b) but is lower than that of a college mental health screening program that used direct-to-student email recruitment only (Haas et al., 2008). These findings highlight the considerable challenges of reaching people, even with digital approaches, which also has been demonstrated in other ED trials (DeBar et al., 2009; Lindenberg, Moessner, Harney, McLaughlin, & Bauer, 2011). That is, these programs are currently not reaching a significant number of individuals who could benefit, which will be an important area for future research to address. It is also notable that reach to racially/ethnically diverse students was lower than expected based on data on the diversity of the participating campuses, whereby on 85% of the campuses, the recruited sample was less diverse than expected. Research indicates that EDs do not discriminate and that they affect individuals of all genders, races, and ethnicities (Schaumberg et al., 2017). When screening methods rely on students self-selecting to take the screen, as was done here, it may be that stereotypes about EDs influence who chooses to

take the screen (e.g., Grillo & Keel, 2018; Räisänen & Hunt, 2014). In the future, screening initiatives might be paired with campaigns dedicated to improving awareness of the occurrence of EDs among individuals from minority groups (e.g., Mitchison, Hay, Slew-Younan, & Mond, 2014). We also demonstrated that reach was associated with several key campus characteristics. In particular, reach was greater at smaller schools, at schools with more students living on campus, and at private versus public institutions. In the future, at campuses where it may be more difficult to engage students in general in ongoing initiatives (such as at universities that are larger, public, and have many commuter students), extra efforts may need to be taken to recruit students for online mental health screening and intervention efforts (e.g., institutional support for regularly sending out student-wide emails to advertise the program).

Findings demonstrated that email was the most effective recruitment method overall (accounting for >50% of screens), consistent with other eHealth clinical trials in which digital recruitment strategies yielded the highest reach (Lattie et al., 2018); however, significantly greater proportions of individuals screening into the ED and pAN groups heard about HBI through the counseling/health center or on a website, relative to the low- and high-risk groups. Flyers yielded relatively low uptake across groups. Relatedly, Bauer, Bilic, Ozer, and Moessner (2019) found that different access paths for an Internet-based program for the prevention/early intervention of EDs were associated with differences in sample composition, whereby methods that relied on self-selection versus a more universal approach (i.e., school-based recruitment) resulted in greater proportions of individuals at high risk for an ED. Our pattern of results suggests that screening for EDs on college campuses should be primarily implemented through systematic email distribution, but that such efforts should be supplemented through partnerships with counseling/health centers to refer individuals in need of treatment to the program and to make such programming available on their websites. However, these findings need to be replicated. Administrative support such as annual, mandated ED screening for all students or regular student-wide emails advertising the program would likely increase reach.

Second, we demonstrated that ED risk in participating students was quite high—almost 60% of respondents screened as being at high risk for ED onset or having a clinical/subclinical ED, which is similar to observed rates in Missouri public universities (Fitzsimmons-Craft et al., 2019b). This finding is also similar to a randomized controlled trial comparing two online ED prevention programs that recruited young adult women who wished to improve their body image; in that study, 67% of participants had baseline disordered eating and 79% had baseline WCS scores in the elevated range (Wilksch et al., 2018). Findings must be interpreted in the context of the fact that students self-selected to participate in HBI, which likely explains the greater risk level relative to some other work. For example, a population-level study of ED symptoms at 12 U.S. colleges and universities found that prevalence of possible EDs ranged from 12-40% depending on the ED definition utilized (e.g., ED psychopathology, past month binge eating, or past month compensatory behaviors) (Lipson & Sonnevile, 2017). The finding that ED risk was elevated in the current study is important as it suggests that the HBI screen attracts students with elevated ED pathology. Further, similar results were observed in our work disseminating an online EDs screen in collaboration with the National Eating Disorders Association, the largest U.S. non-profit

organization related to EDs, whereby 86% of the over 71,000 adults who completed the screen over the course of 6 months screened positive for an ED (Fitzsimmons-Craft, Balantekin, et al., 2019a). In the current work, we identified over 180 students with pAN and nearly 1,000 students screening positive for other EDs in just three years, highlighting the potential for online screening to increase problem recognition.

Finally, findings highlight differences across ED status groups. Individuals identified with pAN were younger, and individuals at low risk for an ED had a significantly lower mean BMI than individuals in the high-risk and ED groups (whose mean BMIs were in the overweight range). This aligns with other research suggesting elevated weight status may increase risk for EDs (e.g., Duncan, Ziobrowski, & Nicol, 2017). Race and ethnicity did not differ across ED risk status groups, but racial/ethnic minority individuals with EDs are significantly less likely than their White counterparts to be diagnosed with an ED, receive care or a referral for evaluation, or be asked by a doctor about ED symptoms (Becker, Franko, Speck, & Herzog, 2003; Cachelin & Striegel-Moore, 2006; Marques et al., 2011). These disparities in ED identification and treatment further highlight the need for accessible screening and intervention, such as that offered through HBI; however, as noted above, even within HBI, there are biases in who chooses to participate. Results regarding ED symptoms and ED-related clinical impairment across ED status groups provide additional validity and clinical utility for our SWED screening algorithm (Graham et al., 2019) using a large, national sample of college students, as these constructs generally increased incrementally by ED status group as would be expected (Aspen et al., 2014). Notably, individuals in the high-risk group exhibited ED-related clinical impairment at levels greater than the low-risk group but lower than the ED or pAN groups. A similar pattern of findings was generally observed for depression, anxiety, sleep problems, and ED risk factors. These findings highlight the increasing pathology, impairment, and psychiatric comorbidity levels in the high-risk group and thus the need for timely screening and intervention to prevent onset of a full-threshold ED.

Strengths of this study include use of a large, national sample, increasing generalizability. However, findings should be interpreted in the context of limitations. HBI was not implemented as a population-based screen, and as such, results should not be understood as representative of all college students' ED risk status levels. Screen results are suggestive of the ED risk level of students who elected to complete a body image/ED screen and the possibility of receiving access to an online intervention. Additionally, screening results are based on online self-report questionnaires rather than diagnostic interviews. We also did not track the number of times various recruitment strategies were used on each campus or collect the data that would be required to shed light on the cost-effectiveness of different recruitment methods (e.g., Moessner, Minarik, Ozer, & Bauer, 2016). Finally, although social media was used for recruitment, its reach was not assessed. Past research has indicated that targeted social media can be useful for recruiting for mental health research (Lane, Armin, & Gordon, 2015).

The ultimate goal of HBI is to reduce the incidence and prevalence of EDs on college campuses. As such, understanding program reach, level of pathology, and differences across ED status groups is essential. Using a multi-pronged recruitment approach, an average of

1.9% of the undergraduate female student body on each campus took the screen. Higher-level support for screening and systematic email distribution may increase program uptake; however, strategies such as use of targeted referrals to the program from providers in the counseling/student health center and linking to the program on counseling/student health center websites should continue to be utilized, given that these strategies result in increased access to the program for those who need it most. Findings also demonstrate the increasing pathology and impairment in the high-risk group and the importance of scalable programs such as HBI, which provide access to timely screening and intervention for this vulnerable group.

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Table 1
Reach of the Screen to Undergraduate Female Students on Participating University Campuses

University ^a	Undergraduate enrollment ^b	% Female ^c	Estimate of total female undergraduates ^d	Years of recruitment for the trial	Total possible undergraduate females that could have been reached, accounting for 1 or 2 additional incoming classes (depending on whether recruitment occurred for 2 or 3 years, respectively) ^e	Total undergraduate female screens	Percent female undergraduates screened ^f
1	2,110	49%	1,034	3	1,551	113	7.29%
2	33,331	52%	17,332	3	25,998	223	0.86%
3	27,496	52%	14,298	3	21,447	136	0.63%
4	1,577	61%	962	3	1,443	30	2.08%
5	20,049	47%	9,423	2	11,779	81	0.69%
6	4,163	57%	2,373	3	3,559	124	3.48%
7	27,723	56%	15,525	2	19,406	98	0.50%
8	25,471	56%	14,264	2	17,830	15	0.08%
9	41,032	56%	22,978	2	28,722	87	0.30%
10	4,976	64%	3,185	2	3,981	12	0.30%
11	10,255	47%	4,820	3	7,230	136	1.88%
12	9,268	58%	5,375	2	6,719	48	0.71%
13	4,522	64%	2,894	2	3,618	9	0.25%
14	5,385	50%	2,693	3	4,039	97	2.40%
15	26,822	48%	12,875	3	19,312	10	0.05%
16	7,000	49%	3,430	3	5,145	317	6.16%
17	19,049	60%	11,429	2	14,287	108	0.76%
18	7,841	58%	4,548	2	5,685	66	1.16%
19	5,883	48%	2,824	3	4,236	81	1.91%
20	29,585	57%	16,863	2	21,079	98	0.46%
21	28,312	50%	14,156	3	21,234	118	0.56%
22	16,091	66%	10,620	3	15,930	151	0.95%
23	20,607	53%	10,922	2	13,652	241	1.77%
24	6,782	62%	4,205	3	6,307	295	4.68%

University ^a	Undergraduate enrollment ^b	% Female ^c	Estimate of total female undergraduates ^d	Years of recruitment for the trial	Total possible undergraduate females that could have been reached, accounting for 1 or 2 additional incoming classes (depending on whether recruitment occurred for 2 or 3 years, respectively) ^e	Total undergraduate female screens	Percent female undergraduates screened ^f
25	10,973	57%	6,255	2	7,818	62	0.79%
26	3,260	54%	1,760	3	2,641	24	0.91%
27	7,504	53%	3,977	3	5,966	501	8.40%
					Total = 300,613	Total = 3,281	Average = 1.85%

Note.

^aParticipating universities labeled by number so as to protect their privacy.

^bData (Fall 2015) from the National Center for Education Statistics.

^cData on the % of the student body that is female from Peterson's.

^dEstimate of total female undergraduates = undergraduate enrollment * % female.

^eTotal possible undergraduate females that could have been reached = Estimate of total female undergraduates * [1.25 for those participating 2 years OR 1.5 for those participating 3 years].

^fPercent female undergraduates screened = Total undergraduate female screens / Total possible undergraduate females that could have been reached.

Table 2
 Comparison of Demographic Variables and Recruitment Method Across Eating Disorder Status Groups

	LR (n = 1972)	HR (n = 1748)	ED (n = 992)	pAN (n = 182)	Significance	Pairwise Comparisons
Demographics						
Age	22.20 (5.62)	22.60 (6.29)	22.13 (5.14)	20.94 (4.45)	$F(3,4885) = 5.47; p = .001$ partial $\eta^2 = .003$	pAN < LR, HR, ED
Gender (% Female)	82.4%	89.8%	92.1%	92.3%	$\chi^2(3,4894) = 77.59; p < .001$ Cramer's $V = .07$	LR < HR, ED, pAN HR < ED
Race (% White)	63.2%	62.6%	62.0%	59.9%	$\chi^2(3,4802) = 1.01; p = .798$ Cramer's $V = .01$	--
Ethnicity (% non-Hispanic)	84.4%	82.3%	84.5%	86.3%	$\chi^2(3,4894) = 4.52; p = .210$ Cramer's $V = .02$	--
BMI	23.14 (4.06)	25.37 (5.34)	25.74 (5.92)	19.44 (2.52)	$F(3,4860) = 150.12; p < .001$ partial $\eta^2 = .09$	LR < HR, ED pAN < LR, HR, ED
Recruitment method, $\chi^2(18,3706) = 137.84; p < .001$, Cramer's $V = .05$						
% Flyer	7.6%	8.3%	10.8%	10.9%	$\chi^2(3,3707) = 7.49; p = .058$ Cramer's $V = .03$	--
% Email	57.9%	54.9%	46.2%	46.1%	$\chi^2(3,3707) = 29.72; p < .001$ Cramer's $V = .05$	ED < LR, HR pAN < LR
% Website	4.8%	6.4%	10.1%	11.7%	$\chi^2(3,3707) = 26.82; p < .001$ Cramer's $V = .05$	LR < ED, pAN HR < ED, pAN
% Counseling center	8.2%	13.3%	20.4%	17.2%	$\chi^2(3,3707) = 66.76; p < .001$ Cramer's $V = .08$	LR < HR, ED, pAN HR < ED
% Peer/friend	8.3%	7.0%	7.5%	6.3%	$\chi^2(3,3707) = 2.19; p = .534$ Cramer's $V = .01$	--
% In class/professor	7.4%	5.9%	3.2%	4.7%	$\chi^2(3,3707) = 15.31; p = .002$ Cramer's $V = .04$	ED < LR, HR

Note. LR = low risk for an ED; HR = high risk for an ED; ED = clinical/subclinical ED (with the exception of AN); pAN = possible anorexia nervosa. Pairwise comparisons listed were significant at least at $p < .05$.

Table 3
 Comparison of Eating Disorder Pathology, Psychiatric Comorbidity, Eating Disorder Risk Factors across Eating Disorder Status Groups Controlling for Age, Gender, and BMI

	LR (n = 1972)	HR (n = 1748)	ED (n = 992)	pAN (n = 182)	Significance	Pairwise Comparisons
<i>Eating disorder symptoms</i>						
WCS	27.92 (12.04)	62.05 (13.62)	66.61 (18.40)	75.88 (12.52)	$F(3,4842) = 2536.83; p < .001$ partial $\eta^2 = .61$	LR < HR, ED, pAN HR < ED, pAN pAN < ED
Binge eating frequency (past 3 months)	.57 (2.36)	1.22 (1.70)	19.83 (31.34)	10.96 (20.27)	$F(3,4771) = 416.52; p < .001$ partial $\eta^2 = .21$	LR < ED, pAN HR < ED, pAN pAN < ED
Vomit frequency (past 3 months)	.03 (.27)	.20 (.73)	5.21 (16.93)	6.22 (21.49)	$F(3,4829) = 110.43; p < .001$ partial $\eta^2 = .06$	LR < ED, pAN HR < ED, pAN
Diuretics/laxatives frequency (past 3 months)	.04 (.32)	.15 (.65)	2.88 (14.23)	2.92 (11.80)	$F(3,4686) = 49.35; p < .001$ partial $\eta^2 = .03$	LR < ED, pAN HR < ED, pAN
Excessive exercise frequency (past 3 months)	1.49 (8.21)	4.98 (13.43)	8.37 (16.12)	16.36 (25.40)	$F(3,4825) = 124.94; p < .001$ partial $\eta^2 = .07$	LR < HR, ED, pAN HR < ED, pAN ED < pAN
Fasting frequency (past 3 months)	.66 (4.17)	2.27 (6.57)	5.05 (10.39)	8.85 (15.74)	$F(3,4827) = 125.08; p < .001$ partial $\eta^2 = .07$	LR < HR, ED, pAN HR < ED, pAN ED < pAN
<i>Eating disorder-related clinical impairment</i>						
School work	1.52 (.74)	2.31 (1.04)	2.98 (1.14)	3.08 (1.26)	$F(3,4695) = 537.27; p < .001$ partial $\eta^2 = .26$	LR < HR, ED, pAN HR < ED, pAN
Relationships	1.63 (.81)	2.58 (1.08)	3.31 (1.11)	3.26 (1.12)	$F(3,4689) = 638.80; p < .001$ partial $\eta^2 = .29$	LR < HR, ED, pAN HR < ED, pAN
Self	2.33 (.97)	3.55 (1.00)	4.15 (.88)	4.16 (.89)	$F(3,4687) = 862.99; p < .001$ partial $\eta^2 = .36$	LR < HR, ED, pAN HR < ED, pAN
<i>Psychiatric comorbidity</i>						
Alcohol (% binge drank past 2 weeks) ^a	38.5%	41.0%	44.0%	40.7%	$\chi^2(3,4891) = 8.63; p = .035$ Cramer's V = .02	--
Depression	1.86 (.98)	2.33 (1.15)	2.81 (1.18)	2.92 (1.25)	$F(3,4703) = 165.51; p < .001$ partial $\eta^2 = .10$	LR < HR, ED, pAN HR < ED, pAN
Anxiety	2.69 (1.06)	3.13 (1.08)	3.45 (1.12)	3.67 (1.10)	$F(3,4695) = 123.38; p < .001$ partial $\eta^2 = .07$	LR < HR, ED, pAN HR < ED, pAN
Sleep problems	2.08 (1.14)	2.40 (1.25)	2.71 (1.33)	2.79 (1.34)	$F(3,4701) = 56.90; p < .001$ partial $\eta^2 = .04$	LR < HR, ED, pAN HR < ED, pAN
<i>Eating disorder risk factors</i>						

	LR (<i>n</i> = 1972)	HR (<i>n</i> = 1748)	ED (<i>n</i> = 992)	pAN (<i>n</i> = 182)	Significance	Pairwise Comparisons
Social comparison	26.94 (10.18)	39.77 (11.63)	44.85 (11.23)	48.62 (10.81)	$F(3,3674) = 570.41; p < .001$ partial $\eta^2 = .32$	LR < HR, ED, pAN HR < ED, pAN ED < pAN
Idealization of thinness	2.73 (1.16)	4.08 (1.01)	4.58 (.99)	4.03 (1.13)	$F(3,3675) = 521.91; p < .001$ partial $\eta^2 = .30$	LR < HR, ED, pAN HR < ED, pAN
Body talk	23.93 (9.02)	28.62 (9.72)	30.81 (10.16)	28.96 (10.99)	$F(3,3669) = 88.03; p < .001$ partial $\eta^2 = .07$	LR < HR, ED, pAN HR < ED

Note. LR = low risk for an ED; HR = high risk for an ED; ED = clinical/subclinical ED (with the exception of AN); pAN = possible anorexia nervosa. We present unadjusted means (and standard deviations in parentheses) for each measure, with the exception of the Alcohol measure, for which the percentage of individuals who reported engaging in binge drinking in the past 2 weeks is reported. For all measures, higher scores reflect higher levels of the construct. Pairwise comparisons listed were significant at least at $p < .05$.

^aWe note that the chi-square presented for the Alcohol measure is unadjusted. Chi-square analyses controlling for age ($p = .037$), gender ($p = .035$), and BMI ($p = .029$) revealed a similar pattern of findings.