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## Research Article

# Pre-Clinical Study of Immediate Effects of Religious and Non-Religious Mindfulness Practice on Cardiovascular and Cortical Modulation

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### ABSTRACT

Although low levels of stress can be motivating, high levels of stress – especially when it is sustained – can be detrimental to mental and physical health. Mindfulness practice has been widely applied in health care worldwide as an effective stress management approach. This study compared the immediate effects of two types (religious: Serenity Prayer; and non-religious: Body Scan) of mindfulness practice with a control condition (resting: sitting) in six adults. This study found no statistically significant difference between the conditions, but data visualization showed a trend of cardiovascular modulation (increased high frequency of heart rate variability) and cortical modulation (increased alpha to beta ratio and theta to beta ratio of quantitative electroencephalogram) with a greater level of perceived stress-relieved by both types of mindfulness practice. In addition, religious belief may be a moderator of the effects of intervention. The results of this study offered insight into the effect of prayer on cardiovascular and cortical modulation for promoting the well-being of a person.

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## Introduction

### Mindfulness, Religion and Health Care

Stress is inevitable. However, stress can hamper the mental and physical well-being of a person. Therefore, the management of stress is a significant clinical concern. Recent studies have shown that mindfulness practice can reduce anxiety and enhance the well-being of individuals who practice mindfulness regularly. Mindfulness is a kind of practice involving paying attention with a focused mind, in the present moment, and without judgment [1]. Mindfulness is rooted in Eastern meditation or Zen practice (i.e., Buddhist-based mindfulness). Meditation contains the principles of non-judgmental deep awareness in the present and letting go. Meditation is considered as a practice that can help people to get rid of suffering, to search for a true-self, and to integrate with the universe. In addition to Buddhism, meditation is also practiced by other religions (e.g., Christianity and Islam) [2-4]. To avoid confusion by using different terminologies across disciplines or traditions, this paper used the term “mindfulness” for both religious and non-religious

mindfulness practice. There are several common techniques in religious mindfulness, including prayer, in which the focus is directed to oneself, “God” and/or scripture. There are also several common techniques in non-religious mindfulness, including Body Scan, in which the focus is directed to oneself.

From the neurophysiological perspective, the hypothalamic-pituitary-adrenal (HPA) axis is an important system in physiological regulation in stress [5]. The stress response involves regulation of the central nervous system, the autonomic nervous system and the neuroendocrine system. Therefore, the neurophysiological response related to the activity of these systems could reveal the mechanism underlying the perceived effects of mindfulness practice. Mindfulness has also been applied for people with medical issues (e.g., chronic pain or cancer) or healthy people to improve their sense of well-being [6]. Moreover, religious and spiritual intervention could be complementary to health care [7]. Prayer is one of the channels that can be used to cope with a stressful event [8]. Most people with or without religious affiliation will pray. In prayer, a person may gain spiritual support, collaborate with God to solve the

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problem, and shift their attention to God or religious activities. However, the mechanisms underlying praying in cardiovascular disease is unknown [9]. It is also uncertain if people with a stronger belief in God's power will respond to intervention (e.g., mindful praying) in the same way as those with a weaker belief in God's power.

In this pre-clinical study, we compared the immediate effect of two types of mindfulness practice on cardiovascular and cortical modulation. To help identify potential moderator that deserve future study, we also examined the influence of religious belief/spirituality (e.g. belief in God's power) on cardiovascular and cortical modulation. The rationale of this study is built upon the process model of stress and coping, concepts of acceptance-based mindfulness practice and religious coping.

## Methods

### I Participants

In this study, we recruited six participants from tertiary institutes, who were undergraduate or postgraduate students, aged 18 to 40 years, and novice mindfulness practitioners.

### II Procedures

The participants attended a session with three experimental conditions in a sequence of (1) non-religious mindfulness practice (Body Scan), (2) control condition (Resting), and (3) religious mindfulness practice (Serenity Prayer). A 10-minute break was assigned between the three conditions. The participants were required to put on sensors for neurophysiological measurements (i.e., electrocardiogram and electroencephalogram), and sat comfortably in front of a computer screen in a quiet room throughout the session. The set-up is similar to telerehabilitation, where face-to-face meeting with the clinician is not required.

Body Scan technique was used for the non-religious method. The Body Scan procedure is similar to most Body Scan techniques, but it was done in a sitting position. A written instruction was shown on a computer screen for the participants to review the general instruction as necessary. The participants were asked to pay attention to their bodies. When there was any sensation in their bodies, the participant could allow him/herself to recognize the feeling and then let it go. An audio script (10 minutes) was played from the beginning to the end of the session to guide the participants to practice. The initial 3 minutes of the audio script was a general instruction and initial practice of the Body Scan, while the successive 7 minutes was the time for eye-closed practice.

For the religious method, the Serenity Prayer was used. The Serenity Prayer is "God, grant me the serenity to accept the things I cannot change, courage to change the things I can, and wisdom to know the difference" [10]. A written instruction was shown on a computer screen for the participants to review the general instruction as necessary. The participants were asked to pay attention to the keywords of the Serenity Prayer. When any thoughts arose, the participant could allow him/herself to recognize the thoughts and emotions, say the Serenity Prayer silently again, and then let go. An audio script (10 minutes) was played from the beginning to the end of the session to guide the participants in their practice. The initial 3 minutes of the audio script was a general

instruction and practice of the prayer, while the successive 7 minutes was the time for eye-closed self-practice.

For the control condition, the participants were required to sit in front of a computer screen (as in the other two conditions) to take rest but not sleep. A written instruction was shown on a computer screen for the participants to review the general instruction as necessary. The initial 3 minutes of the audio script was a general instruction of the procedures in this session, while the successive 7 minutes was the time for eye-closed rest.

### III Measuring Instruments

Before the experimental session, participants were required to complete a survey to report on their religious background (i.e., religious affiliation, religious engagement and religious belief). For the religious belief, they rated their perceived God's power by using a visual analog scale measure from a scale of 1 (not capable) to 7 (very capable). These two items reflect their belief in God's power in terms of God's ability to control things and God's ability to change things. These two items are adopted from the items 2 and 4 of the Subscale "Reappraisal of God's Power" of a standardized test of religious coping, RCOPE [11].

We applied data acquisition device MP160 (Biopac, U.S.A.) to examine the cardiovascular and cortical activity across the three experimental conditions. The cardiovascular activity was measured by electrocardiogram. Lead II placement of electrodes was used, and the sampling rate was set at 2000 Hz. Frequency-domain indexes (e.g., high frequency normalized unit (HF n.u.), low frequency normalized unit (LF n.u.) and HF to (LH + HF) ratio) of heart rate variability (HRV) were obtained. The cortical activity was measured by quantitative electroencephalogram (qEEG). The EEG electrode was attached to the scalp at the midline (Cz), and the sampling rate was set at 2000 Hz. The averaged power of different frequency bands of cortical activity (theta (4-8 Hz), alpha (8-13 Hz), and beta (13-30 Hz), theta/beta ratio, alpha to beta ratio) were obtained. The participants were also asked to rate on a visual analog scale after each experimental condition (i.e., from "worse than baseline" and "no change" to "better than baseline") to indicate their perceived stress-relieved in the corresponding experimental condition.

**Table 1:** Neurophysiological parameters and perceived stress-relieved across three experimental conditions (n=6).

Group Mean	Body Scan	Resting	Serenity Prayer
HF n.u.	38.12	34.35	40.37
LF n.u.	58.08	61.00	56.12
HF/(LF+HF)	0.40	0.36	0.42
Alpha to Beta Ratio	1.10	1.00	1.17
Theta to Beta Ratio	0.92	0.83	1.05
Perceived Stress-Relieved	2.83	1.17	4.17

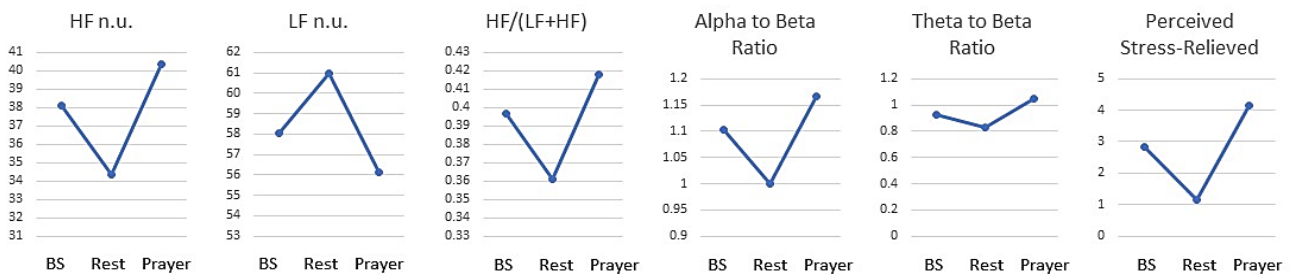
Note: HF n.u. is high frequency (normalized unit). LF n.u. is low frequency (normalized unit).

**IV Data Analysis**

A paired sample t-test was applied to compare the neurophysiological parameters and extent of perceived stress-relieved between religious and non-religious mindfulness practice. The significance value was set at 0.05. Considering the small sample size of this study, we also applied data visualization to examine the pattern of change across the three experimental conditions

**Results**

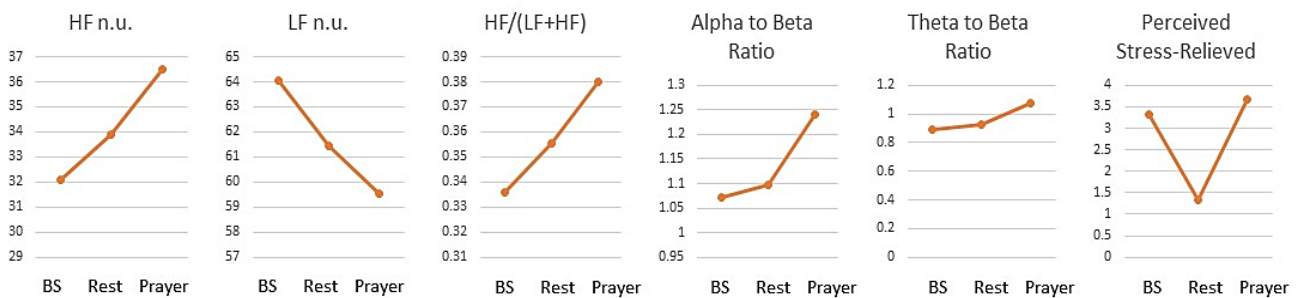
We found no significant statistical difference in the neurophysiological parameters and perceived stress-relieved between the three conditions (Table 1). However, data visualization showed a trend of higher neurophysiological parameters (i.e., HF n.u., HF to (LF + HF) ratio, alpha to beta ratio, and theta to beta ratio) in both religious mindfulness practice (Serenity Prayer) and non-religious mindfulness practice (Body Scan) compared to those in the control condition (resting). A pattern of change in perceived stress-relieved level consistent with the neurophysiological parameters across the three conditions was observed (see Figure 1).



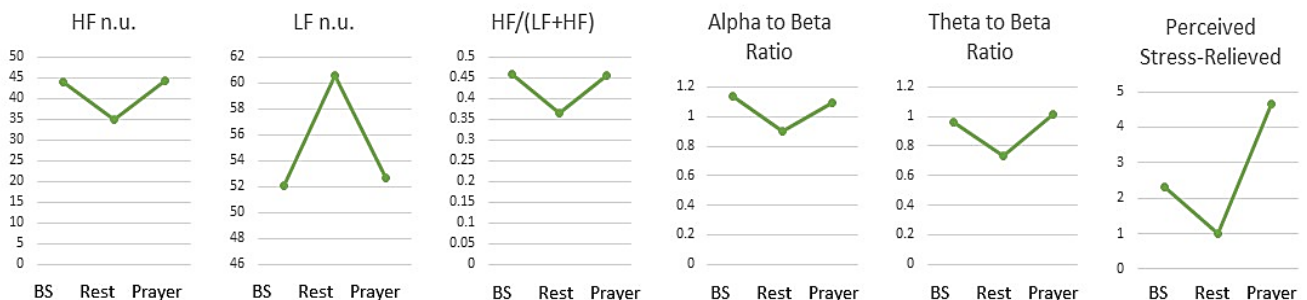
**Figure 1:** Neurophysiological parameters and perceived stress-relieved across three experimental conditions (n=6).  
 Note: HF n.u. is high frequency (normalized unit). LF n.u. is low frequency (normalized unit). BS is body scan.

When we classified the participants (according to their religious belief in God’s power by split-half method) into two groups, we found that the pattern of change across conditions of the two groups was different (Figure 2). More specifically, in the stronger God’s power group (stronger belief in God’s power to make a change), their cardiovascular response (HF n.u. and HF to (LF + HF) ratio) and cortical response (alpha to beta ratio and theta to beta ratio) towards religious mindfulness practice and non-religious mindfulness practice seemed similar but higher than that in the control condition (Figure 3).

practice seemed to be higher than that in both the non-religious mindfulness practice and the control condition. In the weaker God’s power group (weaker belief in God’s power to make a change), their cardiovascular response (HF n.u., and HF to (LF + HF) ratio) and cortical response (alpha to beta ratio and theta to beta ratio) towards religious mindfulness practice and non-religious mindfulness practice seemed similar but higher than that in the control condition (Figure 3).



**Figure 2:** Neurophysiological parameters and perceived stress-relieved across conditions: Stronger belief in God’s power group (n=3).  
 Note: HF n.u. is high frequency (normalized unit). LF n.u. is low frequency (normalized unit). BS is body scan.



**Figure 3:** Neurophysiological parameters and perceived stress-relieved across conditions: Weaker belief in God’s power group (n=3).  
 Note: HF n.u. is high frequency (normalized unit). LF n.u. is low frequency (normalized unit). BS is body scan.

## Discussion

In this pre-clinical study, we found no statistically significant difference in the effects of the two types of mindfulness practices on cardiovascular and cortical modulation. However, data visualization shows their pattern of change across the three experimental conditions, in which a higher level of HF n.u., HF to (LF + HF) ratio, alpha to beta ratio and theta to beta ratio was noticed. The HF n.u. and HF to (LF + HF) ratio can reflect the cardiovascular response of individuals (high level of the value representing a more relaxing but less focusing state), while the alpha to beta ratio and theta to beta ratio can reflect the cortical response of individuals (high level of the values representing a more calming and relaxing state). Heart rate variability is an index reflecting the activity of the autonomic nervous system that is important in supporting the immune system as well as the capacity to face external challenges [12-14]. Other than these objective measures of neurophysiological response, subjective measures of perceived stress-relieved can help to identify the effects of an intervention. This study shows that the pattern of change of perceived stress-relieved was consistent with the change of these neurophysiological parameters.

Although there is substantial evidence that mindfulness practice has a positive effect on the cognitive and affective processes, the capacity of neurophysiological regulation may vary between individuals [15]. This suggests that there may be moderators that influence the overall efficacy of mindfulness practice. Religious/spiritual factors may play a role in stress coping. However, to our knowledge, no one has examined the potential influence of religious belief in God's power on the immediate effect of brief mindfulness practice. In our study, we examined the moderating effects of an individual's religious belief (belief on God's power) on the effects of mindfulness practice.

Belief in God's power influences the participants' responses to mindfulness, just as they influence how a person responds to challenging situations [16, 17]. Pargament *et al.* found that mental health and emotional distress were significantly correlated with the reappraisal of God's powers [11]. Disregarding the degree of belief in God's power, a brief prayer (10 minutes) may have a positive effect on both cardiovascular and cortical modulation. Since this pre-clinical study recruited only six participants, a larger sample size is necessary in further study. The reader is advised to interpret the results of this study with caution. On the other hand, our experimental set up is a computer-based format with wearable sensors for monitoring the neurophysiological status. This format of the mindfulness practice and computerized monitoring system of this study may offer an insight to the development of telerehabilitation or religious activity upon facing health crisis where face-to-face contact is not favorable. This paper is dedicated to healthcare professionals who are fighting against the COVID-19 pandemic.

## Consent

Written consent was obtained prior to data collection.

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