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Mental health trajectories in undergraduate students over the first year of university: a longitudinal cohort study

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ABSTRACT

Objective This study examined the association between candidate psychosocial and lifestyle variables and the trajectories of clinically significant anxiety and depressive symptoms from entry to completion of first-year university.

Design A longitudinal cohort study

Participants First-year undergraduate students

Methods We analysed the responses of 1686 first-year undergraduate students attending Queen's University who completed electronic surveys at both the beginning and completion of their academic year. Predictors of change in positive anxiety and depressive symptom screens (based on exceeding validated symptom threshold scores) were identified using logistic regression.

Results Increased university connectedness reduced the odds of emergent significant depressive and anxiety symptoms in healthy students and increased the odds of recovery in students who screened positive at the start of university. Students who screened positive for depression or anxiety at university entry were less likely to recover if they had a lifetime history of internalising disorders. Healthy students who increased their drug use over their first year had higher odds of developing significant levels of both anxiety and depressive symptoms by completion of the academic year.

Conclusions Moderate to severe levels of anxiety and depressive symptoms are common among students at entry to university and persist over the first year. University connectedness may mitigate the risk of persistent or emergent symptoms, whereas drug use appears to increase these risks. Findings have implications for university well-being initiatives.

INTRODUCTION

The transition to university coincides with the peak period for the onset of mental illnesses.[1 2] The majority (approximately 75%) of mental illnesses first appear in young adulthood, the most common being anxiety and depression, considered collectively as internalising disorders.[3] Internalising disorders refer to conditions that are directed or experienced inwardly and often include sadness, loneliness and anxiety. Mental health problems and distressing symptoms that fall short of a full-threshold diagnosis are more common over adolescence and young adulthood.[4]

Emergent adulthood (age 16–25) is a period of accelerated brain development, resulting in increased susceptibility to external stressors.[5] Moreover, it is a time of intensive psychosocial development and increased autonomy.[6] University students experience several risk factors for anxiety and depression, including financial pressure, moving away from family and established friendships, and adjusting to new ways of learning and academic demands.[7 8] However, flexible timetables and on-campus services facilitate access to professional support, and there is opportunity for students to create new social networks. Therefore, although the transition to university may be a high-risk period for the emergence of internalising symptoms and disorders, it also provides opportunities for resiliency and prevention.

Estimates of the prevalence of internalising disorders within student populations attending western universities centre at around 20%,[9–12] ranging from 10% to 84%, depending on the measures used.[13] In Canada and the UK, these figures appear to be on the rise.[14 15] Furthermore, on average,

the prevalence of internalising symptoms appears to increase steadily throughout the years of university.[16–19]

For both university students and the general population of the same age, certain demographic and lifestyle factors are associated with higher risks of internalising disorders, such as being female and of lower socioeconomic status (SES).[10 20–22] Alcohol and drug misuse are also associated with higher levels of internalising symptoms.[23–26] Early life adversities, such as parental divorce and abuse, have been linked to subsequent anxiety and depression in emerging adulthood across cultures, although research on students specifically is limited.[27–29] On the other hand, social support and university connectedness, defined as one's subjective feelings of integration to the university campus and the student body, have been identified as protective factors.[30–34]

Longitudinal studies conducted on community samples have identified associations with female sex, higher SES and greater social support and improvements in mental health across emergent adulthood.[35–37] On the other hand, problems with peers, drug use and parental history of depression appear to predict increases in depressive symptoms over time.[38] In students, specifically neuroticism, academic stress and social connectedness have been found to predict trajectories of adjustment.[39] However, as this study only considered international students, findings are not generalisable to the broader student population. Other studies have highlighted improvements in the mental health of students using professional support or interventions.[40 41]

Most research in university students has been limited by small, unrepresentative samples, driven by low participation rates and participation biases. Groups such as women and psychology students are often over-represented. Studies vary in how mental health outcomes are measured, impeding comparison across studies. Moreover, the majority of work is cross-sectional, meaning that one cannot infer the directionality of effects. Few studies distinguish between the emergence and maintenance of internalising disorders, though the mechanisms underlying these may differ. Cohen *et al.*[42] postulated a requirement for the identification of time-varying covariates of mental health trajectories in emerging adults; however, so far, there has been relatively little work of this nature in students.

Here, we examine the persistence and new onset of clinically significant levels of anxiety and depressive symptoms in a representative cohort of students over their first year. Clinically significant symptoms refer levels of symptoms that exceed the threshold for caseness for the relevant measure, thus indicating moderate to severe levels of symptoms that may constitute a disorder and ideally warrant assessment. However, this is not analogous to a clinical disorder or confirmed diagnosis. This study addressed two questions that can identify determinants and inform university support services moving forward.

1. In students who start university with moderate to severe anxiety and/or depressive symptoms, which factors are predictive of recovery over their first year?
2. In students who start university without clinical internalising symptom levels, which factors are predictive of the emergence of moderate to severe anxiety and/or depressive symptoms over their first year?

METHODS
Participants
The inclusion criteria were that participants were Queen's University students who began the first year of their undergraduate degree in September 2018. Queen's University is a large, research-based, public university in Kingston, Ontario, Canada. Students must have completed the relevant measure of internalising symptoms at time 1 and 2. Participants older than 25 were excluded, as there was not enough variation in age to include it as a factor. As a limited number of participants (25 out of a total of 3029 at time 1) self-identified as a gender other than male or female, these individuals were excluded from this analysis, as we were unable to include 'non-binary' as a category in the gender predictor variable due to limited power.

Procedure
The U-Flourish study protocol and methods have been published in detail elsewhere.[43–45] Briefly,

the survey explored factors previously associated with academic performance and mental health in student populations. The time 1 survey was launched 2 weeks into the first term of 2018, and the time 2 survey was launched in March 2019, 2 weeks prior to the start of the final examination period.

The survey was run on the Qualtrics survey platform. Students were emailed the link to participate and three reminder emails. A student-led media engagement campaign was run to maximise participation, which included appearances at fairs, presentations and talks (full details in Goodday *et al.*[43]). To incentivise participation, students were awarded CAD $5 in their university account, which could be used towards campus food, a pizza lunch and the chance to win one of 10 iPads on completion of both surveys.

Patient and public involvement statement
Students, student welfare clinicians and public health educators gave feedback on the questionnaires, which were adapted accordingly.

Materials
Dependent variables
Patient Health Questionnaire 9 (PHQ9): this measured the students' level of depressive symptoms on a scale from 0 to 27. There are nine statements pertaining to the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition's (DSM-V) core symptoms of depression[46] and patients report how often in the last 2 weeks this statement has applied to them on a scale of 0 (not at all) to 3 (nearly

every day). The threshold for significant symptoms was 10 or greater, whereas the reliable change threshold is 6. This measure has demonstrated both construct and criterion validity within both clinical and general population samples, when validated against gold-standard measures such as interviews with mental health professionals.[47 48]

Generalised Anxiety Disorder Questionnaire (GAD7): this measured the students' level of anxiety symptoms, resulting in a rating from 0 to 21. There are seven statements about pertaining to the DSM-V core symptoms of anxiety[46] and participants indicate how often they have experienced this in the last 2 weeks on a scale of 0 (not at all) to 3 (nearly every day). The threshold for significant symptoms is 10, whereas the reliable change threshold is 4. The GAD7 has been demonstrated to have good reliability and validity in both clinical and general population samples, when validated against gold-standard measures such as interviews with mental health professionals.[49 50]

To be classed as reliably recovered, an individual must have scored above the relevant symptom threshold for the appropriate measure at time 1, have scored below the symptom threshold at time 2 and demonstrated a decrease in symptoms that is greater than the reliable change threshold for that measure.[51] The reverse is true for the definition of reliable emergence. This accounts for natural symptom fluctuation, which is not indicative of an underlying change.

Students were split into groups according to the above scores at baseline. Those in group 1 were above the symptom threshold for clinically significant anxiety at time 1, whereas group 2 was below the threshold. Group 3 was above the symptom threshold for clinically significant depression at time 1, whereas group 4 was below the threshold.

Independent variables

For a detailed description of the independent measures, please see the published study protocol in this journal.[43]

Participants self-reported on the following:

Parental education was used as a proxy for SES, as it is a valid and reliable indicator and correlates highly with other measures such as parental income and occupation.[52 53] The highest level of parental education was numerically scored (data dictionary available on request).

A composite score was created for early life adversity. Occurrences of self-reported parental divorce, childhood sexual abuse, childhood physical abuse and bullying were coded as binaries and summed (if the response was 'don't know', this was reported as a non-occurrence). This resulted in a scale from 0 to 4. These factors have all been demonstrated to have reliable effects on students' mental health.[27–29]

The lifetime occurrence of mood or anxiety disorders was included as studies using general population samples have identified this as a critical risk factor for both anxiety and depression.[54 55]

University connectedness was measured using the school connectedness subscale of the College Student Wellbeing Scale.[56] This measures students' sense of belonging within the university campus and their peers.

The Social Support Subscale of the Resilience Scale for Adolescents was used to measure social support. This has high validity.[57]

Whether participants were currently receiving treatment for a mental health condition was coded as a binary.

The frequency of alcohol use was measured with a 5-point Likert scale, ranging from 0 (never) to 4 (4+times a week). The same Likert scale was used to establish the frequency of usage of non-prescribed sleeping pills, non-prescribed stimulants, cannabis, pain killers and opiates, psychedelics and other recreational drugs. These scores were summed to give a scale of drug usage ranging from 0 to 24.

The change in the above factors was calculated by subtracting the time 1 score from the time 2 score.

Statistical analysis

To ensure the validity of the GAD7 and PHQ9 as measures of anxiety and depression respectively, their Cronbach alphas were calculated in R V.4.0.1[58] using the psych package.[59] Additionally, both measures were correlated with participants' subjective mental health ratings.

Multiple imputations were used to replace the missing values using the mice package in R.[58 60]

Binary logistic regression was used for analysis. All assumptions were checked. Predictors were gender, SES, early life adversity, lifetime occurrence of internalising disorders, initial symptom severity, changes in the utilisation of support, university connectedness, changes in drug use, changes in alcohol use and changes in social support.

Logistic regressions were run on each of the groups using the glm function in R.[58] The logistic regression on group 1 predicted whether students who had significant anxiety symptoms at time 1 had recovered by time 2. The logistic regression used for group 2 predicted whether or not students who did not have significant anxiety symptoms at time 1 developed them by time 2. The design for group 3 was the same as for group 1, and group 4 was the same as group 2, but for depression rather than anxiety. These models resulted in adjusted ORs (AOR), which control for all of the predictors in the model.

The assumption of linearity with the logit was violated for the change in social support in group 1, and the initial GAD7 score in groups 1 and 2. Therefore, restricted cubic splines were used on these variables, using the rms package in R.[61] Where significant, ORs were calculated using the emmeans package.[62]

Critical values

Critical values within each data set were corrected using the Benjamini-Hochberg procedure.[63]

Ethics

Participants' responses were deidentified to ensure confidentiality. Participants were provided with a letter
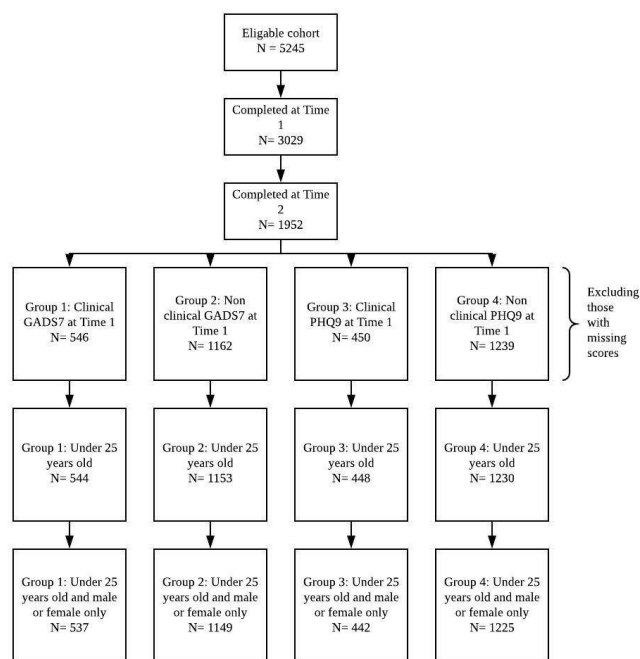
Figure 1 Flowchart for inclusion in the study and allocation to groups. GADS7, Generalised Anxiety Disorder Questionnaire; PHQ9, Patient Health Questionnaire 9.

of information outlining the experiment, the aims and how their data would be handled on the first pages of the surveys. Participants were told that they were able to skip questions or quit the questionnaire at any time. Before undertaking the survey, informed consent was obtained by participants clicking a box to indicate they understood the aforementioned details and were willing to participate.

RESULTS

Fifty-eight per cent of eligible students completed time 1 measures (3029 out of 5245) and 37% of the target population completed measures at both time points (1952, see figure 1). Between time 1 and time 2, there was a retention of 64%. The 36% that did not complete the time 2 questionnaire could include both those who dropped out of university and those who remained students but did not complete the second questionnaire. See table 1 for the demographics.

Both the GAD7 and PHQ9 were demonstrated to have high split-half validity, as indicated by their Cronbach's alphas (0.91 and 0.87, respectively). Moreover, both had significant correlations with subjective measures of participant's mental health (−0.56 for the GAD7 and −0.58 for the PHQ9).

Participant demographics are shown in table 1. Prior papers have assessed the degree to which the samples at both Time 1 and 2 represent the entire eligible cohort.[44 45] In summary, the respondents at time 1 were mainly similar to the eligible pool of first years. However,

they were more likely to be women (66% vs 58%; χ^2 p<0.01), slightly younger (mean 18.2 vs 18.5 years, p<0.01) and domestic Canadian students (90.1% vs 87.3%, χ^2 p<0.01). These differences were small. When compared with the time 1 sample, the time 2 sample was comparable in terms of age, lifetime history of mental illness and early life adversity. However, there were significantly more women (67% vs 74%; χ^2 p<0.01), fewer indigenous (0.3 vs 0%) and more mixed ethnicities (9.5 vs 12%; χ^2 for ethnicity overall p=0.03), fewer parents with professional or doctorate degrees (22% vs 12%; χ^2 p<0.01) and a higher rate of family mental illness (40% vs 44%; χ^2 p=0.02). Again, aside from the proportion of women, and parental education, these differences are generally small. This suggests that results are reasonably representative of the target population.

Changes in students' internalising scores are illustrated in the online supplemental materials. Stability is more common than change, and non-clinical levels of symptoms are more common than clinical levels of symptoms. At time 1, the rate of clinically significant anxiety symptoms in students was 32.1%, whereas for depressive symptoms, this was 26.7%. At time 2, this increased to 37.0% and 32.5%, respectively.

Group 1—predicting recovery in students beginning university with significant levels of anxiety
See tables 2 and 3 for the full results. The full model (including the non-linear effects for initial GAD7 and change in social support) was found to be a significantly better fit than the intercept only model ($\chi^2(10)=67.65$, p<0.001). Nagelkerke's R^2 indicated that the model explained 45% of the variation in clinical change, suggesting that the combination of the predictor variables explains the outcome fairly well.[64] In terms of the individual predictors, after the Benjamini-Hochburg correction, having a lifetime history of internalising disorders was significant (β=−1.01, p<0.001). Inverting the OR suggests that those who did not have a history of internalising disorders had 2.8 times higher odds of recovering from significant levels of anxiety symptoms (AOR=0.36, 95% CI 0.22 to 0.61). University connectedness was also significant (β=0.13, p<0.001), with an increase in one point on this scale corresponding to 1.14 times higher odds of recovery (AOR=1.14, 95% CI 1.08 to 1.20).

Group 2—predicting the development of clinically significant anxiety symptoms over first year
See tables 4 and 5 for the full results. The full model (including the non-linear effects for initial GAD7) was similarly a significant improvement over an intercept only model ($\chi^2(10)=97.01$, p<0.001). Nagelkerke's R^2 indicated that the model explained 58% of the variation in clinical change. Initial GAD7 scores significantly predicted the emergence of clinically significant levels of anxiety symptoms in participants who began university healthy ($\chi^2(2)=6.70$, p<0.001). The estimated ORs suggest that an increase in one point on the GAD7 from

Table 1 Sample demographics

	Total sample	Group 1 (+GAD7)	Group 2 (−GAD7)	Group 3 (+PHQ9)	Group 4 (−PHQ9)
Mean (SD)					
Age	18.0 (1.1)	18.0 (1.1)	18.0 (1.1)	18.0 (1.1)	18.1 (1.1)
Early life adversity	0.5 (0.8)	0.7 (0.8)	0.5 (0.7)	0.8 (0.9)	0.5 (0.7)
Socioeconomic status	5.2 (1.7)	5.0 (1.6)	5.1 (1.6)	4.9 (1.6)	5.1 (1.6)
University connectedness	15.8 (6.5)	15.7 (5.1)	17.9 (4.6)	15.0 (5.2)	18.0 (4.5)
Time 1 drug use	0.7 (1.8)	0.9 (2.1)	0.6 (1.5)	1.2 (2.7)	0.5 (1.2)
Time 2 drug use	1.3 (2.7)	1.6 (2.7)	1.3 (2.6)	1.8 (2.9)	1.2 (2.6)
Change in drug use	0.6 (2.8)	0.6 (2.9)	0.7 (2.4)	0.6 (2.9)	0.7 (2.5)
Time 1 alcohol use	1.7 (1.2)	1.7 (1.2)	1.7 (1.2)	1.8 (1.12)	1.7 (1.2)
Time 2 alcohol use	1.7 (1.1)	1.8 (1.1)	1.7 (1.1)	1.8 (1.1)	1.7 (1.1)
Change in alcohol use	−0.1 (1.0)	0.0 (1.0)	0.0 (1.0)	0.0 (1.0)	0.0 (1.0)
Time 1 social support	16.4 (3.9)	15.7 (3.9)	16.7 (3.9)	15.1 (4.0)	16.8 (3.8)
Time 2 social support	15.1 (5.5)	14.5 (5.4)	15.4 (5.5)	14.0 (5.3)	15.5 (5.5)
Change in social support	−1.2 (5.9)	−1.2 (5.6)	−1.3 (6.1)	−1.1 (5.7)	−1.3 (6.0)
Time 1 GAD7	7.6 (5.7)	14.5 (3.5)	4.3 (2.8)	13.2 (4.9)	5.4 (4.2)
Time 2 GAD7	8.5 (6.1)	12.4 (5.6)	6.6 (5.3)	12.8 (5.8)	6.9 (5.4)
Change in GAD7	1.0 (5.6)	−2.0 (5.5)	2.4 (5.1)	−0.4 (6.2)	1.5 (5.3)
Time 1 PHQ9	6.9 (5.7)	12.0 (5.7)	4.5 (3.6)	14.6 (4.2)	4.1 (2.8)
Time 2 PHQ9	8.6 (6.1)	12.0 (6.6)	6.9 (5.8)	13.7 (6.7)	6.7 (5.3)
Change in PHQ9	1.7 (5.6)	0.0 (6.3)	2.4 (5.2)	−0.9 (6.4)	2.6 (5.0)
Percentage					
Lifetime anxiety/depression	20.3	37.6	11.9	37.4	13.8
Female	72.0	84.4	67.5	69.7	81.0
White	65.6	66.9	65.7	63.2	67.1
Asian	18.9	16.2	20.7	18.5	19.6
Black	1.6	1.1	1.7	1.8	1.5
Other	13.9	15.8	11.9	16.5	11.8
Time 1 attended support	5.1	11.8	2.2	10.3	3.4
Time 2 attended support	6.8	15.1	3.2	14.7	4.3

Early life adversity, frequency of drug use and frequency of alcohol use scored from 0 to 4 (4 indicating higher levels).
Group 1 = clinically significant GAD7 score at time 1; Group 2 = no significant GAD7 score at time 1; Group 3 = clinically significant PHQ9 score at time 1; Group 4 = no significant PHQ9 score at time 1.
GADS7, Generalised Anxiety Disorder Questionnaire; PHQ9, Patient Health Questionnaire 9.

the mean results in a 1.17 times increases in the odds of significant symptom emergence (AOR=1.17, 95% CI=1.10 t0 1.25). However, an increase from the mean to the threshold of the GAD7 was not significant. University connectedness was also a significant predictor of emergent anxiety (β=−0.07, p<0.001). With every increase in one point in this scale, students had 1.06 times higher odds of maintaining non-significant anxiety symptoms (AOR=0.94, 95% CI 0.91 to 0.97). An increase in drug use was also a significant predictor (β=0.08, p=0.011). For every increase in one point on the drug use frequency measure, students had 1.08 times higher odds of developing clinically significant levels of anxiety symptoms (AOR=1.08, 95% CI 1.02 to 1.15). A change in therapy

attendance was also associated with the emergence of symptoms (β=1.55, p<0.001). Those who began attending therapy had 4.7 times higher odds of developing clinically significant anxiety symptoms (AOR=4.70, 95% CI 2.00 to 11.04).

Group 3—predicting recovery in students beginning university with significant levels of depression

See table 6 for the full results. The full model was a significant improvement over an intercept only model ($\chi^2(10)$=66.56, p<0.001). Nagelkerke's R^2 indicated that the model explained 46% of the variation in clinical change. Never having had a lifetime history of either depression or anxiety was a significant predictor of

Table 2 Logistic regression results for group 1

Predictors	ß value	SE	Wald value	P value	OR	95% CI
Gender	−0.08	0.30	−0.28	0.780	0.92	0.51 to 1.67
SES	0.01	0.07	0.21	0.831	1.01	0.86 to 1.16
Early life adversity	−0.01	0.15	−0.04	0.972	0.99	0.75 to 1.32
Lifetime disorder *	−1.01	0.26	−3.84	<0.001	0.36	0.22 to 0.61
University connectedness *	0.13	0.03	4.50	<0.001	1.14	1.08 to 1.20
Change in drug use	0.00	0.04	−0.01	0.992	1.00	0.92 to 1.09
Change in alcohol use	−0.19	0.12	−1.65	0.100	0.83	0.66 to 1.04
Change in support utilisation	−0.75	0.36	−2.08	0.038	0.47	0.23 to 0.96

R^2=0.45 (Nagelkerke). Model χ^2 (10)=67.65, p<0.001.
*Statistically significant once corrected for multiple comparisons using the Benjamini-Hochberg procedure.
SES, socioeconomic status.

recovery (β=−1.29, p<0.001). Inverting the OR suggests that those who have a lifetime history of internalising disorders have 3.7 times lower odds of recovering from clinically significant depressive symptoms by time 2 (AOR=0.27, 95% CI 0.13 to 0.56). University connectedness was also a significant predictor of recovery (β=0.16, p<0.001). For every increase of one point in the university connectedness measure, participants had 1.18 times higher odds of recovering from clinically significant levels of depressive symptoms (AOR=1.18, 95% CI 1.10 to 1.26).

Group 4—predicting the development of clinically significant depressive symptoms over first year

See table 7 for the full results. The full model was significantly more discriminative than the intercept-only model (χ^2(10)=100.74, p<0.001). The model explained 59% of the variation in outcomes. University connectedness was a significant predictor of the emergence of significant levels of depressive symptoms in participants who began university healthy (β=−0.11, p<0.001). For every increase of one point on the university connectedness scale, participants had 1.06 times lower odds of developing significant levels of depressive symptoms (AOR=0.90, 95% CI 0.87 to 0.93). Change in drug use was also a statistically significant predictor (β=0.15, p<0.001). For every increase in one point on the change in drug use scale, participants had 1.16 times higher odds of developing clinically significant levels of depressive symptoms (AOR=1.16, 95% CI 1.09 to 1.23).

Table 3 Restricted cubic spline results for group 1

	L.R. χ^2	df	P value
Initial GAD7	4.42	2	0.110
Change in social support	3.36	2	0.187

*Statistically significant once corrected for multiple comparisons using the Benjamini-Hochberg procedure
df, Degrees of freedom; GADS7, Generalised Anxiety Disorder Questionnaire; L.R., Likelihood ratio.

DISCUSSION

To our knowledge, this is the first large-scale study investigating predictors of both the recovery from and emergence of clinically significant levels of anxiety and depressive symptoms in undergraduate students from entry to the completion of their first academic year.

At entry to university, 32% of students reported moderate to severe anxiety symptoms, and 27% of students reported moderate to severe depressive symptoms. By March of the first year, these rates increased to 37% and 33%, respectively. These findings are broadly consistent with existing research.[11 13 65 66] Differences in published rates may be due to the use of different outcome measures, symptom thresholds or differences in the student populations and experience across institutions and countries.

In terms of the trajectories of internalising symptoms, this study found that stability was more common than change, and clinically non-significant levels (below screening thresholds) were much more common than significant levels. This is consistent with prior findings on depression in general population samples.[37 38] The increase in the prevalence of significant internalising symptoms from entry to completion of first year is also consistent with the available longitudinal research.[16–19]

The most notable predictor of internalising symptom trajectories was university connectedness, which is predictive of recovery and associated with lower odds of emergence of significant levels of depressive and anxiety symptoms. This is consistent with prior reports, despite the use of varying measures of school connectedness and mental health across studies.[33 34 67] University connectedness has been shown to moderate the link between perceived stress and depression, but not anxiety, suggesting a possible mechanism for the emergence of new symptoms.[33] One aspect of university connectedness encompasses one's relationship with their peers. Other students can provide instrumental support, such as help with academic work, and emotional support, both of which may reduce stress. Moreover, socialising and getting involved with events, activities and sports on campus may

Table 4 Logistic regression results for group 2

Predictors	ß value	SE	Wald value	P value	OR	95% CI
Gender	0.18	0.19	0.95	0.314	1.2	0.83 to 1.74
SES	−0.04	0.05	−0.75	0.454	0.96	0.87 to 1.06
Early life adversity	0.23	0.11	2.03	0.042	1.26	1.01 to 1.56
Lifetime disorder	0.30	0.24	1.26	0.207	1.35	0.85 to 2.15
University connectedness *	−0.07	0.02	−3.85	<0.001	0.94	0.91 to 0.97
Change in drug use *	0.08	0.03	2.56	0.011	1.08	1.02 to 1.15
Change in alcohol use	−0.12	0.09	−1.36	0.173	0.89	0.75 to 1.05
Change in social support	−0.02	0.01	−1.57	0.117	0.98	0.95 to 1.01
Change in support utilisation*	1.55	0.43	3.56	<0.001	4.70	2.00 to 11.04

R^2=0.58 (Nagelkerke). Model χ^2 (10)=97.01, p<0.001.
*Statistically significant once corrected for multiple comparisons using the Benjamini-Hochberg procedure.
SES, socioeconomic status.

provide an important outlet and coping mechanism and build resilience.[68] This finding is especially pertinent given the COVID-19 crisis, which has resulted in considerable reductions in person-to-person contact and recreational and leisure opportunities for students.

After university connectedness was taken into account, changes in social support were not found to be significant predictors in any of the models. This may be due to a high degree of overlap between these two variables. Although the variance inflation factor in our assumption checks indicated there were acceptable levels of multicollinearity, previous work has highlighted an association between university connectedness and perceived social support.[69] Furthermore, in exploratory analyses, when university connectedness was removed from the model, changes in levels of reported social support were found to significantly predict the emergence of clinically significant depressive and anxiety symptoms.

In this study, an increase in drug use was a risk factor for the emergence of both clinically significant depressive and anxiety symptoms. Presently, directionality cannot be established. Students' internalising symptoms may cause them to self-medicate with drugs, or frequent use of drugs may result in brain changes linked to the development of internalising disorders.[70] The likelihood is that influences are bidirectional. Our findings were broadly consistent with prior research.[23–25] However, one previous study found that although the frequency of drug use was associated with depressive symptoms, this was not the case for anxiety.[26] Musliner and colleagues' review identified drug use as a significant predictor of the depression *trajectories* of young adults.[38] Our findings substantiate this specifically within students and extend findings to anxiety. This initial, exploratory finding highlights a need for further, longitudinal research to establish directionality.

Results showed that that accessing therapy was associated with an increased risk of the emergence of anxiety in students who began university healthy. Rather than suggesting any iatrogenic effects, this likely reflects the fact that students who develop significant anxiety symptoms are more likely to begin accessing support. This relationship should become clearer as data becomes available for more time points.

A lifetime history of internalising disorders predicted a lower likelihood of recovery from moderate to severe levels of depressive and anxiety symptoms. This is consistent with extant research, which highlights the high recurrence rates of anxious and depressive episodes.[53 54] Additionally, higher initial symptoms conferred a higher risk for the emergence of a positive screen for anxiety in those who initially screened negative.

The non-significance of SES as a predictor of mental health trajectories is somewhat inconsistent with the literature.[35 36] This may be because there was little variation in SES in the current study, and/or because the prior studies consider general population rather than student samples. Additionally, both of these studies consider mental health trajectories over a longer period than the current study.

Table 5 Restricted cubic spline predictors for group 2

	L.R. χ^2	df	P value	OR	95% CI
Initial GAD7*	6.70	2	<0.001		
Increase from mean by one point *				1.17	1.10 to 1.25
Increase from mean to threshold				1.29	0.78 to 2.16

*Statistically significant once corrected for multiple comparisons using the Benjamini-Hochberg procedure.
df, Degrees of freedom; GADS7, Generalised Anxiety Disorder Questionnaire; L.R., Likelihood ratio.

Table 6 Logistic regression results for group 3

Predictors	ß value	SE	Wald value	P value	OR	95% CI
Gender	−0.15	0.36	−0.43	0.668	0.86	0.43 to 1.73
SES	0.05	0.09	0.54	0.587	1.05	0.88 to 1.25
Early life adversity	−0.20	0.19	−1.09	0.277	0.81	0.56 to 1.18
Lifetime disorder *	−1.29	0.36	−3.58	<0.001	0.27	0.13 to 0.56
Initial PHQ9	0.02	0.04	0.61	0.541	1.02	0.95 to 1.10
University connectedness *	0.16	0.04	4.64	<0.001	1.18	1.10 to 1.26
Change in drug use	−0.07	0.05	−1.34	0.181	0.93	0.84 to 1.03
Change in alcohol use	0.06	0.15	0.40	0.688	1.06	0.79 to 1.42
Change in social support	0.06	0.03	2.21	0.028	1.06	1.01 to 1.12
Change in support utilisation	−1.23	0.55	−2.25	0.025	0.29	0.10 to 0.86

R^2=0.46 (Nagelkerke). Model χ^2 (10)=66.56, p<0.001.
*Statistically significant once corrected for multiple comparisons using the Benjamini-Hochberg procedure.
PHQ9, Patient Health Questionnaire 9; SES, socioeconomic status.

Findings have been equivocal as to the effect of gender on mental health trajectories within the general population of emergent adults, with one study finding an effect,[35] and another systematic review finding no effect.[38] However, Galambos's study began data collection in 1985, limiting generalisability to the current day, due to changes in gender roles. The non-significance of alcohol use in predicting mental health trajectories in the current study supports Edgerton and colleagues' findings.[37] However, the lack of an association could also be due to how common alcohol use was within students, or an overlap between the use of alcohol and other predictors in our model.

Although significant, the effect sizes in the current study were mostly small. Considering that mental health is etiologically heterogeneous, meaning there are multiple causes, this was to be expected. A large number of interacting factors influence the emergence and maintenance of mental health problems, including biological, psychological and social factors. Therefore, even explaining a small proportion of variance may be useful.

Implications

Findings have important implications for university mental health policies, programmes and practices. First, the factors identified as predictive of students' mental health could serve as indicators of well-being and be used to identify at-risk groups of students suitable for targeted intervention. Results may also be used to improve existing interventions. For example, on-campus therapy could focus more on developing university connectedness alongside their current practices, and campus wide campaigns throughout the year could highlight the risks of drug use and protective effects of engaging in social and recreational pursuits, with reference to these findings. In general, universities should aim to share findings such as these, so students are able to make well-informed

Table 7 Logistic regression results for group 4

Predictors	ß value	SE	Wald value	P value	OR	95% CI
Gender	−0.01	0.19	−0.09	0.929	0.98	0.67 to 1.44
SES	0.06	0.05	1.12	0.261	1.06	0.96 to 1.18
Early life adversity	0.28	0.12	2.36	0.019	1.32	1.05 to 1.66
Lifetime disorder	0.38	0.24	1.60	0.110	1.46	0.92 to 2.31
Initial PHQ9	0.03	0.03	1.03	0.306	1.03	0.97 to 1.10
University connectedness*	−0.11	0.02	−6.00	<0.001	0.90	0.87 to 0.93
Change in drug use *	0.15	0.03	4.66	<0.001	1.16	1.09 to 1.23
Change in alcohol use	0.01	0.09	0.06	0.951	1.01	0.84 to 1.20
Change in social support	−0.03	0.01	−2.30	0.021	0.97	0.94 to 1.00
Change in support utilisation	0.78	0.38	2.03	0.043	2.17	1.03 to 4.59

R^2=0.59 (Nagelkerke). Model χ^2 (10)=100.74, p<0.001.
*Statistically significant once corrected for multiple comparisons using the Benjamini-Hochberg procedure.
PHQ9, Patient Health Questionnaire 9; SES, socioeconomic status.

lifestyle decisions. A promising direction we are exploring is an online student-tailored mental health literacy course. Universities may also benefit from allotting more of their budgets to creating free and easy to access societies and clubs that students may join, in order to feel better connected to campus life. As well as benefitting the students, a better understanding of students' mental health could result in fewer drops outs, and, therefore, more money generated from course fees for the university.

Strengths

The student-led engagement campaign appeared to have been effective in maintaining higher than usual response rates and mitigating attrition. Most cross-sectional studies had significantly lower, or unreported, responses rates.[9–11 66] Moreover, the amount of missing data was relatively low. The final sample was also reasonably representative of the target population.

The study used well-validated and standardised measures of predictors and outcomes. Additionally, the approach to operationalising the changes in anxiety and depression accounted for the natural fluctuations observed when using these measures, by requiring that any clinical change must exceed the reliable change threshold.

Limitations

One cannot establish the directionality of effects, as the majority of predictor variables and outcome variables within this study were measured concurrently. However, the U-Flourish study will be continued across further time points, allowing for potential causal relationships to be explored and enabling the use of latent class growth models, which can encapsulate the changes across multiple time points. The number of predictors was also limited, meaning some factors, which may have an effect on student mental health, were not considered (eg, experience of interpersonal violence such as sexual assault or microaggressions, majors, financial situations and academic progress). Additionally, the second survey was sent out prior to final exams, which is a stressful time for students. As this is a stressful time for students, it may have resulted in a lower response rate and have impacted the levels of internalising symptoms reported. However, we wanted to extend the observation period over the full academic year and avoid the examination period.

Universities are incredibly heterogeneous, and certain features that vary across institutions are associated with the mental health of students.[11] Thus, findings from this study on Queen's University are not necessarily generalisable. Somewhat addressing this, the U-Flourish study is currently being replicated independently at the University of Oxford in the UK. However, both of these Universities are large, research-focused establishments. Future research would benefit from replication of this design across multiple, diverse universities internationally.

There was also the potential for bias introduced by systematic influences on participation and drop-out rates.

Although our sample was reasonably representative of the student population, women were over-represented, while students with parents with professional or doctorate degrees were under-represented. Moreover, as symptoms of internalising mental health issues are known to impact motivation and concentration, those with more severe internalising symptoms may be less likely to respond.[10] Conversely, those with mental health issues may have more of a vested interest in responding in full, due to their personal experience with the topic at hand.[71] Both could bias the prevalence estimates. Moreover, although the GAD7 and PHQ9 are both validated against clinical diagnoses, neither measures are sufficient to infer a diagnosis.

CONCLUSION

Higher university connectedness predicts recovery in students who began university with significant depressive or anxiety symptoms. In contrast, lower university connectedness predicts the emergence of significant depressive or anxious symptoms in students who began university below symptom thresholds. Students with a lifetime history of internalising conditions have lower odds of recovering from significant depressive or anxiety symptoms. Increases in drug use with the transition to university indicate higher odds for the emergence of significant depressive and anxiety symptoms. This is the first stage of a large-scale project, which will provide a more holistic picture of students' mental health across their time at university.

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