Effectiveness of StriveWeekly, a Preventive Digital Mental Health Intervention for University Students: Replication Randomized Controlled Trial

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Submitted to: JMIR Mental Health
on: December 18, 2025

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Abstract

Background: University students experience disproportionately high rates of anxiety and depression, which threatens their academic success. Digital mental health interventions (DMHIs) offer a scalable, cost-effective approach to universal prevention. StriveWeekly is a skills-based DMHI designed to prevent anxiety and depression among university students. A prior randomized controlled trial (RCT) demonstrated its effectiveness and acceptability.

Objective: This study aimed to test replication of StriveWeekly's effectiveness in reducing or preventing anxiety, depression, and stress symptoms, when delivered in a next context: with a different student population (undergraduate students at midsized private college), during a global pandemic, and with new engagement strategies. Secondary aims included examining mediators of symptom change, and user engagement and acceptability.

Methods: We conducted a cluster-randomized pragmatic RCT with 519 full-time undergraduates (7.2% of student body). Participants were randomized to the intervention (n = 244) or waitlist control (n = 275). StriveWeekly consisted of seven weekly modules teaching cognitive and behavioral skills. Surveys were administered online at baseline, posttest, 2-month follow-up, and 4-month follow-up.

Results: Intervention effects replicated prior findings. The group × time interaction was significant (t = ?2.62, p = .009, power = 81%) for Depression Anxiety Stress Scale (DASS-21) scores, favoring StriveWeekly with a small between-group effect over the waitlist (d = 0.24). Waitlist participants worsened (d = 0.19), while intervention participants remained stable (d = ?0.04). Among asymptomatic students at baseline (n = 202), symptom onset was lower in the intervention group (15.7%) versus waitlist (28.7%; $?^2$ = 4.26, p = .047). Effects were maintained at 2-month follow-up and converged for students who received delayed access to the intervention. Mediation analyses showed direct effects of higher module completion and specific modules (behavioral activation, cognitive reappraisal) on symptom improvement, but no indirect effects via self-reported habit change. Engagement was high: 93% of immediate intervention participants initiated StriveWeekly, and average completion was 41% of modules. Acceptability ratings indicated most participants found the program easy to use and satisfactory overall.

Conclusions: StriveWeekly demonstrated small but significant preventive effects on anxiety and depression symptoms, even during pandemic-related stressors. We successfully replicated prior trial results. Findings support the generalizability of StriveWeekly as a scalable, effective DMHI for campus-wide mental health promotion. We discuss considerations for guiding ethical and evidence-based implementation of DMHIs on campuses, especially given the dearth of commercially available DMHIs and the rise of student artificial intelligence (AI) tool use. Clinical Trial: ClinicalTrials.gov: NCT049278450

(JMIR Preprints 18/12/2025:89336)
DOI: https://doi.org/10.2196/preprints.89336

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Leslie Rith-Najarian is currently affiliated with University of California Los Angeles (UCLA) and Strive Weekly Inc. The data collection and analyses for this study were completed when she was solely affiliated with Harvard University. The final version of this manuscript was drafted when she was affiliated with UCLA and Strive Weekly Inc.
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Abstract

Background: University students experience high rates of anxiety and depression, which threatens their academic success. Digital mental health interventions (DMHIs) offer a scalable, cost-effective approach to universal prevention. StriveWeekly is a self-guided, skills-based DMHI designed to prevent anxiety and depression among university students. A prior randomized controlled trial (RCT) demonstrated its effectiveness and acceptability.

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Methods: We conducted a cluster-randomized pragmatic RCT (ClinicalTrials.gov: NCT049278450) with 519 full-time undergraduates (7.2% of student body). Participants were recruited online and randomized to the intervention (n = 244) or waitlist control (n = 275). StriveWeekly consisted of seven weekly modules teaching cognitive and behavioral skills. Surveys were self-administered online at baseline, posttest, 2-month follow-up, and 5-month follow-up.

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Conclusions: StriveWeekly demonstrated small but significant preventive effects on anxiety and depression symptoms, even during pandemic-related stressors. We successfully replicated prior trial results. Findings support the generalizability of StriveWeekly as a scalable, effective DMHI for campus-wide mental health promotion. We discuss considerations for guiding ethical and evidence-based implementation of DMHIs on campuses, especially given the dearth of commercially available DMHIs and the rise of student artificial intelligence (AI) tool use.

Keywords: Mental Health; Digital Health; Depression; Anxiety; Students; Universities; randomized controlled trial

Introduction

College is a time of both stress and opportunity. Individuals seek higher educational attainment with hopes of long-term professional, financial, and personal benefits, yet only two thirds of college students will complete their degrees.[1] Of the many factors affecting student retention, mental health issues increase a student's likelihood of dropping out from university.[2] University students are experiencing a "mental health crisis," [3] with higher anxiety and depression prevalence rates than for the general adult population. For example, one-third of university students reported clinical anxiety and two-fifths of students report clinical depression,[4] which is six times higher than 6-7% prevalence rates found by research using the same assessment tools in general adult populations.[5] Prevention of anxiety and depression in university students could improve academic functioning and overall mental health.

Ideally, new campus mental health services can be offered broadly without adding further demand on counseling centers.[3] Digital mental health interventions (DMHIs) are such an alternative service. DMHIs for university students offer several benefits that overcome common barriers to in-person services, including: convenience of time and location, ability to self-guide for those with preference with self-reliance, privacy, and fewer stigma concerns.[6] DMHIs that are self-guided and offered campus-wide are particularly promising, as they can be easily scaled up and at a lower cost than traditional in-person services.[7] Research has found that service stigma concerns are lowered by offering prevention programming to all students in a population (ie, campus-wide), compared to formal services or programs only offered to symptomatic students.[8–10] Moreover, past DMHIs have successfully reached university students from minority groups,[10,11] thus possibly reducing mental health disparities for previously under-served students. In summary, DMHIs are accessible to a broad student audience, maximizing their reach and potential impact.

Given the high prevalence rates of anxiety and depression in college students, DMHIs for preventing these mental health issues are a priority. Prevention programs intervene before young

people develop full clinical symptoms, ultimately reducing the burden of disease.[12] Multiple meta-analyses and reviews have shown DMHI effectiveness in improving anxiety and depression outcomes for university students in randomized controlled trials (RCTs).[13–15] Depression and anxiety are highly comorbid and thus increasingly targeted by transdiagnostic interventions.[16,17] There is also overlap in skills (eg, cognitive restructuring, sleep hygiene) of effective interventions targeting either condition on its own.[14] Skills-based DMHIs are a priority, as a meta-analysis of 176 RCTs of DMHIs for anxiety and depression found larger effects for those with cognitive and behavioral skills (g = 0.35 for depressive; g = 0.30 for anxiety) versus those without (g = 0.21 for depressive, g = 0.23 for anxiety).[18] For individuals with subclinical depression, self-guided DMHIs that teach cognitive and behavioral skills are equally effect as professional-guided DMHIs that teach cognitive and behavioral skills.[19] Taken together, there is a strong rationale for developing self-guided, skills-based DMHIs for campus-wide prevention of anxiety and depression.

One such DMHI—StriveWeekly[20] – is a promising candidate. Developed specifically for university students, StriveWeekly teaches skills through individual user accounts but simultaneously to all users at a given campus. This group-level delivery was informed by research supporting that new health behaviors can be motivated by processes such as social support, social contagion, and social accountability.[21,22] The cognitive behavioral skills taught in StriveWeekly were informed by a systematic review of best intervention practices (eg, behavioral activation, cognitive restructuring) for preventing anxiety, depression, and stress in university students.[14] Finally, the platform design was informed by: (a) prior research on consumer marketing and digital intervention adherence (eg, branding, prize incentives, email reminders); and (b) iterative product development based on student feedback.[10,20,23,24] In a first RCT, results showed that students assigned to StriveWeekly experienced small (d = 0.18–0.21) but significant improvements in total symptoms of depression, anxiety, and stress.[20] For students with high motivation for change, intervention effects were even larger (d = 0.63-0.70).[25] Moreover, symptom improvements were maintained at 3-month follow-up.[20] Thus,

StriveWeekly has demonstrated preliminary evidence of effectiveness for anxiety and depression.

StriveWeekly has also demonstrated promise for large-scale, cost-effective reach of students. Compared to the modest reach (< 200 students) of similar online programs,[14] StriveWeekly reached thousands of students in studies at two universities.[10,20] Furthermore, most enrolled students had no prior mental health service use (eg, therapy, psychiatric medication). Moreover still, some traditionally underserved groups (eg, Asian- and Hispanic/Latinx students) were not underrepresented in the samples.[10,20] Finally, in terms of cost-effectiveness, the number of students initiating StriveWeekly during two academic quarters of the RCT exceeded one tenth the number who initiated services at the campus counseling center (with a staff above 80) for that whole academic year.[20,26] As such, StriveWeekly has demonstrated the potential for serving more students on a campus, without increasing costs.

Study Objectives

We sought to test StriveWeekly in a second RCT, with a different student population, during a global pandemic, and with new engagement strategies. A main goal was to assess if the results of the first trial would be replicated. Successful replication in a new context would support the generalizability of StriveWeekly's effectiveness. There are also broader implications. Psychological science is among several fields affected by a replication crisis.[27] Even studies published in top-tier psychology journals are difficult to replicate: one mass effort replicated only 36% of findings, with effect sizes at half of originals.[28] As such, successful replication in this second trial would demonstrate that DMHI research can overcome a hurdle common in the field of psychology.

Our primary research aim was to compare pre-post symptom change between students randomly assigned to the same two conditions (StriveWeekly versus waitlist) but at a new campus (undergraduate college within midsized private university, instead of large public university) and at a different time. During the academic year when this second trial was conducted, students were navigating unique COVID-19 stressors (eg, social distancing, regular health testing, travel

restrictions, isolation protocols). Do symptoms still improve more for students assigned to (A) a self-guided, skills-based DMHI for synchronous campus-wide prevention of anxiety and depression, compared to (B) a waitlist? We hypothesized that students in StriveWeekly would exhibit more improved anxiety, depression, and stress symptoms, relative to waitlisted students. This main hypothesis is consistent with prior trial results.[20] Even in the context of the unique pandemic-related stressors, the accessibility of a DMHI like StriveWeekly offers continuity of services for students on-campus, in isolation, or learning remotely. If results support our main hypothesis, this suggests a DMHI like StriveWeekly is effective on a campus even during an unprecedented situation. Alternatively, the differences between trials might render StriveWeekly less effective. If so, we would expect smaller effects or no differences between conditions. For example, perhaps students are too burned out from learning remotely on their computer to be interested in an online intervention, or the severity of pandemic stressors exceeds the capacity of a preventive-level intervention. In addition, any methodological differences between the trials (eg, students sampled, intervention content updates) might contribute to differences in findings.

A second exploratory aim was to investigate mediators of symptom change. The use of a waitlist condition allows us to experimentally assess *if* StriveWeekly is responsible for reducing or preventing symptoms over time. Mediator analyses help us understand *why*. Presumably there are active ingredients in the module contents that are translating to daily activities that enhance psychological well-being. As such, mediation analyses will test if either (a) dosage and/or (b) specific modules predict improved outcomes, as explained indirectly via specific daily activity changes.

A final exploratory aim was to conduct user experience analyses. In this trial, we engaged in community-based participatory research to make StriveWeekly programming more engaging to students on the target campus. We collaborated with a campus partner to conduct a needs assessment, involve students in beta testing, and enlist residential life staff for enhanced marketing of

StriveWeekly for recruitment. This collaboration was intended to improve rates of enrollment, engagement, and acceptability.

Methods

Ethical Considerations

This study was approved by the Harvard University Area Institutional Review Board (Protocol #: IRB20-1337) and pre-registered on clinicaltrials.gov (NCT049278450). All research participants completed informed consent and confirmed their eligibility online via Qualtrics. Confidentiality was protected by: encrypting all Qualtrics forms and surveys; auto-generating participant IDs stored in a separate password-protected key; collecting participant data with IDs instead of identifiable info; storing only de-identified datasets; password-protecting and restricting access of files with identifiable info to only approved research staff via secure cloud server; and deleting all identifiable data after completion of data collection and analysis. Participants were compensated $5 per survey plus entry into a $50 bonus raffle for each survey, with their choice of preferred compensation format (campus cash loaded onto their student ID card or Amazon.com gift card).

Pre-Trial Community-based Participatory Research

Prior to the full trial, we took a community-based participatory research approach in collaboration with our campus partner, the Harvard College Dean of Students Office. We conducted (1) a campus-wide needs assessment survey and (2) pilot beta testing with student users. The purpose of these activities was to inform our implementation plan during the academic year and update StriveWeekly content for this campus' students. Students who participated in either of these activities would still be eligible to participate in the subsequent RCT study. A written summary of the results from these pre-trial activities was circulated and presented to our campus partners and residential life staff during the summer break before the main RCT began. A copy of this written summary (including sample demographics and highlighted statistics that informed intervention content updates

and platform revisions) can be found online in this study's OSF project files (see **Data Availability** statement).

Needs Assessment

In the semester preceding the trial's baseline assessment, an online survey was circulated by our campus partner to all undergraduate students. The majority of the sample (n = 524) was racially White (40.2%) and identified as female/woman/feminine (59.4%).

Survey questions assessed prevalence rates of anxiety and depression symptoms as well as use rates of mental health services. Nearly half of the sample had symptom scores above the "normal" cut-off, according to 21-item Depression, Anxiety, & Stress Scale (DASS-21)[29] The majority of students (85%) reported using at least one app for stress management, mental health skills, coping skills, relaxation, mindfulness, time management, or life skills. Moreover, 63% of students said they would definitely or probably sign-up for StriveWeekly. "StriveWeekly" was the preferred program name, over other hypothetical brand names (eg, "The Happiness Challenge"). Together these findings suggested sufficient need for a DMHI like StriveWeekly.

Survey questions also solicited feedback from students regarding the online intervention delivery (eg, prize preferences) and content (eg, ranking of skills modules). Based on feedback regarding program timing and duration, we decided to schedule StriveWeekly to start in the beginning of each semester, and run for 7 weeks. This was 1 week shorter than the intervention ran in the prior trial.[20] To inform which module to cut, we reviewed respondents' rankings of skills they wanted to learn, which extra attention given to respondents of historically under-served identities (eg, Black, Latinx). Socializing skills were ranked lowest, and thus the interpersonal and communication skills module was cut. Finally, we selected the rewards for prize drawings (eg, gift packages from local restaurants) based on students' reported preferences.

Beta Testing

Prior to beta testing, the platform was upgraded to meet Web Content Accessibility

Guidelines 2.1 Level AA (WCAG).[30] Beta testers were recruited from (1) the sample of students who completed the needs assessment survey and (2) students who were on campus during summer break. This pre-trial pilot sample included 29 students. Various bugs were addressed on a rolling basis as students reported the issues in weekly surveys. For example, at the start of the pilot one third of students reported experiencing issues with a new university-hosted single sign-on feature, which helped us identify workarounds and resolve bugs. Students also completed a feedback survey at the end of the pilot. Regarding platform accessibility, 0% students reported encountering issues, which suggested our efforts to upgrade StriveWeekly to WCAG were successful. When asked about the contents' cultural and developmental appropriateness: 79% said "yes" the language and tone felt appropriate for the college students; 79% said "yes" the content felt inclusive for a student of their respective identities; 72% said "yes" the images felt inclusive for a student of their respective identities; and 59% said "yes" the images felt appropriate for college students. Based on this feedback, revisions to the intervention prioritized updated illustrations. According to our adapted mHealth App Usability Questionnaire (explained below), 83% of students agreed or somewhat agreed that "StriveWeekly was easy to use."

Main Trial Design

Recruitment

Study staff led a presentation during the residential life staff's summer training to advertise the StriveWeekly resource, encourage staff to refer students, and answer questions. Similar presentations took place at other campus events and meetings (eg, student health services staff meeting, wellness fairs). In the first 2 weeks of the semester, recruitment materials were distributed via: (a) emails to all enrolled students from our campus partner, (b) announcements over dorm emails lists, and (c) posts from residential life staff (eg, dorm Slack channels, social media announcements). This recruitment approach thus combined self-selection and referral methods.

Pragmatic Trial Design

For an RCT of a self-guided online intervention, it is important that the design mimics intended intervention use.[7] Therefore, we designed our methods to simulate how a real-world campus might offer online services as usual. First, we employed cluster randomization, for reasons elaborated below. Second, participants in either condition were allowed to access other on- or off-campus mental health services, which would be controlled for in our statistical analyses. Third, all data collection and participant communications were online rather than in-person to: (a) include all students regardless of campus COVID-19 isolation protocols, (b) avoid unintentionally bolstering motivation (eg, inducing social desirability to please researchers), and (c) avoid added barriers (eg, time demands, concerns about privacy). Finally, survey compensation amount was modest enough ($5 per survey + entry into $50 bonus raffle) to hopefully increase participant response rates without artificially inflating intervention adherence rates or self-reported symptom improvement due to financial incentive.

Random Assignment

Cluster randomization was used to assign students according to their residential affiliation to the immediate intervention condition (Fall semester access) or the waitlist condition (Spring semester access). An electronic randomizer tool was applied to evenly distribute assignment of students to either condition (ie, 6-7 upper classman houses and half of freshmen dormitories per condition). This randomization plan along with other randomization options (ie, total randomization by student; randomization by class year) were discussed with and was preferred by our campus collaborators. Although cluster randomization can introduce statistical confounds for analyzing intervention outcomes at the individual participant level, they can be preferred: (a) to avoid intervention "contamination" effects (eg, if participants in both conditions can regularly interact and thus might exchange health-related knowledge), and (b) if it allows the intervention to be delivered as it would be in real practice.[31] Moreover, the benefits of cluster randomized by residential house/dorm affiliation for this trial are crucial for the social aspects of the StriveWeekly program. For example,

students will know who else is concurrently participating in the program (eg, any of their friends who live in X, Y, or Z dorm), allowing for peer-to-peer engagement. Students were automatically assigned to conditions based on their residential affiliation, which they inputted online after consenting to participate via Qualtrics.

Conditions

Students assigned to the intervention group received 7 weeks of StriveWeekly. Students assigned to the waitlist group received no intervention or communication between their baseline randomization and the invitation for posttest survey. They were provided access to the online program after completing the posttest survey. Thus, students were not masked to condition and knew if they had been assigned to the immediate intervention condition or not.

Online Surveys

After completing informed consent, participants were directed to an online survey for the study baseline assessment (Sep 7-17, 2021). Students assigned to the intervention group received an access code via email, allowing them to access the StriveWeekly platform and set up their account. The intervention group was then active for 7 weeks (Set 20 - Nov 7, 2021), after which students in both conditions were invited to the posttest survey, which was a couple of weeks before exam period (Nov 8-19, 2021). After winter break, there was a 2-month follow-up survey (Jan 24 - Feb 4, 2022), after which students who were assigned to the waitlist group gained delayed access to StriveWeekly. Finally, after 7 weeks of the delayed intervention group (Feb 7-Apr 3, 2022), there was a 5-month follow-up survey (Apr 4-15, 2022). All surveys were self-assessment and open for 2 weeks.

Intervention

When users first access the StriveWeekly platform, they set up their account, including customization of email reminders and selection of one of seven program goals (eg, anxiety reduction, mood management). They then engaged in motivational enhancement strategies (eg, writing reasons that this goal was important), which are recorded along with their goals in a pop-out “My Plan”

feature on their timeline. Under the timeline, the user dashboard has four tabs. First, the “Content” tab displays the current module’s content. Second, the “Progress” tab displays (a) activity log function, (b) history of user activity logs and earned virtual medals, (c) weekly reflection check-in function, and (d) graph of self-reported stress and mood ratings over time. Third, the “Campus” tab provides users with: (a) info about relevant campus resources; (b) a notification center with campus-specific messages and updates; (c) an anonymous livestream of all campus users’ activity, and (d) FAQs including information about prize drawings. Fourth, the “Settings” tab allows users to update their email reminder schedule, contact info, etc.

During each active intervention week, a new module is released to all users on Monday. Weekly module release emails are sent to all users, while reminders emails are sent to individual users based on their settings. See **Table 1** for module contents. The “Content” of each module includes a list of activities to practice the respective skill as well as tips and ideas. Users save a plan of intended activities, barriers they expect, and solutions to those barriers. Users earn higher virtual medals (bronze, silver, gold) by logging more activities per week. Weekly check-in questions assess goal progress, and are incentivized by weekly prize drawings ($23-50 value, eg, movie theater tickets, chair massage vouchers). Program completers are also eligible for a finalist prize drawing ($100 value, eg, escape room for four, school branded designer clothing).

This version of StriveWeekly was mostly the same as tested in a prior trial.[20] Changes to the platform and content are as follows, all informed by the pre-trial research activities. First, we removed multiple branding options,[20] leaving “StriveWeekly” as the sole program name. Second, there were seven instead of eight modules. Two of these modules were reorganized: time management skills were moved into the “Welcome” week leaving sleep hygiene skills in their own module. Although the skills within the modules were largely the same, the content was updated before the trial with all new images, new module names, and more up-to-date references and examples. Finally, technology changes included: (1) a licensed copy of the platform was hosted on

the school's servers; (2) this copy used a school-branded URL; (3) the school's single sign-on was incorporated; and (4) the platform met WCAG 2.1 Level AA standards.

Participants

The only inclusion criterion was being enrolled fulltime as an undergraduate student at the time of recruitment, which was screened at the consent form phase by limiting access via the university's unified online credential sign-on system. There were no *a priori* exclusion criteria. Internet literacy was not assessed as an inclusion/exclusion criterion. Participants could withdraw at any time during the trial, and none of their data was included in analyses. *Post hoc* exclusion procedures removed students with invalid data reporting (ie, straight-lined responses to surveys, high inconsistency in responses). Participants were excluded for: (a) straight-lining on the primary outcome measure at baseline or posttest; (b) straight-lining on multiple secondary outcome measures at baseline or posttest; (c) having eight or more "invalid reporting flags"; or (d) having five or more "invalid reporting flags" and straight-lining outcome measures partially/mostly at multiple assessment points. "Invalid reporting flags" were calculated based on: inconsistencies across outcome measure on cross-validation item pairs assessing similar content; or providing responses far outside expected range (eg, reporting 32+ hours total on daily activities). Participants were retained in the final sample but simply had single measures removed from their data if there was evidence of straight-lining on one secondary outcome measure at any timepoint or on the primary outcome measure in one follow-up survey only. See details of participant inclusion, withdrawal, and exclusion flow in **Figure 1.**

Measures

Demographic Information

Self-reported demographic data was collected in the baseline survey and included: race/ ethnicity, international student status, gender identity, LGBTQ+ identity, first generation college student status, academic year, residential affiliation. We also asked about sexual orientation in the

second follow-up survey.

Primary Outcome: Depression Anxiety and Stress Scale (DASS-21)

The primary symptom outcome measure was the 21-item Depression Anxiety and Stress Scale,[29] a self-report scale and thus an unmasked assessment. Total scores range from 0 - 63, with high scores representing more symptoms of depression, anxiety, and stress. Psychometrics for the DASS-21 in university student samples include high internal consistency (α = .83 - .90) and good construct validity.[32] High internal consistency of baseline DASS-21 was good in the original StriveWeekly trial (α = .79 - .92),[20] as well as in this second trial (total: α = .90; depression: α = .87; anxiety: α = .74; stress: α = .79). Examining item-total statistics for DASS-21 total scores, deletion of just one item improved alpha, and only by .004. Principal axis factoring using both direct Oblimin and promax rotations identified five factors (eigenvalue ≥ 1), and respective items were identified by factor loading ≥ .4 as a cut-off.[33] Factor 1 (eigenvalue = 7.47) included six of seven depression subscale items. Factor 2 (eigenvalue = 1.82) included only three of seven anxiety subscale items, and one of the stress subscale items. Factor 3 (eigenvalue = 1.24) included two of seven stress subscale items, while Factor 4 (eigenvalue = 1.09) included three others of the seven stress subscale items. Factor 5 (eigenvalue = 1.04) included one repeat item from Factor 4's stress subscale items. Six items loaded into none of the factors. Given these psychometric results, we decided to examine DASS-21 total scores as an outcome, but not the individual subscales.

Secondary Outcome: Perceived Stress Scale (PSS)

This 10-item scale measures subjective perceptions of stress.[34] The PSS is a self-report measure and thus an unmasked assessment. Total scores range from 0 - 40, with high scores representing appraisal of situations in one's life as more stressful, unpredictable, uncontrollable, and overwhelming. Psychometrics for the PSS include good internal consistency and good test-retest reliability, and it has been validated with university students[34] Using our sample, internal consistency of PSS at baseline was good (total: α = .86). Examining item-total statistics, deletion of no items

improved alpha. As such, PSS was deemed a reliable outcome variable.

Secondary Outcome: Warwick-Edinburgh Mental Wellbeing Scale (WEMWS)

We used the 7-item version of the Warwick-Edinburgh Mental Wellbeing Scale, [35] a self-report scale and thus an unmasked assessment. Total scores range from 7 - 35, with higher scores representing more positive aspects of mental health and psychological functioning.[35] Psychometrics for the WEMWS in a university student sample include good internal consistency (α = .89), test-retest reliability (0.83), content validity, and convergent validity.[35] Using our sample, internal consistency of WEMWS at baseline was good (total: α = .87). Examining item-total statistics, deletion of just one item improved alpha, and only by .002. Thus, WEMWS was deemed another reliable outcome variable.

Mediator: Daily Activities

We invited students to self-report their estimated average time spent on a list of daily activities (eg, academics, sleep, exercise). Time could be entered as partial or full hours. Seven items on the list represented daily activities that are targeted by StriveWeekly intervention modules: (1) sleep; (2) procrastination (ie, difficulties with time management); (3) physical exercise; (4) relaxation/mindfulness; (5) recreation- and value-based activities (ie, behavioral activation); (6) social time (ie, behavioral activation); and (7) rumination. Two additional activities were used for measurement validation: (a) time spent on academics and (b) time spent on employment or extracurricular activities. After data collection was complete, we cleaned the data for mis-entered hours (eg, some participants entered % instead of hours/day) and excluded hours data for implausible values (eg, total hours/day across the nine categories exceeded 40). Test-retest reliability was significant (r = .22 to .48, p < .001) within each category.

Other Mental Health Service Use

Every survey included self-report questions assessing past and current use of mental-health-related services using a checklist of common services and resources on- and off-campus (eg, therapy

at the counseling center) as well as a write-in “other” option. For the purposes of per protocol analyses, we defined “concurrent service use” as checking “yes” for having used any of the following in the past 2 months: academic accommodations for psychological reasons; alternative medicine for psychological reasons (eg, homeopathy, acupuncture); family therapy or couples therapy by any mental health professional; formal group-based therapy or services (off- or on-campus); hospitalization/partial/day treatment for psychological, psychiatric, or substance use; individual therapy on- or off-campus; informal group-based supports (eg, Alcoholics Anonymous); other individual counseling (eg, peer counseling, academic coach); psychiatric medications; and/or workshops for psychological problem led by a professional.

Program Satisfaction

The posttest survey and second follow-up surveys assessed program satisfaction and functionality for students in the respective condition that just completed the intervention. The main satisfaction measure was an adapted version of the mHealth App Usability Questionnaire (MAUQ), a measure that has demonstrated good internal consistency (α = .93) and convergent validity.[36] See **Appendix A** for adapted MAUQ. In addition, we assessed satisfaction with the individual modules, written content, and graphics using non-standardized rating questions and checklists. Finally, we solicited feedback using open-ended questions.

Program Initiation and Module Completion

Behavioral data was collected directly from participants’ StriveWeekly accounts. Intervention initiation was defined as having finished setting up their online account. Individual module participation rates were calculated based on the number of users with at least one logged activity for skills practice within a given module.

Data Analytic Approach and Software

All psychometric analyses and descriptive statistics were run in SPSS version 29.[37] For main analyses, linear mixed effects (LME) models were run in RStudio[38] using the multilevel package.[39]

We updated the R syntax from the data analyses of the first StriveWeeky trial,[20] allowing us to test replication of results using the same data models.

First, we assessed immediate intervention effects. LME models handled missing data using restricted maximum likelihood estimation, so all participants could be included in main analyses. In selecting covariates for these LME models, we followed the Committee for Medicinal Products for Human Use recommendation to include covariates that have a known association with the primary outcome based on previous evidence.[40] Fortunately, our previous trial provides such evidence, and thus we planned to test gender as a covariate, as it was the only covariate (a) identified in the prior trial[20] and (b) collected in the current trial. Piecewise LME models included group, time, group by time interaction, covariates, and any covariate's respective group by time interaction as fixed effects in predicting outcome scores. Participant intercepts and outcome slopes varied randomly. The intervention condition was the reference group, with time as piecewise variables: (Time A) baseline to posttest; and (Time B) posttest to 2-month follow-up. Main intervention effects were assessed by Group by Time-A interactions and determined by significant simple slopes of time for the intervention group. Per protocol analyses (described further in the results) were run using the same LME formulas, but either on a subset of the sample or with an additional covariate in the model. Maintenance of immediate intervention effects through 2-month follow-up was assessed by Group by Time B interactions and the corresponding simple slopes of time. The dataset for assessing convergence of intervention effects collapsed (a) baseline to posttest data for the immediate intervention group, and (b) 2-month-follow-up to 5-month-follow-up data for the delayed intervention group. These LME models included a single pre-post time variable.

Effect sizes and their 95% confidence intervals (*CI*s) were based on estimated marginal means (*EMM*s) obtained with the emmeans package for R.[41] Within-group effects were calculated as: $d = (M_{pre} - M_{post}) / SD_{pooled}$. Between-group effects were calculated using Morris' (2008) formula for pretest-posttest-control-group designs.

For mediation models, we used the same time-lagged dataset that combined the immediate intervention condition with the delayed intervention condition, with missing values imputed for the mediator and outcome variables. The R mice package[43] was used to implement 5 rounds of multiple imputation. We ran analyses with the R mediation package,[44] with posttest DASS-21 scores as the outcome variable, intervention dosage/module as the treatment variable, change in daily activities as the mediator variable, and pretest DASS-21 scores as a covariate. Because data was collapsed from during the respective immediate intervention phase and the delayed intervention phase, group condition was no longer a predictor of interest. Instead, program initiator status was included as a second covariate, in order to control for any confounded "0" values in the dosage/module treatment terms due to participants who never initiated the intervention. Two rounds of 7 mediation models were run. The first round tested the treatment effects of intervention dosage (ie, total number of modules used) as mediated by change in the seven self-reported daily activities. The second round tested the treatment effects of specific modules (ie, total number of activities logged for each module) as mediated by change in the respective theoretically relevant daily activities. For example, the module that taught sleep hygiene was used as a treatment variable as paired with pre-post change in self-reported hours of sleep.

Results

Participants

The final sample included 519 students, exceeding the necessary sample size of 328 calculated from the previous trial's power analysis.[20] This sample constituted 7.2% of the entire undergraduate student body at the university. The majority of the sample was racially White (42.8%) and identified as female/woman/feminine (64.0%), and in their first academic year (33.7%). See **Table 2** for further demographic details of the sample. Relative to the demographic composition of the entire undergraduate student body,[45–49] this sample over-represented participants from three traditionally underserved and/or minority groups: Asian students (30.4% of sample relative to ~25%

of student body); Latinx students (17.3% of sample relative to ~12% of student body); and LGBTQ+ students (22.2% relative to ~17% of student body).

At baseline, the DASS-21 total mean score was 16.51 (*SD* = 10.33), which is in the mild range, and comparable to other university students.[32] Prior to the baseline assessment, 71 had previously participated in the needs assessment in the prior year, and 15 had also participated in the beta-testing. According to self-report, 31% (*n* = 162) of the sample had received mental health services (eg, therapy, psychiatric medication, meditation groups, peer counseling) within the preceding 2 months.

Of the nine residential dorm clusters randomized to the intervention group, recruitment yields ranged from 4.5% to 12.4% of the students from respective dorms. Of the nine residential dorm clusters randomized to the intervention group, recruitment yields ranged from 5.4% to 12.5% of the students from respective dorms. Overall, 244 (47%) students were assigned to the intervention condition, and 275 (53%) to the waitlist condition. Taken together, the cluster randomization approach was successful, as it produced relatively even condition size and good representation across residential affiliations.

Covariate Confirmation

We tested gender as a predictor of baseline differences in outcome variables using one-way ANOVA with post hoc test of TukeyHSD. For DASS-21 total symptoms, there were significant group differences by gender ($p < .001$), with all three gender groups significantly differing from each other ($p < .001$). For PSS total symptoms, there were significant group differences by gender ($p < .001$), with students in the male gender group significantly differing from the other two gender groups ($p < .001$). For WEMWS scores, there were significant group differences by gender ($p < .001$), with students in the male gender group significantly differing from the other two gender groups ($p < .001$). As such, gender was tested as a covariate in all LME models predicting intervention effects.

Intervention Effects

Main Analyses of Intervention Effects

For the models predicting change in DASS-21 total scores, both the models with and without covariate terms produced significant interaction terms, but the model with covariate terms explained 4.4% more variance in DASS-21 outcomes. The model with covariates terms showed a significant group by time interaction (t = -2.62, p = .009, power = 81%), with the simple slope of time was significant for the waitlist group (t = 2.19, p = .03), but not for the intervention group (p = .3). Based on EMMs from this model, greater worsening in symptoms (ie, increase in DASS-21 scores) was found for those in waitlist group (d = 0.19 [0.02, 0.36]), compared with the intervention group (d = -0.04 [-0.25, 0.17]), with small between-group effects favoring the intervention group (d = 0.24 [0.06, 0.41]).

For the models predicting change in PSS total scores, neither of the models with and without covariates produced significant interaction terms (p = .21 to .38).

For the models predicting change in WEMWS total scores, the model without covariate terms produced a significant group by time interaction term (t = 2.00, p = .046, power = 53%), while the model with covariate terms was almost but not quite significant (t = 1.95, p = .052, power = 55%). Predicting WEMWS scores from the model without covariates, the simple slope of time was significant for the waitlist group (t = -4.19, p < .001), but not for the intervention group (p = .4). Based on EMMs from this model, greater worsening in mental wellbeing (ie, decrease in WEMWS scores) was found for those in waitlist group (d = -0.25 [-0.42, -0.08]), compared with those in the intervention group (d = -0.06 [-0.27, 0.15]), with small between-group effects favoring the intervention group (d = 0.19 [0.02,0.36]).

Treating the six models above as multiple tests, Benjamini-Hochberg[50] procedures were applied to adjust for Type I error by using more conservative critical values. The group x time interaction terms were still significant (p < critical value of .017) for both LME models that predicted

DASS-21 outcomes. The group x time interaction term for the LME model with covariates predicting WEMWS scores was no longer significant (p > critical value of .025).

Per Protocol Analyses of Intervention Effects

Per protocol analyses were run predicting DASS-21 total scores. First, models were re-run comparing the waitlist condition versus only intervention group participants who were program initiators (ie, finished setting up their account). As such, these analyses were not on a purely randomized sample. Both initiator-only models (with and without gender covariate terms) still produced significant group by time interaction terms (p = .006 and .007), with simple slopes of time indicating increased symptoms (ie, worse deterioration) for the waitlist group. Next, we included concurrent service use as a covariate in three different models: (1) with concurrent service use as an additional predictor, (2) with concurrent service use and its interaction with time as predictors, and (3) with concurrent service use, gender covariate, and the respective interaction with time terms. All three models still produced significant group X time interaction terms (p = .01, .01, and .01). In other words, per protocol results converged with the intention-to-treat results. Finally, models were re-run excluding the 15 participants who had participated in beta-testing, and both models (with and without gender covariate terms) still produced significant group by time interaction terms (p = .01 and .01).

Maintenance and Convergence of Intervention Effects

Maintenance of intervention effects was assessed by examining the Group by Time B interactions from the main LME model that included covariates. Interaction terms were not significant for neither the intention-to-treat model (p = .7) nor the per-protocol model (p = .7). Simple slopes of time indicated that symptoms for the immediate intervention group further decreased from posttest to 2-month-follow-up. In other words, maintenance of immediate intervention effects was demonstrated through follow-up.

With data collapsed across the immediate intervention group and the delayed intervention

group (n = 459), convergence of immediate intervention effects was tested. The main LME model including covariates was run twice: intention-to-treat and per-protocol (ie, intervention initiators only for both groups). Group by time interaction terms were not significant in either model (p > .8), suggesting that the magnitude of pre–post intervention effects for the delayed intervention was comparable to those observed for immediate intervention. In other words, the delayed intervention group demonstrated convergent results with those of the immediate intervention group.

Prevention of Symptom Onset

The subset of students (n = 202) with low baseline symptoms (ie, scores below mild cutoffs for all subscales: DASS-D < 7, DASS-A < 6, DASS-S < 10) were examined to determine the proportion in each condition with onset of symptoms by posttest. For the students assigned to the immediate intervention group, 15.7% had posttest scores in the moderate or severe range for one or more DASS-21 subscales (ie, onset of symptoms). For the students assigned to the waitlist group, 28.7% had scores indicating onset of symptoms. This difference was significant (X^2 = 4.26, p = .047), indicating that students in waitlist group had a significantly higher rate of onset for depression, anxiety, and/or stress symptoms.

Mediation Analyses

Dosage

All seven models produced significant total effects (estimate = -0.36 to -0.33; p = .02 to .04), indicating that completing more intervention modules predicted lower symptoms at posttest. Of these models, six also produced significant direct effects (ADE estimate = -0.42 to -.30; p = .002 to .04), with the seventh model producing a nearly significant direct effect (p = .06). However, there was no evidence of mediation, as none of the indirect effect estimates were statistically significant (p > .05).

Specific Modules

Of the seven models testing the effects of specific modules, two modules demonstrated significant direct and total effects on posttest symptoms: behavioral activation and cognitive

reappraisal. First, for the model testing behavioral activation as the treatment and daily socializing as the mediator, the direct effect (ADE estimate = -0.28, p = .04) contributed to a significant total effect (estimate = -0.28, p = .04). However, there was no evidence of an indirect effect through the mediator (ACME estimate = -0.001, p = .95). Likewise, for the model testing behavioral activation as the treatment and daily recreation time as the mediator outcome, the direct effect (ADE estimate = -0.26, p = .048) contributed to a significant total effect (estimate: -0.28, p = .03). However, again, there was no evidence of an indirect effect through the mediator (ACME estimate = -0.02, p = .4). Second, for the model testing cognitive reappraisal as the treatment and daily rumination as the mediator, the direct effect (ADE estimate = -0.55, p < .001) contributed to a significant total effect (estimate: -0.54, p < .001). Yet, there was no evidence of an indirect effect through the mediator (ACME estimate = 0.01, p = .8). One other model produced a significant indirect effect (p < .05), however there was a non-significant proportion mediated, non-significant direct effects, and a non-significant total effect. In conclusion, logging more activities during the behavioral activation and the cognitive reappraisal modules predicted lower symptoms at posttest, but not as mediated through change in the respective daily activities.

User Experience Analyses

Engagement Metrics

There were 405 (78.0%) students who initiated the intervention (ie, finished setting up their online account): 226 (92.6%) from immediate intervention and 179 (65.1%) from waitlist condition (ie, delayed access). As a proportion of the full sample, 58.9% of students logged skills for at least one module, and 14.6% logged skills for all seven modules. Of the intervention initiators, 75.6% logged skills for at least one module, and 18.8% logged skills for all seven modules. Their mean number of modules with logged skills practice was 2.85 (*SD* = 2.65); in other words, initiators completed about 41% of the intervention on average. Their individual module participation rates declined over time, with 67.9% participating in the first module and 28.9% in the last module.

One predictor of engagement (collected from the feedback survey) was assessed: how many peer participants they personally knew. Knowing at least one peer who was also participating in StriveWeekly predicted one's own higher module completion (M = 4.46 modules, SD = 2.65), compared to those who knew no peers also participating (M = 3.52 modules, SD = 2.73) at a statistically significant level (t = 2.23, p = .02). Students were also invited to self-report on what motivated their engagement, and the top three motivators selected from a checklist (**Appendix A**) were: weekly prize drawings (64%), email reminders (59%), and the completer prize drawing (51%).

Acceptability metrics

Of students in both conditions who initiated the intervention, 245 completed their respective feedback survey. Agreement rates on the mHealth App Usability Questionnaire were calculated by totaling frequencies for "Agree" or "Somewhat Agree" responses to each item. A majority of participants (64.5%) agreed that StriveWeekly was "easy to use". A slight majority (56.1%) agreed they were satisfied with the program overall. More participants (63.1%) were satisfied with how adequately the program "tracked and acknowledged my progress and actions". When asked if they would use StriveWeekly again, 49.0% agreed. Half of participants (49.8%) said the program was useful for their health and well-being. Examining the ratings from those participants who had tried individual modules, "Relaxation" was rated highest (72.8% "loved" or "liked" it), and "Welcome" was rated lowest (47.6% "loved" or "liked" it). Finally, much of the qualitative feedback included positive comments about specific StriveWeekly features. For example, one student said "I really liked the topics featured and how they're evidence-based. Getting the weekly reminders really helped. The prize drawings definitely motivated me as well." Complete details of accessibility measure results and additional representative quotes are included in **Appendix A**.

Discussion

This study was the second RCT testing the effectiveness of StriveWeekly, a self-guided, skills-based DMHI for synchronous campus-wide prevention of anxiety and depression. We

hypothesized that students assigned to StriveWeekly would show better pre-post outcomes (anxiety, depression, and stress symptoms), relative to students on the waitlist. Results supported our main hypothesis. Thus, this trial conducted in a new setting and context (ie, midsized private college during the COVID-19 pandemic) successfully replicated the effectiveness results of the first StriveWeekly trial[20] (conducted at a large public university prior to the pandemic). The intervention by time results remained statistically significant regardless of covariates or not, even for per protocol analyses, and even when using a smaller critical value to adjust for Type I error. Moreover, group by time results converged for the immediate intervention group and the delayed intervention group (ie, former waitlist). Finally, improvements in symptoms were maintained through 2-month follow-up. Overall, this trial provides robust results suggesting StriveWeekly's effectiveness.

Additional results help further characterize the effects of StriveWeekly. Students assigned to the intervention experienced small effects (d = 0.24) in total symptoms (DASS-21), with students in the waitlist reporting worsened symptoms from baseline to posttest. Moreover, of the students who were asymptomatic at baseline, the rate of clinical symptom onset was 13% lower for those assigned to StriveWeekly. Therefore, StriveWeekly produced universal prevention effects, extending beyond the indicated prevention effects observed in the prior trial.[20] We also evaluated some secondary outcomes. Examining wellbeing (WEMWS) as an outcome, one model showed greater worsening for waitlisted students compared to students using StriveWeekly. However, it was underpowered (53%), and results were no longer statistically significant when covariates were controlled or Benjamini-Hochberg procedures applied. Separately, results did not show group by time differences for perceived stress (PSS scores). Taken together, our results suggest small effects of StriveWeekly in the universal prevention of anxiety and depression symptoms, yet no clear effects on general wellbeing and stress.

As a secondary aim, we investigated mediators of symptom change. In particular, we were interested in exploring if StriveWeekly dosage and active ingredients (ie, use of specific modules)

might improve symptoms indirectly via changes in daily activities. Our results showed direct effects of completing more intervention modules on better symptoms improvement by posttest, but change in daily activities did not mediate these results. There were two specific modules – behavioral activation and cognitive reappraisal – that had direct and total effects on posttest symptoms, but again change in daily activities did not mediate this effect. In summary, though the exact mediators remain unknown, StriveWeekly symptom improvement is predicted by: (a) higher dosage of total modules and (b) logging more activities in the specific modules of behavioral activation and cognitive reappraisal. These findings extend beyond the prior StriveWeekly RCT[20] to explain that this intervention is even more effective for users who more fully engaged with the content and skills practice.

Our final exploratory aim was to investigate metrics of enrollment, engagement, and acceptability. Regarding reach, our final sample was 7.2% of the respective undergraduate student body, exceeding the 4% enrollment of students at the university tested in the first trial.[20] The enrolled sample was not only large, it was also diverse and representative. Three traditionally underserved and/or minority groups were even over-represented: Asian, Latinx, and LGBTQ+ students. These results are consistent with our prior findings that students with unmet need may be more likely to initiate a DMHI like StriveWeekly, as opposed to traditional campus mental health services.[10] The successful reach of LGBTQ+ students is newly demonstrated, as we did not gather this demographic info in the first trial.[20] Regarding engagement, 93% of students in the immediate intervention condition initiated StriveWeekly, an increase from the 73% of initiators in the first trial.[20] Initiators logged skills practice for 2.85 modules (41% of the intervention) on average, similar to an average module completion rate of 46% in the first trial.[20] The full adherence rate (ie, completing all modules) was 19%, similar to the first trial (24%)[20] and the average all-module completion rate (17%) for other self-guided DMHIs for depression.[17] Converging with research on social motivators of health,[21,22] we found that that students completed one more module on average if they knew a peer

also using StriveWeekly, compared to those who knew no peers also participating. Reward features also remain a main motivator, with two thirds of students self-reporting it as reason for their engagement. Finally, acceptability metrics were mixed with a majority of participants endorsing StriveWeekly as easy to use, progress-focused, and satisfactory overall, but slightly less than half said StriveWeekly was useful for their wellbeing or that they would use it again.

Limitations and Future Directions

Our results should be interpreted with some limitations in mind. First, research staff oversaw the intervention delivery. When a researcher has a strong allegiance to a tested mental health intervention (eg, because they helped develop it), inflated RCT effect estimates can result.[51] Because developers are expert in their own intervention, they might implement the intervention better than would an independent practitioner.[51] Thus, we have not yet tested the effectiveness and fidelity of StriveWeekly when delivered by campus stakeholders, which is essential for sustainable independent delivery of DMHIs. A future priority is developing and testing a user-friendly dashboard for university staff (ie, clinicians, administrators) to locally implement StriveWeekly. Second, the choice of a waitlist condition as the comparison group could artificially inflate trial results in favor of the intervention condition.[51] For example, if participants know that they will receive the intervention soon, their motivation to solve their problems may be diminished.[51] Thus, future trials of StriveWeekly could instead use a more active comparison group such as prevention-as-usual, which would better test if StriveWeekly is more helpful than standard prevention practices on university campuses. Third, our follow-up assessment period of 5 months is too short to determine if StriveWeekly prevents anxiety and depression symptoms long-term. Outcome data could be collected longitudinally (12 months or more) in the future. Fourth, although the prior trial included undergraduate, graduate, and professional students, this trial's sample included only undergraduates. Intervention content that is effective and relatable for undergraduates may not generalize to graduate and professional students, who face their own unique stressors.[52] Future research can investigate the

acceptability of StriveWeekly content across student demographics, and test intervention adaptations as needed. Fifth, the effectiveness results seem limited to prevention of anxiety and depression symptoms, and not to stress outcomes. Future trials should test different depression and anxiety outcomes that do not combine psychological constructs like the DASS-21 measure does.

Strengths and Implications

Despite limitations, some strengths of this study's methodological design and results have important implications.

First, the findings of this second StriveWeekly trial did replicate prior intervention effectiveness findings.[20] This finding had adequate observed power (81%) and was based on the same data analysis syntax from the first trial. In contrast, the majority of psychological research study results fail to replicate.[28] As such, our findings provide more evidence for the reliability and generalizability of StriveWeekly's effectiveness, even when it is delivered at a time of unique campus stressors, as was the case during the COVD-19 pandemic (eg, social distancing, regular health testing, isolation protocols). The finding that a higher dosage of StriveWeekly predicts greater symptom improvement further validates the effectiveness of the intervention itself. Moreover, this trial's successful scientific replication also demonstrates that DMHI research – a relatively new clinical research area – can overcome a common hurdle for broader field of psychology.

Second, given the consistent large-scale effectiveness of StriveWeekly across two different campus settings, expanding such services to more universities could broaden the impact. Improved mental health can cascade into other positive effects for university students, including their ability to complete their university degree.[2] If more students are served at a preventive level, then that could also open space in counseling center staff's caseloads to serve students needing a higher level of care. Such cost-effectiveness is crucial for campuses with already overburdened counseling centers. From administrators' perspectives, the benefits of offering a DMHI to their students (eg, clinical effectiveness, many students reached) need to clearly justify the resources necessary (eg, staffing,

finances).

Third, in hopes of improving intervention reach and engagement, we intentionally engaged in community-based participatory research in collaboration with a campus partner. Some key differences in the current trial – compared to the prior trial – were pre-trial needs assessment, involving students in beta testing, enlist residential life staff for targeted recruitment efforts, and the cluster randomization allowed dorm-specific recruitment and condition assignment. Although we cannot establish which methodological differences between the trials (eg, students sampled, intervention content updates) might be causal for differences in results, we did see improved reach and engagement metrics in this trial compared to the prior StriveWeekly trial. Given our theory about the importance of StriveWeekly's campus-wide and social design, the improved reach and engagement metrics could suggest DMHIs like StriveWeekly should be offered in a more socially integrated context.

Finally, these findings underscore the importance of clinically effective DMHIs within the evolving digital landscape, especially with the rapid rise of artificial intelligence (AI) tools among students. In the United States, 59% of undergraduates reported using generative AI tools at least monthly in 2025, compared to fewer than 25% in early 2023.[53] One study found that as many as 13% of young people now use generative AI for seeking mental health advice.[54] Although some AI chatbots are designed for depression and anxiety intervention purposes,[55] most AI chatbots are not. For example, students report using ChatGPT far more than other AI technologies.[56] Problematically, these more widely used AI chatbots could have harmful effects on mental health[57] and they sometimes violate mental health ethical standards.[58] It is thus critical that clinically effective DMHIs like StriveWeekly become more widely available as a safer alternative for young people to use. Future research could compare StriveWeekly against AI chatbot interventions to assess relative effectiveness, identify possible risks, and determine ways AI features—such as personalized feedback or adaptive content—could be safely integrated for user engagement purposes. For now,

campus administrators should ensure that DMHIs with demonstrated effectiveness data are as accessible to their students as AI tools like ChatGPT.

Conclusion

To reduce the burden of mental illness in young people, we need a range of effective and scalable interventions. According to multiple reviews, the majority of commercially available DMHIs lack scientific evidence, and few have been tested in clinical trials.[59–62] Therefore, it is critical that evidence-based DMHIs become more widely disseminated. Our research suggests StriveWeekly could be such a DMHI for preventing anxiety and depression in university students. Moreover, StriveWeekly's campus-wide synchronous delivery has reached a large and diverse portion of the student body on multiple campuses.[10,20] The successful replication of StriveWeekly's effectiveness, even under shifting social contexts and student needs, highlights its potential for sustained impact. Continued replication across diverse campuses, time periods, and technological environments remains important. Further research and development are necessary to increase the likelihood of DMHIs like StriveWeekly bridging the science-to-practice gap for the promotion of student mental health on university and college campuses.

Acknowledgments

We would like to thank Shayna Greenberg for serving as the study coordinator during this trial and for assistance with dataset management and cleaning. We thank John Flournoy for his feedback and review of statistical medication analyses. We also thank our campus partners for their collaborative planning of this trial and implementation of data security development work and recruitment efforts, including: Charles Haggerty and Scott Kearney from Harvard University Information Technology, and Katherine O'Dair, Lauren Brandt, and Lisa Rask Viola from Harvard College Dean of Students Office.

Microsoft Copilot was used to generate a first draft of this manuscript's abstract, which was then edited by the first author.

This work was supported by the: Harvard Foundations of Human Behavior Initiative, Harvard Dean's Competitive Fund for Promising Scholarship; and Harvard College Dean of Students Office. The content of this article is solely the responsibility of the authors and does not represent the official views of any of the funding sponsors. All authors declared that they had insufficient funding to support open access publication of this manuscript, including from affiliated organizations or institutions, funding agencies, or other organizations. JMIR Publications provided article processing fee support for the publication of this article.

Conflicts of Interest

Leslie Rith-Najarian and Christian St Pierre are co-owners of Strive Weekly Inc, a corporation that commercially profits from StriveWeekly subscription services. This business entity was not formed until after the data collection and statistical analyses for this study were complete. The authors have no other conflicts of interest to disclose.

Data Availability

This trial was pre-registered with ClinicalTrials.gov and results have been posted online (NCT-049278450). Data from this study and statistical analysis syntax are openly available on OSF.org here: https://osf.io/rdmgu/files.

Authors' Contributions (recommended)

Leslie Rith-Najarian's contributions included: conceptualization of study objectives, formal data analysis, funding acquisition, investigation, methodology design, project administration, creation of StriveWeekly intervention content, supervision of study staff, and writing the draft of this manuscript.

Christian St Pierre's contributions included: software development of the StriveWeekly platform, design of platform database, coordination of local information technology implementation, supervision of database security during data collection, and writing commentary in the manuscript about implications of the study.

Katie McLaugling's contributions included: conceptualization of study objectives, funding acquisition, investigation, methodology design, supervision of study staff, and reviewing and editing this manuscript.

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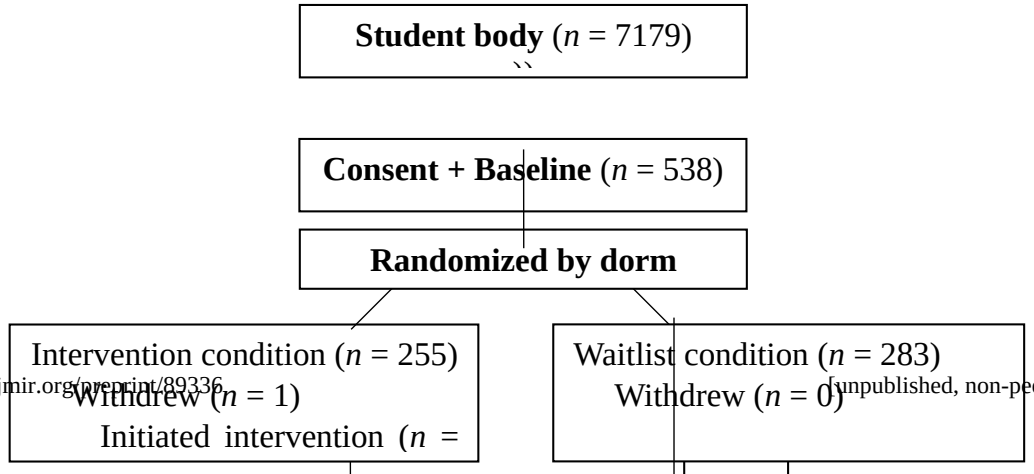
Table 1. Descriptions of module content

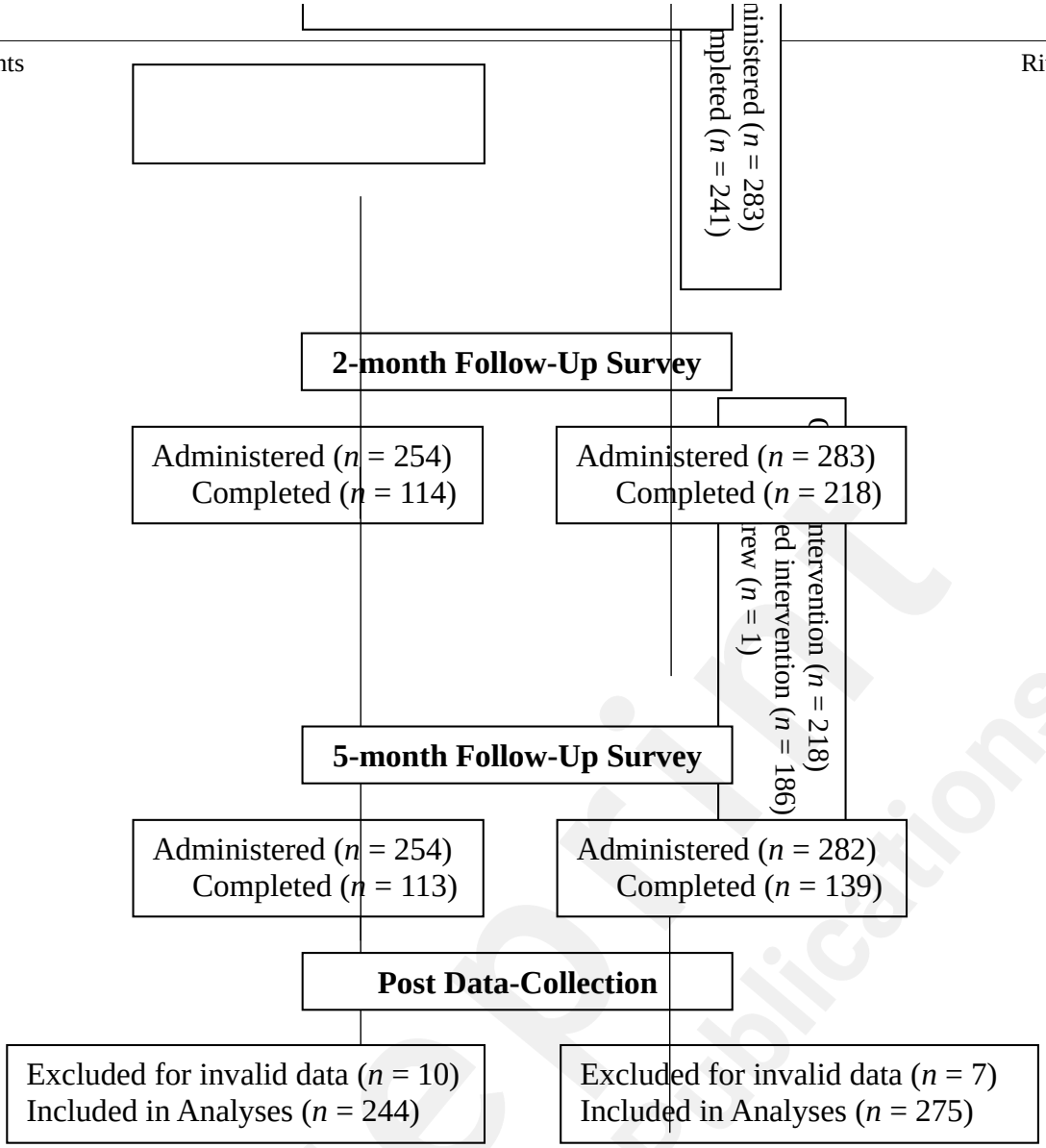
Module	Strategies/Skills	Example activities
1. Welcome	● Treatment rationale ● Self-monitoring ● Time Management	Review your goal plan; Check out the "Progress" section of your dashboard; Set SMART goals; Prioritizing tasks by urgency and your values
2. Reappraisal	● Cognitive distortions ● Cognitive restructuring	Identify unhelpful thinking habits; Identify evidence for and against thoughts; Shift your attention
3. Reinforcement	● Behavioral activation ● Activity scheduling	Spend time on a hobby; Clean and organize; Good deeds
4. Relaxation	● Mindfulness ● Relaxation	Listen to guided meditation; Paced breathing; Progressive muscle relaxation
5. Restoration	● Sleep hygiene	Do relaxing activities pre-sleep; Make a worry list and set aside; Avoid caffeine in the afternoon
6. Recreation	● Physical exercise ● Outdoor recreation	Go to the gym with friends; Try a new sport, fitness activity, or class; Go for a walk
7. Reflection	● Maintenance planning	Review progress; Print favorite materials; Plan for triggers

Table 2. Demographic Composition and Baseline Characteristics by Condition

		Intervention (n = 244)	Waitlist (n = 275)	Total (n = 519)
Race/ ethnicity	Latinx	19.7%	15.3%	17.3%
	American Indian or Alaska Native	0.8%	1.5%	1.2%
	Asian or Asian American	26.2%	34.2%	30.4%
	Black or African American	8.2%	8.0%	8.1%
	Middle Eastern	2.9%	3.3%	3.1%
	multiracial	7.8%	6.5%	7.1%
	Native Hawaiian or other Pacific Islander	0.8%	0.4%	0.6%
	Other	3.7%	2.5%	3.1%
	Prefer Not to Say	3.3%	4.0%	3.7%
	White	46.3%	39.6%	42.8%
International	Yes	13.9%	15.3%	14.6%
	No	85.2%	82.9%	84.0%
	Prefer Not to Say	0.8%	1.8%	1.3%
Gender Identity	Female, Woman, or Feminine	64.3%	63.6%	64.0%
	Gender-non-binary, -queer, -non-conforming, -fluid	2.0%	2.9%	2.3%
	Male, Man, Masculine	32.4%	31.3%	31.8%
	Trans Man, Male, Masculine	0.0%	0.4%	0.2%
	Prefer Not to Say	1.2%	1.8%	1.5%
LGBTQ+	Yes	23.8%	20.7%	22.2%
	Questioning	5.7%	8.0%	6.9%
	No	67.2%	66.9%	67.1%
	Prefer Not to Say	3.3%	4.4%	3.9%
First generation college student = yes		16.4%	17.8%	17.1%
Academic Year	First year	26.2%	40.4%	33.7%
	Junior	27.0%	18.9%	22.7%
	Senior	19.7%	20.4%	20.0%
	Sophomore	25.8%	20.4%	22.9%
	Visiting	1.2%	0.0%	0.6%
Mean Baseline Score	DASS-21	16.73	16.31	16.51
	PSS	19.05	18.48	18.75
	Warwick	23.07	23.25	23.17

Figure 1. CONSORT Flow Diagram





Appendix A: Detailed Acceptability Results

Results from adapted mHealth App Usability Questionnaire (*n* = 245)

	Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Disagree
1. StriveWeekly was easy to use.	32%	33%	12%	16%	8%
2. It was easy for me to learn to use the online platform.	37%	27%	14%	16%	6%
3. I like the interface of the online platform.	20%	30%	19%	18%	13%
4. The information in StriveWeekly was well organized, so I could easily find the information I needed.	22%	34%	19%	16%	8%
5. I feel comfortable using StriveWeekly in social settings.	21%	21%	36%	16%	6%
6. The amount of time required for StriveWeekly was fitting for me.	26%	29%	25%	15%	5%
7. I would use StriveWeekly again.	20%	29%	22%	17%	12%
8. Overall, I am satisfied with StriveWeekly.	22%	34%	24%	12%	7%
9. Whenever I made a mistake using the online platform, I could recover easily and quickly.	22%	26%	38%	9%	5%
10. The online platform adequately tracked and acknowledged my progress and actions.	27%	36%	25%	9%	3%
11. The interface of the platform allowed me to use all the functions when accessing StriveWeekly on my computer	56%	25%	14%	2%	2%
12. The interface of the platform allowed me to use all the functions when accessing StriveWeekly on my phone or tablet	10%	16%	60%	10%	4%
13. The navigation was consistent when moving between sections and tabs.	39%	35%	16%	7%	2%
14. The online platform has all the functions and capabilities I expected it to have.	30%	35%	24%	9%	3%
15. StriveWeekly was useful for my health and well-being.	20%	30%	33%	12%	5%
16. StriveWeekly helped me manage my mental health effectively.	12%	28%	41%	11%	9%

Module ratings

	N	Loved it: it was awesome or very helpful	Liked it: it was interesting or helpful	Neutral: liked some parts, disliked others1 =	Disliked it: it was uninteresting or unhelpful0 =	Hated it: it was awful or very unhelpful
Welcome	227	8%	40%	35%	16%	1%
Reappraisal	201	16%	47%	27%	9%	0%
Reinforcement	191	21%	46%	26%	7%	1%
Relaxation	180	31%	42%	21%	6%	0%
Restoration	162	29%	40%	20%	10%	0%
Recreation	159	31%	33%	23%	10%	3%
Reflection	155	9%	42%	37%	12%	0%

Percentage of participants endorsing self-identified reasons for intervention engagement

Reasons	%
Weekly prize drawings	64%
Email reminders	59%
Completer prize drawing	51%
Finding the exercises and skills to be helpful	34%
Virtual weekly medals (bronze, silver, gold)	33%
Learning about mental health and how skills work	27%
Noticing improvement in my mood, stress, and/or anxiety	16%
Seeing my stress and mood ratings graphed over time	18%
Seeing the history log of my weekly activity	18%
The goal-setting and personal plan that I made when I set-up my account	16%
Reading the "Extras" section each week	10%
Using resources in the "Campus" tab	8%
Knowing that a lot of students were participating at the same time	6%
The anonymous live stream of participant activity (under the “Campus” tab)	6%
Knowing specific people who were also participating	5%

Representative Qualitative Quotes from Student Participants

- “I think StriveWeekly had a lot of things that everybody "knows", like that we should exercise, practice mental health measures, and sleep well, but it was effective to be pushed to actually *do* it for a week.”
- “I like that it was informative and effective without having to consume tons of content. Content was very useful and relevant.”
- “I think the incentive of a weekly prize really helped, and I really liked the idea of a tiered medal every week. It pushed me to go further than I might have otherwise.”
- “I really liked the topics featured and how they’re evidence-based. Getting the weekly reminders really helped. The prize drawings definitely motivated me as well.”
- “The most helpful part was Relaxation. That was my favorite module. It was also well-timed. It was in the midst of a stressful week because of midterms and other social things happening, so to have a reminder to relax really helped me.”
- “I enjoyed how accessible and clear the instructions were - they made it easy to participate without having to dedicate a huge amount of effort.”
- “The best parts of StriveWeekly were the content and the gentle reminders. I also liked talking about it with friends”
- “The most helpful part of StriveWeekly was the lists of different activities suggested for the week as well as the Values chart at the beginning. Being able to go back to the latter really helped me figure out what is important to me. I really liked the suggestions that were provided for different activities we could try to start and reinforce habits, particularly for the Reinforcement and Relaxation weeks. Email reminders helped me stay engaged in using the program.”
- “I liked the general information that was provided and the fact I was able to think about what would hinder me from achieving my set goals for that week. It gave me the chance to pre-recognize what would hinder me and when these obstacles came up I could quickly remind myself what I was trying to achieve that week (or at that moment) and why it was important to achieve it.”
- “Learning tools for mindfulness and reinforcement and cognitive restructuring. I liked setting my own goals and choosing my own activities for the week. It helped me personalize my own week and feel engaged.”
- “I liked the sequencing of the themes and how they all related to each other. The program was motivating. The reminders were really helpful. Overall, lots of great tips!”

Supplementary Files

CONSORT (or other) checklists

CONSORT?EHEALTH checklist.
URL: http://asset.jmir.pub/assets/8bc4a7c4a9b2dbe305d5745077bf4b04.pdf