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Engineering student mental health status across gender identities: Analysis of data from the Healthy Minds Study

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1 Introduction

Depression, anxiety, suicidal ideation and non-suicidal self-injury are some of the many mental health issues that have increased in prevalence among undergraduate college students [1]. College students' mental health is not only important for their wellbeing and belonging, but academic retention and success [2]. In engineering, cisgender women, transgender students, and nonbinary students—in this study referred to as gender minorities—face different challenges potentially explaining reports of worse mental health issues than peers who identify as cisgender men [3], [4]. Gender minoritized students face unique and sometimes compounding discrimination, including misogyny, cisheteronormativity and binarism [5], [6]. Women in engineering face systemic gender discrimination such as having their ideas ignored, being seen as weaker, and gender-based harassment [7], which likely contributes to the higher prevalence of mental health issues [8], [9], [10]. When transgender, nonbinary, and gender nonconforming engineering students are not being ignored or excluded from data collection and analysis, these students report experiencing misgendering/refusal to acknowledge one's gender, harassment, and isolation [11], [12]. In part, these challenges are likely both caused by and contribute to a lack of gender representation in engineering—that is, over three-fourths of students receiving engineering degrees in 2022 identified as men [11], [13], [14].

Despite calls to think beyond the cis and binary, engineering education research still predominantly focuses on the mental health of cisgender men and women without controlling for additional factors [15], [16]. Prior research on all undergraduate disciplines, conducted in 2019 and 2020, has established disparities in mental health across gender identity [3]. More recent work,

using data from the Healthy Minds Study, found that anti-LGBTQ legislation is heightening already high mental health issues among transgender and nonbinary adults [17]. Yet this work alone is not enough as extant research illustrates the need for mental health research specific to engineering students due to the norms of engineering [15]. Few studies in engineering consider the impact of other demographic factors when looking at differences in mental health issues across gender identity [18]. Further, these studies are limited due to small sample size for students who don't identify as cisgender men or cisgender women. Because factors such as race/ethnicity and first-generation status have been shown to impact both mental health issues and mental health help seeking, it is important that these are controlled for when comparing across students from different gender identities [19], [20], [21]. This study aims to address these gaps by using data from the 2022-202x3 Healthy Minds Study to answer the following research questions:

RQ1. How do self-reported mental health issues, as indicated in the Healthy Minds Study, compare between undergraduate engineering students from different gender identity groups when controlling for the differences in sociodemographic composition across gender identity groups?

RQ2. How does mental health help seeking, as indicated in the Healthy Minds Study, compare between undergraduate engineering students from different gender identity groups when controlling for the differences in sociodemographic composition across gender identity groups?

2 Background

Engineering culture is known to cause stress and shame [9], [23], [24]. With competitive programs [9] and rigorous courseloads [25], [26], engineering has been described as a 'meritocracy of difficulty' [26]. Accordingly, data show that students in engineering suffer from mental health issues at high rates [9], [27], [28] while being relatively unlikely to seek help for those issues [29].

For example, a 2021 study of engineering students across eight universities in the United States found that about half of the respondents received a positive screen for at least one diagnosable mental health condition [18]. Despite these high screenings indicating a diagnosis could be made, students in engineering were found to be less likely than other majors to have a diagnosis for anxiety or depression [30]. Because mental health issues can impair academic performance [31], [32], [33], it is important to develop strategies to support engineering students' well-being.

Research has shown that students belonging to historically marginalized and underrepresented groups are exposed to unique stressors that can significantly impact their mental health [34]. For instance, exposure to social factors outside of these students' control, such as systemic injustices, prejudice, and discrimination, can result in disparities in their mental health [35]. In engineering, gender minority students are exposed to marginalization, devaluation, and other microaggressions [36], [37], and gender minorities are at higher risk for mental health issues such as anxiety and depression [8], [9], [10], [18]. As a result, development of mental health support for engineering students, especially those students from historically marginalized identities, is crucial for effective and sustainable broadening participation efforts.

Despite experiencing high rates of mental health issues, engineering students are among the least likely to engage in mental health help seeking, [29], [30]. Research indicates that conventional aspects of engineering culture such as competition and meritocracy negatively influence students' attitudes toward mental health help seeking [38]. Additionally, certain traditionally hegemonic masculine norms such as stoicism and self-reliance are commonly upheld by engineering culture [39], [40], and they have been linked to reduced mental health help seeking in college students [41]. As a potential consequence of this, cisgender men in engineering have reported less favorable views towards mental health help seeking and were found to be less likely

to seek help than gender minority students [8].That being said, there is a lack of robust analysis of large scale datasets that highlight differences in mental health help seeking across gender identity within engineering while controlling for demographic covariates. Therefore, this paper aims to understand how mental health issues and mental health help seeking differ across engineering students from different gender identities.

3 Methods

3.1 Data

The data used in this study was from a web-based survey called the Healthy Minds Study (HMS) that is conducted on an annual basis at universities across the United States (HMS, 2023). Colleges and universities can elect to participate in this study which examines mental health issues, mental health help seeking, as well as other related factors among undergraduate and graduate students. For each institution that chose to participate, a random sample of students were asked to participate in the survey over email. This study used data from the 2022-2023 academic year which consisted of over 75,000 students from various institutions.

3.2 Demographic and Academic Factors

Demographic information provided by participants in the HMS survey was used for this study. Gender identity was reported by selecting all that applied from a list of options. Those who selected only man or woman were assigned to the categories of cisgender men and cisgender women, respectively. Due to limited sample sizes, those who selected trans-man (n = 27), trans-woman (n = 22), genderqueer (n = 63) or gender nonbinary (n = 127) were combined into a new category of “gender expansive” (n = 200). Additionally, this study included only students who selected “bachelors” when indicating the degree being completed and “engineering” when

indicating their degree program. This led to an overall sample size of just over 3800 responses (Table 1).

Table 1. Demographic information for undergraduate engineering student participants.

	Cisgender Men n = 2266		**Cisgender Women** n = 1619		**Gender Expansive** n = 200	
Race/Ethnicity	**n**	**%**	**n**	**%**	**n**	**%**
White	1310	58%	821	51%	116	58%
African American/ Black	159	7%	169	10%	19	10%
American Indian or Alaskan Native	3	0%	1	0%	0	0%
Asian American/ Asian	351	15%	322	20%	22	11%
Hispanic	151	7%	98	6%	5	3%
Native Hawaiian/ Pacific Islander	2	0%	2	0%	0	0%
Middle Eastern/ Arab/Arab American	52	2%	29	2%	3	2%
Multiracial	213	9%	167	10%	35	18%
Other	20	1%	8	0%	0	0%
Sexuality						
Heterosexuality	1955	86%	1048	65%	6	3%
Same-gender attracted	42	2%	37	2%	25	13%
Bisexual	89	4%	210	13%	32	16%
Queer	9	0%	32	2%	23	12%
Questioning	8	0%	30	2%	9	5%
Asexual	22	1%	30	2%	10	5%
Pansexual	10	0%	33	2%	25	13%
Selected multiple	78	3%	146	9%	67	34%
Other	11	0%	6	0%	2	1%

3.3 Measures

Eight mental health issues were examined – depression symptom severity, positive depression screen, depression diagnosis, anxiety symptom severity, positive anxiety screen, anxiety diagnosis, non-suicidal self-injury (NSSI), and suicidal ideation. Self-reported depression symptom severity in the past two weeks was measured using the Patient Health Questionnaire-9 (PHQ-9) which is a validated screening instrument based on the nine core symptoms of a major depressive episode [42]. For self-reported anxiety symptom severity in the past two weeks, the

Generalized Anxiety Disorder 7-item (GAD-7) measure was used [43]. The PHQ-9 and GAD-7 total scores were also categorized into levels of symptom severity based on each instrument's published categorization guidelines, resulting in five categories for depression (minimal, mild, moderate, moderately severe, and severe), and four categories for anxiety (minimal, mild, moderate, and severe). A positive screen was defined as symptoms of at least moderate severity within the past two weeks (a score of 10+; [42], [43]).

Additionally, self-reported lifetime diagnosis of depression and anxiety were examined among all undergraduate students with the question: "Have you ever been diagnosed with any of the following conditions by a health professional?" and a provided list of conditions to choose one or more from. Students who selected depression or anxiety for this item were categorized as having a depression diagnosis or anxiety diagnosis, respectively. Non-suicidal self-injury was assessed with the item: "This question asks about ways you may have hurt yourself on purpose, without intending to kill yourself. In the past year, have you ever done any of the following intentionally?" Students were instructed to "select all that apply." NSSI was operationalized as a binary variable where a positive response to at least one option other than "No, none of these" indicated the presence of NSSI. Lastly, suicidal ideation was assessed with the question "In the past year, did you ever seriously think about committing suicide?" which had the binary options "yes" or "no."

For the purpose of analyzing mental health help seeking, students with a positive screen for depression and/or anxiety (see above) were labeled as "distressed." For students in the dataset who were labeled as distressed, a binary variable for mental health help seeking was created based on the items "Have you ever received counseling or therapy for mental health concerns?" and "How many total visits or sessions for counseling or therapy have you had in the past 12 months?"

An answer of “No, never,” to the first question, or “0 visits” to the second, was coded as “no,” while an answer indicating at least one visit in the past year was coded as “yes.”

3.4 Analysis

Descriptive statistics were calculated and reported across gender identity for each dependent variable. Next, regression analyses were used to examine the relationship between gender identity and each dependent variable while controlling for race/ethnicity, sexual orientation, first-generation status, international status, year in program and financial stress, which are known to influence mental health issues and mental health help seeking. Multiple linear regression was used for the depression and anxiety symptom severity total scores. Binary logistic regression was used for NSSI, suicidal ideation, and depression and anxiety diagnosis. The relationship between gender identity and mental health help seeking was then analyzed using binary logistic regression among those categorized as distressed based on their depression (PHQ-9) and/or anxiety (GAD-7) scores. The baseline population for gender identity that was used for comparison in regression was cisgender men, as they report reduced mental health issues [44] and mental health help seeking compared to people of other gender identities [41].

3.5 Positionality Statement

The research team comprises individuals with expertise in counseling psychology and engineering education, bringing a mix of engineering and non-engineering perspectives. This includes faculty members with experience in mental health measurement and mixed-methods research in engineering education, as well as undergraduate and graduate student researchers at different stages of their chemical engineering training. The team represents a range of gender

identities and professional experiences, contributing both insider and outsider perspectives [45] in relation to engineering and mental health research.

Collectively, our research team recognizes that engineering education environments often implicitly prioritize professional productivity over well-being, creating intrapersonal, interpersonal, and systemic barriers to help-seeking. These barriers can be particularly pronounced for students in gender minority groups, including cisgender women and gender expansive students, who frequently navigate a culture where they are underrepresented. In addition to a lack of representation, these students may experience discrimination, microaggressions, and exclusionary behaviors that contribute to a heightened risk of mental health challenges. Such experiences can compound the difficulty of seeking support and create additional barriers to academic and professional success.

Each member of our team has encountered and reflected on these challenges through personal experiences, professional work, and engagement with students. We acknowledge our own intersectional mix of privileged and marginalized identities, both apparent and hidden, and how these identities shape our perspectives on engineering culture and mental health. To mitigate potential biases and threats to validity [46], the research team engaged in ongoing dialogue about our motivations, identities, and perspectives during each stage of the research process. Through these discussions, we actively engaged in critical self-reflection, questioning our own assumptions, biases, and disciplinary perspectives. This process helped us recognize how our identities and experiences shaped our interpretations, ensuring that our analysis was informed by multiple perspectives and a commitment to reflexivity. We intentionally challenged our own perspectives as both insiders and outsiders in engineering to enhance the validity and depth of our findings [47].

4 Results

4.1 Mental health issues

Mental health issues were investigated across gender identity in undergraduate engineering students. Depression symptom severity among different gender identities can be found in Figure 1.

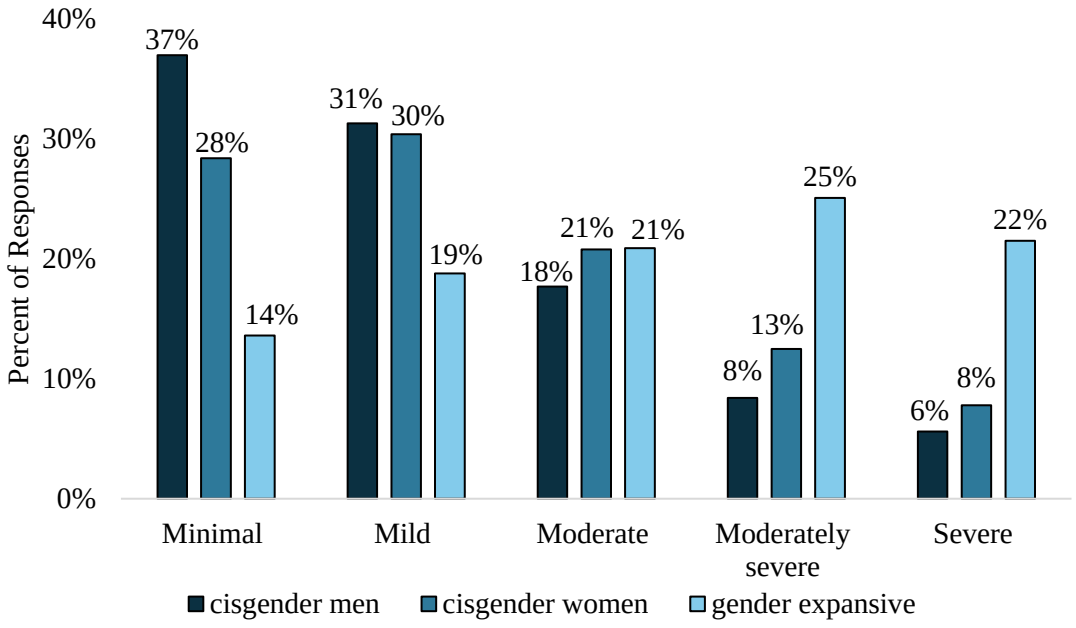

Figure 1. Depression symptom severity based on the PHQ screening instrument for depression

Twenty two percent of gender expansive students reported symptoms of severe depression, as compared to just 7.8% of cisgender women and 5.6% of cisgender men. An additional 25% of gender expansive students reported symptoms of moderately severe depression. On the other hand, cisgender men were more likely to report symptoms associated with minimal or mild depression. Cisgender women were consistently in between cisgender men and gender expansive students for each category. Similarly, gender expansive students reported the highest percentage of positive

screens for depression, with 67.5% screening positive for depression, as compared to cisgender men with the lowest percentage at 31.7% and cisgender women with 41% (Figure 2).

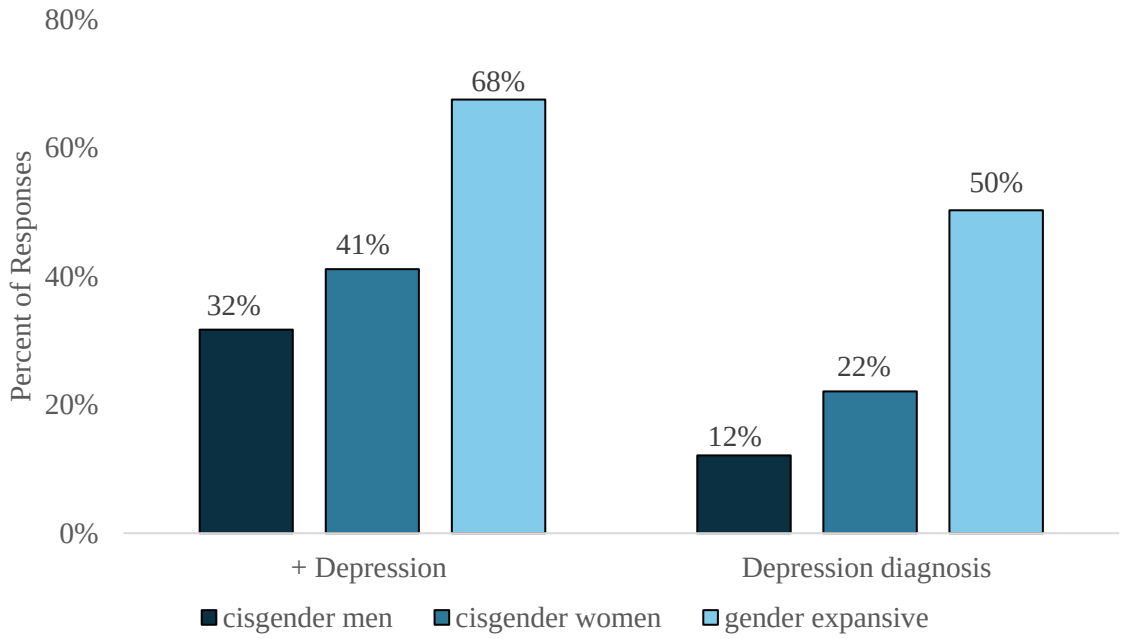

Figure 2. Prevalence of positive depression screen based on the PHQ screening instrument and depression diagnosis

Gender expansive students also had a higher percentage of students diagnosed with depression (50.3%) than cisgender women and men, where only 12.1% of cisgender men and 22.1% of cisgender women reported having a depression diagnosis. Results of the regression (Table 2) confirm these findings, with both cisgender women and gender expansive students being significantly more likely than cisgender men to screen positive for depression and to have a diagnosis for depression.

Table 2. Results of linear regression and binary logistic regression for depression and depression diagnosis

		Cisgender men	Cisgender women	Gender expansive
	Frequency	2089	1484	190
	Std. Dev.	36.8	19.4	4.2
Depression	β	--	**0.047**	**0.074**
	b	--	**0.609**	**2.351**
	LL	--	**0.286**	**1.503**
	UL	--	**0.932**	**3.198**
	p	--	**0.000**	**0.000**
Depression Diagnosis	Odds Ratio	--	**1.560**	**2.633**
	LL	--	**1.331**	**1.912**
	UL	--	**1.829**	**3.627**
	p	--	**0.000**	**0.000**

Notes: Bolded coefficients indicate significant differences from the reference group. β=Standardized Regression Coefficient, b=Unstandardized regression coefficient, LL=lower level, UL=upper level

Cisgender women and gender expansive students were 1.6 and 2.6 times more likely, respectively, to be diagnosed with depression when compared to cisgender men in engineering.

Thirty one percent of gender expansive students reported severe symptoms of anxiety, which was significantly higher than cisgender women at 16.4% and cisgender men at 9.8% (Figure 3).

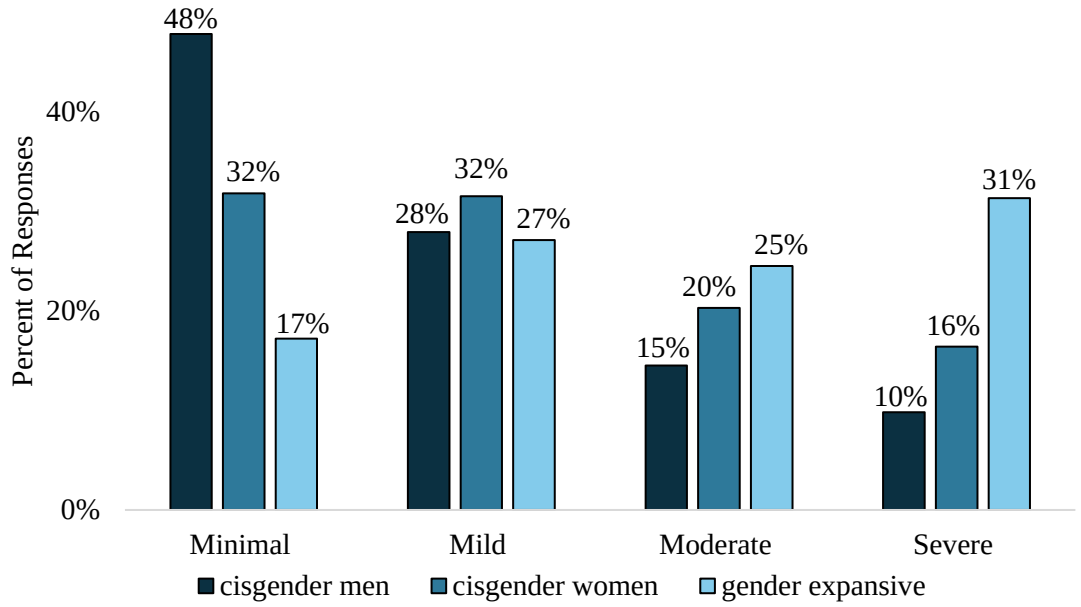

Figure 3. Prevalence of severity of anxiety symptoms based on the GAD screening instrument for anxiety

This high rate of anxiety symptoms in gender expansive students was further echoed by their prevalence of positive anxiety screens (Figure 4).

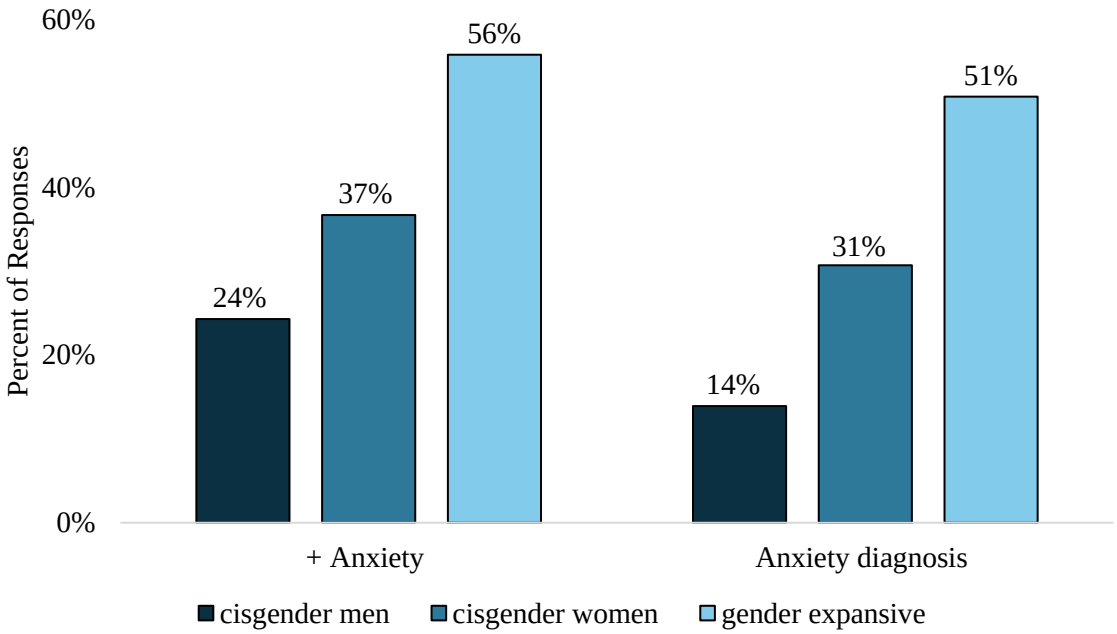

Figure 4. Prevalence of positive anxiety screening on the GAD screening instrument and anxiety diagnosis

Here, 55.8% of gender expansive students received a positive screen for anxiety compared to 36.7% and 24.3% of cisgender women and men, respectively. Likewise, gender expansive students reported the highest percentage of having a previous diagnosis for anxiety (50.8%). This was followed again by 30.7% of cisgender women having a diagnosis and 13.9% of cisgender men. The regression results for anxiety and anxiety diagnosis support these trends (Table 3).

Table 3. Results of linear regression and binary logistic regression for anxiety and anxiety diagnosis

		Cisgender men	**Cisgender women**	**Gender expansive**
	Frequency	2089	1484	190
	Std. Dev.	36.8	19.4	4.2
Anxiety	β	--	**0.117**	**0.070**
	b	--	**1.374**	**1.976**
	LL	--	**1.078**	**1.203**
	UL	--	**1.670**	**2.750**
	p	--	**0.000**	**0.000**
Anxiety Diagnosis	Odds Ratio	--	**2.281**	**2.829**
	LL	--	**1.969**	**2.061**
	UL	--	**2.642**	**3.883**
	p	--	**0.000**	**0.000**

Notes: Bolded coefficients indicate significant differences from the reference group. β=Standardized Regression Coefficient, b=Unstandardized regression coefficient, LL=lower level, UL=upper level

Like with depression and depression diagnosis, cisgender women and gender expansive students were significantly more likely than cisgender men to screen positive for anxiety as well as report an anxiety diagnosis. From the odds ratio, cisgender women and gender expansive students were found to be 2.3 and 2.8 times more likely to have received an anxiety diagnosis, respectively, when compared to cisgender men.

In Figure 5, the prevalence of self-reported non-suicidal self-injury (NSSI) and suicidal ideation are both shown.

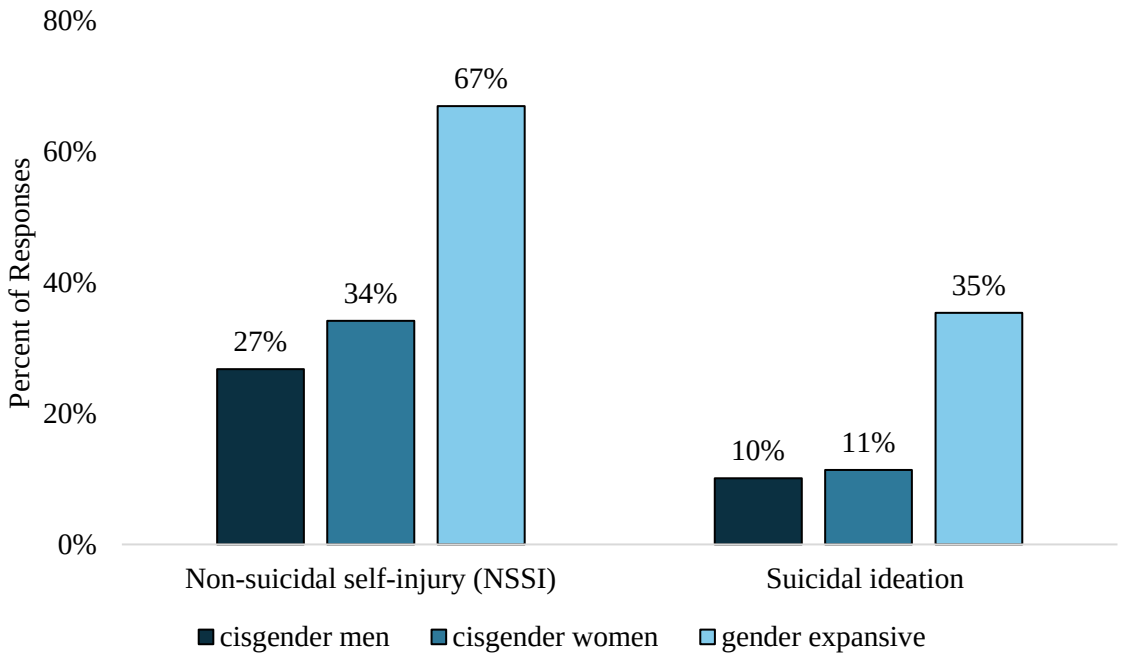

Figure 5. Prevalence of NSSI and suicidal ideation

Overall, 67.0% of gender expansive students reported NSSI, which is about double that of cisgender men or women (26.8% and 34.2%, respectively). Cisgender men and women reported similar rates of suicidal ideation, with cisgender men at 10.1% and cisgender women at 11.4%. Again, gender expansive students reported more prevalent suicidal ideation, at 35.4%. Regression results for NSSI and suicidal ideation indicate that gender expansive students are 2.3 times and 1.8 times more likely than cisgender men to report NSSI or suicidal ideation, respectively (Table 4).

Table 4. Results of binary logistic regression for non-suicidal self-injury and suicidal ideation

		Cisgender men	Cisgender women	Gender expansive
	Frequency	2089	1484	190
	Std. Dev.	36.8	19.4	4.2
Non-Suicidal Self-Injury	Odds Ratio	--	1.096	**2.292**
	LL	--	0.960	**1.655**
	UL	--	1.251	**3.174**
	p	--	0.174	**0.000**
Suicidal Ideation	Odds Ratio	--	0.871	**1.774**
	LL	--	0.720	**1.253**
	UL	--	1.053	**2.512**
	p	--	0.153	**0.001**

Notes: Bolded coefficients indicate significant differences from the reference group. LL=lower level, UL=upper level.

Interestingly, when controlling for potentially confounding demographics factors, cisgender women were not significantly more likely than cisgender men to report NSSI or suicidal ideation.

4.2 Mental health help seeking

Next, we investigated how mental health help seeking for distressed engineering students differs across gender identity. Almost two times more gender expansive students (54.6%) reported seeking help within the past year when compared to men (28.8%) (Figure 6).

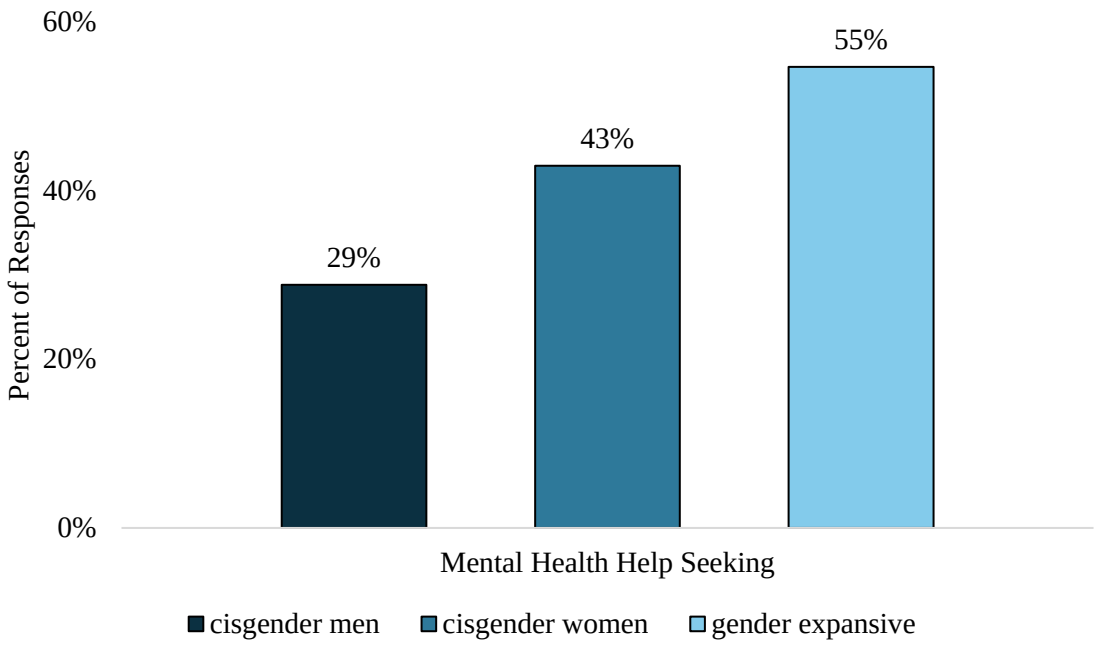

Figure 6. Prevalence of mental health help seeking among distressed students

Distressed cisgender women fell in between cisgender men and gender expansive students, with 42.9% of distressed students having sought help in the past year. Regression results can be found in Table 5.

Table 5. Results of binary logistic regression for mental health help seeking among distressed students

		Cisgender men	**Cisgender women**	**Gender expansive**
	Frequency	758	727	141
	Std. Dev.	17.1	7.3	0.5
Therapy	Odds Ratio	--	**1.553**	**1.612**
	LL	--	**1.290**	**1.103**
	UL	--	**1.870**	**2.354**
	p	--	**0.000**	**0.014**

Notes: Bolded coefficients indicate significant differences from the reference group. LL=lower level, UL=upper level.

Cisgender women and gender expansive students were both found to be statistically significantly more likely than cisgender men to have sought help, with odds ratios of 1.55 and 1.61, respectively.

5 Discussion

This study aimed to characterize the differences in mental health issues and mental health help seeking in undergraduate engineering students of differing gender identities (i.e., cisgender men, cisgender women, and gender expansive students) while controlling for the potential differences in sociodemographic composition of these gender identity groups. Results show that cisgender women and gender expansive students self-reported more severe symptoms of depression and anxiety than cisgender men. Similarly, gender expansive students self-reported non-suicidal self-injury (NSSI) and suicidal ideation at significantly higher rates than cisgender men. Cisgender women, on the other hand, reported similar rates to cisgender men in these categories. Through regression analyses, we found that gender expansive students were more likely than cisgender men to: screen positive for or be diagnosed with depression and anxiety, self-report NSSI and suicidal ideation, and report seeking mental health help in the past year. Regression analysis found that cisgender women were not statistically significantly more likely than men to report NSSI or suicidal ideation. Our findings are consistent with the general college student population, where gender expansive students were found to have significantly higher prevalence of mental health symptoms when compared to cisgender students [4], and these disparities continued to widen between 2008 and 2018 [48]. Because gender identity is not a causal factor in mental health distress, it is important to consider the systemic factors that contribute to the mental health and well-being of cisgender women and gender expansive students.

The engineering culture that exists on college campuses is oftentimes hostile, overly competitive and promotes unhealthy behaviors, which can lead to an increased prevalence of mental health issues [26], [49]. These cultural norms are not limited to academic rigor but also rooted in norms derived from hegemonic masculinity, such as competition, individualism and emotional detachment [5], [50]. These norms implicitly favor those who fit certain social identities

(e.g., cisgender, straight, White, able-bodied men), making the environment more difficult for students who transgress these ideals. These can be especially challenging for students who hold multiple minoritized identities, as they may face compounded barriers related to their gender, race, sexuality, disability status, or other marginalized aspects of their identity. A lack of representation can further impact sense of belonging for cisgender women and gender expansive students. Gender-expansive students navigate pressures to conceal aspects of their identity in engineering spaces, balancing the perceived risks and opportunities associated with visibility [14], [51]. For example, LGBTQ+ STEM students are significantly less likely to be out to peers also in STEM disciplines and thus less likely to have support both for their intersectional LGBTQ+ and STEM identity [52]. This extends beyond students; A 2013 study of science and engineering faculty found that 5.4% identified as LGBTQ+, and only 48% of those faculty had self-disclosed their identity to their students [53]. Many of those who made the decision to self-disclose their identity hoped to increase representation and be a source of support for students within the LGBTQ+ community. Together, these factors could amplify the "culture of stress" in engineering [9] and thereby increase their attrition from engineering programs. This is supported by a recent study that found that transgender and gender nonconforming people in science, technology, engineering and mathematics disciplines were 10% less likely to continue in their major when compared to their cisgender peers [54].

Given that cisgender women and gender expansive students were more open to seeking mental health help, receiving this help could help improve retention [55]. That being said, a majority of engineering students who self-report symptoms of at least moderate anxiety and/or depression are not seeking mental health help, with just 29% of distressed cisgender men, 43% of distressed cisgender women and 55% of gender expansive students seeking help. Furthermore, the

high rates of mental health distress among cisgender women and gender expansive students highlight the inadequacy of current mental healthcare systems in effectively supporting student well-being. Literature also shows that discriminatory healthcare policies and negative experiences with campus mental health services (e.g., misgendering, deadnaming, invasive and irrelevant questioning) can result in distress for sexual and gender minority students as well as result in students not revealing their identity to a new healthcare provider [56], [57]. Some students sought services off campus, specifically services not offered on campus or limited on-campus availability, which were reported to be less accessible due to transportation and financial burden [57]. Therefore, it is important for university administrators to continue to build robust, inclusive mental health resources for students and work to intentionally market those resources to students within engineering.

6 Implications

Addressing this mental health treatment gap will require collaboration among higher education administrators, educators, mental health professionals, and students. Efforts should focus on mitigating the hostile culture and normalization of stress to reduce mental health issues and improve retention. At the administrative level, support should be provided to faculty to create environments that embrace flexibility, encourage open conversations about mental health, and challenge the normalization of stress culture in engineering [58]. Administrators should prioritize students' well-being over solely focusing on the coursework they complete [58], [59]. This shift in emphasis will contribute to fostering healthier and more supportive learning environments [58], [59].

The development of mental health support is especially important for gender expansive students who are under threat by widespread discriminatory legislation across the country [60].

Anti-trans legislation has not only resulted in increased feelings of fear, anxiety and hopelessness within transgender people [17], [61], but there have also been increases in hate speech, bullying and discrimination against transgender communities [61], [62]. According to the Trans Legislation Tracker [63], there has been a significant increase in anti-trans legislation over the past ten years, with 21 anti-trans bills in 2015 and 672 anti-trans bills in 2024. Further, there are already 848 anti-trans bills that have been pre-filed across 49 states in 2025. These state-level bills have resulted in statistically significant increases in past-year suicide attempts for transgender and nonbinary people within two years of the laws being enacted [64]. Further, a recent executive order aims to prevent the promotion of gender ideology, defined as, “the idea that there is a vast spectrum of genders that are disconnected from one’s sex” [65]. This has the potential to impact future data collection efforts, limiting federally funded researchers in their ability to study groups outside of the federal definition of sex as binary (male and female). Therefore, efforts at supporting the mental health of gender expansive engineering students are more important than ever.

These efforts can come in many forms, at different ecological levels of the university. At the institutional and college level, gender-inclusive housing, inclusive name and pronoun policies, gender-neutral restroom availability, emergency financial and legal assistance programs, access to gender affirming healthcare, and no-tolerance policies for transphobia have been recommended [66], [67], [68], [69], [70]. Staff, faculty, and/or students can be given opportunities to learn more about modern best practices in understanding gender identity and pronouns to help all members of the community learn to speak and act in ways that create a culture of belonging for trans and nonbinary people [70], [71]. For instance, Safe Zone workshops have been implemented to promote LGBTQ equality in engineering, with workshops taking place at national engineering conferences [72]. This training has been further adapted to focus on supporting transgender

students and colleagues in engineering [73]. Universities and colleges of engineering can ensure support for LGBTQ+ student organizations, conduct periodic climate surveys to inform policy change, develop mentorship programs for connecting trans and nonbinary students with faculty, staff, and engineering professionals [66], [68], [74]. With many anti-DEI and anti-LGBTQ bills impacting state-level funding for DEI and LGBTQ programming, it is important to support these programs and student organizations through other means. Lastly, universities and colleges of engineering can actively involve gender expansive students in developing and reviewing trans-inclusive policies, hire more trans and nonbinary faculty and staff, and ensure their career/professional development staff are prepared to mentor these students regarding trans-specific workplace concerns (e.g., workplace disclosure, dress code, workplace rights, transitioning on the job) [66], [74], [75].

7 Addressing Limitations

There are a few limitations to this study that need to be considered. First, the sample sizes of certain gender identity groups within the HMS dataset such as transgender, genderqueer, or gender nonbinary were relatively small on their own, which would have afforded insufficient statistical power to examine differences across these individual groups. As a result, our research team made the decision to group students from these small cell size groups into one larger group, which we labeled gender expansive. Therefore, this study was unable to examine potential differences in mental health issues and mental health help seeking for different gender identity groups within this omnibus gender expansive group. For example, the present data did not allow us to determine if genderqueer students experience mental health issues at a greater rate than nonbinary students. To address this, future studies could aggregate data across multiple years of the HMS study into a single dataset, creating more robust sample sizes for these smaller groups.

Another limitation of this study is the reliance on self-report measures for mental health issues. Because the PHQ and GAD ask students about their experiences of different mental health symptoms, they rely on the student being able to recognize their symptoms and accurately respond accordingly. Further, for self-report measures related to mental health, it is possible that a student might not respond to the items truthfully due to a fear of repercussions or stigma, despite the anonymity of completing the HMS survey. Finally, because engineering students are immersed in a culture where stress is normalized, students might not recognize the true severity of symptoms that they might be experiencing. The capacity to recognize severity of their symptoms may also differ across gender identity, resulting in asymmetric under-reporting of mental health symptoms across the sample that may skew the true size of potential gender differences.

8 Conclusion

This study explored mental health issues and help-seeking behaviors in undergraduate engineering students across gender identities (cisgender men, cisgender women, and gender expansive), while controlling for differences in sociodemographic composition. Gender expansive students reported the most severe symptoms of depression and anxiety, the highest rates of clinical diagnoses for anxiety and depression, and the greatest prevalence of NSSI and suicidal ideation. Cisgender women were consistently more likely than cisgender men to report these outcomes—with the exception of NSSI and suicidal ideation. Notably, even though distressed cisgender women and gender expansive students are more likely to seek mental health help, the high rates of mental health distress in these students indicate that current support systems are insufficient. More concerted effort is needed to address the mental health gap among gender minority students, as these disparities arise not only from systemic issues within engineering culture, but also from broader inequities pervasive throughout the university and society at large. Progress will require

reducing stress, mitigating stigma, and dismantling discriminatory practices that undermine the well-being of all students. This call to action is especially urgent as discriminatory legislation continues to spread across the United States, further threatening the mental health and retention of gender expansive and other marginalized students.

References

[1] M. E. Duffy, J. M. Twenge, and T. E. Joiner, "Trends in mood and anxiety symptoms and suicide-related outcomes among US undergraduates, 2007–2018: Evidence from two national surveys," *Journal of Adolescent Health*, vol. 65, no. 5. pp. 590–598, 2019.

[2] R. Bruffaerts *et al.*, "Mental health problems in college freshmen: Prevalence and academic functioning," *J. Affect. Disord.*, vol. 225, pp. 97–103, 2018.

[3] M. K. Dinger *et al.*, "Gender Identity and Health-related Outcomes in a National Sample of College Students," *Am. J. Health Educ.*, vol. 51, no. 6, pp. 383–394, 2020, doi: 10.1080/19325037.2020.1822242.

[4] S. K. Lipson, J. Raifman, S. Abelson, and S. L. Reisner, "Gender minority mental health in the US: Results of a national survey on college campuses," *Am. J. Prev. Med.*, vol. 57, no. 3, pp. 293–301, 2019.

[5] E. De Pillis and L. De Pillis, "Are engineering schools masculine and authoritarian? The mission statements say yes," *Journal of Diversity in Higher Education*, vol. 1, no. 1. p. 33, 2008.

[6] J. C. Garvey and C. V. Dolan, "Queer and Trans College Student Success," in *Higher Education: Handbook of Theory and Research: Volume 36*, L. W. Perna, Ed., in Higher Education: Handbook of Theory and Research. , Cham: Springer International Publishing, 2021, pp. 161–215. doi: 10.1007/978-3-030-44007-7_2.

[7] D. Starovoytova Madara and S. Cherotich, "Challenges faced by female students in Engineering," *J. Educ. Pract.*, vol. 7, no. 25, 2016.

[8] L. E. Hargis, C. J. Wright, E. L. Usher, J. H. Hammer, S. A. Wilson, and M. E. Miller, "Relationship Between Mental Health Distress and Help-Seeking Behaviors Among Engineering Students," *American Society for Engineering Education Annual Conference*. 2021.

[9] K. J. Jensen and K. J. Cross, "Engineering stress culture: Relationships among mental health, engineering identity, and sense of inclusion," *J. Eng. Educ. Wash. DC*, vol. 110, no. 2, pp. 371–392, 2021, doi: 10.1002/jee.20391.

[10] M. L. Sánchez-Peña and S. A. Kamal, "A comparative analysis of mental health conditions prevalence and help seeking attitudes of engineering students at two institutions in the U.S.A," presented at the 2023 World Engineering Education Forum - Global Engineering Deans Council (WEEF-GEDC), Oct. 2023, pp. 1–9. doi: 10.1109/WEEF-GEDC59520.2023.10343627.

[11] J. A. Yang, M. K. Sherard, C. Julien, and M. Borrego, "Resistance and community-building in LGBTQ+ engineering students," *J. Women Minor. Sci. Eng.*, vol. 27, no. 4, 2021.

[12] A. N. Gentry, J. P. Martin, K. A. Douglas, E. Holloway, and C. Thompson, "Nonbinary Engineering Students' Access to Resources Through Cis* and Trans* Alters," in *2024 ASEE Annual Conference & Exposition*, 2024.
[13] "Profiles of Engineering and Engineering Technology, 2023.," American Society for Engineering Education, Washington, D.C., 2023. [Online]. Available: https://ira.asee.org/by-the-numbers/.
[14] A. Haverkamp, A. V. A. Butler, D. Montfort, Q. Driskill, N. S. Pelzi, and M. K. Bothwell, "Exploring transgender and gender noncomforming engineering undergraduate experiences through autoethnography.," *Collab. Netw. Eng. Comput. Divers.*, 2019.
[15] M. Asghar, A. Minichiello, and S. Ahmed, "Mental health and wellbeing of undergraduate students in engineering: A systematic literature review," *J. Eng. Educ.*, vol. 113, no. 4, pp. 1046–1075, 2024.
[16] A. Haverkamp, M. Bothwell, D. Montfort, and Q.-L. Driskill, "Calling for a paradigm shift in the study of gender in engineering education," *Stud. Eng. Educ.*, vol. 1, no. 2, 2021.
[17] M. P. Fenton *et al.*, "Examining the relationship between proposed anti-LGBTQ+ legislation and LGBTQ+ college student mental health: findings from the Healthy Minds Study, 2021–2022," *J. Am. Coll. Health*, pp. 1–15, 2024.
[18] A. Danowitz and K. Beddoes, "Mental Health in Engineering Education: Identifying Population and Intersectional Variation," *IEEE Transactions on Education*, vol. 65, no. 3. pp. 257–266, 2022. doi: 10.1109/TE.2022.3182626.
[19] S. K. Lipson *et al.*, "Trends in college student mental health and help-seeking by race/ethnicity: Findings from the national healthy minds study, 2013–2021," *Journal of Affective Disorders*, vol. 306. pp. 138–147, 2022. doi: 10.1016/j.jad.2022.03.038.
[20] D. Smith and R. McLellan, "Mental health problems in first-generation university students: A scoping review," *Rev. Educ.*, vol. 11, no. 3, p. e3418, Dec. 2023, doi: 10.1002/rev3.3418.
[21] M. J. Stebleton, K. M. Soria, and R. L. Huesman Jr, "First-generation students' sense of belonging, mental health, and use of counseling services at public research universities," *Journal of College Counseling*, vol. 17, no. 1. pp. 6–20, 2014.
[22] S. K. Lipson, E. G. Lattie, and D. Eisenberg, "Increased Rates of Mental Health Service Utilization by U.S. College Students: 10-Year Population-Level Trends (2007–2017)," *Psychiatric services (Washington, D.C.)*, vol. 70, no. 1. pp. 60–63, 2019. doi: 10.1176/appi.ps.201800332.
[23] K. Beddoes and A. Danowitz, "In Their Own Words: How Aspects of Engineering Education Undermine Students' Mental Health," Minneapolis, MN: ASEE Conferences, 2022. [Online]. Available: https://peer.asee.org/40378
[24] S. Secules, N. W. Sochacka, J. L. Huff, and J. Walther, "The social construction of professional shame for undergraduate engineering students," *J. Eng. Educ. Wash. DC*, vol. 110, no. 4, pp. 861–884, 2021, doi: 10.1002/jee.20419.
[25] K. J. Jensen, J. F. Mirabelli, A. J. Kunze, T. E. Romanchek, and K. J. Cross, "Undergraduate student perceptions of stress and mental health in engineering culture," *Int. J. STEM Educ.*, vol. 10, no. 1, p. 30, Apr. 2023, doi: 10.1186/s40594-023-00419-6.
[26] R. Stevens, D. Amos, A. Jocuns, and L. Garrison, "Engineering As Lifestyle And A Meritocracy Of Difficulty: Two Pervasive Beliefs Among Engineering Students And Their Possible Effects," *American Society for Engineering Education Conference and Exposition*. American Society for Engineering Education-ASEE, Atlanta, p. 12.618.1, 2007.

[27] A. Danowitz and K. Beddoes, “Characterizing Mental Health and Wellness in Students Across Engineering Disciplines.” American Society for Engineering Education-ASEE, Atlanta, 2018.
[28] M. Whitwer, S. Wilson, and J. Hammer, “Engineering Student Mental Health and Help Seeking: Analysis of National Data from the Healthy Minds Study,” in *2023 IEEE Frontiers in Education Conference (FIE)*, Oct. 2023, pp. 1–7. doi: 10.1109/FIE58773.2023.10343045.
[29] S. K. Lipson, S. Zhou, B. Wagner, K. Beck, and D. Eisenberg, “Major Differences: Variations in Undergraduate and Graduate Student Mental Health and Treatment Utilization Across Academic Disciplines,” *Journal of College Student Psychotherapy*, vol. 30, no. 1. pp. 23–41, 2016. doi: 10.1080/87568225.2016.1105657.
[30] M. Whitwer, S. Wilson, J. Hammer, and B. Gomer, “Mental health and treatment use in undergraduate engineering students: A comparative analysis to students in other academic fields of study,” *J. Eng. Educ.*, vol. in press, 2025.
[31] R. Bruffaerts *et al.*, “Mental health problems in college freshmen: Prevalence and academic functioning,” *J. Affect. Disord.*, vol. 225, pp. 97–103, 2018, doi: 10.1016/j.jad.2017.07.044.
[32] H. Gerdes and B. Mallinckrodt, “Emotional, Social, and Academic Adjustment of College Students: A Longitudinal Study of Retention,” *J. Couns. Dev.*, vol. 72, no. 3, pp. 281–288, 1994, doi: 10.1002/j.1556-6676.1994.tb00935.x.
[33] D. Wynaden, H. Wichmann, and S. Murray, “A synopsis of the mental health concerns of university students: results of a text-based online survey from one Australian university,” 2013, doi: 10.1080/07294360.2013.777032.
[34] R. Shadick and S. Akhter, “Suicide Prevention in a Diverse Campus Community,” *New Dir. Stud. Serv.*, vol. 2013, no. 141, pp. 71–81, 2013, doi: 10.1002/ss.20041.
[35] P. W. Holland, “Causation and Race,” in *White Logic, White Methods : Racism and Methodology*, T. Zuberi and E. Bonilla-Silva, Eds., Lanham, MD, UNITED STATES: Rowman & Littlefield Publishers, 2008.
[36] E. A. Cech and W. R. Rothwell, “LGBTQ Inequality in Engineering Education,” *Journal of engineering education (Washington, D.C.)*, vol. 107, no. 4. pp. 583–610, 2018. doi: 10.1002/jee.20239.
[37] K. Robert and J. A. Leydens, “Dignity and well-being: Narratives of modifying the culture of engineering education to improve mental health among underrepresented STEM students,” presented at the 2023 ASEE Annual Conference & Exposition, 2023.
[38] M. L. Sánchez-Peña, A. M. McAlister, N. Ramirez, D. B. Samuel, S. A. Kamal, and X. Xu, “Stigma of mental health conditions within engineering culture and its relation to help-seeking attitudes: Insights from the first year of a longitudinal study,” *American Society for Engineering Education Annual Conference & Exposition*. 2023.
[39] U. M. Akpanudo, J. L. Huff, J. K. Williams, and A. Godwin, “Hidden in plain sight: Masculine social norms in engineering education,” presented at the 2017 IEEE Frontiers in Education Conference (FIE), IEEE, 2017, pp. 1–5.
[40] U. M. Akpanudo, J. L. Huff, and A. Godwin, “Exploration of Relationships between Conformity to Masculine Social Norms and Demographic Characteristics,” presented at the 2018 IEEE Frontiers in Education Conference (FIE), IEEE, 2018, pp. 1–6.
[41] R. C. McDermott, P. N. Smith, N. Borgogna, N. Booth, S. Granato, and T. D. Sevig, “College students’ conformity to masculine role norms and help-seeking intentions for suicidal thoughts,” *Psychol. Men Masculinity*, vol. 19, no. 3, p. 340, 2018.

[42] K. Kroenke, R. L. Spitzer, and J. B. W. Williams, “The PHQ-9,” *J. Gen. Intern. Med.*, vol. 16, no. 9, pp. 606–613, 2001, doi: 10.1046/j.1525-1497.2001.016009606.x.
[43] R. L. Spitzer, K. Kroenke, J. B. W. Williams, and B. Löwe, “A Brief Measure for Assessing Generalized Anxiety Disorder,” *Arch. Intern. Med.*, vol. 166, no. 10, p. 1092, 2006, doi: 10.1001/archinte.166.10.1092.
[44] R. P. Auerbach *et al.*, “WHO World Mental Health Surveys International College Student Project: Prevalence and Distribution of Mental Disorders,” *J. Abnorm. Psychol.*, vol. 127, no. 7, pp. 623–638, 2018, doi: 10.1037/abn0000362.
[45] S. Secules *et al.*, “Positionality practices and dimensions of impact on equity research: A collaborative inquiry and call to the community,” *Journal of Engineering Education*, vol. 110, no. 1. pp. 19–43, 2021.
[46] J. Walther, N. W. Sochacka, and N. N. Kellam, “Quality in interpretive engineering education research: Reflections on an example study,” *Journal of engineering education*, vol. 102, no. 4. pp. 626–659, 2013.
[47] N. W. Sochacka, J. Walther, J. R. Rich, and M. A. Brewer, “A narrative analysis of stories told about engineering in the public discourse: Implications for equity and inclusion in engineering,” *Stud. Eng. Educ.*, vol. 2, no. 2, p. 54, Aug. 2021, doi: 10.21061/see.55.
[48] D. C. R. Kerr, H. Bae, and S. S. Dermody, “Trends and disparities in suicidal thoughts and behaviors and mental health symptoms among sexual and gender minority college students in the U.S., 2008–2018.,” *Psychol. Sex. Orientat. Gend. Divers.*, vol. 11, no. 2, pp. 305–315, 2024, doi: 10.1037/sgd0000599.
[49] B. N. Geisinger and D. R. Raman, “Why They Leave: Understanding Student Attrition from Engineering Majors,” 2013.
[50] E. Godfrey and L. Parker, “Mapping the cultural landscape in engineering education,” *J. Eng. Educ.*, vol. 99, no. 1, pp. 5–22, Jan. 2013, doi: https://doi.org/10.1002/j.2168-9830.2010.tb01038.x.
[51] J. B. Yoder and A. Matthews, “Queer in STEM: Workplace experiences reported in a national survey of LGBTQA individuals in science, technology, engineering, and mathematics careers.,” *J. Homosex.*, vol. 63, no. 1, pp. 1–27, 2016.
[52] B. E. Hughes and S. MGWatson, “In/authenticity in STEM Social Networks: How ‘Out’ are LGBTQ Students with their Peers in STEM?,” in *2023 ASEE Annual Conference & Exposition*, 2023.
[53] C. A. Busch, P. B. Bhanderi, K. M. Cooper, and S. E. Brownell, “Few LGBTQ+ Science and Engineering Instructors Come Out to Students, Despite Potential Benefits,” *CBE- Life Sci. Educ.*, vol. 23, no. 2, Apr. 2024, doi: https://doi.org/10.1187/cbe.23-10-0181.
[54] J. Maloy, M. B. Kwapisz, and B. E. Hughes, “Factors Influencing Retention of Transgender and Gender Nonconforming Students in Undergraduate STEM Majors,” *CBE- Life Sci. Educ.*, vol. 21, no. 1, Jan. 2022, doi: https://doi.org/10.1187/cbe.21-05-0136.
[55] Y. Zhai and J. V. Carney, “The role of mental health adn protective factors in student academic persistence and retention during a global crisis,” vol. 11, 2024, doi: https://doi.org/10.1017/gmh.2024.12.
[56] G. Babbs, H. L. Wolfe, M. R. Ulrich, J. Raifman, and S. K. Lipson, “Sexual and Gender Minority University Students Report Distress Due to Discriminatory Health Care Policies,” *Stigma Health*, vol. 9, no. 4, pp. 601–604, Nov. 2024.
[57] Santos Theodore C., Mann Emily S., and Pfeffer Carla A., “Are university health services meeting the needs of transgender college students? A qualitative assessment of a public

university," *J. Am. Coll. Health*, vol. 69, no. 1, pp. 59–66, Jan. 2021, doi: 10.1080/07448481.2019.1652181.
[58] S. Wilson and K. Jensen, "Strategies to integrate wellness into the engineering classroom," *Chemical Engineering Education*, vol. 57, no. 4. 2023.
[59] S. Wilson and D. Goldberg, "Strategies for Supporting Engineering Student Mental Health," *Chemical Engineering Education*, vol. 57, no. 2. 2023. doi: 10.18260/2-1-370.660-132290.
[60] L. E. Kuper, M. B. Cooper, and M. A. Mooney, "Supporting and advocating for transgender and gender diverse youth and their families within the sociopolitical context of widespread discriminatory legislation and policies.," *Clin. Pract. Pediatr. Psychol.*, vol. 10, no. 3, pp. 336–345, 2022, doi: 10.1037/cpp0000456.
[61] "Human Rights Campaign Post- Election Survey of Youth," Human Rights Campaign Foundation, Washington D.C., 2017. [Online]. Available: http://hrc-assets.s3-website-us-east-1.amazonaws.com//files/assets/resources/HRC_PostElectionSurveyofYouth.pdf
[62] DuBois, L. Zachary *et al.*, "The Impact of Sociopolitical Events on Transgender People in the US," *Bull. Appl. Transgender Stud.*, vol. 2, no. 1–2, pp. 1–26, 2023, doi: 10.57814/SDX3-7Y41.
[63] "2025 anti-trans bills tracker." Accessed: Apr. 10, 2025. [Online]. Available: https://translegislation.com/
[64] W. Y. Lee, J. N. Hobbs, S. Hobaica, J. P. DeChants, M. N. Price, and R. Nath, "State-level anti-transgender laws increase past-year suicide attempts among transgender and non-binary young people in the USA.," *Nat. Hum. Behav.*, vol. 8, no. 11, pp. 2096–2106, 2024.
[65] "Defending women from gender ideology extremism and restoring biological truth to the federal government." White House, Jan. 20, 2025.
[66] A. E. Goldberg and K. A. Kuvalanka, "Nagivating identity development and community belonging when 'there are only two boxes to check': An exploratory study of nonbinary trans college students.," *J. LGBT Youth*, vol. 15, no. 3, pp. 1–26, 2018.
[67] C. Haslop, C. Bonner-Thompson, and P. Hubbard, "Trans students and campus cultures: Queering the university," *Gend. Place Cult.*, vol. 28, no. 3, pp. 409–429, 2021.
[68] A. C. Lange, "Transgender men and non-binary studetns managing their identities to pay for college.," *Rev. High. Educ.*, vol. 48, no. 1, pp. 129–159, 2024.
[69] M. McGinley, E. Matsuno, and S. Schwartz, "Advocacy for trans students in higher education," *Couns. Psychol. Q.*, vol. 33, no. 2, pp. 159–181, 2020.
[70] E. Mearns, K. Storrie, and Rohleder, "The experiences of nonbinary students in UK universities," *J. Gend. Stud.*, vol. 29, no. 3, pp. 318–334, 2020.
[71] S. L. Budge, S. J. Dominguez, and A. E. Goldberg, "Minority stress in nonbinary students in higher education: The role of campus climate and belongingness.," *Psychol. Sex. Orientat. Gend. Divers.*, vol. 7, no. 20, pp. 222–229, 2020.
[72] S. Farrell, E. A. Cech, R. C. C. Guerra, A. Minerick, and T. J. Waidzunas, "ASEE safe zone workshops and virtual community of practice to promote LGBTQ equality in engineering.," *2016 ASEE Annu. Conf. Expo.*, Jun. 2016.
[73] S. Farrell, K. F. Trenshaw, and R. Sandeklan, "Safe zone deep dive into supporting transgender students and colleagues (90-minute workshop)," *Collab. Netw. Eng. Comput. Divers.*, Apr. 2019.
[74] T. Scott, T. Jourian, and S. Simmons, "Career development concerns among trans college students," *J. Coll. Couns.*, vol. 12, no. 2, pp. 137–151, 2011.

[75] S. Marine B. and Z. Nicolazzo, “Campus climate and the experiences of trans students.,” *J. Stud. Aff. Res. Pract.*, vol. 51, no. 2, pp. 173–187, 2014.