

ABSTRACT

Title of Thesis: THE STATE OF GRADUATE STUDENT
MENTAL HEALTH IN THE UNITED
STATES: ELEVEN YEARS AND 200,000
STUDENTS

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Graduate students are an essential part of the academic enterprise. Converging lines of evidence suggests that many graduate students experience high levels of emotional distress. Yet the true depth and breadth of this public health “crisis” has remained unclear. The present study used survey data collected from 187,427 American graduate students between 2008 and 2019 as part of the ACHA-NCHA II¹ to demonstrate that moderate-to-severe emotional distress, psychiatric illness, and suicidality are common among graduate students. Remarkably nearly 1 in 3 students were diagnosed with or treated for one or more psychiatric disorders. Notably, every

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indicator of emotional distress and illness increased over the past decade, in some cases substantially, above and beyond contemporaneous shifts in demographic and institutional characteristics. This study represents the most comprehensive assessment to date, provides crucial information for refining research and policy, and sets the stage for efforts aimed at developing effective intervention strategies.

THE STATE OF GRADUATE STUDENT MENTAL HEALTH IN THE UNITED
STATES: ELEVEN YEARS AND 200,000 STUDENTS

by

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The State of Graduate Student Mental Health in the United States:

Eleven years and 200,000 Students

Chapter 1: Introduction

Statement of the Problem

More than 1 in 7 (15%) university students—3 million in total—are enrolled in post-baccalaureate master's, professional (e.g., law, medicine), or research-focused doctoral programs (National Center for Education Statistics, 2019b). Over the past decade, post-baccalaureate enrollment jumped by more than 10% and the student body has become increasingly diverse (National Center for Education Statistics, 2019a; 2019b). Graduate school is a uniquely stressful experience for most students. Financial strains, discouraging academic job prospects, and uneven, inadequate, or occasionally even toxic relationships with faculty supervisors add to this burden for many (Alberts et al., 2014; Cyranoski et al., 2011; Schmidt & Hansson, 2018; Sverdik et al., 2018; Woolston, 2017; Woolston, 2019). Buffeted by stressors that are substantial, chronic, and often uncontrollable, some students develop clinically significant levels of depression and anxiety. While the true prevalence of these disorders among graduate students remains unknown, a growing body of research suggests that it has reached a “crisis” point (Evens et al., 2018). In particular, a provocative and widely discussed (Flaherty, 2018; Okahana, 2018; Pain, 2018; Wood, 2020) international study of more than 2,000 respondents (92% U.S.-based) provided evidence suggesting that graduate students are over six times more likely than the general population to experience depression and anxiety (Evans et al., 2018). While it must be acknowledged that there may be significant differences between the nature of graduate study in the U.S. and

programs abroad, preliminary work focused on U.S. graduate students paints a similarly alarming picture (Brownson et al., 2011; Eisenberg et al., 2007; Garcia-Williams et al., 2014; Hyun et al., 2006; Silverman et al., 1997; Smith & Brooks, 2015; University of California Berkeley Graduate Assembly, 2014; University of California Office of the President, 2017). For example, nearly half (47%) of doctoral students and more than a third (37%) of master's students at the University of California, Berkeley reported symptoms of depression (University of California, Berkeley, 2014). Moreover, certain subpopulations (e.g., women, minorities) may be at heightened risk. For example, studies have documented differences in the prevalence of mental health problems between men and women (Nolen-Hoeksema, 2001; McLean et al., 2011; Piccinelli & Wilkinson 2000). Although the prevalence of frequent mental distress has increased for the population in general, it remains higher for women than for men (National Institute of Mental Health, 2019). This is noteworthy considering 3 out of 5 (60%) graduate students is a woman (National Center for Education Statistics, 2019b). Other work underscores the potential importance of institutional characteristics, such as institution type (public or private), for graduate student mental health (Oswalt et al., 2015). While graduate student health is a growing area of research, the full state of graduate student mental health and wellbeing remains far from clear. The goals of the present study are to assess the current state of graduate student mental health, determine whether it has changed in the U.S. over the past decade, and the degree to which any detected changes reflect parallel shifts in demographic or institutional characteristics. Addressing these questions is important and would not only provide a clearer picture of the state of

graduate students in the U.S, but guide the development of evidence-based policy and intervention with this population, if warranted.

Chapter 2: Review of the Literature

The graduate student experience fundamentally differs from that of undergraduates. Graduate students are an essential part of the larger academic enterprise. They are targets and generators of funding, producers of research, and instructors and mentors of undergraduate students (Sampson et al., 2018)². In the literature review, the type of stress unique to graduate student will be examined.

The Unique Pressures of Graduate Training

Work-Life Balance

Compared to undergraduates, graduate students face an academic workload driven by a greater focus on developing authoritative expertise and proficiency in complex, often novel and ambiguous tasks (e.g., write a play, develop an innovative research idea from inception to publication, diagnose and care for a gravely ill patient). Expectations for intellectual independence, self-motivation, and productivity are also greater than earlier phases of training. In many graduate programs, the number of competencies to be mastered has risen dramatically (Alberts et al., 2014; Barrett, 2019; Eiko, 2017; Frith, 2019; McMinn et al., 2009), and students are often expected to master multifaceted interdisciplinary techniques (e.g., Big Data, Digital Humanities, Machine Learning, Network Science), often in the absence of formal coursework and without a corresponding increase in time-to-degree (Alberts et al., 2014; Kahn & Ginther, 2017; Tsai & Muindi, 2016). Despite these lofty expectations, graduate

² In these varied capacities, graduate students represent a comparatively cheap source of labor and can even be a net positive source of revenue for departments when tuition funding is considered (Sampson et al., 2018).

students rarely receive the same degree of institutional infrastructure (e.g., on-campus residential facilities, robustly funded social and athletic clubs) that help undergraduates build supportive networks of friends, mentors, and counselors (Fox, 2008; Longfield et al., 2006; Wyatt & Oswalt, 2013). As a consequence, many graduate students experience heightened levels of stress and reduced work-life balance (Jaremaka et al., 2020; Kausar, 2010; Mazzola et al., 2011; Oswalt & Riddock, 2007). In 2019, the editors of *Nature* magazine surveyed more than 6,000 graduate students ($n=6,320$) across the globe (22% U.S.-based) and found nearly half (49%) agreed that, “There is a long-hours culture at my university, including sometimes working through the night.” (Woolston, 2019). The majority (54%) of U.S. graduate students reported working more than 50 hours a week, with close to a quarter (23%) working more than 60 hours a week (Nature Research, 2019).

Financial Stress

Today’s graduate students are more likely to experience financial strains than their predecessors. Cumulative debt for a four-year degree is expensive—roughly \$32,000 on average (National Center for Education Statistics, 2020)—and the growth in U.S. student debt has outpaced other major categories of non-mortgage consumer debt. Between 2004 and 2017, as the number of total college students increased by 15% (National Center for Education Statistics, 2019a; National Center for Education Statistics, 2019b), total student debt quadrupled, from \$345 billion to \$1.4 trillion (Board of Governors of the Federal Reserve System, 2018; Peter J. Peterson Foundation, 2018). Recent data point to a tightening lending market. Fewer students received loans (down 6% from 2010-2011 to 2017-2018; National Center for Education

Statistics, 2020), and those who managed to secure loans received smaller lines of credit (about 5% drop from 2010-2011 to 2017-2018; National Center for Education Statistics, 2020). These historical changes in financial support occurred against the backdrop of a 19% increase in tuition and fees (National Center for Education Statistics, 2020).

For graduate students fortunate enough to secure teaching assistantships and other kinds of university-funded positions, pay is typically low (\$16,035 in 2017; Sampson et al., 2018), depriving them of the financial security necessary to achieve age-appropriate milestones. In the 2019 *Nature* survey, more than two-thirds of graduate students (67%) agreed that “financial worries after my PhD (cost of living, inability to save for a house, children, retirement)” were a top stressor (Nature Research, 2019). Other work points to financial strain as a key determinant of psychiatric distress among graduate students (for review see Sverdik et al., 2018).

Academic Career Prospects

Systemic flaws in the academic enterprise have created a hypercompetitive environment for obtaining federal research funding, long training periods for graduate students in research-oriented programs, and discouraging academic job prospects (Alberts et al., 2014; Cyranoski et al., 2011). This is particularly stressful for those at the doctoral level. For years, the number of degrees conferred has far exceeded the number of open faculty positions. Of these, a growing proportion are untenured instructional positions, which typically provide less security and lower salaries (Cyranoski et al., 2011; Kahn & Ginther, 2017). Despite this, more than half (56%) of respondents in the 2019 *Nature* survey said that academia is their first choice for a

career (Woolston, 2019). Students who wish to navigate opportunities outside of academia face additional challenges, as few research-oriented graduate programs have implemented best practices for scaffolding the transition to non-academic positions in the government, industry, and non-profit sectors (Bangasser et al., 2016; Cyranoski et al., 2011; Woolston, 2019). The 2019 *Nature* survey revealed that only a quarter (26%) of respondents felt that their program was preparing them ‘very well’ for a satisfying career (Woolston, 2019). When asked what resources they need most to establish a satisfying career, the majority (55%) indicated, “better data/information about available career opportunities” (Nature Research, 2019). Work by the University of California system suggests that more negative career prospects were associated with reduced life satisfaction and elevated levels of depression (University of California, 2017). Graduate students in the humanities (53%) and social sciences (41%) were more likely to be pessimistic than those in STEM (25%) and professional degree programs (18%; e.g., medical school; University of California, 2017).

Supervisor-Student Relationships

Mentorship, often one-on-one, is an integral part of graduate training and there is ample evidence that the quality of supervisor relations is a key determinant of graduate student wellbeing, retention, productivity, and mental health (for review see Sverdik et al., 2018). Yet many faculty are often unaware of their outsized role in student success, and faculty and administrators are often biased to attribute problems to inadequate student skills or motivation, rather than any shortcoming of their peers, program, or institution (Gardner, 2009; Lovitts, 2001). While faculty members are typically experts in their substantive area of scholarship or clinical practice, they rarely

receive formal training in effective mentorship, personnel management, and other crucial “soft skills.” Instead, hiring and promotion practices incentivize more easily enumerated outcomes, such as publications, patents, grants, and courses taught.

Dramatic reports of toxic laboratory directors and sexual abuse periodically rise to the surface (Hartocollis, 2019; Mangan, 2018; Matthews, 2019; Mervis, 2019), but less extreme negative experiences are more common than many stakeholders realize. The 2019 *Nature* survey revealed that more than 1 in 5 graduate students (21%) had experienced bullying or discrimination in their program (Woolston, 2019): “I have witnessed and been the subject of bullying and intimidation by an academic supervisor ... The absolute impunity of the top academic professors is astonishing and the biggest threat to young researchers (including mental health),” (p. 406). Of those who experienced harassment, more than half (57%) felt unable to discuss their situation for fear of professional or academic repercussions (Woolston, 2019). In another recent international survey ($n=2,279$; 92% U.S.-based) more than half (55%) of graduate students with depression indicated they did not feel valued by their mentor (Evans et al., 2018).

Historical Trends in Emotional Distress

Mental distress is on the rise in the U.S., and this is particularly evident among youth and young adults (Auerbach et al., 2018; Global Burden of Disease 2015 Disease and Injury Incidence and Prevalence Collaborators, 2015; Hunt & Eisenberg, 2010; Lipson et al., 2019). For example, results from the 2018 National Survey on Drug Use and Health indicate annual rates of major depression in young adults (18-25 years) jumped by 57%, from 8.8% in 2005 to 13.8% in 2018. By comparison, rates of major

depression among all adults only increased by 9% (from 6.6% to 7.2%) (Substance Abuse and Mental Health Services Administration, 2018). Consistent with this worrisome trend, national surveys of counseling center directors have revealed substantial increases in mental health service utilization among college and university students (Gallagher, 2015). Using survey data collected from more than 450,000 undergraduate students between 2009 and 2015, Oswalt and colleagues recently reported substantial increases in the diagnosis and treatment of depression (9% to 12%) and anxiety disorders (9% to 15%) (Oswalt et al., 2020). Whether similar trends are evident among U.S. graduate students remains unknown.

Demographic Trends Relevant to Understanding Graduate Student Mental Health

While there is evidence that mental distress is rising in the U.S., it is unclear if this increase is true of graduate students specifically. Determining whether graduate student mental health is worsening, improving, or remaining constant over time mandates thoughtful consideration of potentially confounding shifts in demographic variables that confer risk for depression and anxiety, including gender, race, ethnicity, and international status (Evans et al., 2018; Hyun et al., 2006; University of California, 2017; Woolston, 2019). For example, over the past decade (2008 to 2018) the enrollment of women in graduate programs increased at a higher rate than men (12% vs. 8%; National Center for Education Statistics, 2019b). The enrollment of international students surged by 38% (National Center for Education Statistics, 2009; National Center for Education Statistics, 2019c). From 2010 to 2018, enrollment of White students decreased by 10% (National Center for Education Statistics, 2019c),

whereas enrollment of multiracial (+156%) and Hispanic (+48%) students increased (National Center for Education Statistics, 2019c). Appropriately accounting for such demographic shifts is essential for understanding historical trends in the prevalence of emotional distress and psychiatric treatment among graduate students.

Institutional Characteristics

Institutional characteristics (e.g., public or private) may also influence students' mental health. For example, there is evidence that undergraduates at public institutions had lower levels of substance use, mental illness, and sleep difficulties compared to those at private institutions (Oswalt et al., 2015). While the mechanisms underlying this difference remain unclear, enrollment at private (non-profit) colleges and universities grew at a much faster rate than public schools (17% vs. 7%) over the past decade (2008-2018; National Center for Education Statistics, 2019b). Developing a complete account of the state of graduate student mental health requires due consideration of co-varying shifts in such institutional characteristics.

Graduate Student Mental Health

Converging lines of evidence suggest that a growing number of U.S. graduate students are at risk for emotional distress. Despite growing interest in graduate student wellbeing, the existing literature is sparse and our understanding of graduate student mental health remains far from complete (see Table 1).

Much of the current interest in graduate student mental health can be traced to a pioneering 2006 University of California (UC) Berkeley study ($n=3,121$), which provided evidence that close to half of students (46%) felt overwhelmed and more than a third (40%) felt exhausted most of the time (Hyun et al., 2006). These dramatic results

set the stage for a second generation of studies, many employing well-established depression screening tools (e.g. Center for Epidemiologic Studies Depression Scale) (Garcia-Williams et al., 2014; Smith & Brooks, 2015; University of California Berkeley, 2014). For example, in 2014 researchers at Emory University reported that more than 1 in 3 graduate students (34%) screened positive for moderate-to-severe depression, with another third (35%) showing evidence of mild depression ($n=301$) (Garcia-Williams et al., 2014). More than 1 in 20 (7%) contemplated suicide. Remarkably, only 3% of students were free from depressive symptoms (Garcia-Williams et al., 2014). That same year, a survey conducted at UC Berkeley ($n=790$) showed that nearly half of doctoral (47%) and more than a third of master's students (37%) reported symptoms of depression (University of California Berkeley, 2014). The following year, more than half of the students in a University of Arizona survey ($n=309$) reported steep increases in stress since beginning their graduate studies, with parallel declines in mental health, well-being, and self-care (Smith & Brooks, 2015).

These alarming institution-specific reports motivated a third generation of surveys, with samples that were more diverse and an order of magnitude larger. Using data gleaned from a survey of students enrolled at 10 separate campuses ($n=5,356$), the University of California reported that more than 1 in 3 students (35%) screened positive for depression (University of California Office, 2017). In a landmark international study ($n=2,279$; 92% U.S.-based), Evans and colleagues used a well-established anxiety screening instrument (General Anxiety Disorder-7; Kroenke et al., 2007) to show that more than 2 in 5 students (41%) evinced moderate-to-severe anxiety (Evans et al., 2018). Another 1 in 3 students (39%) showed moderate-to-severe symptoms of

depression, echoing the results of the Emory, Berkeley, and UC studies. Most recently, *Nature* magazine leveraged a large international sample ($n=6,320$; 22% U.S.-based) to show that more than a third of students (36%) had sought treatment for depression or anxiety triggered by their graduate studies (Woolston, 2019). Collectively, these observations indicate that a substantial number of graduate students experience clinically significant levels of depression and anxiety (Table 1).

Limitations of the Existing Literature

Recent years have witnessed tremendous advances in our understanding of graduate student mental health, both in the United States and abroad (Table 1). Yet key methodological limitations preclude decisive inferences. To date, most research has focused on relatively small samples collected at specific institutions, limiting generalizability, or has relied on convenience samples or non-random sampling, raising the possibility of selection biases. Very low response rates ($<10\%$; Garcia-Williams et al., 2014; Smith & Brooks, 2015) amplify these concerns.

Further, most studies have relied on either ratings of emotional distress or reports of psychiatric treatment. However, the two measures have complementary strengths and weaknesses. Subjective ratings of emotional distress are more sensitive because they capture individuals who have not sought treatment. But because they lack independent confirmation of distress or impairment, they are likely to be upwardly biased (i.e. high sensitivity, low specificity; elevated “false-alarm” rate). Conversely, self-reported psychiatric diagnosis or treatment is more objective, insofar as it *implies* independent assessment by a mental health professional. But because many individuals with frank psychopathology do not seek or receive treatment (Substance Abuse and

Mental Health Services Administration, 2018; Wang et al., 2002), such self-reports are likely to be downwardly biased (i.e., low sensitivity, high specificity; elevated rate of “misses”). Ideally, both measures would be acquired, as convergent results would provide more credible evidence than either alone. Most importantly, all of the studies detailed in Table 1 are based on a single assessment, leaving it unclear whether the apparent “crisis” in graduate student mental health is abating or worsening over time. In sum, while it is clear that graduate students are struggling, the true depth and breadth of the “crisis” remains unknown. Addressing this question is essential for developing intelligent intervention strategies and guiding program directors, university administrators, policymakers, and other stakeholders in their decision making.

The American College Health Association-National College Health Assessment

II

First conducted in 2008, the American College Health Association-National College Health Assessment II (ACHA-NCHA II) is the largest, most comprehensive, and longest running survey of graduate and undergraduate student health and wellbeing in the U.S. (American College Health Association, 2020a). In its most recent iteration (Spring 2019), the ACHA-NCHA II included data from more than 11,000 students enrolled at 82 separate institutions. In total, the ACHA-NACA II database encompasses 11 years of data collected from close to 200,000 graduate students (American College Health Association, 2020d). A key advantage of the ACHA-NCHA II database is the opportunity to ascertain whether historical trends in the prevalence of emotional distress reflect parallel shifts in demographic or institutional factors.

To date, the ACHA-NCHA II database has never been systematically used to comprehensively understand the state of graduate student mental health. The vast majority of studies have focused on specific sub-populations (e.g., student athletes) or institutions (e.g., Turner et al., 2012; Cannonier et al., 2018; Greason et al., 2015; Gilkey et al., 2010), undergraduate students (e.g., Oswalt et al., 2018; Bartlett et al., 2016; Blosnich et al., 2015; Kroshus & Davoren, 2016; Lytle et al., 2014) or undergraduate and graduate students in aggregate (e.g., Cleveland et al., 2015; Jao et al., 2018; Lindsey et al., 2009; Liu et al., 2018; Sawatzky et al., 2012). In fact, across more than 150+ published reports, only 4 examined graduate students (Kernan et al., 2011; Kernan et al., 2008; Oswalt & Wyatt, 2015; Wyatt & Oswalt, 2013). To my knowledge, only a single report examined graduate student mental health, and analyses primarily focused on differences between graduate and undergraduate students (Wyatt & Oswalt, 2013; Table 1). In sum, there is urgent need for a more comprehensive analysis of the state of graduate student mental health.

Aims of the Present Study

The ACHA-NCHA II database will enable me to address two specific questions.

Aim 1. What Is the State of Graduate Student Mental Health in the U.S., and How Has It Changed Over the Past Decade?

Building on prior work (Table 1), I will assess the current state of graduate student mental health, and the degree to which it credibly changed between Fall 2008 and Spring 2019. I will examine measures of:

- Subjective emotional distress (past 2 weeks)
- Suicide ideation and suicide attempt (past year)
- Reported diagnosis or treatment of specific emotional disorders (anxiety, depression, panic, and phobia)
- Reported diagnosis or treatment of any psychiatric disorder (past year)

To clarify specificity, I will also examine historical changes in the severity of severe mental illnesses, including schizophrenia and bipolar disorder (past year).

Aim 2. Do Trends in Graduate Student Mental Health Remain Credible After Accounting for Contemporaneous Changes in Demographic or Institutional Characteristics?

I will determine whether apparent historical trends in the prevalence of emotional distress (e.g. worsening over time) are credible above and beyond parallel changes in the demographic (e.g. greater enrollment of women, minorities, or international students) or institutional composition (e.g. public vs. private) of the ACHA-NCHA II sample.

Chapter 3: Method

Overview

The aims of the present study are to (1) determine the current state of graduate student mental health, and the degree to which it changed between Fall 2008 and Spring 2019, and (2) determine whether any changes reflect parallel shifts in demographic or institutional characteristics. In the remainder of this document, I will refer to these characteristics using the umbrella term ‘covariates.’ To address these aims, a secondary data analysis of the American College Health Association-National College Health Assessment II (ACHA-NCHA II) Fall 2008 - Spring 2019 dataset will be conducted.

Developed by an interdisciplinary team of college health professionals, the ACHA-NCHA II is a biannual national research survey of health-related habits, behaviors, and perceptions. The ACHA-NCHA surveys provide the largest and most comprehensive data set on the health of college and university students (American College Health Association, 2020a). The ACHA-NCHA II has been shown to be reliable, valid, and of empirical value for representing the U.S. college population (American College Health Association, 2013).

Institutions that chose to participate administered the ACHA-NCHA II survey via in-person classroom sampling (“paper”; 1.4%) or online (“web”; 98.6%). Only institutions that surveyed all students (i.e., census) or used random sampling approaches are included in the database. Response rates were only available for the aggregate ACHA-NCHA II dataset (i.e., combined undergraduate and graduate students). The grand average aggregate response rate between Fall 2008 and Spring

2019 was 24%. Data collected in the fall semesters had sample sizes ranging from 2,665 to 5,584 across 26 to 45 institutions. Data collected in the spring had samples sizes ranging from 9,570 to 21,167 across 67 to 119 institutions. In total, the ACHA-NCHA II database includes 22 assessments collected between Fall 2008 and Spring 2019 from 195,208 graduate students at 577 institutions.

Participants

Participants who did not identify as a full or part-time student at a U.S. university (4-year institution) were excluded. As in prior work (Oswalt et al., 2020), respondents who endorsed 11 or more of the 12 core mental health diagnoses were excluded as there is reason to suspect these responses may be falsified. These procedures yielded a final sample of 187,427 graduate students across 480 institutions (see Table 2-3 for descriptive statistics aggregated by academic year).

As shown in Table 2, 63% of participants were female with a mean age of 28.3 years ($SD=6.8$). More than half (60.5%) of the participants were White, followed by Asian/Pacific Islander, 20.0%; Multiracial, 7.2%; Hispanic/Latino, 5.5%; Black, 4.4%; Other; 2.2%; and American Indian/Alaskan Native or Native Hawaiian, 0.4%. International students made up more than a fifth (22.8%) of the sample. Most participants were enrolled full-time (85.5%) and completed the survey online (98.6%). As shown in Table 3, more than half (57.1%) were enrolled at institutions with a campus size of 20,000 or more and slightly more than half (51.4%) were enrolled at public institutions. Participating institutions were also geographically diverse with 16.6% in the Midwest, 23.7% in the South, 26.7% in the West, and 33.0% in the Northeast.

Measures of Dependent Variables

Emotional Distress and Suicidality

The participants were asked about standalone items measuring different elements of psychological distress. For this study, I will examine responses to 10 distinct feelings and behaviors: “felt things were hopeless”; “felt overwhelmed by all you had to do”; “felt exhausted (not from physical activity)”; “felt very lonely”; “felt very sad”; “felt so depressed that it was difficult to function”; “felt overwhelming anxiety”; “felt overwhelming anger”; “seriously considered suicide”; and “attempted suicide.” The participants could respond with: “no, never”; “no, not in the last 12 months”; “yes, in the last 12 months”; “yes, in the last 30 days”; or “yes, in the last two weeks.” Consistent with prior work (see Table 1), I focused on *current* symptomatology. Accordingly, responses for 8 of these items were binarized into “no, not in the last two weeks” and “yes, in the last two weeks.” To maximize interpretability and enable interpretation of the results with respect to other recently published, large scale U.S. surveys (e.g., Substance Abuse and Mental Health Services Administration, 2018), “seriously considered suicide” and “attempted suicide” were binarized into “no, not in the last 12 months” and “yes, in the last 12 months.” Because suicidal behaviors are relatively infrequent, this longer time frame has the added benefit of minimizing zero inflation, which can cause problems for model convergence (McElreath, 2020). Given that the mental health items were developed to be used as standalone items of psychological distress and were not part of a scale, each item was analyzed separately, rather than creating a composite 'internalizing' symptom

index. This approach is consistent with prior research (e.g., Wyatt & Oswalt, 2013) and enables a more straight-forward interpretation.

Reported Mental Health Diagnosis or Treatment in the Past Year

Participants were asked to respond to the question, “Within the last 12 months, have you been diagnosed or treated by a professional for any of the following.” Participants were then presented with a list that included 15 mental health diagnoses: anorexia, anxiety, attention deficit hyperactivity disorder (ADHD), bipolar disorder, bulimia, depression, insomnia, other sleep disorder, obsessive compulsive disorder (OCD), panic attacks, phobia, schizophrenia, substance abuse/addiction, other addiction (e.g., gambling, internet, sexual), and other mental health condition. The participants could respond with: “no”; “yes, diagnosed but not treated”; “yes, treated with medication”; “yes, treated with psychotherapy”; “yes, treated with medication and psychotherapy”; or “yes, other treatment.”

Given the focus of the present report, responses for measures of internalizing illnesses (anxiety, depression, panic attacks, phobia) and severe mental illnesses (bipolar and schizophrenia) were binarized into “no, not diagnosed or treated in the last 12 months” or “yes, diagnosed or treated in the last 12 months.” To enable comparison with other large-scale U.S. surveys (e.g., Substance Abuse and Mental Health Services Administration, 2018), all of the listed mental health diagnoses (with the exception of ADHD and Substance Use Disorders [SUDs]) were used to create a binary, “any diagnosis or treatment in the past year.”

Covariates

Individual Characteristics

Age. Age was assessed with a numeric drop-down value ranging from 0 to 99.

Gender. Participants were asked to identify their gender. Response options included: “female”; “male”; and “transgender.” In the Fall of 2015, the ACHA-NACHA II survey was updated to assess sex assigned at birth and transgender status. To enable the examination of historical trends, respondents who indicated “yes” to “Do you identify as transgender?” were recoded as transgender (i.e., independent of the sex assigned at birth).

Race/Ethnicity. Race/Ethnicity was assessed with a single multi-response question “How do you usually describe yourself?” Participants were able to select “White”; “Black”; “Hispanic or Latino/a”; “Asian or Pacific Islander”; “American Indian, Alaskan Native or Native Hawaiian”; “Biracial or Multiracial”; and/or “Other.” Participants who selected two or more responses were recoded as “Biracial/ethnic or Multiracial/ethnic”³. Due to changes to response items in the Fall of 2011, survey responses from the Fall of 2008 to the Spring of 2011 were recoded to correspond with future response options (i.e., “White, non-Hispanic [includes Middle Eastern]” was recoded as “White” and “Black, non-Hispanic” was recoded as “Black”).

International Student. International student status was assessed with one question that asked, “Are you an international student?” Respondents could select “yes” or “no.”

³ The ACHA-NCHA II survey did not include separate assessments of race and ethnicity, making it impossible to clearly determine one’s race.

Enrollment Status. Participants were asked what their enrollment status was. Respondents could select “full-time” or “part-time.”

Institutional Characteristics

Public vs. Private Institutions. The institution type (i.e., public or private) is documented and provided by the American College Health Association.

Campus Size. Campus size is documented and provided by the American College Health Association. Categories include: “< 2,500 students”; “2,500-4,999 students”; “5,000-9,999 students”; “10,000-19,999 students”; and “20,000 students or more.”

Analytic Strategy

The overarching goal of the present study is to understand the current state of graduate student mental health in the U.S., and how it has changed over the past decade. Here, the current state of graduate student mental health was determined using descriptive statistics for the 2018-2019 academic year (AY), the most recent AY for which data were available. For this purpose, data were aggregated across the fall and spring assessments. Aggregating by AY improves comparability between these data and other collegiate and public health datasets, which are typically compiled on an annual basis. Moreover, institutions that participated in the fall ACHA-NCHA II assessment rarely participated in the spring and vice versa⁴. Thus, aggregating at the level of AY enhances the size and representativeness of the key results.

⁴ Of the 480 institutions across 11 academic years and 22 assessments, there was only one instance where a participating institution administered a survey in the fall and spring of the same academic year (1.21% of the 2010-11 AY; 0.13% of the total sample).

Changes in graduate student mental health were determined using a series of Bayesian multilevel regressions to estimate changes in graduate student mental health across the 11 years spanned by the ACHA-NCHA II database. Because the data were collected biannually, the model summary statistics reported in the accompanying tables are based on linear changes from Fall 2008 to Spring 2019.

In cases where a statistically credible change in a mental health indicator was detected (see below for details), follow-up analyses were performed to determine whether such changes remained credible after adjusting for shifts in demographic or institutional characteristics. Three possible outcomes can emerge from these analyses:

1. There is no credible historical trend in the focal mental health indicator.
2. There is a credible historical trend in the focal mental health indicator, but it is no longer credible after adjusting for shifts in demographic or institutional characteristics.
3. There is a credible historical trend in the focal mental health indicator, and it remains credible after adjusting for shifts in demographic or institutional characteristics.

To limit the number of comparisons, I leveraged a hierarchically arranged ‘go/no-go’ analytic framework. First, I tested for credible changes in each mental health indicator. This first set of models probed linear changes across assessments. If a credible change was not detected for a focal mental health indicator, it was excluded from subsequent analyses (i.e., Outcome 1; ‘no-go’). Next, I tested for credible linear

trends in covariates, including demographic (e.g., gender) and institutional (e.g., public vs. private) characteristics. As with the focal mental health indicators, covariates that did not show credible linear trends were excluded from follow-up tests. Finally, using the subset of focal indicators and covariates that satisfy the above ‘go’ criteria, I determined the degree to which historical trends in mental health indicators were credible above and beyond shifts in the demographic or institutional characteristics. The latter test enabled me to distinguish Outcome 2 from 3.

Bayesian Multilevel Modeling (MLM)

The ACHA-NCHA II dataset include several features that render standard regression models sub-optimal. Respondents were recruited through participating institutions, which results in a ‘nesting’ of individual students within schools. As such, each observation cannot be considered fully independent⁵, violating a core assumption of ordinary least squares regression. Multilevel models (MLMs) provide a well-established tool for modeling nested data (Gelman & Hill, 2007; Raudenbush & Bryk, 2002). Bayesian MLMs were used because they are robust to missingness and provided a unified framework for analyzing dichotomous (e.g., every binarized mental health indicator variable, student enrollment status), multinomial (e.g., race/ethnicity, gender), ordinal (e.g., school size), and continuous (e.g., age) outcomes. This approach had the benefit of simplifying the analyses and facilitating cross-model comparisons.

⁵ Because the ACHA-NCHA II dataset does not identify individual respondents, I did not model this potential source of dependency. As described in more detail in the Discussion, the vast majority of institutions only participated twice, with an average interval of 2.8 years between assessments over the 11-year period, making it unlikely that more than a small fraction of students responded to multiple survey waves.

Modeling Strategy

Analyses focused on the linear effect of time (i.e., slope). Bayesian 95% credibility intervals were used to determine statistical significance. Intervals for a given slope that *did not* contain 0 were deemed credible, analogous to common usage of frequentist confidence intervals (McElreath, 2020).

Unadjusted Change. Consistent with the hierarchical ‘go/no-go’ analytic framework, the first set of analyses tested the linear effect of time on focal mental health indicators, unadjusted for potential shifts in demographic or institutional characteristics. Equation (1) details the basic structure of the logistic MLMs.

$$\begin{aligned} y_i &\sim \text{Binomial}(1, p_i) \\ \log\left(\frac{p_i}{1-p_i}\right) &= \alpha_{ij} + \gamma_1(\text{Time}_i) + \gamma_2(\text{SurvMeth}_i) + \varepsilon_i \\ \alpha_{ij} &\sim \text{Normal}(\overline{\mu}_j, \sigma_j), \text{ for } j \text{ in } 1..480 \\ \gamma &\sim \text{Normal}(\beta, \sigma) \end{aligned} \tag{1}$$

Per the definition in (1), the initial set of unadjusted models included a random intercept (α_{ij}), a fixed effect for time (γ_1). Survey method (paper vs. web) was included as a nuisance variable and modeled as a fixed effect (γ_2).

To implement the second step of the hierarchical framework, the next set of analyses tested the linear effect of time on each of the demographic and institutional variables. Aside from the distribution of the dependent variables, this second set of MLMs used the basic structure detailed in (1): a random intercept, a fixed effect for time, and a fixed effect for survey method. Dichotomous variables in (international/enrollment status and institutions type) were modeled using the same

binomial distribution (i.e., logistic) employed for the mental health indicators. Multinomial variables (gender, race/ethnicity) were modeled using a binomial distribution and a series of $k - 1$ pairwise contrasts with a reference category (e.g., male), where k is the number of categories. Ordinal variables (campus size) were modeled using a logistic cumulative distribution, which tests the probability of transitioning from one rank order level to the next highest (i.e., y_i to y_{i+1}). Continuous variables (age) were modeled using a normal distribution and thus required no link function. If credible change was detected in any of these analyses, that variable was carried forward to the final set of models.

Adjusted Change. This third and final set of analyses can be conceptualized as a sensitivity analysis, which addressed the question: *Is the unadjusted estimate of change for a mental health indicator altered by the inclusion of a particular covariate?* Using change in age as an example covariate, the combined model (2) was defined as follows:

$$\begin{aligned}
y_i &\sim \text{Binomial}(1, p_i) \\
age_i &\sim \text{Normal}(\mu_{age}, \sigma_{age}) \\
\log\left(\frac{p_i}{1 - p_i}\right) &= \alpha_{y|i,j} + \gamma_1.(Time_i) + \gamma_2.(SurvMeth_i) + \gamma_3.(age_i) + \varepsilon_{y|i} \\
age_i &= \alpha_{age|i,j} + \gamma_4.(Time_i) + \gamma_5.(SurvMeth_i) + \varepsilon_{age|i} \\
\alpha_{y|i,j} &\sim \text{Normal}(\overline{\mu_{y|j}}, \sigma_{y|j}), \text{ for } j \text{ in } 1..480 \\
\alpha_{age|i,j} &\sim \text{Normal}(\overline{\mu_{age|j}}, \sigma_{age|j}), \text{ for } j \text{ in } 1..480 \\
\Sigma &\sim \begin{pmatrix} \sigma_{y|j}^2 & \sigma_{y|j,age|j} \\ \sigma_{y|j,age|j} & \sigma_{age|j}^2 \end{pmatrix}
\end{aligned} \tag{2}$$

$$\gamma \sim Normal(\beta, \sigma)$$

Note the inclusion of two linear terms, one for the focal mental health indicator (y_i) and one for the covariate (age_i in this example). Additionally, the inclusion of a random effects covariance matrix (Σ) allowed the random intercepts across the models for y_i and age_i to covary.

A given mental health indicator was deemed *insensitive* to concurrent change in a demographic or institutional characteristic if the effect of time remained credible, and the adjusted estimate of the time slope fell *inside* the unadjusted 95% credibility interval. Conversely, if the estimate of adjusted change (third set of models) fell *outside* the unadjusted 95% credibility interval (first set of models), then estimated change was considered *sensitive* to the inclusion of that demographic or institutional characteristic.

Measures of Change

With respect to the analyses of change over time, I focused on two intuitive measures of change: risk ratio (RR) and risk difference (RD) (Holmberg & Andersen, 2020). RR was computed as the model-fitted probability of endorsing a particular mental health outcome in Spring 2019 divided by the fitted probability in Fall 2008, and represents an index of the slope of change irrespective of overall prevalence. RD was computed as the difference in the model-fitted prevalence (i.e., percentage of respondents) between Spring 2019 and Fall 2008, and represents an index of the overall change in public health burden. For example, if the model fit indicated that 10% of students experienced a particular outcome in Fall 2008, and this increased to 20% in Spring 2019, the RR would be 2.0 and the RD would be +10%. Reporting

both metrics is important because infrequent outcomes (e.g., schizophrenia) can exhibit substantial changes in RR, despite small changes in the number of afflicted individuals. Additionally, odds ratios (OR) are included in the summary tables as a standardized measure of effect size.

Model Implementation

Statistical Software and Diagnostic Procedures. Data were processed and analyzed using a mixture of R packages (*brms*, *lme4*, and *rstan*) and Stan (Stan Development Team, 2020). Each Bayesian MLM relied on two Markov Chain Monte Carlo (MCMC) chains (8,000 warmup iterations, 2,000 posterior draws).

To minimize computational demand, priors for the distributions ($\overline{\mu}_j, \sigma_j, \beta, \sigma$) were set using a two-step process in which maximum likelihood (ML) estimates (generated using the *lme4* package; Bates et al., 2015) were scaled by 10 and used as priors for Bayesian modeling.

Consistent with recent methodological recommendations (Gelman et al., 2013), model convergence was confirmed using a combination of diagnostic plots (traceplots, posterior predictive distributions, and observed vs. predicted estimates over time) and statistical indicators (e.g., $R\text{-hat} < 1.1$).

Hardware Implementation. Bayesian modeling was implemented using a Linux workstation and 5 Amazon Web Services Elastic Compute Clouds. At peak intensity, analyses simultaneously utilized 172 cores and 384 GB of RAM, the equivalent of 40 laptop computers working in parallel. In total, modeling took 19 days to complete, or a little more than 3 hours for each of the 143 Bayesian MLMs.

Chapter 4: Results

The Current State of Graduate Student Mental Health in the U.S.

Descriptive statistics for outcome variables are presented in Tables 4-6 aggregated by academic year.

Emotional Distress and Suicidality

Focusing on the most recent academic year for which data were available (2018-19), emotional distress was common (Tables 4-5). Roughly half of graduate students reported feeling overwhelmed (49%) or mentally exhausted (50%) in the past two weeks. Another quarter experienced overwhelming anxiety (25%).

Depression-related symptoms were also common, with roughly 1 in 4 students feeling very sad (25%) or very lonely (22%), and roughly 1 in 10 indicating they felt too depressed to function (13%) or experienced overwhelming anger (10%). Additionally, 1 in 6 students (17%) reported feeling hopeless in the past two weeks. Consistent with these results, 7% of graduate students seriously considered suicide, and approximately 1 in 150 made an attempt (0.7%) in the past year. In short, moderate-to-severe emotional distress is prevalent among U.S. graduate students.

Mental Health Diagnosis or Treatment

Self-reported mental health diagnoses or treatment provided a complementary source of information about the prevalence of mental illness among U.S. graduate students (Table 6). During the 2018-19 AY, a remarkable 1 in 3 graduate students reported receiving a diagnosis or treatment for one or more psychiatric disorders in the past year (30%; excluding ADHD and SUDs). Nearly a quarter received a diagnosis or treatment for anxiety (24%) and close to 1 in 5 for depression (18%).

Another 1 in 10 students received a diagnosis or treatment for panic attacks (9%). Phobia and more severe mental illnesses were infrequently reported (phobia, 1%; bipolar disorder, 1.4%; and schizophrenia, 0.2%). These results converge with those obtained using more subjective indicators of emotional distress.

Trends in Graduate Student Mental Health in the U.S.

Changes in graduate student mental health were determined using a series of Bayesian multilevel regressions focused on individual assessments conducted between Fall 2008 and Spring 2019 (i.e., using disaggregated data).

Trends in Emotional Distress and Suicidality

Using a series of Bayesian multilevel regressions, results revealed that every indicator of emotional distress and suicidality showed a credible increase between Fall 2008 and Spring 2019, with Risk Ratios ranging from 1.04 to 2.11 and Risk Differences ranging from 0.26% to 8.44%. As shown in Figure 1, increases were modest for the two most common indicators of emotional distress: mental exhaustion (RR=1.09, RD=+4.03%) and being overwhelmed (RR=1.04, RD=+1.63%). Feeling overwhelming anxiety (RD=+8.44%) and very sad (RD=+7.14%) showed the largest absolute increases, while feeling too depressed to function showed the largest relative increase (RR=1.76). Other indicators of emotion distress showed smaller increases, as detailed in Table 7. Consistent with these trends in distress, the number of students who seriously considered suicide more than doubled from 2008 to 2019 (RR=2.11; Table 8 and Figure 2). Reported suicide attempts, while still rare (<1%), were roughly 1.5 times more common in 2019.

Trends in Mental Health Diagnosis or Treatment

Bayesian multilevel regressions indicated that the rates of mental illness treatment and diagnosis credibly increased for every disorder examined (RR=1.39-2.96), with the prevalence of anxiety disorders and panic attacks approximately doubling between Fall 2008 and Spring 2019 (RR=2.00-2.18). As shown in Figure 3, substantial absolute increases were evident for anxiety disorders (RD=+10.97%), depression (RD=+6.69%), and any psychiatric disorder (RD=+10.63%; excluding ADHD and SUDs). Smaller absolute increases were found for the remaining disorders, ranging from +4.78% for panic attacks to +0.10% for schizophrenia (Table 9). Taken together, these results demonstrate marked increases in emotional distress and mental illness over the past decade among U.S. graduate students, with the largest increases evident for indicators of anxiety and depression.

Accounting for Contemporaneous Changes in Demographic or Institutional Characteristics

Next, we used a series of multilevel regressions to examine potential shifts in the demographic or institutional composition of the ACHA-NCHA II sample between Fall 2008 and Spring 2019. Results revealed that all variables exhibited credible changes over this 11-year period, as detailed in Tables 10 and 11. These analyses encompassed a range of measurement scales, precluding the use of a single, standardized metric of change over time. Accordingly, I focus on the odds ratio (OR) for dichotomous and multinomial outcomes; proportional OR for the ordinal outcome (campus size); and standardized differences for the continuous measure (age).

Results revealed that every outcome showed a statistically credible change over the 11 years of assessment. In some cases, changes were substantial. For example, the odds of attending a private university fell by approximately 50% from Fall 2008 to Spring 2019. Consistent with recent trends in higher education, the proportion of White male graduate students also decreased, with the odds of being non-White increasing by 76% and the odds of being male decreasing by 17%. Although the vast majority of U.S. graduate students during this span were American citizens (>85%), the odds that a graduate student was a foreign citizen increased by 27%. While credible, remaining trends were small-to-negligible in magnitude. For example, the mean age of U.S. graduate students decreased by approximately one third of a year (0.04 *SD*). The odds of attending school on a part-time basis decreased by 16%, and the odds of attending a larger school decreased by approximately 2% (proportional OR = .98).

Pairwise Adjusted Trends in Emotional Distress, Suicidality, and Mental Health Diagnosis or Treatment

A series of simultaneous MLMs demonstrated that all 17 mental health indicators continued to show credible historical increases after adjusting for contemporaneous changes in each of the demographic and institutional characteristics (i.e., covariate-adjusted credibility intervals excluded 0; see Tables 12-14). Nevertheless, the inclusion of information about student race/ethnicity did result in small, but discernible, alterations in a handful of indicators, including feeling overwhelmed or mentally exhausted, and diagnosis or treatment for anxiety, depression, panic attacks, and ‘any’ psychiatric disorder in the past year. In each case,

the adjusted estimate of change was slightly strengthened in models incorporating race/ethnicity. For example, the unstandardized regression coefficient for change in ‘any’ psychiatric disorder increased from $b = 0.057$ to $b = 0.066$. In short, the growing diversity of American graduate students suppresses the historical increase in a subset of mental health indicators, albeit to a negligible degree.

Chapter 5: Discussion

A growing body of evidence suggests that many American graduate students experience high levels of emotional distress, depression, and anxiety. Yet the true depth and breadth of this public health “crisis” has remained unclear. Here I leveraged data gleaned from nearly 200,000 graduate students over 11 years to provide the first comprehensive analysis of mental distress and illness among U.S. graduate students.

The Current State of Graduate Student Mental Health in the U.S.

My findings demonstrate that moderate-to-severe emotional distress is common. In the 2018-2019 academic year, roughly half of U.S. graduate students reported feeling overwhelmed or mentally exhausted. A quarter felt very sad—a key symptom of depression—or overwhelming anxiety. Roughly 1 in 5 felt very lonely or hopeless, and more than 1 in 10 were too depressed to function. This pattern of results is broadly consistent with recent work using clinically validated measures of emotional distress (American College Health Association, 2020b; 2020c) and converges with students’ self-reported clinical diagnosis and care. In the past year, nearly 1 in 4 graduate students were diagnosed with or treated for anxiety, close to 1 in 5 for depression, and nearly 1 in 10 for panic attacks. Remarkably, nearly 1 in 3 students were diagnosed with or treated for one or more psychiatric disorders (30%; excluding ADHD and SUDs). Of greater concern, 1 in 14 students seriously considered suicide, and approximately 1 in 150 attempted to kill themselves. These observations paint an alarming picture of the current state of graduate student mental health

Trends in Graduate Student Mental Health in the U.S.

The present study provides the first examination of recent historical trends in graduate student mental health. Between Fall 2008 and Spring 2019, every indicator of emotional distress credibly increased. In 2019, students were 1.76 times more likely to be too depressed to function compared to their 2008 peers. In absolute terms, the number of students who felt overwhelming anxiety (+8.44%) or very sad (+7.14%) also increased substantially. Given a total population of approximately 3 million students, this means that hundreds of thousands more American graduate students are in distress compared to a decade earlier. Again, this converges with trends in self-reported clinical diagnosis and care. The prevalence of anxiety disorders and panic attacks roughly doubled during this period (RR=2.00-2.18), with substantial absolute increases in the prevalence of anxiety disorders (+10.97%), depression (+6.69%), and any psychiatric disorder (+10.63%; excluding ADHD and SUDs). In contrast, changes in the absolute prevalence of severe mental illness was much smaller (e.g., schizophrenia, +0.10%). These findings were expected considering indicators of schizophrenia and bipolar disorder are more biological based and were included to serve as a negative control (i.e. they were not expected to show marked change over time) (American Psychiatric Association, 2013). Notably, the number of students who seriously considered suicide more than doubled from 2008 to 2019 (RR=2.11). Reported suicide attempts, while still rare (<1%), were roughly 1.5 times more common in Spring 2019. If anything, this trend may represent an underestimate. Data collected as part of the revised ACHA-NCHA survey (ACHA-NCHA III) in Fall 2019 showed the single largest survey-to-survey increase in attempted suicide since 2008 (American College Health Association,

2020b). In short, contemporary American graduate students are more likely to experience moderate-to-severe emotional distress, psychiatric illness, and suicidality compared to their predecessors.

Accounting for Contemporaneous Changes in Demographic or Institutional Characteristics

One consideration in designing this study was whether any changes observed in the 17 focal mental health indicators may be statistical artifacts of changes in the composition of the graduate student population (e.g., increasingly non-male and non-White student bodies) or basic properties of the schools participating in the research over time (e.g., school size and public vs. private universities). Results show that during the same 11-year span all demographic and institutional characteristics exhibited credible change, even if the change was slight. However, the final model indicated little to no effect on the magnitude of change in each of the emotional distress and psychiatric disorder variables when each covariate and its collinear change variance were accounted for.

Graduate School Confers Heightened Risk for Mental Illness

While the present results indicate that the mental health of American graduate students is a pressing concern, the degree to which it differs from that of their peers and the general population is unclear. In an international study of more than 2,000 respondents (92% U.S.-based), Evans and colleagues reported that graduate students are over six times more likely to experience depression and anxiety compared to the general population (Evans et al., 2018). Although this provocative finding was widely discussed on social media and in the scientific and academic press (Flaherty, 2018;

Okahana, 2018; Pain, 2018; Wood, 2020), it has been criticized as misleading, insofar as the normative data used for comparison were derived from a German community sample assessed more than decade earlier (Duffy et al., 2019). For the present study, the U.S. National Survey on Drug and Health (NSDUH) provides an ideal reference population for key indicators of graduate student mental health, including any psychiatric diagnosis, depression, and suicidality (past year). NSDUH is a nationally representative annual survey of mental illness covering the period from 2002 to 2018, with roughly 40,000 adult respondents annually (“What is NSDUH?, n.d.). Because graduate students are younger and more likely to be female than the national population; and nearly all have completed a baccalaureate degree, I used data from the 2018 NSDUH to compare the mental health of graduate students to their age-, gender-, and education-matched peers⁶ as well as the general U.S. population.

As shown in Figure 4, when compared to their college-educated, young-adult peers, graduate students were somewhat more likely to have been diagnosed or treated for any psychiatric disorder (excluding ADHD and SUD) in the past year (RR=1.18). Students were 1.74 times more likely to be depressed, and 1.21 times more likely to have seriously considered suicide. While suicide attempts among graduate students were infrequent (0.71%), it was more than two-and-a-half times higher than their peers. When compared to the general U.S. population, these differences were magnified for every outcome except suicide attempt (U.S.

⁶ After first excluding those without a college degree, we used the 2008 and the 2018 NSDUH data (weighted to match the national population) to estimate the prevalence of “any mental illness” for 6 age groups (18-20, 21-25, 26-29, 30-34, 35-49, and 50+), separately for each sex. The prevalence rates for these 12 sampling strata were then weighted to match the demographic characteristics of the AY 2018 ACHA-NCHA II dataset.

Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, Center for Behavioral Health Statistics and Quality, 2018). Collectively, these observations provide some of the strongest evidence to date that the American graduate school experience confers heightened risk for mental illness.

Another important question concerns the future of graduate student mental health and the likelihood that it will worsen in the future. Historical trends provide an important clue about future outcomes, and the trends observed here serve as a warning. Our results are broadly consistent with other evidence of an increase in mental distress among young adults and more recent birth cohorts (Auerbach et al., 2018; Global Burden of Disease 2015 Disease and Injury Incidence and Prevalence Collaborators, 2015; Hunt & Eisenberg, 2010; Lipson et al., 2019). Moreover, a direct comparison with the NSDUH dataset indicates that these trends are amplified among U.S. graduate students. When compared to their age-, gender-, and education-matched peers, the prevalence of mental illness increased at a much steeper rate among graduate students (see Figure 5). The same pattern was evident, albeit much larger in magnitude, when compared to the general population (U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, Center for Behavioral Health Statistics and Quality, 2008; 2018). These observations indicate that the recent rise in graduate student mental illness does not reflect a birth cohort effect (e.g., Millennials). Instead, it suggests that rising mental illness likely reflects a systematic shift in the graduate school experience over the past decade.

Implications for Policy Makers

The prevalence of emotional distress, mental illness, and suicidality is alarmingly high among graduate students, and has steadily worsened over the past decade. Graduate students are an essential, but often overlooked, component of the American academic enterprise and scientific workforce, underscoring the urgency of addressing this public health challenge. Doing so will require a sustained investment, commensurate with the scope of the problem, and a multipronged strategy that involves all stakeholders—from funders, accreditation bodies, and non-governmental organizations (NGOs) to administrators, faculty, and students—and an evidence-based, data-driven approach. In partnership with several major philanthropic foundations, the U.S. Council of Graduate Schools (CGS) recently launched an initiative aimed at raising faculty and student awareness of the mental health challenges and needs of graduate students, reducing stigma and other barriers to care, and developing and disseminating evidence-based practices for enhancing student mental health and wellbeing (“Graduate Student Mental Health and Well-Being,” n.d.; “New Initiative to Support Graduate Student Mental Health and Wellness,” 2019).

Building on suggestions by Evans and others (Evans et al., 2018; University of California Office of the President, 2017), the CGS has identified graduate faculty as a key target for psychosocial education and training efforts (Okahana, 2018). This “train-the-trainers” approach is an important first step and is likely to be beneficial in many cases (e.g., faculty that are motivated to help, but unsure how to do so). However, in some cases, conflict between supervisors and students or genuinely toxic

faculty behaviors (e.g., bullying, harassment, assault) likely contribute to graduate student mental health (Evans et al., 2018; Hartocollis, 2019; Mangan, 2018; Matthews, 2019; Mervis, 2019; Sverdik et al., 2018; Woolston, 2019). Faculty and administrators need to be trained to identify potentially problematic supervisor-student relationships and empowered to intervene accordingly. Most importantly, policies aimed at protecting the mental health of students need to be devised and enforced.

While initiatives aimed at reducing stigma and encouraging graduate students to use campus mental healthcare resources are laudable, there are indications that counseling centers around the country are already overwhelmed (Prince, 2015). As part of a 2019 investigative report, the Associated Press used records from 39 flagship public universities to show that many are unable to meet existing demands for treatment (Binkley & Fenn, 2019). The number of students receiving treatment increased by 35% since 2014, 7 times greater than the increase in enrollment. By Fall 2018, nearly 1 in 10 students was seeking help, but the average number of licensed counselors changed little, from 16 to 19 over the same span. At many universities, the wait for services can take weeks or months. In part, this supply-demand imbalance reflects a broader nationwide shortage of mental healthcare providers (U.S. Department of Health and Human Services, 2016). Addressing these challenges will require an immediate investment in mental healthcare resources and a sustained investment in growing the behavioral healthcare workforce (e.g., clinical graduate students).

Moving forward, it will be important to carefully monitor the state of graduate student mental health and determine whether emerging initiatives are having the intended effect. While an annual census or large-scale representative survey would be optimal, it may be possible to partially address this goal by directing greater resources to ongoing data collection efforts, including ACHA-NCHA (https://www.acha.org/NCHA/NCHA_Home), Healthy Minds Network (<https://healthymindsnetwork.org/>), and gradSERU (“gradSERU Survey Design,” n.d.). To have the greatest impact, it will be necessary to significantly increase student response rates (to guard against potential response biases) and form partnerships aimed at harmonizing data collection efforts (American College Health Association & The Healthy Minds Network, 2020).

More specifically, universities should direct resources toward surveys that include the assessment of salient predictors for graduate development. The gradSERU survey, grounded in tenets of Tito’s 1993 “theory of graduate communities and doctoral persistence,” includes modules designed to focus on the unique challenges and needs of graduate students, and represents a good paradigm (“gradSERU Survey Design,” n.d.). Partnering with an external organization such as gradSERU would provide a centralized common form that reduces burden on programs and departments by limiting the time and resources they devote to the development, dissemination, and processing of site-specific graduate student and program assessments. Additionally, this structure may increase a sense of anonymity which in turn may increase overall participation and data quality.

Additionally, organizations involved in the collection and dissemination of graduate student health data should collect comprehensive information on the following attributes: discipline, department, degree type, program format, and stage of training. This information is important to aid the development of more targeted interventions and the rational allocation of resources considering universities, disciplines, and professional fields vary on the factors that influence the student experience. In fact, emerging evidence suggests stark differences in both the key predictors and prevalence of mental illness across degree types and fields (University of California Berkeley Graduate Assembly, 2014; Hyun et al., 2006; Smith & Brooks, 2015; University of California Office of the President, 2017). For example, U.C. Berkeley found that doctoral students had lower life satisfaction and higher levels of depressive symptoms than master's and professional degree students. However, doctoral students get more sleep and more exercise than master's students (University of California Berkeley Graduate Assembly, 2014). The 2017 University of California Graduate Student Well-Being Survey Report found differences across students enrolled in humanities, social science, and STEM programs in terms of depression symptoms and the factors influencing mental health, with higher rates of depression among students in the humanities and social sciences (University of California Office of the President, 2017). Further, there is reason to suspect, and data to support, the conclusion that certain professional tracks are at heightened risk and may need specialized programming as a part of their graduate training. For example, behavioral health trainees may be at heightened risk for adverse health effects as professional stress is an occupational hazard (e.g., secondary trauma, empathy fatigue) specific to

the nature of helping profession (El-Ghoroury et al., 2012; Kovach-Clark et al., 2009; Myers et al., 2009; Pakenham & Stafford-Brown, 2012; Richardson et al., 2018; Rummel, 2015). These preliminary observations underscore the importance of attending to potential differences across degree programs and scholarly fields.

Ultimately, improving the state of graduate student mental health will require a deeper understanding of the mechanisms that underlie this growing problem. While the key etiological factors remain unclear, there are growing indications that this crisis reflects systemic issues, including hyper-competition for dwindling tenure-track academic positions and research funding, student financial strain, social isolation, and challenges maintaining a healthy work-life balance (Alberts et al., 2014; Cyranoski et al., 2011; Eleftheriades et al., 2020; Schmidt & Hansson, 2018; Sverdik et al., 2018; Woolston, 2017; Woolston, 2019). In addition to providing training and psychoeducation to raise awareness and reduce stigma, more immediate and less resource intensive practices to address stressors associated with perverse incentives and hypercompetition could include encouraging faculty and advisors to share their own experiences with rejection and stressors (e.g. unsuccessful grant application, manuscript rejection) and openly emphasizing the importance of self-care. Moreover, faculty and administrators should work to promote opportunities for student socialization and the development of supportive student cohorts. While grassroots cultural change is necessarily a part of the solution, addressing these challenges goes beyond the capacity of individual faculty, many of whom struggle with the same systemic forces (Alberts et al., 2014; Barrett, 2019; Edwards & Roy, 2016; Eiko,

2017; Frith, 2019; McMinn et al., 2009). In fact, a recent national survey revealed that roughly a third of faculty at research-intensive universities already struggle with their own work-life balance and do not have enough time to balance the teaching, research, and service activities expected of them (Azubike et al., 2019). While there is limited research on the mental health of U.S. post-secondary faculty, the literature that does exist suggests there are high levels of burnout (see Sabagh et al., 2018 and Watts & Robertson, 2011 for review). Policy makers should consider the impact of adding additional responsibilities and think carefully about the degree to which faculty should be tasked with solving this problem. Addressing the systemic issues facing academia will require a sustained investment commensurate with the scope of the problem, a frank dialogue about the current state of the academic enterprise and the unintended consequences of perverse incentive structures, and the development of new partnerships among key stakeholders, funders, industry, and scholarly societies (Alberts et al., 2014; Edwards & Roy, 2016; Karmerlin, 2015; Schmidt et al., 2012).

Limitations and Future Research Challenges

Although the present study represents the most comprehensive assessment of U.S. graduate student mental health to date, there were three main limitations to the approach. First, there was a relatively low response rate (24%), raising concerns about potential self-selection biases. Second, because the ACHA-NCHA II data are deidentified, it is possible that some cases are non-independent (i.e., reflecting a subset of individuals completing multiple assessments across the 11 years of data collection). Of the institutions that participated more than once (60%), the average interval between assessments was 2.8 years. Taken with the relatively low response

rate and the fact that the sample encompasses a mixture of doctoral, professional and master's students, the length of this interval suggests that the fraction of non-independent cases is likely to be small. Naturally, this issue has no bearing whatsoever on my conclusions about the current state of graduate student mental health, which reflect simple point estimates. Furthermore, the sizable magnitude of the historical trends in graduate student distress and mental illness makes it unlikely that accounting for potential non-independence would substantively change any of the other key conclusions. In the future, this could be addressed by including permanent subject identifiers. Third, the combination of single-item distress indicators and self-reported psychiatric service utilization provides a useful, but fairly coarse estimate of the prevalence of emotional disorders among graduate students. A key challenge for the future will be to more precisely determine the true prevalence of mental illness in graduate students, using either clinically validated screening tools or structured interviews in large, nationally representative samples.

Another key challenge for the future will be to more fully understand the relevance of student demographics and environment to risk and intervention. The present results demonstrate that graduate student emotional distress has risen over the past decade, above and beyond parallel changes in key demographic variables. However, this does not mean that student gender, race, international status, and so on are not relevant in understanding graduate student mental health and wellbeing. Future research should assess how indicators of mental health may vary for different populations. It will also be important to include qualitative studies to better understand how a graduate student's social location influences their lived

experiences. Notably, members of some groups may manifest their emotional distress in ways that do not align with traditional quantitative measures. It is important to consider the possibility that lower rates of emotional distress and formally diagnosed psychiatric illnesses may obscure significant mental health burden among specific groups. For instance, it is generally thought that women are more likely to suffer from emotional illness, reporting higher rates of anxiety and depression than men (National Institute of Mental Health, 2019; Nolen-Hoeksema, 2001; McLean et al., 2011; Piccinelli & Wilkinson 2000). Yet, there is clear evidence that men are more likely to suffer from substance use disorders and antisocial personality disorders (American Psychiatric Association, 2013). Moreover, although women have been found to be at higher risk of suicide attempts, men are more likely to die by suicide (Afifi, 2007; Miranda-Mendizabal et al., 2019 for review). These patterns suggest that discrepancies in emotional distress may be due to men developing alternative symptoms, behaviors, and disorders in response to emotional distress. This raises the possibility that men may be less likely to be identified as “in need of services” when using common psychological distress screenings (e.g., Kessler-6; Kessler et al., 2003). Similarly, Black and Hispanic college students have been found to be less likely than Whites to self-report psychiatric diagnosis or to endorse symptoms of mental illness, yet have similar or elevated rates of past-year suicide attempts (Chen et al., 2019). In sum, students with different demographic backgrounds may have undetected psychiatric problems and, therefore, represent a particularly at-risk group on campus.

Lessons Learned

The Go/No-Go Procedure. The Go/No-Go process for variable selection was designed to reduce the total number of tests. In practice, an abundance of statistical power virtually guaranteed that every historical trend, even those of trivially small magnitude, was ‘statistically significant.’ As a result, the strategy had no impact on limiting the computational resources required to execute the final set of analyses. Ironically, had the modeling strategy been to include all covariates in each model from the start, the increase in average model run time may have been offset by the reduction in the total number of models executed. A possible alternative to using a 95% credibility interval for variable selection would have been the use of an effect size cutoff such that only variables that exhibited a pre-defined amount of change would be included in the final model set. The use of an effect-size-based cutoff may have circumvented the overly inclusive 95% interval used in the present study. However, identification of an appropriate cutoff a priori would have been challenging.

Model Structure. There are two properties of the final models worthy of further investigation. The first is the number of random effects. There was a minimal effort to examine the impact of specifying an intercepts-only set of random effects versus the inclusion of both random effects and random slopes. The four models used to compare different random effects specifications all indicated that there was no improvement in data-model fit when a random slope included. However, it remains an open question as to whether there is some subset of models for which the inclusion of random slopes would have incrementally improved fit.

The second model property that deserves consideration in future work with these data is whether the inclusion of a non-linear term would yield improved fit. For instance, inspection of the data suggests that change in anxiety diagnoses accelerated in recent years. A quadratic model may have better captured recent exponential growth for certain outcomes of interest. Such a model would have also been able to answer an unasked question of the NCHA data – have increases in mental illness risk reliably accelerated in recent years.

Participating Institutions. Across ACHA-NCHA assessments, a number of institutions only provided a single observation. By design, these single observation instances have little-to-no impact on the final estimates in a Bayesian multilevel model. However, there are practical costs to including schools that only returned a single respondent's worth of data. Turning again to computational resources, the estimation of random effects for each school is one of major factors in model run time. Inclusion of schools with data that provide very little information in terms of parameter estimates while considerably increasing run time may not make much sense going forward with these data.

Impact of Coronavirus Disease (COVID-19)

The present results paint a stark portrait of graduate student mental health in the U.S. This challenge is likely to be exacerbated by the emergence of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus responsible for the ongoing COVID-19 pandemic. This global health emergency has had a major impact on the U.S. academic research enterprise, with many institutions struggling with the financial and logistical consequences. What this will mean for the future of

graduate student education and the higher education system at large remains unclear. What we do know is that self-reported symptoms of depression doubled among U.S. graduate students during the COVID-19 pandemic (Chirikov et al., 2020). This reinforces the possibility that the present results represent an under-estimate of the true prevalence of distress and illness.

Conclusion

Graduate students are an essential part of the academic enterprise and their wellbeing has direct implications for the future of the arts, sciences, law, and medicine. Converging lines of evidence suggests that many graduate students experience high levels of emotional distress, depression, and anxiety. Yet the true depth and breadth of this public health “crisis” has remained unclear. The present study leveraged data gleaned from nearly 200,000 graduate students over 11 years to provide the most comprehensive assessment of U.S. graduate student mental health to date and extends the current literature by conducting a trend analysis using a national sample. The present results demonstrate that moderate-to-severe emotional distress, psychiatric illness, and suicidality is common among American graduate students. When compared to their college-educated, young-adult peers, graduate students were found to be at heightened risk across all key mental health indicators. While suicide attempts among graduate students were infrequent, it was more than two-and-a-half times higher than their peers. Over the past decade, every indicator of graduate student emotional distress credibly increased, in some cases substantially, above and beyond contemporaneous shifts in demographic or institutional characteristics. When compared to their age-, gender-, and education-matched peers, the prevalence of

emotional distress and illness increased at a much steeper rate among graduate students. Collectively, these observations provide some of the strongest evidence to date that the American graduate school experience confers heightened risk for mental illness and indicates that the recent rise in graduate student mental illness does not reflect a birth cohort effect. Instead, it suggests that rising mental illness likely reflects a systematic shift in the graduate school experience over the past decade. This public health challenge is likely to be exacerbated by the ongoing COVID-19 pandemic and resulting economic and social disruption. Addressing this will require a sustained investment, commensurate with the scope of the problem, and a multipronged strategy that involves all stakeholders, from policy makers and program directors to individual faculty and students. Most importantly, these challenges will require an immediate investment in mental healthcare resources and a sustained investment in growing the behavioral healthcare workforce.

Tables

Table 1

Prominent Studies of Graduate Student Mental Health

Study	Population	Survey Date	Sample Size	Sampling	Design	Emotional Distress/Treatment	Key Results
Present Study	United States (ACHA-NCHA-II)	Fall 2008-Spring 2019	187,427	Census/Random Sampling	Repeated Cross-Sectional	<ul style="list-style-type: none"> • Prevalence of 8 subjective distress items (e.g., hopeless, overwhelmed, too depressed to function). Responses collapsed into 2 categories: “no, not in the last 2 weeks” and “yes, in the last two weeks.” • Prevalence of seriously considered suicide and attempted suicide. Responses collapsed into 2 categories: “no, not in the last 12 months” and “yes, in the last 12 months.” • Diagnosed/treated for mental illness in past year. Responses collapsed into 2 categories: “no, not diagnosed or treated in the last 12 months” and “yes, diagnosed or treated in the last 12 months.” 	TBD
Silverman et al., (1997)	Big Ten Universities	September 1980-August 1990	84	Chart Review	Retrospective	<ul style="list-style-type: none"> • Completed suicide 	<ul style="list-style-type: none"> • Higher rate of suicide among graduate students (32%) than undergraduate students (18%)
Hyun et al., (2006)	UC Berkeley	Spring 2004	3,121	Census	Cross-Sectional	<ul style="list-style-type: none"> • <i>Ad hoc</i> composite depression index, current • Experienced a serious emotional or stress-related problem, past year • Mental health treatment, since beginning graduate school 	<ul style="list-style-type: none"> • Nearly half (45%) reported one or more serious stressors • Nearly half (46%) felt overwhelmed and more than a third (40%) felt exhausted most of the time • Nearly a third (31%) received treatment

Table 1 (cont.)*Prominent Studies of Graduate Student Mental Health*

Study	Population	Survey Date	Sample Size	Sampling	Design	Emotional Distress/Treatment	Key Results
Eisenberg et al., (2007)	University of Michigan	Fall 2005	1,662	Census	Cross-Sectional	<ul style="list-style-type: none"> • Depression, past 2 weeks (PHQ-9) • Anxiety, past 4 weeks (PHQ-Anxiety) • Suicidality, past 4 weeks • Suicide attempt, past 4 weeks 	<ul style="list-style-type: none"> • More than 1 in 10 (13%) screened positive for a depressive or anxiety disorder • 1.6% contemplated suicide, with <1% reporting a concrete plan
Brownson et al., (2011)	United States	Spring 2006	11,441	Census/ Random Sampling	Cross-Sectional	<ul style="list-style-type: none"> • Suicidal thinking and behaviors past year 	<ul style="list-style-type: none"> • 4% of females and 3% of males reported seriously considered suicide • Of those who seriously considered suicide, 12% of females and 5% of males reported a suicide attempt
Wyatt & Oswalt (2013)	United States (ACHA-NCHA-II)	Fall 2009	3,040	Census/ Random Sampling	Cross-Sectional	<ul style="list-style-type: none"> • Prevalence of 10 items of subjective distress (e.g., hopeless, overwhelmed, seriously considered suicide) and suicide attempt. Responses collapsed into 3 categories: “no, never”; “no, not in the last 12 months”; and “yes, in the last 2 weeks, 30 days, or 12 months.” • Diagnosed/treated for mental illness in past year. Responses collapsed into 3 categories: “no”; “yes, diagnosed but not treated”; and “yes, diagnosed and treated.” 	<ul style="list-style-type: none"> • More than half felt sad or lonely (51-54%), a third felt hopeless (38%), and more than a quarter felt depressed (27%) • Most (79%) felt overwhelmed and more than 2 in 5 (44%) felt anxious • 1 in 10 (10%) self-harmed, 3% seriously considered suicide, and 1% attempted suicide • More than 1 in 6 (17%) were treated for depression

Table 1 (cont.)

Prominent Studies of Graduate Student Mental Health

Study	Population	Survey Date	Sample Size	Sampling	Design	Emotional Distress/Treatment	Key Results
Garcia-Williams et al., (2014)	Emory University	July 2010-January 2012	301	Census	Cross-Sectional	<ul style="list-style-type: none"> • Depression, past 2 weeks (PHQ-9) • <i>Ad hoc</i> composite anxiety, past 2 weeks • Frequency of 4 feelings/behaviors (e.g. lonely, hopeless) • Suicidality, past 2 weeks • Suicide attempt, lifetime • Mental health treatment, on-going 	<ul style="list-style-type: none"> • More than a third (34%) showed moderate-to-severe depression, and more than a third (35%) showed mild depression • Only 3% of graduate students were completely free from depressive symptoms • More than half (52%-95%) endorsed feeling nervous, irritable, stressed, anxious, lonely, and having fights/arguments • Many felt hopeless (44%) and/or lonely (54%) • 7% contemplated suicide, with 2% reporting a concrete plan • 1 in 10 (10%) reported a suicide attempt • More than 1 in 5 received treatment (22% pharmacotherapy, 19% psychotherapy)
The Graduate Assembly UC Berkeley (2014)	UC Berkeley	Spring 2014	790	Stratified Random	Cross-Sectional	<ul style="list-style-type: none"> • Depression, past week (CESD-10) 	<ul style="list-style-type: none"> • Nearly half (47%) of doctoral students and more than a third (37%) of master's students reported symptoms of depression
Smith, E., & Brooks, Z. (2015)	University of Arizona	Spring 2015	309	Convenience	Cross-Sectional	<ul style="list-style-type: none"> • Subjective mental health, from the start of graduate studies to the present 	<ul style="list-style-type: none"> • A marked decline in mental health
University of California Office of the President (2017)	University of California (10 campuses)	Winter/Spring 2016	5,356	Stratified Random	Cross-Sectional	<ul style="list-style-type: none"> • Depression, current (CESD-R) • Mental health treatment, past year 	<ul style="list-style-type: none"> • More than 1 in 3 (35%) screened positive for depression
Woolston (2017)	International	2017	5,723	Census of Subscribers	Cross-Sectional	<ul style="list-style-type: none"> • Mental health concern (due to studies), from the start of graduate studies to the present 	<ul style="list-style-type: none"> • More than a quarter (28%) identified mental health as a key concern
Evans et al., (2018)	International (92% US-based)	NR	2,279	Convenience	Cross-Sectional	<ul style="list-style-type: none"> • Depression, past 2 weeks (PHQ-9) • Anxiety, past 2 weeks (GAD-7) 	<ul style="list-style-type: none"> • More than 1 in 3 (39%) showed moderate-to-severe depression • Close to half (41%) showed moderate-to-severe anxiety

Table 1 (cont.)

Prominent Studies of Graduate Student Mental Health

Study	Population	Survey Date	Sample Size	Sampling	Design	Emotional Distress/Treatment	Key Results
Woolston (2019)	International (22% US-based)	2019	6,320	Census of Subscribers	Cross- Sectional	<ul style="list-style-type: none">• Mental health concern (due to studies), from the start of graduate studies to the present• Mental health treatment for anxiety or depression caused by PhD, since beginning graduate school	<ul style="list-style-type: none">• More than half (57%) identified mental health as a key concern. More than a third (37%) ranked it in the top 5.• More than 1 in 3 (36%) sought treatment

Note. Some of the results provided for Woolston 2017 & 2019 were computed by me using the same publicly available data (https://figshare.com/articles/Nature_Graduate_Survey_2017/5480716;https://figshare.com/articles/2019_Nature_PhD_Students_Survey_Data/10266299).

Abbreviations—CESD, Center for Epidemiologic Studies Depression Scale; CESD-R, Center for Epidemiologic Studies Depression Scale Revised; GAD-7, General Anxiety Disorder-7; NR, not reported; PHQ-9, Patient Health Questionnaire-9.

Table 2*Demographic Characteristics*

Demographic Characteristics (percentage of valid responses)															
	<i>N</i>	Age (SD)	Gender			Race/Ethnicity							INTL	Enrollment Status	
			Female	Male	Trans	White	Asian/ PI	Black	Hispanic/ Latino	AI/AN/ NH	Other	Multi	%	Full-time	Part-time
AY 2008	14,629	28.24 (6.90)	64.13	35.77	0.10	64.92	19.00	4.32	5.00	0.32	1.64	4.80	22.48	84.49	15.51
AY 2009	12,315	28.28 (7.34)	61.14	38.60	0.26	66.41	19.40	4.01	3.68	0.41	1.78	4.31	23.31	84.54	15.46
AY 2010	19,975	28.21 (6.52)	63.77	36.00	0.22	63.15	18.55	4.50	5.55	0.22	2.11	5.93	21.85	83.38	16.62
AY 2011	14,278	28.61 (7.12)	62.27	37.53	0.20	65.76	16.36	4.26	4.00	0.35	2.15	7.12	20.67	86.64	13.36
AY 2012	23,203	28.11 (6.50)	63.88	35.92	0.20	60.29	19.55	4.47	5.50	0.26	2.36	7.58	24.14	84.65	15.35
AY 2013	14,790	28.13 (6.79)	58.53	41.24	0.22	64.10	18.60	4.16	4.04	0.29	2.03	6.78	22.80	88.27	11.73
AY 2014	20,896	28.07 (6.56)	63.72	36.01	0.27	55.46	22.87	4.75	5.51	0.36	2.33	8.71	26.13	85.21	14.79
AY 2015	15,255	28.54 (7.14)	60.53	37.86	1.61	58.80	20.18	3.91	5.88	0.55	2.00	8.67	21.66	86.21	13.79
AY 2016	19,125	28.20 (6.69)	63.47	35.45	1.08	54.78	23.52	4.76	6.00	0.31	2.78	7.84	26.04	84.87	15.13
AY 2017	16,726	28.59 (7.34)	65.54	33.17	1.28	58.50	18.74	4.36	7.96	0.44	2.27	7.73	17.14	84.63	15.37
AY 2018	16,235	28.18 (6.67)	64.21	34.49	1.30	57.76	21.27	4.03	6.02	0.44	2.18	8.29	22.65	88.48	11.52
Total/Mean	187,427	28.27 (6.83)	63.01	36.38	0.61	60.48	19.98	4.36	5.46	0.35	2.18	7.19	22.80	85.48	14.52

Note. Descriptive statistics were computed using valid responses. Across all measures and surveys, an average of 99.54% of data were valid. Abbreviations—AI/AN/NH, American Indian, Alaskan

Native, or Native Hawaiian; M, mean; INTL, international; PI, Pacific Islander; SD, standard deviation.

Table 3*Institutional Characteristics*

Institutional Characteristics (percentage of valid responses)								
	<i>N</i>	Institution Type		Campus Size				
		Public	Private	Less than 2,500	2,500-4,999	5,000-9,999	10,000-19,999	20,000 or more
AY 2008	14,629	39.20	60.80	0.31	17.42	9.12	16.59	56.56
AY 2009	12,315	65.42	34.58	5.63	5.54	8.62	26.80	53.41
AY 2010	19,975	33.00	67.00	2.42	7.71	6.03	18.73	65.11
AY 2011	14,278	61.56	38.44	1.93	6.58	7.62	28.20	55.67
AY 2012	23,203	43.91	56.09	1.56	6.83	10.12	20.35	61.13
AY 2013	14,790	60.83	39.17	6.46	5.21	11.74	29.34	47.25
AY 2014	20,896	41.04	58.96	0.03	7.40	7.70	16.85	68.01
AY 2015	15,255	71.35	28.65	2.01	3.94	8.99	26.84	58.23
AY 2016	19,125	36.63	63.37	2.54	10.38	12.31	19.24	55.53
AY 2017	16,726	63.66	36.34	3.04	3.35	19.40	22.28	51.93
AY 2018	16,235	66.97	33.03	7.12	4.61	13.17	27.68	47.42
Total/Mean	187,427	51.40	48.60	2.81	7.21	10.40	22.45	57.13

Note. Descriptive statistics were computed using valid responses. Across all measures and surveys, an average of 100 of data were valid.

Table 4*Emotional Distress*

Emotional Distress, Past 2 Weeks (percentage of valid responses)									
	<i>N</i>	Hopeless	Overwhelmed	Mentally Exhausted	Very Lonely	Very Sad	Too Depressed to Function	Overwhelming Anxiety	Overwhelming Anger
AY 2008	14,629	11.95	43.85	43.71	18.61	19.30	7.89	16.21	8.36
AY 2009	12,315	11.32	44.35	43.46	17.22	17.96	7.69	16.07	8.22
AY 2010	19,975	11.34	46.05	45.34	17.47	18.15	7.50	16.70	8.01
AY 2011	14,278	11.02	46.56	45.63	16.77	17.79	7.76	16.47	7.39
AY 2012	23,203	12.57	45.76	45.24	18.08	18.87	8.35	18.13	8.24
AY 2013	14,790	12.33	46.65	46.86	18.20	18.81	8.44	17.75	7.74
AY 2014	20,896	13.05	44.51	45.14	18.70	20.76	9.26	19.01	8.58
AY 2015	15,255	13.48	46.05	46.38	19.02	21.57	10.08	20.29	9.21
AY 2016	19,125	15.04	45.00	45.90	19.69	22.60	10.86	20.57	9.25
AY 2017	16,726	14.55	47.48	48.47	20.27	23.05	11.15	22.34	9.40
AY 2018	16,235	16.82	48.94	49.91	22.25	25.44	12.71	24.68	9.83
Total/Mean	187,427	13.10	45.91	46.02	18.78	20.44	9.27	19.01	8.58

Note. Descriptive statistics were computed using valid responses. Across all measures and surveys, an average of 99.3% of data were valid. Variable Descriptions—*Hopeless*, felt things were hopeless;

Mentally Exhausted, felt exhausted (not from physical activity); *Overwhelmed*, felt overwhelmed by all you had to do; *Overwhelming Anger*, felt overwhelming anger; *Overwhelming Anxiety*, felt

overwhelming anxiety; *Too Depressed to Function*, felt so depressed that it was difficult to function; *Very Lonely*, felt very lonely; *Very Sad*, felt very sad.

Table 5*Suicidality*

	<i>N</i>	Suicidality, Past Year (percentage of valid responses)	
		Seriously Considered Suicide	Attempted Suicide
AY 2008	14,629	3.91	0.45
AY 2009	12,315	3.55	0.65
AY 2010	19,975	4.06	0.44
AY 2011	14,278	4.16	0.48
AY 2012	23,203	4.02	0.54
AY 2013	14,790	4.44	0.47
AY 2014	20,896	4.96	0.59
AY 2015	15,255	5.29	0.59
AY 2016	19,125	5.91	0.63
AY 2017	16,726	6.86	0.68
AY 2018	16,235	7.24	0.71
Total/Mean	187,427	4.96	0.57

Note. Descriptive statistics were computed using valid responses. Across all surveys, an average of 99.3 of data were valid.

Table 6*Reported Mental Health Diagnosis or Treatment*

Mental Health Diagnosis or Treatment, Past Year (percentage of valid responses)								
	<i>N</i>	Internalizing Illness				Severe Mental Illness		Any Psychiatric Disorder
		Anxiety	Depression	Panic Attacks	Phobia	Bipolar Disorder	Schizophrenia	
AY 2008	14,629	12.40	11.45	4.52	0.69	1.07	0.08	19.75
AY 2009	12,315	11.59	10.25	4.49	0.54	0.92	0.12	18.19
AY 2010	19,975	13.79	11.49	4.97	0.80	1.05	0.08	20.77
AY 2011	14,278	13.22	11.67	4.51	0.61	1.09	0.02	20.43
AY 2012	23,203	14.63	11.57	5.37	0.85	1.08	0.07	21.39
AY 2013	14,790	13.68	11.17	4.87	0.63	0.96	0.04	20.10
AY 2014	20,896	15.41	11.99	5.72	0.78	0.95	0.05	22.09
AY 2015	15,255	16.23	12.63	6.37	0.66	1.04	0.09	22.72
AY 2016	19,125	18.75	14.67	7.11	0.82	1.26	0.11	25.46
AY 2017	16,726	20.99	16.30	8.04	0.80	1.43	0.15	28.02
AY 2018	16,235	23.56	18.17	9.21	1.08	1.42	0.21	30.45
Total/Mean	187,427	15.96	12.89	5.97	0.76	1.12	0.09	22.79

Note. Descriptive statistics were computed using valid responses. Across all measures and surveys, an average of 99.3 of data were valid. Variable Descriptions—*Any psychiatric disorder*, this included all the 15 mental health diagnoses listed (with the exception of ADHD and SUDs).

Table 7*Trends in Emotional Distress*

Trends in Emotional Distress, Past 2 Weeks								
	Unstandardized Regression Coefficient	Lower Bound	Upper Bound	Overall Odds Ratio	Risk Ratio (RR)	Model fitted % in Fall 2008	Model fitted % in Spring 2019	Risk Difference % (RD)
Hopeless	0.04	0.04	0.05	1.60	1.50	10.13	15.24	+5.11
Overwhelmed	0.01	0.00	0.01	1.07	1.04	45.43	47.06	+1.63
Mentally Exhausted	0.02	0.01	0.02	1.18	1.09	44.29	48.32	+4.03
Very Lonely	0.03	0.02	0.03	1.31	1.24	16.09	20.03	+3.94
Very Sad	0.04	0.04	0.05	1.56	1.43	16.61	23.75	+7.14
Too Depressed to Function	0.06	0.05	0.06	1.86	1.76	6.53	11.48	+4.95
Overwhelming Anxiety	0.05	0.05	0.06	1.74	1.56	14.95	23.39	+8.44
Overwhelming Anger	0.03	0.02	0.03	1.31	1.28	7.59	9.72	+2.13

Note. Descriptive statistics were computed using valid responses. Across all measures and surveys, an average of 99.3% of data were valid. Unstandardized regression coefficients, overall odds ratios, and risk ratios are based on the model fit for Fall 2008 to Spring 2019. Variable Descriptions—*Hopeless*, felt things were hopeless; *Mentally Exhausted*, felt exhausted (not from physical activity); *Overwhelmed*, felt overwhelmed by all you had to do; *Overwhelming Anger*, felt overwhelming anger; *Overwhelming Anxiety*, felt overwhelming anxiety; *Too Depressed to Function*, felt so depressed that it was difficult to function; *Very Lonely*, felt very lonely; *Very Sad*, felt very sad.

Table 8*Trends in Suicidality*

Trends in Suicidality, Past Year								
	Unstandardized Regression Coefficient	Lower Bound	Upper Bound	Overall Odds Ratio	Risk Ratio (RR)	Model fitted % in Fall 2008	Model fitted % in Spring 2019	Risk Difference % (RD)
Seriously Considered Suicide	0.07	0.07	0.08	2.19	2.11	3.33	7.02	+3.69
Attempted Suicide	0.04	0.02	0.06	1.57	1.57	0.45	0.71	+0.26

Note. Descriptive statistics were computed using valid responses. Across all surveys, an average of 99.3% of data were valid. Unstandardized regression coefficients, overall odds ratios, and risk ratios are based on the model fit for Fall 2008 to Spring 2019.

Table 9*Trends in Mental Health Diagnosis or Treatment*

Trends in Mental Health Diagnosis or Treatment, Past Year								
	Unstandardized Regression Coefficient	Lower Bound	Upper Bound	Overall Odds Ratio	Risk Ratio (RR)	Model fitted % in Fall 2008	Model fitted % in Spring 2019	Risk Difference % (RD)
Anxiety	0.08	0.07	0.08	2.28	2.00	10.97	21.94	+10.97
Depression	0.06	0.05	0.06	1.80	1.67	10.02	16.71	+6.69
Panic Attacks	0.08	0.07	0.09	2.29	2.18	4.07	8.85	+4.78
Phobia	0.04	0.02	0.06	1.56	1.55	0.58	0.90	+0.32
Bipolar Disorder	0.03	0.02	0.05	1.40	1.39	0.98	1.36	+0.38
Schizophrenia	0.10	0.05	0.16	2.97	2.96	0.05	0.15	+0.1
Any Psychiatric Disorder	0.06	0.05	0.06	1.82	1.58	18.37	29.00	+10.63

Note. Descriptive statistics were computed using valid responses. Across all measures and surveys, an average of 99.3 of data were valid. Unstandardized regression coefficients, overall odds ratios, and risk ratios are based on the model fit for Fall 2008 to Spring 2019. Variable Descriptions—*Any psychiatric disorder*, this included all the 15 mental health diagnoses listed (with the exception of ADHD and SUDs).

Table 10*Trends in Demographic Characteristics*

Trends in Demographic Characteristics								
	Unstandardized Regression Coefficient	Lower Bound	Upper Bound	Overall Odds Ratio	Risk Ratio (RR)	Model fitted % in Fall 2008	Model fitted % in Spring 2019	Risk Difference % (RD)
Age	-0.03	-0.04	-0.02	NA	NA	NA	NA	NA
Gender (vs. Male)								
Female	0.02	0.01	0.02	1.11	NA	65.43	67.65	+2.22
Transgender	0.28	0.26	0.31	17.28	NA	0.11	1.83	+1.72
Race/Ethnicity (vs White)								
Asian/ PI	0.06	0.05	0.06	1.50	NA	11.03	15.72	+4.69
Black	0.05	0.04	0.06	1.31	NA	4.85	6.25	+1.4
Hispanic/ Latino	0.06	0.05	0.07	1.42	NA	4.58	6.39	+1.81
AI/AN/NH	0.04	0.01	0.06	1.19	NA	0.61	0.73	+0.12
Other	0.05	0.04	0.07	1.46	NA	1.69	2.45	+0.76
Multi	0.08	0.07	0.08	1.88	NA	4.68	8.44	+3.76
International (vs. U.S. Citizen)								
Non-U.S. Citizen	0.02	0.02	0.03	1.27	NA	10.74	13.27	+2.53
Enrollment Status (vs. Full-Time)								
Part-Time	-0.02	-0.02	-0.01	0.84	NA	15.81	13.61	-2.2

Note. Descriptive statistics were computed using valid responses. Across all measures and surveys, an average of 99.54 of data were valid. Unstandardized regression coefficients, overall odds ratios, and risk ratios are based on the model fit for Fall 2008 to Spring 2019.

Table 11*Trends in Institutional Characteristics*

Trends in Institutional Characteristics									
		Unstandardized Regression Coefficient	Lower Bound	Upper Bound	Overall Odds Ratio	Risk Ratio (RR)	Model fitted % in Fall 2008	Model fitted % in Spring 2019	Risk Difference % (RD)
Institution Type (vs. Public)									
	Private	-0.06	-0.07	-0.06	0.51	NA	57.39	40.68	-16.71
Campus Size		-0.02	-0.02	-0.01	NA	NA	NA	NA	NA

Note. Descriptive statistics were computed using valid responses. Across all measures and surveys, an average of 99.54 of data were valid. Unstandardized regression coefficients, overall odds ratios, and risk ratios are based on the model fit for Fall 2008 to Spring 2019.

Table 12*Trends in Emotional Distress, Adjusted for Demographic or Institutional Characteristics*

Pairwise Adjusted Trends in Emotional Distress, Past 2 Weeks								
	Unstandardized Regression Coefficient	Lower Bound	Upper Bound	Overall Odds Ratio	Risk Ratio (RR)	Model fitted % in Fall 2008	Model fitted % in Spring 2019	Risk Difference % (RD)
Uncorrected trend in Hopeless	0.045	0.039	0.050	1.60	1.50	10.13	15.24	+5.11
Corrected for:								
Age	0.045	0.040	0.050	1.61	1.52	9.82	14.92	+5.10
Gender	0.044	0.039	0.049	1.63	1.53	9.90	15.18	+5.28
Race/Ethnicity	0.042	0.037	0.047	1.62	1.52	9.70	14.79	+5.09
International Status	0.045	0.040	0.050	1.63	1.54	9.75	15.00	+5.25
Enrollment Status	0.044	0.040	0.049	1.57	1.48	9.94	14.74	+4.80
Institution Type	0.045	0.040	0.050	1.60	1.51	10.06	15.14	+5.09
Campus Size	0.044	0.039	0.049	1.57	1.49	10.28	15.26	+4.99
Uncorrected trend in Overwhelmed	0.006	0.003	0.010	1.07	1.04	45.43	47.06	+1.64
Corrected for:								
Age	0.006	0.003	0.010	1.07	1.04	45.56	47.27	+1.72
Gender	0.005	0.001	0.008	1.11	1.06	43.65	46.12	+2.47
Race/Ethnicity	0.011	0.008	0.015	1.07	1.03	47.15	48.72	+1.57
International Status	0.009	0.005	0.012	1.03	1.02	46.48	47.28	+0.80
Enrollment Status	0.006	0.003	0.010	1.06	1.03	45.60	46.96	+1.36
Institution Type	0.006	0.003	0.010	1.08	1.04	45.22	47.08	+1.86
Campus Size	0.006	0.003	0.010	1.06	1.03	45.97	47.50	+1.53

Table 12 (cont.)

Trends in Emotional Distress, Adjusted for Demographic or Institutional Characteristics

Pairwise Adjusted Trends in Emotional Distress, Past 2 Weeks								
	Unstandardized Regression Coefficient	Lower Bound	Upper Bound	Overall Odds Ratio	Risk Ratio (RR)	Model fitted % in Fall 2008	Model fitted % in Spring 2019	Risk Difference % (RD)
Uncorrected trend in Mentally Exhausted	0.016	0.012	0.019	1.18	1.09	44.29	48.32	+4.03
Corrected for:								
Age	0.015	0.012	0.019	1.18	1.09	44.02	48.13	+4.11
Gender	0.014	0.011	0.018	1.21	1.11	42.91	47.58	+4.67
Race/Ethnicity	0.020	0.017	0.023	1.18	1.09	45.18	49.26	+4.08
International Status	0.018	0.014	0.021	1.14	1.07	44.52	47.82	+3.30
Enrollment Status	0.015	0.012	0.019	1.17	1.09	44.13	47.95	+3.82
Institution Type	0.016	0.012	0.019	1.19	1.10	43.62	47.91	+4.29
Campus Size	0.015	0.012	0.019	1.17	1.09	44.22	48.03	+3.81
Uncorrected trend in Very Lonely	0.026	0.021	0.030	1.31	1.24	16.09	20.03	+3.94
Corrected for:								
Age	0.026	0.022	0.030	1.32	1.26	15.82	19.88	+4.06
Gender	0.024	0.020	0.029	1.33	1.27	15.76	19.97	+4.21
Race/Ethnicity	0.024	0.020	0.029	1.33	1.26	15.89	20.07	+4.17
International Status	0.026	0.022	0.030	1.31	1.25	15.91	19.87	+3.97
Enrollment Status	0.025	0.021	0.029	1.28	1.22	15.96	19.53	+3.56
Institution Type	0.025	0.021	0.030	1.29	1.23	16.30	20.09	+3.79
Campus Size	0.025	0.021	0.030	1.29	1.23	16.34	20.12	+3.79

Table 12 (cont.)

Trends in Emotional Distress, Adjusted for Demographic or Institutional Characteristics

Pairwise Adjusted Trends in Emotional Distress, Past 2 Weeks								
	Unstandardized Regression Coefficient	Lower Bound	Upper Bound	Overall Odds Ratio	Risk Ratio (RR)	Model fitted % in Fall 2008	Model fitted % in Spring 2019	Risk Difference % (RD)
Uncorrected trend in Very Sad	0.043	0.038	0.047	1.56	1.43	16.61	23.75	+7.15
Corrected for:								
Age	0.043	0.039	0.047	1.57	1.44	16.25	23.38	+7.14
Gender	0.042	0.038	0.046	1.61	1.47	15.88	23.32	+7.44
Race/Ethnicity	0.042	0.038	0.046	1.59	1.45	16.40	23.79	+7.39
International Status	0.043	0.039	0.047	1.56	1.43	16.45	23.50	+7.05
Enrollment Status	0.042	0.038	0.047	1.54	1.41	16.30	23.05	+6.75
Institution Type	0.043	0.038	0.047	1.55	1.42	16.49	23.44	+6.95
Campus Size	0.043	0.038	0.047	1.55	1.42	16.69	23.69	+7.00
Uncorrected trend in Too Depressed to Function	0.059	0.053	0.065	1.86	1.76	6.53	11.48	+4.95
Corrected for:								
Age	0.059	0.054	0.065	1.87	1.77	6.49	11.47	+4.98
Gender	0.058	0.053	0.064	1.91	1.81	6.24	11.29	+5.05
Race/Ethnicity	0.056	0.050	0.061	1.88	1.78	6.21	11.06	+4.86
International Status	0.059	0.054	0.065	1.90	1.80	6.29	11.31	+5.02
Enrollment Status	0.059	0.053	0.065	1.82	1.73	6.41	11.08	+4.67
Institution Type	0.059	0.053	0.065	1.85	1.75	6.58	11.55	+4.96
Campus Size	0.059	0.052	0.065	1.82	1.73	6.68	11.56	+4.87

Table 12 (cont.)

Trends in Emotional Distress, Adjusted for Demographic or Institutional Characteristics

Pairwise Adjusted Trends in Emotional Distress, Past 2 Weeks								
	Unstandardized Regression Coefficient	Lower Bound	Upper Bound	Overall Odds Ratio	Risk Ratio (RR)	Model fitted % in Fall 2008	Model fitted % in Spring 2019	Risk Difference % (RD)
Uncorrected trend in Overwhelming Anxiety	0.053	0.048	0.057	1.74	1.56	14.95	23.39	+8.44
Corrected for:								
Age	0.053	0.048	0.057	1.74	1.57	14.91	23.41	+8.50
Gender	0.052	0.048	0.056	1.81	1.62	14.51	23.52	+9.01
Race/Ethnicity	0.054	0.050	0.058	1.75	1.57	15.34	24.04	+8.69
International Status	0.054	0.049	0.058	1.71	1.54	15.28	23.55	+8.27
Enrollment Status	0.053	0.048	0.057	1.71	1.55	14.90	23.07	+8.17
Institution Type	0.053	0.049	0.057	1.75	1.57	14.86	23.37	+8.51
Campus Size	0.053	0.048	0.057	1.73	1.56	15.03	23.43	+8.40
Uncorrected trend in Overwhelming Anger	0.026	0.020	0.032	1.31	1.28	7.59	9.72	+2.13
Corrected for:								
Age	0.025	0.020	0.031	1.31	1.28	7.57	9.68	+2.10
Gender	0.025	0.020	0.031	1.35	1.31	7.50	9.86	+2.36
Race/Ethnicity	0.022	0.017	0.028	1.36	1.32	7.49	9.89	+2.41
International Status	0.025	0.020	0.031	1.31	1.28	7.62	9.73	+2.11
Enrollment Status	0.026	0.020	0.031	1.30	1.27	7.66	9.74	+2.09
Institution Type	0.026	0.020	0.032	1.32	1.29	7.54	9.72	+2.18
Campus Size	0.026	0.020	0.032	1.31	1.28	7.64	9.77	+2.13

Note. Descriptive statistics were computed using valid responses. Across all measures and surveys, an average of 99.3% of data were valid. Unstandardized regression coefficients, overall odds ratios, and risk ratios are based on the model fit for Fall 2008 to Spring 2019. Variable Descriptions—*Hopeless*, felt things were hopeless; *Mentally Exhausted*, felt exhausted (not from physical activity); *Overwhelmed*, felt overwhelmed by all you had to do; *Overwhelming Anger*, felt overwhelming anger; *Overwhelming Anxiety*, felt overwhelming anxiety; *Too Depressed to Function*, felt so depressed that it was difficult to function; *Very Lonely*, felt very lonely; *Very Sad*, felt very sad.

Table 13

Trends in Suicidality, Adjusted for Demographic or Institutional Characteristics

Pairwise Adjusted Trends in Suicidality, Past Year								
	Unstandardized Regression Coefficient	Lower Bound	Upper Bound	Overall Odds Ratio	Risk Ratio (RR)	Model fitted % in Fall 2008	Model fitted % in Spring 2019	Risk Difference % (RD)
Uncorrected trend in Seriously Considered Suicide	0.075	0.067	0.082	2.19	2.11	3.33	7.02	+3.69
Corrected for:								
Age	0.075	0.068	0.083	2.20	2.12	3.27	6.93	+3.66
Gender	0.073	0.066	0.081	2.33	2.23	3.29	7.33	+4.04
Race/Ethnicity	0.074	0.067	0.082	2.31	2.22	3.30	7.31	+4.01
International Status	0.077	0.070	0.084	2.18	2.10	3.35	7.01	+3.67
Enrollment Status	0.075	0.068	0.082	2.18	2.10	3.31	6.95	+3.64
Institution Type	0.075	0.067	0.083	2.24	2.15	3.24	6.98	+3.74
Campus Size	0.075	0.067	0.083	2.18	2.09	3.36	7.03	+3.67
Uncorrected trend in Attempted Suicide	0.043	0.022	0.065	1.57	1.57	0.45	0.71	+0.26
Corrected for:								
Age	0.042	0.021	0.062	1.55	1.55	0.44	0.69	+0.24
Gender	0.040	0.020	0.059	1.65	1.64	0.45	0.74	+0.29
Race/Ethnicity	0.033	0.011	0.053	1.67	1.67	0.41	0.68	+0.27
International Status	0.044	0.024	0.063	1.67	1.66	0.41	0.68	+0.27
Enrollment Status	0.043	0.023	0.064	1.53	1.53	0.48	0.73	+0.25
Institution Type	0.043	0.021	0.064	1.61	1.61	0.44	0.71	+0.27
Campus Size	0.043	0.022	0.065	1.54	1.53	0.46	0.71	+0.25

Note. Descriptive statistics were computed using valid responses. Across all measures and surveys, an average of 99.3% of data were valid. Unstandardized regression coefficients, overall odds ratios, and risk ratios are based on the model fit for Fall 2008 to Spring 2019.

Table 14*Trends in Mental Health Diagnosis or Treatment, Adjusted for Demographic or Institutional Characteristics*

Pairwise Corrected Adjusted in Mental Health Diagnosis or Treatment, Past Year								
	Unstandardized Regression Coefficient	Lower Bound	Upper Bound	Overall Odds Ratio	Risk Ratio (RR)	Model fitted % in Fall 2008	Model fitted % in Spring 2019	Risk Difference % (RD)
Uncorrected trend in Anxiety	0.079	0.074	0.084	2.28	2.00	10.97	21.94	+10.97
Corrected for:								
Age	0.080	0.075	0.084	2.28	2.00	10.76	21.56	+10.80
Gender	0.078	0.073	0.082	2.44	2.12	10.19	21.66	+11.46
Race/Ethnicity	0.089	0.084	0.094	2.30	1.99	12.03	23.94	+11.91
International Status	0.083	0.078	0.088	2.21	1.95	11.37	22.13	+10.75
Enrollment Status	0.080	0.075	0.084	2.31	2.02	10.92	22.09	+11.17
Institution Type	0.079	0.074	0.084	2.29	2.00	10.95	21.94	+10.99
Campus Size	0.079	0.074	0.085	2.29	2.01	10.83	21.76	+10.93
Uncorrected trend in Depression	0.056	0.051	0.062	1.80	1.67	10.02	16.71	+6.69
Corrected for:								
Age	0.057	0.052	0.063	1.80	1.67	9.86	16.48	+6.62
Gender	0.054	0.049	0.059	1.92	1.76	9.66	17.04	+7.38
Race/Ethnicity	0.063	0.058	0.068	1.82	1.68	10.71	17.95	+7.24
International Status	0.059	0.054	0.064	1.75	1.62	10.33	16.77	+6.43
Enrollment Status	0.057	0.052	0.062	1.83	1.68	10.15	17.09	+6.95
Institution Type	0.057	0.051	0.062	1.82	1.68	9.99	16.80	+6.82
Campus Size	0.057	0.051	0.062	1.80	1.67	9.98	16.64	+6.65

Table 14 (cont.)

Trends in Mental Health Diagnosis or Treatment, Adjusted for Demographic or Institutional Characteristics

Pairwise Corrected Adjusted in Mental Health Diagnosis or Treatment, Past Year								
	Unstandardized Regression Coefficient	Lower Bound	Upper Bound	Overall Odds Ratio	Risk Ratio (RR)	Model fitted % in Fall 2008	Model fitted % in Spring 2019	Risk Difference % (RD)
Uncorrected trend in Panic Attacks	0.079	0.072	0.086	2.29	2.18	4.07	8.85	+4.79
Corrected for:								
Age	0.079	0.072	0.086	2.29	2.17	4.01	8.72	+4.71
Gender	0.077	0.071	0.084	2.47	2.34	3.74	8.75	+5.00
Race/Ethnicity	0.087	0.080	0.093	2.31	2.19	4.38	9.57	+5.19
International Status	0.082	0.075	0.089	2.21	2.11	4.16	8.77	+4.61
Enrollment Status	0.080	0.073	0.087	2.31	2.19	4.11	9.02	+4.90
Institution Type	0.079	0.072	0.087	2.31	2.20	3.97	8.74	+4.77
Campus Size	0.079	0.072	0.087	2.30	2.19	3.98	8.70	+4.72
Uncorrected trend in Phobia	0.042	0.023	0.060	1.56	1.55	0.58	0.90	+0.32
Corrected for:								
Age	0.041	0.023	0.058	1.53	1.52	0.60	0.91	+0.31
Gender	0.038	0.021	0.056	1.66	1.66	0.56	0.94	+0.37
Race/Ethnicity	0.045	0.027	0.062	1.56	1.56	0.62	0.97	+0.35
International Status	0.042	0.024	0.060	1.52	1.52	0.60	0.90	+0.31
Enrollment Status	0.042	0.025	0.059	1.55	1.55	0.59	0.91	+0.32
Institution Type	0.042	0.023	0.061	1.54	1.53	0.58	0.89	+0.31
Campus Size	0.043	0.025	0.062	1.56	1.55	0.59	0.92	+0.33

Table 14 (cont.)

Trends in Mental Health Diagnosis or Treatment, Adjusted for Demographic or Institutional Characteristics

Pairwise Corrected Adjusted in Mental Health Diagnosis or Treatment, Past Year								
	Unstandardized Regression Coefficient	Lower Bound	Upper Bound	Overall Odds Ratio	Risk Ratio (RR)	Model fitted % in Fall 2008	Model fitted % in Spring 2019	Risk Difference % (RD)
Uncorrected trend in Bipolar Disorder	0.032	0.017	0.047	1.40	1.39	0.98	1.36	+0.38
Corrected for:								
Age	0.032	0.018	0.047	1.39	1.39	0.94	1.30	+0.36
Gender	0.029	0.015	0.043	1.54	1.54	0.94	1.45	+0.51
Race/Ethnicity	0.036	0.021	0.051	1.42	1.42	1.05	1.48	+0.44
International Status	0.033	0.019	0.048	1.35	1.35	1.02	1.37	+0.36
Enrollment Status	0.033	0.019	0.048	1.44	1.43	0.98	1.40	+0.42
Institution Type	0.032	0.016	0.047	1.45	1.44	0.94	1.36	+0.42
Campus Size	0.032	0.016	0.048	1.37	1.37	0.98	1.34	+0.36
Uncorrected trend in Schizophrenia	0.105	0.053	0.156	2.97	2.96	0.05	0.15	+0.10
Corrected for:								
Age	0.103	0.055	0.152	2.94	2.94	0.05	0.15	+0.10
Gender	0.094	0.043	0.145	3.34	3.33	0.06	0.19	+0.13
Race/Ethnicity	0.098	0.049	0.146	3.38	3.37	0.04	0.15	+0.10
International Status	0.106	0.058	0.154	3.22	3.22	0.05	0.15	+0.10
Enrollment Status	0.105	0.055	0.153	3.05	3.04	0.05	0.16	+0.10
Institution Type	0.102	0.052	0.154	2.99	2.98	0.05	0.15	+0.10
Campus Size	0.107	0.058	0.158	3.00	3.00	0.05	0.16	+0.10

Table 14 (cont.)

Trends in Mental Health Diagnosis or Treatment, Adjusted for Demographic or Institutional Characteristics

Pairwise Corrected Adjusted in Mental Health Diagnosis or Treatment, Past Year								
	Unstandardized Regression Coefficient	Lower Bound	Upper Bound	Overall Odds Ratio	Risk Ratio (RR)	Model fitted % in Fall 2008	Model fitted % in Spring 2019	Risk Difference % (RD)
Uncorrected trend in Any Psychiatric Disorder	0.057	0.053	0.062	1.82	1.58	18.37	29.00	+10.64
Corrected for:								
Age	0.059	0.055	0.063	1.82	1.59	17.80	28.32	+10.52
Gender	0.056	0.052	0.060	1.92	1.66	17.05	28.34	+11.30
Race/Ethnicity	0.066	0.062	0.070	1.84	1.58	19.29	30.54	+11.24
International Status	0.061	0.057	0.065	1.76	1.54	18.56	28.66	+10.10
Enrollment Status	0.058	0.054	0.062	1.84	1.60	18.20	29.06	+10.86
Institution Type	0.058	0.053	0.062	1.83	1.59	17.87	28.46	+10.58
Campus Size	0.058	0.053	0.062	1.82	1.59	17.84	28.34	+10.50

Variable Descriptions—Any psychiatric disorder, this included all the 15 mental health diagnoses listed (with the exception of ADHD and SUDs).

Table 15

Prevalence of mental illness among U.S. graduate students, demographically matched peers, and the general population in 2018

	ACHA-NCHA II 2018		Matched NSDUH 2018			Unmatched NSDUH 2018		
	%	[95% CI]	%	Risk Ratio	RD	%	Risk Ratio	RD
Any Psychiatric Disorder	30.45	[29.72, 31.17]	25.8	1.18	+4.65	19.1	1.59	+11.35
Depression	18.17	[17.58, 18.77]	10.44	1.74	+7.73	7.2	2.52	+10.97
Seriously considered suicide	7.24	[6.84, 7.65]	5.97	1.21	+1.27	4.3	1.68	+2.94
Attempted suicide	0.71	[0.59, 0.85]	0.27	2.63	+0.44	0.6	1.18	+0.11

Table 16

Change in prevalence of mental illness among U.S. graduate students, demographically matched peers, and the general population between 2008 and 2018

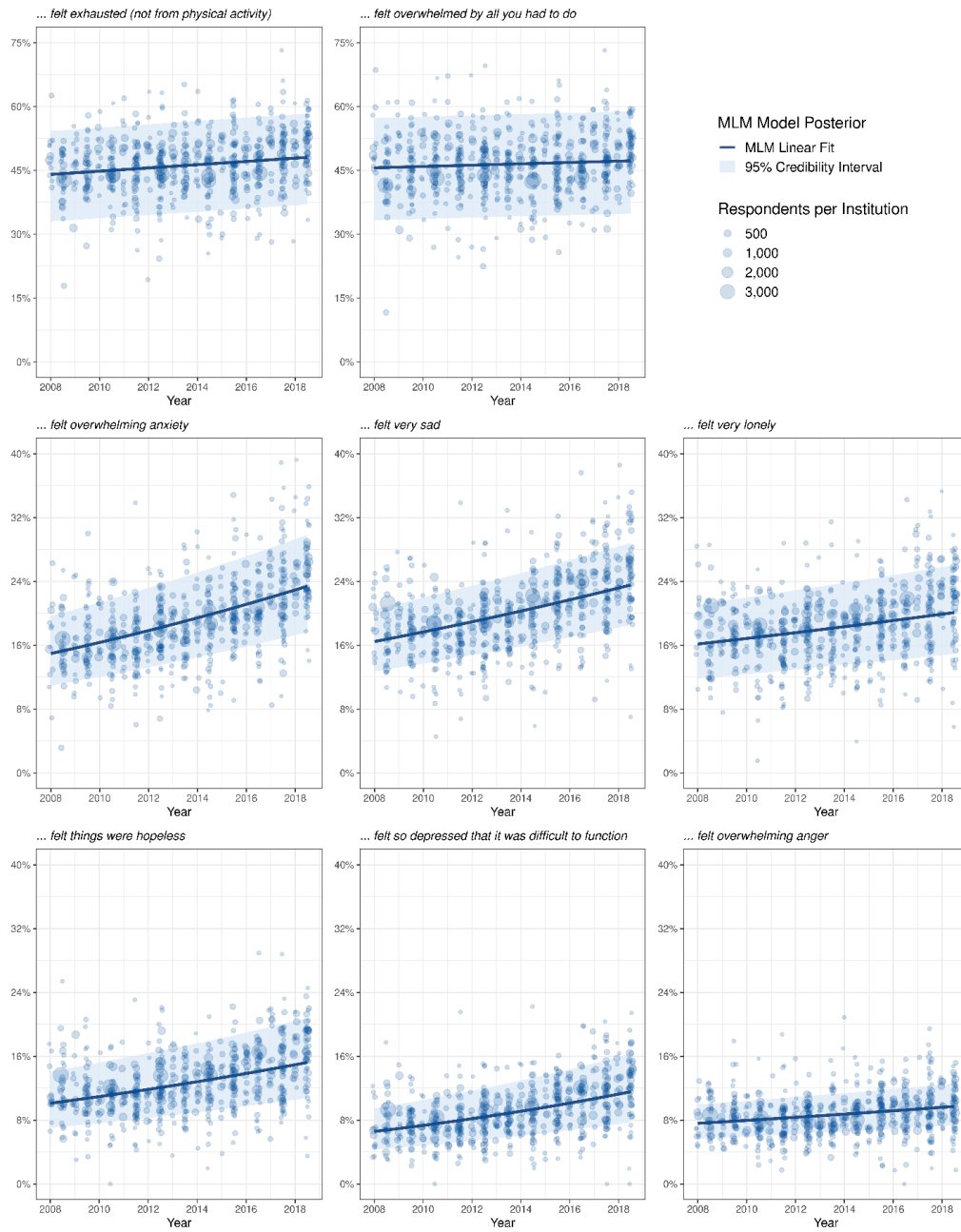
	ACHA-NCHA II 2008 -2018		Matched NSDUH 2008-2018		Unmatched NSDUH 2008-2018	
	RR [95% HDI]	RD [95% HDI]	RR [95% HDI]	RD [95% HDI]	RR [95% HDI]	RD [95% HDI]
Any Psychiatric Disorder	1.58 [1.49, 1.69]	+10.63 [7.51, 13.36]	1.25	+5.24	1.08	+1.40
Depression	1.67 [1.57,1.78]	+6.69 [4.11, 9.71]	1.35	+2.73	1.11	+0.70
Seriously considered suicide	2.11 [1.95, 2.28]	+3.69 [2.57, 5.14]	1.66	+2.37	1.16	+0.60
Attempted suicide	1.57 [1.26, 1.97]	+0.26 [0.10, 0.50]	1.35	+0.07	1.20	+0.10

Figures

Figure 1

Trends in Emotional Distress

Percentage of graduate students who, in the past two weeks...

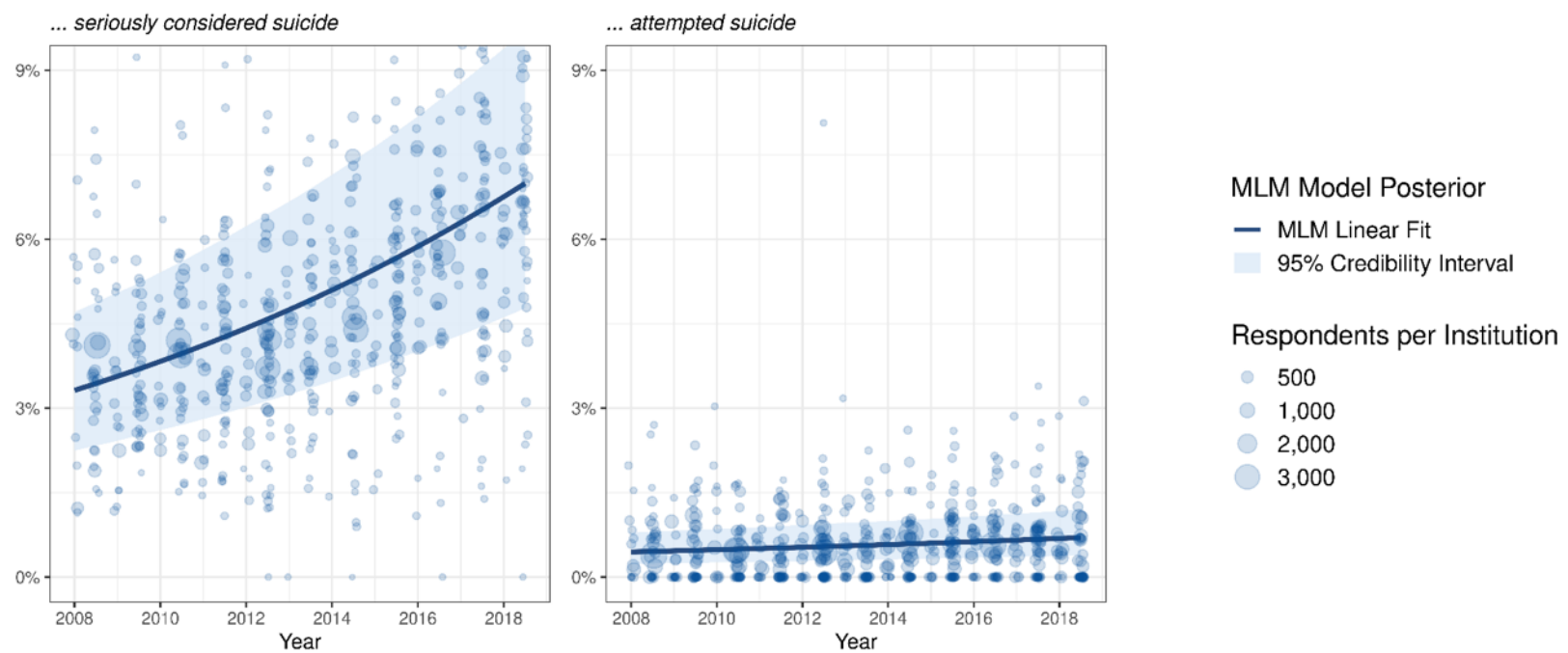


Note. Panels depict change over time in the percentage of U.S. graduate students who reported elevated emotional distress in the past two weeks. The points represent each participating school's percentage of students who reported the focal distress in a given panel and they vary in size based on the number of participating graduate students from the institution at each survey time point. The shaded region represents the 95% posterior credibility interval around the model-estimated change over time, which is captured by the dark blue line in each panel.

Figure 2

Trends in Suicidality

Percentage of graduate students who, in the past year..

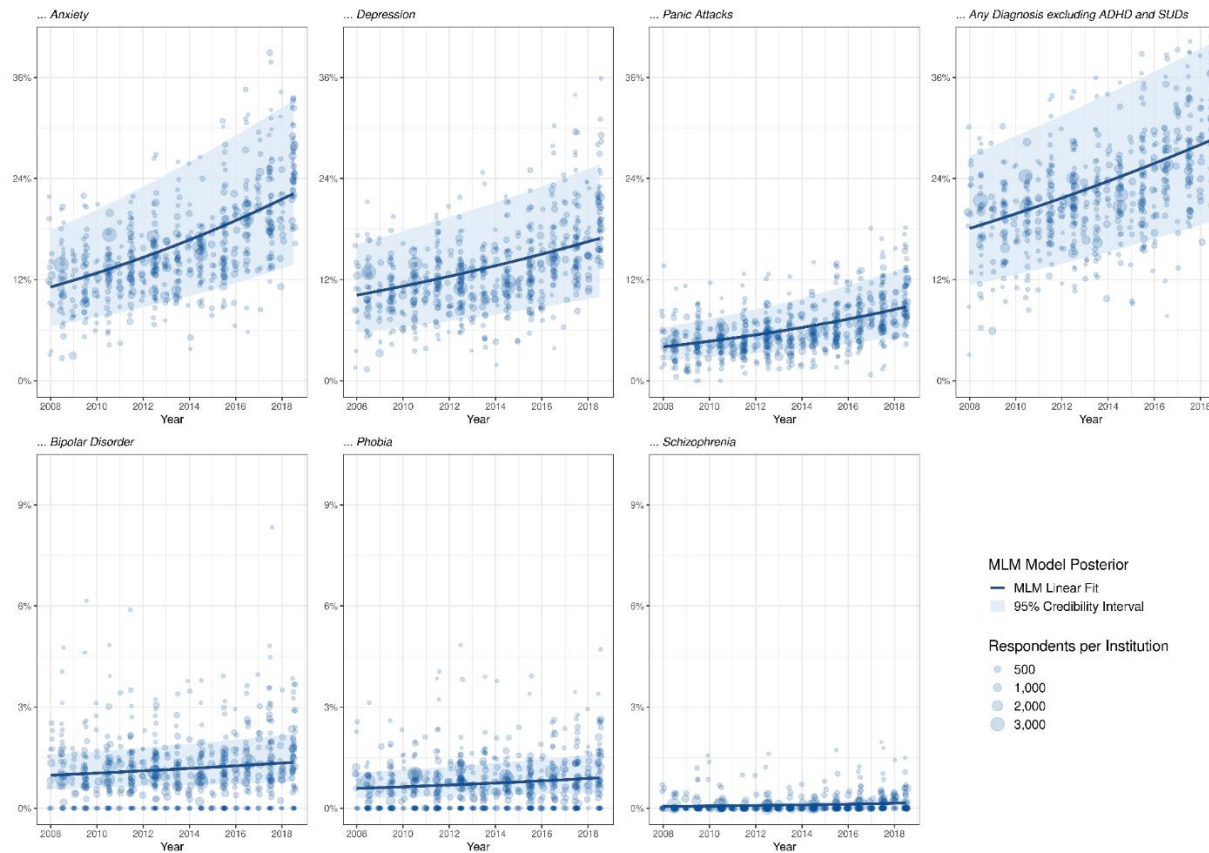


Note. Panels depict change over time in the percentage of U.S. graduate students who were either seriously considered or attempted suicide in the past year. The points represent each participating school's percentage of students who reported thinking about or trying to commit suicide and they vary in size based on the number of participating graduate students from the institution at each survey time point. The shaded region represents the 95% posterior credibility interval around the model-estimated change over time, which is captured by the dark blue line in each panel.

Figure 3

Trends in Mental Health Diagnosis or Treatment

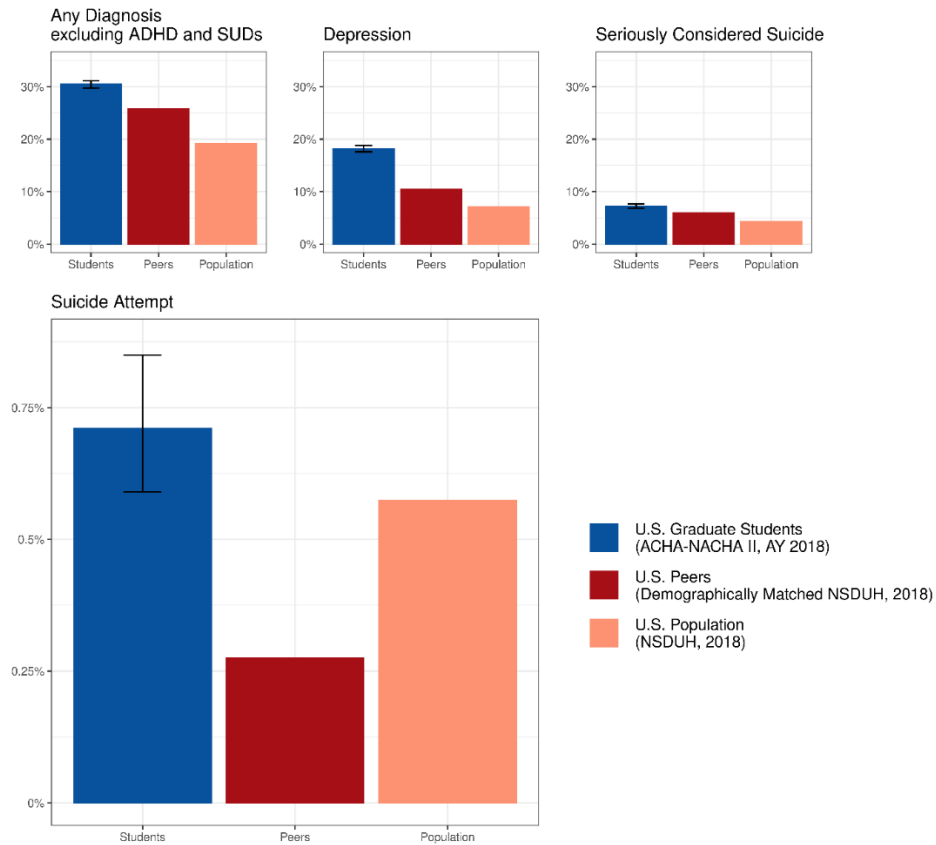
Percentage of graduate students who have been diagnosed or treated by a professional in the past year for...



Note. Panels depict change over time in the percentage of U.S. graduate students who were diagnosed with or treated for psychiatric disorders in the past year. The points represent each participating school's percentage of students with the focal disorder in a given panel and they vary in size based on the number of participating graduate students from the institution at each survey time point. The shaded region represents the 95% posterior credibility interval around the model-estimated change over time, which is captured by the dark blue line in each panel

Figure 4

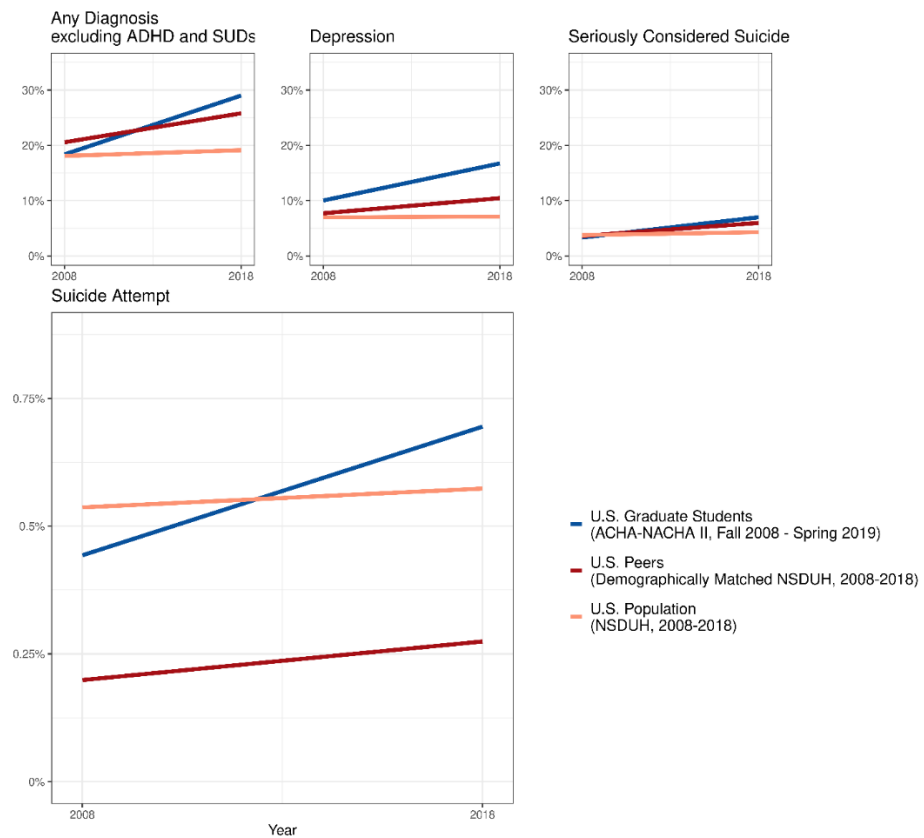
Prevalence of mental illness among U.S. graduate students, demographically matched peers, and the general population in 2018



Note. Panels compare U.S. Graduate Students' rate of mental health problems in the 2018 academic year to the rate of mental health problems in a demographically matched sample of U.S. peers in calendar year 2018. The rate of mental health problems for the U.S. population in calendar year 2018 is also provided as a second point of comparison. U.S. population comparison values, for demographically matched peers and overall, were generated from the National Survey of Drug Use and Health (NSDUH). Aggregated values leveraged existing NSDUH sampling weights to create more accurate estimates at the level of the U.S. population. U.S. Graduate Students' rates of mental health problems were based on the model posterior estimates. Error bars represent 95% credibility intervals around the overall rate for U.S. graduate students.

Figure 5

Change in prevalence of mental illness among U.S. graduate students, demographically matched peers, and the general population between 2008 and 2018



Note. Panels compare U.S. graduate students' changes in mental health problems from the 2008 academic year up through the 2018 academic year to changes in mental health problems in a demographically matched sample of U.S. peers, as well as to the U.S. population overall. U.S. population-based estimates were calculated from data collected for the National Survey of Drug Use and Health (NSDUH) during the 2008 and 2018 calendar years. Aggregated population values leveraged existing NSDUH sampling weights to create more accurate estimates. U.S. Graduate students' rates of mental health problems were based on the model posterior estimates.

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