

**Title:** Events and Behaviors Associated with Symptoms of Generalized Anxiety Disorder in First-year College Students

**Author list:** Laura S. P. Bloomfield, MD/PhD<sup>a,b,c,j\*</sup>, Mikaela I. Fudolig, PhD<sup>b,c</sup>, Peter Sheridan Dodds, PhD<sup>b,c,d,e</sup>, Jordan Llorin BS<sup>b</sup>, Juniper L. Lovato, MS<sup>b,c</sup>, Julia Kim, BA<sup>b</sup>, Ellen W. McGinnis, PhD<sup>f</sup>, Ryan S. McGinnis, PhD<sup>g</sup>, Matthew Price, PhD<sup>b,h</sup>, Taylor H. Ricketts, PhD<sup>a,i</sup>, Kathryn Stanton DPT<sup>b,c</sup>, and Christopher M. Danforth, PhD<sup>a,b,c,j</sup>

a Gund Institute for Environment, University of Vermont

b Vermont Complex Systems Center, University of Vermont

c MassMutual Center of Excellence in Complex Systems and Data Science

d Department of Computer Science, University of Vermont.

e Santa Fe Institute, New Mexico

f Department of Psychiatry, University of Vermont College of Medicine

g Department of Electrical and Biomedical Engineering, University of Vermont

h Department of Psychological Science, University of Vermont

i Rubenstein School of Environment and Natural Resources, University of Vermont

j Department of Mathematics & Statistics, University of Vermont

\*Corresponding author: [lbloomfi@uvm.edu](mailto:lbloomfi@uvm.edu)

## **Abstract**

### **Objective**

Identifying associations between individual characteristics, psychological history, academic stressors, and the trajectory of generalized anxiety disorder symptoms in a college cohort may provide insight into the design of mental health interventions.

### **Method**

We recruited first-year undergraduate students between the ages of 18-24 at a university in the northeastern United States. Following consent, enrolled participants completed surveys between October 21, 2022 - December 12, 2022 on self-reported exposures to potentially traumatic life events, mental health history, and stressors. The main outcomes of interest were the occurrence, persistence, development, and reduction in generalized anxiety disorder (GAD) symptoms using the Generalized Anxiety Disorder Questionnaire (GAD-7).

### **Results**

A previous anxiety disorder diagnosis was associated with occurrence (adjusted odds ratio [AOR], 2.10; 95% CI, 1.51-2.93), persistence (incidence rate ratio [IRR], 1.64; 95% CI, 1.29-2.09), and duration of GAD symptoms during the study (IRR, 2.90; 95% CI, 1.30-6.46). Prior exposure to traumatic life events was associated with the occurrence (AOR, 1.80; 95% CI, 1.28-2.52) and persistence of GAD symptoms (IRR, 1.36; 95% CI, 1.06-1.74). The presence of a test or project was associated with occurrence (AOR, 1.68; 95% CI, 1.42-1.98), persistence (IRR, 2.09; 95% CI, 1.43-3.04), and development of GAD symptoms (AOR 1.58, 95% CI, 1.30-1.92), and decreased the likelihood of GAD symptom reduction (AOR, 0.69; 95% CI, 0.56-0.86). The personality trait of emotional stability decreased the likelihood of occurrence (AOR, 0.60; 95% CI, 0.50-0.67), persistence (AOR, 0.90 95% CI, 0.65- 0.78), development (AOR, 0.84; 95% CI, 0.77-0.92), and reduction in GAD symptoms (AOR, 0.82; 95% CI, 0.75-0.88). The personality trait of extraversion also decreased the likelihood of GAD symptoms (AOR, 0.89; 95% CI, 0.83-0.95).

## Conclusion

These findings suggest that beginning college with a history of an anxiety disorder or prior exposure to multiple traumatic events increases the likelihood of occurrence and persistence of a GAD-7 score consistent with moderate-to-severe GAD symptoms. Personality traits also play a role in the occurrence and persistence of GAD symptoms, which may be important for personalizing psychological treatments. Academic stressors (i.e., a test or project), were significantly associated with the presence, persistence, development, and reduction in GAD-7 scores consistent with moderate-to-severe GAD symptoms.

## Key Words

College students; Mental Health; Generalized Anxiety Disorder; Personality Traits

## Introduction

Anxiety disorders are a leading cause of disability globally and affect one out of every three people in their lifetime (Bandelow & Michaelis, 2015). Generalized anxiety disorder (GAD), or the persistence of generalized anxiety symptoms for at least 6 months, affects 3.1% of the U.S. adult population (*COVID-19 and Mental Health: A Growing Crisis*, 2021), with many individuals first meeting the criteria for GAD in early adulthood (Rhebergen et al., 2017). GAD and other common mental health disorders, such as depression, are internalizing disorders that lead to emotional distress in response to life stressors and previous traumatic events (Nigatu et al., 2016; Weiss et al., 2011). Exacerbating these trends, clinically significant anxiety tripled during the COVID-19 pandemic due to increased uncertainty, social isolation, and other pandemic-related stressors (Asmundson et al., 2020), which intensified the declining mental health of young adults (Taylor et al., 2020).

Young adults suffer from anxiety disorders two times more often than the rest of the United States adult population, and their onset has been associated with poor academic outcomes, suicide risk, drug and alcohol misuse, and risky behaviors (Donovan & Spence, 2000). During young adulthood, psychological distress and anxiety symptoms are linked to worse career outcomes, adverse mental health outcomes, and poor well-being in later adulthood (Casey et al., 2022). In particular, the first year of college has been linked to common mental health disorders because it marks a transition from adolescence to adulthood, including changes in physical context, social context and increased independence (Arnett, 2000; Bernal-Morales et al., 2015; Smith et al., 2020). In a global study of college students, more than one-third reported a common mental health disorder during their first year, and one-tenth reported suicidal ideation (Auerbach et al., 2016). In another study, 40% of Bangladeshi university students suffered from symptoms of moderate-to-severe GAD (Faisal et al., 2022).

Stressful life events influence the onset and course of mental health disorders (Caspi et al., 1989) and are associated with an increased risk of anxiety disorders (McLaughlin et al., 2010). In particular, previous exposure to potentially traumatic life events has been associated with the development of anxiety disorders (Backholm & Björkqvist, 2012). Many young adults begin their college experience with a mental health diagnosis which has been associated with worsening mental health during this period (Lipson et al., 2022; Mahmoud, 2015). Longitudinal studies have shown that being female and having a lower socio-economic status increases the risk of developing internalizing disorders such as anxiety (Edgerton et al., 2019; Galambos et al., 2006; Stoolmiller et al., 2005).

Personality traits have also been linked to GAD as well as differences in stress response and recovery (Contrada & Baum, 2011). This association has been observed in students during the adjustment to college (Hirai et al. 2015). Additionally, individuals with higher levels of the personality traits Extraversion and Openness have shown higher levels of mental health deterioration associated with the COVID-19 pandemic, whereas those with higher Agreeableness were less affected (Proto & Zhang, 2021; Rettew et al., 2021).

Most estimates of the mental health burden for young adults are cross-sectional, and much less is known about the course of anxiety symptoms during the transition to college. In a recent study, students who had depression and anxiety at the beginning of college were less likely to recover from anxiety by the end of their first year (Adams et al., 2021). Small prospective naturalistic and treatment studies of

GAD have shown long durations, low rates of recovery, and high rates of recurrence (Mahmoud, 2015). Recent longitudinal studies have also shown that anxiety symptoms significantly change from one month to another (Amendola et al., 2021). These studies point to the importance of serial assessments in populations at risk, given that single-point measures are not a comprehensive picture of an individual's mental health.

The course of anxiety symptoms during the first year of college is not well understood, and thus opportunities for time-sensitive interventions may be missed. Suicide is among college students' leading causes of death, and students with underlying anxiety disorders are at increased risk (Casey et al., 2022). As suicidal ideation can fluctuate from week to week, frequent assessments may be useful in responding to changes in anxiety symptoms and addressing this population's mental health needs in a timely fashion. One reason that response measures are limited is that we do not fully understand the course of GAD.

The current study examined the course of moderate GAD symptoms in first-year college students during their first semester. This study addresses four questions to identify determinants of mental health that may inform college-based support and interventions in the future. We ask: (A) Which factors increase a first-year student's likelihood of experiencing anxiety symptoms during the first semester of college? (B) Which factors are associated with the persistence of anxiety symptoms during the first semester of college? (C) Which factors are associated with the development of anxiety symptoms from one week to another, and (D) Which factors are associated with a reduction in anxiety symptoms from one week to another? We use the term development to describe individuals reporting symptoms of anxiety consistent with a GAD-7 score  $<10$  and then reporting a GAD-7 score  $\geq 10$  in the following assessment. We use the term reduction to describe individuals reporting symptoms of anxiety consistent with a GAD-7 score  $\geq 10$  and then reporting a GAD-7 score  $<10$  the following assessment. These terms do not mean that it is the first time a participant has a GAD-7 score  $\geq 10$  nor that they have long-term recovery from anxiety symptoms if they have a GAD-7 score  $<10$ . A conceptual graphic is provided in the Supplemental Information ([Supplemental Information Figure S1](#)).

## **Methods**

### **Sample**

We conducted a longitudinal cohort study to analyze changes in mental health and well-being over the first semester of college. We recruited full-time, incoming first-year undergraduate students between the ages of 18-24 at a university in the northeastern US. Following consent, enrolled participants completed a baseline survey, and weekly surveys were administered through RedCap between October 21, 2022 - December 12, 2022. The study followed the Strengthening of Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines for cohort studies. All procedures were approved by the university Institutional Review Board.

### **Outcome**

The Generalized Anxiety Disorder Questionnaire (GAD-7) was used for assessing anxiety symptoms (Spitzer et al., 2006). The GAD-7 is a seven-item self-report scale where anxiety-defining items are rated on a 4-point Likert scale (0 = not at all to 3 = nearly every day), resulting in a composite score between 0 and 21. GAD-7 items describe salient features of anxiety (e.g., feeling on edge and worrying too much about different things). The GAD-7 has good reliability and validity in both clinical (Kroenke et al., 2007) and population-based samples (Amendola et al., 2021; Löwe et al., 2008) when validated against assessments by mental health professionals, which are considered the gold standard. Clinically significant symptoms refer to reported symptoms that exceed the threshold of moderate anxiety and a GAD-7 score  $\geq 10$  has been identified as the optimal point for sensitivity (89%) and specificity (82%) (Rutter & Brown, 2017). We also calculated the proportion of weeks for which participants who completed their survey had a GAD-7 score  $\geq 10$ . To ensure the reliability of participant responses to the GAD-7 measure, the Cronbach alpha was calculated in Stata/SE 17.0 using the alpha package (0.90). Though self-reported measures are not analogous to a confirmed diagnosis, they provide insight into the

trajectories of mental health for young adults in their first year of college, and the factors that influence these trajectories.

### **Covariates**

We collected information on the age, gender, race, and ethnicity of all participants at the time of enrollment. We also collected information on personality traits, mental health diagnoses, and history of exposure to potentially traumatic life events.

#### *The Ten Item Personality Inventory (TIPI; (Gosling et al., 2003)*

Personality traits describe the self-efficacy with which individuals appraise and cope with life challenges (Costa et al., 1995), which have been useful for understanding stress response and coping behaviors (David & Suls, 1999; McCrae & Costa Jr., 1989). The TIPI is a measure composed of 10 items to identify dimensions of the ‘Big Five,’ which is a widely recognized personality trait model (Kirton & De Ciantis, 1986). Each trait is represented by two items, one stated in a way that represents the positive pole of the dimension and the other stated in a way that represents the negative pole. Each item was scored from 1 (strongly disagree) to 7 (strongly agree). Five of the items are reverse scored to create a composite score. Each personality trait can be divided into low, moderate, and high for each trait based on population-established averages (Gosling et al., 2003).

#### *Mental Health History*

Participants were asked: “Do you have a history of an underlying mental health condition?” If participants selected “yes,” they were prompted to select from the following list of common mental health conditions: anxiety, depression, attention deficit hyperactivity disorder (ADHD), alcoholism, psychosis, delusions, anorexia or bulimia, post-traumatic stress disorder (PTSD), obsessive-compulsive disorder (OCD), bipolar disorder (BPD), panic attack disorder, or an emotional disorder. We created a binary variable to indicate a diagnosis of an anxiety disorder at the start of college.

### **Exposures**

#### *Trauma Exposure History*

The life events checklist (LEC) assesses the occurrence of major life events that a person has experienced, witnessed or learned about happening to someone close to them that are potentially traumatic. In our sample, the LEC was collected at baseline for all participants indicating events that occurred prior to the study. Though there are multiple ways in which LEC scoring is approached, we totaled items 1-16 that were endorsed as experienced only, in line with previous researchers (Gray et al., 2004; Reger et al., 2019). We then created an ordinal variable for traumatic exposures (i.e., 0 exposures, 1 exposure, and 2 or more exposures).

#### *Academic Stressor*

Participants were asked: “Was there an event or events this week that were particularly stressful?” Participants were then asked to characterize the nature of the stressful event (i.e., social, romantic, familial, financial, academic, physical, or mental). If the event was characterized as academic, participants were asked whether they had a test or project due in the last week. Participants who indicated that they had a test or project due in the previous week were assigned a value of 1; those who did not were assigned a value of 0.

### **Statistical Analysis**

Data were analyzed from December 2022 - May 2023. Time invariant predictors included gender, race, personality traits, having a previous diagnosis of an anxiety disorder, and exposure to potentially traumatic life events (LEC). Time varying predictors included the week of the semester and exposure to weekly academic stressors (i.e., tests and projects).

We analyzed the panel data with four different models to address the research questions. First, we used a generalized estimating equation (GEE) to assess the occurrence of moderate GAD symptoms (GAD-7 score  $\geq 10$ ). Our model used a binomial distribution and a log link function with an exchangeable correlation structure which assumes that two observations from the same participant were correlated irrespective of their time apart.

Second, we investigated which factors influenced the persistence of GAD over the course of the study. To model the proportion of weeks for which participants met the threshold for moderate anxiety, we used a zero-one inflated beta regression model to account for excess zeros and ones. We included participants who completed at least three out of seven weekly surveys and had complete demographic data ( $n=539$ ) and calculated the proportion of weeks during which they reported symptoms of moderate anxiety (GAD-7  $\geq 10$ ). Third, we created an outcome variable for those who reported symptoms of moderate anxiety (GAD-7  $\geq 10$ ) for all weeks of participation. We used a logistic regression model to model this outcome.

Fourth, we assessed changes in GAD symptoms between weeks. For those participants who endorsed no or minimal symptoms one week (GAD  $< 10$ ) and then symptoms consistent with moderate GAD (GAD-7  $\geq 10$ ) the following week, we designated the development of moderate GAD (GAD+). Conversely, for participants who had symptoms consistent with moderate GAD one week (GAD  $\geq 10$ ) and then no or minimal symptoms of moderate GAD the following week (GAD  $< 10$ ), we designated a reduction in moderate GAD (GAD-). To model these changes, we used a GEE with a logit link and binomial family for each of these outcomes: development and reduction from one week to another.

## Results

There were 605 eligible participants who completed the baseline survey. 89% ( $n=539$ ) of participants completed at least three surveys and had complete demographic data, and 52% ( $n=287$ ) of participants completed all weeks of the survey. We included all participants in our analysis who had completed baseline demographic information and at least three surveys for a total of 3,318 survey responses. Our sample included 20% of the first-year class and was representative of the study population - 65% ( $n=354$ ) of participants were female and 87% ( $n=473$ ) of participants were white (Table 1). Like national estimates (Pew Research Center, 2022), 6% ( $n=35$ ) of our sample population identified as a gender different than their assigned sex at birth (i.e., non-binary, genderfluid, and transgender). Data were missing at random and no covariates were associated with higher attrition rates or lower response rates ([Supplemental Information Table S1](#)).

The average GAD-7 score was 6.49 ( $SD=5.33$ ). Participants with a mental health diagnosis, a history of exposure to potentially traumatic life events, and having an academic stressor (i.e., project or test) had higher average GAD-7 scores at all weeks of the semester (Figure 2).

### Occurrence of moderate anxiety symptoms

In our population, 51% ( $n=275$ ) of participants reported GAD-7 score  $\geq 10$  at least once during the study. Of participants who had no previous diagnosis of an anxiety disorder, 40% (122/331) reported moderate symptoms of GAD at least once during the first semester compared to 75% (153/210) of participants with a previous diagnosis of an anxiety disorder. Similarly, of those without a previous anxiety disorder diagnosis, 14% (46/331) reported severe symptoms of GAD at least once during the first semester compared to 41% (87/210) of those with a previous diagnosis.

The GEE logistic regression revealed that higher levels of extraversion and emotional stability are associated with decreased likelihood of moderate GAD symptoms. Higher levels of agreeableness, a mental health diagnosis,  $LEC \geq 2$ , and having a test or project significantly increased the likelihood of GAD symptoms at the population level (Table 1). For each unit increase in extraversion, the likelihood of GAD symptoms decreased by 18.5%. For a one-unit increase in emotional stability, the likelihood of GAD decreased by 39.6% ( $p < 0.01$ ). Individuals with a mental health diagnosis had 2.23 times the odds of reporting GAD compared to those without a diagnosis ( $p < 0.01$ ). Individuals who have experienced

multiple potentially life events have 2.07 the odds of reporting GAD ( $p < 0.01$ ). Individuals with a test or project in the preceding week were 2.12 times more likely to have a GAD-7 score consistent with moderate anxiety symptoms ( $p < 0.01$ ) (Table 1).

### **Persistence of moderate anxiety scores**

We calculated the proportion of weeks for which participants who completed their survey scored above the GAD-7 cut-off for moderate and severe anxiety. 9% (43/541) of participants had moderate anxiety ( $GAD \geq 10$ ) at all time points and 3% (13/541) of participants had severe anxiety for all completed surveys. 49% (275/541) of participants never reported GAD-7 scores consistent with moderate anxiety symptoms and 76% (421/541) of participants never reported symptoms consistent with severe anxiety. There was a statistically significant relationship between the initial anxiety score and final anxiety score ( $\chi^2 = 33.21, p = 0.000$ ). We also created a group of participants for which their GAD-7 scores  $\geq 10$  for all assessments.

A one-unit increase in extraversion was associated with a decrease in the probability that a participant had  $GAD-7 \geq 10$  for all weeks of participation ( $p < 0.001$ ). A one-unit increase in emotional stability was associated with a decrease in the expected proportion of weeks for which a participant had  $GAD-7 \geq 10$  ( $p < 0.01$ ). A one-unit increase in emotional stability was also associated with a decrease in the probability that a participant had  $GAD-7 \geq 10$  for all weeks of participation ( $p < 0.001$ ). Having a previous anxiety diagnosis was associated with a 2.90 increase in the probability that a participant had  $GAD-7 \geq 10$  for all weeks of participation ( $p < 0.001$ ). Having experienced multiple potentially traumatic life events was associated with a 2.09 increase in the expected proportion of weeks for which a participant had  $GAD-7 \geq 10$ , holding all other predictors constant ( $p < 0.05$ ). For each additional week with an academic stressor, there is a 28% increase in the expected number of weeks with moderate anxiety ( $p < 0.01$ ).

### **Development of and reduction in moderate anxiety symptoms**

20% (562/2772) of responses from participants increased from GAD-7 score  $< 10$  to GAD-7 score  $\geq 10$  (GAD+). GAD+ was significantly associated with the personality trait of emotional stability ( $p < 0.001$ ), having a test or project ( $p < 0.001$ ), and the week of the study ( $p < 0.1$ ) (Table 3). For each one-unit increase in emotional stability, the odds of GAD+ decreased by a factor of 0.84. Having a test or project due was associated with an increased likelihood of GAD+ by 1.58 compared to those who did not have a test or project (Table 3a).

Additionally, 20% (560/2783) of responses from participants decreased from GAD-7 score  $\geq 10$  to GAD-7 score  $< 10$  from one survey assessment to the next (GAD-). Similar to GAD+, GAD- was significantly associated with the personality trait of emotional stability ( $p < 0.001$ ) and an academic stressor ( $p < 0.001$ ). Additionally, a history of two or more potentially traumatic life events and the week of the study was associated with GAD- ( $p < 0.001$ ) (Table 3b). When observing transitions (GAD+ or GAD-) between weeks of the survey, the majority of participants were GAD+ or GAD- (Figure 3a). These transitions are clear at the participant level when assessing changes in GAD-7 scores (Figure 3b).

We performed a series of sensitivity analyses for our models. For the occurrence model, we also ran the regression with an autoregressive correlation structure which assumes that observations closer in time are more highly correlated than those that are far apart ([Supplemental Information Table S2](#)). The results were similar between both models. These results were consistent for GAD-7 scores as a continuous outcome using a gamma distribution ([Supplemental Information Tables S3 and S4](#)) and using mixed-effects multilevel regression models ([Supplemental Information Tables S5 and S6](#)) due to the skewed distribution of GAD scores ([Supplemental Information Figure S2](#)).

For the persistence models, we also used a two-part hurdle model, an ordinal regression model, and a logit transformation ([Supplemental Information Tables S7, S8, S9, and S10](#)) to assess the influence on individual characteristics and events on GAD symptoms.

## Discussion

Over 60% of young adults (ages 18-24) in the United States are at risk for depression and anxiety; a quarter of these adults report considering suicide in the last month (Czeisler et al., 2020) illustrating the critical importance of addressing declining mental health for young adults in the United States (Twenge et al., 2019). Though ample evidence supports the growing prevalence of mental health disorders among young adults, the factors that increase the occurrence, persistence, development, and recovery of their symptoms is not clear.

To our knowledge, this is the first large-scale study investigating predictors of clinically relevant levels of anxiety serially during the first semester of college after the end of COVID-19 restrictions. While other studies have looked at the development of anxiety over the course of the first semester or the first year of college (Adams et al., 2021; S. P. Becker et al., 2018), higher temporal resolution in anxiety symptom changes have not been well described. A recent study on emergence and recovery from clinically significant levels of anxiety for first year students measured the beginning and end of the freshmen year, but did not provide information on intermediate periods (Adams et al., 2021).

Consistent with the demographic composition of college students, nearly two-thirds of our participants were female. Female gender has been associated with a higher risk of anxiety in previous studies (Elmer et al., 2020; Naser et al., 2020), though other studies have found these differences insignificant (Cao et al., 2020; Zimmermann et al., 2020). Compared to female participants, male participants had significantly lower GAD-7 scores ([Supplemental Information Tables S2-S7](#)). The personality trait of emotional stability was significantly associated with study outcomes (Tables 1-3), indicating that this individual trait may be linked to anxiety symptoms. In our cohort, those with a history of anxiety disorder diagnosis had a significantly higher likelihood of GAD symptoms (Table 1) and persistence of GAD through all weeks of the study (Table 2b) and lower likelihood of reduction (GAD-) (Table 3b). Those with  $LEC \geq 2$  had significant association with occurrence of GAD symptoms (Table 1), persistence (Table 2a), and reduction in GAD symptoms (Table 3b). There was an effect of the study week on GAD symptom development and reduction (Table 3).

When evaluated at only the first and final weeks of the study, more than three-quarters of students did not move below or above the anxiety threshold revealing the persistence in anxiety for many participants. There was a statistically significant relationship between the initial anxiety score and final anxiety score ( $\chi^2 = 33.21, p = 0.000$ ). Analyzing GAD scores at only the beginning and end of a study period may neglect important transitions in well-being for a substantial proportion of the population.

When pooled across the study, the prevalence of anxiety in our sample is consistent with previous samples of university students (Chi et al., 2020; Faisal et al., 2022; Naser et al., 2020; Perz et al., 2022; Savitsky et al., 2020; Wang & Zhao, 2020). Importantly, which participants met the cut-off for moderate to severe anxiety changed throughout the course of the semester (Figure 3). More than half of participants (51%) remained below the threshold of GAD for the entire semester, the other half varied between presenting clinically significant symptoms of GAD and lack thereof depending on the week. In all weeks of the study, except for the week of Thanksgiving break, the majority of participants transitioned from a GAD-7 score  $< 10$  to a GAD-7 score  $\geq 10$  (GAD+) or moved from GAD-7 score  $\geq 10$  to a GAD-7  $< 10$  (GAD-) (Figure 3a). These transition proportions are further reflected by individual trajectories of participants in their GAD-7 scores (Figure 3b).

The findings of this study should be interpreted with some limitations in mind. The use of self-report measures could lead to increased risk of social desirability response bias. There is also the potential for repeated administration of the self-report measure to lead to decreased reporting of anxiety. Overestimation of the proportion of participants with a previous diagnosis of anxiety disorder and traumatic experiences could be present if the event happened far in the past, however, reporting of salient experiences is not as affected by recall bias and these events are often under-reported. An imbalance between the number of female participants and male participants and those who do not ascribe to either of these binary descriptions was present. Gender imbalance is not uncommon in survey-based research and is consistent with current undergraduate student populations. There may be some limitations in the generalizability of the results outside of the university setting.

Despite these limitations, our study demonstrates the importance of higher temporal granularity in longitudinal studies on mental health in young adults. Though nearly half of our participants never reported symptoms consistent with moderate anxiety throughout the course of the first semester of college, the other half experienced at least one week of moderate to severe anxiety symptoms during the semester. With an increased focus of universities on the mental health and well-being of students, the advent and success of mobile assessments of stress, and the growing evidence for single time-point interventions, the utility of following young adults through a potentially turbulent period of their life holds promise for reducing mortality in this age and supporting long-term health.

## Conclusion

The transition to college poses increased risk for the onset and worsening of anxiety disorders. Within a cohort of first-year students, individual and psychological factors increase the likelihood for generalized anxiety disorder (GAD) symptoms during the first semester of college. Beginning college with a previous diagnosis of anxiety disorder and a history of multiple potentially traumatic exposures increased the likelihood of GAD during the first semester. Not only did these factors increase the likelihood of moderate anxiety during the semester, but they were significantly associated with measures of anxiety persistence. Unsurprisingly, the reported occurrence of a test or project in the preceding week greatly influenced the likelihood of the occurrence, the persistence, development, and reduction in GAD symptoms from one week to another. Identifying which traits and exposures make first-year students more vulnerable to experiencing GAD symptoms and their shifts will inform more targeted interventions to improve mental health in young adults.

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## Tables and Figures

**Table 1. Occurrence of Clinically Significant GAD symptoms During the Study (N=3,311).** A Generalized Estimating Equation was used to model the presence of GAD-7 scores as a binary outcome using a binomial distribution, log link function, and exchangeable correlation structure.

		Sample	GAD-7 Score	GAD-7 $\geq$ 10		
<i>Time invariant predictors</i>		% (N)	Mean (SD)	Estimate (SE)	P-value	Odds Ratio (95% CI)
Gender	Female	66% (354)	7.07 (5.30)	<i>Reference</i>		
	Male	28% (151)	4.51 (4.68)	-0.30 (0.20)	0.135	0.74 (0.50, 1.10)
	Nonbinary/Transgender	6% (35)	8.71 (5.91)	0.32 (0.30)	0.273	1.38 (0.78, 2.44)
Race	White	88% (473)	6.55 (5.33)	<i>Reference</i>		
	Non-white	12% (66)	6.20 (5.34)	-0.11 (0.26)	0.677	0.89 (0.54, 1.47)
Personality Trait	Extraversion	-	-	-0.19 (0.05)	0.001***	0.83 (0.75, 0.92)
	Emotional Stability	-	-	-0.54 (0.07)	0.000***	0.58 (0.50, 0.67)
	Agreeableness	-	-	0.18 (0.08)	0.020**	1.20 (1.03, 1.39)
Anxiety Diagnosis	No	61% (331)	5.01 (4.52)	<i>Reference</i>		
	Yes	39% (210)	8.85 (5.66)	0.68 (0.17)	0.000***	2.10 (1.51, 2.93)
Life Events Checklist	LEC = 0	37% (202)	5.30 (4.90)	<i>Reference</i>		
	LEC = 1	28% (151)	6.08 (4.83)	0.15 (0.20)	0.444	0.94 (0.64, 1.39)
	LEC $\geq$ 2	35% (188)	7.95 (5.77)	0.77 (0.19)	0.001***	1.80 (1.28, 2.52)
<i>Time varying predictors</i>						
	Week of Study	-	-	-0.03 (0.02)	0.206	0.98 (0.94, 1.02)
	Academic stressor	-	-	-0.37 (0.11)	0.000***	1.68 (1.42, 1.98)
	Constant	-	-	-0.30 (0.31)	0.691	1.42 (0.52, 3.88)

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

**Table 2. Persistence of Clinically Significant GAD symptoms During the Study (N=539).** Persistence was measured by (2a) the proportion of weeks for which GAD -7  $\geq$  10 using a Zero-One Inflated Beta Regression Model and (2b) participants for which GAD-7  $\geq$  10 for all weeks of participation using a Logistic Regression Model.

	(2a) Proportion of weeks with GAD-7 $\geq$ 10				(2b) GAD-7 $\geq$ 10 for all weeks of participation			
<i>Time invariant predictors</i>	Mean (SD)	Estimate (SE)	P-value	(95% CI)	% (N)	Estimate (SE)	P-value	Odds Ratio (95% CI)
Gender								
Female	0.29 (0.34)	<i>Reference</i>			9% (31)	<i>Reference</i>		
Male	0.15 (0.27)	-0.09 (0.15)	0.528	0.82 (0.61, 1.10)	5% (7)	0.10 (0.42)	0.817	1.20 (0.45, 3.16)
Nonbinary/Transgender	0.41 (0.34)	0.22 (0.15)	0.284	1.25 (0.92, 1.68)	14% (5)	0.30 (0.46)	0.507	1.43 (0.45, 4.49)
Race								
White	0.26 (0.33)	<i>Reference</i>			8% (36)	<i>Reference</i>		
Non-white	0.23 (0.34)	-0.19 (0.19)	0.322	0.95 (0.68, 1.34)	11% (7)	0.42 (0.43)	0.324	2.04 (0.75, 5.55)
Personality Trait								
Extraversion	-	-0.07 (0.04)	0.096	0.90 (0.85, 0.96)	-	-0.32 (0.10)	0.001***	0.66 (0.51, 0.84)
Emotional Stability	-	-0.13 (0.06)	0.022**	0.72 (0.65, 0.78)	-	-0.59 (0.15)	0.000***	0.47 (0.33, 0.67)
Agreeableness	-	0.07 (0.05)	0.151	1.11 (1.01, 1.22)	-	0.25 (0.16)	0.118	1.43 (1.02, 1.99)
Anxiety Diagnosis								
No	0.16 (0.26)	<i>Reference</i>			3% (9)	<i>Reference</i>		
Yes	0.42 (0.37)	0.50 (0.12)	0.231	1.64 (1.29, 2.09)	16% (34)	1.07 (0.41)	0.004***	3.46 (1.30, 6.46)
Life Events Checklist								
LEC = 0	0.19 (0.30)	<i>Reference</i>			6% (13)	<i>Reference</i>		
LEC = 1	0.24 (0.33)	0.06 (0.13)	0.012**	1.06 (0.81, 1.38)	5% (8)	-0.37 (0.41)	0.364	0.63 (0.31, 1.49)
LEC $\geq$ 2	0.35 (0.35)	0.31 (0.13)	0.022**	1.36 (1.06, 1.74)	12% (22)	0.15 (0.35)	0.678	1.30 (0.57, 2.31)
<i>Time dependent predictors</i>								
Academic stressor (Proportion of weeks)	-	0.74 (0.19)	0.002***	2.09 (1.43, 3.04)	-	0.69 (0.62)	0.264	2.56 (0.60, 6.63)
Constant	-	-0.81 (0.35)	0.221	0.44 (0.23, 0.88)	-	-1.39 (1.18)	0.240	0.35 (0.02, 2.53)

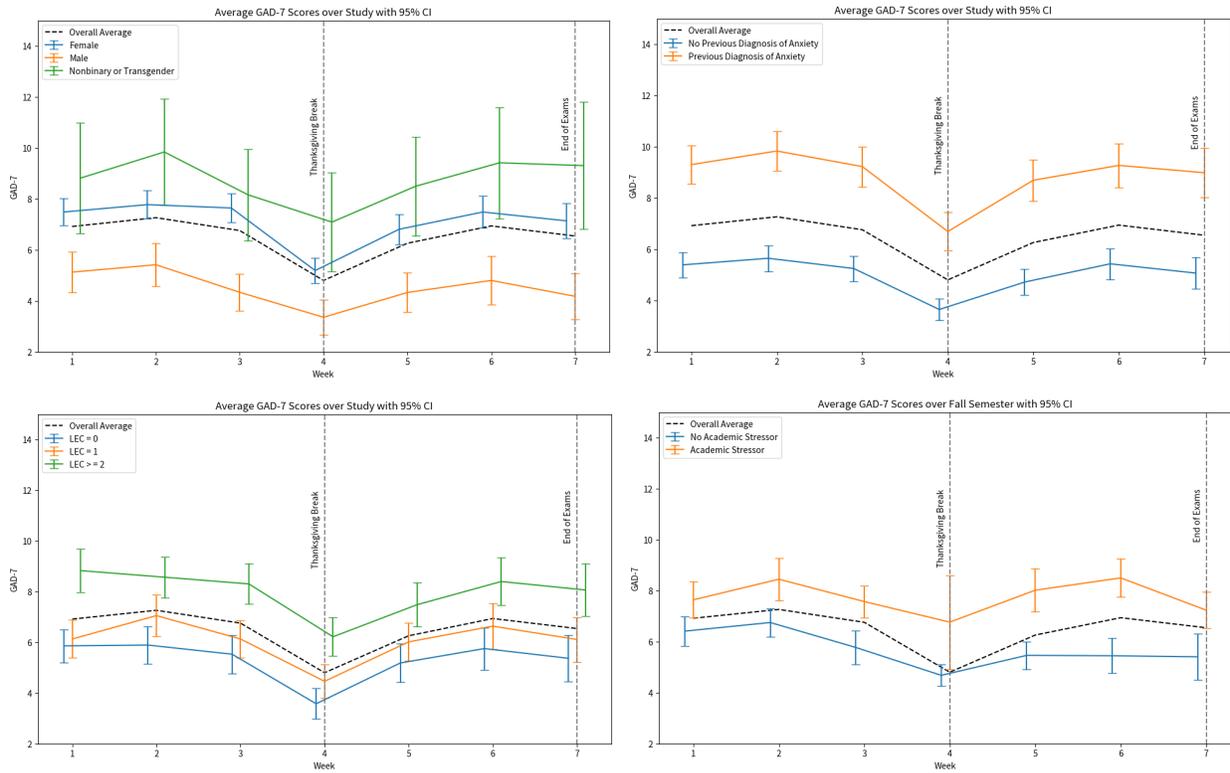
\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

**Table 3. Development and Reduction in Clinically Significant GAD Symptoms During the Study.** Generalized Estimating Equations were used to quantify processes that affected the (3a) development (GAD+) and (3b) reduction (GAD-) of anxiety symptoms.

		(3a) GAD +				(3b) GAD-			
<i>Time invariant predictors</i>		% (N)	Estimate (SE)	P-value	(95% CI)	% (N)	Estimate (SE)	P-value	Odds Ratio (95% CI)
Gender									
	Female (n=1854)	22% (408)	Reference			21% (398)	Reference		
	Male (n=741)	16% (119)	-0.22 (0.12)	0.063*	0.80 (0.64, 1.01)	18% (132)	-0.10 (0.12)	0.373	0.90 (0.72, 1.13)
	Nonbinary/Transgender (n=183)	18% (33)	-0.24 (0.18)	0.162	0.79 (0.56, 1.11)	20% (36)	-0.20 (0.19)	0.295	0.83 (0.57, 1.19)
Race									
	White (n=2424)	21% (500)	Reference			21% (499)	Reference		
	Non-white (n=353)	17% (60)	-0.22 (0.14)	0.121	0.80 (0.61, 1.06)	19% (67)	-0.10 (0.15)	0.500	0.90 (0.68, 1.20)
Personality Trait									
	Extraversion	-	0.03 (0.03)	0.300	1.03 (0.97, 1.10)	-	0.04 (0.03)	0.226	1.04 (0.98, 1.11)
	Emotional Stability	-	-0.17 (0.04)	0.000***	0.84 (0.77, 0.92)	-	-0.20 (0.04)	0.000***	0.82 (0.75, 0.88)
	Agreeableness	-	0.02 (0.04)	0.306	1.04 (0.96, 1.12)	-	0.02 (0.04)	0.756	1.01 (0.96, 1.12)
Anxiety Diagnosis									
	No (n=1703)	19% (319)	Reference			19% (317)	Reference		
	Yes (n=1075)	21% (243)	0.12 (0.11)	0.791	1.02 (0.83, 1.26)	23% (250)	0.04 (0.10)	0.689	1.02 (0.93, 1.10)
Life Events Checklist									
	LEC = 0 (n=935)	19% (176)	Reference			18% (171)	Reference		
	LEC = 1 (n=844)	20% (169)	-0.03 (0.12)	0.817	0.97 (0.77, 1.23)	20% (165)	-0.05 (0.12)	0.659	1.05 (0.83, 1.33)
	LEC ≥ 2 (n=1004)	22% (217)	0.07 (0.11)	0.529	1.07 (0.86, 1.34)	23% (231)	0.23 (0.11)	0.043**	1.25 (1.01, 1.56)
<i>Time varying predictors</i>									
	Week of Study	-	-0.04 (0.02)	0.080*	0.96 (0.91, 0.99)	-	-0.09 (0.03)	0.001***	0.92 (0.87, 0.97)
	Academic stressor	-	0.46 (0.10)	0.000***	1.58 (1.30, 1.92)	-	-0.37 (0.11)	0.001***	0.69 (0.56, 0.86)
	Constant	-	-0.93 (0.33)	0.005***	0.40 (0.21, 0.76)	-	-0.30 (0.31)	0.335	0.74 (0.40, 1.36)

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

**Figure 1. Weekly distribution of anxiety scores (GAD-7) by predictors.** 1a) Weekly average GAD-7 score by gender, 1b) Weekly average GAD-7 for those with and without a history of a diagnosis of an anxiety disorder. 1c) Weekly average GAD-7 for those with potentially traumatic life events (LEC = 0, no events; LEC = 1, one event; LEC  $\geq 2$ , at least two events), 1d) Weekly average GAD-7 for those with and without a test or project due in that week.



**Figure 2: Transitions in moderate anxiety symptoms at the study population and participant level.**  
 A) Transition matrix of participant trajectories of GAD-7 scores from week to week of the study. B) Heatmap of GAD-7 Scores over the study period.

