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A Theory-Based Meta-Analysis: Stress Management Interventions for College Students

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Abstract

The purpose of this study was to determine the combined average effect size for the efficacy of stress management interventions in randomized controlled trials with college students. A workplace stress intervention approach guided article selection. A single instrument measured stress. The analysis was a random effects model. The literature search in the spring of 2020 yielded eight qualifying studies, published from 2014-2020. The overall effect size was statistically significant (g = –0.41). Especially given pandemic-related stressors, this meta-analysis could serve as a baseline for future research comparisons. It mirrored results of other meta-analyses, discussed in the literature review. No prior meta-analysis to our knowledge has employed the same approach or framework.

Keywords: college students, mental well-being, randomized controlled trials, Perceived Stress Scale, stress management interventions

1. Introduction

According to the World Health Organization (WHO, 2018), physical health cannot exist without mental health and mental health is fundamental to overall well-being, affecting people in every aspect of their lives. Mental health is closely linked to work efficiency, productivity, and organizational functioning (Schmidt & Hansson, 2018). Institutions, including schools and workplaces, have the ability to promote mental health by implementing activities and programs geared toward stress prevention and remediation (WHO, 2018).

Stress levels that college student face threaten their mental health, a situation exacerbated by the ongoing pandemic (Benjet, 2020). University students are likely to experience stress if for no other reason than the transitional nature of going to college (Hamaideh, 2011). Students may doubt their ability to thrive in some classes in addition to their experiences with major stress of daily life (Gallagher & Stocker, 2018). Other sources of stress are self-imposed (e.g., desire to compete and win), pressures (e.g., grades and work), conflicts, and frustrations; reactions to stressors vary, including cognitive, emotional, behavioral, and physiological responses (Hamaideh, 2011). Relevance and timeliness for stress management interventions (SMIs) with this population have never been higher (Benjet, 2020).

The ongoing pandemic resulted in temporary closure of on-site campuses during the spring of 2020, the very time frame in which the current study was conducted. This meta-analysis may stand as a reference point for literature on college student stress interventions before the pandemic began to affect campus services visibly and significantly. The overarching goal of the current meta-analysis was to examine the effect of stress management interventions (SMIs) in randomized controlled trials (RCTs) on self-reported stress within the college student population, using a theoretical framework of workplace stress management interventions in gaining a pre-pandemic snapshot of efforts to address students' general well-being and mental health. This microscopic goal as applied in the context of a broad systematic review on the topic with this population would fill a gap in the literature.

2. Literature Review

2.1 Stress and Stressors in College Students

Well-being literature has encompassed a broad scope of college students and settings: undergraduates (Eubank & DeVita, 2020; Moses, Bradley, & O'Callaghan, 2016); graduate students of color (Phelps-Ward, 2021); peer educators (Wawrzynski & Lemon, 2021); university counseling centers (Berman, Bevan, & Sparks, 2020); and, university students with disabilities (Vaccaro, Moore, Kimball, Troiano, & Newman, 2019). Connected to mental health and

wellness, stress has been found to be broadly present in the overall college student population (e.g., Bamber & Schneider, 2016; Oswalt & Riddock, 2007). Indicators, meanwhile, have continued to point toward rising stress among the college student population since 2000 (Bamber & Schneider, 2016).

Stress affects all levels of college students. Acharya, Jin, and Collins (2018) asked 631 undergraduates about 41 stressor items for the then-current school year (2014-2015). Among other findings, multivariate tests produced statistically significant differences in stress levels that varied for specific stressors based upon gender and domestic or international status. When considered as a whole, the study showed a need for attention to and for addressing stressors within the student population and with attention to diverse groups of students. Graduate students who participated in another study said that they had experienced at least some level of stress (*stressed*, 48.9%; *very stressed*, 24.7%), and many were not even aware of services available to them (Oswalt & Riddock, 2007). Men and women reported different coping strategies and many participants expressed interest in learning new strategies. Jones' (2013) thematic analysis of journal publications about doctoral students, which spanned a 40-year period, identified stress as an important factor related to both student progress and attrition. Leaders in higher education have the unique ability to promote student mental health and well-being, which in turn is known to correlate with students' academic success. However, additional research on actual empirically demonstrated health outcomes using multi-faceted approaches is needed. (Silverman & Little, 2021). In short, it is crucial to know what works and what does not.

2.2 Synopsis of Syntheses on Stress and Stress Management

A sample of synthesized literature about SMIs and stress reduction that included outcomes for college students encompassed diverse individual study characteristics: number of included articles, variations in design and specific interventions, nature of findings, and instruments for measuring stress (see Table 1). The number of included studies with a stress outcome for college students in each review within the sample was minimal (range 1 to 26) when compared to the overall number of studies in each review (range 27 to 59).

Table 1. Sample: Stress-inclusive systematic reviews and meta-analyses with college students

Source # Articles	Design Relevant population Relevant intervention # Articles with student stress outcome	Stress findings for college students	Some stress measures included
Amanvermez et al. (2021) n = 30	Systematic review; meta-analysis; RCTs College students Self-guided SMIs General college student studies (n = 26) Highly stressed student studies (n = 3)	 $g = 0.25$, $p < .001$ $g = 0.27$, $p = .087$	DASS PCOSES PSS
Bamber & Schneider (2016) n = 57	Narrative synthesis College students Mindfulness Meditation (Perceived) Stress (n = 11)	Significant reductions: 7 Reductions with controls: 2 Downward trend, not significant: 1 No Effect: 1	DASS PSS CSOSI
Clarke, Kuosmanen, & Barry (2015) n = 28	Systematic review University students; high stress (n =1) Online SMI, RCT Stress	No significant effect on perceived stress	PSS
Farrer et al. (2013) n = 27	Systematic review Tertiary students (ages 18-25) Technology-based mental health (n = 4) Stress (n = 2)	Insufficient data to calculate effect sizes for interventions targeting stress	MMSC PSS
Victorson et al. (2015) n = 59	Systematic review; meta-analysis; RCTs School/university-based students (n = 5) Mindfulness meditation Stress for college students (n = 2)	Significantly lower stress levels for the two studies	Not reported by study; PSS and State Trait Anxiety Inventory most used overall

Note: CSOSI: Calgary Symptoms of Stress Inventory; DASS: Depression Anxiety Stress Scale; MMSC: Momentary Mood States Checklist; PCOSES: Perceived Control over Stressful Events Scale; PSS: Perceived Stress Scale

The review with the largest number of articles that contained the stress outcome (Bamber & Schneider, 2016) had positive findings in ¾ of the overall articles. Relatively few of the designs in the review sample focused solely on the strongest methodology for causal inference, RCTs (Bickman & Rog, 2009). Both reviews that examined only RCTs (Amanvermez et al., 2021); Victorson et al., 2015) found evidence of significant reductions in the stress outcome. The most recent examination of RCTs for SMIs among college students in the sample (Amavermez et al , 2021) employed two meta-analyses, covered a wide range of years, and included a stress/distress outcome (see Table 1). High-stress studies were published as far back as 1987 and 2000. Unselected studies (students not identified as highly stressed) in the other meta-analysis were published as far back as the 90s. The majority of studies were coded as Cognitive Behavioral Therapy (CBT) and a large percent of study participants were females (high stress, 77%; unselected population, 71%).

Similar meta-analytic work has suggested that SMIs may not function in the same way with the student subpopulation as with the overall adult population. Wilson, Mackintosh, Power, and Chan (2019), for instance, examined RCTs for adults known to have clinical or subclinical disorders and included only one type of intervention, self-compassion related therapies. The therapies yielded improvements in all three outcomes (stress not measured): anxiety (g = 0.46), depressive symptoms (g = 0.40), and self-compassion (g = 0.52). That finding reversed, however, when the analysis was only for studies with active control conditions. Sedlmeier et al. (2012) found that effects were roughly the same in their meta-analysis of meditation and psychological benefits for nonclinical adults regardless of whether studies had randomization (overall effect size weighted by sample size, medium, r = .28). Taken together, the synthesized literature in this brief synopsis illuminates discrepant findings and suggests that use of RCTs may make important differences in findings. Randomization is the best known means to handle differences in groups prior to an intervention when treatment effects are under study (Sedlmeier et al, 2012).

2.3 The Perceived Stress Scale (PSS)

The Perceived Stress Scale (PSS) measures an individual's self-reported stress during the most recent month (Cohen, Kamarck, & Mermelstein, 1983; Cohen, 1994). Participants rate frequencies of feelings and thoughts over the last month on a five-point scale ranging from zero (*never*) to four (*very often*) for given statements. For example, one statement reads: "In the last month, how often have you found that you could not cope with all the things that you had to do?" Cohen (1994) reported on the norming of the 10-item version by gender, age, and race on over 2,000 respondents in the United States. Average scores ranged from 11.9 to 14.7 and showed evidence of validity. It correlated well with other health measures. Later, Cohen and Janicki-Deverts (2012) reported on use of the 10-item English version to measure psychological stress and how often participants found their lives to be unpredictable, uncontrollable, and overloading. Probability samples were from the United States in 1983, 2006, and 2009. Higher scores indicated higher stress. Internal reliabilities (Cronbach's α) were .78 in one sample, and .91 the other two samples.

A psychometric assessment of the PSS-10 indicated that inferences made with the instrument are valid but questioned its multidimensionality (Taylor, 2015). A large study concerning validity of the PSS-10 reported scalability problems with Rasch modeling (Nielsen et al., 2016). Although researchers have conducted meta-analyses that have employed RCTs to examine mental health and college students (Amavermez et al., 2021 Huang, Nigatu, Smail-Crevier, Zhang, & Wang, 2018), none to our knowledge has examined RCTs and SMIs with a single instrument.

2.4 Workplace Stress Intervention Framework

Universities are organizations and students are members who can learn work-related skills there (Mozahem & Ghanem, 2018). Students produce work and students' perspectives about academic work influence well-being (Chambel & Curral, 2005). Hence, we chose to structure our meta-analysis in a framework that organized SMIs in terms of workplace psychological well-being (Holman, Johnson, & O'Connor, 2018) (see Table 2).

Table 2. Holman et al. (2018) typology of stress management interventions (p. 795)

	Individual	Organizational
Primary	Selection & assessment Pre-employment medical examination	
Secondary	Mindfulness training Health promotion Cognitive behavioral therapy Relaxation Mediation Personal & interpersonal skill training Acceptance & commitment therapy Psychosocial intervention training Coping skills training Resilience training	Improving communication and decision-making Conflict management Peer support groups Coaching & career planning
Tertiary	Employee assistance programs Counseling Posttraumatic stress assistance Disability management	Vocational rehabilitation Outplacement

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The Holman et al. (2018) framework with individual and organizational interventions contains three levels: prevention of stress (primary); equipment with skills/abilities to manage stress (secondary); and, management of high or chronic stress or stress-related mental health issues that could impair work (tertiary). We framed our study within the individual level for two reasons. From a logic-based view, expansive organizational changes may be more challenging to implement than changes in individuals or small groups of individuals. From a literature-based view, environmental initiatives for individuals and specific problems in the workplace have demonstrated greater effectiveness than organizationally rooted programs have (Holman et al., 2018; Robotham, 2008). Within the individual SMI framework category, we chose to examine the secondary level of interventions for two reasons. We aimed to add to the knowledge base more information about helping students gain skills and develop abilities to manage stress.

In summary, we have responded to the literature, concerns noted therein, and widespread use of the PSS for measuring self-reported stress levels. The major objective of this meta-analysis was to examine the overall effect size for SMIs on reported stress for college students within peer-reviewed journals from 2000-2020 and utilizing RCT designs. A subcomponent of the objective was to examine the direction of the effect size for interventions found in individual studies that met specific inclusion criteria. Another component, which differed from previous known meta-analyses on similar topics, was to measure stress exclusively with a single instrument commonly employed internationally to measure recent, self-reported stress. A final unique aspect of this meta-analysis, workplace theory for stress management interventions framed article selection for the study (Holman et al., 2018)

3. Method

3.1 Study Inclusion

The design of this study followed the PICOT format: population, intervention, comparator, outcome, and time frame (Riva, Malik, Burnie, Endicott, & Busse, 2012). The population of interest was college students. Interventions were SMIs for individuals at the secondary level of the Holman et al. typology (2018). The comparisons were appropriate control groups; the outcomes were self-reported stress. The time pattern, published from 2000 through early summer, 2020, followed one used in a recent systematic review of youth health promotion and prevention interventions (Clarke et al., 2015).

Design choice also adhered to "*utos"* elements: units, treatments, outcomes, and settings (Cronbach & Shapiro, 1982; Shadish, Cook, & Campbell, 2001). Units were peer-reviewed, published studies. In order to ensure consistency and applicability of findings, all treatments included pre- and post-test means, standard deviations, and group sample sizes (e.g., Haddaway, 2016). Study types were only Randomized Controlled Trials (RCTs) due to their causality legacy. Treatments were SMIs and the setting was the college student environment.

3.2 Selection Strategy

The PRISMA flow chart guided article inclusion decisions (Moher, Liberati, Tetzlaff, Altman, & The PRISMA Group, 2009) (see Figure 1). This pattern guided searches, with replacements of specific interventions and other terms for college:

Subject *is (exact)* **stress management** AND Any field *is (exact)* **college students** AND Any field *is (exact)* **stress** AND Any field *is (exact)* **control group**.

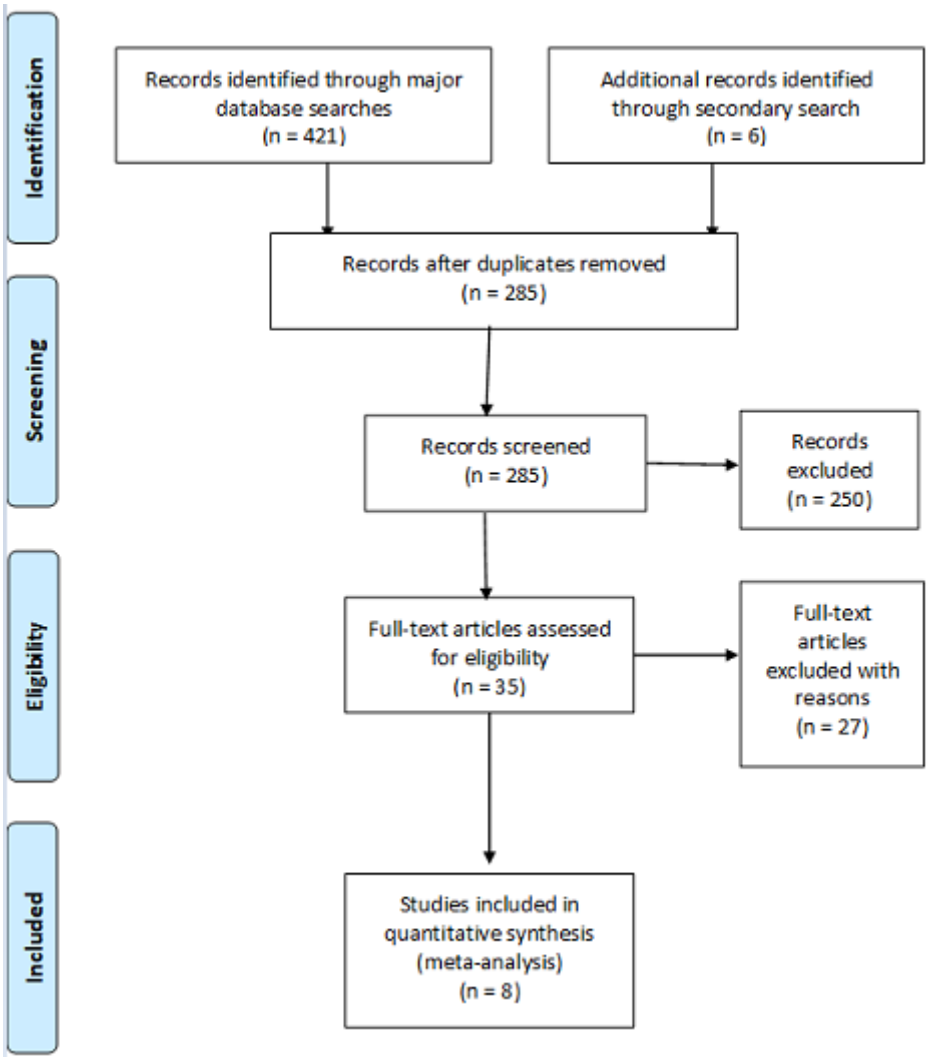

Figure 1. PRISMA flow diagram

Inclusion protocol included: SMI from ProQuest Ex Libris Knowledge Center; randomized controlled trial; stress outcome (PSS-10) (Cohen et al., 1983); college students; means, *SD*s, and *N* for pre- and post-tests; peer-reviewed; and, in English. Exclusion criteria included: dissertations, proposals, meta-analyses, and quality issues. A follow-up literature scan of meta-analyses and other syntheses that were discovered in the original searches helped to set expectations for effect size and to consider similarities and differences between the current study and prior professional literature.

Eight articles qualified for inclusion, indicated in the references by an asterisk. Of the 427 articles originally identified, we removed 142 duplicates. Abstract and title screening for inclusion criteria resulted in the loss of another 250 articles (e.g., inappropriate population, mixed students and staff, quasi-experimental design, and no use of PSS-10). Full-text scanning resulted in the loss of one retracted and several other articles that did not meet criteria. A final review of the 11 remaining articles resulted in the loss of another three articles that did not meet criteria. One article, part of a larger randomized trial, was admissible. We were able to include the data from the relevant part of the trial. Four of the articles had three measurements, one after post-test (Ahmad et. al, 2020; Huberty et al., 2019; Phang, Mukhtar, Ibrahim, Keng, & Sidik, 2015; Räsänen, Lappalainen, Muotka, Tolvanen, & Lappalainen, 2016), though only two had enough information in the article to be treated as such. Seven of the eight articles referred to the overarching well-being construct (exception, Papp, Nygren-Bonnier, Gullstrand, Wändell, & Lindfors, 2019).

3.3 Data Coding and Extraction

We created codebooks for organization and coding of study characteristics of interest and extraction of statistics for outcomes measured in each study (see Table 3).

Table 3. Sample codebook for included articles

First author, country, source, treatment	Some reported participant traits
Ahmad, Canada, *JMIR Mental Health,* Mindfulness Virtual Community	York University, undergraduates, 75% women, 59% born in Canada, 65% English first language, 37% white, 24.8 years average age (*SD*= 6.5 years)
Flett, New Zealand, *Creativity Research Journal,* Coloring Activity	University of Otago: 104 women students, 75% New Zealand European descent, ages 18 to 38 years (*M* = 19.73 years, *SD* = 2,29 years)
Greeson, U.S., *Journal of American College Health,* Koru Program (Mindfulness)	90 undergraduate, graduate, and professional students, 66% women, 62% white, 85% non-Hispanic, about 75% in graduate or professional school, oldest to complete, 31 years (*M* = 25.4, *SD* = 5.7, range = 18-59)
Huberty, U.S., *JMIR mHeatlh and uHealth,* Mobile App, *Calm* (Meditation)	88 Arizona State University, full-time undergraduates who scored at least 14 points on PSS, 88% women, 59% white, 77% non-Hispanic, mean age treatment = 20.41 years (*SD* = 2.31), mean age control = 21.85 years (*SD* = 6.3) (mean age adjusted for gender and race)
Ko, U.S., *Journal of American College Health,* Seminar on Compassion	Southern California, 41 students at small, liberal arts campus (24 in Year 1), 66% women, ages 18 to 22 years (*M* = 19.78, *SD* = 1.36)
Papp, Sweden, *Journal of Bodywork and Movement Therapies,* High Intensity Yoga	54 students, 25 years median age, 20 to 39 age range, treatment and control included 3 men each
Phang, Malaysia, *Advances in Health Sciences Education, Mindful Gym*	Universiti Putra Malaysia, medical students, years 1 to 3, 70% of treatment and 82% of control women, 54% of treatment and 53% of control Malay, 21.14 years mean treatment age (*SD* = 1.10), 20.94 years mean control age (*SD* = 1.17)
Räsänen, Finland, *Behavior Research and Therapy,* Acceptance & Commitment Therapy (ACT)	University of Jyväskylä (JYU), 68 university students, 61.9% reported at least mild depression, 85.3% female, 24.29 years mean age *(SD* = 3.28)

All articles had design and measurement traits in common: RCTs and use of the PSS-10. Characteristics also differed. Though not labeled as health promotion and skills training, all articles arguably had these underlying themes. All studies reported relatively low attrition or relatively high adherence. Students were traditional college-aged students in studies from six countries. Participants were at diverse levels in their academic studies: undergraduate, graduate, or professional. One study was with medical students and another with distressed students. Three-fourths of studies had mostly women participants.

SMIs varied. Some examples follow. The Mindfulness Virtual Community in Ahmad et al.'s study (2020) on students' mental health included videos on health intimacy, pain reduction, healthy body image, healthy eating, and better sleep. Engagement strategies were vital to positive outcomes and self-reporting bias was addressed. Possible benefits of implementation were easing the burden on or providing a supplement to traditional counseling services, cost effectiveness, student convenience, student-centered design, and stigma reduction for internet-based instead of in-person service delivery.

The term *Koru* in the mindfulness course implemented in New Zealand referred to the unfurling fern frond and symbolized balance and growth (Greeson, Juberg, Maytan, James, & Rogers, 2014). As compared to other mindfulness interventions, the mind-body skills in the relatively brief program showed promise as a tool for quick stress reduction. Participants also read a required text, Jon Kabat-Zinn's *Wherever You Go, There You Are*, and used a daily meditation log to document two things for which they felt grateful. The tool may have been motivational toward continued engagement in the study, self-care, and stress management.

The mindfulness study for the *Calm* app, part of a registered clinical trial, compared results to several other mindfulness meditation apps used in recent studies on students' mental health (e.g., Headspace and Wildflowers) (Huberty et al., 2019). Many students reported the app to be enjoyable and helpful and said that they would likely use it in the future. Remote delivery of services held promise for practice in that the app intervention could reduce required institutional resources and time burdens.

One of the most noteworthy aspects of the Seminar on Compassion was the argument that lack of statistical significance in stress reduction may have resulted from the course design, as the course did not target anxiety, depression, or stress (Ko et al., 2018). Each of the course assignments required integration of contemplative thinking (e.g., deep listening, nature observation) with analytical thinking. The academic component included reading the life stories of exemplars such as Ghandi, Mother Teresa, and Nelson Mandela. The course also required community service. In reflection, the researchers felt that the course may have focused more on others than self, which may have explained the lack of effect on student well-being measures.

The Mindful Gym intervention described participants as undergraduates, years 1-3, of medical training in Malaysia (Phang, 2015). Despite a small sample size and the limitation of a specific population of students who mostly reported significant mental distress prior to the intervention (72 of 75), over 90% reported that the intervention would be useful in their patients and only three participants were not sure that they benefitted. Each of the multi-ethnic group of participants stated that they would recommend the program to friends or family.

The Räsänen et al. (2016) online guided intervention was based in Acceptance and Commitment Therapy (ACT). Under the supervision of a licensed psychology, 22 ACT-trained psychology student in at least their third year of study and mostly women coached and supported participants. Although six coaches reported prior experience in psychological intervention provision, analyses prior to intervention showed that coaches were both inexperienced and highly motivated to give support. Coaches tailored face-to-face and online interventions to participant's individual needs and offered personalized feedback. Technology-based interventions may have benefitted those who might otherwise not seek help. Guided internet programs offered by peer students was promising.

Studies not as clearly connected to mindfulness also offered insights. In their study, Flett et al. (2017) argued that coloring is likely mindless instead of mindful. They described coloring as low-risk, accessible, rule-governed, and safe. Intervention adherence assessment was simple, a daily text with a hyperlink to participants' phones to ask whether they had completed the session that day (*yes* or *no*). The study on High-Intensity Yoga (HIY) focused on health-related outcomes for the HIY group and a group not changing exercise behavior (Papp et al, 2019). Although no statistical significance existed between groups, within-group associations for the HIY group were statistically significant and showed reductions in depression and insomnia. The low dosage in the short time period (average of 6.5 hours over weeks), the challenge of home training for inexperienced students, the lack of ideal type of control group, the attention the control group received due to weekly monitoring, and the general good health of the participants may have been problematic. Clinically speaking, however, HIY demonstrated relevance for decreased depression, improved sleep, and as a feasible physical activity for healthy students (no injuries).

Relevant descriptive and inferential statistics (*t*, *F*, *d*, *SD,* mean) were extracted from each article for computation of Hedges *g* effect size. Standard mean differences were calculated and entered into an effect size converter to obtain Hedges *g* and standard error (Bailey, 2009). Because our intent was to consistently extract and analyze data through identical, independent, converter-based calculations, we only informally compared to authors' calculations.

Using the computed effect sizes from each study, a classical meta-analysis in JASP (University of Amsterdam, n.d.) was conducted using a random effects model and Restricted Maximum Likelihood (RML) estimation. We used NIST (2018) standards (0.2, small effect; 0.5, medium effect). Dependencies, articles that reported measurements for more time periods than pre- and post-test, required sensitivity analyses (e.g., Murano, Sawyer, & Lipnevich, 2020; Scherrer & Preckel, 2019). Examination of possible bias occurred in two ways: a qualitative review of suggestions and limitations within articles and a statistical test to examine publication bias.

4. Results

A random-effects model was used to examine the average effect size for articles ($n = 8$) measuring SMIs at Times 1 and Time 2. Results revealed a statistically significant medium overall effect size per Cohen (1988), Hedges' $g = –0.42$ ($p < .001$, 95% CI [–0.63, –0.20]). The estimated standard error was 0.11. This finding indicated that college students who participated in SMIs experienced statistically significant reductions (e.g., negative effect size) in reported stress levels from pre-test to post-test when compared to college students in control groups. The overall study level heterogeneity, $Q = 14.11$ was significant, $p < .001$, despite the small sample size. Between-study variation was $\tau^2 = 0.04$, and I^2, proportion of true variance, was 41.60%.

A forest plot graphically represents the distribution of effect sizes of studies included in the meta-analysis and the overall mean effect size, along with their 95% confidence interval (Sedgwick, 2015). The pattern of effect sizes is shown around a horizontal line, which represents zero (or null) effect. The forest plot in the current meta-analysis portrayed effect sizes in the negative direction (to the left of the horizontal line) for all studies except one.

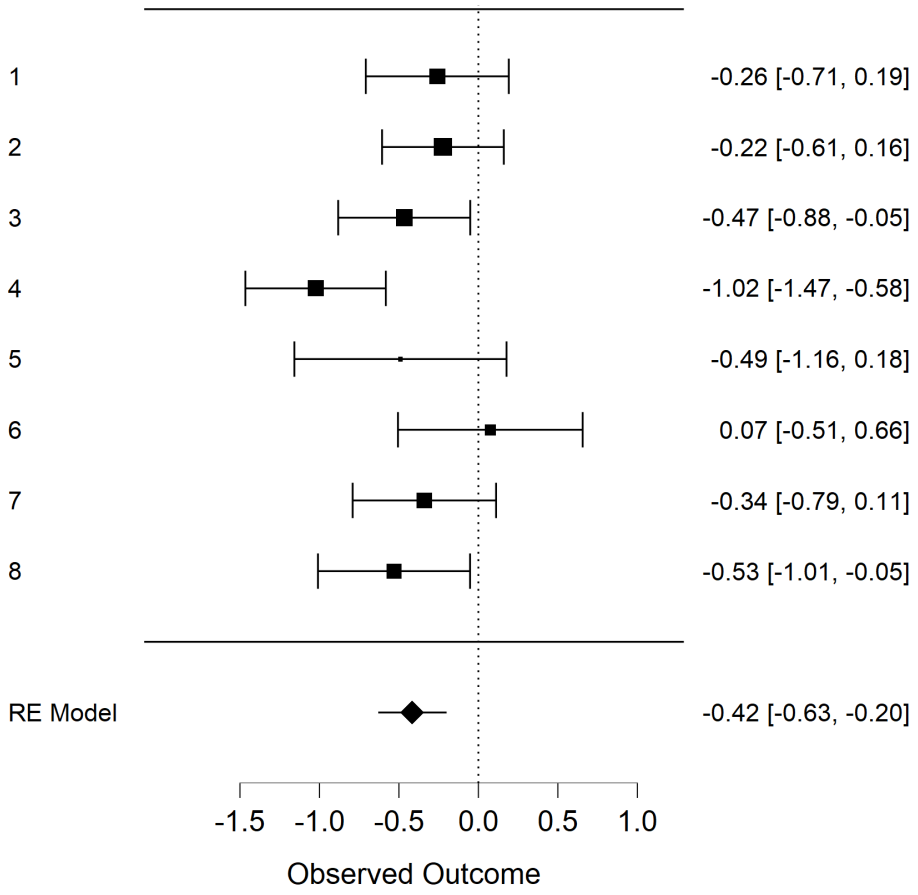

Figure 2. Forest plot

Publication bias, an issue not unique to meta-analysis, is attributable in part to unpublished literature and to the reality that statistically significant studies are more likely to be published than non-significant ones (Borenstein, Hedges, Higgins, & Rothstein, 2009). We used more than one way to examine potential publication bias. The Rosenthal fail-safe *N* was 63 (p <.001), which indicated that 63 articles with an effect size of zero would need to be added to the study in order to change the outcome, $\alpha = 0.05$. It has been proposed that funnel plot asymmetry may suggest publication bias (McIntosh, Sharpe, & Lawrie, 2010), though interpretation of funnel plots is not always straightforward. Generally speaking, funnel plots are like scatterplots for effect sizes of individual studies related to sample size (Card, 2016). Examination of the funnel plot was not optimal by the applicable standard of 95% of points falling within the lines (Card, 2016) but deemed acceptable overall by applicable standards because the one article beyond the lines affected the overall percentage due to the small sample size (see Figure 3).

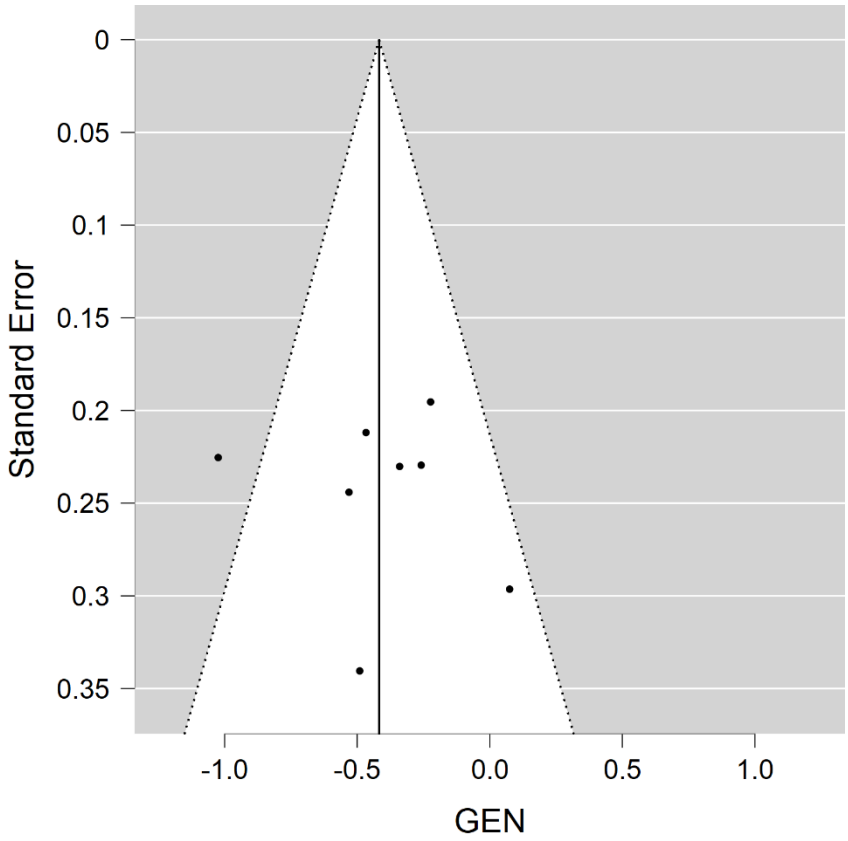

Figure 3. Funnel plot

An adjusted rank correlation test was also used to examine publication bias by testing the correlation between the effect sizes and their precision (Begg & Mazumdar, 1994). The test was not statistically significant (Kendall's $\tau = 0.00$, $p = 1.00$), indicating no evidence of publication bias. Even though test output must be interpreted with caution in small meta-analyses, the adjusted rank correlation test is considered a complement to the funnel plot and bias cannot be ruled out solely on the basis of non-significant result (Begg & Mazumdar, 1994).

Follow-up sensitivity analyses of effect sizes from the studies ($n = 8$) produced similar findings to the original analysis with Times 1 and 2. Averaging of outcome data for Times 2 and 3 for the two articles treated as having dependencies also yielded a medium effect size. Results using only data for Times 1 and 3 were similar and made no difference in outcomes.

5. Discussion

Research using methodologies that permit assessing causal effects in the area of student mental-health interventions such as Randomized Control Trials (RCT) are relatively uncommon. Additionally, meta-analyses with relatively few studies are, on the other hand fairly common, as evidenced by a review of the Cochrane Library (Seide, Röver, & Friede, 2019), which found that half of the meta-analyses there are conducted with only two or three studies. Based on the present meta-analysis of RCT-based studies meeting the inclusionary criteria, we found robust evidence for the efficacy of SMIs in reducing reported stress of college students. The statistically significant overall effect was substantiated by significant decreases in reported stress for seven articles (88%). The overall effect size was consistent with similar meta-analyses despite sign differences due to design variability, especially in terms of instrumentation. Because all of our studies used the PSS-10 (Cohen, 1994; Cohen et al., 1983), a negative effect size meant a decrease in reported stress. The PSS-10 performed with acceptable levels of reliability in all studies.

The current study focused on the effectiveness of various SMIs of which half used SMIs that incorporated the use of some form of technology tool. Batastini, Paprrzycki, Jones, & MacLean (2021) conducted a meta-analysis of 43 RCTs comparing the effectiveness of mental and behavioral health services delivered through videoconference and in-person. The study found evidence that video-conferencing technology is as effective as traditional in-person mental healthcare delivery modes. This is consistent with the results of the present meta-analysis and may help explain the significant positive effects of SMIs in reducing students' reported stress and leaves open the possibility that technological tools may benefit larger numbers of students by making these interventions more convenient and accessible.

When compared to the two meta-analyses that consisted solely of RCTs in Table 1, several contrasts were apparent. The most glaring contrasts were that article selection here was guided by a theoretical framework (Holman et al, 2018) and that only one instrument was used for measurement of self-reported stress. The current meta-analysis was not limited to self-guided SMIs (Amanvermez et al., 2021) or Mindfulness Meditation (Victorson et al, 2015). The number of studies here was consistent with both meta-analyses, if only primary analysis (highly stressed group) is taken into account in the Amanvermez et al. (2021) double meta-analysis. In fact, the current study had a larger sample size in that regard than either Amanvermez et al. (2021) or Victorson et al. (2015), although Amanvermez et al. (2021) had a larger group of studies in the unselected-studies second meta-analysis. This meta-analysis was not limited to highly stressed students (Amanvermez et al., 2021). Consistent with both analyses, this study found SMIs to be effective in the college student population (Amanvermez et al., 2021; Victorson et al, 2015), though comparison fir the highly stressed student group, for which Amanvermez et al. (2021) did not find statistical significance for the three studies included, were not possible. In spite of these differences, the results of the current meta-analysis support the use of SMIs as well as the use of the Perceived Stress Scale and the Holman framework for future studies on this topic.

Duplications of studies found in the search process were likely due to terminology overlap and pointed toward the reality that some categories in the underlying framework represent variations of the same or a similar construct. For example, the question emerged as to whether Yoga is a form of meditation or relaxation or possibly even exercise, though that issue did not confound our study or affect the interpretation of our results. Delineation of mindfulness, mediation, and relaxation in studies included was weak. These phenomena suggested that the framework utilized successfully captured qualifying literature and often did so repeatedly. Some interventions were not found in the literature, which implies minimal application of those interventions for reducing student stress in higher education settings or failure of the search methods to capture those items. No searches, for example, produced qualifying articles based upon *personal and interpersonal skills training* search terminology. Given the stress-related results that Acharya et al. (2018) reported concerning social situations and working with unknown people for some groups of students, this finding was concerning and represents areas ripe for future study.

A major limitation of the present meta-analysis is restricted generalizability due to heterogeneity of the aggregated samples which included students from a variety of countries and cultures. Medical students may differ from other students in stress levels, for instance, as students in Finland may differ from students in New Zealand. We acknowledge this limitation and believe that the meta-analysis still can be of benefit to students, counseling services, and other student mental health professionals, especially in conjunction with other literature connections provided. The fact that only randomized controlled trial were included is a definite and important strength of the current meta-analysis since with such studies causal inference can be deduced with a high level of confidence (Shadish et al., 2001). Thus, the breadth of information provided herein may provide a springboard for improved service delivery to students in need as Silverman and Little (2021) promoted and provide a foundation for the development of empirically-derived best practices standards to help students manage stress.

Restricting inclusionary criteria to the PSS-10 likely caused worthwhile studies to be excluded. We maintain that those studies needed to be excluded in the context of this study because of the decision to design with tight study boundaries. Further, the in-depth look at that instrument offers practitioners the opportunity to explore in one document a variety of uses of the PSS-10 within multiple university settings and with students at different levels of study.

6. Conclusion

Echoing Eubank and Devita (2020) based on their qualitative study on informal recreation as a buffer to undergraduate students' stress and anxiety, we recommend attention to intervention promotion and marketing, intervention access ease, organizational partnerships, and technology integration. Vaccaro et al. (2019) recommended a person-centered approach from what they learned in their qualitative study of coping strategies from the histories of 59 students with different disabilities and at four universities. We recommend the same toward building student resilience for diverse students and go a step further. We recommend the compilation and sharing at the university level (with student permission) of de-identified success narratives for managing stress. This suggestion takes into account Kimball and Ryder's (2014) that honors the lived experiences of our students and bridges theory to practice. They wrote, "An institution can demonstrate the role that history plays in creating institutional memory, how the organization has internalized and learned from its history, and how history informs current practice (Kimball & Ryder, 2014, p. 308). Although they wrote of capturing the knowledge of seasoned professionals, we believe that the theory also applies to capitalizing on the knowledge of students in our research studies and within our institutions. We endorse the use of peer training and leadership in stress reduction efforts, as promoted by Wawrzynski and Lemon (2021). We encourage the sharing of information among stakeholders locally, nationally, and internationally, as stress crosses all student levels and countries. Local students may be aware of resources that could be added to a list of free or low-cost SMIs that might help international students, for example.

We recommend use of the PSS-10 to assess students and in students' assessment of themselves for management of stress levels. Finding out more about the stress levels of men in particular, and how they can or do manage them in college is overdue. As research examining the effectiveness of SMI on student stress levels increases, future research can look at potential moderators to help explain differences in stress level outcomes among student subgroups, such as across gender, race/ethnicity, and country. Additionally, future meta-analyses can search a more diverse set of databases. All in all, our work shows that stress management interventions were effective prior to the COVID-19 pandemic. We believe that our work will serve as a catalyst for further investigations regarding the effects of the pandemic on college students' well-being and mental health and that the work will provide a comparison point.

References

Acharya, L., Jin, L., & Collins, W. (2018). College life is stressful today – Emerging stressors and depressive symptoms in college students. *Journal of American College Health, 66*(7), 655-664. https://doi.org/10.1080/07448481.2018.1451869

Ahmad, F., El Morr, C., Ritvo, P., Othman, N., Moineddin, R., & MVC Team. (2020). An eight-week, web-based mindfulness virtual community intervention for students' mental health: Randomized controlled trial. *JMIR Mental Health, 7*(2), e15520. https://doi:10.2196/15520

Amanvermez, Y., Rahmadiana, M., Karyotaki, E., de Wit, L., Ebert, D. D., Kessler, R. C., & Cuijpers, P. (2021, May 22). Stress management interventions for college students: A systematic review and meta-analysis [Advance online publication]. *Clinical Psychology: Science and Practice*. https://doi.org/10.1111/cpsp.12342

Bailey, T. M. (2009). Effect size calculator converter. Free Software Foundation. Retrieved from http://fsf.org/

Bamber, M. D., & Schneider, J. K. (2016). A narrative synthesis of the research. *Educational Research Review, 18*, 1-32. https://doi.org/10.1016/j.edurev.2015.12.004

Batastini, A. B., Paprzycki, P., Jones, A., & MacLean, N. (2021). Are videoconferenced mental and behavioral health services just as good as in-person? A meta-analysis of a fast-growing practice. *Clinical psychology review, 83*, 101944. https://doi.org/10.1016/j.cpr.2020.101944

Begg, C. B., & Mazumdar, M. (1994). Operating characteristics of a rank correlation test for publication bias. *Biometrics, 50*(4):1088-101. https://doi.org/10.2307/2533446

Benjet, C. (2020). Stress management interventions for college students in the context of the COVID-19 pandemic [Online version]. *Clinical Psychology Science and Practice*, e12353. https://doi.org/10.1111/cpsp.12353

Berman, A., Bevan, J. L., & Sparks, L. (2020). Readiness to visit university counseling centers: Social support, stigma, and communication efficacy. *Journal of Student Affairs Research and Practice, 57*(3), 282-295. https://doi.org/10.1080/19496591.2019.1648272

Bickman, L., & Rog, D. J. (2009). T*he SAGE handbook of applied social research methods (2nd ed.)*. Thousand Oaks, CA: SAGE Publications, Inc. https://doi.org/10.4135/9781483348858

Borenstein, M., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. R. (2009). *Introduction to meta-analysis*. United Kingdom: John Wiley & Sons. https://doi.org/10.1002/9780470743386

Card, N. A. (2016). *Applied meta-analysis for social science research.* New York, NY: The Guilford Press.

Chambel, M. J., & Curral, L. (2005). Stress in academic life: Work characteristics as predictors of student well-being and performance. *Applied Psychology: An International Review, 54*(1), 135-147. https://doi.org/10.1111/j.1464-0597.2005.00200.x

Clarke, A., Kuosmanen, T., & Barry, M. (2015). A systematic review of online youth mental health promotion and prevention interventions. *Journal of Youth and Adolescence, 44*(1), 90-113. https://doi.org/10.1007/s10964-014-0165-0

Cohen (1988). Statistical power analysis for the behavioral sciences (2nd ed.) Hillsdale, NJ: Lawrence Erlbaum

Cohen, S. & Janicki-Deverts, D. (2012). Who's stressed? Distributions of psychological stress in the United States in probability samples from 1983, 2006, and 2009. *Journal of Applied Psychology, 42*(6), 1320-1334. https://doi.org/10.1111/j.1559-1816.2012.00900.x

Cohen, S. (1994). Perceived Stress Scale. Mind Garden. Retrieved from http://www.mindgarden.com/documents/PerceivedStressScale.pdf

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior, 24*, 386-396. https://doi.org/10.2307/2136404

Cronbach, L., & Shapiro, K. (1982). *Designing evaluations of educational and social programs* (1st ed.). Ssan Francisco, CA: Jossey-Bass.

Eubank, J. M., & DeVita, J. M. (2020). Informal recreation's relationship with college student stress and anxiety. *Journal of Student Affairs Research and Practice* [ahead-of-print], 1-14. https://doi.org/10.1080/19496591.2020.1822854

Farrer, L., Gulliver, A., Chan, J., Batterham, P. J, Reynolds, J., Calear, A., … & Griffiths, K. (2013). Technology-based interventions for mental health in tertiary students: Systematic review. *Journal of Medical Internet Research, 15*(5), e101. https://doi.org/10.2196/jmir.2639

Flett, J. A. M., Lie, C., Riordan, B. C., Thompson, L. M., Conner, T. S., & Hayne H. (2017). Sharpen your pencils: Preliminary evidence that adult coloring reduces depressive symptoms and anxiety. *Creativity Research Journal, 29*(4), 409-416. https://doi.org/10.1080/10400419.2017.1376505

Gallagher, K. M., & Stocker, S. L. (2018). A guide to incorporating social-emotional learning in the college classroom: Busting anxiety, boosting ability. *Society for the Teaching of Psychology: Division 2 of the American Psychological Association*. Gallagher and Stocker SEL Manual - FULL.pdf (teachpsych.org)

Greeson, J. M., Juberg, M. K., Maytan, M., James, K., & Rogers, H. (2014). A randomized controlled trial of Koru: A mindfulness program for college students and other emerging adults. *Journal of American College Health*, *62*(4), 222-233. https://doi.org/10.1080/07448481.2014.891595

Haddaway, N. (2016). The importance of meta-analysis and systematic review: How research legacy can be maximized through adequate reporting [blog post]. *Campbell Collaboration*. Retrieved from https://campbellcollaboration.org/blog/the-importance-of-meta-analysis-and-systematic-review-how-research-legacy-can-be-maximized-through-adequate-reporting.html

Hamaideh, S. H. (2011). Stressors and reactions to stressors among university students. *International Journal of Social Psychiatry, 57*(1), 69-80. https://doi.org/10.1177/0020764009348442

Holman, D., Johnson, S., & O'Connor, E. (2018). Stress management interventions: Improving subjective psychological well-being in the workplace. *Handbook of well-being* (E. Diener, S. Oishi, & L. Tay, Eds.). Salt Lake City, UT: DEF Publishers. Retrieved from https://www.nobascholar.com/books/1/download.pdf

Huang, J., Nigatu, Y. T., Smail-Crevier, R., Zhang, X., & Wang, J. (2018). Interventions for common mental health problems among university and college students: A systematic review and meta-analysis of randomized controlled trials. *Journal of Psychiatric Research*, *107*, 1-20. https://doi.org/10.1016/j.jpsychires.2018.09.018

Huberty, J., Green, J., Glissmann, C., Larkey, L., Puzia, M., & Lee, C. (2019). Efficacy of the mindfulness meditation mobile app "calm" to reduce stress among college students: Randomized controlled trial. *Journal of Medical Internet Research Mhealth and Uhealth*, *21*(6). https://doi.org/10.2196/14273

Jones, M. (2013). Issues in doctoral studies – forty years of journal discussion: Where have we been and where are we going? *International Journal of Doctoral Studies, 8*, 83-104. https://doi.org/10.28945/1859

Kimball, E. W., & Ryder, A. J. (2014). Using history to promote reflection: A model for reframing student affairs practice. *Journal of Student Affairs Research and Practice, 51*(3), 298-310. https://doi.org/10.1515/jsarp-2014-0030

Ko, C. M., Grace, F., Chavez, G. N., Grimley, S. J., Dalrymple, E. R., & Olson, L. E. (2018). Effect of Seminar on Compassion on student self-compassion, mindfulness and well-being: A randomized controlled trial. *Journal of American College Health*, *66*(7), 537-545. https://doi.org/10.1080/07448481.2018.1431913

McIntosh, A. M., Sharpe, M. & Lawrie, S. M. (2010). Research methods, statistics and evidence-based practice. *Companion to Psychiatric Studies* (8th ed.). [ebook]. In E.C. Johnstone, D.C. Owens, S.M. Lawrie, A.M. McIntosh, & M. Sharpe., Eds. Elsevier Ltd. https://doi.org/10.1016/B978-0-7020-3137-3.00009-7

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G., The PRISMA Group (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Journal of Clinical Epidemiology, 62*(10), 1006-1012. https://doi.org/10.1016/j.jclinepi.2009.06.005

Moses, J., Bradley, G. L., & O'Callaghan, F. V. (2016). When college students look after themselves: Self-Care practices and well-being. *Journal of Student Affairs Research and Practice, 53*(3), 346-359. https://doi.org/10.1080/19496591.2016.1157488

Mozahem, N., & Ghanem, C. (2018). The university is an organization: Teaching organizational behavior by relying on students' university experience. *Management Teaching Review, 3*(4), 271-286.

https://doi.org/10.1177/2379298118760220

Murano, D., Sawyer, J. E., & Lipnevich, A. A. (2020). A meta-analytic review of preschool social and emotional learning interventions. *Review of Educational Research, 90*(2), 227-263. https://doi.org/10.3102/0034654320914743

Nielsen, M., Ørnbøl, E., Vestergaard, M., Bech, P., Larsen, F., Lasgaard, M., & Christensen, K. (2016). The construct validity of the Perceived Stress Scale. *Journal of Psychosomatic Research, 84*, 22-30. https://doi.org/10.1016/j.jpsychores.2016.03.009

NIST. (2018). Hedges *g*. *Statistical Engineering Division: Dataplot*. Retrieved from https://www.itl.nist.gov/div898/software/dataplot/index.htm

Oswalt, S., & Riddock, C. (2007). What to do about being overwhelmed: Graduate students, stress and university Services. *College Student Affairs Journal, 27*(1), 24-44.

Papp, M. E., Nygren-Bonnier, M., Gullstrand, L., Wändell, P. E., & Lindfors, P. (2019). A randomized controlled pilot study of the effects of 6-week high intensity hatha yoga protocol on health-related outcomes among students. *Journal of Bodywork and Movement Therapies*, *23*(4), 766-772. https://doi.org/10.1016/j.jbmt.2019.05.013

Phang, C. K., Mukhtar, F., Ibrahim, N., Keng, S. L., & Sidik, S. M. (2015). Effects of a brief mindfulness-based intervention program for stress management among medical students: the Mindful-Gym randomized controlled study. *Advances in Health Sciences Education*, *20*(5), 1115-1134. https://doi.org/10.1007/s10459-015-9591-3

Phelps-Ward, R. (2021). Pictures of health: Examining well-being and resistance of graduate students of color. *Journal of Student Affairs Research and Practice* [ahead-of-print], 1-16. https://doi.org/10.1080/19496591.2021.1943416

Räsänen, P., Lappalainen, P., Muotka, J., Tolvanen, A., & Lappalainen, R. (2016). An online guided ACT intervention for enhancing the psychological wellbeing of university students: A randomized controlled clinical trial. *Behaviour Research and Therapy*, *78*, 30-42. https://doi.org/10.1016/j.brat.2016.01.001

Riva, J. J., Malik, K. M., Burnie, S. J., Endicott, A.R., & Busse, J. W. (2012). What is your research question? An introduction to the PICOT format for clinicians. *Journal of the Canadian Chiropractic Association. 56*(3), 167-171.

Robotham, D. (2008). Stress among higher education students: Towards a research agenda. *The International Journal of Higher Education and Educational Planning, 56*(6)**,** 735-746 (2008). https://doi.org/10.1007/s10734-008-9137-1

Scherrer, V., & Preckel, F. (2019). Development of motivational variables and self-esteem during the school career: A meta-analysis of longitudinal studies. *Review of Educational Research, 89*(2), 2111-258. https://doi.org/10.3102/0034654318819127

Schmidt, M., & Hansson, E. (2018). Review of doctoral students' well-being: A literature review. *International Journal of Qualitative Studies on Health and Well-being, 13*(1). https://doi.org/10.1080/17482631.2018.1508171

Sedgwick P. (2015). How to read a forest plot in a meta-analysis. *BMJ: British Medical Journal*, *351*, h4028. https://doi.org/10.1136/bmj.h4028

Sedlmeier, P., Eberth, J. Schqarz, M., Zimmerman, D., Haarig, F., Jaeger, S., & Kunze, S. (2012). The psychological effects of meditation: A meta-analysis. *Psychological Bulletin: American Psychological Association, 138*(6), 1139-1171. https://doi.org/10.1037/a0028168

Seide, S. E., Röver, C. & Friede, T. (2019). Likelihood-based random-effects meta-analysis with few studies: empirical and simulation studies. *BMC Med Res Methodology 19*(16). https://doi.org/10.1186/s12874-018-0618-3

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2001). *Experimental and quasi-experimental designs for generalized causal inference*. Boston, MA: Houghton-Mifflin.

Silverman, S., & Little, S. (2021). Journal of Student Affairs Research and Practice Special Issue - Health and Wellbeing. *Journal of Student Affairs Research and Practice, 58*(2), 119-120. https://doi.org/10.1080/19496591.2020.1859929

Taylor, J. M. (2015). Psychometric analysis of the ten-item Perceived Stress Scale. *Psychological assessment, 27*(1), 90-101. https://doi.org/10.1037/a0038100

University of Amsterdam. (n. d.) JASP: A fresh way to do statistics. Retrieved from jasp-stats.org

Vaccaro, A., Moore, A., Kimball, E., Troiano, P. F., & Newman, B. M. (2019). "Not Gonna Hold Me Back": Coping and resilience in students with disabilities. *Journal of Student Affairs Research and Practice, 56*(2), 181-193. https://doi.org/10.1080/19496591.2018.1506793

Victorson, D., Kentor, M., Maletich, C., Lawton, R., Kaufman, V., Borrero, M., … & Berkowitz, C. (2015). Mindfulness meditation to promote wellness and manage chronic disease: A systematic review and meta-analysis of mindfulness-based randomized controlled trials relevant to lifestyle medicine. *American Journal of Lifestyle Medicine, 9*(3), 185-211. https://doi.org/10.1177/1559827614537789

Wawrzynski, M. R., & Lemon, J. D. (2021). Trends in health and wellness peer educator training: A five-year analysis. *Journal of Student Affairs Research and Practice, 58*(2), 135-147. https://doi.org/10.1080/19496591.2020.1853554

WHO. (2018). *Mental health: Strengthening our response*. Retrieved from https://www.who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response

Wilson, A. C., Mackintosh, K., Power, K., & Chan, S. W. Y. (2019). Effectiveness of self-compassion related therapies: A systematic review and meta-analysis. *Mindfulness, 10*, 979-995. https://doi.org/10.1007/s12671-018-1037-6