



**ACCEPTABILITY AND PERCEIVED EFFECTIVENESS OF
APPROACHES TO SUPPORT BIOMEDICAL DOCTORAL STUDENT
WELLNESS: ONE SIZE DOESN'T FIT ALL**

Alexander J. Hish	Mount Sinai Hospital, New York, NY, USA	alexander.hish@mountsinai.org
Gabriela A. Nagy	Duke University, Durham, NC, USA	gabriela.nagy@duke.edu
Caitlin M. Fang	Duke University, Durham, NC, USA	caitlin.fang@duke.edu
Lisalynn Kelley	Duke University, Durham, NC, USA	lisalynn.kelley@duke.edu
Christopher V. Nicchitta	Duke University, Durham, NC, USA	christopher.nicchitta@duke.edu
Kafui Dzirasa	Duke University, Durham, NC, USA	kafui.dzirasa@duke.edu
M. Zachary Rosenthal*	Duke University, Durham, NC, USA	mark.rosenthal@duke.edu

* Corresponding author

ABSTRACT

Aim/Purpose	National and international survey studies have begun to identify heightened levels of depression, anxiety, and burnout among doctoral students. Nevertheless, little research has been done to evaluate which interventions may support doctoral student wellness.
Background	To guide future interventions research, this study evaluated perceptions of the acceptability and effectiveness of wellness approaches among biomedical doctoral students.
Methodology	In this study, 69 biomedical doctoral students were sampled from a research institution in the southeastern United States. Participants completed a structured psychiatric diagnostic interview and self-report questionnaires. Questionnaires assessed participants' beliefs about the acceptability and effectiveness of 36 wellness approaches in reducing burnout symptoms and depression symptoms, and the participants' attitudes towards psychological services.
Contribution	This study demonstrates that approaches to support biomedical doctoral student wellness should be tailored according to a student's history of problems with mental health.

Accepting Editor Nicole A. Buzzetto-Hollywood | Received: May 19, 2020 | Revised: July 15, September 27, October 19, October 27, 2020 | Accepted: November 22, 2020.

Cite as: Hish, A. J., Nagy, G. A., Fang, C. M., Kelley, L., Nicchitta, C. V., Dzirasa, K. & Rosenthal, M. Z. (2020). Acceptability and perceived effectiveness of approaches to support biomedical doctoral student wellness: One size doesn't fit all. *International Journal of Doctoral Studies*, 15, 653-684. <https://doi.org/10.28945/4669>

(CC BY-NC 4.0) This article is licensed to you under a [Creative Commons Attribution-NonCommercial 4.0 International License](https://creativecommons.org/licenses/by-nc/4.0/). When you copy and redistribute this paper in full or in part, you need to provide proper attribution to it to ensure that others can later locate this work (and to ensure that others do not accuse you of plagiarism). You may (and we encourage you to) adapt, remix, transform, and build upon the material for any non-commercial purposes. This license does not permit you to use this material for commercial purposes.

Findings	Among candidate approaches, those involving spending time socializing with friends and family were rated most favorably by the entire sample. However, participants with high burnout or depression symptoms negatively evaluated approaches involving social engagement. Participants with high burnout symptoms or a history of psychological diagnoses or treatment rated individual therapy more favorably.
Recommendations for Practitioners	Social engagement is highly valued by biomedical doctoral students, above and beyond institution-based wellness resources. University administrators should prioritize interventions favored by students struggling with symptoms of burnout and mental health problems, especially individual therapy.
Recommendations for Researchers	Randomized trials should be conducted to assess the effectiveness in reducing problems with mental health of the approaches rated favorably, particularly those involving social engagement. Studies should investigate facilitators and barriers to approaches rated highly likely to be effective, but not acceptable, including peer support groups and individual therapy.
Impact on Society	In the interest of preventing attrition from biomedical doctoral programs and promoting the wellness and success of future scientists, it is important to develop training programs sensitive to the mental health needs of their students. This study provides important insights guiding next steps in intervention testing and implementation to support biomedical doctoral students.
Future Research	Future studies should validate the findings in this study with large internationally representative samples of students across various fields of doctoral study. Future intervention studies should include rigorous evaluation of facilitators and barriers for approaches rated favorably in this study.
Keywords	burnout, depression, doctoral students, intervention, wellness

INTRODUCTION

In recent years, large national and international survey studies have begun to demonstrate evidence of heightened depression, anxiety, and burnout among doctoral students (e.g., Evans et al., 2018; Levesque et al., 2017). Contributing to these problems include doctoral students' struggle to maintain work-life balance (Fuhrmann et al., 2011) and significant financial pressures related to low compensation and limitations in research funding (Alberts et al., 2014; Van Der Haert et al., 2014). Doctoral students in the biomedical sciences constitute the largest fraction of graduate students in the sciences in the United States (National Academy of Sciences, National Academy of Engineering, & Institute of Medicine, 2014). Despite the well-documented need to intervene to prevent burnout and improve wellness for this vulnerable population, little scientific work has been done to evaluate which interventions may be effective (Tsai & Muindi, 2016).

University program administrators are faced with the daunting task of choosing interventions that benefit the most students at the lowest cost to the institution. A necessary step in achieving this objective involves selecting interventions, tailoring their implementation to particular contexts, and evaluating their efficacy, acceptability, and feasibility (Bartholomew et al., 2011; Green et al., 2001; Kane & Trochim, 2007; Powell et al., 2017; Rouwette et al., 2002). To this end, the current study aims to increase knowledge in the areas of intervention acceptability and effectiveness among biomedical doctoral students.

LITERATURE REVIEW

BIOMEDICAL DOCTORAL STUDY PROGRAMS AND MENTAL HEALTH

The biomedical sciences are unique in that they deal with the principles that shape health and disease processes, seeking the means to prevent or cure illnesses that afflict millions of individuals and their loved ones on a daily basis. Given the pressing nature of the problems it seeks to solve, this enterprise attracts substantial funding from the National Institutes of Health (NIH), alongside numerous federal agencies, academic institutions, and charitable foundations (Alberts et al., 2014). Nevertheless, as articulated close to a decade ago by the economist Paula Stephan (2012), the landscape for biomedical PhD training is under considerable economic pressure. The principle drivers of this growing crisis include continued instability in federal funding of research and the economic “supply and demand” demographic impact of an extended expansion in biomedical PhD training without a commensurate increase in available faculty positions (Stephan, 2012). Compounding the challenge is the paucity of research track positions within academia, hyper-competition for research funding, and a PhD training paradigm that has not evolved to meet these challenges (Alberts et al., 2015; Casadevall & Fang, 2017). Furthermore, the overall length of training for these students is often longer than several comparable scientific disciplines such as chemistry and physics, with an average time-to-PhD of 5-7 years, and postdoctoral training that may last another 5-8 years (National Institutes of Health, 2012). In the face of protracted, demanding training programs, along with the uncertainty of career advancement due to an inadequate supply of tenure-track faculty positions and funding for biomedical research (Alberts et al., 2014; Fuhrmann et al., 2011), it is unsurprising that biomedical doctoral students in particular may face an increased burden of mental illness. Addressing these issues is an important area of concern for the future of the broader biomedical enterprise and its promise of understanding and treating illness, as poor mental health in doctoral student samples has been associated with reduced academic productivity, decreased quality of work, and attrition (Hyun et al., 2006; Levecque et al., 2017).

Little work has been done to examine the prevalence of various mental health problems among graduate students generally and biomedical doctoral students specifically (Levecque et al., 2017; Tsai & Muindi, 2016). Our research team found that, in a sample of 69 biomedical doctoral students at one institution, 15% of students met diagnostic criteria for a mood disorder and 32% for an anxiety disorder in the past year (Nagy et al., 2019), compared to 10% and 18% in the general population, respectively (Kessler et al., 2005). While we are not aware of studies in other doctoral disciplines using standardized interviews to ascertain the mental disorders of students, one study of PhD students representing various disciplines from 81 institutions (Lipson et al., 2016) found, for example, the following prevalence rates of moderate-to-severe depressive symptoms as measured on the gold standard Patient Health Questionnaire-9 (PHQ-9; Kroenke et al., 2001): 16% in social sciences, 21% in humanities, 14% in natural sciences, and 16% in engineering. This same study (Lipson et al., 2016) measured prevalence rates of moderate-to-severe anxiety using the Generalized Anxiety Disorder-7 instrument (GAD-7; Spitzer et al., 2006), with the following results: 9% in social sciences, 14% in humanities, 6% in natural sciences, and 4% in engineering. Given these data, biomedical doctoral students may experience clinically significant depression and anxiety at rates higher than the general population and exceeding or on par with those of students in other doctoral disciplines.

Burnout is a more difficult construct to measure. Although the Maslach Burnout Inventory (MBI; Maslach & Jackson, 1981) has been considered by some as the gold standard measure of burnout, other measures have proliferated over the years to target the particular experiences of burnout in specific disciplines or circumstances, and there are not accepted symptom thresholds at which an individual is considered “burned out” (Rotenstein et al., 2018). These characteristics make it difficult to meaningfully compare the prevalence and severity of burnout experienced by students in different doctoral disciplines. Our work demonstrated a normal distribution of overall burnout and subscale

scores (i.e., inadequacy, exhaustion, cynicism) of biomedical doctoral students as measured by a modified version of the School Burnout Inventory (SBI; Salmela-Aro et al., 2009), which may indicate that the majority of students are reporting moderate levels of burnout (Nagy et al., 2019). The SBI has been mainly applied to examine the burnout experiences of high school and college students (e.g., Evers et al., 2020; Lee & Anderman, 2020). However, one study (May et al., 2016) using the SBI to measure burnout in medical students found a mean SBI score of 24.09 (SD = 6.79), compared to a mean of 28.77 (SD = 11.07) among doctoral students in our earlier study (Nagy et al., 2019). In further comparison, one study of psychology graduate students (Richardson et al., 2020) found that burnout scores as measured by the Copenhagen Burnout Inventory (CBI; Kristensen et al., 2005) were above the mean of a normative sample. Another study of a mixed sample of students in master's and doctoral programs of diverse disciplines (Allen et al., 2020) found that students had moderate scores (mean of 2.7/6, standard deviation of 1.4) on the exhaustion subscale of the MBI. Again, while it is difficult to compare these samples due to the diversity of methods used to measure burnout, it seems reasonable to suggest that biomedical doctoral students, similar to other graduate and professional students, experience significant levels of burnout.

ACCEPTABILITY AND EFFECTIVENESS

Acceptability is the interest in and willingness of subjects to engage in particular activities, measured directly through self-report or inferred through the levels at which individuals actually participate in an intervention (Berry et al., 2016; Sekhon et al., 2018). Various elements have been identified that contribute positively to the acceptability of an intervention. For example, the ease of use of the delivery format contributes positively to acceptability (Poole et al., 2012), as well as to what extent safety and privacy are protected during the intervention (Gleeson et al., 2014). Similarly, the fit of the intervention to an individual's personal interests is positively associated with acceptability (Beattie et al., 2009). Conversely, one aspect that tends to decrease acceptability is the severity of a particular individual's psychological symptoms; for example, if a subject's depressive symptoms decrease their motivation to engage in help-seeking behaviors generally, these symptoms may also reduce the subject's willingness to engage in the intervention of interest (Todd et al., 2012). Another barrier to acceptability particularly relevant to mental health interventions is stigma associated with the intervention (Clement et al., 2015). Stigma about mental health and wellness services is modifiable, for example, through direct conversation with mental health professionals that addresses negative attitudes and fears (Egisdóttir et al., 2011) or through reflection on personal values that may be consistent with help-seeking (Lannin et al., 2017). Although knowledge of the relative acceptability of mental health interventions would be useful in choosing interventions that the majority of students are likely to benefit from, this remains a significant gap in the biomedical doctoral student literature.

Effectiveness refers to the degree to which a given intervention accomplishes its targeted outcome (Hanisch et al., 2016). For example, the effectiveness of an intervention designed to reduce burnout could be measured by a change in pre- to post-intervention self-report of the symptoms of burnout, including emotional exhaustion, depersonalization, and lack of personal accomplishment (Iancu et al., 2018). Although implementation of mental health interventions should be guided by their effectiveness, there is a dearth of empirical research investigating the comparative effectiveness of wellness interventions among biomedical doctoral students. An important first step in considering which interventions may be most effective, and for whom, is to examine the perceived effectiveness of a range of approaches.

PREVIOUSLY TESTED INTERVENTIONS

Although few studies have explored the acceptability and effectiveness of wellness interventions for biomedical doctoral students, studies of this nature among other categories of doctoral students have been conducted. Among these, individual psychotherapy has been offered and utilized at many institutions (Prince, 2015; Xiao et al., 2017). However, despite high rates of mental health problems in

biomedical graduate samples, traditional in-person mental health services are under-utilized by this population as indicated by our prior research finding that only 47% of these students with a past year psychological diagnosis utilized such services (Nagy et al., 2019). This may be due, in part, to common barriers to mental health treatment, such as time, finances, and stigma (Eisenberg et al., 2007; Gallagher, 2014).

Leveraging technology to disseminate effective, brief interventions at low-cost to students may help circumvent some treatment barriers. In general, inclusion of mobile technology (e.g., smartphone apps to administer frequent symptom assessments; text messaging with a therapist between sessions) supported by some clinician contact has been associated with positive treatment outcomes in psychotherapy, with some studies even showing superior outcomes relative to traditional therapy without mobile technology (Lindhiem et al., 2015). In addition, technology-delivered interventions for severe mental health problems can reach a wider subset of the general population as they may reduce the stigma associated with in-person mental health services (Portnoy et al., 2008). Online and mobile interventions are often well-accepted by participants once they have been initiated (Berry et al., 2016), and may be more acceptable to hard-to-reach populations such as those with less social support and those of lower income levels (Short et al., 2017). With regard to student populations, a recent meta-analysis of technology-delivered interventions (e.g., interventions delivered by computer or smartphone) among higher-education students (i.e., undergraduate, graduate, and professional students) showed that such strategies were effective at reducing depression, anxiety, and stress (Conley et al., 2016). Furthermore, attrition rates were low across interventions (15-18%), indicating their promising ability to maintain participants from student populations (Conley et al., 2016). There may be more specific factors affecting whether technology-delivered mental health interventions are accepted by individuals. For example, the specific delivery format may have an influence on acceptability, as a review of technology-delivered interventions found higher acceptability of mobile phone-delivered interventions relative to online interventions (Berry et al., 2016). In summary, this is a budding field; further studies are necessary to identify characteristics of technology-based interventions that optimize their acceptability and effectiveness, and more germane to the population of interest, further studies are required to identify acceptable technology-based interventions for doctoral students.

In lieu of traditional psychotherapy, mindfulness approaches to well-being have entered the collective consciousness in recent years. Mindfulness practices may take many forms, including meditation, yoga, journaling, making art, or listening to music (Creswell, 2017). Mindfulness meditation in particular has been the subject of extensive study, with large meta-analyses finding significant reductions in symptoms including anxiety (Bamber & Morpeth, 2019) and depression (Halladay et al., 2019) in college students, though other meta-analyses have shown mixed results (Breedvelt et al., 2019; Dawson et al., 2020). When looking at studies of graduate and professional students, the medical student literature is most robust and also demonstrates mixed evidence for the efficacy of mindfulness interventions in reducing problems with mental health (Daya & Hearn, 2018). Unfortunately, few randomized controlled trials have tested mindfulness interventions to improve wellness in doctoral students, though one of these trials found that a daily, guided mindfulness practice significantly reduced depression and improved measures of positive coping after 8 weeks (Barry et al., 2019). We are not aware of any studies testing these interventions among biomedical doctoral students.

Creating more structured opportunities for students to engage with their peers and develop a strong support system in their training program may be a way for students to manage stress and prevent burnout before developing severe symptoms, thereby reducing the need for resource-heavy conventional interventions such as psychotherapy and psychotropic medications (Ziegelstein, 2018). One example drawn from medical training involves creating small groups of students and faculty to debrief in an informal setting periodically (Hernandez, 2018; Hernandez et al., 2018). Such a setting provides the opportunity to converse with trusted peers and faculty on a regular basis, allowing students to be vulnerable, to establish meaningful connections with each other and with mentors, and to

discuss emotionally distressing experiences. Similarly, in a qualitative study of doctoral student experiences, emotional and professional support from friends within a student's degree program were considered important factors leading to successful degree completion (Jairam & Kahl, 2012). Notably, fellow students were considered well-suited to provide empathy and encouragement, partly because of their ability to provide unique perspectives on shared challenges and their ability to act as sounding boards to vent frustrations (Jairam & Kahl, 2012). These findings indicate that doctoral students would respond positively to interventions involving increased peer support, and these preventative interventions could potentially yield large reductions in student psychological distress at low cost. However, no studies we know of have tested the impact of such interventions on biomedical doctoral student wellness.

Another approach to prevention of mental health problems involves altering the curricular structure of a study program to address the underlying stressors predisposing students to these problems. Little scientific work has been done to study curricular interventions addressing mental health among doctoral students. Common themes among the interventions tested thus far include enforcing a more structured study program (Hovdhaugen, 2011; Viđak et al., 2017), and enhancing the quality of communication with student advisors (Cornér et al., 2017; Geven et al., 2018; Tompkins et al., 2016). In contrast, structural reform to reduce or prevent mental health issues has been extensively studied among medical trainees and physicians; this work can be drawn on to guide similar studies among doctoral students. Taken as a whole, this body of evidence supports organizational-level changes (e.g., duty hour limitations) as being more effective than individual-level changes (e.g., mindfulness training; Busireddy et al., 2017; Daya and Hearn, 2018; Panagioti et al., 2017; Wasson et al., 2016; West et al., 2018; Williams et al., 2015).

STUDY AIMS

A foundational step toward the development, dissemination, and implementation of strategies to improve doctoral student wellness is the identification of acceptable and effective interventions. The present study reports on findings from a sample of biomedical doctoral students at a university in the southeastern United States regarding their perceptions of the acceptability and effectiveness of various wellness resources, services, and practices. Specifically, the aims of the present study were to examine (a) perceptions of acceptability and effectiveness of candidate wellness approaches; (b) the influence of burnout and problems with mental health (lifetime and current) on perceptions of wellness approaches; and (c) the influence of stigma regarding psychological services on perceptions of wellness approaches.

METHODS

This study involved a survey- and interview-based correlational research design that utilized quantitative data to explore perceptions of wellness approaches among biomedical doctoral students and to determine if a relationship existed between problems with mental health and stigma regarding mental health care, and perceptions of these wellness approaches. The study represents a secondary analysis of data acquired in the context of a larger study on biomedical doctoral student mental health (see Nagy et al., 2019). We were granted approval from our institution's Institutional Review Board (IRB; protocol 2017-0232) to conduct this study.

PARTICIPANTS AND RECRUITMENT

Study participants were biomedical doctoral students at a large research institution in the southeastern United States ($n = 69$). The only inclusion criterion was that participants be biomedical doctoral students currently engaged in training within a department in our institution's school of medicine. Participants were recruited through brochures and flyers, website postings, emails sent to doctoral students, and in-person presentations at group meetings. All students in our institution's biological

and biomedical sciences doctoral programs ($N = 592$) were allowed to participate in our study; therefore, our sample comprises 11.6% of the total eligible students at our institution.

STUDY PROTOCOL

During the study visit, participants were presented with an IRB-approved informed consent. The informed consent packet covered details relating to the purpose of the study, the components of the study visit, an invitation to participate in future studies, risks (e.g., experiencing unpleasant thoughts and emotions) and benefits (e.g., the collective benefit of improving knowledge of student mental health problems at our institution and how to address them) of participating in the study, limits to confidentiality, the process to withdraw from the study (no participants chose to withdraw), and monetary compensation for participation (\$100). All participants were informed that should they start experiencing strong feelings of upset and/or suicidal thoughts during the study visit, a trained professional would be available to speak with them, and if they were at imminent risk of suicide, they would be taken to the nearest hospital emergency department; no participants met either of these conditions through the entire duration of the study. The study visit, which lasted an average of 4 hours, consisted of self-report questionnaires administered through use of an online survey tool (Qualtrics, 2013) on a computer in our laboratory, along with an in-person diagnostic interview. While participants completed the online self-report questionnaires in our laboratory, study personnel were present to answer participant questions. During instances when participants were unable to complete the entire study visit in one session, they were scheduled for a second session. All paper assessment data and research consent forms were kept in a secure locked cabinet in our laboratory accessible only to approved study team members. All Qualtrics survey data was de-identified and stored electronically on a secure server only accessible to approved study team members.

INTERVIEWS

Structured clinical interviews (i.e., diagnostic interviews) were conducted by reliably trained assessors, including four doctoral students in clinical psychology, one postdoctoral trainee in clinical psychology, and one licensed clinical social worker. The general training protocol to become proficient in conducting these structured clinical interviews comprised several stages. First, assessors met to discuss the assessment in general, the flow of the assessment based on study criteria, and the different modules. Second, assessors observed (i.e., either live or via a recording) a structured clinical interview conducted by a reliably trained assessor, concurrently rated responses, and afterward compared their ratings and discussed discrepancies. Third, assessors were observed conducting the structured clinical interview by the reliably trained assessor. The reliably trained assessor concurrently rated responses and discussed discrepancies in ratings afterward. This process was repeated until there was complete agreement in diagnoses assigned. Contingent on aligned agreement in coding and confidence level of assessor in training, the assessor was deemed to be sufficiently reliably conducting this structured interview.

To detect the presence of current or lifetime clinical diagnoses (not including personality disorders), we utilized the Structured Clinical Interview for DSM-5, Research Version (SCID-5-RV; First et al., 2015). The SCID-5-RV assesses the presence of mood disorders, psychotic disorders, substance use disorders, anxiety disorders, obsessive-compulsive and related disorders, sleep disorders, feeding and eating disorders, somatic symptom and related disorders, externalizing disorders, and trauma- and stressor-related disorders.

To obtain information about psychiatric treatment history, we utilized the Treatment History Interview-Modified (THI-M; Linehan & Heard, 1987). The THI-M assesses participants' history of psychiatric treatment, prior hospitalizations, and medication history. The THI-M was administered by reliably trained assessors after the SCID-5-RV.

MEASURES

Table 1 presents a summary of the survey measures used in this study, including previously reported psychometric properties, original study population, and internal consistency in the present study. These survey measures were included in the portion of the study protocol involving self-report questionnaires administered through an online survey tool. For each measure we provide examples of items found on the measure; for the complete measure, please refer to the cited literature.

Table 1. Description of Measures

Measure	Construct	Items	Scale	Original study acceptable psychometric properties	Original study population	Present study internal consistency
SBI ^a	Burnout	9	1-6	Internal consistency, structural validity, convergent validity ^a	Secondary high school and vocational school students (<i>n</i> = 1418)	<i>a</i> = 0.90
PHQ-9 ^b	Depression symptoms	9	0-3	Internal consistency, construct validity, criterion validity ^b	Primary care and obstetrics-gynecology clinic patients (<i>n</i> = 6,000)	<i>a</i> = 0.89
BAPS ^c	Beliefs about psychological services	18	1-6	Internal consistency, test-retest reliability, construct validity, convergent validity ^c	Undergraduate students (<i>n</i> = 243)	<i>a</i> = 0.70

Note. Criterion validity assesses how well the measure correlates with or predicts scores on previously validated measures. Structural, construct, and convergent validity assess the degree to which the survey measures what it claims to. Test-retest reliability refers to the agreement between successive administrations of the same measure. Internal consistency refers to how closely related the items are in a measure, and is measured by the value Cronbach's *a*. ^aSalmela-Aro et al., 2009 (original measure was modified in the following manner: replaced "schoolwork" with "graduate program" on every item); ^bKroenke et al., 2001; ^cÆgisdóttir & Gerstein, 2009.

Key. SBI = School Burnout Inventory, PHQ-9 = Patient Health Questionnaire-9, BAPS = Beliefs About Psychological Services

To quantify burnout symptoms, we utilized a modified version of the School Burnout Inventory (SBI; Salmela-Aro et al., 2009). The SBI utilized herein is a 9-item self-report measure that assesses clinically relevant indices of burnout in the context of one's graduate program, including exhaustion due to graduate work, cynicism toward the meaning of graduate school, and sense of inadequacy at graduate school. Items are rated on a 1 (completely disagree) to 6 (completely agree) scale, and higher scores indicate greater burnout symptoms. Example items include "I feel overwhelmed by my graduate program" and "I often have feelings of inadequacy in my graduate program".

To assess the presence and severity of depression symptoms, we utilized the Patient Health Questionnaire-9 (PHQ-9; Kroenke et al., 2001). The PHQ-9 is a 9-item self-report measure, with participants rating the frequency at which they experience symptoms of major depression (e.g., loss of interest, depressed mood, sleeplessness, lack of energy). Items are rated on a 0 (not at all) to 3 (nearly every day) scale, and higher scores indicate greater and more frequent symptoms of depression. Example items include "Little interest or pleasure in doing things?" and "Feeling down, depressed, or hopeless?".

To assess attitudes and beliefs about seeking psychological services, we utilized the Beliefs About Psychological Services scale (BAPS; Ægisdóttir & Gerstein, 2009). The BAPS is an 18-item self-report measure, with participants rating statements such as “I would be willing to confide my intimate concerns to a psychologist” and “I would feel uneasy going to a psychologist because of what some people might think”. Items are rated on a 1 (strongly disagree) to 6 (strongly agree) scale, and higher scores reflect more favorable attitudes toward mental health treatment and greater willingness to seek help (negatively-worded items are reverse-scored).

ACCEPTABILITY AND EFFECTIVENESS OF CANDIDATE WELLNESS APPROACHES

We developed a list of 36 potential wellness resources and services that an institution could offer for biomedical doctoral students (i.e., “wellness approaches”). To identify these candidate approaches, we (1) reviewed the literature, which revealed few interventions that had been specifically tested among biomedical doctoral students, and (2) decided, based on input from our team of interdisciplinary investigators, to include a wide range of approaches, both conventional and unconventional. For each of these items, we asked participants to rate how likely they would be to use each strategy (i.e., “acceptability”) on a 0 (not at all likely) to 10 (extremely likely) scale. We also asked them to rate how effective they thought these strategies would be in reducing problems with mental and emotional health (i.e., “effectiveness”) on a 0 (not at all effective) to 10 (extremely effective) scale. Wellness approaches were separated into four categories based on which entity was responsible for implementing the approach: the individual (i.e., “Self”), the individual’s support system (i.e., “Friends & Family”), the individual’s study program and associated advisors and administrators (i.e., “Lab, Department, & Program”), or the individual’s institution (i.e., “Institution”). These questions were also included in the portion of the study protocol involving self-report questionnaires administered through an online survey tool.

The specific wording of the survey prompt was as follows: “The following table lists a number of things people can do to manage problems with mental/emotional health (e.g., stress, anxiety, depression, burnout, frustration). The left column lists strategies (activities, services, techniques) people could use to manage problems with mental/emotional health. In the center column, please rate, in general, how likely you would be to use each strategy to manage problems with mental/emotional health on a 0 to 10 scale, with 0 being not at all likely and 10 being extremely likely. In the right column, please rate, in general, how effective you think these strategies would be in reducing any problems with mental/emotional health you might have on a 0 to 10 scale, with 0 being not at all effective and 10 being extremely effective.”

STATISTICAL METHODS

Acceptability and effectiveness ratings were not normally distributed. Accordingly, non-parametric tests were used in analyses. Analyses included one-sample Wilcoxon signed rank tests, bivariate correlations, and Mann-Whitney U tests. Statistical analysis was conducted using the Statistical Package for Social Sciences (SPSS; IBM Corp, 2015).

RESULTS

Table 2 provides a description of demographic information of participants. Study findings are presented in three categories, with key findings listed below:

1. Acceptability and Effectiveness of Candidate Wellness Approaches
 - a. Candidate approaches involving spending time socializing with friends and family were rated most favorably by the entire sample.
 - b. Specifically, approaches rated both highly likely to be acceptable and effective included exercise, listening to/playing music, talking to parents, talking to friends who

- are far away, spending more time with friends in the area, watching movies with friends, socializing with colleagues during lab functions, and massage.
- c. Approaches that were rated highly likely to be effective, but not acceptable, included peer support groups, group exercise/yoga/mindfulness classes, individual therapy, and therapy dogs.
2. Acceptability and Effectiveness of Candidate Wellness Approaches among Students with Mental Health Problems
 - a. Participants with high burnout or depression symptoms negatively evaluated approaches involving social engagement.
 - b. Participants with high burnout symptoms or a history of psychological diagnoses or treatment rated individual therapy more favorably.
 3. Acceptability and Effectiveness of Candidate Wellness Approaches based on Beliefs about Psychological Services
 - a. Participants with favorable perceptions of psychological services rated therapy-based approaches more positively.

Table 2. Sociodemographic Characteristics of Biomedical Doctoral Student Participants (N=69)

	n (%)	M (SD)	Range
Age		26.5(2.3)	22-33
Sex: Female	42 (60.9%)		
Race			
White/Caucasian	48 (69.6%)		
Asian	16 (23.2%)		
Black/African American	4 (5.8%)		
Other	4 (5.8%)		
Middle Eastern/Arab	2 (2.9%)		
Native American/American Indian	1 (1.4%)		
Ethnicity: Hispanic	12 (17.4%)		
Nativity: Born in USA	50 (72.5%)		
Family of Origin Income			
\$0 - \$10,000	4 (5.8%)		
\$10,001 - \$20,000	3 (4.3%)		
\$20,001 - \$40,000	7 (10.1%)		
\$40,001 - \$65,000	9 (13%)		
\$65,001 - \$100,000	20 (29%)		
> \$100,000	26 (37.7%)		

	n (%)	M (SD)	Range
Income covers expenses: Yes	68 (98.6%)		
Marital Status			
Never married; in relationship	31 (44.9%)		
Never married; not in relationship	24 (34.8%)		
Married	12 (17.4%)		
Separated	1 (1.4%)		
Divorced	1 (1.4%)		
Number of children		0.10 (0.43)	0-3

Note. To protect the confidentiality of research participants and reduce the likelihood of individual participants being identified, we do not report on the academic program in which participants were enrolled nor the academic year that they are completing at the time of the study.

ACCEPTABILITY AND EFFECTIVENESS OF CANDIDATE WELLNESS APPROACHES

Table 3 outlines results regarding perceived acceptability and effectiveness of candidate wellness approaches among the entire sample. We employed one-sample Wilcoxon signed rank tests, which test whether the median of a distribution is significantly different from a hypothesized value. We utilized a hypothesized value of 5, as this is the intermediate value on the 0-10 scale, and allowed us to assess whether the intervention was commonly rated as “highly likely” (i.e., greater than 5) to be acceptable and/or effective. The following approaches were rated both highly likely to be acceptable and highly likely to be effective among all participants: (1) in the “Self” category, exercise ($p < .001$) and listening to/playing music ($p < .001$); (2) in the “Friends & Family” category, talking to parents ($p < .01$), talking to friends who are far away ($p < .001$), spending more time with friends in the area ($p < .001$), and watching movies with friends ($p < .01$); (3) in the “Lab, Department, & Program” category, socializing with colleagues during lab functions ($p < .01$); and (4) in the “Institution” category, being offered massage services ($p < .05$; see Table 3 for details). The following approaches were rated highly likely to be effective, with a moderate-to-low likelihood of acceptability: (1) in the “Lab, Department, & Program” category, peer support groups and (2) in the “Institution” category, group exercise classes, group yoga class, group mindfulness practices, individual therapy (outside our institution), individual therapy (within our institution), and playing with therapy dogs. For these interventions, the findings suggest that students believe these approaches would be very effective but perceive barriers to the acceptability of these approaches (see Table 3 for details).

Table 3. Acceptability and Effectiveness of Wellness Approaches

	Wilcoxon Signed Rank Test	Mean (SD)	95% CI of Mean	Median	
Self					
Exercise	A	<.001	8.26 (2.37)	7.69 – 8.83	9***
	E	<.001	8.25 (1.83)	7.81 – 8.69	8***

		Wilcoxon Signed Rank Test	Mean (SD)	95% CI of Mean	Me- dian
Meditation	A	.001	3.83 (2.79)	3.16 – 4.50	4**
	E	.31	5.36 (2.62)	4.73 – 5.99	5
Getting a massage	A	.001	3.59 (3.16)	2.83 – 4.35	3**
	E	.62	5.16 (2.68)	4.52 – 5.80	5
Reading self-help books	A	<.001	3.32 (2.81)	2.65 – 3.99	3***
	E	.003	4.01 (2.60)	3.39 – 4.64	4**
Posting to/ receiving advice on anonymous message boards	A	<.001	1.38 (1.82)	0.94 – 1.81	1***
	E	<.001	2.41 (1.83)	1.97 – 2.84	2***
Attending religious services	A	<.001	2.38 (3.85)	1.45 – 3.30	0***
	E	<.001	3.42 (3.04)	2.69 – 4.15	4***
Private spiritual practice	A	<.001	2.78 (3.43)	1.96 – 3.61	1***
	E	<.001	3.74 (3.03)	3.01 – 4.47	5***
Using a mobile phone app to manage emotions	A	<.001	1.55 (2.32)	0.99 – 2.11	0***
	E	<.001	2.16 (2.11)	1.65 – 2.67	2***
Using a mobile phone app to manage weight	A	.002	3.54 (3.67)	2.65 – 4.42	2**
	E	.008	3.96 (3.11)	3.21 – 4.70	4**
Listening to/ playing music	A	<.001	8.14 (2.14)	7.63 – 8.66	9***
	E	<.001	6.45 (2.40)	5.87 – 7.03	6***
Making art	A	.001	3.67 (3.03)	2.94 – 4.39	3**
	E	.445	5.20 (2.75)	4.54 – 5.86	5
Writing in a journal	A	<.001	3.16 (3.07)	2.42 – 3.90	2***
	E	.955	5.00 (2.80)	4.33 – 5.67	5
Watching movies by your- self	A	<.001	6.71 (2.71)	6.06 – 7.36	8***
	E	.693	4.88 (2.39)	4.31 – 5.46	5
Friends & Family					
Talking to your parents	A	.001	6.32 (3.00)	5.60 – 7.04	7**
	E	<.001	6.45 (2.63)	5.82 – 7.08	7***

		Wilcoxon Signed Rank Test	Mean (SD)	95% CI of Mean	Me- dian
Talking to friends who are far away	A	<.001	7.04 (2.71)	6.39 – 7.69	8***
	E	<.001	6.88 (2.25)	6.34 – 7.43	7***
Spending more time with friends in the area	A	<.001	7.32 (2.19)	6.79 – 7.85	8***
	E	<.001	7.59 (1.88)	7.14 – 8.05	8***
Watching movies with friends	A	.002	6.07 (2.71)	5.42 – 6.72	7**
	E	.005	5.74 (2.27)	5.19 – 6.28	6**
Lab, Department, & Pro- gram					
Talking to your mentor	A	.06	5.58 (2.56)	4.96 – 6.20	6
	E	.488	5.16 (2.65)	4.52 – 5.80	5
Peer support groups	A	.001	3.72 (3.00)	3.00 – 4.45	4**
	E	<.001	6.19 (2.45)	5.60 – 6.78	6***
Socializing with colleagues during lab functions	A	<.001	7.00 (2.31)	6.45 – 7.55	7***
	E	.003	5.93 (2.42)	5.35 – 6.51	6**
Attending department events	A	<.001	6.43 (2.56)	5.82 – 7.05	6***
	E	.899	5.00 (2.49)	4.40 – 5.60	5
Institution					
Group exercise classes	A	.081	5.70 (3.44)	4.87 – 6.52	6
	E	<.001	6.93 (2.70)	6.28 – 7.58	7***
Group yoga class	A	.851	5.09 (3.48)	4.25 – 5.92	5
	E	.008	6.07 (2.98)	5.36 – 6.79	7**
Group mindfulness prac- tices	A	<.001	3.61 (2.68)	2.96 – 4.25	4***
	E	.031	5.67 (2.54)	5.06 – 6.28	6*
Other group meditation	A	<.001	2.94 (2.56)	2.33 – 3.56	2***
	E	.824	5.06 (2.66)	4.42 – 5.70	5
Massage	A	.035	5.78 (3.49)	4.95 – 6.62	5*
	E	.008	5.93 (2.79)	5.26 – 6.60	6**

		Wilcoxon Signed Rank Test	Mean (SD)	95% CI of Mean	Me- dian
Acupuncture	A	<.001	3.13 (3.36)	2.32 – 3.94	2***
	E	.007	3.96 (3.11)	3.20 – 4.71	4**
Religious groups focused on spiritual and emotional well-being	A	<.001	1.80 (2.60)	1.17 – 2.42	0***
	E	.001	3.68 (3.09)	2.94 – 4.42	4**
Group therapy	A	<.001	2.46 (2.59)	1.84 – 3.09	2***
	E	.155	5.39 (2.56)	4.78 – 6.01	5
Individual therapy (outside our institution)	A	.645	5.17 (3.50)	4.33 – 6.01	5
	E	<.001	7.46 (2.32)	6.91 – 8.02	8***
Individual therapy (within our institution)	A	.416	5.32 (3.45)	4.49 – 6.15	5
	E	.001	6.36 (2.99)	5.64 – 7.08	6**
Attending a skills training led by an expert	A	.041	4.25 (2.99)	3.53 – 4.97	5*
	E	.468	5.19 (2.74)	4.53 – 5.85	5
Using an app to manage mood that includes peer support from another graduate student	A	<.001	2.39 (2.95)	1.68 – 3.10	1***
	E	<.001	3.49 (2.80)	2.82 – 4.16	3***
Attending a workshop on emotional well-being with other graduate students	A	<.001	3.07 (2.97)	2.36 – 3.79	2***
	E	.046	4.29 (2.81)	3.61 – 4.97	4*
Playing with therapy dogs	A	.062	5.83 (3.67)	4.94 – 6.71	6
	E	.005	6.16 (3.13)	5.41 – 6.91	6**
Full or half day event celebrating mental well-being	A	.154	4.35 (3.52)	3.50 – 5.19	4
	E	.295	4.65 (2.88)	3.96 – 5.34	5

Note. Table 3 presents results on acceptability and effectiveness of wellness approaches. Results are presented as Wilcoxon Signed Rank tests (with hypothesized value of 5), along with mean and median values among all subjects. Acceptability and effectiveness values are presented adjacent to each other for a particular approach.

Key. SD = standard deviation, CI = confidence interval, A = Acceptability, E = Effectiveness; * = $p < .05$, ** = $p < .01$, *** = $p < .001$

ACCEPTABILITY AND EFFECTIVENESS OF CANDIDATE WELLNESS APPROACHES AMONG STUDENTS WITH MENTAL HEALTH PROBLEMS

Next, we examined the role of problems with burnout and mental health on perceptions of acceptability and effectiveness of wellness approaches (Table 4). Bivariate correlations (i.e., Spearman's rho) revealed that burnout symptoms (measured by total score on the SBI) were significantly positively correlated with perceived acceptability ratings of the following approaches in the "Institution" category: group exercise classes (Spearman's rho [r_s] = .287, $p < .05$), group mindfulness practices (r_s =

.373, $p < .01$), other group meditation ($r_s = .360, p < .01$), acupuncture ($r_s = .267, p < .05$), and individual therapy within our institution ($r_s = .237, p = .05$). Burnout symptoms were significantly positively correlated with perceived effectiveness ratings of the following approaches in the “Institution” category: group mindfulness practices ($r_s = .295, p < .05$), other group meditation ($r_s = .259, p < .05$), and group therapy ($r_s = .285, p < .05$). Burnout symptoms also were significantly positively correlated with acceptability and/or effectiveness ratings of the following “Self” approaches: meditation (Acceptability [Ac], $r_s = .243, p < .05$), using a mobile phone app to manage emotions (Ac, $r_s = .286, p < .05$; Effectiveness [Ef], $r_s = .249, p < .05$), and writing in a journal (Ac, $r_s = .306, p < .05$). Conversely, burnout symptoms were significantly negatively correlated with perceived acceptability and effectiveness ratings of the following approaches in the “Lab, Department, & Program” category: talking to your mentor (Ac, $r_s = -.255, p < .05$; Ef, $r_s = -.465, p < .001$), socializing with colleagues during lab functions (Ac, $r_s = -.263, p < .05$; Ef, $r_s = -.275, p < .05$), and attending department events (Ac, $r_s = -.356, p < .01$; Ef, $r_s = -.431, p < .001$; see Table 4).

Depression symptoms (measured by total score on the PHQ-9) were significantly negatively correlated with perceived acceptability and effectiveness ratings of approaches in the “Lab, Department, & Program” category: socializing with colleagues during lab functions (Ac, $r_s = -.259, p < .05$; Ef, $r_s = -.365, p < .01$) and attending department events (Ac, $r_s = -.375, p < .01$; Ef, $r_s = -.493, p < .001$). Depression symptoms were significantly negatively correlated with the perceived acceptability of spending more time with friends in the area ($r_s = -.257, p < .05$) and watching movies with friends ($r_s = -.269, p < .05$), as well as with the perceived effectiveness of talking to friends who are far away ($r_s = -.373, p < .01$), talking to your mentor ($r_s = -.405, p < .01$), attending a skills training led by an expert ($r_s = -.310, p < .01$), and attending a workshop on emotional well-being with other graduate students ($r_s = -.271, p < .05$; see Table 4).

Mann-Whitney U tests were used to compare median perceived acceptability and effectiveness scores between groups of students who did or did not have a history of mental health problems or treatment. As shown in Table 4, analyses revealed that participants with a current psychiatric diagnosis ($n = 34, 49.3\%$), lifetime diagnosis ($n = 46, 66.7\%$), or with a self-reported history of psychological treatment (e.g., from a therapist, psychologist, psychiatrist, or medical provider prescribing psychiatric medications) in the past year ($n = 22, 31.9\%$) all rated individual therapy (within our institution) significantly more likely to be acceptable than participants without such histories ($p < .05$). Participants with a past year treatment history also rated the acceptability of individual therapy (outside our institution) significantly more positively compared to those without a past year history of receiving treatment for any mental health problem ($p < .05$). Participants with a lifetime psychiatric disorder rated using a mobile phone app to manage emotions and writing in a journal significantly more likely to be acceptable and effective, compared to those without a lifetime history of any psychiatric disorder ($p < .05$).

Table 4. Correlation of Acceptability and Effectiveness Scores with Burnout Scores, Depression Scores, and Presence of Mental Health Problems

	Burnout (rho, <i>p</i>)	Depression (rho, <i>p</i>)	Current Diagnosis (MWU, <i>p</i>)	Lifetime Diagnosis (MWU, <i>p</i>)	Past Year Treatment (MWU, <i>p</i>)
Self					
Exercise	A	.046 (.706)	-.115 (.346)	570 (.750)	468 (.409)
	E	.109 (.374)	-.063 (.609)	562 (.687)	329** (.008) (N)

		Burnout (rho, p)	Depres- sion (rho, p)	Current Diagnosis (MWU, p)	Lifetime Diagnosis (MWU, p)	Past Year Treatment (MWU, p)
Meditation	A	.243* (.045)	-.018 (.885)	546 (.557)	498 (.695)	454 (.909)
	E	.145 (.235)	-.096 (.434)	543 (.526)	506 (.771)	448 (.846)
Getting a mas- sage	A	.094 (.440)	-.024 (.846)	553 (.615)	422 (.169)	348 (.104)
	E	.033 (.788)	-.200 (.100)	577 (.828)	523 (.944)	420 (.554)
Reading self-help books	A	.139 (.255)	-.197 (.105)	546 (.553)	489 (.607)	418 (.530)
	E	.128 (.293)	-.148 (.226)	550 (.590)	454 (.336)	419 (.544)
Posting to/ re- ceiving advice on anonymous mes- sage boards	A	.101 (.409)	.014 (.912)	526 (.386)	421 (.152)	411 (.456)
	E	-.028 (.821)	-.185 (.129)	541 (.511)	461 (.380)	380 (.240)
Attending reli- gious services	A	-.003 (.979)	-.104 (.394)	553 (.580)	513 (.823)	413 (.449)
	E	-.113 (.355)	-.204 (.093)	583 (.883)	494 (.649)	447 (.828)
Private spiritual practice	A	-.155 (.203)	-.136 (.264)	511 (.290)	520 (.910)	454 (.911)
	E	-.118 (.333)	-.176 (.148)	581 (.864)	509 (.800)	437 (.718)
Using a mobile phone app to manage emo- tions	A	.286* (.017)	.165 (.175)	523 (.355)	360* (.020) (L)	382 (.233)
	E	.249* (.039)	.093 (.446)	424* (.034) (C)	348* (.017) (L)	372 (.195)
Using a mobile phone app to manage weight	A	.089 (.469)	-.054 (.660)	584 (.893)	481 (.532)	373 (.203)
	E	.049 (.692)	-.123 (.314)	582 (.875)	479 (.520)	394 (.335)
Listening to/ playing music	A	-.021 (.861)	.117 (.336)	544 (.527)	512 (.828)	411 (.456)
	E	-.107 (.380)	-.028 (.822)	562 (.689)	421 (.167)	454 (.915)
Making art	A	.095 (.438)	-.027 (.829)	574 (.803)	500 (.713)	405 (.415)
	E	-.096 (.433)	-.100 (.415)	542 (.521)	504 (.753)	394 (.332)

		Burnout (rho, p)	Depres- sion (rho, p)	Current Diagnosis (MWU, p)	Lifetime Diagnosis (MWU, p)	Past Year Treatment (MWU, p)
Writing in a journal	A	.306* (.011)	.126 (.304)	541 (.511)	348* (.020) (L)	460 (.983)
	E	.153 (.211)	.049 (.688)	446 (.072)	339* (.015) (L)	370 (.193)
Watching movies by yourself	A	-.190 (.118)	-.170 (.162)	495 (.225)	455 (.341)	400 (.380)
	E	-.173 (.155)	-.056 (.647)	570 (.766)	459 (.370)	401 (.386)
Friends & Family						
Talking to your parents	A	-.096 (.431)	.000 (1.000)	555 (.631)	406 (.114)	324* (.048) (N)
	E	-.224 (.064)	-.136 (.266)	505 (.277)	309** (.005) (N)	421 (.562)
Talking to friends who are far away	A	-.101 (.411)	-.149 (.222)	592 (.971)	524 (.954)	340 (.082)
	E	-.214 (.078)	-.373** (.002)	449 (.075)	408 (.117)	432 (.666)
Spending more time with friends in the area	A	-.040 (.745)	-.257* (.033)	473 (.138)	434 (.222)	372 (.198)
	E	-.032 (.797)	-.143 (.240)	573 (.793)	401 (.097)	395 (.334)
Watching movies with friends	A	-.199 (.101)	-.269* (.025)	578 (.842)	487 (.594)	387 (.285)
	E	-.237 (.050)	-.227 (.060)	579 (.851)	426 (.187)	420 (.548)
Lab, Depart- ment, & Program						
Talking to your mentor	A	-.255* (.035)	-.185 (.128)	465 (.116)	362* (.032) (N)	368 (.180)
	E	-.465*** ($<.001$)	-.405** (.001)	442 (.065)	384 (.063)	436 (.716)
Peer support groups	A	.138 (.258)	.028 (.821)	589 (.942)	486 (.580)	403 (.400)
	E	.158 (.196)	-.101 (.409)	516 (.338)	460 (.378)	440 (.759)

		Burnout (rho, p)	Depres- sion (rho, p)	Current Diagnosis (MWU, p)	Lifetime Diagnosis (MWU, p)	Past Year Treatment (MWU, p)
Socializing with colleagues during lab functions	A	-.263* (.029)	-.259* (.032)	555 (.627)	408 (.121)	418 (.534)
	E	-.275* (.022)	-.365** (.002)	544 (.536)	329** (.010) (N)	450 (.864)
Attending depart- ment events	A	-.356** (.003)	-.375** (.001)	486 (.186)	330* (.010) (N)	382 (.253)
	E	-.431*** (<.001)	-.493*** (<.001)	394* (.015) (N)	295** (.003) (N)	459 (.972)
Institution						
Group exercise classes	A	.287* (.017)	.033 (.789)	549 (.580)	485 (.571)	299* (.020) (N)
	E	.164 (.179)	-.082 (.501)	520 (.364)	508 (.791)	378 (.231)
Group yoga class	A	.185 (.129)	-.102 (.403)	540 (.510)	520 (.908)	369 (.185)
	E	.105 (.391)	-.182 (.135)	577 (.828)	475 (.488)	362 (.154)
Group mindful- ness practices	A	.373** (.002)	-.019 (.878)	589 (.947)	493 (.648)	462 (1.000)
	E	.295* (.014)	-.080 (.514)	505 (.275)	477 (.506)	441 (.763)
Other group meditation	A	.360** (.002)	-.042 (.733)	581 (.865)	485 (.574)	453 (.903)
	E	.259* (.032)	-.064 (.600)	558 (.651)	496 (.669)	416 (.512)
Massage	A	.187 (.125)	.126 (.302)	512 (.312)	435 (.225)	407 (.435)
	E	.119 (.329)	-.094 (.441)	586 (.913)	513 (.842)	456 (.937)
Acupuncture	A	.267* (.027)	.166 (.174)	510 (.295)	417 (.141)	395 (.328)
	E	.092 (.455)	-.107 (.384)	578 (1.000)	445 (.420)	417 (.627)
Religious groups focused on spir- itual and emo- tional well-being	A	-.001 (.997)	-.134 (.274)	484 (.143)	456 (.308)	362 (.110)
	E	-.063 (.610)	-.176 (.148)	585 (.908)	493 (.646)	396 (.346)
Group therapy	A	.185 (.128)	.108 (.377)	537 (.480)	513 (.840)	408 (.440)
	E	.285* (.018)	.030 (.806)	457 (.096)	428 (.197)	450 (.864)
Individual ther- apy (outside our institution)	A	-.016 (.898)	.003 (.980)	489 (.200)	390 (.075)	305* (.025) (I)
	E	.063 (.610)	-.062 (.612)	469 (.122)	401 (.097)	393 (.322)

		Burnout (rho, p)	Depres- sion (rho, p)	Current Diagnosis (MWU, p)	Lifetime Diagnosis (MWU, p)	Past Year Treatment (MWU, p)
Individual therapy (within our institution)	A	.237* (.050)	.065 (.597)	432* (.049) (C)	335* (.013) (L)	265** (.005) (I)
	E	.163 (.182)	-.063 (.608)	439 (.059)	394 (.082)	338 (.077)
Attending a skills training led by an expert	A	-.051 (.676)	-.165 (.176)	496 (.233)	375* (.049) (N)	369 (.185)
	E	-.063 (.607)	-.310** (.010)	556 (.641)	361* (.031) (N)	399 (.373)
Using an app to manage mood that includes peer support from another graduate student	A	.236 (.051)	.046 (.705)	585 (.905)	437 (.223)	448 (.838)
	E	.182 (.133)	-.054 (.659)	569 (.753)	454 (.335)	460 (.983)
Attending a workshop on emotional well-being with other graduate students	A	.174 (.152)	-.002 (.987)	519 (.352)	483 (.555)	304 (.024) (N)
	E	-.038 (.755)	-.271* (.024)	494 (.224)	520 (.913)	384 (.266)
Playing with therapy dogs	A	.236 (.051)	.167 (.170)	478 (.158)	450 (.309)	436 (.716)
	E	-.031 (.800)	-.097 (.428)	549 (.578)	480 (.534)	387 (.285)
Full or half day event celebrating mental well-being	A	.196 (.106)	.193 (.111)	534 (.464)	459 (.372)	444 (.803)
	E	.062 (.614)	.030 (.805)	586 (.913)	437 (.241)	387 (.286)

Note. Table 4 presents results on correlations between acceptability and effectiveness of wellness approaches with burnout (SBI) and depression (PHQ-9) scores. Results are presented as Spearman's rho, with p value in parentheses. It also presents results on Mann-Whitney U tests comparing acceptability and effectiveness scores of candidate wellness interventions between groups of students with and without mental health problems. Results are presented as Mann-Whitney U test scores, with p value in parentheses. The "Current Diagnosis" column compares students with and without a current DSM-5 disorder diagnosis. The "Lifetime Diagnosis" column compares students with and without a lifetime DSM-5 disorder diagnosis. The "Past Year Treatment" column compares students who have and have not received treatment for a mental health disorder in the past year. Acceptability and effectiveness values are presented adjacent to each other for a particular approach.

Key. MWU = Mann-Whitney U test score; A = Acceptability; E = Effectiveness; (C) = median score is significantly greater in group of students with a Current Diagnosis; (L) = median score is significantly greater in group of students with a Lifetime Diagnosis; (I) = median score is significantly greater in group of students with Past Year Treatment; (N) = median score is significantly greater in group of students without Current Diagnosis, Lifetime Diagnosis, or Past Year Treatment; * = $p < .05$, ** = $p < .01$, *** = $p < .001$

ACCEPTABILITY AND EFFECTIVENESS OF CANDIDATE WELLNESS APPROACHES BASED ON BELIEFS ABOUT PSYCHOLOGICAL SERVICES

Finally, we assessed how a participant's attitudes regarding psychological treatment affected their perceptions of candidate approaches, to better understand the importance of stigma as a barrier to wellness practices (Table 5). Spearman's correlations showed that favorable beliefs about psychological services were significantly positively correlated with perceived acceptability and/or effectiveness ratings of the following approaches: (1) in the "Self" category, reading self-help books (Ac, $r_s = .314, p < .01$; Ef, $r_s = .344, p < .01$) and watching movies by yourself (Ef, $r_s = .274, p < .05$); (2) in the "Friends & Family" category, spending more time with friends in the area (Ac, $r_s = .243, p < .05$) and watching movies with friends (Ac, $r_s = .366, p < .01$); (3) in the "Lab, Department, & Program" category, peer support groups (Ac, $r_s = .310, p < .01$; Ef, $r_s = .301, p < .05$); and (4) in the "Institution" category, group exercise classes (Ef, $r_s = .249, p < .05$), group mindfulness practices (Ac, $r_s = .268, p < .05$; Ef, $r_s = .279, p < .05$), group therapy (Ef, $r_s = .283, p < .05$), individual therapy outside our institution (Ac, $r_s = .308, p < .05$; Ef, $r_s = .548, p < .001$), individual therapy within our institution (Ac, $r_s = .431, p < .001$; Ef, $r_s = .511, p < .001$), attending a workshop on emotional well-being with other graduate students (Ef, $r_s = .308, p < .01$), and playing with therapy dogs (Ef, $r_s = .248, p < .05$; see Table 5).

Table 5. Correlation of Acceptability and Effectiveness Scores with Beliefs About Psychological Services Scores

		BAPS (rho, p)
Self		
Exercise	Acceptability	-.031 (.802)
	Effectiveness	.048 (.698)
Meditation	Acceptability	.093 (.447)
	Effectiveness	.133 (.275)
Getting a massage	Acceptability	.122 (.316)
	Effectiveness	.120 (.327)
Reading self-help books	Acceptability	.314** (.009)
	Effectiveness	.344** (.004)
Posting to/ receiving advice on anonymous message boards	Acceptability	-.022 (.859)
	Effectiveness	.160 (.189)
Attending religious services	Acceptability	-.021 (.863)
	Effectiveness	.034 (.785)
Private spiritual practice	Acceptability	-.025 (.838)
	Effectiveness	.113 (.355)
Using a mobile phone app to manage emotions	Acceptability	.042 (.735)
	Effectiveness	.058 (.633)

		BAPS (rho, p)
Using a mobile phone app to manage weight	Acceptability	.191 (.116)
	Effectiveness	.124 (.311)
Listening to/ playing music	Acceptability	.190 (.118)
	Effectiveness	.075 (.541)
Making art	Acceptability	-.124 (.309)
	Effectiveness	.028 (.820)
Writing in a journal	Acceptability	.161 (.187)
	Effectiveness	.073 (.552)
Watching movies by yourself	Acceptability	.218 (.072)
	Effectiveness	.274* (.023)
Friends & Family		
Talking to your parents	Acceptability	-.006 (.959)
	Effectiveness	.106 (.386)
Talking to friends who are far away	Acceptability	.194 (.111)
	Effectiveness	.222 (.067)
Spending more time with friends in the area	Acceptability	.243* (.044)
	Effectiveness	.095 (.438)
Watching movies with friends	Acceptability	.366** (.002)
	Effectiveness	.255* (.035)
Lab, Department, & Program		
Talking to your mentor	Acceptability	.117 (.340)
	Effectiveness	.186 (.127)
Peer support groups	Acceptability	.310** (.010)
	Effectiveness	.301* (.012)
Socializing with colleagues during lab functions	Acceptability	.142 (.245)
	Effectiveness	.231 (.056)
Attending department events	Acceptability	.065 (.598)
	Effectiveness	.127 (.297)

		BAPS (rho, p)
Institution		
Group exercise classes	Acceptability	.053 (.668)
	Effectiveness	.249* (.039)
Group yoga class	Acceptability	.192 (.114)
	Effectiveness	.182 (.135)
Group mindfulness practices	Acceptability	.268* (.026)
	Effectiveness	.279* (.020)
Other group meditation	Acceptability	.218 (.072)
	Effectiveness	.204 (.093)
Massage	Acceptability	-.009 (.939)
	Effectiveness	.132 (.281)
Acupuncture	Acceptability	-.089 (.466)
	Effectiveness	.108 (.379)
Religious groups focused on spiritual and emotional well-being	Acceptability	.018 (.883)
	Effectiveness	.139 (.254)
Group therapy	Acceptability	.223 (.066)
	Effectiveness	.283* (.019)
Individual therapy (outside our institution)	Acceptability	.308* (.010)
	Effectiveness	.548*** (<.001)
Individual therapy (within our institution)	Acceptability	.431*** (<.001)
	Effectiveness	.511*** (<.001)
Attending a skills training led by an expert	Acceptability	.186 (.126)
	Effectiveness	.156 (.202)
Using an app to manage mood that includes peer support from another graduate student	Acceptability	.196 (.106)
	Effectiveness	.147 (.227)
Attending a workshop on emotional well-being with other graduate students	Acceptability	.115 (.346)
	Effectiveness	.308** (.010)
Playing with therapy dogs	Acceptability	.191 (.116)
	Effectiveness	.248* (.040)
Full or half day event celebrating mental well-being	Acceptability	-.035 (.773)
	Effectiveness	.169 (.164)

Note. Table 5 presents results on correlations between acceptability and effectiveness of wellness approaches with beliefs about psychological services (BAPS) scores. Results are presented as Spearman's rho, with p value

in parentheses. Acceptability and effectiveness values are presented adjacent to each other for a particular approach.

Key. BAPS = Beliefs About Psychological Services; * = $p < .05$, ** = $p < .01$, *** = $p < .001$

DISCUSSION

This study investigated perceptions of a wide range of strategies to help institutions improve wellness among biomedical doctoral students. We analyzed student ratings of acceptability and effectiveness of various approaches to explore which were most favored by students, and how current symptoms of burnout, depression, and sentiments of stigma related to mental health influenced these perceptions. Few interventions have been rigorously tested to improve mental health among biomedical doctoral students (Tsai & Muindi, 2016); our results extend the existing literature by identifying approaches that may be best suited for this population. As research funding to study interventions is limited, it would be ideal to identify low-cost, scalable, organization-level interventions that the majority of students find acceptable, rather than emphasizing interventions for individual students (Glass, 2016; Panagioti et al., 2017). Our study provides guidance to program administrators and researchers desiring to undertake these kinds of studies.

Our results demonstrate that, although many candidate wellness approaches may be considered by institutions to support student wellness, only eight (i.e., exercise, listening to/playing music, talking to parents, talking to friends who are far away, spending more time with friends in the area, watching movies with friends, socializing with colleagues during lab functions, massage) were rated as highly likely to be both acceptable and effective in our biomedical doctoral student sample. Notably, most of these approaches involve spending time socializing with friends and family, rather than activities or resources offered by the student's department or institution. It is well-established that enhancing social interaction has a positive impact on a variety of physical and psychological indices of health (Martino et al., 2017). Regarding the other approaches that were rated favorably, there is a wealth of evidence demonstrating the effectiveness of exercise in reducing and preventing burnout and depression symptoms among students (e.g., Dyrbye et al., 2017; Kvam et al., 2016; Pascoe & Parker, 2019). Music has been shown to have beneficial effects in reducing stress and anxiety in stressful circumstances (e.g., Hirokawa & Ohira, 2003; Umbrello et al., 2019). Massage therapy has also been increasingly used in the treatment of psychiatric symptoms and disorders (Rapaport et al., 2018), with efficacy partly linked to reduction in cortisol levels (Field, 2016). Nonetheless, our results point to the conclusion that students may be most likely to believe more time spent with loved ones is the best way to support their wellness.

A substantially larger number of the approaches we studied were rated as likely to be effective, but not as likely to be acceptable, indicating barriers to their use (see Table 3). Future studies should include rigorous evaluation of facilitators and barriers for these approaches to aid identification of implementation strategies that would directly target the identified barriers (Baker et al., 2010). It is also important to acknowledge that students' perceptions may be biased in favor of the immediate mood-boosting and stress-relieving benefits of resources such as massage therapy and pet therapy (Ward-Griffin et al., 2018; Wood et al., 2018). Conversely, they may be less likely to positively view interventions with sustained benefits that require more time and effort to take effect, such as psychotherapy and mindfulness training.

Students in our study with current or past mental health problems perceived distinct approaches to be more acceptable and effective, relative to students without mental health problems. In particular, students with a history of psychological treatment in the past year positively evaluated the effectiveness of individual therapy both within and outside our institution. It should be noted that there is some variability in the type, frequency, and duration of treatment received among individuals in this group. Nevertheless, these results suggest that students are generally satisfied with their treatment and are consistent with prior evidence demonstrating that stigma associated with mental health care is reduced after patients enter therapy (Collado et al., 2019). Unsurprisingly, students with favorable

perceptions of psychological services also rated therapy-based approaches more positively. Furthermore, students with a history of mental health problems or students with present symptoms of burnout identified individual psychotherapy as a campus resource they would likely use. It is informative to know that biomedical doctoral students with a variety of mental health problems value psychological services, as differences in rates of use of these services have been reported among diverse graduate programs (Lipson et al., 2016). In addition, when making decisions about allocation of resources to improve wellness and reduce burnout, institutional leaders may benefit from considering that students with a history of psychiatric disorder or treatment for psychological problems may benefit from different approaches than students without such histories.

Of particular interest are the correlations among wellness approach ratings and levels of burnout and depression symptoms, for at least two reasons. First, individuals with high burnout scores rated mindfulness and meditation groups to be highly acceptable and effective. Though these approaches were not rated highly by the overall sample, it may be that mindfulness-based approaches are more likely to be used by students presently experiencing symptoms of burnout. There are a number of potential explanations for this finding. One hypothesis is that these students may have already sought help and been introduced to mindfulness through other avenues, or perhaps they are more willing to try mindfulness due to the degree of their distress. In either case, institutions should consider prioritizing such programs, as they target these at-risk individuals and have previous data supporting their efficacy in reducing psychological distress in doctoral students (e.g., Barry et al., 2019; Falsafi, 2016). Second, students with either high burnout symptoms or high depression symptoms negatively evaluated several approaches involving social engagement (e.g., spending more time with friends in the area, socializing with colleagues during lab functions, talking to your mentor). One might hypothesize that these activities, rather than supporting wellness, may contribute to burnout and depression among a subset of students. Our findings suggest that a primary source for psychological distress among struggling students may be the people in their departments—namely, their peers and mentors—thus emphasizing the need for mentor-, department-, and institution-level interventions that target the student's environment (Scheirer, 2013). Alternatively, these individuals, because they are highly burned out or depressed, may be more likely to avoid such activities. Nevertheless, these results demonstrate that approaches that most students in our sample found agreeable for promoting wellness, such as socializing with peers, may not be as acceptable for students already experiencing a high degree of burnout or depression symptoms. This emphasizes the importance of maintaining a range of approaches to address wellness, including counseling and psychological services and mindfulness practices, for individuals already experiencing significant psychological distress that prevents them from accessing or benefiting from other resources.

A notable finding is that although app-based approaches were rated unfavorably among the entire sample, the ratings of “using a mobile phone app to manage emotions” were positively correlated with burnout symptoms, and this approach was favorably rated by students with a lifetime history of mental health problems. This finding suggests that app-based interventions to improve wellness may have greater appeal to students who are experiencing higher burnout or have a history of mental health problems.

LIMITATIONS

Our findings are reported with acknowledgement of several important limitations. First, the sample size of this study, which comprised 11.6% of the total eligible students at our institution, limited power to detect significant results. Second, we studied only one population of doctoral students (i.e., biomedical sciences), limiting generalizability of our results to other doctoral students. Third, participants were recruited based on advertisements, introducing a self-selection bias. Fourth, self-report questionnaires are subject to problems involving response bias, participant insight, and differences in responding styles (Paulhus & Vazire, 2007). Finally, the large number of statistical tests conducted in this study introduces the risk of false positive findings. To mitigate this risk, we report all *p*-values for

each statistical test, allowing readers to scrutinize each finding individually, and we note that even with a conservative alpha correction to $<.01$, the results that support conclusions and recommendations of this study remain statistically significant.

RECOMMENDATIONS

Recommendations for researchers:

- Randomized controlled trials should be conducted to assess the effectiveness in reducing problems with mental health of the approaches rated both highly likely to be acceptable and effective (i.e., exercise, listening to/playing music, talking to parents, talking to friends who are far away, spending more time with friends in the area, watching movies with friends, socializing with colleagues during lab functions, massage).
- Studies should investigate facilitators and barriers to approaches rated highly likely to be effective, but not acceptable (i.e., peer support groups, group exercise/yoga/mindfulness classes, individual therapy, therapy dogs).
- More research is needed on mobile device-based interventions to support wellness in this population.
- Future studies should recruit large, nationally- and internationally-representative samples from diverse doctoral programs to validate our findings.

Recommendations for practitioners:

- Social engagement is highly valued by biomedical doctoral students, above and beyond institution-based wellness resources. Allow students flexibility in their schedules to engage with friends and colleagues on their own terms, and allow time to balance life activities (e.g., exercise) and hobbies (e.g., music).
- Students with mental health problems may not be able to benefit from the same resources as other students—for example, those involving social engagement. Maintain robust campus psychological services for these struggling students. Identify barriers to use of psychological services at your institution, and attempt to mitigate these barriers.
- Students suffering from symptoms of burnout may particularly benefit from mindfulness-based approaches to wellness.

CONCLUSION

The field of biomedical graduate education research continues to face challenges related to being in its early stages, only recently identifying significant problems with mental health among its students and facing a dearth of interventions research to solve these problems. As a first step towards further interventions research, this study investigated perceptions of a wide range of approaches to improve wellness among biomedical doctoral students, analyzing student ratings of acceptability and effectiveness of the approaches. We found that overall, students prefer managing their wellness with the help of friends and family, rather than their department or institution. In addition, we identified wellness approaches that may be effective for students that have experienced burnout or mental health problems, particularly individual therapy. We recommend that these interventions be further investigated in future study, along with rigorous evaluation of facilitators and barriers for these approaches. Future studies should also strive to recruit nationally- and internationally-representative samples of students from diverse doctoral programs, to test the validity of our findings among different populations.

Our results provide important insights guiding next steps in intervention testing and implementation to support biomedical doctoral students. We hope that our report offers guidance to administrators working to identify resources and services to aid these students.

REFERENCES

- Ægisdóttir, S., & Gerstein, L. H. (2009). Beliefs about psychological services (BAPS): Development and psychometric properties. *Counselling Psychology Quarterly*, 22(2), 197-219. <https://doi.org/10.1080/09515070903157347>
- Ægisdóttir, S., O'Heron, M., Hartong, J., Haynes, S., & Linville, M. (2011). Enhancing attitudes and reducing fears about mental health counseling: An analogue study. *Journal of Mental Health Counseling*, 33(4), 327-346. <https://doi.org/10.17744/mehc.33.4.a5673mh711w3g441>
- Alberts, B., Kirschner, M. W., Tilghman, S., & Varmus, H. (2014). Rescuing US biomedical research from its systemic flaws. *Proceedings of the National Academy of Sciences*, 111(16), 5773-5777. <https://doi.org/10.1073/pnas.1404402111>
- Alberts, B., Kirschner, M. W., Tilghman, S., & Varmus, H. (2015). Opinion: Addressing systemic problems in the biomedical research enterprise. *Proceedings of the National Academy of Sciences*, 112(7), 1912-1913. <https://doi.org/10.1073/pnas.1500969112>
- Allen, H. K., Barrall, A. L., Vincent, K. B., & Arria, A. M. (2020). Stress and burnout among graduate students: Moderation by sleep duration and quality. *International Journal of Behavioral Medicine*, 1-8. <https://doi.org/10.1007/s12529-020-09867-8>
- Baker, R., Camosso-Stefinovic, J., Gillies, C., Shaw, E. J., Cheater, F., Flottorp, S., & Robertson, N. (2010). Tailored interventions to overcome identified barriers to change: Effects on professional practice and health care outcomes. *Cochrane Database of Systematic Reviews*, 3, Art. No.: CD005470. <https://doi.org/10.1002/14651858.CD005470.pub2>
- Bamber, M. D., & Morpeth, E. (2019). Effects of mindfulness meditation on college student anxiety: A meta-analysis. *Mindfulness*, 10(2), 203-214. <https://doi.org/10.1007/s12671-018-0965-5>
- Barry, K. M., Woods, M., Martin, A., Stirling, C., & Warnecke, E. (2019). A randomized controlled trial of the effects of mindfulness practice on doctoral candidate psychological status. *Journal of American College Health*, 67(4), 299-307. <https://doi.org/10.1080/07448481.2018.1515760>
- Bartholomew, L. K., Markham, C. M., Ruiters, R. A. C., Fernández, M. E., Kok, G., & Parcel, G. S. (2011). *Planning health promotion programs: An intervention mapping approach*. Jossey-Bass, Inc.
- Beattie, A., Shaw, A., Kaur, S., & Kessler, D. (2009). Primary-care patients' expectations and experiences of online cognitive behavioural therapy for depression: A qualitative study. *Health Expectations*, 12(1), 45-59. <https://doi.org/10.1111/j.1369-7625.2008.00531.x>
- Berry, N., Lobban, F., Emsley, R., & Bucci, S. (2016). Acceptability of interventions delivered online and through mobile phones for people who experience severe mental health problems: A systematic review. *Journal of Medical Internet Research*, 18(5), e121. <https://doi.org/10.2196/jmir.5250>
- Breedvelt, J. J., Amanvermez, Y., Harrer, M., Karyotaki, E., Gilbody, S., Bockting, C. L., Cuijpers, P., & Ebert, D. D. (2019). The effects of meditation, yoga, and mindfulness on depression, anxiety, and stress in tertiary education students: A meta-analysis. *Frontiers in Psychiatry*, 10, 193. <https://doi.org/10.3389/fpsy.2019.00193>
- Busireddy, K. R., Miller, J. A., Ellison, K., Ren, V., Qayyum, R., & Panda, M. (2017). Efficacy of interventions to reduce resident physician burnout: A systematic review. *Journal of Graduate Medical Education*, 9(3), 294-301. <https://doi.org/10.4300/JGME-D-16-00372.1>
- Casadevall, A., & Fang, F. C. (2017). Reforming science: Methodological and cultural reforms. *Infection and Immunity*, 85(6), 891-896. <https://doi.org/10.1128/IAI.06183-11>
- Clement, S., Schauman, O., Graham, T., Maggioni, F., Evans-Lacko, S., Bezborodovs, N., Morgan, C., Rüsch, N., Brown, J. S. L., & Thornicroft, G. (2015). What is the impact of mental health-related stigma on help-seeking? A systematic review of quantitative and qualitative studies. *Psychological Medicine*, 45(1), 11-27. <https://doi.org/10.1017/S0033291714000129>

- Collado, A., Zvolensky, M., Lejuez, C., & MacPherson, L. (2019). Mental health stigma in depressed Latinos over the course of therapy: Results from a randomized controlled trial. *Journal of Clinical Psychology, 75*(7), 1179-1187. <https://doi.org/10.1002/jclp.22777>
- Conley, C. S., Durlak, J. A., Shapiro, J. B., Kirsch, A. C., & Zahniser, E. (2016). A meta-analysis of the impact of universal and indicated preventive technology-delivered interventions for higher education students. *Prevention Science, 17*(6), 659-678. <https://doi.org/10.1007/s1121-016-0662-3>
- Cornér, S., Löfström, E., & Pyhältö, K. (2017). The relationship between doctoral students' perceptions of supervision and burnout. *International Journal of Doctoral Studies, 12*, 91-106. <https://doi.org/10.28945/3754>
- Creswell, J. D. (2017). Mindfulness interventions. *Annual Review of Psychology, 68*, 491-516. <https://doi.org/10.1146/annurev-psych-042716-051139>
- Dawson, A. F., Brown, W. W., Anderson, J., Datta, B., Donald, J. N., Hong, K., Allan, S., Mole, T. B., Jones, P. B., & Galante, J. (2020). Mindfulness-based interventions for university students: A systematic review and meta-analysis of randomised controlled trials. *Applied Psychology: Health and Well-Being, 12*(2), 384-410. <https://doi.org/10.1111/aphw.12188>
- Daya, Z., & Hearn, J. H. (2018). Mindfulness interventions in medical education: A systematic review of their impact on medical student stress, depression, fatigue and burnout. *Medical Teacher, 40*(2), 146-153. <https://doi.org/10.1080/0142159X.2017.1394999>
- Dyrbye, L. N., Satele, D., & Shanafelt, T. D. (2017). Healthy exercise habits are associated with lower risk of burnout and higher quality of life among US medical students. *Academic Medicine, 92*(7), 1006-1011. <https://doi.org/10.1097/ACM.0000000000001540>
- Eisenberg, D., Golberstein, E., & Gollust, S. E. (2007). Help-seeking and access to mental health care in a university student population. *Medical Care, 45*(7), 594-601. <https://doi.org/10.1097/MLR.0b013e31803bb4c1>
- Evans, T. M., Bira, L., Gastelum, J. B., Weiss, L. T., & Vanderford, N. L. (2018). Evidence for a mental health crisis in graduate education. *Nature Biotechnology, 36*(3), 282. <https://doi.org/10.1038/nbt.4089>
- Evers, K., Chen, S., Rothmann, S., Dhir, A., & Pallesen, S. (2020). Investigating the relation among disturbed sleep due to social media use, school burnout, and academic performance. *Journal of Adolescence, 84*, 156-164. <https://doi.org/10.1016/j.adolescence.2020.08.011>
- Falsafi, N. (2016). A randomized controlled trial of mindfulness versus yoga: Effects on depression and/or anxiety in college students. *Journal of the American Psychiatric Nurses Association, 22*(6), 483-497. <https://doi.org/10.1177/1078390316663307>
- Field, T. (2016). Massage therapy research review. *Complementary Therapies in Clinical Practice, 24*, 19-31. <https://doi.org/10.1016/j.ctcp.2016.04.005>
- First, M. B., Williams, J. B. W., Karg, R. S., & Spitzer, R. L. (2015). *Structured clinical interview for DSM-5—Research version (SCID-5 for DSM-5, research version; SCID-5-RV)*. American Psychiatric Association.
- Fuhrmann, C. N., Halme, D. G., O'Sullivan, P. S., & Lindstaedt, B. (2011). Improving graduate education to support a branching career pipeline: Recommendations based on a survey of doctoral students in the basic biomedical sciences. *CBE—Life Sciences Education, 10*(3), 239-249. <https://doi.org/10.1187/cbe.11-02-0013>
- Gallagher, R. P. (2014). National survey of college counseling centers. http://d-scholarship.pitt.edu/28178/1/survey_2014.pdf
- Geven, K., Skopek, J., & Triventi, M. (2018). How to increase PhD completion rates? An impact evaluation of two reforms in a selective graduate school, 1976–2012. *Research in Higher Education, 59*(5), 529-552. <https://doi.org/10.1007/s11162-017-9481-z>
- Glass, G. D. (2016). Introducing a psychotherapy for the collective: A paradigm shift for college mental health. *Change: The Magazine of Higher Learning, 48*(6), 16-23. <https://doi.org/10.1080/00091383.2016.1247576>
- Gleeson, J. F., Lederman, R., Wadley, G., Bendall, S., McGorry, P. D., & Alvarez-Jimenez, M. (2014). Safety and privacy outcomes from a moderated online social therapy for young people with first-episode psychosis. *Psychiatric Services, 65*(4), 546-550. <https://doi.org/10.1176/appi.ps.201300078>

- Green, P. E., Krieger, A. M., & Wind, Y. (2001). Thirty years of conjoint analysis: Reflections and prospects. *Interfaces*, 31(3_supplement), S56-S73. <https://doi.org/10.1287/inte.31.3s.56.9676>
- Halladay, J. E., Dawdy, J. L., McNamara, I. F., Chen, A. J., Vitoroulis, I., McInnes, N., & Munn, C. (2019). Mindfulness for the mental health and well-being of post-secondary students: A systematic review and meta-analysis. *Mindfulness*, 10(3), 397-414. <https://doi.org/10.1007/s12671-018-0979-z>
- Hanisch, S. E., Twomey, C. D., Szeto, A. C., Birner, U. W., Nowak, D., & Sabariego, C. (2016). The effectiveness of interventions targeting the stigma of mental illness at the workplace: A systematic review. *BMC Psychiatry*, 16(1), 1. <https://doi.org/10.1186/s12888-015-0706-4>
- Hernandez, R. G. (2018). Creating structured opportunities for social interactions to promote wellness: One residency program's experience. *Academic Medicine*, 93(10), 1421-1422. <https://doi.org/10.1097/ACM.0000000000002357>
- Hernandez, R. G., Collins, K., Hopkins, A., Ashworth, J., Quigley, P., & Dudas, R. (2018). Establishing learning communities that foster career development skills within residency training. *Medical Science Educator*, 28(1), 7-8. <https://doi.org/10.1007/s40670-017-0513-2>
- Hirokawa, E., & Ohira, H. (2003). The effects of music listening after a stressful task on immune functions, neuroendocrine responses, and emotional states in college students. *Journal of Music Therapy*, 40(3), 189-211. <https://doi.org/10.1093/jmt/40.3.189>
- Hovdhaugen, E. (2011). Do structured study programmes lead to lower rates of dropout and student transfer from university? *Irish Educational Studies*, 30(2), 237-251. <https://doi.org/10.1080/03323315.2011.569143>
- Hyun, J. K., Quinn, B. C., Madon, T., & Lustig, S. (2006). Graduate student mental health: Needs assessment and utilization of counseling services. *Journal of College Student Development*, 47(3), 247-266. <https://doi.org/10.1353/csd.2006.0030>
- Iancu, A. E., Rusu, A., Măroiu, C., Păcurar, R., & Maricuțoiu, L. P. (2018). The effectiveness of interventions aimed at reducing teacher burnout: A meta-analysis. *Educational Psychology Review*, 30(2), 373-396. <https://doi.org/10.1007/s10648-017-9420-8>
- IBM Corp. (2015). *IBM SPSS Statistics for Windows, Version 23.0*. IBM Corp.
- Jairam, D., & Kahl, D. H., Jr. (2012). Navigating the doctoral experience: The role of social support in successful degree completion. *International Journal of Doctoral Studies*, 7(31), 1-329. <https://doi.org/10.28945/1700>
- Kane, M., & Trochim, W. M. K. (2007). *Concept mapping for planning and evaluation*. Sage. <https://doi.org/10.4135/9781412983730>
- Kessler, R. C., Chiu, W. T., Demler, O., & Walters, E. E. (2005). Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry*, 62(6), 617-627. <https://doi.org/10.1001/archpsyc.62.6.617>
- Kristensen, T. S., Borritz, M., Villadsen, E., & Christensen, K. B. (2005). The Copenhagen Burnout Inventory: A new tool for the assessment of burnout. *Work & Stress*, 19(3), 192-207. <https://doi.org/10.1080/02678370500297720>
- Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine*, 16(9), 606-613. <https://doi.org/10.1046/j.1525-1497.2001.016009606.x>
- Kvam, S., Kleppe, C. L., Nordhus, I. H., & Hovland, A. (2016). Exercise as a treatment for depression: A meta-analysis. *Journal of Affective Disorders*, 202, 67-86. <https://doi.org/10.1016/j.jad.2016.03.063>
- Lannin, D. G., Vogel, D. L., & Heath, P. J. (2017). Can reflecting on personal values online increase positive beliefs about counseling? *Journal of Counseling Psychology*, 64(3), 261. <https://doi.org/10.1037/cou0000201>
- Lee, Y. J., & Anderman, E. M. (2020). Profiles of perfectionism and their relations to educational outcomes in college students: The moderating role of achievement goals. *Learning and Individual Differences*, 77, 101813. <https://doi.org/10.1016/j.lindif.2019.101813>

- Levecque, K., Anseel, F., De Beuckelaer, A., Van der Heyden, J., & Gisle, L. (2017). Work organization and mental health problems in PhD students. *Research Policy*, 46(4), 868-879. <https://doi.org/10.1016/j.respol.2017.02.008>
- Lindhiem, O., Bennett, C. B., Rosen, D., & Silk, J. (2015). Mobile technology boosts the effectiveness of psychotherapy and behavioral interventions: A meta-analysis. *Behavior modification*, 39(6), 785-804. <https://doi.org/10.1177/01454455155595198>
- Linehan, M. M., & Heard, H. L. (1987). *Treatment history interview (THI)*. University of Washington, Seattle. <http://depts.washington.edu/uwbtrc/resources/assessment-instruments/>
- Lipson, S. K., Zhou, S., Wagner, B., III, Beck, K., & Eisenberg, D. (2016). Major differences: Variations in undergraduate and graduate student mental health and treatment utilization across academic disciplines. *Journal of College Student Psychotherapy*, 30(1), 23-41. <https://doi.org/10.1080/87568225.2016.1105657>
- Martino, J., Pegg, J., & Frates, E. P. (2017). The connection prescription: Using the power of social interactions and the deep desire for connectedness to empower health and wellness. *American Journal of Lifestyle Medicine*, 11(6), 466-475. <https://doi.org/10.1177/1559827615608788>
- Maslach, C., & Jackson, S. E. (1981). The measurement of experienced burnout. *Journal of Organizational Behavior*, 2(2), 99-113. <https://doi.org/10.1002/job.4030020205>
- May, R. W., Seibert, G. S., Sanchez-Gonzalez, M. A., & Fincham, F. D. (2016). Physiology of school burnout in medical students: Hemodynamic and autonomic functioning. *Burnout Research*, 3(3), 63-68. <https://doi.org/10.1016/j.burn.2016.05.001>
- Nagy, G. A., Fang, C. M., Hish, A. J., Kelly, L., Nicchitta, C. V., Dzirasa, K., & Rosenthal, M. Z. (2019). Burnout and Mental Health Problems in Biomedical Doctoral Students. *CBE—Life Sciences Education*, 18(2), ar27. <https://doi.org/10.1187/cbe.18-09-0198>
- National Academy of Sciences, National Academy of Engineering, & Institute of Medicine. (2014). *The Postdoctoral Experience Revisited*. Committee to Review the State of Postdoctoral Experience in Scientists and Engineers, Committee on Science, Engineering, and Public Policy, Policy and Global Affairs. National Academies Press. <https://doi.org/10.17226/18982>
- National Institutes of Health. (2012). *Biomedical Research Workforce Working Group Report*. National Institutes of Health. https://acd.od.nih.gov/documents/reports/Biomedical_research_wgreport.pdf
- Panagioti, M., Panagopoulou, E., Bower, P., Lewith, G., Kontopantelis, E., Chew-Graham, C., Dawson, S., van Marwijk, H., Geraghty, K., & Esmail, A. (2017). Controlled interventions to reduce burnout in physicians: A systematic review and meta-analysis. *JAMA Internal Medicine*, 177(2), 195-205. <https://doi.org/10.1001/jamainternmed.2016.7674>
- Pascoe, M. C., & Parker, A. G. (2019). Physical activity and exercise as a universal depression prevention in young people: A narrative review. *Early Intervention in Psychiatry*, 13(4), 733-739. <https://doi.org/10.1111/eip.12737>
- Paulhus, D. L., & Vazire, S. (2007). The self-report method. In R. W. Robins, R. C. Fraley, & R. F. Krueger (Eds.), *Handbook of research methods in personality psychology* (pp. 224-239). The Guilford Press.
- Poole, R., Simpson, S. A., & Smith, D. J. (2012). Internet-based psychoeducation for bipolar disorder: A qualitative analysis of feasibility, acceptability and impact. *BMC Psychiatry*, 12(1), 1-10. <https://doi.org/10.1186/1471-244X-12-139>
- Portnoy, D. B., Scott-Sheldon, L. A., Johnson, B. T., & Carey, M. P. (2008). Computer-delivered interventions for health promotion and behavioral risk reduction: A meta-analysis of 75 randomized controlled trials, 1988–2007. *Preventive Medicine*, 47(1), 3-16. <https://doi.org/10.1016/j.ypmed.2008.02.014>
- Powell, B. J., Beidas, R. S., Lewis, C. C., Aarons, G. A., McMillen, J. C., Proctor, E. K., & Mandell, D. S. (2017). Methods to improve the selection and tailoring of implementation strategies. *The Journal of Behavioral Health Services & Research*, 44(2), 177-194. <https://doi.org/10.1007/s11414-015-9475-6>
- Prince, J. P. (2015). University student counseling and mental health in the United States: Trends and challenges. *Mental Health & Prevention*, 3(1-2), 5-10. <https://doi.org/10.1016/j.mhp.2015.03.001>

- Qualtrics. (2013). *QualtricsSM of the Qualtrics Research Suite*. <http://www.qualtrics.com>
- Rapaport, M. H., Schettler, P. J., Larson, E. R., Carroll, D., Sharenko, M., Nettles, J., & Kinkead, B. (2018). Massage therapy for psychiatric disorders. *Focus*, 16(1), 24-31. [https://doi.org/10.1176/appi-focus.20170043](https://doi.org/10.1176/appi.focus.20170043)
- Richardson, C. M., Trusty, W. T., & George, K. A. (2020). Trainee wellness: Self-critical perfectionism, self-compassion, depression, and burnout among doctoral trainees in psychology. *Counselling Psychology Quarterly*, 33(2), 187-198. <https://doi.org/10.1080/09515070.2018.1509839>
- Rotenstein, L. S., Torre, M., Ramos, M. A., Rosales, R. C., Guille, C., Sen, S., & Mata, D. A. (2018). Prevalence of burnout among physicians: A systematic review. *Jama*, 320(11), 1131-1150. <https://doi.org/10.1001/jama.2018.12777>
- Rouwette, E. A., Vennix, J. A., & Mullekom, T. V. (2002). Group model building effectiveness: A review of assessment studies. *System Dynamics Review: The Journal of the System Dynamics Society*, 18(1), 5-45. <https://doi.org/10.1002/sdr.229>
- Salmela-Aro, K., Kiuru, N., Leskinen, E., & Nurmi, J. E. (2009). School burnout inventory (SBI) reliability and validity. *European Journal of Psychological Assessment*, 25(1), 48-57. <https://doi.org/10.1027/1015-5759.25.1.48>
- Scheirer, M. A. (2013). Linking sustainability research to intervention types. *American Journal of Public Health*, 103(4), e73-e80. <https://doi.org/10.2105/AJPH.2012.300976>
- Sekhon, M., Cartwright, M., & Francis, J. J. (2018). Acceptability of health care interventions: A theoretical framework and proposed research agenda. *British Journal of Health Psychology*, 23(3), 519-531. <https://doi.org/10.1111/bjhp.12295>
- Short, N. A., Fuller, K., Norr, A. M., & Schmidt, N. B. (2017). Acceptability of a brief computerized intervention targeting anxiety sensitivity. *Cognitive Behaviour Therapy*, 46(3), 250-264. <https://doi.org/10.1080/16506073.2016.1232748>
- Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of internal medicine*, 166(10), 1092-1097. <https://doi.org/10.1001/archinte.166.10.1092>
- Stephan, P. E. (2012). *How economics shapes science* (Vol. 1). Harvard University Press.
- Todd, N. J., Jones, S. H., & Lobban, F. A. (2013). What do service users with bipolar disorder want from a web-based self-management intervention? A qualitative focus group study. *Clinical Psychology & Psychotherapy*, 20(6), 531-543. <https://doi.org/10.1002/cpp.1804>
- Tompkins, K. A., Brecht, K., Tucker, B., Neander, L. L., & Swift, J. K. (2016). Who matters most? The contribution of faculty, student-peers, and outside support in predicting graduate student satisfaction. *Training and Education in Professional Psychology*, 10(2), 102. <https://doi.org/10.1037/tep0000115>
- Tsai, J. W., & Muindi, F. (2016). Towards sustaining a culture of mental health and wellness for trainees in the biosciences. *Nature Biotechnology*, 34(3), 353. <https://doi.org/10.1038/nbt.3490>
- Umbrello, M., Sorrenti, T., Mistraretti, G., Formenti, P., Chiumello, D., & Terzoni, S. (2019). Music therapy reduces stress and anxiety in critically ill patients: A systematic review of randomized clinical trials. *Minerva Anestesiologica*, 85(8), 886. <https://doi.org/10.23736/S0375-9393.19.13526-2>
- Van Der Haert, M., Arias Ortiz, E., Emplit, P., Halloin, V., & Dehon, C. (2014). Are dropout and degree completion in doctoral study significantly dependent on type of financial support and field of research? *Studies in Higher Education*, 39(10), 1885-1909. <https://doi.org/10.1080/03075079.2013.806458>
- Vidak, M., Tokalić, R., Marušić, M., Puljak, L., & Sapunar, D. (2017). Improving completion rates of students in biomedical PhD programs: An interventional study. *BMC Medical Education*, 17(1), 144. <https://doi.org/10.1186/s12909-017-0985-1>
- Ward-Griffin, E., Klaiber, P., Collins, H. K., Owens, R. L., Coren, S., & Chen, F. S. (2018). Petting away pre-exam stress: The effect of therapy dog sessions on student well-being. *Stress and Health*, 34(3), 468-473. <https://doi.org/10.1002/smi.2804>

- Wasson, L. T., Cusmano, A., Meli, L., Louh, I., Falzon, L., Hampsey, M., Young, G., Shaffer, J., & Davidson, K. W. (2016). Association between learning environment interventions and medical student well-being: A systematic review. *Jama*, *316*(21), 2237-2252. <https://doi.org/10.1001/jama.2016.17573>
- West, C. P., Dyrbye, L. N., & Shanafelt, T. D. (2018). Physician burnout: Contributors, consequences and solutions. *Journal of Internal Medicine*, *283*(6), 516-529. <https://doi.org/10.1111/joim.12752>
- Williams, D., Tricomi, G., Gupta, J., & Janise, A. (2015). Efficacy of burnout interventions in the medical education pipeline. *Academic Psychiatry*, *39*(1), 47-54. <https://doi.org/10.1007/s40596-014-0197-5>
- Wood, E., Ohlsen, S., Thompson, J., Hulin, J., & Knowles, L. (2018). The feasibility of brief dog-assisted therapy on university students stress levels: The PAWS study. *Journal of Mental Health*, *27*(3), 263-268. <https://doi.org/10.1080/09638237.2017.1385737>
- Xiao, H., Carney, D. M., Youn, S. J., Janis, R. A., Castonguay, L. G., Hayes, J. A., & Locke, B. D. (2017). Are we in crisis? National mental health and treatment trends in college counseling centers. *Psychological Services*, *14*(4), 407. <https://doi.org/10.1037/ser0000130>
- Ziegelstein, R. C. (2018). Creating structured opportunities for social engagement to promote well-being and avoid burnout in medical students and residents. *Academic Medicine*, *93*(4), 537-539. <https://doi.org/10.1097/ACM.00000000000002117>

BIOGRAPHIES



Alexander J. Hish, M.D. completed his medical education at the Duke University School of Medicine and is completing a combined residency in Pediatrics, Psychiatry, and Child and Adolescent Psychiatry at Mount Sinai Hospital in New York.



Gabriela A. Nagy, Ph.D. is a clinical psychologist and assistant professor at the Duke University School of Medicine and the School of Nursing. Her research is funded by the National Institutes of Health and internal grants and primarily centers on reducing health disparities.



Caitlin Fang, Ph.D. is a clinical psychologist and clinical associate at the Duke University School of Medicine. Upon completion of her postdoctoral fellowship in July 2020, she will be starting a community private practice.



Lisalynn Kelley, CCRP has over 20 years of research experience within the Duke Department of Psychiatry & Behavioral Sciences. She has been involved in conducting and managing a range of studies on emotion regulation, sensory processing, psychopathology, and treatment.



Christopher V. Nicchitta, Ph.D. is a professor in the Departments of Cell Biology, Biochemistry, and Pathology at Duke University. He has previously served as the Associate Dean for Research Training at the Office of Biomedical Graduate Education and Director of Graduate Studies for the Department of Cell Biology in the School of Medicine.



Kafui Dzirasa, M.D., Ph.D. is a psychiatrist and National Institutes of Health-funded brain researcher at Duke University. He is also a Public Engagement Fellow of the American Association for the Advancement of Science.



M. Zachary Rosenthal, Ph.D. is a clinical psychologist and associate professor at Duke University Medical Center and Duke University. He has previously served as the Vice Chair of Clinical Services for the Department of Psychiatry and Behavioral Sciences.