Meeting the mental health needs of college-aged young adults: evaluating the value and impact of digital mental health interventions.

Sara Atherton Choate
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MEETING THE MENTAL HEALTH NEEDS OF COLLEGE-AGED YOUNG ADULTS: EVALUATING THE VALUE AND IMPACT OF DIGITAL MENTAL HEALTH INTERVENTIONS

By

Sara Atherton Choate
B.S., University of Wisconsin-Madison, 2001
M.S.Ed., City College of New York, 2009

A Dissertation
Submitted to the Faculty of the
School of Public Health and Information Sciences of the University of Louisville
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University of Louisville
Louisville, Kentucky

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A Dissertation Approved on

August 4, 2022

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DEDICATION

This dissertation is dedicated to my mother who taught me the value of perseverance and hard work and to my partner, Kent and daughter, Frances, for keeping me grounded in the preciousness of the present moment.
I would like to thank my academic advisor and colleague, Dr. Liza Creel, for her consistent and thoughtful guidance in the last seven years. She has been instrumental in creating access to numerous academic and professional opportunities, and I am forever grateful for her mentorship. I would also like to elevate one of my committee members, Dr. David Johnson, who has also been in my corner for the last decade providing sage wisdom and opportunities to grow as a budding academic. In addition, I would like to express gratitude to my other committee members Dr. Seyed Karimi and Dr. Bernadette Walter, for sharing their valuable time and expertise during the various stages of my academic and professional journey. Additionally, I’d like to thank Dr. Dave Roelf, who provided critical support and a wealth of thoughtfully designed instruction that informed much of my statistical knowledge and skill-building. Finally, I’d like to thank my family and close friends who stepped up and supported me through my doctoral studies, especially my mother-in-love, Laura, who helped us co-parent our daughter, Frankie, when daycare wasn’t a safe option. And to my partner, Kent, for his love and patience as we weathered the many challenges that naturally arise when growing a life together.
ABSTRACT

MEETING THE MENTAL HEALTH NEEDS OF COLLEGE-AGED YOUNG ADULTS: EVALUATING THE VALUE AND IMPACT OF DIGITAL MENTAL HEALTH INTERVENTIONS

Sara A. Choate

July 6, 2022

BACKGROUND: The growing prevalence of common mental health problems poses a serious hindrance to young adults, and the majority of those in need of mental health support do not seek professional psychological services. Digital mental health interventions (DMHIs) that allow for self-management of mental health symptoms could provide a useful adjunctive to traditional one-on-one counseling or therapy and offer a useful prevention tool for students at risk for experiencing mental health crises. This dissertation explored the efficacy of self-guided DMHIs targeting college students, the factors associated with help-seeking in young adults, and the impact of implementing an evidence-based DMHI at a public 4-year university for first-year students.

METHODS: The first analysis employed a systematic review guided by the PRISMA protocol to examine the effectiveness of technology-delivered interventions (e.g., mobile app) in reducing, improving, or preventing symptoms associated with depression,
anxiety, psychological distress, or stress in college students from 2008 to 2021. The second analysis used the Healthy Minds Study (HMS) data from 2015-16 to 2020-21 to analyze help-seeking associations of college students through a binary logistic regression model. The final paper proposed a cost consequences model using HMS data from 2018-19 to 2020-21 to identify differences in cost-effectiveness of digital versus traditional mental health services. The RE-AIM model and Aday and Anderson’s Framework for the Study of Access guided the final analysis.

FINDINGS: Certain evidence-based mindfulness, cognitive behavioral therapy (CBT), and acceptance commitment therapy (ACT) apps effectively improved symptoms associated with common mental health problems in college-aged students, though adherence was a common challenge faced by researchers. As young adults experience an increase in severity of their mental health symptoms, the odds that they seek professional help diminishes. This trend was more pronounced in students with depressive symptoms compared to those presenting anxiety symptoms. Non-Latinx Black students presented the greatest lack in help-seeking in the study sample. Non-Latinx White, Latinx, and multi/other race students demonstrated a steady increase in help-seeking behavior prior to the COVID-19 pandemic. However, by 2018, help-seeking began to plateau and decline in the years leading up to and during the pandemic. Headspace, an evidence-based mindfulness app, demonstrated promising outcomes as a cost-effective intervention that may serve to complement traditional campus mental health services and prevent the onset of common mental health problems when integrated early in the college experience.
CONCLUSIONS: Leaders and mental health professionals in higher education continue to face serious challenges as they navigate the increasing severity and complexity of student mental health needs in the wake of the COVID-19 pandemic. Although utilization of mental health services has steadily increased in the last decade, colleges and universities are not able to keep up with demand. Most students in need of mental health services will never seek professional services. When integrated thoughtfully into different aspects of campus life, certain evidence-based, self-guided DMHIs offer a versatile and cost-effective approach to improving student access to a wider range of quality mental health services.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEDICATION</td>
<td>iii</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iv</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>v</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>x</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xi</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>CHAPTER 1: A SYSTEMATIC REVIEW OF SELF-MANAGED TECHNOLOGY-DELIVERED INTERVENTION EFFICACY IN YOUNG ADULTS: POLICY IMPLICATIONS FOR HIGHER EDUCATION</td>
<td>9</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>10</td>
</tr>
<tr>
<td>METHODS</td>
<td>13</td>
</tr>
<tr>
<td>RESULTS</td>
<td>16</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>16</td>
</tr>
<tr>
<td>CHAPTER 2: THE INFLUENCE OF SOCIODEMOGRAPHIC, MENTAL HEALTH STATUS, AND HELP-SEEKING FACTORS ON LOW AND HIGH HELP-SEEKING IN COLLEGE-AGED STUDENTS</td>
<td>46</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>47</td>
</tr>
<tr>
<td>METHODS</td>
<td>50</td>
</tr>
<tr>
<td>RESULTS</td>
<td>51</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>56</td>
</tr>
<tr>
<td>CONCLUSIONS</td>
<td>62</td>
</tr>
</tbody>
</table>
Table 1. Characteristics of Studies with Self-Management of Technology-Delivered Mental Health Support for Young Adults.................................................................60
Table 2. Study Characteristics of Low and High Help-Seeking Students ................. 66
Table 3. Deleted Observations: Medium Help-Seeking Students ........................... 69
Table 4. Binary regression predicting the odds of student who would seek help for emotional distress from a clinical professional\(^a\) (high help-seeking) versus 0-1 non-clinical source .................................................................................. 72
Table 5. Number of Observations ........................................................................... 102
Table 6a. Perceived Helpfulness of Mental Health Support: Therapy and Apps (freq.) .............................................................................................................. 103
Table 6b. Perceived Helpfulness of Mental Health Support: Therapy and Apps (%) ...................................................................................................................... 104
Table 7a. Perceived helpfulness of mental health apps for students presenting depressive &/or anxiety symptoms ........................................................................... 105
Table 7b. Perceived helpfulness of therapy or counseling for students presenting depressive &/or anxiety symptoms ........................................................................... 106
Table 8a. Costs of Headspace intervention for academic year targeting first-year students............................................................................................................ 107
Table 8b. Effects of Headspace intervention for academic year targeting first-year students............................................................................................................ 108
Table 9a. Costs of current practice (in-person therapy) for academic year targeting first-year students............................................................................................................ 109
Table 9b. Effects of current practice (in-person therapy) for academic year targeting first-year students............................................................................................................ 111
Table 10. Return on investment for proposed intervention and current practice........ 112
LIST OF FIGURES

Figure 1. Logic model of digital mental health interventions for college students........ 43
Figure 2. Study Flow Diagram for the Systematic Review ................................ 44
Figure 3. Study Missing Observations Flow Diagram........................................ 61
Figure 4. Predicted Odds by Year and Race .................................................. 70
Figure 5. Framework for the Study of Access .................................................. 107
INTRODUCTION

In the last two decades, symptoms associated with depression, anxiety, psychological distress, and stress have more than doubled in U.S. college student populations (Eisenberg, Golust, Golberstein, & Hefner, 2007; Mortier et al., 2018; Gallagher, 2012; Duffy et al., 2019). Nationally, mental health diagnoses have increased almost 15% over the course of a decade. Concurrently, due to an array of factors including decreased stigma, the rate of treatment for mental health disorders has also increased from 19% in 2007 to 34% by 2017 (Lipson, Lattie, & Eisenberg, 2019). According to a study conducted by Lipson et al. (2022), by 2021, more than 60% of college students reported symptoms associated with one or more mental health problems, revealing an almost 50% increase from 2013. The COVID-19 pandemic compounded these trends, creating additional stressors that have further increased the severity of stress, depression, anxiety, and psychological distress in this population of young adults, especially those with historically marginalized identities at a critical stage in their development (Kim et al., 2022). Consequently, campus counseling centers have struggled to meet the spike in demand (Association for University and College Counseling Center Directors, 2019). Eisenberg et al. (2022) have demonstrated that untreated mental health issues are associated with lower academic achievement, which increases the likelihood that a student will drop out before completing their degree. In response, leaders in higher education have become increasingly more open to exploring innovative approaches that
integrate an array of student-centered strategies to address this persistent challenge
(Lipson, Abelson, Ceglarek, Phillips, & Eisenberg, 2019).

**Help-seeking Behaviors in College-aged Adults**

Initially proposed by Fischer and Turner (1970), mental health help-seeking attitudes are based on 4 dimensions: recognition of need for psychological help, stigma tolerance, interpersonal openness, and confidence in mental health professionals. Not surprisingly, positive mental health help-seeking attitudes have been shown to be positively related to increased mental health service use (Nam, Choi, Lee, Lee, Kim, & Lee, 2013). However, despite an increase in overall utilization of mental health services by college students in the last decade, this trend has not been consistent across ethnicities. Black, Latinx, and Asian-American students are less likely to seek clinical services than their White counterparts (Li, Dorstyn, & Denson, 2016; Masuda et al. 2009a; Masuda, Price, Anderson, Schmertz, & Calamaras, 2009b; Mendoza, Masuda, & Swartout, 2015).

This disparity in help-seeking is influenced by students’ knowledge of those close to them who have sought professional psychological services. In a study conducted by Masuda et al. (2009a), 80% of White students reported having a close friend or family member who had received therapy or counseling for mental health problems compared to 46% of Black and 26% of Asian American students. Contributing to this cultural difference, Masuda and his colleagues (2009b) found that non-whites in their sample demonstrated lower perceived need when experiencing psychological distress, less tolerance for stigma surrounding seeking mental health services, less willingness to disclose personal issues with another person, and greater distrust in clinical professionals.
than White students. These factors, as well as other barriers including a lack of culturally sensitive services (Augsberger, Yeung, Dougher, & Hahm, 2015; Busby et al., 2019) and location of services (Hunt, Eisenberg, Lu, Gathright, 2015) have resulted in historically marginalized student groups not seeking the treatment they need, and consequently posing serious risk to their long-term mental health and well-being without proper intervention.

**Digital Mental Health Interventions for Students in Higher Education**

Compared to traditional, in-person psychological services, digital mental health interventions (DMHIs) have the ability to reach a greater number of individuals at a lower cost, while simultaneously minimizing typical barriers to seeking help (e.g., time spent seeking treatment) (Lattie, Adkins, Winquist, Stiles-Shields, Wafford, & Graham, 2019). However, while there has been a proliferation of DMHIs in the last decade, few have been rigorously evaluated for effectiveness (Ondersma & Walters, 2020). Still, many of these interventions have shown promising approaches to address treatment gaps by providing varying levels of support for a range of conditions, including depression, anxiety, and stress (Martinez, Rojas, Martinez, Lara, & Perez, 2018; Lau, Htunn Wong, Tam, & Klainin-Yobas, 2017; Spijkerman, Pots, & Bohlmeijer, 2016; Rogers, Lemmen, Kramer, Mann, & Chopra, 2017). As DMHIs have become more accessible, the American Psychiatric Association has responded by providing mental health professionals with guidance outlining what digital interventions to recommend to a patient to complement or support their treatment (Torous et al., 2018). Many researchers have chosen to use the Mobile Application Rating Scale (MARS), a validated and reliable
instrument, to evaluate the quality of content in commercially available DMHIs (Terhorst et al., 2020). And even still, for DMHIs that do demonstrate meaningful results in controlled studies, there often exists a pronounced research-to-practice gap when they are applied to real-world settings (Folker, Mathiasen, Lauridsen, Stenderup, Dozeman, & Folker, 2018). In one study, Oti and Pitt (2021) found that taking a student-centered approach that focused on certain design elements important to young adult users, including adding personalization, ensuring anonymity and privacy, peer engagement, and improved adherence.

On college campuses, the possible application of DMHIs can vary greatly. As campus counseling centers continue to struggle to meet the demand of students seeking mental health services, there is evidence that self-guided mindfulness apps could effectively support students who are waiting to be seen. In one randomized control study, from a sample of approximately 200 college students who received either one of two commercially available mindfulness apps, Headspace or Calm, results demonstrated significant improvement of common mental health symptoms (Flett, Hayne, Riordan, Thompson, & Conner, 2019). In another study, results from an eight-week mobile mindfulness app targeting 109 undergraduate students indicated a significant reduction of stress (Glissman, 2018). For institutions of higher education considering the possibility of expanding their mental health services to include DMHIs, the wide array of digital mental health products, ranging from self-guided mindfulness meditation apps to clinically supervised cognitive behavioral therapy apps, do not provide a clear roadmap to making the greatest and equitable impact. Before researchers make recommendations on which
commercially available DMHIs are best for students, a more thorough understanding of what types of students would most benefit, what circumstances optimize engagement and support, and best practices for cultivating a climate that lessens the barriers many students, especially those who have historically marginalized identities, face in their access to mental health services on campus is needed.

Overview

The three manuscripts that comprise this dissertation address gaps in the mental health prevention and treatment needs of young adults during their higher education experience in the wake of the COVID-19 pandemic. The papers present a unified argument demonstrating the importance of meeting the diverse range of mental health care needs of college-aged students by augmenting typical campus health mental health services with an evidence-based digital mental health intervention. The first paper identifies self-guided digital mental health interventions that have proven to be effective at reducing common mental health problems in college-aged students. The second paper examines help-seeking behaviors of college students, providing insight into the range of student needs and opportunities to address unmet needs. Finally, the third paper presents a hypothetical economic evaluation of the costs and impact associated with an identified digital mental health intervention pilot targeting first-year undergraduate students at the University of Louisville.

The first manuscript, informed by the Behavioral Intervention Technology (BIT) model, is the first to systematically review the efficacy of self-managed apps targeting college students as a means of identifying digital mental health interventions that have
proven to be effective at reducing, improving, or preventing the symptoms associated with common mental health disorders, including depression, anxiety, psychological distress, and stress. Informed by a logic model and following the PRISMA protocol for systematic reviews, this paper identified peer-reviewed studies based on a set criteria from a sufficient number of appropriate databases, and assessed the quality of included studies using the Cochrane risk-of-bias tool for randomized trials, version 2.0. If institutions of higher education want to be responsive to the growing epidemic of mental health problems facing young adults, then expanding the types and mechanisms by which students can manage their mental health must be considered and implemented. This paper contributes to this national call to action.

Informed by the dimensions of access, approachability, acceptability, availability and accommodation, affordability, and appropriateness (Levesque, Harris, & Russell, 2013) and Diderichsen’s model of the mechanisms of health inequality (2012), the second manuscript examines the help-seeking behavior of a national, population-level, cross-sectional sample of college students. Methodologically, this paper utilizes data from the Healthy Minds Study (HMS) to conduct a binary logistic regression with clustered standard errors at the school level. While controlling for demographic, mental health status, and factors that affect help-seeking, the analysis examines help-seeking behavior of college students when they experience emotional distress, comparing between those who prefer to speak to no one or one non-clinical person (i.e., low help-seeking) and those who seek clinical services (i.e., high help-seeking). This paper contributes to the literature in the breadth of years examined (2015-2021), spanning 5
years prior to the COVID-19 pandemic when both mental health diagnoses and help-seeking were steadily rising to the second year of the global pandemic when college students faced additional mental health stressors and severity of mental health conditions. Through its breadth, this paper reveals opportunities for college health and student services professionals to consider what groups of students require the greatest attention, and how certain help-seeking behaviors need to be addressed to meet the wide range of mental health needs in a diverse student body.

The final manuscript completes the dissertation by considering the impact of a hypothetical implementation of one of the evidence-based DMHIs identified in the first manuscript at the University of Louisville. The analyses, guided by the RE-AIM theory, utilize a cost consequence model, demonstrating the cost effectiveness of the proposed intervention, a pilot Headspace app program targeting 1000 first-year undergraduate students compared to the current practice, clinical in-person therapy for 1000 undergraduate students. To provide a framework for student willingness to use DMHIs to support their mental health based on how helpful students perceived therapy and DMHIs to be, this paper also conducted correlational analyses from the HMS datasets from 2018-2019, 2019-2020, and 2020-2021. Despite the small sample size, the analysis enabled calculations measuring cost effectiveness of the proposed intervention versus the current practice. As such, this economic evaluation provides evidence to support the utility of the coordinated integration of both digital and traditional mental health services to address the mental health prevention and treatment needs of college students early in their higher education experience.
Together, these manuscripts provide a cohesive examination of the stark challenges institutions of higher education face as they endeavor to address the diverse and shifting needs of college-aged adults, the majority of whom will struggle with some form of mental health challenge at some point in their young adulthood. In addition, they demonstrate how effective DMHIs may support the limited selection of mental health services typically offered by campuses, as well as the economic value DMHIs may offer universities and colleges still reeling from the economic impact of the COVID-19 pandemic. This global crisis has presented the industry of higher education with the opportunity to innovate how it addresses student mental health services. These manuscripts challenge leadership in higher education to think beyond traditional means of mental health services, and consider expanding their vision of mental health services to include evidence-based digital interventions to prevent, reduce, and improve common mental health problems that the majority of their students will likely encounter during their early adult years.
CHAPTER 1: A SYSTEMATIC REVIEW OF SELF-MANAGED TECHNOLOGY-DELIVERED INTERVENTION EFFICACY IN YOUNG ADULTS: POLICY IMPLICATIONS FOR HIGHER EDUCATION
INTRODUCTION

The delivery of mental health care on college campuses in the U.S. has traditionally relied upon the standard mechanisms of in-person care, namely one-on-one counseling, medical appointments with a psychiatrist or nurse practitioner, and/or support groups. This practice has proven insufficient in meeting the growing need of young adults, many of whom are currently entering higher education, and disproportionately seek more mental health services compared to previous generations (Eisenberg, Hunt, & Speer, 2013). Despite a greater willingness compared to previous generations, approximately 75% of college-aged students who have experienced mental health problems do not seek professional support because they were not aware of services offered (Hunt & Eisenberg, 2010), or experienced other barriers to seeking treatment including a lack of perceived need, attitude towards treatment value, discomfort with emotions, perceived stigma, limited health literacy, lack of access, and cultural barriers (Andrade et al., 2014; Eisenberg, Golberstain, & Gollust, 2007; Shea, Wong, Nguyen, & Gonzalez, 2019). This need has only been exacerbated by the COVID-19 pandemic, which has further overwhelmed and complicated how students seek and receive psychological services (Le et al., 2020). As mental health issues go untreated, symptoms and their effects become more persistent and less responsive to intervention over time (Wang, Berglund, Olfson, Pincus, Wells, & Kessler, 2005). This increase in common mental health problems is characteristic of the current generation of students, known as GenZ or iGen (born 1997-2012), who report higher rates of stress, anxiety and/or depression, have less tolerance for emotional distress, and spend six to eight hours/day
online/texting/on social media (Lipson, Lattie, & Eisenberg, 2019; Twenge, Joiner, & Rogers, 2017). Campus counseling centers are failing to keep up with demand; as a result, most college-aged students in need of services are going untreated (Lipson, Lattie, & Eisenberg, 2019). Due to a collective familiarity and frequency of smartphone use, this population may be more inclined to access services using their digital devices, which offer a low-cost option that is easy to access and demonstrates robust habit strength (East & Havard 2015). Technology-mediated upstream approaches integrated into their higher education experience could circumvent some of the barriers to seeking mental health support through a combination of smart design, ease of mobile device use, and campus-wide buy-in of an effective app or platform.

According to the National Institute of Mental Health (2009), technology-delivered interventions may address a range of topics including self-management, cognition improvement, coping skills, and tracking of symptoms. And yet, most app development models have not been empirically validated, resulting in a variety of interventions on the market that may or may not be effective in meeting the mental health issues of their users (Ondersma & Walters, 2020). In one study addressing symptoms of anxiety and depression disorders, certain computerized Cognitive Behavioral Therapy (cCBT) treatments were overall effective in populations of young adults, deeming them worthwhile in a patient’s range of therapy options (Andrews, Cuijpers, Craske, McEnvoy, & Titov, 2010). While many of these are best utilized under the care of a mental healthcare professional, some digital interventions may offer an alternative approach to traditional therapy. In a systematic review, Musiat & Tarrier (2014) identified approximately one hundred publications examining cCBT treatments; the
results overall suggested that cCBT treatments are more often less expensive than standard mental healthcare services. Additionally, the evidence indicated high satisfaction among patients who received cCBT treatment, as well as decreased attrition and greater commitment to the skills learned, which was achieved through the support of therapists and other support sources (Musiat & Tarrier, 2014). Furthermore, mobile apps that are based on mindfulness skill building and practice, which may include a combination of formal meditation (e.g., focus on one’s breath) and informal practices (e.g., bringing awareness to everyday activities) have also demonstrated evidence of improving symptoms associated with depression, anxiety, and stress in young adults (Spijkerman, Pots, & Bohlmeijer, 2016). In a meta-analysis of online mindfulness interventions and their effect on common mental health problems in adults, Spijkerman, Pots, & Bohlmeijer (2016) observed significant, small effects in subjects’ level of depression, anxiety and well-being and a moderate effect on stress. These findings suggest that digital mindfulness training may offer users a practical tool to address mild to moderate mental health symptoms.

The goal of this systematic review is to summarize the current modes of technology-delivered interventions addressing mental health of emerging adults, specifically those in a higher education setting, to examine which of these technologies are effective in improving the coping skills without the support of a clinical professional. This research is rooted in the Behavioral Intervention Technology (BIT) model, which combines the evaluation techniques of software designers with the principles of behavioral science to inform the specific aims, behavioral change strategies, and technology aspects of the design process; these elements, in turn inform the BIT-tech
framework (Mohr, Liberati, Tetzlaff, & Altman, 2014). To the best of our knowledge, there is no current review of this research topic that addresses this specific set of inclusion criteria or focus.

**METHODS**

*Design.* We conducted the systematic review based on relevant guidance in the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement (Moher, Liberati, Tetzlaff, & Altman, 2010). Following the Cochrane Collaboration guidelines, the systematic review of technology-assisted interventions was informed by conceptual and operational definitions relevant to the research and PICOS review parameters--Participants, Intervention, Comparison group, Outcomes, Study design (Higgins et al., 2022).

We adapted a logic model to identify relevant inclusion criteria, further supported the development of a narrow review focus that revealed causal links and identified moderator effects. See Figure 1.

*Data sources and search strategy.* Electronic databases Pubmed, Proquest Dissertation & Theses Global, Science Direct, Embase, Web of Science, APA PsycArticles, APAPsycInfo were searched using key search terms. These databases were selected because of the journals, dissertations, and gray literature they index. Articles selected were published between January 1, 2008, the year in which the first mobile app was launched (Donker, Petrie, Proudfoot, Clarke, Birch, & Christensen, 2013) and December 31, 2021.

We finalized search terms based on previous reviews and input from a field expert and health science librarians. The following search terms were used for each database:
mental health app, depression app, anxiety app, psychological distress app, e-mental
health app, eMental health app, mobile mental health, smartphone mental health app,
mHealth app, wellbeing app, happiness app, mindfulness meditation app, positive
psychology app, mental illness app, CBT app, cognitive behavioral therapy app, ACT
app, acceptance and commitment therapy app, DBT app, dialectical behavior therapy
app, IPT app, interpersonal therapy app.

The following filters were used when permitted: young adult (subject), English
only (language), and peer-reviewed journal articles and clinical study (type of
publication).

We were interested in any type of intervention study that addressed the most
common types of mental health conditions (e.g., depression and anxiety), including stress
or ideal states that prevent common mental health conditions from occurring (e.g.,
wellbeing) in young adults in higher education settings. According to the American
Psychiatric Association (n.d.), depression is defined as a state characterized by “a lack of
interest and pleasure in daily activities, significant weight loss or gain, insomnia or
excessive sleeping, lack of energy, inability to concentrate, feelings of worthlessness or
excessive guilt and recurrent thoughts of death or suicide “and anxiety is defined as “an
emotion characterized by feelings of tension, worried thoughts and physical changes like
increased blood pressure”. For the purposes of this review, we used Cuijpers, Smits,
Donker, ten Have, & de Graf’s (2009) definition of psychological distress, which
describes it as a mental health state characterized by non-specific symptoms of stress,
anxiety, and/or depression. Finally, stress is defined as the feeling of being overwhelmed
or unable to cope with mental or emotional pressure (Mental Health Foundation, n.d.).
Inclusion criteria

Study Identification. To narrow the scope of this research, the range of studies was limited to those that included technology-delivered interventions aimed at college-aged students with the goal of improving symptoms associated with anxiety and/or depression. Moreover, different types of technology-delivered interventions were examined, as recommended by the American Psychiatric Association’s app evaluation model, including (cCBT) applications, which take into consideration individual user needs and preferences (Torous et al., 2018).

Studies were included if they met each of the following criteria: (1) examined the effectiveness of a mental health technology intervention; (2) targeted college students (i.e., young or emerging adults aged 18-26); (3) assessed depression, anxiety, psychological distress, and/or stress conditions or symptoms or the prevention of aforementioned conditions using standardized outcome measures; (4) supported self-management of the condition or related symptoms.

Studies were excluded if they met any of the following criteria: (1) were not published in English; (2) did not include a standardized measure of depression, anxiety, psychological distress, stress or prevention of aforementioned conditions; (3) addressed any other comorbid mental health condition, addiction, or eating disorder; (4) required additional clinical supervision or support in participant use of the mental health technology (e.g., video conferencing); (5) were any of the following: conference abstract, study protocol, or any type of review, report, or meta-analysis/es.

Data extraction
After duplicates were removed, all abstracts were screened independently by two researchers (SC, HD) using Abstrackr citation manager. Any conflicts were resolved by discussion; there did not arise the need for a third party (LC) to reach consensus. Using EndNote 20, included abstracts were then independently reviewed along with their full text for inclusion in the final review by SC and HD.

RESULTS

Study Selection. A total of 6,332 articles were identified in the initial search. After removing duplicates, 5,799 abstracts were screened; 221 articles were selected for full-text extraction, and 146 articles were excluded after the first full-text review, resulting in 75 articles for full review. The final full-text review focused on narrowing the participant inclusion criteria from young adults to specifically college students, wherein the majority of the young adults attended college, graduate or professional school. Of the remaining 75 articles screened, 21 articles were included in the final review. See Figure 2.

Study characteristics

The characteristics of studies included methodology, outcome measures and results relevant to the scope of the review are outlined in Table 1. Thirteen studies were randomized controlled trials; six were single-arm pilot, proof-of-concept, or evaluation studies; two were non-randomized (i.e., quasi-experimental) studies. Most studies \( n = 16 \) were quantitative; the remaining five employed mixed methods. The search identified fifteen published studies and six unpublished studies. The range of sample size of studies was 18 to 348, with all participants being college or university students.
The majority of interventions employed the use of an app, two versions of the same app, or multiple different apps (n = 17); the remaining modes of delivery were text messages or notifications (n = 2), chatbox via an app (n = 1), or a website and app of the same intervention (n = 1). Among the range of app brands and unnamed prototypes examined, Headspace (n = 3), Calm (n = 3), and ACT Daily (n = 2) were the most common. Outcomes for depression, anxiety, distress, stress, or related prevention of adverse mental health symptoms were measured using validated instruments across studies and varied depending on the mental health focus. Participant outcomes were monitored before and after for the majority of studies (n = 12); the remaining studies assessed 3 times (n = 6), or 4 to 5 times (n = 2) during the study duration. The range of intervention period was 1 (Clarke & Draper, 2020) to 13 weeks (Flett, Conner, Riordan, Patterson, & Hayne, 2020), with 4 weeks being the most frequent length (n = 6), followed by 8 weeks (n = 4). While the majority of studies required participants to complete daily use of the technology, some did not specify frequency of use or instead required a certain number of sessions or minutes of use on a weekly basis. Incentives were offered in 11 studies ranging from payment based on the number of completed tasks to academic credit (e.g., extra credit in a course). Table 1 outlines the methods used in each study in detail.

Psychometric properties

Reliability of measures. As per the inclusion criteria, all studies employed a selection of reliable and validated measures to assess depression, anxiety, psychological distress, stress, and prevention-related outcomes. The most widely employed measures included some form of the Depression Anxiety Stress Scale (DASS) (Bosso, 2020; Haeger, 2016; Krafft, Potts, Schoendorff, & Levin, 2019; Levin, Haeger, & Cruz, 2019;
Vu, 2018), the Perceived Stress Scale (PSS) (Flett, Hayne, Riordan, Thompson, & Conner, 2019; Gabrielli et al., 2021; Glissman, 2018; Huberty et al., 2019; Vu, 2018), the Hospital Anxiety and Depression Scale (HADS) (Bendtsen, Mussener, Linderoth, & Thomas, 2020; Flett, Hayne, Riordan, Thompson, & Conner, 2019; McCloud, Jones, Lewis, Bell, & Tsakanikos, 2020), General Anxiety Disorder Scale (GADS-7) (Gabrielli et al., 2021; Kim, 2017); Center for Epidemiological Studies Depression Scale (CES-D) (Flett, Hayne, Riordan, Thompson, & Conner, 2019; Kajitani et al., 2020; Takahashi, Takada, & Hirao, 2019). While the majority of studies assessed internal consistency of at least one measure ranging from acceptable (.71) (Bosso, 2020) to excellent (.94) (Levin, Haeger, & Cruz, 2019) across time points (n = 16), 6 studies reported acceptable internal consistency (.70-.79) on at least one measure (Daugherty et al., 2018; Haeger, 2016; McCloud, Jones, Lewis, Bell, & Tsakanikos, 2020; Stallman, 2019; Vu, 2018), 1 study demonstrated poor to questionable (.50-.69) results (Stallman, 2019), and 4 studies did not report these measures (Kajitani et al., 2020; Kim, 2017; Lattie, Cohen, Winquist, & Mohr, 2020; Takahashi, Takada, & Hirao, 2019). See Table 1 for relevant measures used in each study.

**Quality Assessment**

*Study protocol.* All studies included in the final review described standardized conditions for all participants with only 2 studies reporting pre-registering study protocols (Bendtsen, Mussener, Linderoth, & Thomas, 2020; Flett, Hayne, Riordan, Thompson, & Conner, 2019).

**Internal Validity**
Blinding of participants and researchers. A small minority of studies blinded participants (Bendtsen, Mussener, Linderoth, & Thomas, 2020; Bosso, 2020; Levin et al., 2019) (n = 3) and researchers (Bendtsen, Mussener, Linderoth, & Thomas, 2020) (n = 1). This was due to sampling and comparator design choices that made blinding not possible. As a result, the majority of the studies demonstrated a high risk of performance and detection bias, respectively.

Randomization and concealment. Of the 14 studies that randomized intervention and control groups, nine described the randomization sequence generator employed. Two studies reported concealment of participant allocation (Bendtsen, Mussener, Linderoth, & Thomas, 2020; Stallman, 2019), and 2 studies reported reasons for not concealing allocation (McCloud, Jones, Lewis, Bell, & Tsakanikos, 2020; Pierce, 2019).

Attrition. Nineteen studies reported attrition providing all associated numbers; the majority of these provided reasons when available and exclusions for participants who did not meet certain criteria at various stages. Two studies did not report attrition, one due to a 100% participation rate (Haeger, 2016), while the other was a small feasibility study with no control group (Takahashi, Takada, & Hirao, 2019).

Handling of missing data. While 9 studies did not report how they handled missing data, one reported not having any missing data. The remaining studies reported a range of approaches including person-mean imputation (MacIsaac et al., 2021), multiple imputation (Flett et al., 2020), sensitivity analysis (Bendtsen, Mussener, Linderoth, & Thomas, 2020; McCloud et al., 2020), listwise deletion (Vu, 2018), pairwise deletion (Flett et al., 2020), and restricted maximum or maximum likelihood estimation (Kim, 2017; MacIsaac et al., 2021; Pierce, 2019).
Self-reporting. All studies in the final review relied on self-reporting of symptoms and related aspects of common mental health concerns. Some studies also relied on subjects’ self-reporting on adherence, satisfaction, and engagement.

External Validity

Sampling method and size. All studies depended on a voluntary response (i.e., non-probability) sampling method. Four studies relied on a convenience sample from a class or selection of classes or campus counseling center clients. Only 3 studies achieved 80% power for the desired effect size (Bendtsen, Mussener, Linderoth, & Thomas, 2020; Stallman, 2019; Vu, 2018). In 7 studies, sample size was not powered due to the lack of control or aim of the study (e.g., feasibility pilot).

Inclusion and exclusion criteria. Nineteen studies described inclusion and exclusion criteria; two studies included only one inclusion criterion, that participants be college-aged students (Daugherty et al., 2018; Flett, Hayne, Riordan, Thompson, & Conner, 2019). Five studies only included participants presenting common mental health problems (Bendtsen, Mussener, Linderoth, & Thomas, 2020; Haeger, 2016; McCloud et al., 2020; Pierce, 2019; Stallman, 2019), while two excluded participants who had a mental health diagnosis (Clarke & Draper, 2020; Takahashi et al., 2019). Fourteen studies accepted the range of mental health present in college-aged students, thereby increasing the representative nature of their sample.

Testing effect. Fourteen studies employed a pre- and post-test only testing approach; three of these followed up with participants 1-3 months post-intervention. Seven studies tested participants at baseline, mid-treatment and post-intervention, while
the remaining 2 studies tested four or five times over the duration of the study (McCloud, Jones, Lewis, Bell, & Tsakanikos, 2020; Pierce, 2019).

Useability and engagement

*Participation rates.* There was a wide range of participation within and across studies. For studies with no control (Clarke & Draper, 2020; Gabrielli et al., 2021; Haeger, 2016; Lattie, Cohen, Winquist, & Mohr, 2020; MacIsaac et al., 2021; Takahashi, Takada, & Hirao, 2019), those with fewer than 25 subjects reported participation rates that were either 50% (Takahashi, Takada, & Hirao, 2019) or 95-100% (Haeger, 2016; Lattie, Cohen, Winquist, & Mohr, 2020). For studies with larger sample sizes (n = 71-269), participation rates ranged from 49% to 81% (Clarke & Draper, 2020; Gabrielli et al., 2021; MacIsaac et al., 2021). Gabrielli et al. (2021) demonstrated an association between symptom severity and participation, specifically students who exhibited greater severity of anxiety and stress symptoms were more likely to continue to use the app through the study duration. For studies that had a single intervention and control groups (Bendtsen, Mussener, Linderoth, & Thomas, 2020; Bosso, 2020; Daugherty et al., 2018; Flett et al., 2020; Glissman, 2018; Huberty et al., 2019; Kajitani et al., 2020; McCloud, Jones, Lewis, Bell, & Tsakanikos, 2020; Pierce, 2019; Stallman, 2019), those with the smallest sample sizes (n < 58) completed the post-test (84-89%) (Bosso, 2020; Kajitani et al., 2020; Stallman, 2019). For studies with sample sizes ranging between 72 and 112, there was a greater spread of post-test completion (35-81%) (Daugherty et al., 2018; Glissman, 2018; Huberty et al., 2019; McCloud, Jones, Lewis, Bell, & Tsakanikos, 2020; Pierce, 2019). Daugherty et al. (2018) also reported a 63% response rate to notifications, which may offer some insight into the disparity between intervention and control group
participation, 62 and 35, respectively. For the largest sample sizes (n ≥ 250), approximately 49-67% of participants completed the post-test. Finally, there were 5 studies with a combination of 3 experimental group types (Flett, Hayne, Riordan, Thompson, & Conner, 2019; Kim, 2017; Krafft, Potts, Schoendorff, & Levin, 2019; Levin, Haeger, & Cruz, 2019; Vu, 2018) ranging in sample size from 59 (Levin et al., 2019) to 420 (Vu, 2018). Participation rates ranged from 69% in one waitlist control group (Vu, 2018) to 93% in a Headspace app intervention group (Flett, Hayne, Riordan, Thompson, & Conner, 2019).

**Reminders to engage.** Eleven studies reported use of automated reminders that served to encourage participants to engage with the mental health intervention(s) including text messages, push notifications with prompts, or emails at an established time or at random; of these, 2 studies describe a notification feature being something the participant had to enable. The remaining 10 studies did not contact participants during the course of the study for the purposes of improving engagement.

**Perception of participants.** Thirteen studies asked participants a range of engagement topics including motivations for participation, perceived useability, satisfaction or reward, user experience (i.e., UX), facilitators and barriers to use, and intention for future use. Among these, 3 studies employed a post-test questionnaire (Huberty et al., 2019; Kajitani et al., 2020; Krafft, Potts, Schoendorff, & Levin, 2019; Pierce, 2019), 4 studies asked students open-ended questions (Clarke & Draper, 2020; Daugherty et al., 2018; Lattie, Cohen, Winquist, & Mohr, 2020; Vu, 2018), while 6 studies administered a range of validated measures (Gabrielli et al., 2021; Haeger, 2016; Krafft, Potts, Schoendorff, & Levin, 2019; Levin et al., 2019; Takahashi, Takada, &
Hirao, 2019; Vu, 2018) to capture user feedback. Flett, Hayne, Riordan, Thompson, & Conner (2019) employed a pre-test to what participants would consider to be useful and effective in the intervention before it was administered. One study asked participating students about their motivations for participation; top responses included curiosity about mindfulness and a desire for the intervention to quickly improve their wellbeing (Clarke & Draper; 2020). The User Engagement Scale-Short Form (UES-SF) results from Gabrielli et al. (2021) revealed over 85% of participants positively responded to the perceived useability factor, measuring emotional and cognitive results of the outcome.

When asked, approximately half of the participants in Huberty et al. (2019) indicated that the Calm app had been useful in improving stress symptoms in the short and long-term. Pierce et al. (2019) reported approximately 30% of participants appreciating the ability to self-reflect and consider their emotional and cognitive state as the most helpful outcomes of the intervention.

Haeger (2016) employed the 9-item Program Satisfaction Questionnaire (PSQ), finding that majority of participants reported positive responses to the ACT Daily app’s ease of use, overall satisfaction, and willingness to recommend the app to others. Huberty et al. (2019) reported similar outcomes with approximately 85% of participants reporting satisfaction and enjoyment using the Calm app. Krafft, Potts, Schoendorff, & Levin (2019), employing the System Useability Scale (SUS), found that participants in the simple and complex app conditions reported high levels of satisfaction, including enjoyment, helpfulness, and ease of use. Levin et al. (2019) also employed the SUS, finding high usability ratings that were equivalent between conditions. Participants in Gabrielli et al. (2021) responded in a neutral way to the aesthetic and reward aspects of
the Atena chatbot. Despite every participating student positively responding to the app’s ease of use, only 55% of the sample expressed satisfaction (Takahashi, Takada, & Hirao, 2019). The majority of participants in Vu (2018) (68%) reported the Pacifica app to be helpful; specifically, health activity tracking, the ability to log-in and review their data over time, and the app making participants aware of their emotions and stress were reported as the most useful.

Approximately 14% of participants in Pierce et al. (2019) and 13% of participants in Vu (2018) reported that receiving reminders to reflect or use skills was useful. Among the studies that offered notifications, participants in 2 studies recommended more control over the ability to set reminders for their preferred time of day (Gabrielli et al., 2021; Haeger, 2016).

Fewer participants in Huberty et al. (2019) (68%) reported a willingness to continue using Calm in the future; approximately 76% were likely to recommend it to peers. Of participants using the Intellicare for College Students app, 90% responded positively to the ability to use the program in short bursts of time and indicated a willingness to continue use beyond the study period (Lattie, Cohen, Winquist, & Mohr, 2020).

**Mental health outcomes**

*Depression.* Of the 11 studies addressing depression, 9 interventions demonstrated significant reduction of symptoms associated with the condition. These interventions included 2 unnamed apps (Bendtsen, Mussener, Linderoth, & Thomas, 2020; Takahashi, Takada, & Hirao, 2019) and 7 branded apps, 4 of which are either mindfulness (n = 2), resilience skill-building (n = 1), or cognitive behavior therapy-based
(CBT) (n = 1) and commercially available: Headspace (Flett, Hayne, Riordan, Thompson, & Conner, 2019), Smiling Mind (Flett, Hayne, Riordan, Thompson, & Conner, 2019), JoyPop (MacIsaac et al., 2021), and Feel Stress Free (McCloud, Jones, Lewis, Bell, & Tsakanikos, 2020). Two of the interventions, Intellicare (Lattie, Cohen, Winquist, & Mohr, 2020) and Headspace (Bosso, 2020) failed to demonstrate a significant reduction in depressive symptoms, however, both studies had small sample sizes that either failed to achieve 80% power (Bosso, 2020) or did not attempt due to the nature of the feasibility study (Lattie, Cohen, Winquist, & Mohr, 2020).

**Anxiety.** Of the 11 studies addressing anxiety, 7 interventions demonstrated significant reduction of symptoms associated with the condition. These interventions included 1 unnamed app (Bendtsen, Mussener, Linderoth, & Thomas, 2020) and 6 branded or adapted apps, 3 of which are either mindfulness (n = 2) or cognitive behavior therapy-based (CBT) (n = 1) and commercially available: Headspace (Flett, Hayne, Riordan, Thompson, & Conner, 2019), Smiling Mind (Flett, Hayne, Riordan, Thompson, & Conner, 2019), and Pacifica (Vu, 2018). Among these, Headspace and Smiling Mind apps demonstrated less effectiveness for anxiety than for depression (Flett, Hayne, Riordan, Thompson, & Conner, 2019). Only participants in the Atena psychoeducational chatbot intervention group who were above the clinical threshold and in the severe range for anxiety reported reduction of symptoms by post-intervention (Gabrielli et al., 2021). One intervention, JoyPop (MacIsaac et al., 2021) produced only weak evidence of efficacy. Two of the remaining 3 studies (Bosso, 2020; Lattie, Cohen, Winquist, & Mohr, 2020) failed to demonstrate a significant reduction in anxiety symptoms for the aforementioned reasons (See Depression). While a sufficient sample size was achieved,
the cognitive restructuring aspect of an unnamed app may not have been comprehensive enough (i.e., lacked a behavioral intervention) to produce a significant positive effect on participants (Kim, 2017).

**Psychological distress.** Of the 4 studies that examined psychological distress, all reported some level of improvement from baseline to post-intervention between intervention and control groups. Participants who used Headspace in the fall compared to spring semester demonstrated greater initiation and persistence beyond week 1; greater app use frequency was associated with improvement in distress (Flett, Conner, Riordan, Patterson, & Hayne, 2020). My Coping Plan app, which supports user-development of a healthy coping plan to manage distress on a continuum of low-intensity to high-intensity strategies, demonstrated significantly lower distress in participants and a small effect size at post-intervention (Stallman, 2019). Two types of Acceptance and Commitment Therapy apps, ACT Matrix (Krafft, Potts, Schoendorff, & Levin, 2019) and the ACT app (Levin, Haeger, & Cruz, 2019), demonstrated limited efficacy, namely the simple and tailored skill coaching versions, respectively.

**Stress.** Of the 6 studies that examined perceived stress as either the primary or secondary outcome, all reported at least some significant decrease from baseline to post-intervention between intervention and control groups. The interventions included 2 apps that are not commercially available, Atena psychoeducational chatbot (Gabrielli et al., 2021) and ACT Matrix (Krafft, Potts, Schoendorff, & Levin, 2019). The remaining commercially available apps included: Calm (Glissman, 2018; Huberty et al., 2019), Headspace (Flett, Hayne, Riordan, Thompson, & Conner, 2019), Smiling Mind (Flett, Hayne, Riordan, Thompson, & Conner, 2019), and Pacifica (Vu, 2018). Gabrielli et al.
(2021) found an inverse effect on participants, specifically, those reporting severe levels of perceived stress experienced a positive effect from the intervention compared to those in the intermediate stress range, who reported an increase in stress at post-intervention.

Prevention of adverse mental health symptoms or condition. Of the 4 studies that examined some type of positive mental health intervention, all demonstrated a significant increase in positive mental health (Bendtsen, Mussener, Linderoth, & Thomas, 2020), hope as a mediator of wellbeing (Daugherty et al., 2018), or wellbeing (Clarke & Draper, 2020; Stallman, 2019) in intervention compared to control groups from baseline to follow-up. Significant gains were reported for daily and intermittent Calm app users (Clarke & Draper, 2020) and My Coping Plan app users (Stallman, 2019). Some participants, specifically those who reported being very depressed and/or predisposed to negative self-talk, experienced negative mental health outcomes from Calm app usage (Clarke & Draper, 2020). The 1 unnamed app employed an ecological momentary intervention (EMI), which delivered in-the-moment, contextually appropriate interventions (Bendtsen, Mussener, Linderoth, & Thomas, 2020).

Treatment implications. Most studies (n = 18) reported results that could offer implications for the treatment, and in some cases, prevention of common mental health issues in college-aged students. Clarke & Draper (2020) found that encouraging daily use of the Calm app had a negative effect on participants with severe depressive tendencies, including those who were predisposed to engage in negative self-talk, suggesting such users are more likely to feel a sense of failure for not adhering to regular mindfulness practice. Other studies that addressed mindfulness apps found that regular Headspace and Smiling Mind app users moved on average 3-3.5 points into the healthy range of
depressive symptoms. Moreover, students who used the app more frequently reported greater improvement of symptoms compared to those who used the app less often (Flett, Hayne, Riordan, Thompson, & Conner, 2019). MacIsaac et al. (2021) also highlighted the wellbeing benefits for students (e.g., improved emotional regulation who use the JoyPop app on a daily basis), specifically those who have experienced adversity during childhood. One study found that students experienced stress reduction benefits from practice no matter how much they used the app, noting that positive effects persisted for a few weeks after the intervention period (Huberty et al., 2019). Kajitani et al. (2020) noted that the Mental app aimed at Japanese students demonstrated efficacy within two weeks, suggesting short-term benefits for young adults experiencing depressive or anxiety symptoms.

Multiple studies highlighted the efficacy of mental health interventions for students struggling from higher levels of depression, anxiety and/or stress. Gabrielli et al. (2021) reported the Atena chatbot, which supported students with ways to build healthy coping skills, had greater engagement and lower attrition of participants with severe anxiety and perceived stress compared to those presenting moderate to mild symptoms. McCloud, Jones, Lewis, Bell, & Tsakanikos, (2020) highlighted preliminary findings suggesting that the mobile CBT app, Feel Stress Free, may improve symptoms of depression and anxiety in students presenting a wide range of severity.

One study discussed targeting students who do not seek treatment for mental health problems, suggesting the use of a mindfulness-based stress reduction (MBSR) app offers a viable alternative because the training originally supported those who were not responsive to traditional therapy approaches (Glissman, 2018).
Qualitative feedback from student users suggests that tailoring aspects of app content and interface may increase usage. Some student participants reported being irritated by the lack of voice options offered by the app. Additionally, some found the daily reminders and record of completed sessions helpful, while others found it to be a barrier when they stopped using the app regularly (Clarke & Draper, 2020). Levin, Haeger, & Cruz (2019) employed a quantitative approach, finding participants had significantly more positive mental health gains using the tailored version of ACT Daily app compared to the other non-tailored conditions.

Finally, Flett, Conner, Riordan, Patterson, & Hayne (2020) found greater uptake of Headspace mindfulness app usage from students in the fall compared to the spring semester, suggesting greater benefits can be achieved by an early administration start in the academic year.

**DISCUSSION**

The aim of this systematic review was to summarize and assess evidence-based, self-managed interventions that demonstrated a reduction, improvement or prevention of common mental health symptoms or conditions, including depression, anxiety, psychological distress and stress in college-aged adults (aged 18-26) from clinical and non-clinical campus settings. We specifically examined psychometric properties employed, quality assessment, useability and engagement of participants, and mental health outcomes.

**Psychometric properties**

All studies assessed psychometric properties as it was an inclusion criterion for this review. There was ample evidence of acceptable to excellent internal consistency
throughout the majority of the studies (n =16). A smaller number of studies either did not report reliability of their measures (n = 4) or reported poor to questionable outcomes (n = 1).

**Quality assessment**

Fourteen studies that employed some type of randomized control design demonstrated a lower risk of selection bias compared to non-randomized studies included in the review. However, over half of these reported how the randomization sequence was generated, bringing into question their methods. Moreover, a small minority of randomized studies employed concealment allocation (n = 2), thereby increasing their risk of selection bias. A large majority of studies demonstrated high performance and detection biases due to the small minority of randomized studies that blinded participants (n = 3) and researchers (n = 1). All studies included in this review demonstrated a level of self-reporting bias as they all relied on subjective responses from participants for all measures. Finally, 9 studies exhibited a high risk of testing bias testing 3-5 times over the course of the study.

**Useability and engagement**

The majority of the studies demonstrating efficacy in treatment outcomes also reported high levels of user satisfaction in a range of useability and engagement measures, with a smaller majority of users expressing the intent to use the app in the future. Among the studies that inquired about user experience (i.e. UI/UX), apps that demonstrate ease of use (Daugherty et al., 2018; Glissman, 2018; Haeger, 2016; Huberty et al., 2019; Krafft, Potts, Schoendorff, & Levin, 2019), and offer an appealing aesthetic (Daugherty et al., 2018; Kajitani et al., 2020, Krafft, Potts, Schoendorff, & Levin, 2019;
Takahashi, Takada, & Hirao, 2019) are more likely to attract tech-savvy young adults to use the platform. Apps that offer skill building (Krafft, Potts, Schoendorff, & Levin, 2019; Levin, Haeger, & Cruz, 2019; Pierce, 2019), automated coaching that encourages reflection and emotional awareness (Krafft, Potts, Schoendorff, & Levin, 2019; Lattie, Cohen, Winquist, & Mohr, 2020; Levin, Haeger, & Cruz, 2019; Pierce, 2019; Vu, 2018), and ability to track skills or sessions over time (Haeger, 2016; Vu, 2018) were desired features.

Despite unlimited access and intermittent reminders inviting students to continue using their Headspace mindfulness app in subsequent months post-intervention, Flett, Conner, Riordan, Patterson, & Hayne (2020) reported low usage in both treatment and control groups. Krafft, Potts, Schoendorff, & Levin (2019) found similar outcomes, specifically that the number of notifications did not impact the likelihood the student user would engage with either version of the app. Through a randomized repeated measure study design published by Pierce (2019), the authors found that approximately 30% of participating students who completed the final assessment voiced disdain for the app prompts, describing them as too frequent and repetitive in their content; approximately 14% responded positively to receiving reminders prompting users to reflect, use skills they were learning, or shift perspective. While the literature supports the use of notifications to encourage adherence to mobile health apps (Bidargaddi et al., 2018; Freyne et al., 2017), study outcomes included in this review suggest the need to allow users the option of whether or not they want to receive reminders (i.e. user-enabled feature on app), control over when and how often they receive them, and offer a range of content variety to keep students engaged.
Mental health outcomes

Across the common mental health condition categories, a range of types of app platforms demonstrated significant efficacy in preventing, reducing or improving associated symptoms in college-aged participants. Most prominently, mindfulness meditation apps were the most numerous and varied; the Headspace app (Flett, Hayne, Riordan, Thompson, & Conner, 2019; Gabrielli et al., 2021) demonstrated significant reduction in participants struggling with depressive, anxiety, psychological distress, and stress symptoms. The Smiling Mind app (Flett, Hayne, Riordan, Thompson, & Conner, 2019) was studied less frequently than Headspace, and demonstrated efficacy in improving depressive, anxiety, psychological distress, and stress symptoms as well. Finally, the Calm app (Clarke & Draper, 2020; Glissman, 2018; Huberty et al., 2019), which rivals in popularity with Headspace, demonstrated positive mental health outcomes related to stress and wellbeing with participants exhibiting mild-moderate levels of stress. Applied to fewer mental health conditions, two CBT-based apps, Pacifica (Vu, 2018), Feel Stress Free (McCloud, Jones, Lewis, Bell, & Tsakanikos, 2020), demonstrated significant positive effects, the former on anxiety and stress symptoms and the latter on depressive symptoms. Finally, My Coping Plan (Stallman, 2019), a strengths-based app, was effective at improving distress and wellbeing, while JoyPop (MacIsaac et al., 2021), a resilience skill-building app, effectively reduced depressive symptoms in participants.

Limitations

This systematic review has several limitations that warrant consideration. First, while six search engines were used for this search, the authors did not hand pick citations, and as such, some relevant articles may have been excluded unknowingly.
Second, while most of the studies in this review employed some form of randomization, the inclusion of other types of study designs, including evaluation studies that did not have a control condition, prevented a formal risk of bias assessment. Nonetheless, a high risk of biases occurred across studies including selection and self-reporting bias; to a lesser extent there was also a high risk of performance and detection bias. Moreover, only a few of the studies achieved sufficient power for the desired effect size (Bosso, 2020; Flett, Conner, Riordan, Patterson, & Hayne, 2020; Levin, Haeger, & Cruz, 2019; Stallman, 2019; Vu, 2018); consequently the majority had a high risk of attrition bias. Furthermore, some attrition may be due to study design. As a result, it becomes challenging to make definitive conclusions about study outcomes and their generalizability to other college-aged students.

A third limitation that arose from this review was the range of therapeutic approaches to address the same mental health condition(s) and/or symptom(s), making comparisons about app features and components across studies difficult. For example, while comparisons could be drawn between the mindfulness-based apps such as Headspace, Smiling Mind, and Calm, which are relatively similar in content, but may have some differences in their user interface or other design choices, challenges arose when attempting to assess how they compared to skill-building features in the CBT or ACT-based apps that also reported positive outcomes.

Fourth, several studies in this review examined apps that were developed for feasibility or evaluation purposes and are not publicly available. Despite demonstrating positive mental health outcomes in college-aged students, these platforms do not offer real-world solutions for higher education settings. In addition, many of the apps that are
publicly available, come at a cost that would be prohibitive for most college-aged students. As such, there exists a dearth of research assessing free to low-cost app platforms used by young adults that could offer real-world, cost-conscious options for the targeted population.

Finally, most studies in this review reported positive outcomes, which indicates a risk for publication bias. In light of the prevalence of other biases across studies, the findings discussed in this review should be interpreted carefully.

**Campus, clinical and research implications**

In the wake of the COVID-19 pandemic, digital mental health interventions offer promising evidence that may address the mental health needs of a growing number of young adults experiencing low-moderate symptoms related to depression, anxiety, psychological distress, and stress, especially those transitioning to college life. Due to the marked increase in the number and severity of mental health symptoms students are presenting, college counseling centers have not grown to adequately meet the increase in demand (Gallagher, 2014). Several of the apps examined in this review could offer viable options for students waiting to be seen for psychological services, optimizing this time to learn and practice coping skills that could then be reinforced later in treatment (Glissman, 2018; Haeger, 2016; Stallman, 2019). To lessen demand on overwhelmed counseling centers, Pierce et al. (2019) suggest providing students presenting mild-moderate symptoms of distress the option to tailor mental health app features to their own values and concerns, which would allow self-management of symptoms.

Considering the preventative benefits of many of the mental health apps examined in this review, especially those with a mindfulness-focus, there is potential to reach a
wide range of students at various touchpoints in their college trajectory, not just when they are in crisis. Haeger (2016) suggests targeting outreach efforts in student housing to meet first-year students where they are, while Flett, Hayne, Riordan, Thompson, & Conner (2019) found that adjustment to college life was positively associated with frequency of use of the Headspace and Smiling mind apps. Introduction to college courses, which are typically offered during fall semester for most first-year students in undergraduate degree programs, could integrate use of a campus-wide mental health app through course lessons and homework, thereby normalizing its use. Evidence from Flett, Conner, Riordan, Patterson, & Hayne (2020) and their examination of the Headspace app supports initiation of the intervention earlier in the academic year before students begin to experience higher levels of stress compared to those who initiated use in their spring semester. In addition, academic advisors, among other higher education personnel, could be trained to promote use of a campus-wide mental health app, which would, in turn, provide periodic reminders for students to start again multiple times prior to graduation.

There is also ample indication from the studies in this review that highlight student preference for short-term, intermittent, and brief use of mental health apps, most notably those promoting a range of skills such as mindfulness (Clarke & Draper, 2020; Flett, Hayne, Riordan, Thompson, & Conner, 2019; Flett, Conner, Riordan, Patterson, & Hayne, 2020; Glissman, 2018; Huberty et al., 2019), self-monitoring of wellbeing activities (Bendtsen, Mussener, Linderoth, & Thomas, 2020; Huberty et al., 2019; Kim, 2017; Vu, 2018), and in-the-moment interventions (Daugherty et al., 2018; Levin, Haeger, & Cruz, 2019). Ideal use of mental health apps, which allow students to participate remotely, would also permit a range of features, including when and how they
would choose to engage (Gabrielli et al., 2021; Haeger, 2016; Huberty et al., 2019; Kim, 2017; Stallman, 2019).

Finally, many institutions continue to grapple with how to adequately address the increased need for mental health services coupled with the financial implications of the pandemic and other budgetary pressures on their bottom line. The adoption and campus-wide promotion of an evidence-based mental health app for students may offer a cost-effective, resource-light approach to helping address the range of mental health challenges faced by college-aged students at some point during their higher education experience (Huberty et al., 2019).

Future research should examine more promising low- to no-cost mental health apps that offer a range of user interface options reflecting the wide diversity of college student identities. In addition, the small number of exemplary study designs included in this study that limited external and internal biases (Levin, Haeger, & Cruz, 2019; Vu, 2020) may inform future research design choices. Larger studies that allow for an increased sample size may mitigate attrition and improve finding validity. Furthermore, this research should consider how student-centered design, including adding personalization and peer engagement, could maximize adherence and impact of self-managed app use in young adults (Oit & Pitt, 2021). While self-guided digital mental health interventions appear promising in their breadth of potential application on college campuses, there have been a dearth of institutions who have taken the initiative to pursue a rigorous study of them. The authors recognize the need for researchers to partner with institutions of higher education to determine not just which interventions are effective, but which students may benefit the most from their use, how best to reach such students,
and how to engage clinical and non-clinical college personnel alike in supporting student usage.
### Table 1. Characteristics of studies with self-management of technology-delivered mental health support for young adults.

| Condition               | Study Type | Relevant Aim(s)                                                                 | Participants                                                                 | Comparison                                              | Length(wks) | Outcome Measure | Relevant Result(s)                                                                 |
|-------------------------|------------|---------------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------|----------------|--------------------------------------------------------------------------------|
| Anxiety &/or Depression| Bendtsen et al., 2020 | estimate the effect of a fully automated mHealth intervention on positive mental health, anxiety and depression symptomatology | College students in Sweden  
Intervention:  
\(n = 348\)  
Control:  
\(n = 306\) | Daily text messages v. referred to mental health information sources | 10 | MHC-SF HADS | Increased positive mental health compared to usual care; protective effect on depressive and anxiety symptoms |
|                         | Bosso, 2020   | examine the effect of smartphone mindfulness app on emotional and physical well-being | College students in Florida  
Intervention:  
\(n = 22\)  
Control:  
\(n = 22\) | Headspace mindfulness app v. no treatment | 5 | DASS | No difference in depression and anxiety levels between intervention and control groups |
|                         | Flett, Hayne, Riordan, Thompson and Connor, 2019 | Examine whether two meditation apps lead to improvements in depressive, anxiety and stress symptoms | College students in New Zealand  
Headspace Intervention:  
\(n = 72\)  
Smiling Mind Intervention:  
\(n = 63\)  
Evernote Control:  
\(n = 75\) | Daily 10-minute use of Headspace or Smiling Mind apps v. Evernote (attention placebo control) app | 1.5 | CES-D HADS-A PSS | Headspace condition reported significant reduction in depressive symptoms, anxiety, stress; changes mostly maintained at post-intervention except depressive symptoms; Smiling Mind condition reported significant reduction in depressive and anxiety symptoms, not stress; changes only maintained for anxiety at post-intervention; control condition reported small but significant increase |
<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Aim</th>
<th>Participants</th>
<th>Intervention</th>
<th>Outcome Measures</th>
<th>Results</th>
</tr>
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<tbody>
<tr>
<td>Gabrielli et al., 2021</td>
<td>Proof-of-concept; mixed methods</td>
<td>Measure effectiveness of psychoeducational chatbot in supporting healthy coping with stress and anxiety</td>
<td>College students in Italy</td>
<td>Atena chatbot via Telegram app two sessions/week; no control</td>
<td>PSS-10 GAD-7</td>
<td>Significant reduction in severe and moderate anxiety groups from pre to post-intervention; levels of stress symptoms exhibited significant decreases between pre- and postintervention.</td>
</tr>
<tr>
<td>Haeger, 2016</td>
<td>open-trial pretest-posttest</td>
<td>pilot test an initial prototype of the ACT Daily mobile app with depressed and/or anxious students on waiting list at campus counseling center</td>
<td>College students in Utah</td>
<td>Use of ACT daily application v. no treatment</td>
<td>DASS EMA</td>
<td>Seven participants (64%) moved from clinical to nonclinical range on depression and anxiety scores; 100% of participants fell within moderate range or lower for anxiety severity at post and 82% of participants fell within the moderate range or lower for depression severity.</td>
</tr>
<tr>
<td>Kajitani et al., 2020</td>
<td>Non-randomized controlled pilot</td>
<td>Examine the effect of app on mental state</td>
<td>College students in Japan</td>
<td>Use of Mental App v. no treatment</td>
<td>CES-D GHQ</td>
<td>Significant within-group difference in depression and anxiety symptoms for intervention group.</td>
</tr>
<tr>
<td>Kim, 2017</td>
<td>RWCT</td>
<td>Examine effects of mobile app or website use on anxiety</td>
<td>College students in California</td>
<td>Daily use of mobile app or website with daily text</td>
<td>BAI GAD-7 PHQ-9</td>
<td>decrease in anxiety for both interventions; all three groups experienced an increase in depressive symptoms.</td>
</tr>
<tr>
<td>Study</td>
<td>Design</td>
<td>Description</td>
<td>Sample</td>
<td>Outcome</td>
<td>Measure</td>
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<tr>
<td>Krafft, Potts, Schoendorff, and Levin, 2019</td>
<td>Pilot RWCT</td>
<td>Examine effect of simple and complex versions of ACT Matrix app on SONA credit seeking and help-seeking samples</td>
<td>Majority College students in U.S. and Canada&lt;br&gt;Simple app: n = 24&lt;br&gt;Complex app: n = 28&lt;br&gt;Waitlist: n = 26</td>
<td>Use of simple version or complex versions of matrix app v. waitlist control</td>
<td>DASS&lt;br&gt;4</td>
<td></td>
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<tr>
<td>Lattie, Cohen, Winquist, and Mohr, 2020</td>
<td>Single-arm pilot</td>
<td>Examine the preliminary associations between app use and psychosocial targets</td>
<td>College students in Illinois&lt;br&gt;Intervention: n = 19</td>
<td>Use of IntelliCare for College Students app; no control</td>
<td>ALQ&lt;br&gt;PHQ-8&lt;br&gt;GAD-7&lt;br&gt;8</td>
<td></td>
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<tr>
<td>MacIsaac et al., 2021</td>
<td>Single arm, evaluation study</td>
<td>to test whether app promotes resilience in youth with varying degrees of ACEs in their first year in college</td>
<td>College students in Canada&lt;br&gt;Intervention: n = 156</td>
<td>Twice daily use of JoyPop app</td>
<td>DERS-SF&lt;br&gt;PHQ-9&lt;br&gt;4</td>
<td></td>
</tr>
<tr>
<td>McCloud, Jones, Lewis, Bell, Tsakanikos, and 2020</td>
<td>RWCT</td>
<td>evaluate the effectiveness of a self-guided CBT-based app for the treatment of depression and anxiety in students</td>
<td>College students in U.K.&lt;br&gt;Intervention: n = 40&lt;br&gt;Waitlist: n = 55</td>
<td>Usage of Feel Stress Free app</td>
<td>HADS-A&lt;br&gt;HADS-D&lt;br&gt;6</td>
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Initially, with a small reduction at post-intervention.

For Complex app: improved distress, depression, anxiety, and stress outcomes compared to waitlist; For anxiety, simple matrix condition improved from baseline to post-intervention.

Significant improvements were observed in participants’ scores on the ALQ; no meaningful changes were observed in the PHQ-8 or GAD-7 scores over time in either subgroup.

App usage demonstrated improvement in emotion regulation (0.25 points on 18-point scale) for each additional day of app usage; symptoms of depression reduced by 0.08 points on the 9-point scale with each additional day of app usage.

At week 4, symptoms of depression and anxiety reduced; only significant reduction of depression at post-intervention.
<table>
<thead>
<tr>
<th>Reference</th>
<th>Study Design</th>
<th>Intervention Details</th>
<th>Effect Size</th>
<th>Primary Outcome Measures</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pierce, 2019</td>
<td>randomized repeated measure</td>
<td>assessed the effectiveness of an ACT training app in the ability to notice and label the functions of behavior related to common college student concerns</td>
<td>College students in U.S. Mountain West region</td>
<td>Complete 3 sessions 1 week apart in web and app-based ACT Matrix; final weeks’ usage at own discretion</td>
<td>8 PHQ-ADS intervention group demonstrated reduction in symptoms of depression and anxiety across the pre to post-intervention assessments</td>
</tr>
<tr>
<td>Takahashi, Takada, and Hirao, 2019</td>
<td>single arm pre-post</td>
<td>examined the feasibility of an app intervention for individuals with Subthreshold Depression</td>
<td>College students in Japan: Intervention: n = 22</td>
<td>app usage for 70 min/week</td>
<td>5 CES-D CES-D scores were significantly improved at post-intervention</td>
</tr>
<tr>
<td>Vu, 2018</td>
<td>feasibility RCWT</td>
<td>investigate the efficacy of a commercially available mindfulness and CBT-based mobile app aimed at improving stress and anxiety in a college student sample</td>
<td>College students in U.S. Midwest</td>
<td>Use of 1 of 2 Pacifica apps v. waitlist control</td>
<td>2 DASS-21 PSS small to medium effect sizes between the Pacifica and waitlist groups on stress and anxiety; small to medium effect sizes between Pacifica and waitlist groups for stress; significant effects of Pacifica app intervention on PSS when including interaction between participants’ baseline scores and intervention group</td>
</tr>
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</table>

Psychological Distress

<p>| Flett et al., 2020 | Two-arm RWCT | Track effect of mindfulness app across 3 timepoints on distress | College students in New Zealand Intervention: n = 124 | Encouraged use of Headspace app semester 1 or 2; use frequency at discretion of user | 13 K10 moderate app use was associated with a 5-point greater reduction in distress than those reported by non-users at the end of Time 1; at Time 3 moderate users reported a 1.6-point greater reduction in distress than non-users in addition to a 3-point greater reduction in distress than low users. |</p>
<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Intervention</th>
<th>Participants</th>
<th>Measures</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levin, Haeger, and Cruz, 2018</td>
<td>RCT</td>
<td>evaluated whether an ACT app that tailored skill coaching based on EMAs would be more efficacious than the same app where skill coaching was random or an EMA-only condition</td>
<td>Majority college students in U.S. Mountain West region Tailored app: ( n = 18 ) Random app: ( n = 19 ) EMA-only: ( n = 22 )</td>
<td>Use of one of ACT Daily app conditions—tailored, random, or EMA-only</td>
<td>DASS participants in the tailored app improved significantly more on psychological distress relative to the random app and EMA-only conditions; no differences found between the random app and EMA-only conditions on outcomes</td>
</tr>
<tr>
<td>Stallman, 2019</td>
<td>2x2 RCT</td>
<td>evaluated the effectiveness of the strengths-focused My Coping Plan app in improving mental health and coping</td>
<td>College students in Australia Intervention: ( n = 28 ) Waitlist: ( n = 28 )</td>
<td>Use the My Coping Plan app strategies if they felt stressed or distressed</td>
<td>K10 CI WHO-5 participants in intervention condition reported significantly lower psychological distress post-intervention, improved wellbeing and improved healthy coping strategies compared with control condition</td>
</tr>
<tr>
<td>Glissman, 2018</td>
<td>RCT</td>
<td>Examine effects of mindfulness meditation app in reducing stress</td>
<td>College students in Arizona Intervention: ( n = 41 ) Control: ( n = 47 )</td>
<td>Daily use of Calm app for min. 10 minutes daily v. delayed start group</td>
<td>PSS significant decrease in perceived stress in the intervention group as compared with the control group</td>
</tr>
<tr>
<td>Huberty et al., 2019</td>
<td>RWCT</td>
<td>test the initial efficacy and sustained effects of a mindfulness meditation mobile app on stress</td>
<td>College students in Arizona Intervention: ( n = 33 ) Control: ( n = 39 )</td>
<td>Daily use of Calm app for min. 10 minutes</td>
<td>PSS significant interaction between group and time factors in perceived stress; significant differences in between the intervention and control groups after adjustment for covariates</td>
</tr>
<tr>
<td>Study</td>
<td>Design</td>
<td>Method</td>
<td>Objectives</td>
<td>Participants</td>
<td>Interventions</td>
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<tr>
<td>Clarke and Draper, 2020</td>
<td>Convergent parallel, Single arm; mixed methods</td>
<td>determine whether Calm app use is associated with positive wellbeing, even when used intermittently</td>
<td>College students in Scotland</td>
<td>Intervention: ( n = 269 )</td>
<td>Daily 10-minute sessions v. no control</td>
</tr>
<tr>
<td>Daugherty et al., 2018</td>
<td>Quasi-experimental, mixed methods</td>
<td>examine whether a hope EMI using a flexible mobile app-based system increased hope, HWB and/or EWB</td>
<td>College students in Indiana</td>
<td>Intervention: ( n = 66 )</td>
<td>mobile app intervention download, 1-3 random notifications, peer stories v. mobile app intervention download</td>
</tr>
</tbody>
</table>

ACE: Adverse Childhood Experiences  
ACT: Acceptance and commitment therapy  
ALQ: Anxiety Literacy Questionnaire  
BAI: Beck Anxiety Inventory  
CBT: Cognitive behavioral therapy  
CES-D: Center for Epidemiological Studies Depression Scale  
CFI: Compassion-focused intervention  
DASS: Depression Anxiety Stress Scale  
DERS-SF: Difficulties in Emotion Regulation Scale  
EMA: Ecological momentary assessment  
EMI: Ecological momentary intervention  
EWB: Eudaimonic wellbeing  
FFMQ-SF: Five Facet Mindfulness Questionnaire - Short Form  
FS: Flourishing Scale  
GAD-7: Generalized Anxiety Disorder  
GHQ: 12-item General Health Questionnaire  
HADS-A: Hospital Anxiety and Depression Scale–Anxiety Subscale  
HADS-D: Hospital Anxiety and Depression Scale–Depression Subscale  
HWB: Hedonic wellbeing  
K10: 10-item Kessler Psychological Distress Scale  
MOL: Method of Levels  
RCT: Randomized control trial  
PHQ-8, PHQ-9: Patient Health Questionnaire  
PHQ-ADS: Patient Health Questionnaire – Anxiety and Depression Scales  
PS: Peer-supported  
PSS: 10-item Perceived Stress Scale  
RWCT: Randomized waitlist control trial  
SHI: Steen Happiness Index  
SHS: Snyder Hope Scale  
SWEMWBS: Short Warwick-Edinburgh Mental Well-Being Scale
Figure 1. Logic model of digital mental health interventions for college students

**TARGET**
College students (young adults 18-26)
- Undergraduate
- Graduate
- Professional degree-seeking

**INTERVENTION**
Regular use of mental health technology (e.g., app)

**CHANGE MECHANISMS**
Reducing, improving, or preventing common mental health symptoms/condition (e.g., depression, anxiety, psychological distress, stress)

**OUTCOME**
Standardized or in-app assessment

**Personal factors**
e.g., motivation, severity of condition, competing priorities, self-efficacy, self-stigma, knowledge about mental health/condition, expected outcomes

**Structural factors**
e.g., technology and wifi access, lack of financial wellbeing, incentives, reminders
Figure 2. Study Flow Diagram for the Systematic Review

6332 records identified through databases searching

5799 unduplicated records screened in original search 5578 records excluded (from abstract screening)

221 full-text studies assessed for eligibility

73 full-text studies

21 unique studies meeting inclusion criteria

146 full-text studies excluded, with reasons:
2 = duplicates
13 = not a study
5 = not a mental health technology
11 = not targeting young adults
77 = not relevant condition
2 = no standardized measure
36 = no self-management
2 = no response from author

52 = not targeting college students
CHAPTER 2: THE INFLUENCE OF SOCIODEMOGRAPHIC, MENTAL HEALTH STATUS, AND HELP-SEEKING FACTORS ON LOW AND HIGH HELP-SEEKING IN COLLEGE-AGED STUDENTS
INTRODUCTION

Beginning in the 2000s, and steadily increasing after the 2008 U.S. economic crisis, colleges and universities nationwide have experienced an uptick in the number of students seeking mental health services (Hunt & Eisenberg, 2010). With close to 50% of all mental health disorders first presenting by mid-adolescence (Kessler, Amminger, Aguilar-Gaxiola, Alonso, Lee, & Bedirhan Ustan, 2007), college-aged students are primarily affected by anxiety and/or depression, which consistently rank in the top five barriers to academic success (American College Health Association, 2014, 2016, 2018). This prevalence has only intensified since the outbreak of the coronavirus disease (COVID-19) in 2020, which resulted in mass societal disruption that abruptly shifted the usual administration of colleges and universities to virtual learning for the majority of students. The prolonged pandemic has revealed that college-aged students are particularly vulnerable to mental health problems due to increased stress related to academic difficulties presented by online learning, general uncertainty about the pandemic, and increased concerns about their own mental health (Wang, Hedge, Son, Keller, Smith, & Sasangohar, 2020).

While the severity of these conditions differ from student to student, a national sample of college-aged students reported 67% of cis-gendered males, 78.5% of cis-gendered females, and 92% of transgender/gender non-conforming respondents reported moderate to serious psychological distress in the last month (American College Health Association, 2022). While there is minimal variation between racial groups in their presentation of mental health symptoms, students of color exhibit greater disparities in
unmet mental health support when compared to white students (Lipson, Kern, Eisenberg, & Breland-Noble, 2018). Given the magnitude of this mental health crisis facing young adults, namely the cost to individuals in their daily functioning, social connectedness (Berkman, Glass, Brissette, & Seeman, 2000; Hefner & Eisenberg, 2009), academic retention (Arria et al., 2013; Eisenberg, Golbertsein, & Hunt, 2009), and health outcomes, young adults require support to effectively manage their mental health conditions before entering the workforce (Wang et al., 2007). As such, institutions of higher education play a crucial role in early mental health intervention because they typically meet the wide range of social, academic, residential and well-being needs of their students, potentially providing multiple entry points to address mental health issues and healthy coping skills at this critical time in life (Healthy Minds Network, n.d.).

Based on the foundational study conducted by Fischer and Turner (1970), mental health help-seeking is multidimensional and addresses a recognition of need for psychological help, stigma tolerance, interpersonal openness, and confidence in mental health professionals. Help-seeking can be informal (e.g., friends, family or other non-clinical sources), or formal (e.g., psychologist). Young people tend to seek help from informal sources rather than formal ones, with friends and family members acting as primary sources of help (Rickwood, Deane, Wilson, & Ciarrochi, 2005). Increasingly, the internet has become a source of help-seeking, especially for those not inclined to speak to anyone about their mental health problems due to stigma, offering its users anonymity, accessibility, and control (Best, Manketelow, & Taylor, 2014; Clarke, Kuosmanen, & Barry, 2015).
In addition, there is ample evidence demonstrating differences in help-seeking between males and females. Females are twice as likely to seek help from a professional when experiencing mental health symptoms (Oliver, Pearson, Coe, & Gunnell, 2005; Wendt & Shafer, 2016; Haavik, Joa, Stain, & Langeveld, 2017; Thomas, Caputi, & Wilson, 2014), while males are more inclined to seek support from friends and family (Eisenberg, Hunt, Speer, & Zivin, 2011) or online sources (Best, Gil-Rodriguez, Maktelow, & Taylor, 2016). Gender differences for help-seeking behavior are associated with perceived stigma, social norms, and traditional masculine ideology (Rickwood, Masser, & Telford, 2015; Beatie, Stewart, & Walker, 2016; Pederson & Paves, 2014; Spence, Owens-Solari, & Goodyer, 2016; Vogel, Heimerdinger-Edwards, Hammer, & Hubbard, 2011; Vogel et al., 2017). Ayalon and Young (2005) examined differences between white and Black students in their mental health help-seeking behaviors, concluding that Black students were less likely to seek support from professionals, and were more likely to seek religious services than their white counterparts. Stigmatizing attitudes towards individuals with mental health problems is a contributing factor to why many students, especially non-White students choose not to seek clinical mental health services (Masuda et al., 2019a, b). Primary barriers to seeking professional help include negative friend and family perception (Barksdale & Molock, 2009). Similarly, Latinx adolescents are less likely to seek help than non-Hispanic whites, especially those who identify as female. However, there appears to be more willingness of Latinx adolescents to reach out to family and friends no matter the severity of their mental health distress (De Luca, Schmeelk-Cone, Wyman, 2015).
Among the diversity of the Latinx population, a range of structural and logistical barriers tend to influence the rate by which they seek mental health services. Such barriers include cost of services, lack of culturally sensitive and relevant services, and inconvenient scheduling options (Schwatken, 2011).

While there have been numerous studies examining the mental health help-seeking of college-aged students, few have explored characteristics of students who do not seek help from anyone during their higher education experience. Consequently, there is a growing need to understand the help-seeking behaviors of young adults who choose not to seek help from traditional informal or formal sources. Informed by the dimensions of access, approachability, acceptability, availability and accommodation, affordability, and appropriateness (Levesque, Harris, & Russell, 2013) and Diderichsen’s model of the mechanisms of health inequality (2012), we hypothesize that this group experiences more barriers to seeking mental health support. We further hypothesize that lower help-seeking will be exhibited disproportionately by students with historically marginalized identities; we explore how other factors may influence help-seeking behavior and mental health outcomes. Moreover, as seeking help for mental health issues has become more normalized, few studies have addressed how stigma has changed within historically marginalized communities over time. Finally, more insight is needed to understand how to reach diverse college-aged students who may require mental health support through alternative sources to adequately address the persistent decline in positive mental health in young adults.
METHODS

Study Population and Design

This study is a secondary data analysis of the 2015-2021 Healthy Minds Study (HMS), a national web-based survey study examining mental health, health behaviors, service utilization, and related issues among college and university student populations. While there have been some changes to the survey items since 2005 when it was first developed, the HMS design includes the following validated instruments to measure various aspects of mental and emotional health: the Patient Health Questionnaire (PHQ) and the Generalized Anxiety Disorder 7-item (GAD-7). The HMS consists of three core modules, Demographics, Mental Health Status, and Mental Health Service Utilization/Help-Seeking, followed by a range of optional modules schools may choose to administer to their students. Students are randomly selected from participating institutions from their full student population. Through IRB-approved analysis of administrative data supplied by participating institutions, the study sample weight assigns response propensity weights based on logistic multivariable regressions to each student who completed the survey based on the following variables: gender, race/ethnicity, academic level, and grade point average. For more information:
https://healthymindsnetwork.org/research/data-for-researchers/.

The combined dataset is comprised of data collected from 187,770 students enrolled part-time or full-time at 140 two- and four-year U.S. colleges or universities. IRB approval was attained at the institutional level. Students were randomly selected from participating institutions from their full student population with a varying response
rate between 14-27% (Healthy Minds Network, 2021a, b, c, d, e, f). The University of Louisville Institutional Review Board approved this study.

**Measures**

**Dependent variable.** The dependent variable was constructed as a multinomial variable categorizing student responses of to whom they would talk if they were experiencing emotional distress. The survey options allow the respondent to 'select all the apply', with the only mutually exclusive option being 'no one'. Other response options include: clinical professional, roommate, friend, significant other, family member, religious counselor or contact, support group, and other non-clinical source. Response options were collapsed into 3 categories based on low, medium and high help-seeking. Low help-seeking consisted of respondents who reported they would either speak to no one or only 1 person from the options of non-clinical sources. Medium help-seeking consisted of respondents who reported they would speak to 2 or more people from the list of non-clinical sources. High help-seeking consisted of respondents who reported they would speak to only a clinical professional or a clinical professional and any number of non-clinical sources.

**Sociodemographic covariates.** HMS participants self-report sociodemographic characteristics, including ethnicity/race (Non-Latinx White/Caucasian, Non-Latinx Black/African/American, Latinx/Hispanic, multi-race/other race (for any non-Latinx/Hispanic and other race combinations or any single other race selection); age; sex/gender identity (male, female, other gender); sexual orientation (heterosexual, not heterosexual); degree level (undergraduate, graduate, multi-degree seeking, other degree-
seeking); and family financial status ("Always/often a struggle or stressful", "Sometimes tight or stressful", or "Rarely or never a problem or stressful").

Depression and anxiety. Depression was assessed using a single item (‘Over the last 2 weeks, how often have you been bothered by any of the following problems? Feeling down, depressed or hopeless.’) from the Patient Health Questionnaire (PHQ-9), which is a validated, widely used instrument (Beard, Hsu, Rifkin, Busch, & Björgvinsson, 2016). It consists of nine items that address depressive symptoms over the past two weeks and employs a Likert scale ranging from 0 = not at all to 3 = almost every day. Higher scores indicate a greater severity in depressive symptomology; a cut-off point of ≥10 has been recommended for diagnosis of depressive conditions (Moriarty, Gilbody, McMillan, & Manea, 2015). Anxiety was assessed using a single item (‘Over the last 2 weeks, how often have you been bothered by the following problems: feeling nervous, anxious, or on edge?’) from the Generalized Anxiety Disorder Assessment (GAD-7), which is a validated, widely used instrument (Lowe et al., 2008). It consists of seven items that address anxiety symptoms over the past two weeks with response options ranging from 0 not at all to 3 nearly every day. According to Spitzer, Kroenke, Williams, & Lowe (2006), a cut-off point of ≥10 attains the optimal balance between specificity and sensitivity for a GAD diagnosis.

Factors that influence help-seeking behavior. We examined four different factors that influence help-seeking among college-aged students:

Belief about treatment efficacy was measured using the item: How helpful on average do you think therapy or counseling is, when provided competently, for people
your age who are clinically depressed? Respondents could answer, not at all helpful, a little helpful, quite helpful, very helpful. Due to non-linearity, all response options with the exception of the reference (‘not at all helpful’) were dummyied and treated as binary nominal variables.

Perceived need was measured using the item: How much do you agree with the following statement: In the past 12 months, I needed help for emotional or mental health problems such as feeling sad, blue, anxious, or nervous. Respondents could answer, strongly agree, agree, somewhat agree, somewhat disagree, disagree, strongly disagree. Due to non-linearity, response options were dummyied and treated as binary nominal variables.

Perceived stigma was measured using the item: Most people think less of a person who has received mental health treatment. Respondents could answer, strongly agree, agree, somewhat agree, somewhat disagree, disagree, strongly disagree. Due to non-linearity, response options were dummyied and treated as binary nominal variables.

Barriers to help-seeking was measured using the item: In the past 12 months which of the following explain why you have not received medication or therapy for your mental or emotional health? (Select all that apply). A total of eight responses from 2015-2021 instruments were barrier-related (e.g., difficulty finding an available appointment); all barrier-related responses were combined to form a binary variable indicating experiencing at least one barrier or no barrier. There were slight changes to barriers student respondents could select in subsequent years.
Data Analysis

Missing data was handled using listwise deletion. See Figure 3. Multivariable logistic regression analyses tested for initial associations between help-seeking levels and mental health outcomes, adjusting for time (survey year), race/ethnicity, gender identity, age, sexual orientation, degree level, family financial status, belief about therapy efficacy, perceived need for therapy, perceived stigma, and barriers to help-seeking. An interaction between year and race was included in the model to account for any year-by-year variation in student experiences related to race. We chose the low help-seeking category as the reference group, and compared it to the medium and high help-seeking categories in the model. Mean centering was needed to correct for collinearity in all race, year and race*year variables. Year, multi-race*year, other race*year, age, family financial status, depression and anxiety status, belief about treatment efficacy, perceived need and stigma were corrected for non-linearity. Due to under-specification of the model comparing low to medium help-seeking (pseudo R-squared = 0.051), the authors decided not to include this model in the final analysis. The final analytic model used a single binary logistic regression predicting the odds of students who would seek help for emotional distress from a clinical professional (or combination of a clinical professional and two or more non-clinical sources) compared to students who seek help from no one or one non-clinical source. Sample probability weights were used to account for non-response using administrative data on full student populations based on the following variables: gender, race/ethnicity, academic level, and grade point average (The Healthy Minds Study, n.d.). Standard errors were clustered at the school level. All results are presented as odds ratios.
with 95% confidence intervals. Statistical significance was set at $a = 0.05$, $p<0.05$.

Stata/MP 16.1 was used to perform all statistical analyses.

**RESULTS**

Table 2 reports descriptive statistics of the total weighted sample. Of the 187,770 students who participated in the study, over 25% responded that they felt down, depressed or hopeless over half the days or every day in the last two weeks. The largest group of students, close to 45% reported having experienced depressive symptoms several days in the last two weeks. Anxiety posed even greater mental health problems for students with almost 40% reporting they felt nervous, anxious or on edge over half the days or every day in the last two weeks. Slightly under 40% reported having experienced anxiety symptoms several days in the last two weeks. Over half of student respondents acknowledged needing help at some point in the previous year because they were experiencing depressive and/or anxiety symptoms. Just over one-fifth of respondents responded within a neutral range, while under 30% reported that they had not needed help in the past year. The vast majority of students reported to believe that therapy is helpful or very helpful to peers in need of clinical treatment (85%). When asked whether they believe most people would think less of a person who has received mental health treatment, the largest group of students responded in the neutral range (48%). More students disagreed or strongly disagreed with this statement than agreed or strongly agreed, approximately 33% and 20%, respectively. Over 80% of students reported having experienced one or more barriers to seeking mental health treatment in the previous year.
Table 3 reports descriptive statistics of the deleted observations of students who reported they would seek out 2+ non-clinical individuals when experiencing emotional distress. This sample differed from the sample described in Table 2 in one demographic factor, with approximately 8% more who identified as heterosexual than those in the study sample. Close to 10% fewer students in the excluded sample reported feeling depressed or anxious in the last 30 days over half the days to nearly every day. Close to 40% more students in the excluded sample expressed disagreement that they needed help at some point in the previous year because they were experiencing depressive and/or anxiety symptoms.

Table 4 demonstrates the predictive odds of students who would seek help for emotional distress from a clinical professional or a clinical professional and any number of non-clinical sources (i.e. high help-seeking behavior) compared to either no one or one non-clinical source (i.e. low help-seeking behavior). Non-clinical sources included: roommate, friend, significant other, family member, religious counselor/contact, support group, or other support.

*Sociodemographic covariates.*

Figure 4 illustrates the time trend by race as there is no singular year effect; year effect varies by race. Additionally, there is no singular race effect because race effect varies by year. To have the model properly specified, the authors retained all interactions in the model, whether they were significant or not. (See Table 4.) In 2015, the odds of non-Latinx White respondents speaking to a clinical professional when experiencing emotional distress was approximately 55% more compared to those who would opt to
speak to no one or one non-clinical person. In that same study year, non-Latinx Black and Latinx students demonstrated smaller predicted odds, (10 and 15%) between high and low help-seeking behavior in their respective racial/ethnic groups. Students who identified as non-Latinx multi-race or some other race demonstrated 10% lower odds of seeking professional help compared to the lowest level of help-seeking.

While all race/ethnic groups become less likely to seek help over the course of the study period, each group tells a different story (see Figure 4). For example, the increase in MH help-seeking and services utilization, which is well-documented in the literature appears to be most pronounced for Latinx students until it plateaus btw 2017 and 2018 (equivalent to where white students were in 2015), then precipitously drops to its lowest level by 2021. Non-Latinx White and multi-race/other race student groups have a similar positive trajectory until 2017 as well, where the latter plateaus at roughly the same time as Latinx students, but its decline mirrors a similar slope decline as non-Latinx Black students. Between 2015 and 2018, multi-race/other race students briefly demonstrate the same help-seeking behavior as non-Latinx Black students, however their trajectories during this 3-year period headed in different directions, with 15% increased likelihood of help-seeking by multi/other race groups compared to a roughly 15% decreased likelihood in non-Latinx Black students’ seeking help. Finally, there is a sharper decline for Non-Latinx Whites compared to Non-Latinx Blacks due to the fact that the former has historically used more mental health services than the latter, hence the greater decrease.

While age was statistically significant, due to a very small effect, there were no meaningful implications for this variable in the model. For female students and students
who identified as gender non-conforming, gender queer, trans man/woman, or another gender, the odds of speaking to a clinical professional was 21% and 49% higher than cis-gendered males, respectively. The odds were just over 20% higher for students who identified as lesbian, gay, bisexual, queer, questioning, or some other sexual orientation other than heterosexual to speaking to clinical professional compared to their straight-identifying counterparts. Graduate or professional degree-seeking students had 7% higher odds compared to undergraduate students of talking to a clinical professional; in contrast, multiple degree-seeking and other degree-seeking students, which consisted of those working towards an Associate’s, non-degree-seeking, or some other form of degree had a 13% and 25% lower odds, respectively, compared to their undergraduate counterparts.

*Depression and anxiety.* For depressed students, exhibiting high versus low help-seeking behavior was associated with progressively lower odds (31%, 49%, 58%) of those who reported feeling down, depressed, or hopeless for several days to nearly every day compared to students who reported they had not experienced any depressive symptoms in the last two weeks. Conversely, the odds of a student speaking to a clinical professional compared to no one or one non-clinical source was 10%, 11% and 4% higher for students who reported that they had been feeling nervous, anxious or on edge for several days, over half the days or nearly every day, respectively, compared to students who reported they had not experienced any anxiety symptoms in the last two weeks. While high help-seeking was associated with slightly higher odds for students presenting the greatest frequency of anxiety symptoms, these results were not statistically
Factors that influence help-seeking behavior. The odds of a student exhibiting high versus low help-seeking behavior ranged from 129 to 773% higher for students who progressively felt therapy or counseling was helpful (‘a little/somewhat helpful to very helpful) for peers who were clinically depressed compared to students who did not believe therapy or counseling was helpful for peers experiencing depressive symptomology. Compared to peers who strongly disagreed that they needed help for emotional or mental problems in the previous twelve months, the odds of a student speaking to a clinical professional versus no one or one non-clinical source increased steadily from 12% to 452% higher as student responses ranged from ‘disagree’ to ‘strongly agree’. The odds of a student exhibiting high versus low help-seeking behavior who reported agreeing to strongly agreeing that most people think less of a person who has received mental health treatment were 15-27% lower than for students who strongly disagreed that most people view individuals who seek mental health services negatively. Outcomes of students who reported disagreeing to feeling neutral about perceived stigma were not statistically significant. Finally, students who exhibit high versus low help-seeking behavior was significantly associated with 22% lower odds for those who experienced barriers compared to students who reported not having any barriers to treatment.

DISCUSSION

Main Findings

Despite a growing need for professional mental health support of college
students in their young adult years, our findings demonstrated that as a student experiences an increase in severity/frequency of symptoms, the odds that they seek professional help diminishes. This trend was less pronounced in students with anxiety compared to students experiencing depressive symptoms. For depressed students in particular, the association between decreased help-seeking and increased frequency of symptoms reveals the challenges of providing adequate support to students who exhibit the greatest need for mental health interventions and who may self-isolate as severity increases.

Our findings corroborate studies demonstrating disparities in help-seeking in historically marginalized students compared to white students (Eisenberg, Hunt, Speer, & Zivin, 2011; Gloria, Hird, & Navarro, 2001; Barksdale & Molock, 2009) with Black students presenting the most pronounced lack in help-seeking in the study sample. However, our results did not demonstrate significant findings of Latinx/Hispanic students’ help-seeking compared to White students. In addition, perceived stigma had a significant effect on approximately 20% of the sample of student and their willingness to seek professional help if they were to experience emotional distress, which reflects what is documented in the literature about this aspect of stigma (Eisenberg, Downs, Golbertstein, & Zivin, 2009; Pederson & Paves, 2014).

Limitations

Due to the 6-year timeframe of the HMS data, this limited our ability to observe slowly-evolving changes. Additionally, because the data are cross-sectional and rely entirely on self-reported measures, results reflect recall bias of respondents. Despite the
large sample size, there was a drop in response to certain survey items selected due to the sensitivity of the mental health topics being asked (see Figure 3). Moreover, due to how the regression model was designed, the authors did not examine students who reported co-occurring depressive and anxiety symptoms.

There were also limitations imposed by how the dependent variable condensed respondents into three distinct categories and report the odds of their choices of who they prefer to speak to when experiencing emotional distress. Specifically, we were not able to tease out distinctions between those who prefer reaching out to a religious counselor or contact versus those who prefer to talk to family, friends, or a significant other without over-complicating the model. In addition, due to under-specification of one of the underlying binary logistic models that examined medium help-seeking, defined as a student who would seek mental health support from two or more non-clinical sources compared to no one or one non-clinical source, this group of students were excluded from the final analysis.

Finally, we relied on a single item to measure stigma, choosing to focus on perceived stigma and not include personal stigma as the former may have a greater impact on young adult help-seeking as demonstrated in the literature; we acknowledge that this choice does not adequately capture the full complexity of stigma and its effect on student help-seeking (Eisenberg, Downs, Golbertstein, & Zivin, 2009; Pederson & Paves, 2014).

Potential Implications

In the wake of the COVID-19 pandemic, college-aged young adults, and in
particular, non-white students and those who have experienced family financial struggles during their childhood years, reflect persistent challenges and barriers to seeking professional mental health support during this transitional period in life. Due to this pronounced gap in how certain ethnic/racial groups seek help, institutions of higher education should support and promote a range of culturally sensitive and inclusive mental health services, prioritizing how student support staff are trained and services are administered early during the first year of matriculation and throughout the college experience.

Because nearly one-fifth of students reflected that mental health treatment remains stigmatized, implementing a social norms campaign and offering training for faculty and staff to increase awareness of student mental health issues as it pertains to academic performance may provide effective approaches to reducing stigma on campus (Eisenberg, Downs, Golbertstein, & Zivin, 2009).

Future research should focus on the prevalence of specific barriers that may adversely affect Black and Latinx students compared to white students. Moreover, as digital mental health interventions improve and are empirically evaluated, there will be a need to examine how such interventions may address the gap in help-seeking while offering an inclusive alternative to traditional forms of therapy or counseling. Additionally, more research is needed on how the availability of online, free and anonymous mental health screenings provide a reliable means for young adults with a pathway to seeking other forms of mental health support (Murphy et al., 2017).
CONCLUSIONS

The majority of college-aged students continue to struggle with depression and/or anxiety, many forgoing professional services due to a range of challenges and barriers. This study showed that while anxiety was the most prevalent reported mental health problem, students reporting anxiety symptoms were more proactive in seeking professional support compared to students who reported depressive symptoms. Students belonging to historically marginalized ethnic/racial groups and those who struggle financially continue to face barriers to accessing clinical support, and therefore require different strategies when addressing best practices in meeting their unique mental healthcare needs during their young adult years. Leaders and mental health professionals in higher education settings should prioritize more comprehensive mental health toolkits to address the diverse mental health needs of their student populations. Such toolkits need to support ways for students who do not seek help from other people by offering a range of support services that include digital options, allowing for numerous entry points at multiple points during a student’s college experience.
348,209 observations in study

72,928 observations deleted
38,869 Non-Latinx White
1,246 Non-Latinx Black
516 Female
73 Not heterosexual
1,055 Financial status
23,210 Depression status
235 Anxiety status
6,288 Belief about treatment efficacy
235 Perceived need
1,201 Perceived stigma

275,281 observations included in study

87,511 observations deleted from exclusions of underlying of students who would seek help from 2+ non-clinical sources compared to 0-1 non-clinical sources

187,770 observations included in final analysis of students who would seek help from clinical professional compared to 0-1 non-clinical sources
Table 2. Study characteristics of low and high help-seeking students N = 187,770

<table>
<thead>
<tr>
<th></th>
<th>n(%) or M(SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year</strong></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>9,541 (5.08)</td>
</tr>
<tr>
<td>2016</td>
<td>3,292 (1.75)</td>
</tr>
<tr>
<td>2017</td>
<td>12,767 (6.80)</td>
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<tr>
<td>2018</td>
<td>33,358 (17.77)</td>
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<tr>
<td>2019</td>
<td>29,698 (15.82)</td>
</tr>
<tr>
<td>2020</td>
<td>46,340 (24.68)</td>
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<tr>
<td>2021</td>
<td>52,774 (28.11)</td>
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<tr>
<td>Non-Latinx Black/African American</td>
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<tr>
<td>Latinx/Hispanic</td>
<td>9,792 (5.21)</td>
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<tr>
<td>Multi-race/Other race</td>
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</tr>
<tr>
<td><strong>Age, mean(SD)</strong></td>
<td>23.86 (7.41)</td>
</tr>
<tr>
<td><strong>Sex/gender identity</strong></td>
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<td><strong>Degree status</strong></td>
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<tr>
<td>Undergraduate <em>(ref)</em></td>
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<td>Graduate/Professional <em>b</em></td>
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<tr>
<td>Multi-degree seeking</td>
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<td>Variable</td>
<td>Frequency (Percentage)</td>
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<tr>
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<td>------------------------</td>
</tr>
<tr>
<td>Other degree-seeking</td>
<td>22,303 (11.88)</td>
</tr>
<tr>
<td>Family financial status</td>
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</tr>
<tr>
<td>Comfortable/rarely/never stressful</td>
<td>90,026 (47.94)</td>
</tr>
<tr>
<td>Had enough/sometimes stressful</td>
<td>50,136 (26.70)</td>
</tr>
<tr>
<td>Very poor/always/often stressful</td>
<td>47,608 (265.35)</td>
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<tr>
<td>Feeling down, depressed or hopeless</td>
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<tr>
<td>Not at all</td>
<td>57,866 (30.82)</td>
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<tr>
<td>Several days</td>
<td>82,699 (44.04)</td>
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<td>Over half the days</td>
<td>27,511 (14.65)</td>
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<tr>
<td>Nearly every day</td>
<td>19,694 (10.49)</td>
</tr>
<tr>
<td>Feeling nervous, anxious or on edge</td>
<td></td>
</tr>
<tr>
<td>Not at all</td>
<td>40,131 (21.37)</td>
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<tr>
<td>Several days</td>
<td>74,203 (39.52)</td>
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<tr>
<td>Over half the days</td>
<td>37,867 (20.17)</td>
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<tr>
<td>Nearly every day</td>
<td>35,569 (18.94)</td>
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<tr>
<td>Belief about treatment efficacy</td>
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<tr>
<td>Not helpful</td>
<td>4,386 (2.34)</td>
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<tr>
<td>A little/somewhat helpful</td>
<td>23,347 (12.43)</td>
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<tr>
<td>Helpful</td>
<td>70,998 (37.81)</td>
</tr>
<tr>
<td>Very helpful</td>
<td>89,039 (47.42)</td>
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<td>Perceived need</td>
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</tr>
<tr>
<td>Strongly disagree</td>
<td>27,347 (14.56)</td>
</tr>
<tr>
<td>Disagree</td>
<td>24,001 (12.78)</td>
</tr>
<tr>
<td>Somewhat disagree/neutral/somewhat agree</td>
<td>39,067 (20.81)</td>
</tr>
<tr>
<td>Agree</td>
<td>36,499 (19.44)</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>60,856 (32.41)</td>
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<tr>
<td>Perceived stigma</td>
<td></td>
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67
<table>
<thead>
<tr>
<th>Agreement Level</th>
<th>Count (Proportion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly disagree</td>
<td>18,759 (9.99)</td>
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<tr>
<td>Disagree</td>
<td>42,860 (22.83)</td>
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<tr>
<td>Somewhat disagree/neutral/somewhat agree</td>
<td>89,217 (47.51)</td>
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<tr>
<td>Agree</td>
<td>26,464 (14.09)</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>10,470 (5.58)</td>
</tr>
</tbody>
</table>

**Barriers to help-seeking**

- **No barriers**<sup>k</sup> (ref) | 34,113 (18.17)   |
- **Barriers**<sup>l</sup>          | 153,657 (81.83)  |

Notes: Table values are percentages of the weighted sample. M = mean; SD = standard deviation; ref = reference variable.

<sup>a</sup> Undergraduate degree includes the following response: Bachelor’s.
<sup>b</sup> Graduate/Professional degree includes any of the following responses: Master’s, JD, PhD or MD.
<sup>c</sup> Other degree-seeking includes any of the following responses: Associate’s, other or non-degree-seeking student.
<sup>d</sup> Family financial status was assessed by a single item—How would you describe your financial situation while growing up?
<sup>e</sup> Depression status was assessed using a single item from the Patient Health Questionnaire (PHQ-9)—Over the last 2 weeks, how often have you been bothered by any of the following problems? Feeling down, depressed or hopeless.
<sup>f</sup> Anxiety status was assessed using a single item from the Generalized Anxiety Disorder Scale (GAD-7)—Over the last 2 weeks, how often have you been bothered by the following problems? Feeling nervous, anxious, or on edge.
<sup>g</sup> Beliefs about treatment efficacy were assessed by a single item—How helpful on average do you think therapy or counseling is, when provided competently, for people your age who are clinically depressed?
<sup>h</sup> Perceived need was assessed by a single item—How much do you agree with the following statement?: In the past 12 months, I needed help for emotional or mental problems such as feeling sad, blue, anxious or nervous.
<sup>i</sup> Perceived stigma was assessed by a single item—Most people think less of a person who has received mental health treatment.
<sup>j</sup> Barriers to help-seeking was assessed by a single item—In the past 12 months, which of the following factors have caused you to receive fewer services (counseling, therapy, or medications) for you mental or emotional health than you have otherwise received?
<sup>k</sup> No barriers includes either of the following responses: I haven’t had the chance to go but I plan; no barriers.
<sup>l</sup> Barriers to help-seeking include any of the following responses: financial reasons (too expensive, not covered by insurance); not enough time; not sure where to go; difficulty finding an available appointment; other (please specify)).
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<thead>
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<td>8,538 (9.76)</td>
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<tr>
<td>2016</td>
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<tr>
<td>2017</td>
<td>4,344 (4.96)</td>
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<tr>
<td>2018</td>
<td>18,080 (20.66)</td>
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<tr>
<td>2019</td>
<td>13,657 (15.61)</td>
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<tr>
<td>2020</td>
<td>21,182 (24.20)</td>
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<tr>
<td>2021</td>
<td>20,709 (23.66)</td>
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<thead>
<tr>
<th>Ethnicity/race</th>
<th>n(%) or M(SD)</th>
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<td>Non-Latinx White/Caucasian (ref)</td>
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<td>Non-Latinx Black/African American</td>
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<tr>
<td>Latinx/Hispanic</td>
<td>4,509 (5.15)</td>
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<tr>
<td>Multi-race/Other race</td>
<td>14,755 (16.86)</td>
</tr>
</tbody>
</table>

| Age, mean(SD)                       | 22.48 (5.62)      |

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<thead>
<tr>
<th>Sex/gender identity</th>
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<td>Female</td>
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<td>Other gender</td>
<td>1,404 (1.60)</td>
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<tr>
<th>Sexual orientation</th>
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<td>Not heterosexual</td>
<td>13,620 (15.56)</td>
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<table>
<thead>
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<th>Degree status</th>
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<td>Graduate/Professional ^b</td>
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<td>Multi degree-seeking</td>
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<td>Category</td>
<td>Count</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
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<tr>
<td>Other degree-seeking&lt;sup&gt;c&lt;/sup&gt;</td>
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<td>Family financial status&lt;sup&gt;d&lt;/sup&gt;</td>
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<td>45,802</td>
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<td>Had enough/sometimes stressful</td>
<td>23,962</td>
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<tr>
<td>Very poor/always/often stressful</td>
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</tr>
<tr>
<td>Feeling down, depressed or hopeless&lt;sup&gt;e&lt;/sup&gt;</td>
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</tr>
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<td>Not at all</td>
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<td>Several days</td>
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<td>Over half the days</td>
<td>9,168</td>
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<tr>
<td>Nearly every day</td>
<td>4,507</td>
</tr>
<tr>
<td>Feeling nervous, anxious or on edge&lt;sup&gt;f&lt;/sup&gt;</td>
<td></td>
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<tr>
<td>Not at all</td>
<td>22,691</td>
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<td>Several days</td>
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<tr>
<td>Over half the days</td>
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<tr>
<td>Nearly every day</td>
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</tr>
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<td>Belief about treatment efficacy&lt;sup&gt;g&lt;/sup&gt;</td>
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</tr>
<tr>
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<td>1,799</td>
</tr>
<tr>
<td>A little/somewhat helpful</td>
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<td>Very helpful</td>
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</tr>
<tr>
<td>Perceived need&lt;sup&gt;h&lt;/sup&gt;</td>
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<td>Strongly disagree</td>
<td>18,667</td>
</tr>
<tr>
<td>Disagree</td>
<td>17,742</td>
</tr>
<tr>
<td>Somewhat disagree/neutral/somewhat agree</td>
<td>24,614</td>
</tr>
<tr>
<td>Agree</td>
<td>14,193</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>12,295</td>
</tr>
<tr>
<td>Perceived stigma&lt;sup&gt;i&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Response</td>
<td>Count (Percentage)</td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>9,440 (10.79)</td>
</tr>
<tr>
<td>Disagree</td>
<td>22,626 (25.86)</td>
</tr>
<tr>
<td>Somewhat disagree/neural/somewhat agree</td>
<td>41,965 (47.95)</td>
</tr>
<tr>
<td>Agree</td>
<td>10,527 (12.03)</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>2,953 (3.37)</td>
</tr>
<tr>
<td>Barriers to help-seeking</td>
<td></td>
</tr>
<tr>
<td>No barriers (^k) (ref)</td>
<td>14,836 (16.95)</td>
</tr>
<tr>
<td>Barriers (^l)</td>
<td>72,675 (83.05)</td>
</tr>
</tbody>
</table>

Notes: Table values are percentages of the weighted sample. M = mean; SD = standard deviation; ref = reference variable.

\(^a\) Undergraduate degree includes the following response: Bachelor’s.
\(^b\) Graduate/Professional degree includes any of the following responses: Master’s, JD, PhD or MD.
\(^c\) Other degree-seeking includes any of the following responses: Associate’s, other or non-degree-seeking student.
\(^d\) Family financial status was assessed by a single item—How would you describe your financial situation while growing up?
\(^e\) Depression status was assessed using a single item from the Patient Health Questionnaire (PHQ-9)—Over the last 2 weeks, how often have you been bothered by any of the following problems? Feeling down, depressed or hopeless.
\(^f\) Anxiety status was assessed using a single item from the Generalized Anxiety Disorder Scale (GAD-7)—Over the last 2 weeks, how often have you been bothered by the following problems? Feeling nervous, anxious, or on edge.
\(^g\) Beliefs about treatment efficacy were assessed by a single item—How helpful on average do you think therapy or counseling is, when provided competently, for people your age who are clinically depressed?
\(^h\) Perceived need was assessed by a single item—How much do you agree with the following statement?: In the past 12 months, I needed help for emotional or mental problems such as feeling sad, blue, anxious or nervous.
\(^i\) Perceived stigma was assessed by a single item—Most people think less of a person who has received mental health treatment.
\(^j\) Barriers to help-seeking was assessed by a single item—In the past 12 months, which of the following factors have caused you to receive fewer services (counseling, therapy, or medications) for you mental or emotional health than you have otherwise received?
\(^k\) No barriers includes either of the following responses: I haven’t had the chance to go but I plan; no barriers.
\(^l\) Barriers to help-seeking include any of the following responses: financial reasons (too expensive, not covered by insurance); not enough time; not sure where to go; difficulty finding an available appointment; other (please specify)).
Table 4. Binary regression predicting the odds of student who would seek help for emotional distress from a clinical professional<sup>a</sup> (high help-seeking) versus 0-1 non-clinical source<sup>b</sup> (low help-seeking) N = 187,770

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>0.92</td>
<td>0.00**</td>
</tr>
<tr>
<td>Year (squared for non-linearity)</td>
<td>0.96</td>
<td>0.00**</td>
</tr>
<tr>
<td><strong>Ethnicity/race (ref = Non-Latinx White/Caucasian)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Latinx Black/African American</td>
<td>0.56</td>
<td>0.00**</td>
</tr>
<tr>
<td>Latinx/Hispanic</td>
<td>0.96</td>
<td>0.38</td>
</tr>
<tr>
<td>Multi-race/Other race</td>
<td>0.64</td>
<td>0.00**</td>
</tr>
<tr>
<td><strong>Interaction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year*Non-Latinx Black</td>
<td>0.97</td>
<td>0.25</td>
</tr>
<tr>
<td>Year*Non-Latinx Black (squared for non-linearity)</td>
<td>1.01</td>
<td>0.26</td>
</tr>
<tr>
<td>Year*Latinx/Hispanic</td>
<td>1.02</td>
<td>0.44</td>
</tr>
<tr>
<td>Year*Latinx/Hispanic (squared for non-linearity)</td>
<td>0.98</td>
<td>0.04*</td>
</tr>
<tr>
<td>Year*Multi/Other race</td>
<td>1.03</td>
<td>0.20</td>
</tr>
<tr>
<td>Year*Multi/Other race (squared for non-linearity)</td>
<td>1.00</td>
<td>0.70</td>
</tr>
<tr>
<td><strong>Age (squared for non-linearity)</strong></td>
<td>3.3e-134</td>
<td>0.00**</td>
</tr>
<tr>
<td><strong>Sex/gender identity (ref = Male)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1.21</td>
<td>0.00**</td>
</tr>
<tr>
<td>Other gender identity</td>
<td>1.49</td>
<td>0.00**</td>
</tr>
<tr>
<td><strong>Sexual orientation (ref = Heterosexual)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not heterosexual</td>
<td>1.21</td>
<td>0.00**</td>
</tr>
<tr>
<td><strong>Degree status (ref = Undergraduate)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graduate/professional</td>
<td>1.07</td>
<td>0.06</td>
</tr>
<tr>
<td>Multi degree-seeking</td>
<td>0.87</td>
<td>0.01**</td>
</tr>
<tr>
<td>Other degree-seeking</td>
<td>0.75</td>
<td>0.00**</td>
</tr>
<tr>
<td><strong>Family financial status (ref = Comfortable/rarely/never stressful)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Had enough/sometimes stressful</td>
<td>0.83</td>
<td>0.00**</td>
</tr>
<tr>
<td>Very poor/always/often stressful</td>
<td>0.73</td>
<td>0.00**</td>
</tr>
<tr>
<td><strong>Feeling down, depressed or hopeless (ref = Not at all)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Several days</td>
<td>0.69</td>
<td>0.00**</td>
</tr>
<tr>
<td>Over half the days</td>
<td>0.51</td>
<td>0.00**</td>
</tr>
<tr>
<td>Nearly every day</td>
<td>0.42</td>
<td>0.00**</td>
</tr>
<tr>
<td><strong>Feeling nervous, anxious or on edge (ref = Not at all)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Several days</td>
<td>1.10</td>
<td>0.00**</td>
</tr>
<tr>
<td>Over half the days</td>
<td>1.11</td>
<td>0.01**</td>
</tr>
<tr>
<td>Nearly every day</td>
<td>1.04</td>
<td>0.24</td>
</tr>
<tr>
<td><strong>Belief about treatment efficacy (ref = Not helpful)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A little/somewhat helpful</td>
<td>2.29</td>
<td>0.00**</td>
</tr>
<tr>
<td>Helpful</td>
<td>4.25</td>
<td>0.00**</td>
</tr>
<tr>
<td>Very helpful</td>
<td>8.73</td>
<td>0.00**</td>
</tr>
<tr>
<td><strong>Perceived need (ref = Strongly disagree)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disagree</td>
<td>1.12</td>
<td>0.00**</td>
</tr>
<tr>
<td>Somewhat disagree/neutral/somewhat agree</td>
<td>1.52</td>
<td>0.00**</td>
</tr>
<tr>
<td>Agree</td>
<td>2.92</td>
<td>0.00**</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>5.52</td>
<td>0.00**</td>
</tr>
<tr>
<td><strong>Perceived stigma (ref = Strongly disagree)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disagree</td>
<td>1.02</td>
<td>0.62</td>
</tr>
<tr>
<td>Response</td>
<td>OR</td>
<td>p-value</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>------</td>
<td>---------</td>
</tr>
<tr>
<td>Somewhat disagree/neutral/somewhat agree</td>
<td>1.00</td>
<td>0.97</td>
</tr>
<tr>
<td>Agree</td>
<td>0.85</td>
<td>0.00**</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>0.73</td>
<td>0.00**</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Barriers to help-seeking (ref = No barriers)</th>
<th>OR</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barriers</td>
<td>0.77</td>
<td>0.00**</td>
</tr>
</tbody>
</table>

Notes: OR = Odds ratio; ref = reference variable.
* denotes statistical significance at the 95% level
** denotes statistical significant at the 99% level
a Responses may include student who would seek help from clinical professional and two or more non-clinical sources.
b Non-clinical sources include any of the following: roommate, friend, significant other, family member, religious counselor/contact, support group, and other support source.
Figure 4. Predicted Odds by Year and Race

Figure 2. Predicted odds of student speaking to a clinical professional versus no one by year and race
CHAPTER 3: THE IMPACT OF A DIGITAL MENTAL HEALTH INTERVENTION VERSUS TRADITIONAL IN-PERSON MENTAL HEALTH SERVICES ON A SAMPLE OF COLLEGE-AGED STUDENTS
The majority of college-aged adults increasingly struggle with mental health problems, a trend that has been on the rise for the last two decades (Storrie, Ahern, & Tuckett, 2010; Oswalt et al., 2018; Bruffaerts et al., 2018). In the wake of the COVID-19 pandemic, college students have further experienced an increase in the prevalence of depressive and anxiety symptoms as they found themselves navigating additional life uncertainty and disruption characteristic of this global phenomenon. In a meta-analysis of college-aged student experience from the beginning of the pandemic in early to mid-2020, included studies demonstrated a prevalence of depression and anxiety at 39% and 36%, respectively (Yang, Wang, Wu, & Huang, 2021). Institutions of higher education are poised to address these mental health challenges by providing multiple opportunities to intervene before young adults enter the workforce. Such opportunities may support student learning and future earnings, as well as the development of healthy coping skills and social relationships (Eisenberg, Golbertstein, & Hunt, 2009; Etner, Frank, & Kessler, 1997; Kessler, Foster, Saunders, & Stang, 1995; Kessler, Walters, & Forthofer, 1998; Mojtabai et al., 2015).

As the number of college students who are willing to seek clinical services has steadily increased in the last decade (Oswalt et al., 2018), challenges persist in meeting demand. For some institutions, including the University of Louisville, which has a total of 16 mental health professionals (University of Louisville Counseling Center, n.d.) for a student population of approximately 23,000 (University of Louisville Just the Facts, n.d.), recommendations of one mental health professional for every 1000-1500 students have
barely been met (International Accreditation of Counseling Services, n.d.). Nonetheless, over 60% of college-aged students experiencing moderate to severe depression, anxiety, or stress, are not seeking mental health services on- or off-campus (Lee, Jeong, & Kim, 2021; Lipson, Lattie, & Eisenberg, 2018). During the pandemic when many campus counseling centers were not seeing students in person, access to mental health services became even more challenging for many students, especially those in high risk categories (Salimi, Gere, Talley, & Irioogbe, 2021). In many instances, college-aged students who do not seek clinical support experience increased severity of their symptoms, which in turn, makes it less likely that they will see a mental health professional as their symptoms worsen (Choate, 2022).

Considering a growing need to address these compounded mental health challenges, institutions of higher education have struggled to find innovative solutions to address this persistent issue, one that threatens their bottom line and contributes to ongoing financial strain. According to the National Alliance on Mental Health, 64% of college-aged students who had prematurely left their college or university did so due to mental health problems (Gruttadoro & Crudo, 2012), resulting in revenue loss for institutions of higher education. Digital mental health interventions (DMHIs) may offer a cost-effective alternative for some students who require mental health support but, for whatever reason, are unlikely to seek it successfully during their college career. Additionally, if integrated thoughtfully into the first-year campus experience, self-guided mental health-related apps may provide the greatest versatility in application for students.
who are at high risk of experiencing a mental health crisis or distress and who experience a range of other competing needs.

To that end, the results of a systematic review examining efficacy of self-guided DMHIs for college students revealed a small number of useful apps that have demonstrated an improvement in symptoms of common mental health problems and require little regular use to produce positive outcomes. Among the most effective types are mindfulness meditation apps; in particular, Headspace, demonstrated significant reduction in college-aged participants struggling with depressive, anxiety, psychological distress and stress symptoms (Flett, Conner, Riordan, Patterson, & Hayne, 2020; Flett, Hayne, Riordan, Thompson, Conner, 2019).

To determine whether Headspace provides adequate value for associated costs at the University of Louisville, the authors conducted an economic evaluation comparing health and non-health outcomes (i.e., effects) and costs of the intervention with relevant controls. Due to the broad range of costs and effects of the interventions being compared and the absence of a cost-per-QALY assessment, a cost consequences analysis (CCA) was selected (National Institute for Health And Care Excellence). In such a case, university stakeholders would be required to make value judgments when deciding if the benefits of the intervention exceed the costs incurred by implementation (Gomes, Murray, & Raftery, 2022).

This CCA model was informed by the RE-AIM model, which assesses five dimensions of access and cost, specifically: reach, efficacy/effectiveness, adoption, implementation, and maintenance. As these dimensions exist within a social ecology,
they occur and interact at multiple levels (e.g., individual or organizational), thus defining the public health impact of a program or policy (Glasgow, Vogt, & Boles, 1999). Furthermore, the development of the model was informed by Aday and Anderson’s Framework for the Study of Access (1974), addressing how health policy informs the interdependent relationship between the characteristics of health delivery systems and populations at risk, utilization of health services, and consumer satisfaction (see Figure 4). The adapted framework considers how college-aged students would be impacted by the introduction of a technology-delivered intervention with a focus on students who demonstrate the greatest need (i.e., high risk populations), strength of the impact on the anticipated reduction in mental health symptoms (i.e., effectiveness/volume and distribution of intervention), percentage of students we anticipate participating voluntarily (i.e., adoption/utilization), costs and delivery mode (i.e., implementation/utilization), and sustainability and short-intermediate term effects (i.e., maintenance). This study aimed to estimate the short-term (1-academic year) cost-effectiveness of Headspace mindfulness meditation app usage by first-year undergraduate students. Based on current recommendations for practice, the intervention was compared to a control group of college-aged students presenting common mental health problems who have received clinical mental health services sometime prior to matriculation and/or during their higher education experience. The overall goal of the CCA was to quantify the potential health and non-health effects of student exposure to the intervention, specifically a reduction of anxiety and/or depression symptoms compared to that of clinical mental health services while factoring in the range of labor
and capital costs associated with annual implementation as it relates to student retention.

**METHODS**

The CCA was conducted in five stages: (i) correlational analyses of three consecutive years of data from the Healthy Minds Study (2018-2021) measuring self-reported usage of digital mental health interventions (DMHIs) versus traditional (i.e. clinical) services and how helpful students reported them to be in improving their mental health problem(s), (ii) costing analyses to estimate the cost of the alternative intervention, a 1-year pilot that would provide 1000 first-year undergraduate students free, unlimited access to Headspace, versus the current practice, in-person clinical services provided by a campus counseling center for 1000 first-year undergraduate students, (iii) effects analyses to estimate the effects of the alternative intervention versus the current practice, (iv) return on investment analyses of the alternative intervention versus the current practice, (v) and parametric sensitivity analyses demonstrating the range of potential costs and outcomes of the alternative intervention versus the current practice.

**Correlational analyses**

Using an HMS sub-sample from institutions who collected student data on the Attitudes of Mobile Resources elective module in 2018-19, 2019-20, and 2020-21, correlational analyses were run to measure any app and therapy usage, perceived helpfulness of digital mental health interventions compared to traditional in-person mental health services, and perceived helpfulness of these interventions by student user who presented any depressive and/or anxiety symptoms in the last month.

**Costing analyses**
The cost of the proposed intervention included minimal capital and labor costs. The only capital cost was the annual licensing fee to provide Headspace at the University of Louisville (UofL) for 1000 first-year students; this value was derived from the number of students as a percentage of the entire student body based on a price quoted from a Headspace customer representative (Basile, 2022). From initial correspondence with several staff members from Louisville Metro Department of Public Health and Wellness in Louisville, KY, which provides Headspace free of charge to 200 employees, the authors were able to determine a starting point to inform a range of labor costs required to manage the app (Louisville Metro Department of Public Health and Wellness, 2022). Because the university role equivalent would entail a greater number of duties to support and encourage student usage and adherence, the authors considered a range of 1%, 3%, and 5% (lower bound, mid-point, upper bound) full-time effort to account for this discrepancy. The UofL Human Resources employee salaries and wages website provided the range of program coordinator salaries; see level EE (Salary & Wage Ranges University of Louisville, n.d.). Estimating the value of a first-year college student’s time at $10/hour, non-health costs per student are presented as opportunity costs that impact students who choose to use the app. They include time spent exploring and learning about app functionality, frequency of treatment, and treatment duration; all categories included a lower bound, midpoint, and upper bound to account for the range of student user preferences and needs. Health costs per student, which could include eye strain caused by use of the Headspace app on a digital device, were considered negligible.
The cost of the current practice, providing 1000 UofL students in-person therapy with a licensed clinical professional, included labor and capital cost considerations. According to the International Accreditation of Counseling Services, the accrediting recommends one full-time mental health professional per 1000-1500 students at a campus counseling center. In addition to a therapist, a campus counseling center in a mid-large sized university of 5000+ students typically requires a director of services and at least one front desk support staff. Salary ranges for these roles were provided by the UofL Human Resources employee salaries and wages website; see levels EI and Hourly NC (Salary & Wage Ranges University of Louisville, n.d.). Capital costs included the annual average rental rate for a standard sized office space, utilities, furniture, technology, internet and phone services, and miscellaneous office supplies (Commercial search, n.d.; Chase, n.d.). Estimating the value of a first-year college student’s time at $10/hour, non-health costs per student included the time spent scheduling a counseling appointment, traveling to and from an appointment (depending on whether a student lives on or off campus), wait time upon arrival to appointment, treatment frequency, and treatment duration. All categories included a lower bound, midpoint, and upper bound, except treatment duration as most counseling appointments are typically sixty minutes in duration. There were no obvious health costs per student identified in seeking or receiving therapy.

**Effects analyses**

For both the proposed intervention and the current practice, health and non-health effects (i.e. benefits) on the student user were considered. Among the health benefits, a student may experience reduced negative mental health symptoms (e.g., rumination,
negative self-talk, anxiousness), potentially resulting in improved sleep quality and
duration. Among the non-health benefits, a student may experience improved academic
performance/retention, decreased worry/burden on families, greater social inclusion, and
empowerment of mental health improvement. As a result of student usage of the
proposed intervention, college personnel may experience a decreased burden of campus
counseling centers and other support services. Other non-health economic benefits, such
as a projected increase in student retention were included in the return-on-investment
analysis. For the purposes of this study, effectiveness was defined as the likelihood that
the treatment was helpful (i.e., successful). Helpfulness was defined based on student
responses of ‘Helpful’ or ‘Very helpful’ to the following questions: “How helpful,
overall, do you think the smartphone app(s) was or has been for your mental or emotional
health?” “How helpful, overall, do you think therapy or counseling was or has been for
your mental health?” For the proposed intervention, effectiveness was measured for four
groups of students, the total number of students in the sample who had reported having
used an app (whether or not they had seen a therapist), those who had both used an app
and seen a therapist, those who had only used an app and never seen a therapist, and a
projected effectiveness of app use based on the assumption that DMHIs will improve in
effectiveness in the future. For the current practice, effectiveness was measured for three
groups of students, the total number of students in the sample who had reported having
seen a therapist (whether they had used an app), those who had both seen a therapist and
used an app, those who had only seen a therapist and never used an app. Because the
effectiveness and costs of traditional in-person therapy is unlikely to change significantly
in the future, no additional projections were made. Using midpoint costs, the percentages of students who found DMHIs and therapy helpful or very helpful, respectively, were divided by the total cost per student user, resulting in a ratio of the likelihood of success per dollar spent on an intervention.

**Return on investment analysis**

Using the University of Michigan’s Return on Investment Calculator (n.d.), a return on investment for the proposed intervention and current practice was assessed. Responses submitted were uniform across interventions for UofL-specific data (e.g., size of student population, number of students benefiting from the service, university attrition rate, and approximate tuition rate per student). However, responses differed for the purpose of the intervention, prevention (proposed intervention) versus treatment (current practice), depending on the type of intervention. Cost considerations also differed between interventions. Intervention-specific outcomes (digital mental health app versus one full-time mental health therapist) included the number of students retained due to the service, added tuition revenue retained by implementing the service, added lifetime earnings for retained students (i.e., increased societal productivity), and the total cost of implementing the service (Healthy Minds Network ROI Calculator, n.d.).

**Parametric sensitivity analyses**

After building the model and obtaining preliminary results, parametric sensitivity analyses was conducted to test model and parameter uncertainty to ensure the structure and inputs in the model adequately reflected the probability of certain health events and financial projections occurring as a result of the intervention. Using the lower and upper
bound estimates in the costing and effects analyses, parametric sensitivity analyses for the proposed intervention and current practice entailed identifying the parameters by which outcomes could be measured to inform policy considerations. While percentages of full-time effort (FTE) differed between the proposed intervention and current practice due to how each intervention would be implemented, salary ranges allowed for lower and upper bound labor values to be calculated per student user. For capital costs, the proposed intervention did not provide a range of cost values, however, lower and upper cost thresholds were calculated. Finally, both treatments allowed for a range of opportunity costs incurred by the student user. Using total costs from the proposed intervention and current practice, lower and upper thresholds were calculated for the range of percentages of students who reported DMHIs and therapy to be helpful, respective of the treatment in question. For the proposed intervention only, a projected effectiveness of app usage was measured based on expected increase in user engagement due to improvement in app design and user experience.

Measures

*Usage of mental health services.* Usage of clinical mental health services was assessed using a single item (‘Have you ever received counseling or therapy for mental health concerns?’) from the Healthy Minds Study (2018-2021). Responses included: No, never; Yes, prior to starting college; Yes, since starting college; Yes, both of the above (prior to college and since starting college). Usage of digital mental health services was assessed using a single item (‘Have you ever used a smartphone app to manage your wellness or mental/emotional health?’) from the supplemental module entitled, Attitudes
about Mobile Resources in the Healthy Minds Study (2018-2021). Responses included: No, never; Yes.

**Helpfulness of mental health interventions.** Helpfulness of clinical mental health services was assessed using a single item (‘How helpful, overall, do you think therapy or counseling was or has been for your mental health?’) from the Healthy Minds Study (2018-2021). Responses included: very helpful, helpful, somewhat helpful, not helpful. Helpfulness of digital mental health services was assessed using a single item (‘How helpful, overall, do you think therapy or counseling was or has been for your mental health?’) from the supplemental module entitled, Attitudes about Mobile Resources in the Healthy Minds Study (2018-2021). Responses include: very helpful, helpful, somewhat helpful, not helpful.

*Depression and anxiety.* Depression was assessed using a single item (‘Over the last 2 weeks, how often have you been bothered by any of the following problems? Feeling down, depressed or hopeless.’) from the Patient Health Questionnaire (PHQ-9), which is a validated, widely used instrument (Beard, Hsu, Rifkin, Busch, & Björgvinsson, 2016). It consists of nine items that address depressive symptoms over the past two weeks and employs a Likert scale ranging from 0 = not at all to 3 = almost every day. Higher scores indicate a greater severity in depressive symptomology; a cut-off point of $>10$ has been recommended for diagnosis of depressive conditions (Moriarty, Gilbody, McMillan, & Manea, 2015). Anxiety was assessed using a single item (‘Over the last 2 weeks, how often have you been bothered by the following problems: feeling nervous, anxious, or on edge?’) from the Generalized Anxiety Disorder Assessment (GAD-7), which is a
validated, widely used instrument (Lowe et al., 2008). It consists of seven items that address anxiety symptoms over the past two weeks with response options ranging from 0 not at all to 3 nearly every day. According to Spitzer et al. (2006), a cut-off point of $\geq 10$ attains the optimal balance between specificity and sensitivity for a GAD diagnosis (Spitzer, Kroenke, Williams, & Lowe, 2006).

*Return on Investment Calculator.* The estimated economic returns for the Headspace app for 1000 students versus the current practice at University of Louisville was calculated using the University of Michigan Return on Investment Calculator. The questionnaire consists of seven items that inquire about the size of the student population, brief description of the services or program, number of students anticipated to benefit from the service or program over a one year period, whether the service or program is for treatment or prevention purposes, approximate cost of the delivering the proposed service or program per-student, per-year, approximate attrition (drop-out) rate per year for the student population, and approximate annual tuition rate, per student, in dollars (Healthy Minds Network ROI Calculator, n.d.).

**RESULTS**

*Correlational analyses*

Table 5 reflects a correlational analysis of student observations from the HMS data (2018-2019, 2019-2020, 2020-2021) from the following questions: Have you ever received counseling or therapy for mental health concerns? Have you ever used a smartphone app to manage your wellness or mental/emotional health? Of the students who have never used an app to manage their mental health, almost two-thirds had also
never seen a therapist or counselor (63%). Of students who have used an app, close to one-half had seen a therapist prior to starting college and/or since starting college (49%). Missing values reflect most students who did not respond to the app-related question due to their institution not selecting the supplemental module entitled, Attitudes about Mobile Resources.

From the same comparison of student observations in Table 5, perceived helpfulness of mental health support from therapy or counseling and apps is presented in Table 6a and 6b, frequency and percentages, respectively. Among students who reported having used an app and never seeing a therapist or counselor, almost one-half found the app they had used to be helpful to very helpful (49%). For those who had seen a therapist or counselor and used an app at some point in the past, over two-thirds of students reported clinical mental health services to be helpful to very helpful (67%) compared to under one-third of students who reported digital interventions to be helpful to very helpful (31%).

Among students who reported having some measure of depressive and/or anxiety symptoms as well as experience using an app to manage their mental or emotional health, almost 40% of respondents reported that the app had been helpful to very helpful. See Table 7a. Of the much larger sample of students who reported some measure of depressive and/or anxiety symptoms and having seen a therapist or counselor at some point, over 80% expressed that clinical services had been helpful to very helpful. See Table 7b.

Costing analysis
The costing analyses in Tables 8a and 9a demonstrate estimated costs at the midpoint in all categories incurred by the university and individual student user of services. For the proposed intervention, the labor costs for one student services personnel included the salary and benefits (i.e., fringe) were $72,000. For this role, the midpoint percentage of staff time dedicated to support the intervention of 3% was used; this value totaled $2,160 ($2.16 per student user). The single capital cost of the Headspace licensing fee was $54,000 ($54 per student). Indirect costs (i.e. opportunity costs) for student time and effort included exploring (20 minutes total) and using the app for 10 minutes per use at a rate of once per week (totaling 30 uses over the course of an academic year). First-year undergraduate time was valued at $10 per hour. The total opportunity cost incurred by the individual student user was estimated to be $70. The total cost of the proposed intervention incurred by the university (i.e., total labor + total capital costs) was estimated to be $56,160 ($56.16 per student user). Therefore, the total cost per student user (opportunity costs + total labor cost + total capital cost) of the proposed intervention was estimated at $126.16. See Table 8a.

For the current practice, all costs were assessed at the midpoint. Labor costs for the three professional roles, which include the salary and benefits (i.e., fringe) were $72,000 for a therapist, $118,000 for a director of services, and $44,000 for a front desk support staff. For each role, the percentage of staff time dedicated to support the intervention of 100% was used; this value totaled $231,000 ($231 per student user). Capital costs associated with a campus counseling center were assessed and totaled approximately $38,800 ($38.80 per student user). Indirect costs (i.e., opportunity costs)
for student time and effort included scheduling (30 minutes), traveling roundtrip (30 minutes), wait time upon arrival (20 minutes), treatment frequency and duration (8 appointments for 60 minutes per appointment). First-year undergraduate time was valued at $10 per hour. The total opportunity cost incurred by the individual student seeking and receiving therapy was approximately $181 ($18.67 per student user). The total cost of the current practice incurred by the university (i.e., labor + capital costs) was estimated to be $269,800. Therefore, the total cost per student user (opportunity cost + total labor cost + total capital cost) of the proposed intervention was estimated at $450.47. See Table 9a.

The midpoint value of labor and capital costs for the proposed intervention totaled close to 21% of the cost of the current practice, approximately $56,000 and $270,000, respectively. Duration of the total intervention treatment required approximately 63% less time than that of the current practice when factoring all process considerations (e.g., scheduling), many of which did not apply to student usage of the Headspace app.

Effects analyses

The effects analyses in Tables 8b and 9b demonstrate the effects (i.e., benefits) experienced by the university and individual student users of mental health services assessed at the midpoint of total cost per student user. For the proposed intervention, there were 4 values calculated based on student characteristics. In the largest group of all students in the sample who had used an app and found it to be helpful (40%), for every extra dollar spent per student on the Headspace app, the likelihood of effectiveness (i.e. helpfulness) increases 0.32%. In the group of students who had experience both seeing a therapist and using an app and found the app to be helpful (31%), for every extra dollar
spent per student on the Headspace app, the likelihood of effectiveness (i.e. helpfulness) increases 0.25%. In the group of students who had used an app, but not seen a therapist and found the app to be helpful (49%), for every extra dollar spent per student on the Headspace app, the likelihood of effectiveness (i.e. helpfulness) increases 0.39%. In a future effectiveness projection of app usage (60%), for every extra dollar spent per student on the Headspace app, the likelihood of effectiveness (i.e. helpfulness) increases 0.48%. See Table 8b.

For the current practice, there were 3 values calculated based on student characteristics. In the largest group of all students in the sample who had seen a therapist and found it to be helpful (64%), for every extra dollar spent per student on traditional in-person mental health services, the likelihood of effectiveness (i.e. helpfulness) increases 0.14%. In the group of students who had experience seeing a therapist and using an app and found therapy to be helpful (68%), for every extra dollar spent per student on traditional in-person mental health services, the likelihood of effectiveness (i.e. helpfulness) increases 0.15%. In the group of students who had seen a therapist but not used an app and found the app to be helpful (62%), for every extra dollar spent per student on traditional in-person mental health services, the likelihood of effectiveness (i.e. helpfulness) increases 0.14%. See Table 9b.

**Return on investment analysis**

The return-on-investment analyses in Table 10 demonstrate the economic value (i.e., non-health benefit) of the proposed intervention compared to the current practice to the university and student users of services. For the proposed intervention, which serves
the primary purpose of prevention of mental health problems, 119 students would be retained compared to 103 seeking a clinical intervention. As a result, the revenue generated from the proposed intervention of the Headspace app student usage would exceed that of the current practice by $877,952. Lifetime earnings for retained students were projected to be approximately $24M and $21M, respectively. As described in the costing analyses, the cost of the current clinical practice is projected to be approximately five times that of the proposed Headspace intervention.

**Parametric sensitivity analyses**

The parametric sensitivity analyses in Tables 8a, 8b, 9a, and 9b provide lower and upper bounds from which to compare costs and impacts of the proposed intervention and current practice. For the proposed intervention, the lower bound of 1% FTE at the entry level salary of $61K was combined with the capital cost of the Headspace app ($54K) and the lowest usage of time value spent by student users exploring and using the app ($22.50). Total estimated cost per student user at the upper bound was $388.70. See Table 8a. Using this value to calculate the lower bound intervention effect based on the percentage of students who reported DMHIs to be helpful (approximately 40%), for every extra dollar spent per student on the Headspace app, the effectiveness (i.e. helpfulness) increases 0.10%.

At the upper bound of 5% FTE at the advanced level salary of $94K was combined with the capital cost of the Headspace app ($54K) and the highest usage of time value spent by student users exploring and using the app ($330). Total estimated cost per student user at the lower bound was $77.11. See Table 4a. Using this value to
calculate the intervention effect based on the percentage of students who reported DMHIs to be helpful (approximately 40%), for every extra dollar spent per student on the Headspace app, the likelihood of effectiveness (i.e. helpfulness) increases 0.52%. See Table 8b.

For the additional student samples of students who reported (or are projected to report) DMHIs to be helpful, for every extra dollar spent per student on the proposed intervention, the increased likelihood of effectiveness (i.e. helpfulness) increases 0.08% to 0.40% per student who had both used an app and seen a therapist, 0.13% to 0.64% per student who had used an app but not seen a therapist, and 0.15% to 0.78% for the projected effectiveness of app use per student based on expected improvement in app design and user engagement. See Table 8b.

For the current practice, entry level salaries for the three counseling center roles—$61K (therapist), $85K (director), $33K (front desk support)—were combined with the capital cost of the clinical services (approximately $27K) and the lowest opportunity costs incurred by a student user seeking and receiving therapy or counseling ($50.25). Total estimated cost per student user at the upper bound was $794.80. See Table 9a. Using this value to calculate the intervention effect based on the percentage of students who reported therapy or counseling to be helpful (approximately 64%), for extra every dollar spent per student on the clinical services, the likelihood effectiveness (i.e. helpfulness) increases by 0.08%. See Table 9b.

At the upper bound, the advanced level salaries for the three counseling center roles—$94K (therapist), $155K (director), $57K (front desk support)—were combined
with the capital cost of the clinical services (approximately $51K) and the lowest
total estimated cost per student user at the lower bound was $256.15. See
opportunity costs incurred by a student user seeking and receiving therapy or counseling
($437.50). Using this value to calculate the intervention effect based on the percentage of
students in the total sample who reported therapy or counseling to be helpful
(approximately 64%), for every extra dollar spent per student on the clinical services, the
likelihood of effectiveness (i.e. helpfulness) increases by 0.25%. See Table 9b.

For the additional student samples of students who reported clinical services to be
helpful, for every extra dollar spent on the current practice, the increased likelihood of
effectiveness (i.e. helpfulness) increases by 0.09% to 0.27% per student who had seen a
therapist and used an app and 0.08% to 0.24% per student who had seen a therapist but
never used an app. See Table 9b.

DISCUSSION

Correlational analyses

The largest group of students in the sample (60%) were those who had never seen
a therapist or counselor to improve their mental health or well-being, which is
approximately 5% higher than what is known in the literature about overall mental health
help-seeking of college-aged adults (Lee, Jeong, & Kim, 2021; Lipson, Lattie, &
Eisenberg, 2018). Close to 30% of students had at some point seen a clinical mental
health professional but had not tried an app to support their mental health or well-being.
While this group had not yet tried an app to improve their mental health or well-being, a
willingness to seek clinical support may transfer to a willingness to try a digital mental health intervention if properly introduced, supported, and normalized.

Twice as many students in the sample reported therapy to be helpful or very helpful compared to the support, they received from using an app, which suggests that clinical interventions are perceived to be more helpful than digital ones when addressing mental health concerns. In contrast, 20% more students who had never seen a therapist but had used an app for mental health or well-being found the digital intervention to be helpful or very helpful.

Over 10% more students presenting depressive and/or anxiety symptoms in the last month compared to all students in the sample reported therapy to be helpful or very helpful. This suggests that the vast majority of those in need of mental health support who have sought and received support from a mental health professional have experienced symptom improvement. From this sample, just under 10% more reported finding apps to be helpful or very helpful, though this view did not reflect the experience of most students presenting depressive and/or anxiety symptoms. Ultimately, these findings suggest that for students in need of mental health support, clinical services offer the most reliable source for mental health improvement. Digital mental health interventions appear to be effective for some college-aged adults but may not provide the level of support other young adults prefer or need to achieve a reduction in their mental health challenges.

**Costing analyses**
From the analyses comparing capital and labor costs of the proposed intervention versus the current practice at the midpoint, it is evident that the former, which is one-fifth the cost of the latter, provides a far greater cost savings to the university. Additionally, the opportunity costs incurred by student users were disparate as well, with student users of Headspace projected to spend half as much time engaging with the apps as students who pursue clinical treatment.

**Effects analyses**

From the analyses calculating effectiveness per extra dollar spent per student for the proposed intervention versus the current practice at the midpoint, the likelihood of success of the alternative Headspace intervention was over two times as cost-effective compared to traditional in-person therapy. If the pilot project were expanded to include more students experiencing low to moderate mental health problems, allowing for greater comparison between the proposed and current practice interventions, the increase in effectiveness would not be a small effect. Specifically, at the midpoint, hiring one additional mental health professional ($72,000) would cost approximately $3 per student (i.e. likelihood of effectiveness range of 0.30% to 1.5%). For the same cost, close to the entire student population of the University of Louisville could receive Headspace for self-guided use.

**Return on investment analysis**

The authors made the deliberate choice to describe the purpose of the proposed intervention as prevention (i.e., not treatment) due to the self-guided nature of the Headspace app. While it is possible that a therapist could assign a course of treatment that
would include regular use of Headspace, the app is designed to be used by anyone, regardless of whether they concurrently receive or need therapy or counseling. As such, there appears to be a greater potential number of students projected to be retained by the proposed intervention compared to the current practice, presumably those who struggle with low to moderate depression and/or anxiety symptoms. Consequently, this analysis projects close to $1M more in revenue generated with just over $3M more in student lifetime earnings. This has far-reaching economic value potentially than simply revenue retained by the university as young adults who are successful in finding employment in their post-undergraduate or graduate years are more likely to become alumni who give financially to their alma mater later in life (Lipson, Lattie, & Eisenberg, 2018).

**Parametric sensitivity analyses**

At the lower bound, the proposed intervention cost less than 30% of the current practice; at the upper bound, the cost difference was not as pronounced with the app treatment costing slightly under 50% of the clinical treatment.

In line with the direction of the effects analyses, the parametric sensitivity analyses revealed a greater disparity in success between the proposed intervention and the current practice. When examining the combined samples of students who had used an app compared to those who had seen a therapist, at the lower bound the likelihood of success of the alternative Headspace intervention was 150% more cost-effective than traditional in-person therapy. At the upper bound, the likelihood of success of the alternative Headspace intervention was over 200% more cost-effective than traditional in-person therapy.
For students who had reported having used an app and seen a therapist, at the lower bound the likelihood of success for the alternative Headspace intervention was equivalent to the traditional in-person therapy. At the upper bound, the likelihood of success of the alternative Headspace intervention was close to 150\% more cost-effective than traditional in-person therapy.

When comparing the sample of students who had only used an app and never seen a therapist to the student sample who had only seen a therapist and never used an app, at the lower bound the likelihood of success of the alternative Headspace intervention was close to 190\% more cost-effective than traditional in-person therapy. At the upper bound, the likelihood of success of the alternative Headspace intervention was over 265\% more cost-effective than traditional in-person therapy.

When examining the entire range of cost-effectiveness of the alternative intervention versus the current traditional practice, there is overlap for all scenarios of effectiveness. However, the mid cost-effectiveness ratio of the alternative digital intervention in all scenarios is greater than upper bound cost-effectiveness ratio of traditional current practice. Therefore, if digital interventions are conducted appropriately, they can be much more cost-effective than traditional therapy. Even if its effectiveness is low, the digital intervention is still as cost-effective as traditional. See Figure 5.

**Limitations**

There were numerous limitations due to the constraints of this economic evaluation. First, the ability to generalize outcomes was limited. Without being able to
identify which institutions implemented the supplemental module assessing attitudes about mobile resources, there was no way to know what geographical or institution-specific factors may affect a students’ decisions to use or not use an app. In addition, the question did not ask about specific app use; therefore, we could only measure perceived helpfulness generally, which informed our understanding of how many students may be more open to using the alternative intervention, Headspace, due to positive experiences with apps in general. In addition, the authors were not able to control for other confounders due to a lack of randomization. As a result, there may be other unknown factors that may affect a student’s decision to use or not use Headspace. Another limitation of this CCA is that it did not allow for specific or definitive guidance on cost-effectiveness thresholds. Finally, due to how the HMS is structured (i.e. student self-reporting), this study reflects some measure of selection and recall biases. Moreover, for students who reported having seen a clinical professional at some point prior to their college experience, responses may reflect measurement bias depending on when this occurred and whether it was a one-time occurrence or prolonged over a course of treatment.

**Conclusion & Campus Policy Implications**

While the analyses did not reveal the exact intervention type, it did provide some understanding of the approximate percentage of students who need mental health support, are willing to use it, and how effective they felt digital mental health interventions were in addressing their mental health and other well-being needs. This insight allowed the authors to address some of the biases in the analysis of use that was valuable in the CCA
modeling process when estimating the approximate number of undergraduate students who would potentially use a technology-delivered intervention at University of Louisville.

This study reveals useful mental health policy paths by expanding the range of potential cost-effective services universities could offer their students as a means of primary and secondary prevention of common mental health problems and their associated conditions. While the current practice, as demonstrated by this study, is more effective at helping students in need of mental health support, it comes at a much higher financial cost. Campus-wide promotion and integration of the Headspace app into the first-year experience at multiple entry points, including residence halls, Living Learning Communities, and introduction to college classes, may improve adherence and effectiveness of outcomes associated with the proposed intervention, especially as a means of primary prevention of mental health problems in young adults. While the proposed intervention would not nor should it replace clinical services, it could serve to offer cost-effective support for students while waiting for services, and may be sufficient for those experiencing mild to moderate concerns. Moreover, this type of intervention may be useful to reach students who need therapy and will never seek it, and those who are beginning to experience the onset of stressors associated with transition into college life in the wake of global pandemic.

When implemented as a means of primary prevention of common mental health problems that affect most college aged students, the economic viability of offering Headspace to college-aged students early in their academic careers is apparent. Offering
Headspace as one of a range of mental health services has the potential to support young adults more comprehensively in becoming healthy and productive individuals who are more likely to graduate, become contributing members of society, and potentially alumni who may choose to support the alma mater that supported their long-term well-being in their young adult years.
Table 5. Number of observations N = 423

<table>
<thead>
<tr>
<th></th>
<th>app_ever(^a), n(%)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1=No, never</td>
<td>2=Yes</td>
<td></td>
<td>Missing</td>
</tr>
<tr>
<td>1=No, never</td>
<td>204(62.77%)</td>
<td>50(49.5%)</td>
<td>59692(43.42%)</td>
<td></td>
</tr>
<tr>
<td>2=Yes, prior to starting college</td>
<td>61(18.77%)</td>
<td>23(22.77%)</td>
<td>19099(13.89%)</td>
<td></td>
</tr>
<tr>
<td>3=Yes, since starting college</td>
<td>27(8.31%)</td>
<td>6(5.94%)</td>
<td>18783(13.66%)</td>
<td></td>
</tr>
<tr>
<td>4=Yes, both of the above</td>
<td>32(9.85%)</td>
<td>20(19.8%)</td>
<td>21061(15.32%)</td>
<td></td>
</tr>
<tr>
<td>missing</td>
<td>1(0.31%)</td>
<td>2(1.98%)</td>
<td>18855(13.72%)</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) App\_ever is the frequency and percentage of students who responded to the survey item, “Have you ever used a smartphone app to manage your wellness or mental/emotional health?”

\(^b\) Ther\_ever is the frequency and percentage of students who responded to the survey item, “Have you ever received counseling or therapy for mental health concerns?”.
<table>
<thead>
<tr>
<th>ther_ever</th>
<th>app_ever b, (n)</th>
<th>1=No, never</th>
<th>2=Yes</th>
<th>missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1=No, never</td>
<td>na</td>
<td>na</td>
<td>app(25, 24)*</td>
<td>na</td>
</tr>
<tr>
<td>2,3,4=Yes</td>
<td>ther(21,309; 37,172)</td>
<td>ther(45, 74)*</td>
<td>ther(16, 33)<em>; app(34, 15)</em></td>
<td>ther(21,248; 37,065)</td>
</tr>
<tr>
<td>Missing</td>
<td>na</td>
<td>na</td>
<td>app(0, 1)*</td>
<td>na</td>
</tr>
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</table>

na: not applicable

a ther(#, #) reflects responses--NOT HELPFUL (i.e., not helpful or somewhat helpful), HELPFUL (i.e., helpful or very helpful)--to the question, "How helpful, overall, do you think therapy or counseling was or has been for your mental health?".

b app(#, #) reflects responses--NOT HELPFUL (i.e., not helpful or somewhat helpful), HELPFUL (i.e., helpful or very helpful)--to the question, "How helpful, overall, do you think the smartphone app(s) was or has been for your mental or emotional health?".

Yes responses to the question, "" include "Yes prior to starting college," "Yes, since starting college.", and "Yes, both of the above."

*Groups of interest.
Table 6b. Perceived helpfulness of mental health support: therapy and apps, percentage N = 266

<table>
<thead>
<tr>
<th>ther_ever</th>
<th>1=No, never</th>
<th>2=Yes</th>
<th>missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1=No, never</td>
<td>na</td>
<td>na</td>
<td>app(51%, 49%)*</td>
</tr>
<tr>
<td>2,3,4=Yes</td>
<td>ther(37%, 63%)*</td>
<td>ther(38%, 62%)<em>; app(69%, 31%)</em></td>
<td>ther(37%, 63%)</td>
</tr>
<tr>
<td>Missing</td>
<td>na</td>
<td>na</td>
<td>app(100%, 0%)</td>
</tr>
</tbody>
</table>

na: not applicable

a ther(#, #) reflects responses--NOT HELPFUL (i.e., not helpful or somewhat helpful), HELPFUL (i.e., helpful or very helpful)--to the question, "How helpful, overall, do you think therapy or counseling was or has been for your mental health?".

b app(#, #) reflects responses--NOT HELPFUL (i.e., not helpful or somewhat helpful), HELPFUL (i.e., helpful or very helpful)--to the question, "How helpful, overall, do you think the smartphone app(s) was or has been for your mental or emotional health?".

*Groups of interest

Yes responses to the question include "Yes prior to starting college," "Yes, since starting college," and "Yes, both of the above."
<table>
<thead>
<tr>
<th>Depression Status</th>
<th>Anxiety Status</th>
<th>Helpful, Overall</th>
<th>Helpful, Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>phq9_2</strong> &amp;/or <strong>gad7_1</strong></td>
<td>1=Not at all</td>
<td>21(56%), 17(44%)</td>
<td>53(60%), 34(40%)</td>
</tr>
</tbody>
</table>

*a* Depression status was assessed using a single item from the Patient Health Questionnaire (PHQ-9) Over the last 2 weeks, how often have you been bothered by any of the following problems? Feeling down, depressed or hopeless.

*b* Anxiety status was assessed using a single item from the Generalized Anxiety Disorder Scale (GAD-7) Over the last 2 weeks, how often have you been bothered by the following problems? Feeling nervous, anxious, or on edge.

Order of responses reflects--NOT HELPFUL (i.e., not helpful or somewhat helpful), HELPFUL (i.e., helpful or very helpful) to the question, "How helpful, overall, do you think the smartphone app(s) was or has been for your mental or emotional health?". 
Table 7b. Perceived helpfulness of therapy or counseling for students presenting depressive &/or anxiety symptoms N = 22,710

<table>
<thead>
<tr>
<th>ther_ever</th>
<th>phq9_2, &amp;/or gad7_1</th>
<th>1=Not at all</th>
<th>756(13%); 5,148 (87%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2=Yes</td>
<td>2=Several to nearly every day</td>
<td>3,148(19%); 13,658(81%)</td>
<td></td>
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</tbody>
</table>

*a Depression status was assessed using a single item from the Patient Health Questionnaire (PHQ-9) Over the last 2 weeks, how often have you been bothered by any of the following problems? Feeling down, depressed or hopeless.

*b Anxiety status was assessed using a single item from the Generalized Anxiety Disorder Scale (GAD-7) Over the last 2 weeks, how often have you been bothered by the following problems? Feeling nervous, anxious, or on edge.

Order of responses reflects NOT HELPFUL (i.e., not helpful or somewhat helpful), HELPFUL (i.e., helpful or very helpful) to the question, "How helpful, overall, do you think therapy or counseling was or has been for your mental health?"
<table>
<thead>
<tr>
<th>Row</th>
<th>Intervention Costs</th>
<th>Lower bound</th>
<th>Midpoint</th>
<th>Upper bound</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>% of FTE</td>
<td>1%</td>
<td>3%</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Salary range</td>
<td>$61,000</td>
<td>$72,000</td>
<td>$94,000</td>
<td>Row1×Row2</td>
</tr>
<tr>
<td>3</td>
<td>Total labor cost</td>
<td>$610</td>
<td>$2,160</td>
<td>$4700</td>
<td>Row3/1000</td>
</tr>
<tr>
<td>4</td>
<td>Total labor costs per student user</td>
<td>$0.61</td>
<td>$2.16</td>
<td>$4.70</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Total capital cost</td>
<td>$54,000</td>
<td>$54,000</td>
<td>$54,000</td>
<td>Row5/1000</td>
</tr>
<tr>
<td>6</td>
<td>Total capital cost per student user</td>
<td>$54</td>
<td>$54</td>
<td>$54</td>
<td></td>
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<tr>
<td>7</td>
<td>Opportunity cost</td>
<td>$10</td>
<td>$10</td>
<td>$10</td>
<td>Row7×Row8</td>
</tr>
<tr>
<td>8</td>
<td>Total time exploring app (hours)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Total time-value of exploring app</td>
<td>$10</td>
<td>$20</td>
<td>$30</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Frequency of treatment</td>
<td>15</td>
<td>30</td>
<td>90</td>
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<td>11</td>
<td>Treatment duration (minutes)</td>
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<td>20</td>
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<td>12</td>
<td>Total time spent using app (hours)</td>
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<td>5</td>
<td>30</td>
<td></td>
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<tr>
<td>13</td>
<td>Total time-value of using app</td>
<td>$12.50</td>
<td>$50</td>
<td>$300</td>
<td>Row7×Row12</td>
</tr>
<tr>
<td>14</td>
<td>Total time-value exploring &amp; using app</td>
<td>$22.50</td>
<td>$70</td>
<td>$330</td>
<td>Row7×Row12+Row9</td>
</tr>
<tr>
<td>15</td>
<td>Health costs per student user</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Total cost per student user</td>
<td>$77.11</td>
<td>$126.16</td>
<td>$388.70</td>
<td>Row4+Row6+Row14+Row15</td>
</tr>
</tbody>
</table>

FTE: Full-time effort.

*a Management of Headspace app on campus would entail annual purchase, regular dissemination to students, and providing resources and training to college personnel to actively promote app. Salary range reflect additional fringe costs (28.5% of salary base) rounded up or down to the nearest $1000. Estimates retrieved from: https://www.salary.com/research/salary/recruiting/university-counselor-salary/louisville-ky. (See level EE.)

*b Student opportunity cost calculated using value of student’s time @ $10/hour. Based on an academic year (approximately 30 weeks), the following student usage needs were considered: time spent exploring/learning about the app (one-time, fixed value)—10 minutes, 20 minutes, 30 minutes; frequency of treatment—1x/every other week = 15, 1x/week = 30, 3x/week = 90; treatment duration—5, 10, 20 minutes.

*c There were negligible health costs per student user for digital mental health app.
Table 8b. Effects of Headspace intervention for academic year targeting first-year students \(N = 1000\)

<table>
<thead>
<tr>
<th>Row</th>
<th>Intervention Effect</th>
<th>Lower bound</th>
<th>Midpoint</th>
<th>Upper bound</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total cost per student user</td>
<td>$388.70</td>
<td>$126.16</td>
<td>$77.11</td>
<td>See Row16 in Table 4a.</td>
</tr>
<tr>
<td>2</td>
<td>% of students who reported DMHIs to be helpful (^a)</td>
<td>40%</td>
<td>40%</td>
<td>40%</td>
<td>Of all students who had used an app</td>
</tr>
<tr>
<td>3</td>
<td>Likelihood of helpfulness per dollar spent per student (^b)</td>
<td>0.10%</td>
<td>0.32%</td>
<td>0.52%</td>
<td>Row2/Row1</td>
</tr>
<tr>
<td>4</td>
<td>% of students who reported DMHIs to be helpful (^a)</td>
<td>31%</td>
<td>31%</td>
<td>31%</td>
<td>Of students who had used an app and seen a therapist</td>
</tr>
<tr>
<td>5</td>
<td>Likelihood of helpfulness per dollar spent per student (^b)</td>
<td>0.08%</td>
<td>0.25%</td>
<td>0.40%</td>
<td>Row4/Row1</td>
</tr>
<tr>
<td>6</td>
<td>% of students who reported DMHIs to be helpful (^a)</td>
<td>49%</td>
<td>49%</td>
<td>49%</td>
<td>Of students who had used an app but not seen a therapist</td>
</tr>
<tr>
<td>7</td>
<td>Likelihood of helpfulness per dollar spent per student (^b)</td>
<td>0.13%</td>
<td>0.39%</td>
<td>0.64%</td>
<td>Row6/Row1</td>
</tr>
<tr>
<td>8</td>
<td>% of students who reported DMHIs to be helpful (^a)</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>Projected effectiveness of app use</td>
</tr>
<tr>
<td>9</td>
<td>Likelihood of helpfulness per dollar spent per student (^b)</td>
<td>0.15%</td>
<td>0.48%</td>
<td>0.78%</td>
<td>Row8/Row1</td>
</tr>
</tbody>
</table>

DHMIs: Digital mental health interventions.
Note. Percentages are rounded to the nearest one-hundredth of a percent.
\(^a\) Percentage derived from the total number of students in the sample, those who had never seen a therapist and those who had seen a therapist, who reported having used an app for mental or emotional health and found it to be helpful or very helpful (39 out of 98 students.) See Table 2a for included frequencies.
\(^b\) Likelihood of helpfulness per dollar spent per student demonstrates health and non-health benefits to student.
### Table 9a. Costs of current practice (in-person therapy) for academic year targeting first-year students \((n = 1000)\)

<table>
<thead>
<tr>
<th>Row</th>
<th>Intervention Costs</th>
<th>Lower bound</th>
<th>Midpoint</th>
<th>Upper bound</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Labor costs(^a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) Therapist</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% of FTE</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Salary range</td>
<td>$61,000</td>
<td>$72,000</td>
<td>$94,000</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Subtotal labor cost</td>
<td>$61,000</td>
<td>$72,000</td>
<td>$94,000</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>(1) Director</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% of FTE</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Salary range</td>
<td>$85,000</td>
<td>$115,000</td>
<td>$155,000</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Subtotal labor cost</td>
<td>$85,000</td>
<td>$115,000</td>
<td>$155,000</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>(1) Front desk support staff</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% of FTE</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Salary range</td>
<td>$33,000</td>
<td>$44,000</td>
<td>$57,000</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Subtotal labor cost</td>
<td>$33,000</td>
<td>$44,000</td>
<td>$57,000</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Total labor cost (for all roles)</td>
<td>$179,000</td>
<td>$231,000</td>
<td>$306,000</td>
<td>Row3+Row6+Row9 Row10/1000</td>
</tr>
<tr>
<td>11</td>
<td>Total labor costs per student user</td>
<td>$179</td>
<td>$231</td>
<td>$306</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Capital costs(^b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Office rental</td>
<td>$12,000</td>
<td>$18,000</td>
<td>$24,000</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Utilities (gas, electric, water)</td>
<td>$2,400</td>
<td>$3,000</td>
<td>$4,200</td>
<td>Row12+Row13+ Row14+Row15+ Row16+Row17 Row18/1000</td>
</tr>
<tr>
<td>14</td>
<td>Furniture</td>
<td>$5,000</td>
<td>$7,500</td>
<td>$10,000</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Technology</td>
<td>$5,000</td>
<td>$7,500</td>
<td>$10,000</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Internet</td>
<td>$1,500</td>
<td>$1,800</td>
<td>$2,100</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Miscellaneous office supplies</td>
<td>$1,000</td>
<td>$1,000</td>
<td>$1,000</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Total capital costs</td>
<td>$26,900</td>
<td>$38,800</td>
<td>$51,300</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Total capital cost per student user</td>
<td>$26.90</td>
<td>$38.80</td>
<td>$51.30</td>
<td></td>
</tr>
<tr>
<td>Non-health costs per student user, per academic year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Opportunity cost</strong> $^c$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 Hourly wage</td>
<td>$10</td>
<td>$10</td>
<td>$10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21 Scheduling (minutes)</td>
<td>15</td>
<td>30</td>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22 Traveling, roundtrip (minutes)</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23 Waiting (minutes)</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24 Treatment duration (minutes)</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 Frequency of treatment</td>
<td>3</td>
<td>8</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26 Total time spent (hours)</td>
<td>5.25</td>
<td>18.67</td>
<td>43.75 (Row21+Row22+Row23+Row24)×Row25/60 Row26×10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27 Total time-value per student user</td>
<td>$50.25</td>
<td>$180.67</td>
<td>$437.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28 Health costs per student user $^d$</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29 Total costs per student user</td>
<td>$256.15</td>
<td>$450.47</td>
<td>$794.80 (Row11+Row19+Row27+Row28)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FTE: Full-time effort.

$^a$ Salary and wage ranges reflect additional fringe costs (28.5% of salary base) rounded up or down to the nearest $1000. Estimates retrieved from: [https://www.salary.com/research/salary/recruiting/university-counselor-salary/louisville-ky](https://www.salary.com/research/salary/recruiting/university-counselor-salary/louisville-ky); Therapist grade: EF, Director grade: EI; front desk assistant: Hourly NC.

$^b$ Capital costs based on average costs in Louisville, KY. Office rental = calculation for 3 office spaces @ 120 square feet/space with role-appropriate furniture for a therapist, director, and front desk person. Utilities based on annual average for approximately 375 square feet. Technology includes (3) desktop computers, (1) printer/copier/scanner, (1) landline telephone, landline phone service. Miscellaneous office supplies include magazines, tissues, toilet paper, tea, notebooks, pens, cleaning supplies, and copier paper.

$^c$ Student opportunity cost calculated using value of student’s time @ $10/hour. Based on an annual academic year, the following ranges were considered: scheduling—15, 30, 45 minutes; traveling—30, 45, 60 minutes/session; waiting—10, 20, 30 minutes/session; treatment frequency—3, 8, 15 sessions; treatment duration—60 minutes (mid-point only).

$^d$ There were negligible health costs per student user for seeking and receiving therapy.
Table 9b. Effects of current practice (in-person therapy) for academic year targeting first-year students ($n = 1000$)

<table>
<thead>
<tr>
<th>Row</th>
<th>Intervention Effect</th>
<th>Lower bound</th>
<th>Midpoint</th>
<th>Upper bound</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total cost per student user</td>
<td>$794.80</td>
<td>$450.47</td>
<td>$256.15</td>
<td>See Row16 in Table 4a.</td>
</tr>
<tr>
<td>2</td>
<td>% of students who reported DMHIs to be helpful&lt;sup&gt;a&lt;/sup&gt;</td>
<td>64%</td>
<td>64%</td>
<td>64%</td>
<td>Of all students who had seen a therapist</td>
</tr>
<tr>
<td></td>
<td>Likelihood of helpfulness per dollar spent per student user&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.08%</td>
<td>0.14%</td>
<td>0.25%</td>
<td>Row2/Row1</td>
</tr>
<tr>
<td>3</td>
<td>% of students who reported DMHIs to be helpful&lt;sup&gt;a&lt;/sup&gt;</td>
<td>68%</td>
<td>68%</td>
<td>68%</td>
<td>Of students who had seen a therapist and used an app</td>
</tr>
<tr>
<td></td>
<td>Likelihood of helpfulness per dollar spent per student user&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.09%</td>
<td>0.15%</td>
<td>0.27%</td>
<td>Row4/Row1</td>
</tr>
<tr>
<td>4</td>
<td>% of students who reported DMHIs to be helpful&lt;sup&gt;a&lt;/sup&gt;</td>
<td>62%</td>
<td>62%</td>
<td>62%</td>
<td>Of students who had seen a therapist but not used an app</td>
</tr>
<tr>
<td></td>
<td>Likelihood of helpfulness per dollar spent per student user&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.08%</td>
<td>0.14%</td>
<td>0.24%</td>
<td>Row6/Row1</td>
</tr>
</tbody>
</table>

Note. Percentages are rounded to the nearest one-hundredth of a percent.

<sup>a</sup> Percentage derived from the total number of students in the sample, those who had never used an app and those who had used an app, who reported having seen a therapist or counselor for mental health reasons and found it to be helpful or very helpful. See Table 2b.

<sup>b</sup> Likelihood of helpfulness per dollar spent per student demonstrate health and non-health benefits to student.
Table 10. Return on investment for proposed intervention and current practice N=1000

<table>
<thead>
<tr>
<th></th>
<th>Proposed Intervention</th>
<th>Current Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of students retained, due to services/program</td>
<td>119</td>
<td>103</td>
</tr>
<tr>
<td>Added tuition revenue for your institution from retained students:</td>
<td>$6,529,768</td>
<td>$5,651,816</td>
</tr>
<tr>
<td>Added lifetime earnings for retained students (increased societal productivity):</td>
<td>$23,800,000</td>
<td>$20,600,000</td>
</tr>
<tr>
<td>Total cost of implementing services/program:</td>
<td>$56000</td>
<td>$268,000</td>
</tr>
</tbody>
</table>

Note. Estimates based on the following University of Louisville-specific responses: size of student population (23,246); brief description of the services or program (digital mental health app versus 1 full-time mental health therapist); number of students anticipated to benefit from the service or program over a one year period (1000), whether the service or program is for treatment or prevention purposes (prevention versus treatment), approximate cost of the delivering the proposed service or program per-student ($58 versus $270) per year, approximate attrition (i.e. drop-out) rate per year for the student population (19.1%), and approximate annual tuition rate, per student, in dollars ($27,436). Tuition rate averaged based on number of in-state and out-of-state students and associated cost differences.
Figure 5. Framework for the Study of Access
Figure 6. Cost-effectiveness ranges for different effectiveness likelihoods of digital and traditional mental health services

*For every extra dollar spent per student
CONCLUSION

As the national epidemic of college student mental health has gained greater visibility in recent years, leadership in higher education have begun to prioritize student mental health as a top concern. In a small sample of university presidents included in the Pulse Point Presidential Survey on Student Mental Health and Well-being conducted prior to the COVID-19 pandemic, over 80% of those from public 4-year institutions reported reallocating or identifying additional funding to support the mental health of students on their campuses compared to over 70% of private 4-year and under 60% of public 2-year institutions (Chessman & Taylor, 2019). The introduction of an evidence-based digital mental health intervention that is well supported, integrated into campus life, and normalized through mental health awareness building, offers one strategy to address the challenges associated with meeting the mental health needs of a diverse student body. While the literature on help-seeking and mental health utilization of young adults is well established, less is known about how the use of self-guided digital mental health interventions may serve to improve access to mental healthcare services for college students who report common mental health challenges, especially those with historically marginalized identities.

This dissertation expanded the evidence about the usefulness of digital mental health interventions as a preventative and adjunctive treatment component of mental health services for college students in the wake of the COVID-19 pandemic. Specifically, the three papers identified digital mental health intervention that have been proven to be
effective in preventing, reducing, or improving symptoms associated with adverse mental health in college students, examined differences in help-seeking behaviors between low and high help-seeking students, and explored a hypothetical cost-effectiveness evaluation of an evidence-based digital mental health intervention within a university setting.

Guided by the PRISMA protocol, the first manuscript in this dissertation provided a systematic review that identified peer-reviewed studies targeting college student use of a self-managed digital mental health intervention that demonstrated a reduction, improvement, or prevention of condition or symptoms associated with depression, anxiety, psychological distress, and/or stress. In the final analysis of included studies, the results demonstrated that certain mindfulness, CBT, and ACT-based intervention apps may effectively improve symptoms associated with common mental health problems in college-aged students. However, adherence was a common challenge across studies, and a range of approaches to address the issue were examined. The results of studies included in this review suggest the need to allow users the option of whether or not they want to receive reminders (i.e. user-enabled feature on app), control over when and how often they receive them, and offer a range of content variety to keep students engaged.

The second manuscript examined how beliefs and barriers to seeking treatment influence help-seeking behavior of college-aged students in need of mental health services, specifically those who prefer to speak to a clinical professional (i.e., high help-seeking) versus no one or one person in their social network (i.e., low help-seeking). The results demonstrated that non-Latinx Black students present the greatest lack in help-seeking. Additionally, our results demonstrated a steady increase in help-seeking behavior for non-Latinx White, Latinx, and multi/other race students between 2015 and
2018, followed by steady decline to their lowest individual race/ethnicity levels by the end of the study period (2021). In addition, as severity of symptoms increased, the odds that students seek professional help diminished. This trend was less pronounced in students with anxiety compared to students experiencing depressive symptoms. Perceived stigma also had a significant adverse effect on willingness to seek professional help when experiencing emotional distress.

The third manuscript quantified the cost effectiveness of a public 4-year university pilot for 1000 first-year students using Headspace, one of the self-managed DMHIs identified in the first manuscript that demonstrated efficacy in multiple studies in the reduction of anxiety and/or depression symptoms with college students. Guided by the RE-AIM model and Aday and Anderson’s Framework for the Study of Access, a cost consequences model compared the proposed digital alternative intervention to traditional psychological services health and non-health effects, factoring in a range of labor and capital costs associated with annual implementation. The results suggest that digital interventions, if implemented for the purposes of prevention of mental health problems or as an adjunctive to traditional clinical therapy, offer a cost-effective and complementary means by which to support student mental health.

While each of the three manuscripts individually contribute to the literature, collectively they define a more expansive vision for campus mental health service providers, student services personnel, higher education leadership, and policy makers in meeting the mental health needs of college-aged young adults. For campus counseling and health centers, who have struggled to meet the increase in mental healthcare utilization prior to the pandemic, this research offers adjunctive approaches to traditional
in-person care that may lessen some of the burden they and students on their waitlists face. In addition, it may complement traditional therapeutic approaches for students with moderate to severe mental health conditions who are open and interested in practicing coping skills using a digital platform in between their therapy sessions. For student services personnel, this research offers another tool to support students as they transition to college life and learn new socio-emotional skills to buffer the distress and/or stress that arises from new life and school stressors. At a very low cost to institutions of higher education, university leaders should dramatically expand the types of mental health services they offer their students, including digital options that meet and reflect the end user needs and identities. However, this expanding of digital options should always be adjunctive to high-quality clinical therapeutic approaches, which are mandatory to meeting the mental health needs of students with moderate to high levels of severity in the range of mental health conditions that affect young adults. And yet, meeting the mental health needs of students are only as successful as the collective support of mental health that exists on a college campus. For student support to be successful, university presidents and provosts must engage their respective campus communities in a comprehensive, campus-wide campaign that prioritizes mental health as a fundamental building block of its strategic plan. While expanding mental health services should be central to this campaign, greater institutional commitment to the mental health of all people who support campus life is critical to meeting the mental health needs of students they serve.

Health policy makers at the local, state, and federal levels need to focus their efforts on building capacity to train more college personnel and community health
workers in identifying and addressing mental health needs of students and their families. Moreover, policy makers can advocate for mental health screenings for first-year students to identify high-need young adults early in their college career. As telemedicine has grown more useful and relevant since the onset of the COVID-19 pandemic, policy makers should encourage more support of this type clinical care expansion for high-need students. Finally, more health insurance parity is required to meet the mental health care needs of low socio-economic young adults and their families, who are often most in need of quality mental health services.

**Future Research**

Future research of promising, low- to no-cost app platforms using persuasive design is needed as higher education institutions seek cost-effective evidence-based approaches that effectively address mental health challenges in diverse student populations. Students belonging to historically marginalized ethnicities and those who struggle financially continue to face barriers to accessing clinical support, necessitating alternative approaches to improving access to quality mental health services. To this end, app designers should partner with researchers to ensure DMHIs are culturally sensitive and empirically measured to improve adherence and effectiveness rates in high-need young adults. Furthermore, researchers need to address the economic implications of effective DMHIs, specifically the academic benefits to students, and consequently, the cost savings to institutions of higher education that result from increased student retention. As a matter of public health importance, thoughtful partnership of researchers and higher education leadership is needed to design rigorous studies that address attitudes about and barriers to DMHI adherence, how these vary across different types of student
users, and their overall effectiveness when paired with pre-existing clinical mental health services. State policymakers should include data collected from such rigorous research partnerships into policies that address barriers to mental health services historically marginalized groups experience and promote evidence-based interventions that effectively reduce health disparities in communities of color.
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Investigating mental health of US college students during the COVIS-19
doi:10.2196/22817

https://doi.org/10.1093/hsw/hlv089


CURRICULUM VITAE
Sara Atherton Choate, PhD(c), MSEd

GENERAL INFORMATION
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EDUCATION
University of Louisville, Doctor of Philosophy, School of Public Health & Information Sciences, Department of Health Management and Systems Sciences, Public Health Policy (anticipated dissertation defense, August 2022)
The City College of New York, Master of Science in Education, School of Education TESOL-Childhood Education (2010)
University of Wisconsin-Madison, Bachelor of Arts, College of Letters & Science, History (2001)

FELLOWSHIP
New York City Teaching Fellow (2008-2010)

NON-ACADEMIC EMPLOYMENT
University of Louisville Health Promotion, Louisville KY
Program Manager (2018-Present)
Program Coordinator, Sr. (2015-2018)
Boys & Girls Club of the Austin Area, Austin TX, Health Education Director (2011-2013)
Bronx Latin High School, Bronx NY, Teacher of English Language Arts & ESL (2010-2011)
Samuel Gompers High School, Bronx NY, Teacher of ESL (2008-2010)
A Woman’s Touch Sexuality Resource Center, Madison WI, Sexuality Facilitator (2001-2005)

NON-ACADEMIC GRANTS & IN-KIND DONATIONS AWARDED
Choate, S.A. You@College Online Platform Funding. Student Government Association,


**HONORS AND AWARDS**

University of Louisville Student Champion (2021)
The Mary K. Bonsteel Tachau Gender Equity Award (nominated 2017)

**CERTIFICATION**
The Center for Koru Mindfulness, Certificate of Completion, Koru Mindfulness Teacher Training Program, Lexington KY, Certification (2020-Present)
Question, Persuade, Respond Certification Training, Louisville KY, Certification (2019-Present)
Unitarian Universalist Association, Our Whole Live Grades 7-12th Facilitator Training, Boone NC, Certification (2015-Present)
Unitarian Universalist Association, Our Whole Live Grades Young Adult-Adult Facilitator Training, Louisville KY, Certification (2015-Present)
Green Dot Bystander Intervention Training, Lexington KY, Certification (2014-Present)
American Association for Sexuality Educators, Counselors, and Therapists, Sexuality Attitude Reassessment Certification Training, New York City NY (2014-Present)

**PROFESSIONAL MEMBERSHIPS**
Commission on the Status of Women (2019-Present)
American College Health Association (2015-Present)
Mid-American College Health Association (2015-2017)

**TEACHING EXPERIENCE**
University of Louisville 2017-present
    Health Equity (Undergraduate)
    Public Health Intervention Principles & Strategies (Undergraduate)
    Public Health Practice, Guest Lecturer (Undergraduate)
    Koru Mindfulness 4-class series (Undergraduate, Graduate, Faculty & Staff)
Hebron Middle School 2015
    Our Whole Lives Healthy Relationship 4-class series
Burnett Middle School 2012-2014
    Our Whole Lives 7-9th grade sexuality curriculum 12-class series
Bronx Latin High School 2010-2011
    ESL
Samuel Gompers High School 2008-2010
    English Language Arts & ESL
TRAINING EXPERIENCE

University of Louisville, Louisville KY


Louisville Collegiate School, Louisville KY

Community Shield, Louisville KY


Center for Women & Families, Louisville KY


Children Exposed to Violence Collective Impact Initiative, Louisville KY


The Peace Corps, Theis Senegal


A Woman’s Touch Sexuality Resource Center, Madison WI


ADVISING ACTIVITY

University of Louisville 2015-Present
MPH Faculty Advisor, 2021-
Professional and Student Staff Supervisor, 2018-Present
Sexperts Advisor, 2018-2019
Masters Practicum Advisor. Kent School of Social Work, School of Public Health & Information Sciences, 2016-2019
Well-being Coach, 2016-Present
Sexual Health Advisor, 2015-2016

UNIVERSITY SERVICE
University of Louisville
Green Dot Team, Faculty & Staff Trainer (2021-)
Growing Mindfulness Initiative, Co-Creator (2020-Present)
MASKot Program, Coordinator (2020-Present)
Building Resilience in Campus & Community, Coordinator (2020-Present)
Commission on the Status of Women
   Mentor (2021-)
   Commissioner (2019-Present)
Integration of Work & Family Committee Member (2019-Present)
Student Well-being Committee
   Student Wellbeing & Resilience Subcommittee Chair (2020-Present)
   Member (2019-Present)
Sustainability Council Member (2018-2020)
UofL Sleep Forum, Event Coordinator & Director (2018-2019)
Wellbeing & Resilience Survey Workgroup
   Co-Principal Investigator & Chair (2018-Present)
   Coordinator (2016-2018)
Health & Sports Science School Sexual Health Curricula Workgroup
   Co-Developer (2016)
School of Medicine and the American Medical Student Association
   Sexual Health Leadership Course Facilitator (2015)

PROFESSIONAL SERVICE
Community Shield
   Member (2017-2020)
   Training & Capacity Committee Co-Chair (2017-2020)
   Annual Conference Co-Coordinator & Designer (2017-2020)
Louisville Health Advisory Board
   Community Coordination of Care Committee Member (2018)
Children Exposed to Violence Collective Impact Initiative
   Training & Capacity Committee Co-Chair (2017)
   Member (2014-2017)
The Center for Women and Families
   Trauma Informed Care Committee Co-Chair (2014-2015)

PUBLIC SERVICE
White Women Demand Justice for Breonna Facebook Group
   Community Liaison (2020-Present)
Louisville Sex Ed Now
   Member, Spokesperson (2016)
Jefferson County Public School District
   Curriculum Developer, Healthy Relationships Project, 3-Day Teacher Training (2016)
The Peace Corps
   Primary Health Agent (2005-2007)

RESEARCH AND OTHER EXTERNAL SUPPORT GRANTS
GRANTS AWARDED

EXECUTIVE SUMMARIES


PEER-REVIEWED JOURNAL ARTICLES


POSTER PRESENTATIONS


PRESENTATIONS

Kentucky Prevention Network Annual Conference


College Personnel Association of Kentucky Annual Conference


Jefferson County Public Schools Homeless Senior Conference


American College Health Association Annual Conference


Mid-America College Health Association Annual Meeting


University of Louisville School of Medicine Cultural Competency Conference

Choate, S.A. (2015). Rethinking difference: Meeting the healthcare needs of your BDSM patients. Louisville KY

PUBLIC SPEAKING ENGAGEMENTS

Choate, S.A. (2016). Sexuality Guest Speaker. Diversity at the Table. Louisville KY


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