

Effects of Singing Bowl Sound Meditation on Mood, Tension, and Well-being: An Observational Study

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Abstract

Poor mood and elevated anxiety are linked to increased incidence of disease. This study examined the effects of sound meditation, specifically Tibetan singing bowl meditation, on mood, anxiety, pain, and spiritual well-being. Sixty-two women and men (mean age 49.7 years) participated. As compared with pre-meditation, following the sound meditation participants reported significantly less tension, anger, fatigue, and depressed mood (all P s $<.001$). Additionally, participants who were previously naïve to this type of meditation experienced a significantly greater reduction in tension compared with participants experienced in this meditation ($P < .001$). Feeling of spiritual well-being significantly increased across all participants ($P < .001$). Tibetan singing bowl meditation may be a feasible low-cost low technology intervention for reducing feelings of tension, anxiety, and depression, and increasing spiritual well-being. This meditation type may be especially useful in decreasing tension in individuals who have not previously practiced this form of meditation.

Keywords

Tibetan bowls, anxiety, depression, spiritual well-being

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Heart disease, diabetes, addiction, and mental health issues have all been linked to stress and tension.¹⁻⁶ Meditation, including systems such as mindfulness-based meditations, has shown promise in inducing the relaxation response and helping alleviate anxiety and improve well-being.^{7,8} The relaxation response is the body's physiological response in relaxation, including lowered blood pressure to counter the fight-or-flight response and activation of the parasympathetic nervous system.⁹⁻¹¹ As promising as mindfulness and other meditation systems may be, a common complaint is the time, patience, and discipline required to learn meditation. Thus, a form of relaxation and stress relief that does not require a steep learning curve or a great deal of discipline to utilize could potentially be a huge benefit to human wellness and health.

The authors set out to examine the possibility that merely lying down and listening to the high-intensity, low-frequency combination of singing bowls, gongs, and bells in a sound meditation could induce a deep relaxation response and positively affect mood and sense of well-being. Sound healing has been used for centuries and been utilized in various forms by cultures the world over, including native peoples. Australian aboriginal tribes have used the didgeridoo as a sound healing instrument for over 40 000 years.¹² Ancient instruments have also been used for religious and spiritual ceremonies such as

Tibetan (also called "Himalayan") singing bowls.¹³ Tibetan singing bowls are metal bowls usually consisting of a combination of metal alloys and originally used by Tibetan monks for spiritual ceremonies.

While sound healing is not a new concept, there is a paucity of research in areas such as Tibetan or quartz crystal singing bowls. The majority of singing bowl studies relate to the physics of these musical instruments, including the sonic and wave properties, as well as attempting to model the singing bowl's acoustic characteristics.¹⁴⁻¹⁶ In one study, singing bowls were used for emotional healing with high-risk youth as part of what was termed the *best self-visualization method*.¹⁷ The bowls were used in a psychotherapy model in combination with deep breathing, visualization, and a loving kindness meditation. The

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Table 1. Participant Demographics.

| Characteristic | All (n = 62) | Males (15%) | Females (85%) |
|--------------------------|--------------|-------------|---------------|
| Age in years, mean (SD) | 49.7 (13.0) | 42.0 (15.8) | 51.0 (12.0) |
| Education, % | | | |
| High school | 4.8 | 11 | 4 |
| Some college | 31 | 33 | 30 |
| BA/BS | 34 | 33 | 34 |
| Masters | 24 | 11 | 26 |
| PhD/MD | 6.5 | 11 | 6 |
| Marital status, % | | | |
| Single | 38 | 50 | 36 |
| Partner | 7 | 13 | 6 |
| Married | 33 | 25 | 34 |
| Divorced | 21 | 13 | 23 |
| Widowed | 2 | 0 | 2 |
| Meditation experience, % | | | |
| Yes | 87 | 100 | 85 |
| No | 13 | 0 | 15 |
| Bowl experience, % | | | |
| Yes | 59 | 56 | 60 |
| No | 41 | 44 | 40 |

authors reported that this combination of healing methods may be a catalyst for emotional and psychological healing in counseling sessions.

The purpose of the present study was to further advance research in this area by examining the possible effects of singing bowls and sound healing on mood, anxiety, physical pain, and spiritual well-being, and to lay the foundation for a future more formal randomized control trial.

Methods

Participants

A convenience sample of 62 individuals participated (age range, 21-77 years; mean age = 49.7 years, SD = 13.0; 9 males and 53 females). The study was conducted at 3 locations: the Seaside Center for Spiritual Living in Encinitas, California (17 participants), the Chopra Center for Wellbeing in Carlsbad, California (39 participants), and the California Institute for Human Science (CIHS) in Encinitas, California (6 subjects). All participants provided written informed consent. The study was approved by the University of California, San Diego Institutional Review Board (#160174). Demographic information is presented in Table 1.

Design

Participants completed standardized questionnaires prior to and following the meditation, including the short form of the Profile of Mood States (POMS-SF)¹⁸ to assess tension, anger and confusion, the Hospital Anxiety and Depression Scale (HADS)¹⁹ to assess depressed mood and anxiety, and the 10-item Functional Assessment of Chronic Illness Therapy–Spiritual Well-Being Scale (FACIT-SP)²⁰ to assess spiritual well-being.

Additionally, prior to the meditation, participants completed a demographic questionnaire which included questions regarding any prior experience with meditation or singing bowls, substance use, medications, and over-the-counter or herbal supplements. Additionally, the

form asked if they were currently experiencing any physical pain or discomfort. If they were experiencing physical pain, they were asked the type of pain, and to rate the pain on a scale of 1 to 5.

Following the meditation, participants completed a 2-item questionnaire that asked if they had fallen asleep and if they were currently experiencing any physical pain. If they were experiencing pain at that point, they were again asked to rate the pain level on a scale of 1 to 5.

Sound Meditation Protocol

Participants were instructed to bring yoga mats on which to lie down and if desired, a pillow and/or blanket for the sound meditation. Participants were asked to lie down in a half-circle or an oblong-shaped configuration (depending on the size of the room and number of participants) around the room with their heads pointed toward the musical instruments, which were placed on the floor near their heads.

The musical instruments consisted of Tibetan singing bowls, crystal singing bowls, gongs, Ting-shas (tiny cymbals), dorges (bells), didgeridoos, and other small bells. The majority of the Tibetan singing bowls (approximately 90%) consisted of large-sized Jambati bowls (bells), which ranged in size from 9 to 12 inches and ranged in weight from 3 to 5 lbs. Approximately 5% of singing bowls were very small Thadobati bowls, approximately 4.5 inches in size and weighing 0.5 lbs. The remaining 5% of singing bowls were very large Jambati bowls, ranging from 12 to 14 inches in size and weighing 6 to 8 lbs.

The singing bowls (bells) were the primary instrument played during the meditations, played for approximately 95% of the time, while the additional instruments were played for approximately 5% of the meditation session. The major method of creating sound and vibration from the singing bowls was by tapping or striking the bowls with a mallet, which was utilized approximately 95% of the time.

Between 30 and 80 Tibetan bowls, 2 and 3 crystal bowls, and 2 and 6 gongs were used depending on the number of participants. Thus, participants at CIHS and the Chopra Center listened to approximately 25 Tibetan bowls, 2 crystal bowls, and 2 gongs while participants at the Seaside Center listened to approximately 80 Tibetan bowls, 6 crystal bowls, and 6 gongs. Each participant had at least 2 Tibetan bowls near his or her head. The bowls were struck with a cloth-covered wooden mallet called a *puja* stick. The instruments were all played in a regular sequence: tingshas, Tibetan bowls, bells, crystal bowls, gongs, and more Tibetan bowls, then the sequence was repeated. The duration of the sound meditation was approximately 60 minutes.

Additionally, Tibetan (metal) bowls were placed in the center (or near-center) of the room and the bowls were in turn struck by the mallet or rubbed along the rim of the bowls, creating a distinctive sound, which was allowed to trail off. Additionally, several quartz crystal bowls were placed near the center of the room and were played by rubbing the rim with a felt cloth-covered mallet and the sound trailed off after playing the bowl.

At the beginning of the sound healing meditation, the lead musician spoke to participants in a soothing tone. He instructed participants to lie down and if they wished to fall asleep, they were allowed to do so. He then told them to merely observe any sensations they felt in the body during the meditation without judging them and to simply relax and enjoy the meditation. Then the sound meditation began.

At the conclusion of the meditation, the lead musician instructed participants to gently become aware of their surroundings. Participants were also instructed to take their time in readjusting to a state of awareness.

Table 2. Results on Measures at Pre- and Postmeditation.

| Measures | n | Premeditation | | Postmeditation | | Change | P | η^2 |
|-----------------------------------|----|---------------|------|----------------|------|--------|------|----------|
| | | Mean | SD | Mean | SD | | | |
| Tension (POMS) | 62 | 1.26 | 1.03 | 0.14 | 0.57 | 1.12 | .000 | .51 |
| Anger (POMS) | 60 | 0.85 | 0.98 | 0.05 | 0.19 | 0.80 | .000 | .42 |
| Confusion (POMS) | 60 | 1.10 | 0.87 | 0.30 | 0.56 | 0.80 | .000 | .54 |
| Fatigue (POMS) | 60 | 1.65 | 1.12 | 0.42 | 0.75 | 1.23 | .000 | .46 |
| Vigor (POMS) | 59 | 1.97 | 1.19 | 1.48 | 1.05 | 0.49 | .002 | .15 |
| Anxiety (HADS) | 58 | 1.11 | 0.66 | 0.44 | 0.49 | 0.67 | .000 | .49 |
| Depression (HADS) | 57 | 0.62 | 0.51 | 0.42 | 0.36 | 0.20 | .002 | .16 |
| Faith ^b (FACIT) | 62 | 3.18 | 1.10 | 3.46 | 0.96 | 0.28 | .005 | .12 |
| Spirituality ^b (FACIT) | 57 | 2.85 | 0.94 | 3.64 | 0.46 | 0.79 | .000 | .49 |

Abbreviations: POMS, Profile of Mood States; HADS, Hospital Anxiety and Depression Scale; FACIT, Functional Assessment of Chronic Illness Therapy—Spiritual Well-Being Scale (FACIT-SP).

^aEffect size (η^2): .01 = small, .06 = moderate, .14 = large effect.

^bFaith and Spirituality scores displayed a positive direction rather than a negative direction postmeditation.

Data Analysis

Analyses included 2-way (group by time) repeated-measures analysis of variance [(Statistical Program for the Social Sciences (SPSS Version 22)]. Data were normally distributed.

Results

There were significant differences between pre- and posttreatment for all subscale variables on the POMS, HADS, and FACIT measures (Table 2). Eta-squared revealed a large effect size for all subscale variables, except the FACIT Faith subscale, which demonstrated a moderate to large effect size. An effect for these variables was also observed by age (see Table 3). Individuals in the age group 20 to 39 years displayed the largest change in tension, with a mean score of 1.6 at baseline and a mean of 0.2 posttreatment, followed by those in the age group 40 to 59 years who had a tension mean of 1.3 at baseline and 0.2 posttreatment ($P < .05$).

Additionally, effects for participants who had prior experience with singing bowl meditations (termed “Bowl Experienced”) versus those who had never experienced this type of meditation previously (termed “Bowl Naïve”) were examined (Table 4). Significant effects were observed for tension, anxiety, and depressed mood (all $P < .01$).

In order to assess any potential effects of the sound meditations on participants’ levels of physical pain, participants were asked if they were experiencing pain prior to and following the meditation. Twenty-nine participants reported experiencing

Table 3. Mean Change in Tension, Anxiety, and Depressed Mood by Age Group From Pre- to Postmeditation.

| Age Group (Years) | n | Premeditation | | Postmeditation | | Change | P | η^2 |
|------------------------------|----|---------------|------|----------------|------|--------|------|----------|
| | | Mean | SD | Mean | SD | | | |
| Tension (POMS) | | | | | | | | |
| 20-39 | 15 | 1.56 | 0.88 | 0.21 | 0.31 | 1.35 | .000 | .71 |
| 40-59 | 33 | 1.29 | 1.15 | 0.20 | 0.68 | 1.09 | .000 | .47 |
| 60-79 | 14 | 0.88 | 0.78 | 0.26 | 0.43 | 0.62 | .038 | .29 |
| Anxiety (HADS) | | | | | | | | |
| 20-39 | 15 | 1.43 | 0.61 | 0.67 | 0.62 | 0.76 | .000 | .70 |
| 40-59 | 33 | 1.03 | 0.70 | 0.27 | 0.52 | 0.76 | .000 | .54 |
| 60-79 | 14 | 0.74 | 0.46 | 0.29 | 0.47 | 0.45 | .019 | .35 |
| Depressed mood (HADS) | | | | | | | | |
| 20-39 | 15 | 0.63 | 0.37 | 0.48 | 0.32 | 0.15 | .207 | .11 |
| 40-59 | 33 | 0.66 | 0.66 | 0.38 | 0.39 | 0.27 | .012 | .18 |
| 60-79 | 14 | 0.55 | 0.43 | 0.35 | 0.32 | 0.20 | .051 | .26 |

Abbreviations: POMS, Profile of Mood States; HADS, Hospital Anxiety and Depression Scale.

physical pain pre-meditation. If experiencing pain, they were asked to rate their pain on a scale of 1 to 5 (1 representing “very slight discomfort” and 5 representing “extremely painful”) and describe the pain and location on the body. Table 5 displays the mean pain rating of participants (by age group) who reported pain at pre-meditation and their mean pain rating post-meditation. Participants aged 40 to 59 years showed the most significant effects from the meditation, with a reduction (or elimination) of feelings of physical pain post-meditation, with a baseline mean pain rating of 2.00 and a posttreatment mean pain rating of 0.79.

Additionally, physical pain pre- and posttreatment was examined for Bowl Experienced and Bowl Naïve participants (see Table 6). Change (decrease) in reported pain was most significant for participants who were previously naïve to singing bowl meditations, with a mean score of 1.88 at baseline and 0.69 posttreatment.

Discussion

This was an observational study designed to examine the potential effects of a singing bowl meditation on mood, tension, anxiety, physical pain, and spiritual well-being. A significant difference was found in all endpoints examined in response to the meditation.

The tension subscale in particular displayed highly significant effects for participants post-meditation, thus providing support to the hypothesis that a sound meditation would increase feelings of relaxation and decrease feelings of stress. Additionally, depressed mood and anxiety scores on the HADS were significantly reduced post-meditation compared with pre-meditation. Moreover, scores on the FACIT revealed increased feelings of spiritual well-being, as well as faith, immediately following the sound meditation. Thus, while less desirable mood states such as tension, anger, and depression decreased

Table 4. Mean Changes in Tension, Anxiety and Depressed Mood for 'Bowl Naïve' and 'Bowl Experienced' Participants from Pre- to Post-Meditation.

| Measures | n | Premeditation | | Postmeditation | | Change | ANOVA | |
|-------------------------|----|---------------|------|----------------|------|--------|-------|--------|
| | | Mean | SD | Mean | SD | | P | η |
| Bowl naïve | | | | | | | | |
| Tension (POMS) | 26 | 1.61 | 1.13 | 0.32 | 0.80 | 1.29 | .000 | .500 |
| Anxiety (HADS) | 26 | 1.30 | 0.69 | 0.41 | 0.51 | 0.89 | .000 | .590 |
| Depressed mood (HADS) | 26 | 0.80 | 0.61 | 0.41 | 0.41 | 0.39 | .003 | .298 |
| Bowl experienced | | | | | | | | |
| Tension (POMS) | 36 | 1.01 | 0.88 | 0.15 | 0.26 | 0.86 | .000 | .500 |
| Anxiety (HADS) | 36 | 0.89 | 0.61 | 0.47 | 0.43 | 0.42 | .000 | .400 |
| Depressed mood (HADS) | 36 | 0.51 | 0.47 | 0.39 | 0.30 | 0.12 | .100 | .075 |

Abbreviations: ANOVA, analysis of variance; POMS, Profile of Mood States; HADS, Hospital Anxiety and Depression Scale.

Table 5. Mean Change in Physical Pain Ratings by Age Group From Pre- to Post-meditation.

| Age Group (Years) | n | Mean Pain | | | |
|-------------------|----|---------------|----------------|--------|------|
| | | Premeditation | Postmeditation | Change | SD |
| 20-39 | 8 | 1.63 | 0.75 | 0.88 | 1.17 |
| 40-59 | 14 | 2.00 | 0.79 | 1.21 | 1.21 |
| 60-79 | 7 | 1.57 | 1.00 | 0.57 | 0.9 |

Table 6. Mean Change in Physical Pain Ratings for "Bowl Experienced" and "Bowl Naïve" Participants From Pre- to Postmeditation.

| Bowl Naïve or Experienced | n | Mean Pain | | | |
|---------------------------|----|---------------|----------------|-------------|------|
| | | Premeditation | Postmeditation | Mean Change | SD |
| Experienced | 13 | 1.69 | 1.00 | 0.69 | 0.91 |
| Naïve | 16 | 1.88 | 0.69 | 1.19 | 1.29 |

following the meditation, potentially desirable variables such as a sense of spiritual well-being increased.

Interestingly, previous experience with singing bowl meditations (or lack thereof) also appeared to be a factor in the effects of the meditations. Participants who were previously naïve to this meditation demonstrated larger effects than those who were experienced in these meditations. An unexpected effect was discovered in the significant mean change in the tension subscale from baseline to posttreatment for participants in the age group 40 to 59 years. Those participants in this age group who were previously naïve to singing bowl meditations ("Bowl Naïve") had a significant reduction in mean tension from baseline to posttreatment, indicating a dramatic effect of the meditation. On the other hand, Bowl Experienced participants in the age group 20 to 39 years reported a significant reduction in the tension subscale posttreatment.

Participants aged 40 to 59 years appeared to especially benefit from the sound meditation. This age group demonstrated the largest reduction in physical pain and a strong reduction in

tension, especially for those who were previously naïve to this type of meditation. Thus, a follow-up sound meditation study might examine this age group in more depth.

The reason(s) for the beneficial effects of singing bowls is unclear; however, various theories have been proposed. One theory includes the potential effects of binaural beats in which the brain entrains to the hertz difference between tones played in each ear, propelling the brain into brainwave states of deep relaxation, such as beta waves or even meditative or trance-like brainwave states in theta waves.²¹⁻²³ In addition, potentially the action of sound waves on the purported biofield or energy field of the body could be a factor.²⁴ Such theories may begin to characterize the potential effects on mood as well as physiological changes associated with singing bowls. Physical healing was the goal of a study that utilized blood pressure data in relation to a singing bowl. This study attempted to quantify the sonification of blood pressure through 3-dimensional imprinting, designing, and fabricating of a singing bowl using blood pressure data.²⁵ Allen and Shealy²⁶ examined the use of a single quartz crystal singing bowl on participants' electrodermal responses (the body's electric responses) to toning and playing the crystal bowl. The authors recorded electrodermal responses of forty acupuncture meridian points on participants' left hands and right feet, which demonstrated increases and decreases, respectively, in electrical responses to playing the crystal bowl. Another study examined the potential effects of quartz crystal bowl playing on perception of pain and revealed mixed results.²⁷ In a recent randomized crossover study, playing a single Tibetan (or Himalayan) singing bowl was found to decrease blood pressure and heart rate more than silence alone when conducted immediately prior to a guided visualization.²⁸ Participants who listened to the singing bowl also had lowered scores on the Positive and Negative Affect Schedule (PANAS), a measure of affect and mood²⁹ than meditation alone but had comparable PANAS scores to the silence-only group.

There were limitations with the present study. The most notable limitation was that this was a nonrandomized observational study without a control group. The study does, however, provide the groundwork for future research regarding the effects of singing bowl meditations on assessments of stress

and well-being. As discovered by Landry,²⁸ this low-tech form of meditation may have the capacity to lower blood pressure and heart rate, thus there are potential benefits to cardiovascular health yet to be further explored. The results provide promise for a form of stress reduction that does not require the individual to learn a disciplined form of meditation. In fact, the participant may even fall asleep if desired. At the very least, participants generally express feelings of deep relaxation and inner peace following the sound meditation.

Moreover, those in health professions such as nurses and counselors could easily provide these meditations to patients. While it may require a very minimal amount of practice, extensive training is not necessary to learn to play the singing bowls and other instruments; one merely taps or rubs the bowls gently with a mallet. Thus, this type of meditation could be taught to health and counseling professionals and provided in an almost unlimited number of settings to induce the relaxation response, reduce stress, and potentially stress-related disease in the body.

In summary, this observational study found significant beneficial effects of Tibetan singing bowl meditations on a number of markers related to well-being. Future randomized control trials are warranted to further examine the effects of these meditations on mood, well-being, and physical pain. In addition, future research could explore the meditation's effects on various age groups in more depth.

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Author Contributions

TLG conceived of and designed the study and MEG provided ideas on initial design. PJM provided design help and selection of assessment tools. TLG and MMCW conducted the bulk of the study, with assistance from MEG. TLG and MEG conducted the majority of the data analyses with guidance from PJM. TLG and MEG provided the initial draft of the manuscript, of which PJM provided further writing and editing.

Declaration of Conflicting Interests

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Ethical Approval

The study was approved by the University of California, San Diego Institutional Review Board. All participants provided written informed consent.

References

1. Backe EM, Seidler A, Latza U, Rossnagel K, Schumann B. The role of psychosocial stress at work for the development of
- cardiovascular diseases: a systematic review. *Int Arch Occup Environ Health*, 2011; 85 (1), 67-79.
2. Belujon P, Grace AA. Hippocampus, amygdala, and stress: interacting systems that affect susceptibility to addiction. *Ann N Y Acad Sci.*, 2011; 1216: 114-121. doi: 10.1111/j.1749-6632.2010.05896.x
3. Richardson S, Shaffer JA, Falzon L, Krupka D, Davidson KW, Edmondson D. Meta-analysis of perceived stress and its association with incident coronary heart disease. *JAMA Cardiol*, 2012; 110 (12), 1711-1716.
4. Staufenbiel SM, Penninx BWJH, Spijkerman AT, Elzinga BM, van Rossum EFC. Hair cortisol, stress exposure, and mental health in humans: A systematic review. *Psychoneuroendocrinology*. 2013; 38(8), 1220-1235.
5. Thoits PA. Stress and Health: Major Findings and Policy Implications. *J Health Soc Behav*. 2010; 51: S41 - S53.
6. Vitaliano PP, Scanlan JM, Zhang J, Savage MV, Hirsch IB, Siegler IC. A Path Model of Chronic Stress, the Metabolic Syndrome, and Coronary Heart Disease. *Psychosom Med*. 2002; 64(3). 418-435.
7. Cahn BR, Polich J. Meditation states and traits: EEG, ERP, and neuroimaging studies. *Psychol Bull*. 2006 Mar; 132(2): 180-211.
8. Melville GW, Chang D, Colagiuri B, Marshall PW, Cheema BS. Fifteen minutes of chair-based yoga postures or guided meditation performed in the office can elicit a relaxation response. *Evid Based Complement Alternat Med*. 2012; Article ID 501986. doi: 10.1155/2012/501986
9. Benson H. *The Relaxation Response*. New York: Morrow; 1975.
10. Dusek JA, Otu HH, Wohlhueter AL, et al. Genomic counter-stress changes induced by the relaxation response. *PLoS one*. 2008 Jul 2; 3(7): e2576.
11. Park ER, Traeger L, Vranceanu AM, Scult M, Lerner JA, Benson H, Denninger J, Fricchione GL. The development of a patient-centered program based on the relaxation response: The Relaxation Response Resiliency Program (3RP). *Psychosomatics*. 2013; 54:165-174.
12. Gaynor ML. Sounds of healing: A physician reveals the therapeutic power of sound, voice, and music. New York: Broadway Books; 1999.
13. Perry F. Himalayan sound revelations: The complete singing bowl book. London: Polair Publishing, 2014.
14. Burtner M, Serafin S, Topper D. Real-time spatial processing and transformations of a singing bowl. In *Proceedings of the 5th International Conference on Digital Audio Effects (DAFx-02)* 2002 Sep 26 (pp. 123-126).
15. Inácio O, Henrique LL, Antunes J. The dynamics of Tibetan singing bowls. *Acta Acustica United with Acustica*. 2006 Jul 1;92(4): 637-53.
16. Terwagne D, Bush JWM. Tibetan Singing Bowls. *Nonlinearity*. 2011; 24. R51-R66.
17. Schussel L, Miller L. Best Self Visualization Method with high risk youth. *J Clin Psychol* 2013; 69(8), 836-845.
18. Shacham S. A shortened version of the Profile of Mood States. *J Pers Assess*. 1983 Jun; 47(3):305-6.
19. Snaith R P. The Hospital Anxiety and Depression Scale. *Health Qual Life Outcomes*. 2003, 1:29.

20. Celli D. Manual of the Functional Assessment of Chronic Illness Therapy (FACIT) Scales, 1997.
21. Le Scouarnec RP, Poirier RM, Owens JE, Gauthier J, Taylor AG, Foresman PA. Use of binaural beat tapes for treatment of anxiety: A pilot study of tape preference and outcomes. *Altern Ther Health Med.* 2001; Jan: 7(1), 58-63.
22. Padmanabhan R, Hildreth AJ, Laws D. A prospective, randomized, controlled study examining binaural beat audio and pre-operative anxiety in patients undergoing general anaesthesia for day case surgery. *Anaesthesia.* 2005; 60: 874-877. Doi: 10:1111/j.1365-2044.2005.04287.x.
23. Wahbeh H, Calbrese C, Zwickey H. Binaural beat technology in humans: A pilot study to assess psychologic and physiologic effects. *J Altern Complement Med.* 2007; 13 (1), 25-32.
24. Creath K, Schwartz G. Measuring effects of music, noise, and healing energy using a seed germination bioassay. *J Altern Complement Med.* 2004; 10(1), 113-122.
25. Barrass S. Acoustic sonification of blood pressure in the form of a singing bowl. Paper presented at: Conference on Sonification of Health and Environmental Data (SoniHED), September 2014; York, UK.
26. Allen L, Shealy N. An exploration of the effects of toning and quartz crystal bowls on the energetic balance in the body as measured electrically through the acupuncture meridians. *Subtle Energies Energy Med.* 2005;16(2):5-8.
27. Wepner F, Hahne J, Teichmann A, Bera-Schmid G, Hördinger A, Friedrich M. Treatment with crystal singing bowls for chronic spinal pain and chronobiologic activities—a randomized controlled trial [in German]. *Forsch Komplementmed.* 2008;15:130-137.
28. Landry JM. Physiological and psychological effects of a Himalayan singing bowl in meditation practice: a quantitative analysis. *Am J Health Promot.* 2014;28:306-309.
29. Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: The PANAS scales. *J Pers Soc Psychol.* 1988;54:1063-1070.