Education in Medicine Journal ISSN 2180-1932

ORIGINAL ARTICLE
Volume 7 Issue 3 2015
DOI: 10.5959/eimj.v7i3.369
www.eduimed.com

Effects of a DVD-Delivered Mindfulness-Based Intervention for Stress Reduction in Medical Students: A Randomized Controlled Study

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ARTICLE INFO

Received : 07/04/2015
Accepted : 23/06/2015
Published : 15/09/2015

KEYWORD

Mindfulness
Medical Students
Stress
Mental Health
Coping

ABSTRACT

Introduction: The aim of this study was to evaluate the effects of a DVD-delivered mindfulness-based intervention for reducing stress among medical students in a Malaysian university. **Methods:** A total of 76 medical students participated in the intervention program (Mindful-Gym DVD). They were stratified according to year of studies and randomly allocated to intervention (N = 38) and control groups (N = 38). The following outcome variables were measured at pre- and post-intervention: mindfulness (with Mindful Attention Awareness Scale, MAAS); perceived stress (with Perceived Stress Scale, PSS); mental distress (with Depression, Anxiety and Stress Scale, DASS); and self-efficacy (with General Self-efficacy Scale, GSE). Hierarchical multiple regression analyses were used to analyse the effect of group (Intervention vs. Control) on changes in the outcome variables. **Results:** One week after the intervention, participants in the intervention group reported significantly greater improvements with small to medium effect sizes in self-reported levels of mindfulness (β = 0.19, ΔR^2 = 0.04, p = 0.028, f^2 = 0.07), perceived stress (β = -0.25, ΔR^2 = 0.06, p = 0.006, f^2 = 0.11), mental distress (β = -0.27, ΔR^2 = 0.07, p = 0.003, f^2 = 0.13), and self-efficacy (β = 0.27, ΔR^2 = 0.07, p = 0.003, f^2 = 0.13), compared to participants in the control group. The number needed to treat (NNT) to achieve 'normal' levels of depressive, anxiety, and stress symptoms (as indicated by the DASS scores) were 5, 8, and 6 respectively. **Conclusions:** This study found that the DVD-delivered mindfulness-based program is potentially a labour- and cost-effective and easily accessible stress reduction program for medical students.

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Introduction

The level of stress in medical students worldwide is significantly high (1–3) and can lead to various mental health problems (4–6). Excessive stress in medical students can also negatively affect physical health, interpersonal relationships, academic performance, and effective training of doctors (5). The prevalence of significant mental stress (measured using the General Health Questionnaire) among medical students in Malaysia is 29% to 46% (7–9). There are at least 24 published studies supporting the effectiveness of stress management interventions

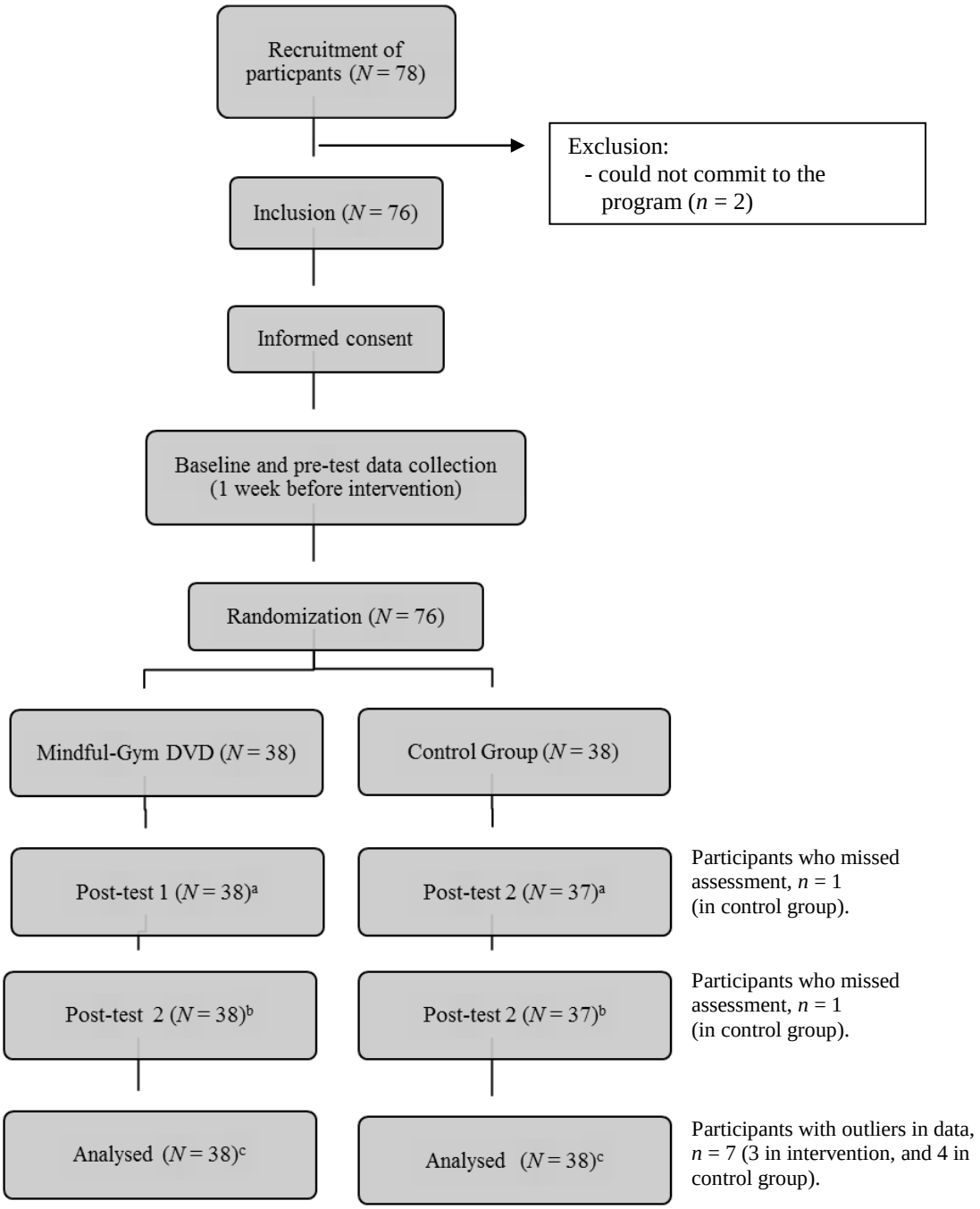
among medical students (10–12). The published studies in Malaysia so far focus on two very brief intervention programs consisting of a one-off, half-day (3-4 hours) of weekend mini lectures and discussion on general stress management (13,14). In the first study on 38 students, there were significant improvements in the level of psychological distress from pre- to four months post-intervention (13). The second study (14) found that during an examination, the levels of depressive and anxiety symptoms among students who had participated in the program six months earlier (N = 19) were significantly lower than those among students who did not participate in the program (N = 29). In a recent randomized controlled trial (N = 35), a five-week face-to-face mindfulness-based program has also been found to be effective for reducing stress among medical students in Malaysia (in press).

Whereas these pioneering local programs are commendable, their delivery requires the presence of a qualified trainer, which can be costly and potentially limits its accessibility to medical students. A five-week DVD-delivered mindfulness-based intervention (Mindful-Gym DVD) was developed for the purpose of increasing the accessibility of mindfulness-based stress management strategies to students. The intervention was adapted from the Mindfulness-based Stress Reduction (MBSR) program (15–17) and Mindfulness-based Cognitive Therapy (MBCT) (18–21). In the latest comprehensive meta-analysis of 209 studies involving a total of 12,145 participants (22), it was concluded that these mindfulness-based interventions (MBIs) are effective for reducing stress, anxiety, and depression. Effect-size estimates suggested that MBIs are moderately effective in pre-post comparisons (N = 72; Hedge's g = 0.55), and in comparisons with waitlist controls (N = 67; Hedge's g = 0.53).

MBIs have also been introduced to medical students. There are 14 medical and dental schools worldwide offering MBI in various formats (23). But there are only seven published studies on effectiveness of the MBIs involving medical students (24–30). Regarding the approach of delivering MBIs, three studies used the traditional MBSR format, which involves an eight-week group program delivered by an MBSR instructor; one used compact disc (CD) of audio-guided mindfulness practice, one was a four-day mindfulness meditation program, and one was part of a semester core curriculum. No study so far has reported on the usage of stand-alone (not part of a MBI with face-to-face interaction), self-help DVDs with audio-video instructions to deliver an entire MBI for medical students. The closest to this is the use of a 30-minute stand-alone, self-help audio-guided MBI (28). The duration of the interventions was between 4 to 10 weeks.

A core principle in all MBIs is 'Mindfulness.' Mindfulness is often described as the awareness that arises through intentionally attending to one's moment-to-moment experience in a non-judgmental way (17). It originated from various ancient spiritual traditions, particularly Buddhism (31). However, mindfulness in contemporary world has been conceptualized and delivered in a secular context as a way to increase awareness and responding skilfully to mental processes that contribute to emotional distress and maladaptive behaviour. Mindful attention enables us to response skilfully to challenges in life, instead of reacting in negative and unhelpful ways. The expanded concept of mindfulness ('meta-mindfulness') has been suggested for further integration in psychotherapy (32). Some of the practices recommended by the meta-mindfulness approach are implemented in the intervention in this study (e.g. the practice of cultivating gratitude and contentment).

The present study is aimed to evaluate the effects of the DVD-delivered MBI in helping medical students to reduce stress. Compared to participants in the control group, we hypothesize that participants in the intervention group would report lower levels of perceived stress, mental distress; and higher levels of mindfulness and self-efficacy, from pre- to post-intervention. We also determined the most frequently used stress reduction tool in the program.



[a] One week after intervention; [b] six months after intervention, [c] Intention-to-treat analysis.

Figure 1: Flow of the intervention study with a randomized pre-post controlled design.

Method

Participants and procedure:

Eligible participants were medical students enrolled in year one to three of their studies in Universiti Putra Malaysia (UPM) who wished to learn ways to managing stress. The program was introduced to the students through emails, Facebook and blog as "Mindful-Gym DVD: A Stress Management Program for Medical Students." Those who were interested to participate in the program were included in the study. Potential participants were reminded that they need to spend 3-5 minutes daily to practice what they would learn from the program; else

they would be excluded from the study (n = 2). Students with 'severe depression' as identified using the Depression, Anxiety and Stress Scale (DASS) (11%) were immediately advised to seek help from the mental health services in UPM (33). They were not excluded from the study as broad inclusion criteria were intended for better generalizability of the effects of the program. In the end, seventy six medical students enrolled in the study. They were stratified according to their years of studies and randomized into intervention (N = 38) and control groups (N = 38). Figure 1 summarizes the flow of the study and Table 1 shows the demographic and other baseline characteristics of the participants. All participants gave written consent and ethics approval was granted by the ethics committee of the Faculty of Medicine and Health Sciences, UPM.

Table 1: Baseline data for both intervention and control groups (N = 76).

Variables	Mindful-Gym DVD (N = 38)	Control Group (N = 38)	X^2	*p-value*
Age, mean (*SD*)	20.91 (1.15)	20.94 (1.17)		
Gender				
Male	9 (24%)	7 (18%)	0.32	0.57
Female	29 (76%)	31 (82%)		
Ethnic				
Malay	16 (42%)	21 (55%)	0.84	0.36
Chinese	19 (50%)	14 (37%)	1.34	0.25
Indian	3 (8%)	3 (8%)	0.00	1.00
Religion				
Islam	16 (42%)	19 (50%)	0.84	0.36
Buddhism	17 (45%)	15 (40%)	0.88	0.35
Hinduism	3 (8%)	2 (5%)	0.21	0.64
Christianity	2 (5%)	2 (5%)	0.00	1.00
Relationship status				
Single	38 (100%)	38 (100%)		
Married	0	0		
Year of study				
Year 1	13 (34%)	12 (32%)	0.06	0.81
Year 2	13 (34%)	11 (29%)	0.24	0.62
Year 3	12 (32%)	15 (39%)	0.52	0.47

SD = standard deviation

Intervention

The intervention of the study was a five-week DVD-delivered mindfulness-based program (Mindful-Gym DVD) which was adapted from and based on the principles of the eight-week MBSR and MBCT programs. It is shorter in duration with more emphasis on informal practice, has sessions on grateful thinking and cultivating loving-kindness; and with instructions tailored for medical students. They were introduced to the students as a stress management program with the promotional name, "Mindful-Gym" (to emphasize the importance of experiential training and daily practice). The slogan of the program was "Be Present, Be Calm & Be Grateful." As part of the intervention, a half-hour briefing was given on how to use the DVD. After that, there were no individual sessions, group meetings or online discussion. The DVD contained about 500 PowerPoint slides with step-by-step audio-video instructions for coping with stress. The training materials were organized in five modules (one for each week). Participants were taught techniques to focus their attention on the present-moment experience, decrease emotional reactivity, and increase feelings of gratitude. Table 2 shows an outline of the program. Those who were randomized to the control group did not participate in the Mindful-Gym DVD program.

Table 2: Outline of the DVD-delivered Mindful-Gym program.

Week 1
• Medical students & stress
• ABC of Mindfulness (introduction to mindfulness)
• Story: Genie with unlimited wishes
• 'NOW-ing' (mentally labelling physical actions)
• Home-gym (homework assignment)
Week 2
• Review of week 1 lessons and exercises
• Song: Happiness is here-and-now (Malaysian version)
• Mindful Body Stretching and Relaxation
• Mindful Breathing
• Home-gym (homework assignment)
Week 3
• Review of week 2 lessons and exercises
• 'Mindful-scope' and 'Beginner's Mind'
• Mindful Imagery – 4 Pleasant States
• 'Gratitude Workout' (cultivating grateful thinking)
• Home-gym (homework assignment)
Week 4
• Review of week 3 lessons and exercises
• Thought-Scan – Mindfulness of Thinking Errors
• Body Scan and Kindness
• Mindful-S.T.O.P. I * – log in to mindfulness, made easy
• Home-gym (homework assignment)
Week 5
• Review of week 4 lessons and exercises
• 'Heartfulness' (cultivating loving-kindness)
• Mindful-S.T.O.P. II* (Extended practice)
• Review of Mindful-Gym tools
• Mindfulness Personal Practice Package (MP3) – customizing mindfulness practice

* Mindful-S.T.O.P. is an acronym for brief informal mindfulness practice (S – Stop, T – Take deep and mindful breaths, O – Observe surrounding sounds, P – Proceed with activities with a smile).

Measures

Several self-report outcome measures were administered. The Mindful Attention Awareness Scale (MAAS) measures levels of awareness and attention to the present-moment experience, which are considered to be foundational to mindfulness (34). It consists of 15 items and participants respond to each item using a six-point Likert scale ranging from 1 (almost always) to 6 (almost never). Item responses for each participant are summed and averaged, yielding a total score of mindfulness ranging from 1 to 6. Higher scores indicate higher levels of mindfulness. The Cronbach's alpha value in this study was 0.92.

The Perceived Stress Scale (PSS) is a 10-item self-report instrument used to assess the degree to which an individual appraises life events as stressful (35). Items were created with the intention of assessing how unpredictable, uncontrollable, and overloaded respondents perceive their lives to be. Participants respond to each item using a five-point Likert scale ranging from 0 (never) to 4 (very often). Item responses for each participant are summed after reverse scoring seven items, yielding a total score of perceived stress ranging from 0 to 40. Higher scores indicate higher levels of perceived stress. The Cronbach's alpha value in this study was 0.85.

The Depression, Anxiety and Stress Scale was used to assess the severity of depression, anxiety and stress (or tension) symptoms (33). It has three sub-scales; depression (DASS-D), anxiety (DASS-A) and stress (DASS-S). Each sub-scale has seven items and each with a four-point response ranging from 0 (did not apply to me at all) to 3 (apply to me very much or most of the time). The subscale scores (after multiplied by two) are classified into normal, mild, moderate, severe and extremely severe symptoms. Each subscale has a different cut-off point for classification of severity. For 'normal' vs. 'mental distress' (mild to extremely severe), the cut-off points are 10 (depression), 8 (anxiety), and 15 (stress) for respective subscales. Both the total DASS scores (indicating severity of mental distress) and categorized sub-scale of DASS scores ('normal' vs. 'mental distress') were used in this study; Cronbach's alpha value was 0.88 for the total DASS scores.

The General Self-Efficacy Scale (GSE) is a 10-item scale for assessing a general sense of perceived self-efficacy, with the aim in mind to predict coping with daily hassles and adaptation after experiencing all kinds of stressful life events (36). Participants respond to each item using a four-point scale ranging from 1 (not at all true) to 4 (exactly true). Higher scores indicate greater self-belief in the capability to cope with

stress and achieve one's goals ('I can' attitude). The Cronbach's alpha value in this study was 0.91.

A one-item questionnaire was constructed to assess compliance with weekly practice "How often have you been practicing the Mindful-Gym exercises for the past one week?" Responses are in the form of a five-point Likert scale, "1 - none at all, 2 - less than half of the days, 3 - about half of the days, 4 - more than half of the days, and 5, Almost every day, an overall score is obtained by dividing the total scores in five weeks by five. Higher scores indicate better compliance with daily practice (1 - none at all, > 1 to 2 - less than half of the days, > 2 to 3 - about half of the days, > 3 to 4 - more than half of the days, and > 4 to 5 - almost everyday. Another question was constructed to obtain feedback on the most frequently used stress reduction tool among the participants, "Which Mindful-Gym tool do you most frequently use for stress reduction?"

Procedures

Randomization

Stratified random sampling method was used to assign the participants to experimental groups. The participants were stratified according to the years of medical studies; one, two and three. Every participant in each year of studies was given a number according to the sequence of appearance in the name lists (according to the years of studies). In each year of studies, participants were randomly allocated to experimental groups with the help of an online computer program known as "RANDOM.ORG" (37). In order to avoid bias in experimental group allocation, the random numbers generation and matching of numbers with students' name were done by a master student in counselling who was not involved in the study. Out of the 76 participants, 38 were randomized to the intervention group, and another 38 were randomized to the control group.

Blinding

This is a non-blinded randomized controlled study. In order to minimize ascertainment bias of intervention outcomes, assessments of outcomes were conducted using self-rated questionnaires sealed in envelopes distributed by the class representatives; instead of the trainer/investigator. Participants in the control group were not explicitly informed that they were in an experimental control group. They were informed that they would receive the intervention at a different time; six months later, which is after the follow-up period of the study.

Data collection

Baseline data collection was done one week before the commencement of intervention with the help of class representatives who distributed and collected the questionnaires sealed in envelopes. Only acronyms of the questionnaires (e.g. 'GHQ' instead of full name, 'General Health Questionnaire') were used during data collection to avoid self-fulfilling expectation (e.g. "I'm supposed to be stress free"). Follow-up data were collected using the same method at one week and six months after the interventions. All assessment times were scheduled to avoid periods of examinations and semester holidays (at least two weeks apart).

Sample size calculation

The sample size calculation was based on a prior quasi-experimental study of a similar intervention among medical students in the same university. Using hierarchical multiple regression (HMR) analysis, the average effect size (f^2) for the study involving four outcomes similar to this study was 0.13, which is close to a medium effect size (0.15). Assisted by an online statistic calculator, "Statistics Calculators" (version 3.0 BETA) (38), the required sample size, based on an expected medium effect size, power of 0.80, and alpha level of 0.05 was 64. Considering a drop-out rate of around 10% among students participating in MBCT (39,40), the total sample size needed would be around 70 (63 x 110% = 70.4); the final sample size used for analysis in this study was 76.

Statistical analyses

We conducted intention-to-treat (ITT) analyses (41) on the data from 76 participants.

Participants who missed at least one assessments (n = 2, 3%), and had outliers in data (n = 7, 9%) were included in the ITT analyses – see Figure 1. The Statistical Program for Social Sciences (IBM SPSS Statistics for Windows, Version 21.0) was used for data analyses. The scores of the DASS and GSE were square-root transformed for normality. For the primary analyses, we evaluated the effect of experimental group (Intervention vs. Control) on each of the dependent outcome measures. This was conducted with a series of HMR of post-intervention scores on the corresponding pre-intervention scores. The post-intervention scores were the dependent variables, and the corresponding pre-intervention scores were included in the first step of the HMR. The second step was for any covariates (age, gender, ethnicity, religion, and year of medical studies), if present (identified earlier using HMR). The final step was for the predictor variable of interest – experimental group (Intervention vs. Control). As the tests were conducted for four outcomes, we maintained an overall family-wise Type I error of < .05 by using the Holm-Bonferroni's procedure to determine statistical significance in the analyses (42). Effect sizes of group as a predictor was estimated by f^2 in which values of 0.02, 0.15, and 0.37 are considered small, medium and large respectively (43). We also calculated the 'Number Needed to Treat (NNT)' for categorized DASS scores (normal vs. mild to very severe), which was used as a measure to assess the clinical importance of change due to intervention. NNT is defined as the expected number of people that need to receive an intervention rather than the control condition for one additional person to have a specified effect within a given time frame (44, 45).

Result

Baseline characteristics of sample

Table 1 shows the demographic and other baseline characteristics of the participants in the study. A chi-square test for association was conducted between treatment groups and demographic, as well as other categorical baseline characteristics. There were no significant correlations between experimental groups and the categorical variables analysed, X^2 (1) = 0-1.34, $p > 0.05$. A Mann-Whitney U test showed no significant difference in age between treatment groups, U = 677, z = -0.48, p = 0.63. Independent-t tests showed no group differences at pre-intervention on any of the outcome measures, $t(74)$ = -0.10 – 1.28, p >0 .05.

Changes in outcome measures

The HMR analyses showed experimental group effects on the outcome scores; significant reduction in the perceived stress (p = .006) and mental distress (p = .003), and increment in the mindfulness (p = .028) and self-efficacy (p = .003) scores at one week post-intervention. The effect sizes of changes were small for the mindfulness, and close to medium for the perceived stress, mental distress, and self-efficacy outcomes (see Table 3).

Table 3: Hierarchical multiple regression analyses for the effects of experimental groups on change in outcome variables at one week after intervention.

Outcomes	**Mindful-Gym*,** mean (*SD*)		**Control Group*,** mean (*SD*)		**Group Effect**			
	Time 1	**Time 2**	**Time 1**	**Time 2**	**β**	**ΔR^2**	***p***	**f^2**
MAAS	4.15 (0.88)	4.48 (0.81)	3.91 (0.74)	4.01 (0.88)	0.19	0.04	0.028*	0.07
PSS	17.82 (5.84)	15.30 (5.43)	19.58 (5.70)	19.04 (5.15)	-0.25	0.06	0.006*	0.11
DASS	40.83 (21.75)	28.73 (18.97)	40.79 (20.42)	41.87 (25.09)	-0.27	0.07	0.003*	0.13
GSE	30.34 (4.91)	31.76 (4.66)	29.03 (4.28)	28.36 (4.47)	0.27	0.07	0.003*	0.13

SD = standard deviation, MAAS = Mindful Attention Awareness Scale, PSS = Perceived Stress Scale, DASS = Depression Anxiety Stress Scale, GSE = General Self-Efficacy Scale, **N* = 38

Within-group analyses with Paired-t tests showed significant improvements in the intervention group for the scores of perceived stress (p = 0.006), mental distress (p < 0.001), mindfulness (p = 0.011); but no changes in the self-efficacy scores (p = 0.062). The significant improvements in perceived stress, mental distress, and mindfulness scores were not found in the control group (p > 0.05). At six months post-intervention, there were no group differences in any of the outcome measures (p > 0.05).

At pre-intervention, the percentages of participants with 'mild to extremely severe' depressive, anxiety, and stress symptoms (mental distress) as indicated by the DASS scores were 55% (depression), 72% (anxiety) and 54 (stress) respectively. After the intervention, the number of participants who scored in the 'normal' range of (without mild to extremely severe) depressive, anxiety, and stress symptoms were respectively 27 (71%), 16 (42%), 25 (66%) in the intervention group; and 19 (50%), 11 (29%), 19 (50%) in the control group. We calculated an absolute risk reduction of 0.211 (depression), 0.132 (anxiety), and 0.158 (stress), with corresponding NNT of about 5 (1/0.211), 8 (1/0.132), and 6 (1/0.158).

When we conducted per protocol (PP) analyses instead of ITT analyses, all the results related to outcomes are similar in terms of statistical significance. In the PP analyses, we excluded participants who missed at least one assessments (n = 2, 3%), and had outliers in data (n = 7, 9%). The fact that both ITT and PP analyses resulted in similar results strengthened the validity of the findings (41).

Compliance with weekly practice

The mean scores of compliance with weekly home practice during the five-week program were 2.2 (SD = 0.9, range = 1.0 to 3.8); on average, participants were practicing the Mindful-Gym exercises on about half of the days in a week. About two-thirds (63%) were practicing on at least half of the days in a week; only one participant did not practice at all. There was a small negative correlation between compliance scores during the five-week program and the mental distress (DASS) scores at one week post-intervention, $r(34) = .34$, p = 0.04. At six months post-intervention, the mean scores in weekly home practice during the last six months dropped from 2.2 to 1.7 (SD = 0.6, range = 1 to 3), referring to an amount of practice that lasted less than half of the days in a week.

Feedback on the most frequently used stress reduction tool

30% of the participants reported that "deep and mindful breathing" was the most frequently used tool for stress reduction in daily practice. 18% of participants rated "mindful stretching and muscle relaxation" as the most frequently used practice; whereas 15% chose "mindful imagery."

Discussion

Prior to intervention, the percentages of participants with 'mild to extremely severe' depressive, anxiety, and stress symptoms as indicated by the DASS were 55% (depression), 72% (anxiety) and 54% (stress) respectively. The considerably high percentages suggest that the Mindful-Gym program was able to reach out to those with significant mental distress. The study showed that a DVD-delivered MBI significantly reduced perceived stress, depression, anxiety, and stress symptoms (mental distress); and increased levels of mindfulness and self-efficacy over a period of five weeks.

The results are comparable to a randomized controlled trial by Warnecke et al., which utilized an eight-week program that involves 30 minutes of daily audio-guided mindfulness practice, and found that the program resulted in significant decreases in depression, anxiety, stress symptoms and perceived stress as measured by the DASS and PSS (28) The findings suggest that with mindfulness training, medical students are better able to perceive challenges in medical school with a positive attitude, and as a result experience reduced mental distress. This is consistent with one of the proposed mechanism of actions of mindfulness

for stress reduction, whereby mindfulness is a meta-cognitive form of awareness, involves the process of 'decentering,' a shifting of cognitive sets that enables alternate appraisals of life events (46). Stopping or avoiding the challenges in medical school is often impossible. Teaching the students to perceive challenges in more positive and helpful ways is more realistic (if we cannot stop the waves, we can learn to surf on the waves).

In this study, participants of mindful-gym reported significant reductions in depression, anxiety, and stress symptoms, and the effect sizes (in the medium range) are similar to those found in the meta-analysis of MBIs (22). The 'Number Needed to Treat' (NNT) for improvements in depression, anxiety, and stress symptoms ('mild to very severe' vs. 'normal' for each subscale of the DASS) were 5, 8, and 6 respectively. Compared to the study for medical and psychology students, the NNT for improvement in mental distress as measured by the General Health Questionnaire (with a cut-off score of ≥ 4) was 4 for a six-week MBI with face-to-face contact (29). The medium effect size of improvement and overall NNT of 5 to 8 in this study are encouraging. The finding suggests that for every 5 to 8 medical students, there is one positive significant outcome that would not otherwise have occurred. In comparison, the NNTs for common therapies of psychiatric disorders are in the range of 2 to 7 (45,47). Given that this study involved a significant proportion of participants (ranging between 54% and 74% of the whole sample) with significant mental distress (as defined by elevated scores in the DASS), the findings suggest that Mindful-Gym as delivered through DVD is effective in supporting students with elevated mental distress. The results have significant implication in terms of delivering intervention programs to medical students for well-being in a cost- and labour-effective manner.

The study also found that participants who enrolled in Mindful-Gym reported significant increases in mindfulness compared to those in the control group. Among studies investigating the efficacy of MBIs in medical students, only one so far has included the measurement of mindfulness, using the Five Facet Mindfulness Questionnaire (FFMQ) (29). Thus, this study adds to the preliminary evidence that increased mindfulness is a beneficial outcome and a potential mediator of stress reduction in MBI among medical students, a finding that has only been shown in the non-medical students populations (48,49). With regards to the small effect size, it is not surprising. In studies on MBI among non-medical students, it is not uncommon to have no report on the measurement of mindfulness (50,51), no increment (52), or partial increment ('observing' subscale of the Kentucky Inventory of Mindfulness Scale - KIMS) in the level of mindfulness (53). The discrepancy in results could be due to the difference in method, duration, and intensity of mindfulness training, methods of measuring mindfulness, choice of statistical analyses, and experience of the MBI trainer.

This study also showed that the intervention increased a sense of self-efficacy in coping with adversities and achieving goals (measured by the GSE scale). Earlier study on 2,435 students has shown a positive correlation between mindfulness and self-efficacy (54) As far as we know, this is the first study that demonstrated the effect of MBI on improving self-efficacy in medical students. This is consistent with another proposed mechanism of actions of mindfulness for well-being, which is that mindfulness practice may enable more adaptive stress responses and coping (55). Taken together, the findings suggest that the intervention helped medical students to perceive stress more positively, have greater confidence in coping with challenges, and thus have less mental distress in achieving their goals in medical school.

During the five-week program, on average and approximately two-thirds (63%) of the participants were practicing the exercises in the program on half of the days in a week. This suggests that the program and its exercises were acceptable to the participants. Compliance to daily practice was reasonable and roughly comparable to other studies among medical

students: 90% practiced at least once a week in a semester (27); practice was done in 30% of the days in eight weeks (28); and total number of hours of practice averaged 5.27 in four weeks (26). In delivering MBI, ensuring compliance to daily practice is often challenging. In this study, six months after the intervention, participants were on average practicing the skills on only less than half of the days in a week. This may explain why the effects of the program were not maintained at six months after intervention. The literature is inconclusive on whether better compliance predicts better outcomes. The findings related to the association between amount of practice and intervention outcomes ranged from no association (56); presence of association (57,58); to partial or conditional association (e.g. after intervention but not at follow-up (59); presence of association between formal practice and outcomes, but absence of association between informal practice and outcomes (60).

The most frequently used stress reduction method among the medical students was "deep and mindful breathing." It is strength of the program with several advantages: 1. It can be practiced at any time and anywhere as we are never separated from our breathing, 2. It can be creatively modified for individual needs, e.g. combined with mindful stretching, imagery, hand movements, 3. It can be easily taught to patients for various health indications. Deep and mindful breathing was also integrated into 'Mindful-S.T.O.P,' which is an acronym for a brief informal mindfulness practice in the program (S – Stop, T – Take deep and/or mindful breaths, O – Observe surrounding sounds, P – Proceed with activities with a smile). Through this simple yet helpful way, medical students can easily 'log on' to mindfulness for stress reduction throughout their years of studies.

To our knowledge, this is the first study that evaluated the effectiveness of a MBI for medical students that was fully delivered though DVDs. Using CD with audio recording for guided mindfulness practice as part of a MBI or on its own has been done and found to be effective (61,62). However, using DVDs containing PowerPoint slides with audio-visual guidance to deliver an entire MBI to medical students is a pioneering attempt. Similar approaches have been attempted in the non-medical student population through online mindfulness courses, and these courses have been found to be as effective as face-to-face MBI (50,63–65). However, the DVD-based delivery method in this study has certain advantages compared to internet-based delivery of MBI. For example, among medical students in our context, access to computers with DVD functions is generally easier than access to reliable internet service.

This study has several limitations. First, as the study was conducted in a specific population – medical students, the findings may not be generalizable to other populations. Future studies should examine the efficacy of this intervention in other populations, such as non-students and clinical populations. Second, the effectiveness of the intervention was not durable after six months. Future studies should examine if the effects can be maintained through follow up efforts to maintain compliance to practice (e.g. reminder emails) after the intervention period. It may also be helpful to explore if alternative formats of delivering the intervention, e.g. a one-day workshop, followed by the use of the DVD, and further monthly reminder through emails, Facebook, Tweeter, or WhatsApp might enhance the efficacy of the intervention. Third, the design of the study could be strengthened by random sampling of participants and not just random allocation of volunteers to intervention and control groups. The use of an active control group (e.g. a DVD with information on signs and symptoms of common mental disorders), and biological measures of stress (e.g. salivary alpha-amylase) in addition to self-reported measures will also add values to the study. Fourth, it might be beneficial to have qualitative study to explore the use of 'deep and mindful breathing' in ways specific to medical students' life. This can provide richer information on how mindfulness-based tool can be used by medical students and healthcare professionals. Finally, moderator and mediator studies would be value-added to shed light on the predictors of outcomes and mechanism of actions of the intervention.

Conclusion

In conclusion, the study showed that a five-week MBI delivered through PowerPoint slides in a DVD was effective in reducing perceived stress, mental distress; and increasing levels of mindfulness and self-efficacy among medical students.

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