

Evaluation of a Yoga-Based Mind-Body Intervention for Resident Physicians: A Randomized Clinical Trial

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Abstract

Background and Objective: Mind-body interventions (MBIs) have been shown to be effective individual-level interventions for mitigating physician burnout, but there are no controlled studies of yoga-based MBIs in resident physicians. We assessed the feasibility of a yoga-based MBI called RISE (resilience, integration, self-awareness, engagement) for residents among multiple specialties and academic medical centers.

Methods: We conducted a waitlist controlled randomized clinical trial of the RISE program with residents from multiple specialty departments at three academic medical centers. The RISE program consisted of six weekly sessions with suggested home practice. Feasibility was assessed across six domains: demand, implementation, practicality, acceptability, adaptation, and integration. Self-reported measures of psychological health were collected at baseline, post-program, and two-month follow-up.

Results: Among 2,000 residents contacted, 75 were assessed for eligibility and 56 were enrolled. Forty-four participants completed the study and were included in analysis. On average, participants attended two of six sessions. Feasibility of in-person attendance was rated as 28.9 (SD 25.6) on a 100-point visual analogue scale. Participants rated feasibility as 69.2 (SD 26.0) if the program was offered virtually. Those who received RISE reported improvements in mindfulness, stress, burnout, and physician well-being from baseline to post-program, which were sustained at two-month follow-up.

Conclusion: This is the first controlled study of a yoga-based MBI in residents. While the program was not feasible as delivered in this pilot study, initial analyses showed improvement in multiple measures of psychological health. Residents reported that virtual delivery would increase feasibility.

Keywords

Yoga, mindfulness, physician, graduate medical education, internship and residency, burnout

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Introduction

Physicians experience high rates of stress, depression, and burnout, a work-related syndrome characterized by increased emotional exhaustion, increased depersonalization, and reduced personal accomplishment.¹ Burnout is associated with medical errors, professionalism issues, career attrition, substance use, and suicidal ideation.^{2–6}

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For many physicians, these symptoms rise during medical school and peak during residency, with a prevalence of approximately 51% among medical residents⁷ and 69% among surgical residents.⁸

Importantly, because of impact on clinicians and the health care system, the Quadruple Aim, developed by the Institute for Health Care Improvement to optimize health system improvement, emphasizes that physician well-being is an essential part of any health care reform.⁹ Both individual- and organization-focused interventions offer clinically meaningful benefit in reducing physician burnout.¹⁰ Successful individual interventions include stress management and mind-body interventions (MBIs).^{10–13} MBIs often incorporate mindfulness, or the ability to dispassionately observe the experience of the present moment with non-judgmental openness; an example of a standardized intervention is mindfulness-based stress reduction (MBSR).^{14–17} Yoga is a mind-body practice that not only incorporates the quality of mindfulness and formal meditation practice, but also physical postures, breath regulation, and relaxation. Evidence suggests the yoga component of MBSR may be the most crucial element for improving psychological well-being.^{18,19}

The Kripalu Center for Yoga & Health developed the yoga-based program, RISE (resilience, integration, self-awareness, engagement), for professional populations. RISE has been studied in frontline professionals in single-arm and controlled designs.^{20–24} In a study with attending physicians, improvements in burnout, professional fulfillment, interpersonal disengagement, stress, resilience, anxiety, and depression were observed at post-program, and interpersonal disengagement, resilience, and mindfulness at two-month follow-up.²⁴

Given the demanding nature of training, there is great interest in evaluating the feasibility and efficacy of MBIs for the resident physician population. The primary aim of the present study was to assess the feasibility of providing a yoga-based MBI, RISE, for residents among multiple specialties in the academic medical center setting. As a secondary aim, the efficacy of RISE on measures of psychological health was explored.

Institutional Review Board

This study was approved by the Partners HealthCare Institutional Review Board.

Methods

Settings, Participants, and Study Design

During 2018 and 2019, residents were recruited from programs based at Brigham and Women's Hospital, Beth Israel Deaconess Medical Center, Boston Children's Hospital, and Harvard combined residency programs.

Two cohorts of the study were conducted at the same time each year; fall of the academic year (September through November) was selected to allow new residents to settle in after starting in July and avoid holiday vacations. Residents were contacted by e-mail distribution lists and via residency program directors and graduate medical education (GME) offices. Paper fliers were placed in workrooms and common areas. Fellows were excluded from the study; residents were excluded if they had practiced a mind-body technique for more than 25 hours in the past six months. All participants, in both the intervention and control groups, provided informed consent and received a \$25 gift card. This study was registered on ClinicalTrials.gov as NCT03687450.

Intervention

Developed by Kripalu Center for Yoga & Health, RISE is a program of yoga-based practices (Supplementary File S1). The program was delivered at the academic medical center as 60-minute weekly sessions over a six-week time period.²⁴ The instructor was a psychologist and certified yoga instructor (E-RYT 500). Sessions contained a combination of didactic and experiential material. Participants had access to online resources that reinforced content and were asked to maintain a daily home practice. The waitlist control group received one session at the end of the study period, which included an overview of didactic material and practices.

Data Collection

Surveys were administered using REDCap software. Feasibility was assessed post-program (at six weeks). Psychological measures were assessed at baseline, post-program, and two-month follow-up. Attendance was kept by the instructor at each session. Participants kept daily home practice logs.

Outcome Measures

At baseline, all participants completed a questionnaire about demographics and current mind-body practices (Supplementary File S2).

Feasibility was assessed according to six dimensions as described in recommendations for the design of feasibility studies from the National Cancer Institute,²⁵ utilized in other studies of mind-body interventions:^{26–28} 1) *demand*, 2) *implementation*, 3) *practicality*, 4) *acceptability*, 5) *adaptation*, and 6) *integration*. *Demand* was qualitatively assessed informally in the local environment. *Implementation* was operationalized as the extent to which the program could be delivered and included weekly class observation. *Practicality* was determined by monetary costs, attendance, and extent of home practice. *Acceptability* was assessed through participant

evaluation of RISE based on a visual analogue scale from 0 (not at all feasible) to 100 (very feasible). *Adaptation* was operationalized as modifications made to RISE to accommodate residents' unique needs, such as long, irregular work hours and limited transportation options. *Integration* was operationalized as participant use of skills outside of sessions and during follow-up. Additional evaluation of feasibility by participants was obtained by questionnaire at post-program follow-up (Supplementary File S3).

Preliminary efficacy was assessed via self-report measures of psychological health at baseline, post-program, and two-month follow-up. Surveys included the Five Facet Mindfulness Questionnaire (FFMQ; short form, 15 items),^{29,30} Resilience Scale (RS-14; 14 items),³¹ Perceived Stress Scale (PSS; 10 items),³² Maslach Burnout Inventory (short form, 2 items),^{33,34} Professional Fulfillment Index (PFI; 16 items),³⁵ Patient Reported Outcomes Measurement Information System (PROMIS) Depression and Anxiety (short form: depression-4, anxiety-4),³⁶⁻³⁸ PROMIS Sleep Disturbance (short form, 4 items),^{39,40} and Resident Well-Being Index (7 items).⁴¹

Analysis

Feasibility was reported utilizing the multidimensional approach described above; participant comments were grouped and reported according to the relevant domain of feasibility, determined by authors J.L. and N.D. For quantitative measures, within group changes were analyzed via paired samples t-tests and between group changes were analyzed via one-way ANOVAs. For questionnaires administered at one timepoint, descriptive data were calculated and presented. SPSS 24.0 was used for data analysis (IBM Corp, Armonk, NY).

Results

Participants

Approximately 2,000 residents were contacted by recruitment methods described above. Seventy-five residents and fellows responded to advertisements and were assessed for eligibility. Fifty-six residents met eligibility criteria and were enrolled; participants were randomized 2:1 using a random number generator to intervention (n=38) vs. control (n=18) (Figure 1). Of the 56

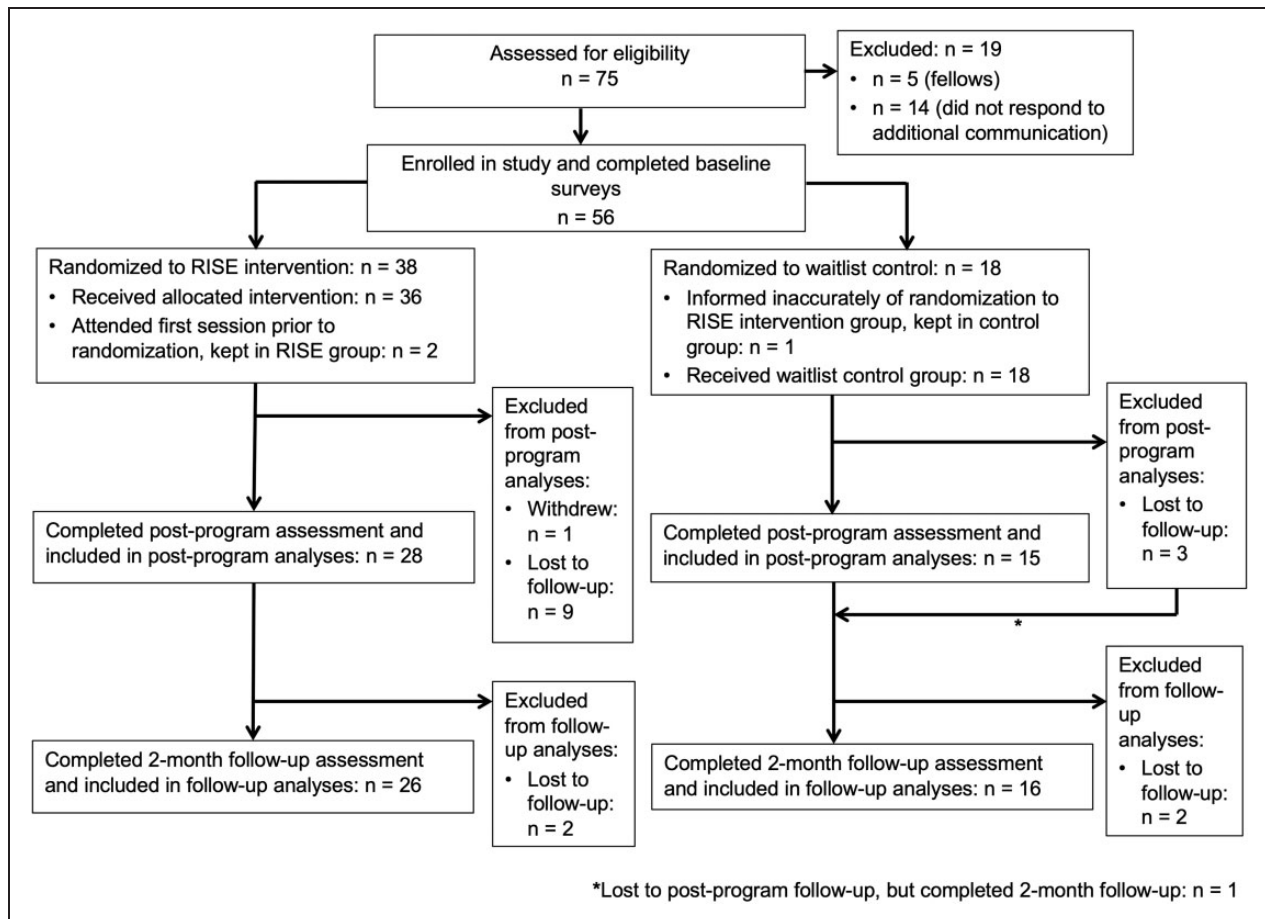


Figure 1. CONSORT Flow Diagram.

residents who enrolled and completed baseline measures, 43 completed post-program measures and 42 completed two-month follow-up. Participants who completed baseline and at least one follow-up assessment were included in analysis (Figure 1).

Both the intervention and control groups had a mean age of approximately 29 years; the majority of participants were female (Table 1). Almost half of participants self-identified their racial background as white. Internal Medicine residents comprised approximately half of the study sample. There was a fairly even distribution across training years. Baseline practice of mind-body techniques is described in Table 1. There were no statistically significant differences in demographic variables between groups (all p values $> .05$).

Feasibility

Demand. Most residency program directors who were contacted responded positively and communicated their support of the study; there were no program directors who negatively responded to inquiries. One program protected their residents' time to attend sessions.

Implementation. Sessions were held in hospital conference rooms at no cost with chairs that could be moved to place yoga mats (stored on-site). None of the sessions were cancelled or truncated. Authors J.L. and M.L.S. observed weekly classes to ensure quality.

Adaptation. RISE was delivered as six 60-minute weekly sessions.²⁴ Sessions were held on hospital premises to

Table 1. Characteristics of study sample (participants who completed baseline and any follow-up surveys).

Characteristic	Number (%)	
	Intervention: n = 28	Control: n = 16
Sex		
Male	7 (25.0%)	1 (6.3%)
Female	21 (75.0%)	15 (93.8%)
Age (mean)	29.3 (range 26–33)	29.1 (range 27–33)
Ethnicity		
Hispanic	2 (7.1%)	1 (6.2%)
Non-Hispanic	26 (92.9%)	14 (87.6%)
Not reported	0 (0.0%)	1 (6.2%)
Race		
White	18 (64.2%)	10 (62.5%)
Black	1 (3.6%)	0 (0.0%)
Asian	7 (25.0%)	4 (25.0%)
American Indian/Alaskan Native	1 (3.6%)	0 (0.0%)
Multiracial	0 (0.0%)	2 (12.5%)
Not reported	1 (3.6%)	0 (0.0%)
Year in training		
1 (intern)	9 (32.1%)	3 (18.8%)
2	6 (21.4%)	5 (31.3%)
3	8 (28.6%)	3 (18.8%)
4+	5 (17.9%)	5 (31.3%)
Specialty		
Internal Medicine	12 (42.9%)	8 (50.0%)
Obstetrics & Gynecology (OB/GYN)	3 (10.7%)	2 (12.5%)
Diagnostic Radiology	3 (10.7%)	2 (12.5%)
Emergency Medicine	2 (7.1%)	0 (0.0%)
Psychiatry	4 (14.3%)	2 (12.5%)
Medicine-Pediatrics	1 (3.6%)	0 (0.0%)
Anesthesiology	3 (10.7%)	1 (6.3%)
Physical medicine & rehabilitation	0 (0.0%)	1 (6.3%)
Previously practiced a mind-body technique	64.3% Yes	75% Yes
Currently practicing a mind-body technique	17.9% Yes	25% Yes
Average practice duration (if currently practicing)	60 minutes, 1 day per week	30 minutes, 1 day per week

There were no statistically significant differences in demographic variables between groups (all p values $> .05$).

improve access for residents working different types of shifts and occurred Thursdays 6:00-7:00 PM, chosen based on a prior informal survey of residents.

Practicality. On average, participants attended a mean of 1.93 in-person sessions ($SD = 1.52$). Six (25%) attended no sessions, 21.4% attended one session, 17.9% attended two sessions, 17.9% attended three sessions, 14.3% attended four sessions, and 3.6% attended five sessions. No participant attended all six sessions. Participant reasons for missing RISE sessions were attributed to work schedule (89%), vacation (10%), or illness (1%).

At post-program follow-up, 74.1% of RISE participants reported they were using online RISE resources for home practice, with 75% using resources some days of the week and 25% more than half of the days of the week.

Acceptability. Participants rated the feasibility and acceptability of attending RISE as low, mean (M) = 28.9, standard deviation (SD) = 25.6, but rated it higher if offered multiple times per week, $M = 63.2$ ($SD = 20.9$), or online, $M = 69.2$ ($SD = 26.0$). If RISE was delivered by residency program, 48.1% of participants said it would have improved attendance; acceptability is summarized in Table 2.

Integration. At two-month follow-up, 44% of the intervention group reported they had practiced RISE techniques 1.9 days per week (range 0–6 days; $SD = 1.93$) for 13.0 minutes (range 0–60 min; $SD = 15.78$) per occurrence. Participants used online resources and incorporated techniques into daily life (Table 2).

Preliminary Efficacy

Means and standard errors of psychological health measures for RISE and control groups at baseline, post-program, and two-month follow-up are displayed in Figure 2(A) and (B). Within-group analysis revealed that the RISE group improved in resilience, [$t(27) = 2.66$, $p = .013$, $d = 0.50$], mindfulness ($t(25) = 6.15$, $p = .0001$, $d = 1.21$), stress [$t(26) = -2.68$, $p = .013$, $d = .52$], sleep disturbance [$t(25) = -2.64$, $p = .014$, $d = .52$], work exhaustion subscale of the PFI [$t(19) = -4.66$, $p = .001$, $d = 1.04$], interpersonal disengagement [$t(25) = -2.01$, $p = .050$, $d = .39$], total burnout [$t(24) = -3.08$, $p = .021$, $d = .48$], and physician well-being [$t(25) = -2.56$, $p = .017$, $d = .50$] from baseline to post-program. There was no improvement ($p < 0.08$) in depression [$t(24) = -2.04$, $p = .073$, $d = .37$]. There were no improvements in psychological health measures from baseline to post-program within the control group.

From baseline to two-month follow-up, the RISE group reported significant improvements in mindfulness

[$t(23) = 3.03$, $p = .006$, $d = .62$], stress [$t(24) = -3.24$, $p = .003$, $d = .65$], work exhaustion [$t(24) = -3.78$, $p = .001$, $d = .75$], interpersonal disengagement [$t(24) = -2.07$, $p = .049$, $d = .37$], total burnout [$t(24) = -3.08$, $p = .005$, $d = .62$], and physician well-being [$t(24) = -2.38$, $p = .026$, $d = 0.48$]. There were marginal improvements in resilience [$t(25) = 1.86$, $p = .075$, $d = .36$] and sleep disturbance [$t(24) = -2.04$, $p = .053$, $d = .41$]. The control group improved in anxiety [$t(15) = 1.36$, $p = .036$, $d = .58$] and sleep disturbance [$t(15) = 2.38$, $p = .031$, $d = .59$] from baseline to two-month follow-up.

An exploratory between-group analysis revealed a statistically significant between-group difference in mindfulness [$F(1, 40) = 9.58$, $p = .004$, $\eta^2 = 0.20$] from baseline to post-program, whereby the RISE group improved compared to the control group, but no improvement in work exhaustion [$F(1, 40) = 4.01$, $p = .052$, $\eta^2 = 0.09$] from baseline to two-month follow-up compared to control (Figure 2(A) and (B)).

Discussion

To our knowledge, this is the first controlled study of a yoga-based MBI in residents and was unique in including residents from multiple academic medical centers and specialty departments. As delivered in this study, RISE was not rated as highly feasible by residents. Most importantly, residents reported that their work schedule conflicted with the delivery of the program. In an efficacy analysis, those receiving RISE reported improvements in multiple measures of psychological health from baseline to post-program, which were sustained at two-month follow-up.

MBIs have previously been evaluated in residents with mixed outcomes. Most studies evaluated mindfulness-based interventions; to our knowledge, there is only one single-arm pilot of a yoga-based MBI in residents.⁴² MBSR administered to surgical interns was found to improve mindfulness, reduce stress, and improve well-being.⁴³ Several studies demonstrated reduced stress and/or burnout after meditation-based MBIs,^{44–48} whereas others did not observe an effect.^{49,50} In a feasibility study of a mindfulness intervention for German residents, the program was rated as highly feasible with no attrition, but included only nine participants and no comparison group.⁴⁴ While our study experienced high levels of nonattendance, this could be attributed to differences in work hours—U.S. residents are limited to a maximum of 80 hours per week while European residents are limited to 48 hours.⁵¹ Several studies included interventions that were structured by residency program with protected didactic time, which improved feasibility.^{26,47,48} One program²⁶ used moonlighters to cover trainee time, which is costly

Table 2. Participant comments: acceptability, integration, and adaptation.

Feasibility	
Domain	Participant comments
Acceptability	<p>“I didn’t always use the RISE yoga videos because I like doing something a little more active so sometimes replaced the yoga component with something else I found online.”</p> <p>“I found it hard to stay engaged in the 15 minute standing [yoga] series. I would find it much easier to do something more similar to the yoga sequences we did at the end of the RISE classes where it involved a lot of restorative/yin-type poses.”</p> <p>“The mental exercises were easy to do and I did those often and liked them. The yoga and stretch exercises were nice but for some reason there was just a high level of activation for me.”</p> <p>“I don’t think I would have used it without a buddy.”</p> <p>“Honestly I think it really is on me. A lot of the time I had downtime and just didn’t do it even though I told myself I would. . .But I can’t honestly blame [it] on residency. If I was on vacation frankly I don’t know if my attendance would have been better.”</p>
Integration	<p>“I really liked the mental exercises and idea of riding the wave. I actually visualized that metaphor and did the exercises frequently in moments of stress during the day.”</p> <p>“The Complete Breath was the meditation I enjoyed.”</p> <p>“I liked the 3 C centering best because it was brief enough that the ‘commitment’ required to do it felt manageable and it was easy to do before work, before bed, really whenever. I still didn’t do a great job of doing even the 3 C centering every day, but I did find it the most helpful because it was a brief pause to reset my day and mindset.”</p> <p>“I do think that RISE helped me become more mindful of how I’m spending my time in the day. Sometimes, if I had a free hour I could have taken 15 minutes to do the standing series, but instead I chose to go out on a run. This serves as a ‘moving meditation’ for me and also promotes my physical health, and is certainly a better choice than sitting on the couch watching TV. Or, I like to cross-stitch which I also consider a mindful activity, so I still think of this in the category of promoting my well-being. So, despite not always using the RISE resources as my method of centering, I do feel like I was more aware of choosing to spend my limited free time in ways that were promoting [my] well-being.”</p>
Potential Future Adaptations	
Implementation	Participant Comments
In-person vs. Online	<p>“[The RISE exercises would be easier to use] if they were available in the form of an app that I could download onto my phone.”</p> <p>“I was on the inpatient services through much of this time and found that I actually enjoyed going to the in-person sessions because it mandated a time period for me to set aside for RISE. I found it difficult to keep up with my e-mails, so also just opted to learn while in-person.”</p> <p>“A better interface and more reliable streaming.”</p> <p>“I don’t like [having] to go to my computer to ‘check out’ and tune into myself.”</p> <p>“I like the idea of having the sessions online. I used online yoga resources and feel like I got the same benefit without having to rush to class after clinic or feeling like it wasn’t a good time for me.”</p>
Scheduling	<p>“I think that if the timing was better it would be a great way to learn at the end of the day. I am bummed I was only able to make 2 sessions due to the timing, which I understand works for most services but not OB/GYN most days.”</p> <p>“I think the time of day worked well when I was on days. However, when one is on a busy night shift, it was absolutely impossible to attend.”</p>
Content	<p>“The only class I went to was largely a lecture about the sympathetic nervous system. I was hoping this would be more actual meditation and especially more physical movement. I would like minimal lecture—it’s the last thing I want at the end of a long day.”</p> <p>“The lectures were ok, but I felt that the activity components were more helpful than the lectures.”</p> <p>“In general I believe that there would have been greater buy-in if the classes were more physically demanding.”</p>

and requires institutional commitment. In all, there is heterogeneity in the design and implementation of MBIs for residents.

The participants in our study reported that feasibility would improve if RISE was offered separately by residency program, potentially addressing work schedule

conflicts. Participants also thought feasibility would improve if RISE was delivered virtually (e.g., videoconferencing or smartphone app). Virtual delivery of MBIs have been studied in a limited manner: a trial of smartphone-delivered vs. in-person mindfulness intervention in health care workers demonstrated increased

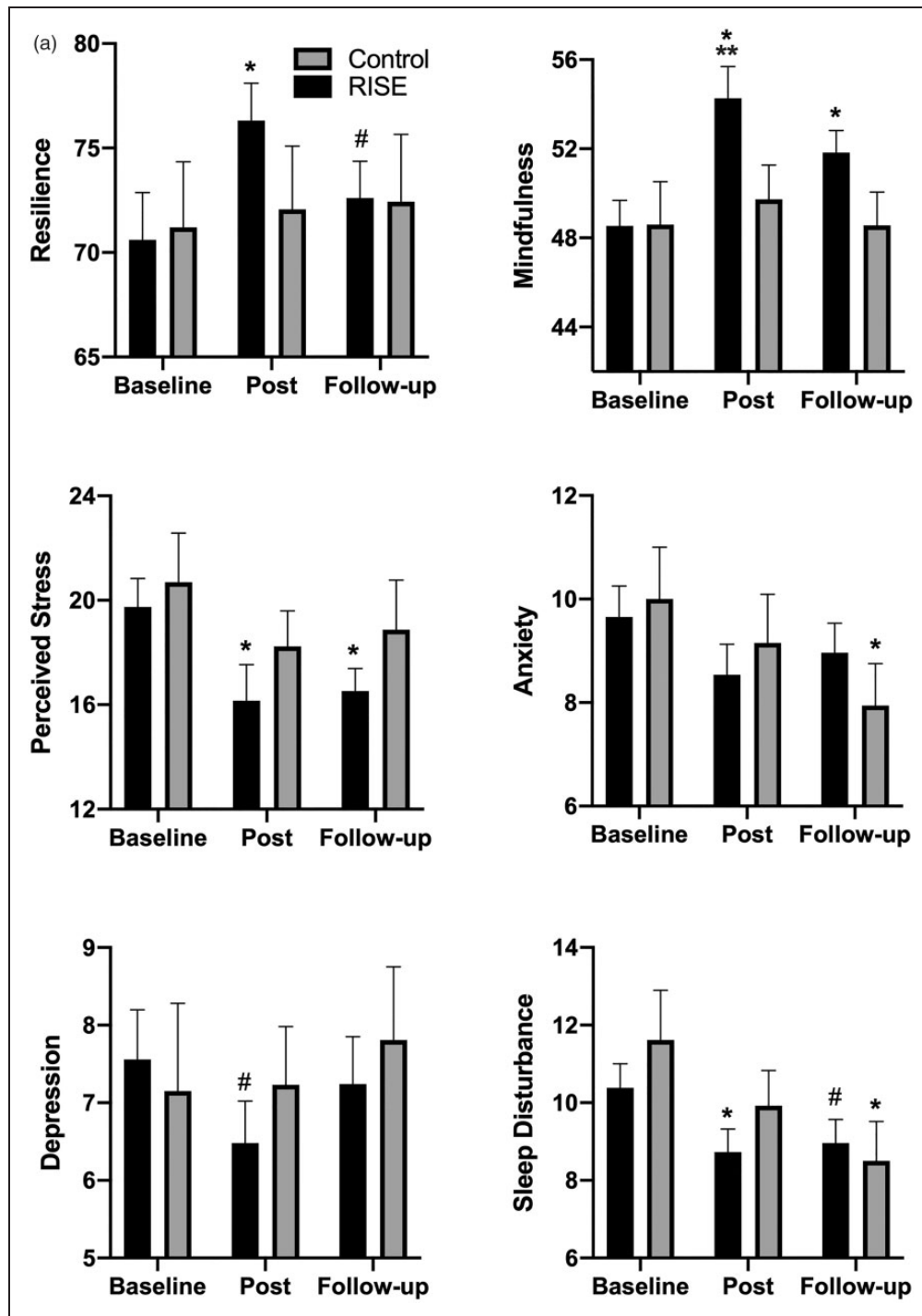


Figure 2. a and b, The means and standard errors of the psychological health measures for the RISE group and control group at baseline, post-program “Post”, and two-month follow-up “Follow-up” time points. * $p < 0.05$ compared to baseline (within groups analysis), # $p < 0.08$ compared to baseline, ** $p < 0.05$ compared to control (between groups analysis).

well-being in both groups, but the in-person group had additional improvements in stress and burnout.⁵² In our study, most participants utilized online RISE resources even if they did not attend in-person sessions, suggesting virtual delivery as a potential adaptation (Table 2). In a

previous RISE study, livestream and recordings of in-person sessions increased participation.²⁴ On a practical note, brief interventions may improve feasibility for busy resident physicians.^{47,53} In the MBSR literature, the standard 26-hour form has the most empirical

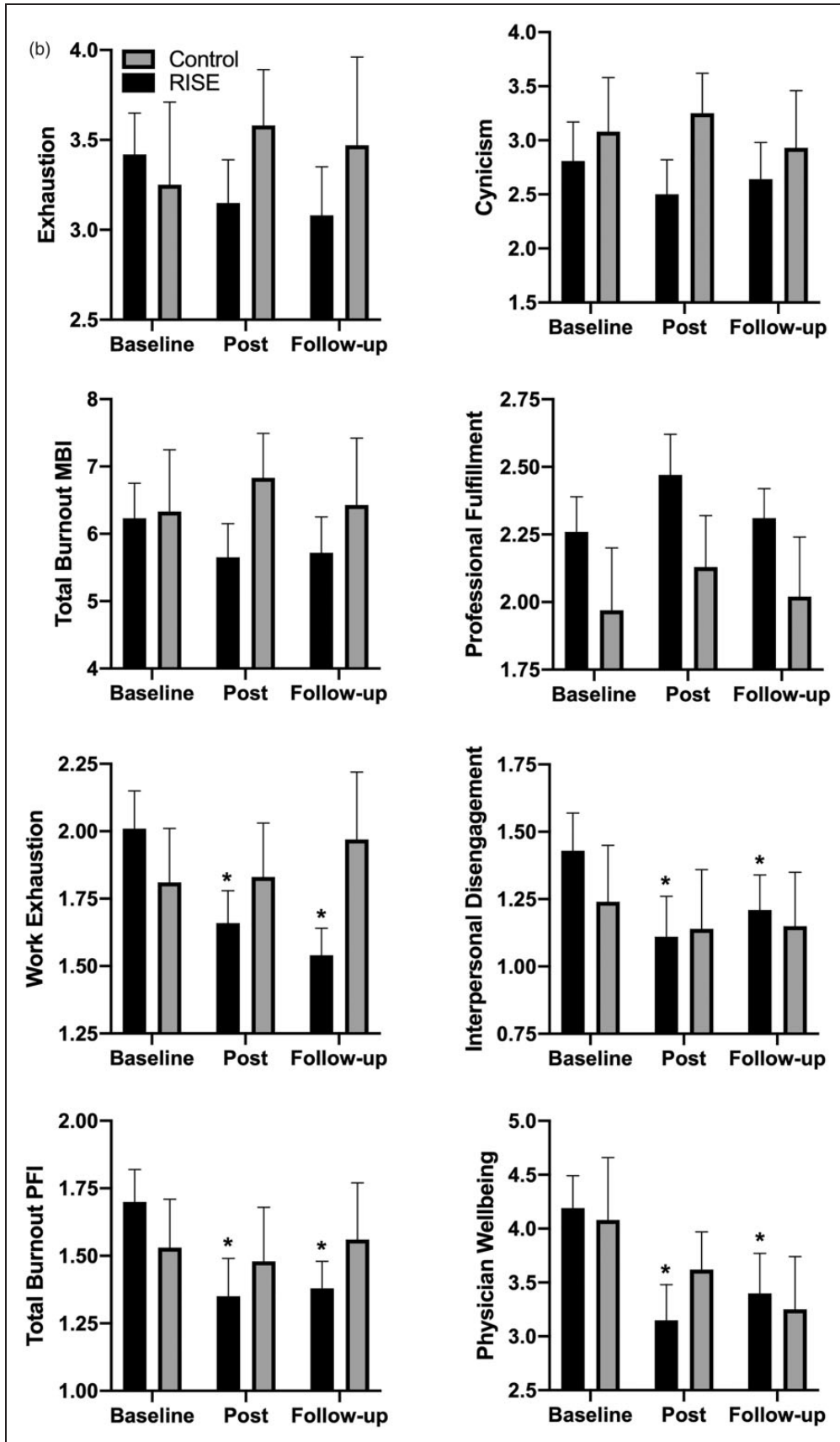


Figure 2. Continued.

Table 3. Resident well-being innovation: supports and barriers.

Supports	Barriers
Buy-in and explicit support from medical education and hospital leadership	Lack of modeling and support from leadership
Local champion, such as a chief resident and/or an Associate Program Director with dedicated time/funding for supporting resident wellness efforts	Resident work hours and clinical workload
Integration into existing residency program via protected didactic time	Schedule complexity and lack of dedicated administrator for scheduling
Explicit clinical coverage (e.g., moonlighters) to protect resident physician time	Clinical coverage at multiple geographic locations
Resident physician advocates and organization into a dedicated committee or council	Evaluation of interventions by traditional research methods (consider drawing from rapid cycle improvement and other methods used in Quality Improvement) ⁵⁹
Separation of medical students and residents into different groups given different lived experiences	Adhering to strict program protocols without adaptation to resident needs
Teaching practical, readily applicable, and culturally acceptable exercises (e.g., mindful hand sanitizing)	
Holding shorter, more frequent sessions	
Flexible, adaptable delivery methods (e.g., virtual delivery)	

support, but there is no correlation between reduction in psychological distress and the number of in-class hours.⁵⁴ In all, a flexible format with a variety of delivery options may better suit resident physician needs.

A larger question inevitably arises: what is the utility of programs such as MBIs when systems-level issues contribute to burnout? While it is crucial organizational changes occur, individual interventions are also effective.¹⁰ Given the time and resources required for organizational changes, MBIs may be a time-sensitive and cost-effective way to address clinician distress in the short term and complement large-scale changes. In addition, there is evidence that individual and workplace factors play similarly large roles in determining burnout and depressive symptoms,⁵⁵ arguing for a fine-tuned approach to problem assessment and solution development. MBIs have been successfully implemented at scale, demonstrated by the Mindful Medical Center.⁵⁶ Finally, medicine is an inherently stressful profession, so providing an MBI could be considered essential resiliency skills training, similar to other high-performing professions.⁵⁷

Limitations

Our study had multiple limitations. It was conducted in a self-selected, single geographic area, limiting generalizability. While between-group analysis is the most rigorous statistical approach, given the exploratory purpose of this feasibility study, we report both between- and within-groups analyses. We also had lower participation of residents in surgical subspecialties, suggesting the need for an individualized approach by specialty. Study

participation and attendance may have been improved by making sessions mandatory, but there is some evidence that MBIs are more effective when individuals volunteer.⁵⁸ RISE is relatively brief compared to other MBIs, offering only 6 hours of in-person intervention compared to 16 hours reported by Lebares et al.²⁶ However, based on our results, we felt a shorter program was more feasible. By chance, the RISE group reported higher baseline mind-body practice compared to control, which may have diminished effect sizes of psychological outcome measures. There was likely heterogeneity introduced given implementation over two years, though this was minimized by administering the study during the fall each year. Finally, though we did not follow participants past the two-month timepoint, most other studies of MBIs in residents used a single-arm study design with minimal follow-up.^{24,44}

Conclusions

This is the first controlled study of a yoga-based MBI in residents. As delivered in the present study, a yoga-based MBI, RISE, was not highly feasible for residents; however, given observed improvements in psychological outcomes, virtual delivery should be studied. In addition, given variability in resident MBIs and time constraints, a minimum effective dose for MBIs in this population should be determined. Finally, RISE may be more feasible if structured into the residency program. Innovation is urgently needed to support physician well-being (Table 3). Future studies will investigate virtual delivery and integration into residency program structures.

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Author Contributions

JL, JAD, and SBSK were responsible for study conception and design. JL, MLS, SB, and NLD were responsible for data collection. NLD analyzed and interpreted data. JL drafted the article. SBSK, JAD, NLD, MLS, and DHM provided critical revision of the article. All coauthors gave final approval for submission of this version of the article.



Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: The authors JL, NLD, MLS, SB, DHM, JAD, and SBSK report no conflicts of interest.

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Supplemental Material

Supplemental material for this article is available online.

References

- Maslach C JS, Leiter MP. *Maslach Burnout Inventory Manual*. 3rd ed. Menlo Park, CA: Mind Garden Inc; 1996.
- Dyrbye LN, Massie FS, Eacker A, et al. Relationship between burnout and professional conduct and attitudes among US medical students. *JAMA*. 2010;304(11):11737–1180.
- Dyrbye LN, Thomas MR, Power DV, et al. Burnout and serious thoughts of dropping out of medical school: a multi-institutional study. *Acad Med*. 2010;85(1):947–102.
- West CP, Huschka MM, Novotny PJ, et al. Association of perceived medical errors with resident distress and empathy: a prospective longitudinal study. *JAMA*. 2006;296(9):1071–1078.
- Dyrbye LN, Freischlag J, Kaups KL, et al. Work-home conflicts have a substantial impact on career decisions that affect the adequacy of the surgical workforce. *Arch Surg*. 2012;147(10):933–939.
- Dyrbye LN, Thomas MR, Massie FS, et al. Burnout and suicidal ideation among US medical students. *Ann Intern Med*. 2008;149(5):334–341.
- West CP, Shanafelt TD, Kolars JC. Quality of life, burnout, educational debt, and medical knowledge among internal medicine residents. *JAMA*. 2011;306(9):952–960.
- Lebares CC, Guvva EV, Ascher NL, O'Sullivan PS, Harris HW, Epel ES. Burnout and stress among us surgery residents: psychological distress and resilience. *J Am Coll Surg*. 2018;226(1):80–90.
- Bodenheimer T, Sinsky C. From triple to quadruple aim: care of the patient requires care of the provider. *Ann Fam Med*. 2014;12(6):573–576.
- West CP, Dyrbye LN, Erwin PJ, Shanafelt TD. Interventions to prevent and reduce physician burnout: a systematic review and meta-analysis. *Lancet*. 2016;388(10057):2272–2281.
- Puerto Valencia LM, Weber A, Spiegel H, et al. Yoga in the workplace and health outcomes: a systematic review. *Occup Med (Lond)*. 2019;69(3):195–203.
- Goodman V, Wardrope B, Myers S, Cohen S, McCorquodale L, Kinsella EA. Mindfulness and human occupation: a scoping review. *Scand J Occup Ther*. 2019;26(3):157–170.
- Wayne PM, Yeh GY, Mehta DH. Minding the Mind-Body Literature: Burnout in Medicine and the Corporate Workforce. *J Altern Complement Med*. 2019;25(1):1–4.
- Kabat-Zinn J. *Wherever You Go, There You Are: Mindfulness Meditation in Everyday Life*. New York, NY: Hyperion; 2005.
- Sauer S, Walach H, Schmidt S, et al. Assessment of mindfulness: review on state of the art. *Mindfulness*. 2013;4(1):3–17.
- Grossman P, Niemann L, Schmidt S, Walach H. Mindfulness-based stress reduction and health benefits: a meta-analysis. *J Psychosom Res*. 2004;57(1):35–43.
- Tang YY, Holzel BK, Posner MI. The neuroscience of mindfulness meditation. *Nat Rev Neurosci*. 2015;16(4):213–225.
- Carmody J, Baer RA. Relationships between mindfulness practice and levels of mindfulness, medical and psychological symptoms and well-being in a mindfulness-based stress reduction program. *J Behav Med*. 2008;31(1):23–33.
- Sauer-Zavala SE, Walsh EC, Eisenlohr-Moul TA, Lykins EL. Comparing mindfulness-based intervention strategies: differential effects of sitting meditation, body scan, and mindful yoga. *Mindfulness*. 2013;4(4):383–388.
- Trent NL, Miraglia M, Dusek JA, Pasalis E, Khalsa SBS. Improvements in psychological health following a residential yoga-based program for frontline professionals. *J Occup Environ Med*. 2018;60(4):357–367.
- Dyer NL, Borden S, Dusek JA, Khalsa SBS. A pragmatic controlled trial of a brief yoga and mindfulness-based program for psychological and occupational health in education professionals. *Complement Ther Med*. 2020;52:102470.
- Trent NL, Borden S, Miraglia M, Pasalis E, Dusek JA, Khalsa SBS. Improvements in psychological and occupational well-being in a pragmatic controlled trial of a yoga-based program for professionals. *J Altern Complement Med*. 2019;25(6):593–605.
- Trent NL, Borden S, Miraglia M, Pasalis E, Dusek JA, Khalsa SBS. Improvements in psychological and

- occupational well-being following a brief yoga-based program for education professionals. *Glob Adv Health Med*. 2019;8:2164956119856856.
24. Scheid A, Dyer NL, Dusek J, Khalsa SBS. A yoga-based program decreases physician burnout in neonatologists and obstetricians at an academic medical center. *Workplace Health Saf*. 2020;68(12):560–566.
 25. Bowen DJ, Kreuter M, Spring B, et al. How we design feasibility studies. *Am J Prev Med*. 2009;36(5):452–457.
 26. Lebares CC, Hershberger AO, Guvva EV, et al. Feasibility of formal mindfulness-based stress-resilience training among surgery interns: a randomized clinical trial. *JAMA Surg*. 2018;153(10):e182734.
 27. Huberty J, Green J, Glissmann C, Larkey L, Puzia M, Lee C. Efficacy of the mindfulness meditation mobile app “Calm” to reduce stress among college students: randomized controlled trial. *JMIR Mhealth Uhealth*. 2019;7(6):e14273.
 28. Zenner C, Herrnleben-Kurz S, Walach H. Mindfulness-based interventions in schools—a systematic review and meta-analysis. *Front Psychol*. 2014;5:603.
 29. Baer RA, Smith GT, Hopkins J, Krietemeyer J, Toney L. Using self-report assessment methods to explore facets of mindfulness. *Assessment*. 2006;13(1):27–45.
 30. Gu J, Strauss C, Crane C, et al. Examining the factor structure of the 39-item and 15-item versions of the Five Facet Mindfulness Questionnaire before and after mindfulness-based cognitive therapy for people with recurrent depression. *Psychol Assess*. 2016;28(7):791.
 31. Wagnild GM, Young H. Development and psychometric. *J Nurs Meas*. 1993;1(2):165–17847.
 32. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav*. 1983;385–396.
 33. West CP, Dyrbye LN, Satele DV, Sloan JA, Shanafelt TD. Concurrent validity of single-item measures of emotional exhaustion and depersonalization in burnout assessment. *J Gen Intern Med*. 2012;27(11):1445–1452.
 34. West CP, Dyrbye LN, Sloan JA, Shanafelt TD. Single item measures of emotional exhaustion and depersonalization are useful for assessing burnout in medical professionals. *J Gen Intern Med*. 2009;24(12):1318.
 35. Trockel M, Bohman B, Lesure E, et al. A brief instrument to assess both burnout and professional fulfillment in physicians: reliability and validity, including correlation with self-reported medical errors, in a sample of resident and practicing physicians. *Acad Psychiatry*. 2018;42(1):11–24.
 36. Pilkonis PA, Choi SW, Reise SP, et al. Item banks for measuring emotional distress from the Patient-Reported Outcomes Measurement Information System (PROMIS®): depression, anxiety, and anger. *Assessment*. 2011;18(3):263–283.
 37. Pilkonis PA, Yu L, Dodds NE, Johnston KL, Maihofer CC, Lawrence SM. Validation of the depression item bank from the Patient-Reported Outcomes Measurement Information System (PROMIS®) in a three-month observational study. *J Psychiatr Res*. 2014;56:112–119.
 38. Cella D, Yount S, Rothrock N, et al. The Patient-Reported Outcomes Measurement Information System (PROMIS): progress of an NIH Roadmap cooperative group during its first two years. *Med Care*. 2007;45(5 Suppl 1):S3.
 39. Yu L, Buysse DJ, Germain A, et al. Development of short forms from the PROMIS™ sleep disturbance and sleep-related impairment item banks. *Behav Sleep Med*. 2012;10(1):6–24.
 40. Buysse DJ, Yu L, Moul DE, et al. Development and validation of patient-reported outcome measures for sleep disturbance and sleep-related impairments. *Sleep*. 2010;33(6):781–792.
 41. Dyrbye LN, Satele D, Sloan J, Shanafelt TD. Ability of the physician well-being index to identify residents in distress. *J Grad Med Educ*. 2014;6(1):78–84.
 42. Babbar S, Renner K, Williams K. Addressing obstetrics and gynecology trainee burnout using a yoga-based wellness initiative during dedicated education time. *Obstet Gynecol*. 2019;133(5):994–1001.
 43. Lebares CC, Guvva EV, Olaru M, et al. Efficacy of mindfulness-based cognitive training in surgery: additional analysis of the mindful surgeon pilot randomized clinical trial. *JAMA Netw Open*. 2019;2(5):e194108.
 44. Fendel JC, Aeschbach VM, Göritz AS, Schmidt S. A mindfulness program to improve resident physicians’ personal and work-related well-being: a feasibility study. *Mindfulness*. 2020;11:1511–1519.
 45. Lases S, Lombarts M, Slootweg IA, Arah OA, Pierik E, Heineman E. Evaluating mind fitness training and its potential effects on surgical residents’ well-being: a mixed methods pilot study. *World J Surg*. 2016;40(1):29–37.
 46. Ireland MJ, Clough B, Gill K, Langan F, O’Connor A, Spencer L. A randomized controlled trial of mindfulness to reduce stress and burnout among intern medical practitioners. *Med Teach*. 2017;39(4):409–414.
 47. Minichiello V, Hayer S, Gillespie B, Goss M, Barrett B. Developing a mindfulness skills-based training program for resident physicians. *Fam Med*. 2020;52(1):48–52.
 48. Chaukos D, Chad-Friedman E, Mehta DH, et al. SMART-R: a prospective cohort study of a resilience curriculum for residents by residents. *Acad Psychiatry*. 2018;42(1):78–83.
 49. Verweij H, van Ravesteijn H, van Hooff ML, Lagro-Janssen AL, Speckens AE. Mindfulness-based stress reduction for residents: a randomized controlled trial. *J Gen Intern Med*. 2018;33(4):429–436.
 50. Goldhagen BE, Kingsolver K, Stinnett SS, Rosdahl JA. Stress and burnout in residents: impact of mindfulness-based resilience training. *Adv Med Educ Pract*. 2015;6:525.
 51. Temple J. Resident duty hours around the globe: where are we now? *BMC Med Educ*. 2014;14(S1):S8.
 52. Mistretta EG, Davis MC, Temkit MH, Lorenz C, Darby B, Stonnington CM. Resilience training for work-related stress among health care workers: results of a randomized clinical trial comparing in-person and smartphone-delivered interventions. *J Occup Environ Med*. 2018;60(6):559–568.
 53. Romceovich LE, Reed S, Flowers SR, Kemper KJ, Mahan JD. Mind-body skills training for resident wellness: a pilot

- study of a brief mindfulness intervention. *J Med Educ Curric Dev*. 2018;5:2382120518773061.
54. Carmody J, Baer RA. How long does a mindfulness-based stress reduction program need to be? A review of class contact hours and effect sizes for psychological distress. *J Clin Psychol*. 2009;65(6):627–638.
55. Rotenstein LS, Zhao Z, Mata DA, Guille C, Sen S. Substantial overlap between factors predicting symptoms of depression and burnout among medical interns. *J Gen Intern Med*. 2021;36(1):240–242.
56. Klatt MD, Bawa R, Gabram O, et al. Embracing change: a mindful medical center meets COVID-19. *Glob Adv Health Med*. 2020;9:2164956120975369.
57. Johnson DC, Thom NJ, Stanley EA, et al. Modifying resilience mechanisms in at-risk individuals: a controlled study of mindfulness training in Marines preparing for deployment. *Am J Psychiatry*. 2014;171(8):844–853.
58. Burton A, Burgess C, Dean S, Koutsopoulou GZ, Hugh-Jones S. How effective are mindfulness-based interventions for reducing stress among healthcare professionals? A systematic review and meta-analysis. *Stress Health*. 2017;33(1):3–13.
59. Taylor MJ, McNicholas C, Nicolay C, Darzi A, Bell D, Reed JE. Systematic review of the application of the plan–do–study–act method to improve quality in healthcare. *BMJ Qual Saf*. 2014;23(4):290–298.