

A Snapshot of Mental Health and Wellness of Engineering Students Across the Western United States

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Abstract—This work in progress research paper characterizes mental wellness in engineering at five institutions across the Western United States to better understand what mental health issues most affect the broader engineering student community. Anecdotal evidence has long suggested that stress and certain mental wellness issues are particularly acute in the field of Engineering, and some recent research has shown elevated rates of mental wellness issues at different institutions around the country. This paper presents the results of a previously validated mental health survey conducted with first- and second-year students at several universities. The results of this work include screening rates for major mental health issues (e.g. DSM diagnosable) and moderate mental health issues as captured by the Kessler 6 screening instrument; screening rates for depressive, anxiety, and eating disorders as measured by the Patient Health Questionnaire (PHQ); and screening rates for post-traumatic stress disorder (PTSD) as measured by the Primary-Care Post Traumatic Stress Disorder (PC-PTSD) instrument. This work also includes a preliminary analysis of screen rates by demographic groups so that educators and academic facilitators may be better aware of the types of challenges that face a diverse engineering student populace. Overall, we find that 28.4% percent of respondents potentially suffer from a diagnosable mental health condition as measured by Kessler 6. We also find that an additional 55.2% of students screen positive for moderate psychological distress. Breaking measurements down by demographic groups, we find that female respondents, particularly those from historically excluded ethnic groups and races, show elevated rates of Panic and PTSD disorders when compared to the male population.

Index Terms—Mental Health, Disability, Accessibility, Equity, Inclusion, Wellness, First and Second Year

I. INTRODUCTION

A growing body of research suggests that engineering students may be particularly vulnerable to mental health and wellness issues. Some studies have shown students suffering from depression and anxiety symptoms at rates much higher than the general population [1], [2]. Other studies have focused on the impacts of stress and stress culture on engineering students [3]. In an earlier study, we found that respondents at one institution had roughly double the levels of depression

and anxiety than the general population, and roughly 10 times the incidence of serious psychological distress [4].

Existing studies of mental health in engineering students have largely been limited to studying students at a single institution. Given that previous work has suggested that students in closely related engineering degree programs exhibit different levels of mental health [5], it is hard to determine the extent to which the mental wellness issues identified in previous work are attributable to institution-specific factors versus national trends in engineering programs.

Indeed, while multi-institutional mental-health data for engineering students is scarce, many studies have found that mental health is a major issue for college students across the nation [6]–[12]. Additional studies have also shown links between student mental health conditions and student retention and success [13], [14]. Therefore, it is important to understand how prevalent mental health and wellness conditions are in the engineering student population if we hope to improve student outcomes.

This work-in-progress expands on previous research by exploring how wide-spread various mental wellness issues are in engineering programs by presenting the results of a mental health survey conducted at five institutions across the American West, including schools in California, Arizona, and Colorado. This work also attempts to identify mental wellness inequities across demographic groups within engineering with the hope that institutions will be able to use this knowledge to support the success of their diverse student bodies.

This work specifically reports on the estimated percentage of students suffering from anxiety, panic disorders, depression, eating disorders, post-traumatic stress, and non-specified psychological distress.

II. METHODS

A. Survey Design

The survey for this study is largely based on the instrument used in [4]. This survey was selected since baseline engineering data from this instrument already exists for at least one university, allowing easy comparison to existing literature.

The survey is composed of portions of pre-existing mental health surveys that are widely used for measuring population mental health. Instruments include the Kessler 6 [15], the Patient Health Questionnaire (PHQ) [16], and the Primary Care Post Traumatic Stress Disorder Scale (PC-PTSD) [17].

The Kessler 6 instrument is a short scale designed to assess the overall mental health of a population. Consisting of 6 Likert-style [18] questions, the Kessler screens for the presence of moderate and severe mental health issues in respondents, although it does not indicate which condition(s) a respondent may be suffering from.

The PHQ is a significantly longer instrument containing modules to screen for various mental health and wellness conditions. For the purpose of this study, we include the modules to screen for depressive disorders (“Major Depression” and “Depression”), anxiety disorders (“Panic Syndrome” and “Other Anxiety”), and eating disorders (“Bulimia-Nervosa” and “Non-Binary Eating Disorder”). The module for somatic disorders was excluded since the authors reasoned that somatic symptoms may be confounded by other health conditions associated with dorm living. The module to screen for alcohol abuse was also omitted as we collected email identifiers from some participants for future longitudinal studies, and did not wish to expose underage students to any potential legal liabilities as a result of their participation in this study.

Finally, we included the PC-PTSD scale to determine whether and to what extent students are suffering from post-traumatic-stress like symptoms. This disorder can be brought on by any number of previous traumatic events, from prior military service to assaults, and can impose significant challenges for student academic success. It is therefore important to measure to what extent this condition is affecting engineering students so that institutions can better address it. While we screen for incidence of PTSD-like symptoms, we do not attempt to discern the causes—whether school related or otherwise.

In addition to these screening instruments, respondents were asked a number of demographic questions including race, gender identity, sexuality, major, parent’s highest level of education, and whether they have ever been diagnosed with or are undergoing treatment for a mental health or wellness condition.

B. Participants and Data Collection

With IRB approval, the survey was distributed to students at five universities across the western United States, including sites in California, Arizona, and Colorado. These sites include schools primarily focused on undergraduate education, as well as at one PhD granting institution.

To assist with future longitudinal research, the survey was only distributed to first and second year engineering students. If a student who reported they were from another program year attempted to complete the survey, they were met with an early disqualification page in the online survey system. While it is possible a student from another program year could have

answered the screening question dishonestly, we do not believe that this would represent a large portion of our respondents.

Students were recruited over email with an initial solicitation and, if needed, a reminder email sent out some time later. Depending on the schedule of the partner institution, the survey was sent either in Fall 2019 or Winter 2020. All data collection was completed weeks before the first U.S. institutions started implementing measures to counteract the COVID-19 pandemic, and therefore it is assumed that student mental health captured here is not affected by pandemic related stress.

Overall, roughly 62% of respondents identified as white, 17% identified as Asian, and 11% identified as Latinx or Hispanic. 52% of respondents identified as male, and 45% identified as female. 80% of respondents identified as heterosexual, with 8% reporting bisexual, and 3% identifying as gay or lesbian. 54% of respondents are in their first year, and 46% are in their second year. While we received responses from individuals from other races, gender identities, and sexual orientations, there were too few of these individuals in the sample population for a meaningful statistical analysis.

C. Data Analysis

The survey yielded 700 usable results total, with participation numbers of 190, 98, 96, and 65 from the four primarily undergraduate universities, and 251 respondents from the PhD granting institution. The average response rate across all sites was approximately 8%.

Screen-rates for various mental wellness conditions were determined using the screening guidelines associated with each instrument. For the Kessler 6, we also included the scoring threshold for moderate psychological distress proposed and validated by Prochaska et al. [19].

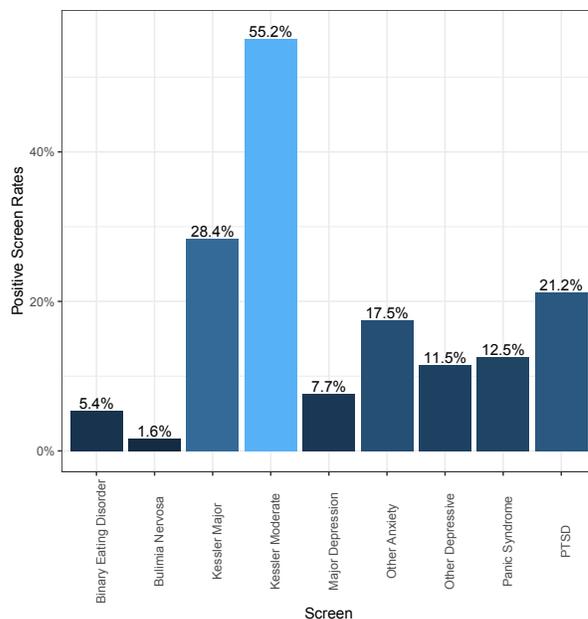


Fig. 1. Positive screen rates for all respondents.

TABLE I
POSITIVE SCREEN RATES FOR RESPONDENTS BY RACE/ETHNICITY AND GENDER (IN % WITH 95% CONFIDENCE INTERVAL).

Gender	Sexuality	Kessler Major	Kessler Moderate	Depressive Major	Depressive Other	Panic Syndrome	Other Anxiety	Bulimia	Binary Eating Dis.	PTSD
Asian	Female	44 ± 13	44 ± 12	10 ± 9	15 ± 10	20 ± 11	20 ± 10	5 ± 6	5 ± 6	39 ± 13
Asian	Male	22 ± 12	60 ± 14	7 ± 8	12 ± 10	3 ± 5	11 ± 9	5 ± 6	0	7 ± 8
Latinx	Female	60 ± 19	30 ± 17	13 ± 14	13 ± 15	29 ± 18	30 ± 17	7 ± 10	10 ± 12	41 ± 19
Latinx	Male	26 ± 14	52 ± 16	9 ± 10	12 ± 11	8 ± 9	12 ± 11	0	5 ± 6	28 ± 15
White	Female	28 ± 6	62 ± 7	10 ± 5	9 ± 5	23 ± 7	26 ± 7	1 ± 1	8 ± 4	23 ± 6
White	Male	22 ± 5	57 ± 7	5 ± 3	10 ± 4	5 ± 3	11 ± 4	0	5 ± 3	15 ± 5

TABLE II
POSITIVE SCREEN RATES FOR RESPONDENTS BY GENDER AND SEXUALITY (IN % WITH 95% CONFIDENCE INTERVAL).

Gender	Sexuality	Kessler Major	Kessler Moderate	Depressive Major	Depressive Other	Panic Syndrome	Other Anxiety	Bulimia	Binary Eating Dis.	PTSD
Female	Bisexual	44 ± 16	51 ± 16	7 ± 10	14 ± 14	31 ± 16	40 ± 16	0	11 ± 11	25 ± 14
Female	Heterosexual	30 ± 6	57 ± 7	11 ± 5	12 ± 5	17 ± 5	20 ± 5	3 ± 2	6 ± 3	28 ± 6
Male	Heterosexual	22 ± 5	56 ± 5	5 ± 3	10 ± 4	4 ± 2	9 ± 3	1 ± 1	4 ± 2	14 ± 4

Screen-rates were computed conservatively, whereby if a respondent selected “prefer not to respond” to one or more questions in a screening module, they were excluded from the sample population for that module. Therefore, the number of respondents N varies with each screening item from a low of 557 for “Other Depressive” to a high of 687 for the Kessler screens. Additionally, with our screening instruments, certain conditions are mutually exclusive: a person with a positive screen for Kessler Major Psychological Distress automatically receives a negative screen for Kessler Moderate Distress. The same is true for Major versus Other Depressive.

Data analysis was conducted using the R programming language [20] in RStudio [21]. Plots for this work were generated using the ggplot2 R-package [22]. Custom data analysis scripts, available for review at https://github.com/adanowitz/mhw_analysis were written to analyze the underlying data and determine positive screen rates.

III. SURVEY RESULTS

The overall screening rates for various mental wellness conditions are shown in Figure 1. Note that each screening instrument provides a binomial (positive, negative) result.

The screening results for this population indicate that 83.6% of respondents were experiencing at least a moderate level of psychological distress, with roughly one-third of students suffering from major—indicative of a DSM diagnosable mental health condition—distress.

Table I shows the positive screen rate broken down by student race and gender. The 95% confidence interval for each measurement is provided for study reproducibility. All groups experience high-levels of moderate-to-severe psychological distress, ranging from a low of 78% for Latinos to a high of 90% for Latina and white women. Troublingly, Latina respondents have a 60% positive screen rate for Kessler Major psychological distress, indicating serious distress among this group.

Due to sample size, Latinas have a much wider 95% confidence interval than the other groups. Therefore, it is

possible that Kessler rates in this population are less severe than the mean indicates. The data shows, however, that non-white female respondents tend to screen positive for major psychological distress at higher rates than their male and white peers.

Roughly 40% of female Asian and Latina respondents also suffer from PTSD-like symptoms, a significantly higher proportion than male or white populations. Additionally, nearly 30% of Latino respondents exhibit PTSD-like symptoms. Asian male respondents exhibit the lowest PTSD screens in the target population, and, taking into account the confidence intervals, are roughly in line with the general population [23].

Females across the board also screen positive for Panic Disorder at a higher rate than their male peers, with white, Asian, and Hispanic women screening positive at rates of 20–30%. With the National Institute of Health (NIH) estimating that only 4.7% of U.S. adults are expected to suffer from Panic Disorder *in their lifetime* [24], this number is very high.

Taken together, the high screening rates for PTSD and Panic Syndrome among participants may indicate an unmet need for targeted mental health interventions and counselling resources.

One positive result from Table I is that Major Depression for respondents in all groups is below the 13.1% estimate incidence rate for major depression in 18–25 year-olds nationally [25].

Finally, table II shows positive screen rates broken out for gender and sexuality. Female Bisexual was the only historically excluded sexual identity with a significant population ($N = 42$), with all other historically excluded identity groupings having fewer than 20 respondents.

The data shows 31% of female bisexual respondents screen positive for Panic Disorder, an incidence over 11 times higher than found in the average United States population [24]. The Bisexual Female respondent population also has the highest incidence of moderate-to-major psychological distress, with a total of 95% of respondents screening positive for one of the two measures.

IV. DISCUSSION

Our sample of respondents from the Western United States experienced very high incidences of moderate-to-major psychological distress, with a population average of 83.6%. Overall, respondents also screen positive for Panic Syndrome at roughly 4.5 times the rate of the general population [24] and screen positive at nearly 6 times the PTSD screen rate from the general population [23]. Incidence of Major Depressive Disorder was lower than the national average for 18–25 year-olds, however [25].

The high incidence of PTSD combined with a low incidence of Major Depressive Disorder is of particular note since some studies have indicated a high-comorbidity of these conditions [26]. While total incidence of Depressive Disorders (both “major” and “other”) matches fairly well with incidence of PTSD in the general survey population (19.2% Depressive vs. 21.2% PTSD) this relationship does not hold for the individual demographic groupings explored in Tables I and II.

While mixed, these results do indicate that all demographic groups of engineering students in the region under study have high-levels of mental health and wellness needs that are currently not being adequately addressed by their host institutions.

The data also reveals a particularly high incidence of Kessler Major distress and PTSD-like symptoms among non-white female respondents. Previous research has documented that non-white women in STEM fields may face challenges and barriers beyond what their white-women and non-white-male peers face [27]–[30]. It is therefore possible that the unique stressors faced by women of color in engineering may contribute to degradation of specific mental wellness traits for this group. While the current data measurements can not be used to verify or disprove this assertion, we hope to tease out some of the causes for these high positive screen rates during a future stage of qualitative research.

The data also shows an elevated level of severe distress for bisexual women. Unfortunately, due to a lack of a significant number of non-heterosexual male respondents, it is unclear whether the elevated Kessler Major and Panic Syndrome screens from this population is correlated with sexuality or a combination of sexuality and gender identity.

This work is part of an ongoing, three-year longitudinal study to track how mental wellness changes over the course of an engineering program and relates to attrition. The data reported here can only show a correlation between demographic identity and screen rates, but planned follow-on qualitative research will be conducted next year to examine the causes of some of these phenomena, as well as to explore if gender norms/roles may have influenced how students rated various items.

V. CONCLUSION

This work explored the overall mental health and wellness of engineering students across the American Southwest. The results of this study confirm that engineering students face elevated mental wellness concerns as a population.

Additionally, while only 16.4% of respondents report that they have been diagnosed with a mental health or wellness condition, the fact that 28.4% may have a diagnosable condition (as indicated by Kessler 6) suggests that engineering students are currently under-served by or under-utilize campus mental health resources. Either way, this population could benefit from targeted outreach.

A. Future Work

Ultimately, these results cover only a small sample of what we hope to study during the course of our longitudinal study on engineering student mental health and wellness. As our respondents progress through their degree programs, we hope to study how overall mental health and screen rates vary, and determine if prevalence of any of the conditions is exacerbated by the respondents’ year in the program. We also hope to keep track of which students persist in engineering over time, and which leave, to see if any particular conditions are strong predictors of program attrition.

Finally, as the project moves forward, we plan to conduct qualitative interviews with students about their experiences in engineering education to try to tease out potential causes for the various trends and disparities we observe in the data set.

Taken together, this work should be viewed as only the first step in our efforts to generate a comprehensive understanding of student mental health and well-being in engineering.

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