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The effect of short-term practice of mindfulness meditation in alleviating stress in university students

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Abstract

Although mindfulness meditation practice appears to confer positive effects on various clinical conditions, physiological responses to this practice in healthy individuals are largely unknown. This study is aimed at evaluating the physiological effects of short-term mindfulness meditation in university students intending to take a written term examination. Young healthy university students (n=18) recruited as participants were divided equally into a meditation group without examination stress, a non-meditating group with examination stress, and a meditation group with examination stress. The meditation intervention groups were offered mindfulness practice twice daily of 1 h each time for a period of 5 weekdays, except for weekends, for 3 consecutive weeks. The parameters measured included heart rate, blood pressure and serum cortisol. Depression Anxiety Stress Scales (DASS) were also obtained to monitor any negative psychological symptoms. All parameters were measured before intervention, just after intervention, which also coincided with the eve of the academic examination and at 3 weeks after. The DASS-Stress scale was significantly (p<0.05) reduced after intervention in the meditation group with no examination challenge. However, no significant changes were found in the cardiovascular and cortisol outcomes amongst all groups for all time lines. Even though these findings did not show any significant physiological responses to the short-term mindfulness practice in stressful conditions, nonetheless, the results demonstrate the potential benefits of this practice in alleviating stress in the neutral environment of university students. Future studies should address the effects of mindfulness practice in larger groups exposed in stressful situations.

Key words: University **e**xamination stress; mindfulness meditation; physiological effects

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Introduction

Mindfulness meditation has been described as a process of bringing attention to the present experience on a moment-to-moment basis in a nonjudgmental fashion [1]. It is the attempt to cultivate a state of consciousness which involves nonjudgmental observation of the ongoing stream of internal and external stimuli as they arise [2]. Thus, mindfulness involves not only paying attention, but also encompasses attitudes of nonjudging and open acceptance [3]. As such, mindfulness meditation is a practice that can develop greater conscious awareness that would reduce negativity, improve vitality and facilitate the coping with stress.

It is well established that stress can have adverse effects on a range of physiological and psychological outcomes. Acute stress has been reported to increase the activity of the hypothalamo-pituitary adrenal (HPA) axis with a subsequent rise in serum cortisol level [4]. One of the more acute forms of stress experienced by university students is that of an impending academic examination, which in extreme cases can lead to feelings of anxiety and depression [5, 6], and suicidal ideation [7] and attempts [8] even in later life.

As an alternative self-regulatory approach to stress reduction and emotional engagement for health and health-related problems, studies on mindfulness meditation have been on the rise in recent years [9]. Although mindfulness meditation was originally rooted in Buddhism, it is now an area of intense research since first being introduced to the west by Kabat-Zinn [1]. Extensive work has demonstrated that mindfulness meditation does indeed confer positive effects on the symptoms of stress, quality of life and mood in various clinical conditions such as

chronic pain [10-12], fibromyalgia [13,14], skin disease [15], cancer [16–18], psychiatric problems such as anxiety disorders [19-21], and on general health. However, the immediate physiological responses to mindfulness meditation are largely unknown as less research is focused on non-clinical situations [22-24]. Moreover, to date, no studies are available that evaluate mindfulness meditation alone as a stress reduction intervention to help university students cope in the stressful environment.

Thus, as an attempt to redress the paucity of information on the physiological responses to mindfulness meditation in the literature, the study presented here is designed to focus on the short-term physiological effects of mindfulness meditation on university students intending to take a written term examination. The physiological stress parameters monitored include heart rate (HR), blood pressure (BP), and serum cortisol level, whilst the psychological stress symptoms are recorded using the Depression Anxiety Stress Scales (DASS) [25].

Methods

Participants and setting

Eighteen healthy undergraduate volunteers (12 females and 6 males with the mean age of 20.9±0.7 y and years of education of 15.4±0.3 y) from the Biomedical Science Program of the University of Malaya were purposely selected onto this study based on their having examination and intention to meditate. All participants were single, neither smokers nor drinkers, and were free from medication and financial constraints.

Participants were reimbursed on a laboratory session basis and those with previous meditation practice experience and /or with known medical conditions were excluded.

Before the study commenced, the nature of the procedures was explained to the participants individually and at the same time, their informed written consents were obtained. In addition, each participant's personal history including medical history and life-style practice was also obtained. A detailed description of the mindfulness meditation technique was given verbally as well as in the written form to the participants who were to be involved in the meditation procedure. The study was approved by the Medical Ethical Committee of University Malaya Medical Centre.

Assessments

Subjective assessment

A validated 42-itemed questionnaire that produces a score on the states of depression, anxiety and stress, the DASS, in the Malay language was given to the participants for assessment of their own self-rated stress level [26]. This questionnaire was developed by Lovibond and Lovibond [25] and it is widely used in research and clinical settings to study the current state or change in state over time on the three dimensions of depression, anxiety and stress. It has acceptable reliability and validity, and established data are available for the non-clinical population [27].

The DASS comprises three sets of self-reported scales that are designed to assess the negative emotional states of depression, anxiety and stress. The stress scale is constructed so that the sensitivity levels of chronic nervous arousals, difficulties in relaxation, and feelings of being upset/agitated, irritability or over-reactivity and impatience are computed. The participants were asked to use a 4-point rating scale (0 = did not apply to me at all, 1 = applied to me to some degree or some of the time, 2 = applied to me to a considerable degree or a good part of the time, 3 = applied to me very much or most of the time). In the present study, only the stress scale (the DASS-Stress scale) was measured by calculating the summation of scores for the relevant items pertinent to the stress domain.

Objective assessment: Cardiovascular (CVS) parameters

Systolic (SBP) and diastolic blood pressure (DBP) and HR were recorded by a clinical digital automatic blood pressure monitor (Colin NIBP). The mean arterial blood pressure (MAP) was calculated using the following: MAP = DBP + 1/3 pulse pressure.

In order to ensure similar autonomic activity on cardiac function, seated resting SBP, DBP, MAP and HR measurements were obtained between 08:00 to 10:00 h from the right arm for 35 min (three readings at 0, 5 and 35 min). For each reading, 2 consecutive readings were obtained and an average value was calculated. The 0-min measurement was discarded, whilst the data obtained at the 5- and 35-min were used for analysis.

Objective assessment: Serum cortisol

Blood samples were taken from the participants for 2 consecutive days, between 08:00 to 08:30 h, allowed to clot and then separated by centrifugation. The serum samples were sent to the clinical diagnostic laboratory of University Malaya Medical Centre on the same day before 10:00 h for analysis by competitive immunoassay using the direct chemiluminescent technology (ADVIA Centaur, Siemens Diagnostic Company) [28].

Experimental design

In order to study the effect of short-term mindfulness practice in the stressful environment of university students, the participants were divided into Group A, who were not sitting for an academic examination but intended

to meditate (n=6), whilst Group B participants (n=6) were those who were sitting for an examination but did not intend to meditate. Subjects of Group C were participants (n= 6) sitting for examination and intended to meditate.
Subjective and objective parameters were taken before the meditation intervention (Time 1), just after 3 weeks of intervention, which is also the eve of the academic examination (Time 2) and 3 weeks after the end of meditation practice (Time 3). All necessary precautions were executed to ensure minimum disturbance to data collection.

Intervention procedure: The mindfulness meditation practice setting
A dimmed and quiet room conducive to meditation was prepared for the participants in Groups B and C to practice in. The participants were asked to meditate for one hour twice a-day for a period of 5 days with a break of 2 days at the weekends. The daily sessions were scheduled between 07:00 to 09:00 h, and between 16:00 to 18:00 h. This regime lasted for 3 weeks.

Principle
The mindfulness technique employed in this study is modeled after the Buddhist meditative practice of the Theravada tradition, a method that is prevalent to the countries of Southeast Asia. Although based on Buddhist principles, this mindfulness technique is actually free from any cultural, ideological and religious constraints, and in reality, helps to release the potential power of the mind-body connection that may enhance the coping mechanism to respond to the daily challenges and stresses of life.

The sequence of events for participants to follow through is as described next, which is based on a two-component model of meditation practice. The meditation practice started by asking the participants to be seated comfortably and then to focus on the sensation of breathing by being conscious of body movements involved the normal process of breathing, *vis-à-vis*, 'air in and air out'. This was to help participants gather their minds and get an awareness of inner peace and stillness. This procedure lasted for 15 min. For the next 45 min, the goal of the meditation practice was to attain complete awareness of all the sensations in the entire body such that the sphere of meditation encompassed all psychophysical events that occurred in the present time. During this period, participants were encouraged to shift their attention so as to be able to observe the entire body sensations passively and objectively. They were allowed to be aware of the moment-to-moment experience (e.g., sounds and thoughts) and to take note of these experiences with the use of gentle verbal labels "spoken" in the mind (e.g., hearing…hearing, thinking…thinking) before returning to the breathing. In addition, participants were encouraged not to react or make judgment on the sensations felt, and to accept them as logical and inevitable occurrences. They should also not feel an aversion to the sensations nor should they desire for more pleasant ones.

After each session, participants were asked to write down in a logbook all the mental and physical experiences felt during their practice time.

Statistical analysis

The sample size used for this study was determined by the programme, OpenEpi. Guided by previous studies of Kabat-Zinn et al. [19], Austin [22], Wu and Lo [29], and in particular that of Barnes et al that was conducted in youth [30], two objective outcome measures i.e. mean SBP and HR were used to calculate the sample size. Allowing for an adequate difference in the mean SBP between the meditation and control groups being 2.8 mmHg with a variance level of 1.4 and 1.2 mmHg respectively, the calculated sample size would be 3 for each group. Similarly, by taking an acceptable mean difference in the HR between the meditation and control groups to be 2.5 bpm with a variance level of 1.5 bpm and 1.3 bpm respectively, the calculated sample size would be 4 for each group. However, for this investigation, it was decided to increase the number of subjects to 6 per group in order to increase precision of the study.

All data analyses were conducted using the STATA software, version 11 (Stata Corp LP, Texas, USA). To check for differences between groups and to compare changes in groups at Time 1, Time 2 and Time 3 on descriptive variables, a series of analyses of variance (ANOVAs) were performed. A probability value of less than 0.05 ($p<0.05$) is taken to be significant.

Results

Participants

All eighteen participants completed the study successfully. No significant group differences are found for gender, age and years of education.

DASS-Stress scale outcome

Table 1 shows the findings for each group for all timelines. The data were further analysed by ANOVA for comparing the Time 1 and Time 2 values. A significant ($p<0.05$) reduction in the mean DASS-Stress scale was found between the Time 1 and Time 2 in the meditation group with no examination.

Table 1. *Comparing scores of the DASS-Stress scale between groups*

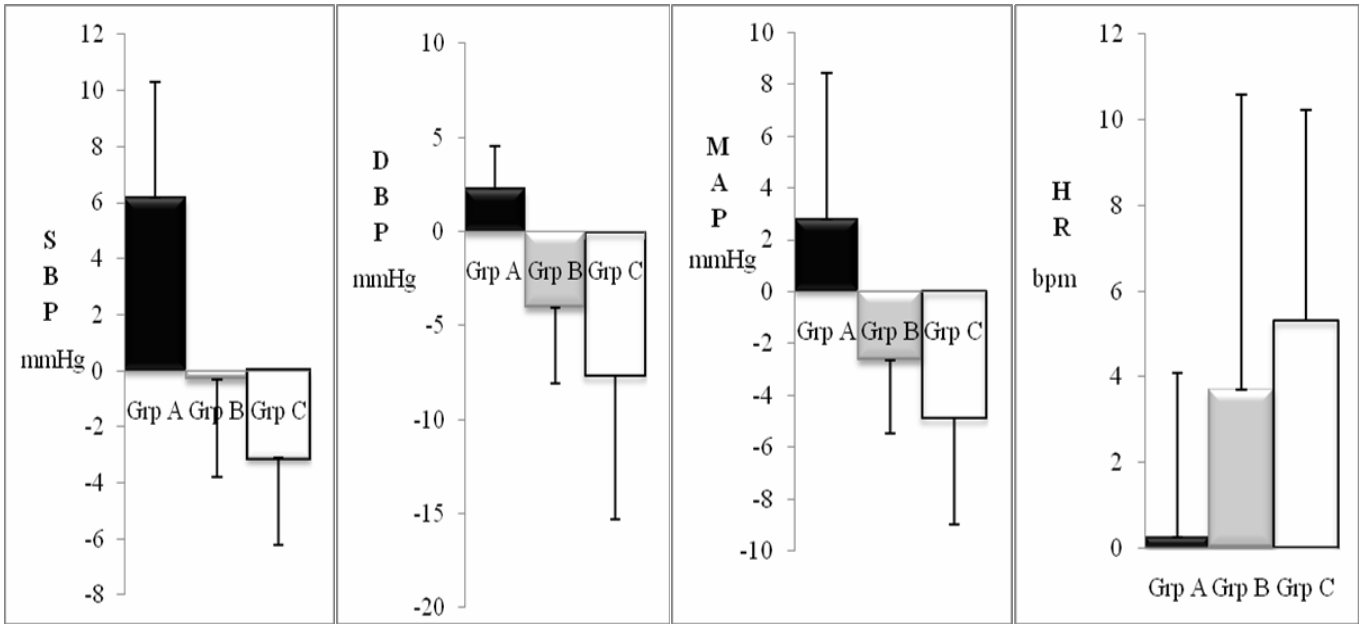
Group	DASS-Stress Scale				
	Time 1	Time 2	Time 3	% Change between Time 1 and Time 2	*p* values
Group A	14.7±2.1	7.8±2.2	7.2±3.1	– 46.7	*
Group B	13.8±1.9	11.0±2.4	10.0±2.8	– 21.4	NS
Group C	15.8±1.7	14.7±1.3	14.2±1.5	– 6.3	NS

*Values are means ± SEM. *p<0.05, NS: Not significant*
Group A = No Examination group with meditation practice
Group B = Examination group with no meditation practice
Group C = Examination group with meditation practice

CVS outcomes

All group participants did not demonstrate any significant changes in the CVS parameters studied when comparing the effect of meditation within session (Table 2) or when comparing to baseline (Figure 1).

Figure 1*: Mean changes in the systolic (SBP) and diastolic blood pressure (DBP), mean arterial blood pressure (MAP) and heart rate (HR) between Time 1 and Time 2 in all groups*



Group A = No Examination group with meditation practice

Group B = Examination group with no meditation practice

Group C = Examination group with meditation practice

Serum cortisol outcome

The morning serum cortisol level did not show any significant difference between the groups at all timelines (Table 3).

Table 2. *Effect of within-session meditation practice on the cardiovascular parameters at Time 2 in the examination groups (n=12)*

Parameter	Group B (n= 6)		Group C (n= 6)	
	Eyes-closed Relaxation		Mindfulness Practice	
	5 min	35 min	5 min	35 min
SBP (mmHg)	125.8±3.6	115.8±3.4	110.0±4.3	105.0±3.6
DBP (mmHg)	68.3±2.7	61.7±2.1	65.8±4.4	60.7±4.6
MAP (mmHg)	88.2±3.2	81.0±2.5	82.3±4.6	78.2±3.3
HR (beats per min)	84.7±6.3	80.8±4.3	78.8±3.8	81.2±3.8

Values are means ± SEM. Values between the groups are not significant
Group B = Examination group with no meditation practice
Group C = Examination group with meditation practice

Table 3. *Comparing serum cortisol values between groups*

Group	Serum Cortisol (nmol/L)			
	Time 1	Time 2	Time 3	*p* values
Group A	444.3±67.7	454.8±51.1	437.8±28.3	NS
Group B	425.7±57.9	494.8±59.5	522.7±74.8	NS
Group C	480.3±59.0	405.0±44.8	488.0±40.7	NS

Values are means ± SEM. NS = not significant (p> 0.05)
Group A = No Examination group with meditation practice
Group B = Examination group with no meditation practice
Group C = Examination group with meditation practice

Discussion

This exploratory small study reports on the immediate impact of a short-term structured mindfulness meditation practice on a group of university students who underwent examination. The design of the intervention was such that the groups that had examination and practiced meditation were compared to another that had examination but did not meditate. It was anticipated that students who meditated would show a reduction in the examination-induced stress level as evidenced by significant changes in the DASS-Stress scales, SBP, DBP, HR and serum cortisol.

The results of this study indicate that mindfulness meditation is effective in alleviating some aspects of self-perceived stress in university students with no academic stress stimuli. When comparing groups with no examination challenge, the DASS-Stress scale was found to be significantly (p<0.05) reduced after intervention in Group C (the meditation group) compared to Group A (no meditation group). However, in participants with examination stress, no significant positive effect of mindfulness meditation practice was found (Table 1). This finding is somewhat in contrast to that of Shapiro et al [23] who found that sitting mindfulness meditation when combined with body scan and Hatha yoga could effectively reduced overall psychological distress during the examination period. Since the scope of the present study is only focused on mindfulness meditation alone, perhaps such practice by itself may not be enough to produce positive effects in the short-term.

For the CVS and cortisol outcomes, contrary to prediction, no significant changes were found amongst groups for all timelines. Nonetheless, even though not significant, there appears to be a trend in the reduction in the SBP and DBP and an increase in the HR. These results support the findings of other studies of increased cardiac variability among Zen practitioners [31, 32], Kundalini yoga [33] and body scan [34] meditators, and those who practice inward attention meditation [29]. The increase in HR could be due to the effect of meditation itself modulating the baroreceptor efficacy, which in turn, may affect the BP, and indirectly, on the activities of the autonomic and limbic systems. All these findings might seem to suggest increased baroreflex sensitivity during the meditation period.

In addition, according to the participants' logbook, 83% of the participants experienced a feeling of relaxation at around 20 to 45 min following the meditation, but felt uncomfortable towards the end. This could partially help explain why no significant changes in the CVS parame-

ters were evident after the sessions. However, to date, the optimal period for meditation on a daily basis to confer positive benefits has not been established. The present study suggests that, for the novice meditator, the duration of meditation practice should be less than 1 h in order to benefit from the relaxation that the meditation may confer.

In the participants who were facing the examination challenge but did not meditate (Group C), no significant changes in the stress scores nor the serum cortisol levels on the eve of examination were observed, when compared to baseline. This finding is unexpected but it is not surprising, as it appears to be in agreement with other studies that monitor similar parameters among university students prior to academic examinations [4,35,36]. Although it is assumed that while taking examination represents routine activity in a student's life, it is still a major milestone, which to some individuals is perceived easier to achieve than others. Thus, mounting evidence suggests that the level of perceived anticipated stress experienced prior to academic examinations is associated with endocrine outcomes [4,37]. Therefore, the finding in this study strengthens the fact that not only the nature of the stressor but also the state of the responder may be of importance in determining the endocrine responses to stress.

Nevertheless, the findings of this pilot study point to the complexity of the meditation practice and, clearly, the major methodological limitation here appears to be that of small number of sample size and short time frame. Further research therefore, calls for larger sample size and longer periods of the meditation practice so that a more positive outcome may be anticipated in order that a link between body and mind and the possible mechanisms can be postulated.

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