



Comparing the Effectiveness of Virtual and In-Person Delivery of Mindfulness-Based Skills Within Healthcare Curriculums

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Abstract

Purpose To promote well-being, healthcare education programs have incorporated mindfulness-based skills and principles into existing curriculums. Pandemic-related restrictions have compelled programs to deliver content virtually. Study objectives were to determine (1) whether teaching mindfulness-based skills within physician assistant (PA) programs can promote well-being and (2) whether delivery type (virtual vs. in-person) can impact the effectiveness.

Methods During this 2-year study, a brief mindfulness-based curriculum was delivered to incoming first-year students at six PA programs, while students at two programs served as controls. The curriculum was delivered in-person in year one and virtually in year two. Validated pre- and post-test survey items assessed mindfulness (decentering ability, present moment attention and awareness, and psychological flexibility) and well-being (perceived stress and life satisfaction).

Results As expected, coping abilities and well-being were adversely impacted by educational demands. The mindfulness-based curriculum intervention was effective in increasing mindfulness and life satisfaction, while decreasing perceived stress when delivered in-person. Virtual curricular delivery was effective in decreasing perceived stress but not improving life satisfaction. Over half of the participants receiving the curriculum reported positive changes on mindfulness measures with approximately 14–38% reporting a change of greater than one standard deviation. Changes on mindfulness measures explained 30–38% of the reported changes in perceived stress and 22–26% of the changes in life satisfaction. Therefore, the mindfulness curriculum demonstrated statistically significant improvements in measures of mindfulness and mitigated declines in life satisfaction and perceived stress.

Conclusion Mindfulness-based skills effectively taught in-person or virtually within PA programs successfully promote well-being.

Keywords Stress · Curriculum · Mindfulness · Virtual delivery · COVID-19 · Professional resilience

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Introduction

Increasing rates of burnout among medical providers have devastating consequences for both clinicians and patients [1–3]. Mindfulness-based skills may foster the development of professional resilience [4], benefiting the clinician, the patient, and the healthcare community. Abilities such as mindful awareness, decentering, and psychological flexibility have been associated with general well-being in patient and nonpatient populations [5–14]. The development of these skills may also contribute to increased professionalism by cultivating focus and improving communication [7, 15].

Mindfulness practices have been incorporated into many areas of patient care and within medical residency training programs predicated on broadly accepted, evidence-based health benefits associated with these practices and acquired skills [16–18]. The traditional approach to incorporate mindfulness training, primarily delivered during residency training, has been to have professionals participate in an 8-week mindfulness-based stress reduction (MBSR) group [16]. Recently, however, healthcare education programs have developed and investigated the benefits and effectiveness of incorporating mindfulness-based content into existing academic curricula within the classroom portion of their training. There are two main differences between the two programs. In the first approach, the trainee receives the education as a member in an actual MBSR group, which is an 8-week, semi-structured, experiential learning group opportunity. It is given while trainees are on residency rotations after completing academic coursework. In the more recently investigated interventions, in contrast, evidence-based interventions and activities are incorporated into academic coursework at time of matriculation within the academic institution. The main aim of curriculum-based intervention is to instill relevant attitudes and skills associated with mindfulness earlier in training. In doing so, these skills and attitudes become essential components of the healthcare profession and serve as tools for students to deal more effectively with both academic and clinical experiences during PA school.

Brief exposure to mindfulness-based training may be feasible in a healthcare curriculum and allow for introduction of concepts and skills early in education and student training [19–21]. The introduction of a curriculum that incorporates mindfulness early in academic coursework can increase levels of mindfulness, decentering, and psychological flexibility, which may, in turn, positively impact levels of perceived stress and life satisfaction [22]. Additional benefits of such a curriculum include the potential for improved academic success and development of skills that serve as a foundation for professional resilience [7, 23].

Escalated stress is common among students pursuing higher education. The fractured well-being that often accompanies this escalated stress may have profound effects on the learning process and professional development. COVID-19 and the global response to the pandemic has introduced additional stressors and challenges for personal self-care and education and training. Recent studies have found stress and anxiety among students increased during the pandemic [24, 25]. Son et al. [26], for example, found that over 70% of students during the COVID-19 pandemic reported increases in stress and anxiety, while almost 90% reported difficulty concentrating.

The COVID-19 pandemic has, more broadly, engendered an environment replete with constant uncertainties, overburdened medical teams, and isolation. This context has contributed to the risk for a “parallel pandemic” related to fear, anxiety, worry, and the declining well-being of those providing patient care [27]. Many educational institutions, from primary to higher education, are recognizing the benefit of prevention strategies to promote and sustain well-being and have developed self-care instruction, founded on mindfulness-based skills and principles, to effectively incorporate into existing curricula [7, 8, 22, 28].

Strategic burnout prevention for professional student populations, in particular, is increasingly viewed as an essential component of professional training and education [9, 20, 26]. Recent changes to accreditation guidelines and standards for several healthcare education programs reflect an expectation for programs to incorporate essential skills in training that foster general well-being of students and prepare them for a challenging professional environment post-graduation [29, 30]. Some institutions are electing to require well-being content within programs of study and core courses, while other universities are choosing to offer instruction as an elective course [4, 7, 22]. While there are a variety of pedagogical approaches to well-being content, only a few education programs have attempted to incorporate mindfulness-based instruction into existing curriculums [7, 8, 22].

Education Delivery During COVID-19 Pandemic

Physician assistant (PA) education is based on an accelerated model of medical training typically consisting of 27 months of instruction [36]. Like other types of health profession education, it can be academically, physically, and mentally challenging. In a study of PA students in Virginia, for example, nearly 80% reported high levels of exhaustion and 78% expressed interest in participating in wellness activities [37]. Prior to the COVID-19 pandemic, PA programs delivered an average of 6% of their curricula remotely; by May of 2020, programs

were delivering an average of 97% of their curricula using virtual formats [38]. With the pandemic, the need to be able to deliver some curricular content through virtual platforms has raised several additional questions about the impact of different delivery methods on learning outcomes. No study to date has examined what might be gained or lost through a virtual delivery versus in-person delivery of a mindfulness-based curriculum intervention embedded within a course.

Current Study

This study, which involves assessing the effectiveness of a mindfulness-based curriculum delivered to first-year PA students, addresses two central questions related to the training and education of healthcare providers. First, can mindfulness-based and related strategies designed to improve resilience against perceived stress and poor life satisfaction be effectively incorporated within a course curriculum? Second, can such a mindfulness-based curriculum be modified and delivered effectively using a virtual delivery format? The current study examined levels of mindfulness and related capacities, perceived stress, and life satisfaction of newly matriculating students within eight PA programs located across the country. The mindfulness-based intervention, designed by the current authors, was developed and validated in a previous study [22]. The curriculum includes a lecture series and associated exercises for skill development. Through lecture and experiential exercises, learners explored topics extremely relevant to medical practice and professional resilience, such as self-compassion, mindful listening, anger response, and present moment awareness [22].

Method

Students comprised either the curriculum intervention group (receiving the mindfulness-based skills within the curriculum) or the control group (receiving the curriculum as usual with no additions or modifications). The study took place over 2 years. Students who participated in year one (2019) received the curriculum intervention through an in-person delivery method prior to the pandemic (COVID-19). Students who participated in year two (2020) received the curriculum intervention through a virtual delivery format and during the pandemic (COVID-19). This provided an opportunity to compare the effectiveness of the curriculum intervention against controls and between different delivery formats (in-person and virtual formats). The curriculum intervention used in the current study was found to be effective in increasing levels of mindfulness and related skills [22] within a traditional class structure/format.

Participants

Seven hundred fifty-four students from eight PA programs across the USA were invited to participate in a voluntary study examining the influence of a mindfulness-based wellness curriculum on aspects of their well-being. The intervention group consisted of students from six programs who received a five-session wellness curriculum delivered in the first 10 weeks of their PA programs. Students from two PA programs who did not receive the mindfulness-based curriculum served as a control group. In each year of the study, 377 first-year PA students (totaling 754 students over 2 years) were sent links to participate in the study and complete a survey to assess a series of pre- and post-test measures, which are described below. Fifty-one percent (384/754) of students sent invitations to participate completed both the pre-test and post-test measures. Participants who did not complete both the pre- and post-tests were not included in the study. All study participants gave informed consent prior to completing surveys. Approximately 22.1% of survey participants from the 2 years were male, and the mean age across both years was 26.0 years.

Procedure

This study received IRB approval at the primary institution with reliance agreements at all of the participating institutions (AZ #1011). Surveys were conducted at two time intervals. The initial pre-test survey was distributed to all students at the onset of PA training, and the post-test survey was sent to all students 10 weeks later, whether they received the mindfulness-based curriculum or not. The survey links included descriptions of the voluntary and confidential nature of the study, and all participants consented prior to survey completion. Surveys were administered using REDCap[®] software. Data collection for year one (in-person delivery) was conducted between May 2019 and October 2019, while year two (virtual delivery) data collection took place between May 2020 and October 2020.

Intervention

The mindfulness-based curriculum, delivered to the intervention group, included a series of five interactive lectures and associated exercises for skill development. The interactive lectures focused on self-care practices of mindfulness and decentering. There are several aspects of mindfulness found to promote well-being [6, 11]. The mechanism by which a mindful approach to medicine is beneficial is through developing an awareness of the present moment without allowing maladaptive cognitions to interfere with decision-making. Decentering, a skill-based component of mindfulness, focuses on the objective observation of experiences and encourages space between stimulus and

response [4, 6, 10]. This may be especially helpful for trainees and providers prone to self-criticism to recognize that not all thoughts represent truth. Decentering has been found to decrease rumination and anxiety [10]. Psychological flexibility is also related to mindfulness [41, 42] and allows the clinician to shift attention during the commonly encountered rapid changes in the medical field, and be present with whatever arises.

The didactic series was developed out of a program initiative to address potential burnout among students starting in a healthcare program and was eventually formally assessed empirically [22]. The curriculum was designed to highlight the importance of emotional health and teach future healthcare providers about the fundamental importance of self-care and its relation to providing the highest quality of care to others. Additional topics covered included self-compassion, the anger response, mindful listening, and present moment awareness, all relevant in daily patient care. In all programs, whether delivered in-person or virtually, the curriculum included experiential sessions of mindful breathing practice, brief videos overviewing the incorporation of mindfulness into medical practice, the concept of neuroplasticity, and many of the programs included reflective writing assignments [22]. Brief daily home practice of mindful breathing was also encouraged.

Measures

Participants were administered a demographic questionnaire as well as three validated mindfulness measures and two validated well-being measures, all commonly used in research and practice. The demographic survey assessed age, gender, and current stress management practices. Respondents were also asked about awareness of mindfulness-based practices and asked to quantify previous (within the last year) and current participation in mindfulness-based activities. Three aspects of mindfulness were examined including decentering, present moment awareness, and psychological flexibility. Well-being measures addressed life satisfaction and perceived stress.

Mindfulness-Based and Related Measures

The previously validated decentering subscale of the Experiences Questionnaire (EQ-D) was utilized to measure the ability to decenter, or to separate oneself from one's thoughts and feelings as a means of responding rather than reacting to the present moment [39]. A sample item from the 11-item subscale is "I remind myself that thoughts aren't facts." Response anchors include never, rarely, sometimes,

often, and all the time (5-point Likert scale; 1 = never to 5 = always) and higher scores indicate higher levels of decentering ability [39].

The 15-item Mindful Attention Awareness Scale (MAAS) was utilized to measure present moment attention and awareness, the second aspect of mindfulness examined in this study. Validity of the MAAS has been previously established [40]. A sample item is "I find it difficult to stay focused on what is happening in the present." Response options include almost always, very frequently, somewhat frequently, somewhat infrequently, very infrequently, and almost never (6-point Likert scale; 1 = almost always to 6 = almost never). The score is determined by computing an average of the 15 items and higher scores indicate higher levels of present moment attention and awareness [40].

Psychological flexibility describes an individual's ability to accept current circumstances and adapt behavior so as to more effectively respond to the present moment [41]. The seven-item Acceptance and Action (AAQ-2) scale was used to measure psychological flexibility and has been validated against similar constructs in other studies [42]. A sample item is, "I worry about not being able to control my worries and feelings" and response options include never true, very seldom true, seldom true, sometimes true, frequently true, almost always true, and always true (7-point Likert scale; 1 = never true to 7 = always true). The scale is a reverse indication of the domain, as lower total scores suggest higher levels of psychological flexibility [42].

Well-Being Measures

The five-item Satisfaction with Life Scale (SWLS), which has demonstrated strong construct and criterion validity in previous studies [43], was utilized to assess overall life satisfaction. A sample item is "the conditions of my life are excellent" and response options include strongly agree, agree, slightly agree, neither agree nor disagree, slightly disagree, disagree, and strongly disagree (7-point Likert scale; 1 = strongly disagree to 7 = strongly agree). Higher satisfaction with life is suggested by higher total scores on the SWLS [43].

Levels of respondent stress were quantified by the 14-item Perceived Stress Scale (PSS). A sample item is, "In the last month, how often have you dealt successfully with irritating life hassles?" and the response options are never, almost never, sometimes, fairly often, and very often (5-point Likert scale; 0 = never to 4 = very often). The PSS has achieved satisfactory concurrent and predictive validity in previous studies. Lower PSS scores are associated with lower perceived stress [44].

Data Analysis

Changes in mindfulness and well-being measures were compared by group (control versus mindfulness-based curriculum) and by year (in-person versus virtual delivery) through two-sample or paired *t*-tests, as appropriate. Effect sizes (ESs) were calculated using Cohen’s *d* or Hedge’s *g*, depending on sample size of the cells comprising the groups of comparison. Correlations among mindfulness and well-being measures were analyzed through the Pearson correlation coefficient. Individual changes in level of mindfulness by participant were examined by calculating the percentage of participants who changed in the desired direction on measures, including the percentage showing a greater than 1 standard deviation change. A multivariate linear regression analysis was performed to determine whether changes in level of mindfulness explained changes in perceived stress and life satisfaction, while controlling for age, gender, and prior participation in mindfulness. To examine the impact of COVID-19 on perceived stress and life satisfaction, changes for participants in the control groups were examined for each condition.

Results

Descriptive and Preliminary Analysis

In year one (in-person delivery), 189 of the 377 possible respondents completed pre-test and post-test surveys for a response rate of 50.1%. In year two (virtual delivery), 195 of the 377 possible respondents completed pre-test and post-test surveys for a response rate of 51.7%.

Collectively, 384 out of 754 possible respondents completed both pre-test and post-test measures for a total response rate of 50.9%.

Approximately 22.1% of survey participants from year one and year two were male, and the mean age across both years was 26.0 years (see Table 1). By comparison, national data on PA student demographics collected in 2019 reveal that 25% of students were male, and the mean age was 25.6 years [45]. No program represented more than 33% of participants in year one (in-person delivery) or more than 34% in year two (virtual delivery).

Table 1 presents demographic characteristics of students who completed both pre- and post-test measures during each year of the study. No meaningful differences in age, gender, or awareness of mindfulness practices were found between years. The percentage of participants who reported participation in mindfulness practice during the past 12 months prior to the study was slightly greater (17.3% in year two (virtual delivery) but not statistically significant (52% vs. 61%, *p* = 0.0691). The number of individuals reporting mindfulness practice at least once a week was meaningfully greater (108.3% in year two (virtual delivery) (12% vs. 25%, *p* = 0.0018).

In year two (virtual delivery), males reported higher levels of psychological flexibility (AAQ-2), *t*(67) = -2.10, *p* = 0.0399, and less perceived stress (PSS), *t*(70) = -3.23, *p* = 0.0019, than females. Decentering ability (EQ-D) approached significance, *t*(55) = 1.99, *p* = 0.0520, indicating that males trended toward higher levels of decentering ability as compared to their female counterparts in year two. No differences between males and females were found on any pre-test study measures in year one.

Table 1 Demographic information for in-person (year one) and virtual delivery (year two) of curricula

Variable	Total (<i>n</i> = 384)	In-person delivery (<i>n</i> = 189)	Virtual delivery (<i>n</i> = 195)	<i>p</i> -value
Male gender	85/384 (22.1%)	45/189 (23.8%)	40/195 (20.5%)	0.5125
Age (mean [range])	26.0 [21–50]	26.1 [21–50]	25.9 [21–49]	0.1235
Aware of mindfulness practice or decentering	255/383 (66.6%)	122/189 (64.6%)	133/194 (68.6%)	0.4699
Participate in mindfulness practice or decentering	216/382 (56.5%)	97/188 (51.6%)	119/194 (61.3%)	0.0691
Frequency of practice				
Never	118/380 (31.3%)	64/187 (34.2%)	54/193 (28.0%)	0.2284
Less than once a week	190/380 (50%)	100/187 (53.5%)	90/193 (46.6%)	0.1822
At least once a week	72/380 (18.9%)	23/187 (12.2%)	49/193 (25.4%)	0.0018

p-values come from a chi-square test or a Mann–Whitney *U* test

Relationship Among Study Variables

For both year one (in-person delivery) and year two (virtual delivery), mindfulness-related measures (MAAS, EQ-D, AAQ-2) were significantly correlated with well-being measures (PSS, SWLS) on pre-test, with correlations ranging between 0.23 and 0.71 (see Table 2). In both years, all mindfulness-related measures were also significantly correlated with each other, with correlations ranging between 0.39 and 0.67. In year one (non-COVID-19), age was only correlated with perceived stress; those who were older reported lower levels of perceived stress ($r = -0.15$, $p = 0.0400$). In year two (COVID-19), those who were older reported higher decentering ability ($r = 0.15$, $p = 0.0447$) and present moment awareness ($r = 0.20$, $p = 0.0046$) than younger counterparts (see Table 2).

Mindfulness Curriculum Effectiveness Over Controls

The in-person mindfulness curriculum was effective in increasing levels of mindfulness and related abilities, while decreasing perceived stress and improving life satisfaction, when compared to the control group (see Table 3). These findings were consistent when the mindfulness curriculum was delivered through a virtual format except for psychological flexibility and life satisfaction. The virtually delivered mindfulness curriculum was not effective in increasing psychological flexibility, $t(108) = -0.04$, $p = 0.97$, $ES = 0.006$, or improving life satisfaction, $t(160) = 1.71$, $p = 0.0895$, $ES = 0.24$, over controls.

Year 1: In-Person Curriculum Delivery During Non-COVID-19 Year

At the end of the first 10 weeks of beginning their PA program, from pre-test to post-test, participants not receiving the mindfulness curriculum intervention reported decreases in present moment awareness, $t(57) = 3.52$, $p = 0.0008$, $ES = 0.47$, and psychological flexibility, $t(61) = -3.24$, $p = 0.0019$, $ES = 0.40$. The participants also reported an increase in levels of perceived stress, $t(61) = -6.27$, $p < 0.0001$, $ES = 0.79$, and decreases in life satisfaction, $t(61) = 3.15$, $p = 0.0025$, $ES = 0.43$. These results confirm expectations that study and training demands accompany graduate training and may impact coping resources and well-being of PA students (see Table 4).

In comparison, at the end of the 10-week period, participants in the mindfulness-based curriculum group reported increases in their level of mindfulness on two of the three measures (EQ-D and MAAS) and no increase in perceived stress or decrease in life satisfaction (see Table 4). Levels of present moment awareness, $t(114) = -4.14$, $p < 0.0001$, $ES = 0.38$, and decentering ability, $t(118) = -4.39$, $p < 0.0001$, $d = 0.41$, both increased after receiving the mindfulness curriculum. Levels of perceived stress, $t(117) = -0.72$, $p = 0.4735$, $ES = 0.09$, and life satisfaction, $t(120) = -0.62$, $p = 0.5332$, $ES = 0.08$, remained stable when compared to the control group participants. These results support the effectiveness of the mindfulness curriculum intervention to increase levels of mindfulness on at least two measures and mitigate the negative impact on life satisfaction and perceived stress of students when starting their PA education and training.

Table 2 Correlations among pre-test mindfulness (EQ-D, MAAS, AAQ-2), well-being (SWLS, PSS), and measures in year one (in-person delivery) and year two (virtual delivery)

	EQ-D	MAAS	AAQ-2	SWLS	PSS	Age
Year one (in-person delivery)						
EQ-D	1.00	0.48 ($p < .0001$)	-0.60 ($p < .0001$)	0.46 ($p < .0001$)	-0.57 ($p < .0001$)	0.04 ($p = 0.61$)
MAAS		1.00	-0.39 ($p < .0001$)	0.23 ($p = 0.0023$)	-0.37 ($p < .0001$)	0.06 ($p = 0.40$)
AAQ-2			1.00	-0.63 ($p < .0001$)	0.71 ($p < .0001$)	-0.11 ($p = 0.13$)
SWLS				1.00	-0.61 ($p < .0001$)	-0.08 ($p = 0.29$)
PSS					1.00	-0.15 ($p = 0.04$)
Age						1.00
Year two (virtual delivery)						
EQ-D	1.00	0.52 ($p < .0001$)	-0.67 ($p < .0001$)	0.48 ($p < .0001$)	-0.64 ($p < .0001$)	0.15 ($p = 0.045$)
MAAS		1.00	-0.44 ($p < .0001$)	0.27 ($p = 0.0009$)	-0.41 ($p < .0001$)	0.20 ($p = 0.004$)
AAQ-2			1.00	-0.58 ($p < .0001$)	0.67 ($p < .0001$)	-0.11 ($p = 0.142$)
SWLS				1.00	-0.52 ($p < .0001$)	-0.08 ($p = 0.293$)
PSS					1.00	-0.12 ($p = 0.087$)
Age						1.00

EQ-D Experiences Questionnaire Decentering Subscale (Decentering), MAAS Mindful Attention Awareness Scale (present moment attention and awareness), AAQ-2 Acceptance and Action Questionnaire (psychological flexibility), SWLS Satisfaction with Life Scale, PSS Perceived Stress Scale

Individual Changes in Mindfulness

Depending on the measure, 48–71% of participants who completed the mindfulness curriculum reported increases in level of mindfulness (see Table 5). Of those reporting increases, 13–22%, depending on the measure, reported increases greater than one standard deviation (see Table 5). Fifty-four percent of participants who received the mindfulness curriculum reported increases in life satisfaction with 10% of participants reporting an increase of greater than one standard deviation. Forty-one percent of participants who received the mindfulness curriculum also reported a decrease in perceived stress with 13% of participants reporting a decrease of greater than one standard deviation.

Changes on mindfulness-related measures, collectively, explained 37.67% of changes in perceived stress, $R^2 = 37.67$, $F(6, 96) = 11.28$, $p < 0.0001$. Present moment awareness (MAAS), $B = -3.611$, $\beta = -0.26$, $t = -2.74$, $p = 0.0073$, and psychological flexibility (AAQ-2), $B = 0.448$, $\beta = 0.35$, $t = 3.45$, $p = 0.0008$, accounted for the strength of the model, while decentering ability (EQ-D) was not significant, $B = -0.163$, $\beta = -0.11$, $t = -1.07$, $p = 0.2859$. Changes on mindfulness-related measures, collectively, explained 26.11% of the variance in life satisfaction, $R^2 = 26.11$, $F(6, 99) = 7.184$, $p < 0.0001$, with psychological flexibility (AAQ-2), $B = -0.184$, $\beta = -0.28$, $t = -2.55$, $p = 0.0122$, and age, $B = -0.201$, $\beta = 0.22$, $t = -2.56$, $p = 0.0121$, each contributing to the strength of the model for life satisfaction (see Table 6).

Year 2: Virtual Delivery During COVID-19 Year

Control group participants in year two (virtual delivery) did not report changes on measures of mindfulness at the end of their first 10 weeks in PA school (see Table 4). Participants in the mindfulness curriculum intervention (virtual delivery), however, reported increases on two mindfulness-related

measures at the end of 10 weeks, present moment awareness (MAAS), $t(122) = -4.54$, $p < 0.0001$, $ES = 0.44$, and decentering ability (EQ-D), $t(121) = -7.65$, $p < 0.0001$, $ES = 0.66$. Similar to those who received the in-person mindfulness curriculum, those who received the virtually delivered mindfulness curriculum did not report increases in perceived stress, $t(119) = 1.12$, $p = 0.2662$, $ES = 0.11$, or decreases in life satisfaction, $t(124) = 0.36$, $p = 0.7210$, $ES = 0.03$, at the end of the 10 weeks of starting their programs (see Table 4). These results support the effectiveness of the mindfulness curriculum intervention delivered in a virtual format to effect changes in at least two aspects of mindfulness and related areas.

Depending on the measure, 51–74% of participants who completed the virtually delivered mindfulness curriculum reported increases in level of mindfulness (see Table 5). Of those reporting increases, 17–39%, depending on the measure, reported increases greater than one standard deviation (see Table 5). Forty-seven percent of participants who received the virtual mindfulness curriculum reported increases in life satisfaction, with 15% of participants reporting an increase of greater than one standard deviation. Fifty-two percent of participants who received the virtual mindfulness curriculum also reported a decrease in perceived stress with 18% of participants reporting a decrease of greater than one standard deviation.

Changes on mindfulness-related measures, collectively, explained 29.99% of changes in perceived stress, $R^2 = 29.99$, $F(6, 105) = 8.924$, $p < 0.0001$. Present moment awareness (MAAS), $B = -3.054$, $\beta = -0.24$, $t = -2.61$, $p = 0.0105$, psychological flexibility (AAQ-2), $B = 0.330$, $\beta = 0.25$, $t = 2.83$, $p = 0.0056$, and decentering ability (EQ-D), $B = -0.392$, $\beta = -0.26$, $t = -2.73$, $p = 0.0074$, each contributed to the strength of the model (see Table 6). Changes on mindfulness-related measures, collectively, explained 22.09% of the variance in life satisfaction, $R^2 = 22.09$, $F(6, 108) = 6.388$, $p < 0.0001$, with psychological flexibility (AAQ-2), $B = -0.238$, $\beta = -0.39$, $t = -4.18$, $p < 0.0001$, and age,

Table 5 Number (percent) of students who experienced change in desired direction in the mindfulness curriculum group in year one ($n = 126$) and year 2 ($n = 131$)

Measure	Mindfulness curriculum group (in-person delivery)		Mindfulness curriculum group (virtual delivery)	
	% Change in desired direction	% Change 1 SD in desired direction	% Change in desired direction	% Change 1 SD in desired direction
EQ-D	84/119 (70.5%)	26/119 (21.8%)	90/122 (73.8%)	47/122 (38.5%)
MAAS	72/115 (62.6%)	25/115 (21.7%)	77/123 (62.6%)	28/123 (22.8%)
AAQ-2	57/120 (47.5%)	16/120 (13.3%)	64/126 (50.8%)	21/126 (16.7%)
SWLS	65/121 (53.7%)	12/121 (9.9%)	59/125 (47.2%)	19/125 (15.2%)
PSS	48/118 (40.7%)	15/118 (12.7%)	62/120 (51.7%)	21/120 (17.5%)

EQ-D Experiences Questionnaire Decentering Subscale (Decentering), MAAS Mindful Attention Awareness Scale (present moment attention and awareness), AAQ-2 Acceptance and Action Questionnaire (psychological flexibility), SWLS Satisfaction with Life Scale, PSS Perceived Stress Scale

Table 6 Multivariate regression analyses explaining variance for changes in perceived stress and life satisfaction explained by changes in mindfulness-related variables due to in-person delivery (year one) and virtual delivery (year two) of the mindfulness curriculum

	PSS				SWLS					
	Beta-estimate (SE)	Beta-weight	T-stat	p-value	VIF	Beta-estimate (SE)	Beta-weight β	T-stat	p-value	VIF
EQ-D	-0.163 (0.15)	-0.107	-1.07	0.2859	1.63	0.143 (0.08)	0.184	1.74	0.0855	1.60
MAAS	-3.611(1.32)	-0.260	-2.74	0.0073	1.48	0.729 (0.74)	0.101	0.99	0.3241	1.47
AAQ-2	0.448 (0.13)	0.349	3.45	0.0008	1.68	-0.184 (0.07)	-0.277	-2.55	0.0122	1.67
Age	0.245 (0.15)	0.136	1.66	0.1004	1.10	-0.201 (0.08)	-0.223	-2.56	0.0121	1.08
Male gender	-1.253 (1.58)	-0.065	-0.80	0.4288	1.08	0.826 (0.90)	0.080	0.92	0.3604	1.09
Prior participation	-0.919 (1.32)	-0.055	-0.70	0.4866	1.02	-0.012 (0.74)	-0.001	-0.02	0.9874	1.04
Adjusted R-squared = 37.67%, $F(6, 96) = 11.28, p < .0001$										
Virtual delivery (year two)										
PSS										
EQ-D	-0.392 (0.14)	-0.255	-2.73	0.0074	1.38	0.085 (0.07)	0.124	1.23	0.2203	1.47
MAAS	-3.054 (1.17)	-0.236	-2.61	0.0105	1.30	0.785 (0.55)	0.139	1.42	0.1585	1.39
AAQ-2	0.330 (0.12)	0.251	2.83	0.0056	1.25	-0.238 (0.06)	-0.385	-4.18	<.0001	1.24
Age	0.124 (0.15)	0.069	0.83	0.4071	1.07	0.163 (0.07)	0.196	2.27	0.0251	1.09
Male gender	-0.246 (1.51)	-0.013	-0.16	0.8710	1.04	-0.513 (0.72)	-0.060	-0.72	0.4750	1.04
Prior participation	0.889 (1.22)	0.059	0.73	0.4677	1.05	0.330 (0.59)	0.047	0.56	0.5769	1.04
Adjusted R-squared = 29.99%, $F(6, 105) = 8.924, p < .0001$										
SWLS										
EQ-D Experiences Questionnaire Decentering Subscale (Decentering), MAAS Mindful Attention Awareness Scale (present moment attention and awareness), AAQ-2 Acceptance and Action Questionnaire (psychological flexibility), SWLS Satisfaction with Life Scale, PSS Perceived Stress Scale										

$B = 0.163$, $\beta = 0.20$, $t = -2.27$, $p = 0.0251$, each contributing to the strength of the model (see Table 6).

Comparisons Between In-Person and Virtual Delivery of Mindfulness Curriculum

The average change between pre-test and post-test on all measures was compared between in-person delivery (year one) and virtual delivery (year two). Results are presented in Table 7. Overall, there were no difference in the magnitude of change on mindfulness or well-being measures for participants who received the mindfulness curriculum based on delivery format (in-person or virtual).

Impact of COVID-19 on Perceived Stress and Life Satisfaction

To examine the impact of COVID-19 on perceived stress and life satisfaction of students starting their PA education, changes for participants in the control groups were examined between years 1 and 2. Somewhat surprising, non-COVID-19 year participants reported significantly greater increases in perceived stress (PSS), $t(122) = 2.59$, $p = 0.0107$, $ES = -0.463$, and decreases in life satisfaction over the first 10 weeks of starting their education than COVID-19 year participants, $t(109) = -3.73$, $p < 0.001$, $ES = -0.664$ (see Table 7). Non-COVID-19 participants reported almost two and a half times the amount of increase in perceived stress than COVID-19 participants reported and nearly two times the decrease in life satisfaction (see Table 7).

To examine the impact on coping resource between COVID-19 and non-COVID-19 years, participants' reported

levels on mindfulness measures were examined for control groups between year one (non-COVID-19) and year two (COVID-19). During year two (COVID-19), participants reported slightly less decrease in present moment awareness, $t(103) = -2.15$, $p = 0.0341$, $ES = -0.39$, psychological flexibility, $t(118) = 2.70$, $p = 0.0079$, $ES = 0.48$, life satisfaction, $t(109) = -3.73$, $p = 0.0003$, $ES = -0.66$, and perceived stress, $t(122) = 2.59$, $p = 0.0107$, $ES = 0.46$, than those in the non-COVID-19 year (see Table 7).

Discussion

The current study examined the importance and viability of initiating skills training that foster professional resilience early within a student's academic training that also impacts and improves well-being and protects against stress encountered in PA education. The two primary aims for this investigation were to determine whether mindfulness-based and related strategies designed to improve resilience against perceived stress and poor life satisfaction can be effectively incorporated within a course curriculum; additionally, whether such a mindfulness-based curriculum could be modified and delivered effectively using a virtual delivery format.

Several interesting findings emerge from the current study. Our findings suggest that it is possible to incorporate well-being enhancing components to current curriculums that effectively mitigate the negative impact related to increased demands within healthcare education and training. The mindfulness-based curriculum intervention examined in the current study was successful in increasing levels of

Table 7 Change in validated measures (pre- to post-test) in years one and two compared by delivery format. The effect size is based on Hedge's g

	Mindfulness curriculum				Control group			
	Year 1: change for in-person delivery (non-COVID) $N = 126$	Year 2: change for virtual delivery (COVID) $N = 131$	$t(df)$ Effect size	p -value	Year 1: change for in-person delivery (non-COVID) $N = 63$	Year 2: change for virtual delivery (COVID) $N = 64$	$t(df)$ Effect size	p -value
EQ-D	2.17 (5.4)	3.34 (4.8)	-1.78 (235) $ES = -0.229$	0.0757	-0.88 (5.5)	0.15 (3.9)	-1.19(107) $ES = -0.215$	0.2362
MAAS	0.24 (0.6)	0.25 (0.6)	-0.13(234) $ES = -0.017$	0.8929	-0.40 (0.9)	-0.10 (0.6)	-2.15(103) $ES = -0.394$	0.0341
AAQ-2	-0.83 (6.2)	-0.71 (5.6)	-0.15(239) $ES = -0.019$	0.8840	2.16 (5.2)	-0.75 (6.8)	2.70(118) $ES = 0.477$	0.0079
SWLS	0.24 (4.2)	-0.13 (4.0)	0.70(243) $ES = 0.089$	0.4839	-1.74 (4.4)	0.77 (3.1)	-3.73(109) $ES = -0.664$	0.0003
PSS	0.53 (7.9)	-0.76 (7.4)	1.29(235) $ES = 0.166$	0.1993	5.94 (7.5)	2.39 (7.8)	2.59(122) $ES = 0.463$	0.0107

EQ-D Experiences Questionnaire Decentering Subscale (Decentering), MAAS Mindful Attention Awareness Scale (present moment attention and awareness), AAQ-2 Acceptance and Action Questionnaire (psychological flexibility), SWLS Satisfaction with Life Scale, PSS Perceived Stress Scale

mindfulness and related abilities and life satisfaction, while also mitigating increases in perceived stress. The majority of individuals receiving the in-person curriculum intervention reported improvements in mindfulness, including present moment awareness, psychological flexibility, and decentering ability. Moreover, approximately 21% of individuals showed improvement of at least one standard deviation in mindful attention and decentering abilities and 13% in psychological flexibility. This translated to over 50% of participants who received the in-person curriculum intervention demonstrating some improvement in life satisfaction and approximately 40% of participants demonstrating some improvements in their perceived stress levels.

There was a relationship found between those who evidenced improvements in mindfulness levels and those who evidenced improvements in perceived stress and life satisfaction. In fact, approximately 38% of the changes in perceived stress levels and about 26% of the changes in life satisfaction were explained by changes in levels of mindfulness when the mindfulness curriculum was delivered in-person. This finding would suggest that interventions that successfully increase mindfulness levels will also be successful in improving well-being. The components of mindfulness found to be most relevant to changes in perceived stress were present moment awareness and psychological flexibility, whereas changes in psychological flexibility were the strongest contributor to life satisfaction. This suggests that selective aspects of mindfulness may have differential effects on types of well-being.

These findings support the mediating role anxiety and mood play in the relationship between mindfulness-based and related skills and well-being [19]. The ability to stay focused and attend within the present moment without cognitive interference and having the capacity to shift attention and not fixate or ruminate on past moments, along with the capacity to decenter one's self-experience from those actions, behaviors, and thoughts that are occurring, have been found to reduce anxiety and depression. Reducing levels of anxiety and depression directly impact one's satisfaction with life and overall perceived stress.

When this curriculum was implemented in a virtual format, similar findings were found to support the effectiveness of the curriculum intervention. Unlike the in-person delivery, however, the virtually delivered curriculum was not effective in changing levels of psychological flexibility on average compared to controls but was effective in increasing levels of mindful attention and decentering over controls. The virtual curriculum overall, however, was successful with nearly half of the participants reporting some improvements in life satisfaction and perceived stress levels. Similar to the in-person delivery, 30% of reported changes in perceived stress levels and approximately 22% of the changes in life satisfaction could be explained by changes

in levels of mindfulness during the 10-week curriculum intervention. All three aspects of mindfulness were able to explain changes in perceived stress, whereas only psychological flexibility was instrumental in explaining changes in life satisfaction.

The current study also provides empirical evidence that supports the adverse impact healthcare education and training can have on student well-being. Within the first 10 weeks of beginning healthcare education pre-pandemic, students' levels of life satisfaction and perceived stress were negatively impacted. These findings are particularly important because students may be at greater risk for developing general health or mental health issues, which may, in turn, potentially impact patient care during training or beyond [7, 17]. It also speaks to the need for healthcare training programs to take steps to address well-being within education and training.

Given the monumental impact of COVID-19 and subsequent protocols impacting social interaction, understanding the impact on levels of perceived stress, life satisfaction, and coping abilities is helpful. Our study suggests that students not receiving curricular intervention during the non-COVID-19 year experienced nearly two and half times the amount of increase in perceived stress and approximately two times greater decrease in life satisfaction than those participants who began their healthcare education and training during the COVID-19 pandemic. Though these findings may seem surprising, they suggest unintended benefits stemming from quarantine measures and related policies and potential benefits of training and education within a home-based context. Not attending classes in-person may have reduced academic training demands associated with increasing stress levels. The impact of COVID-19 quarantine measures, and subsequent virtual delivery of education and training through a virtual format, may have lessened the expected impact of starting a rigorous academic program on perceived stress levels and overall life satisfaction, despite pandemic concerns.

Limitations and Strengths

Though the findings of the study offer important insights into the role improved mindfulness can play in mitigating the adverse effects of healthcare education and training on well-being, they should be viewed within the context of certain limitations to the design of the study. Because students were not assessed at a follow-up date, it is unclear whether students retain mindfulness-based skills and associated improvements in well-being long term. Although the study surveys had high response rates and respondents' demographics suggest they were representative of PA students nationally, the potential for self-report bias cannot be excluded. Another potential limitation may be sample bias

that stems from those who chose not to participate in the study. It is possible that systematic reasons exist for why an individual choose not to participate in the study and that these reasons were significantly associated with responses on well-being measures. Although there is no way to assess individuals who chose not to consent to participate, over 50% of potential participants did choose to complete both pre-test and post-test study measures. This participation rate may be higher than typical rates found in similar studies.

There are many unique strengths of the present study. The multi-site, prospective, nonrandomized, controlled design reduces potential bias and strengthens the internal validity of the findings. The large sample size provides sufficient power to identify important relationships. The administration of five different validated, psychosocial instruments to measure the various aspects of mindfulness and well-being increases the richness of the data collected. The unique opportunity presented to the researchers by initiating a multiyear study 1 year prior to the COVID-19 pandemic fortuitously allowed for the comparison of in-person and virtually delivered curricula. As a result, the study was able to examine the multi-dimensional data from a number of different perspectives. Future research should replicate these findings with a focus on follow-up evaluations on levels of mindfulness and well-being several months after the conclusion of the curriculum to determine stability of any found effects.

Conclusion

Overall, the current study provides insight into the effectiveness and utility of in-person and virtual delivery of a mindfulness-based curriculum designed to support professional resiliency in health profession students. Our results support the effectiveness of the mindfulness training to be incorporated into coursework which was effectively able to increase levels of mindfulness and mitigate the negative impact on life satisfaction and perceived stress of healthcare students. No difference in the magnitude of change for participants who received the mindfulness curriculum was found based on delivery format (in-person or virtual).

The current study also provides empirical evidence to support the adverse impact healthcare education and training demands can have on student coping resources and well-being. Somewhat surprising, however, was that decreases in mindfulness and well-being were significantly less during the pandemic year than the pre-pandemic year. This may reveal unintended benefits for students who had the opportunity to take classes and training with in-person activities removed.

It is unclear how long the COVID-19 pandemic will influence or impact how education and training are delivered. The need to innovate delivery and incorporate content that

enhances awareness around well-being and instills skills and concepts to mitigate the adverse impact of stress is essential. Given the existing empirical support for the role mindfulness and related capacities play in effectively coping with stress and challenging life circumstances, it behooves educators in healthcare delivery to incorporate wellness strategies within curriculum and training. This will serve to not only improve the health and well-being of students during their training but hopefully yield results that extend beyond their education and into their professional careers. The potential benefits from these endeavors will have ramifications for patient care, professional resilience, and reduced burnout.

Declarations

Consent to Participate The manuscript does not contain clinical studies or patient data. All participants gave informed consent prior to participation.

Conflicts of Interest The authors declare that they have no conflict of interest.

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