A comparison of four stress reduction modalities on measures of stress among university students

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Abstract

Purpose – High levels of stress reported at college campuses has led to the need for stress management interventions. College students often do not know how to deal with the increase in stress during college which may lead to ineffective ways to manage stress, such as drugs, alcohol, and under the worst circumstance, suicide. Several universities have implemented stress relieving centers where students can participate in various modalities to relax and reduce symptoms of stress. The purpose of this paper is to compare four stress reduction modalities on the amount of physiologic and perceived stress (PS) reduction in a stress relief center.

Design/methodology/approach – Archival information of 5,526 students (2,759 female, 2,767 male) were analyzed. During their time at the relaxation center, these students would participate in one of four relaxation modalities (massage chair, chi machine, rejuvenation lounger, or sitting meditation). Upon entering and exiting the center, PS, systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) were measured. The dependent variables were compared from pre- to post-relaxation with paired tests. Gain scores were calculated for each dependent variable and compared between modalities with an ANOVA and post hoc independent t-tests. The α was set at = 0.05 for statistical significance.

Findings – Results indicated that all four modalities showed an overall decrease in stress-related symptoms for both men and women (p < 0.05). There was no statistical difference in dependent variable gain scores between the relaxation modalities (p > 0.05) for men. There was no statistical difference in dependent variable gain scores between the relaxation modalities (p > 0.05) for women except for SBP and DBP where the massage chair, chi machine, and sitting meditation all reduced SBP and DBP to a greater degree than the rejuvenation lounger (p < 0.05).

Originality/value – The results of this study suggest that the use of these stress reduction modalities (massage chair, chi machine, rejuvenation lounger, or sitting meditation) is effective at transiently reducing physiologic and perceived measures of stress of college students. Universities should recognize the importance of stress relief centers in order to help students manage stress symptoms and effectively manage their daily stress levels.

Keywords Stress, Relief centres, Stress relief, University health
Paper type Research paper

Introduction

Chronic stress disrupts all of the body systems due to continued activation of the sympathetic nervous system. Chronic stress can result in symptoms of stress, including headaches, muscle pain, increased blood pressure, increased resting heart rate (HR), and many more health problems (Olpin and Hesson, 2016). Stress levels change throughout a person’s life.

Conley et al. (2013) found that students experience higher levels of stress while attending college. The American College Health Association (2015) survey reported stress as the
highest academic impediment at 108 higher education institutions amounting 93,034 participants. This survey also reported that 39 percent of college students reported feeling an average amount of stress, 36.8 percent reported feeling more than average stress, and 8.4 percent reported feeling tremendous stress (American College Health Association, 2015). During the same time, 40.7 percent felt like matters were hopeless, 76 percent felt overwhelmed by all they had to do, 73.2 percent felt exhausted, 29.2 percent felt so depressed it was difficult to function, 45.4 percent felt overwhelming anxiety, and 34.3 percent felt overwhelming anger (American College Health Association, 2015). With lots of decisions to be made, new adaptations, and role diversity, stress especially affects college-aged students (Conley et al., 2013).

College life for students is a time of many adjustments that may lead to increased stress. Beginning students and international students often experience the highest amount of stress (Ekpenyong et al., 2013). Students are now on their own and managing their new surroundings with uncertainties of their futures, career paths, and capabilities (Dyson and Renk, 2006; Ekpenyong et al., 2013). Stressors vary from exams and assignments to financial instability and relationship obstacles. Other challenges that increase stress during college include autonomy from parents, leaving home, self-sufficiency, gender identity, and career choices (Baghurst and Kelley, 2014). Many find college work more challenging and time consuming than high school, creating overwhelming feelings emotionally, physically, and mentally. The more stress a student has, and the more changes the student experiences, the more likely that student will experience symptoms of tense muscles, insomnia, low motivation, and fatigue or increased chances of getting a major illness (Matheny et al., 2005). Students facing high levels of stress also tend to experience an increased risk of academic difficulties, substance abuse, and emotional problems (Chiauzzi et al., 2008).

Excessive stress may lead to physical and psychological impairment. Other diseases and disorders that are influenced by stress include depression, cardiovascular disease, human immunodeficiency virus, and cancer (Cohen et al., 2007). Likewise, anxiety, cognitive dysfunction, cardiovascular episodes, metabolic diseases, osteopenia, osteoporosis, and insomnia are all linked to chronic stress (Chrousos, 2009).

Stress reduction modalities have been developed, each with the goal of reducing the amount of stress the student is feeling (Cady and Jones, 1997). Some of these modalities include massage chairs, chi machines, aqua beds, biofeedback, relaxation loungers, inversion tables, and meditation (Field et al., 1996; Moseley et al., 2004; Oman et al., 2008). The goal of these modalities is to activate parasympathetic nervous system activity and reduce sympathetic nervous system activity, which may result in acutely reduced perceived stress (PS) and a decrease in physiological symptoms of stress.

Many college students are not aware of these stress management strategies and as a result, may experience higher levels of stress than necessary. The need to find more interventions addressing student problems with stress that are inexpensive, easy to implement, and can be used in many different settings continues to exist (Dyson and Renk, 2006).

The purpose of this study was twofold. First, to examine, if four stress relief modalities (massage chair, chi machine, rejuvenation lounger, and meditation) are effective at reducing the amount of PS, HR, and blood pressure over one session at the Weber State University stress relief center. Second, to determine, if there was any difference in stress reduction measures between the four stress relief modalities. It was hypothesized that PS, HR and blood pressure would transiently decrease over one session in the relaxation center and that each modality would be equally effective.

Methodology procedure
This study was reviewed and approved by a University Institutional Review Board committee for the ethical use of humans in research. The study utilized a quantitative causal
comparative post hoc method to analyze archived data available at a university stress relief center. Data were collected from February 2015 to August 2017. This data included (with permission) each student’s name, gender, time they entered the relief center, their PS level based on the Likert scale of 1-10, and what stress modality they were participating in that day (massage chair, meditation lounger, chi machine, meditation, etc.). Their blood pressure and HR were measured using an upper arm blood pressure monitor. Those values were recorded.

Once the student completed their modality, upon leaving, again checked in with the front desk attendant to re-evaluate their blood pressure and HR and give a new value on the Likert scale of their PS levels.

**Modalities**

**Massage chair**

Massage chairs were first developed in the 1980s with the purpose of mimicking the motions of an actual massage. The person sits in the chair while electronic vibrators work up and down the spine and shoulders to relieve tension and stress (Plate 1 – Titan TI Pro Alpine massage chair and Luraco iRobotics 7 massage chair). There are many different types of massage chairs that even massage into the hands and feet. Each massage chair has programmed modalities built in to give the user a choice of the type of massage he or she receives, lasting from 10 to 45 minutes. Field et al. (1996) found that massage therapy reduces anxiety and the stress hormone cortisol after a 15-minute massage chair session.

**Chi machine**

The Chi machine is based on 38 years of research done by Dr Shizou Inoue. The person lays supine on the ground and places his or her ankles in the cups located on the machine (Plate 2). The person is then told to relax as the machine rocks the body back and forth in a fish-like sway for a period of time lasting 5-15 minutes. The chi machine (Sun Ancon Chi Machine® model: SDM-888) is built to increase blood circulation, increase energy and mental focus, and mimic an internal massage that creates a state of relaxation (Inoue, 1990).

**Rejuvenation lounger**

The Kinetic Harmonies rejuvenation lounger combines light, sound, and vibration to produce a whole-body relaxation experience. A student lays on the lounger bed for a period
of time between 10 and 20 minutes and places the headphones and attached light goggles on (Plate 3). As the music plays, the vibrations and lights correlate to engage the senses of hearing, sight, and feeling to create a relaxed state.

**Sitting meditation**
Meditation has been shown to lower cortisol (stress hormone) levels and boost blood flow to the front of the brain (Olpin and Bracken, 2014). Meditation requires the person to sit comfortably in a quiet environment, repeating a mantra, such as peace, relax, or calm over and over for 10-20 minutes. Meditation is a powerful and effective way to lower the stress response and return the body to healing mode (Olpin and Bracken, 2014). The meditation chair is pictured in Plate 4.

**Dependent variables**

**Blood pressure and HR**
Upon entering and leaving the stress relief center, blood pressure and HR were obtained using an Omron BP742N 5 series upper arm blood pressure monitor. The Omron BP742N has been validated for personal and clinical use per the European Society of
International Protocol (Takahashi et al., 2016). This cuff wraps around the participant’s upper arm and pressurizes until blood pressure (both systolic blood pressure (SBP) and diastolic blood pressure (DBP)) and HR are obtained.

**PS**
The PS scale is a Likert scale that ranges from 1 to 10 (1 = extremely relaxed and peaceful, 10 = very high levels of stress). It has been used as a reliable tool ($r = 0.85$ for two-day interval) to evaluate acute or daily levels of stress and perceived pain (Cohen et al., 2007). To use, the researcher asks, “on a scale of 1-10, how stressed do you feel right now?” The participants respond with the appropriate number. That number is then recorded as PS.

**Analysis**
The names of the participants were de-identified from the data prior to statistical analysis. The one independent variable in the current study was relaxation modality with four levels (massage chair, rejuvenation lounger, chi machine, and sitting meditation). The dependent variables (DVs) in this study included PS, SBP, DBP, and HR. The DVs were compared from pre- to post-relaxation modality with paired tests.
Gain scores were then calculated for each DV (post-pre score) and then compared between relaxation modality with an ANOVA. When statistical differences in gain scores were found between modalities, post hoc independent t-tests were employed to determine which modalities differed. The α was set a priori at α ≤ 0.05 for statistical significance. Statistical analysis and data management were conducted with Microsoft Excel 2013. The spreadsheet of study data was peer reviewed for errors prior to analysis as suggested by Al Tarawneh and Thorne (2017).

Results

Usage of modalities

Overall, both genders used the stress relief center approximately equal (males: n = 2,767 and females: n = 2,759). The massage chair and sitting meditating were more popular in males (2,537 vs 2,490, 12 vs 8) with the rejuvenation lounger and chi machine more popular among females (74 vs 45, 187 vs 173). Overall, the most utilized modality was the massage chair (n = 5,027) with sitting meditation being least used (n = 20).

Males

Males participated in the massage chair (n = 2,537), chi machine (n = 173), rejuvenation lounger (n = 45), and sitting meditation (n = 12). Arrival and departure measures collected at the stress relief center for PS (1-10), SBP (mmHg), DBP (mmHg), and HR (BPM) can be found in Table I.

In the massage chair, PS (p < 0.001), SBP (p < 0.001), DBP (p < 0.001), and HR (p < 0.001) were all significantly reduced. The rejuvenation lounger similarly reduced PS (p < 0.001), SBP (p < 0.001), and HR (p < 0.001), but there was no significant reduction in DBP (p = 0.07). The chi machine also significantly reduced PS (p < 0.001), SBP (p < 0.001), DBP (p < 0.001), and HR (p < 0.001). Sitting meditation significantly reduced PS (p < 0.001), SBP (p = 0.04), and HR (p = 0.01), but not SBP (p = 0.46) (Table I).

There was no significant difference in gain scores for any of the DVs (PS (p = 0.36), SBP (p = 0.32), DBP (p = 0.95), and HR (p = 0.72)) between modalities (Table II).

Females

Females participated in the massage chair (n = 2,490), chi machine (n = 187), rejuvenation lounger (n = 74), and sitting meditation (n = 8). Arrival and departure measures collected at the stress relief center for PS (1-10), SBP (mmHg), DBP (mmHg), and HR (BPM) can be found in Table III.

In the massage chair, PS (p < 0.001), SBP (p < 0.001), DBP (p < 0.001), and HR (p < 0.001) were all significantly reduced. The chi machine also significantly reduced PS

<table>
<thead>
<tr>
<th>Perceived stress (0-10)</th>
<th>Massage chair (n = 2,537)</th>
<th>Rejuvenation lounger (n = 45)</th>
<th>Chi machine (n = 173)</th>
<th>Sit and meditate (n = 12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>5.3 ± 2.0</td>
<td>6.1 ± 2.1</td>
<td>5.3 ± 2.1</td>
<td>5.0 ± 1.3</td>
</tr>
<tr>
<td>Post</td>
<td>3.4 ± 1.7*</td>
<td>3.9 ± 2.1*</td>
<td>3.2 ± 1.7*</td>
<td>2.8 ± 1.5*</td>
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<tr>
<td>Systolic BP (mmHg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>120.0 ± 12.3</td>
<td>118.6 ± 11.5</td>
<td>119.9 ± 11.9</td>
<td>117.7 ± 10.7</td>
</tr>
<tr>
<td>Post</td>
<td>116.0 ± 12.8*</td>
<td>111.3 ± 13.0*</td>
<td>115.2 ± 11.5*</td>
<td>117.3 ± 9.5</td>
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<tr>
<td>Diastolic BP (mmHg)</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>76.2 ± 10.0</td>
<td>73.5 ± 9.5</td>
<td>77.2 ± 8.8</td>
<td>78.1 ± 4.7</td>
</tr>
<tr>
<td>Post</td>
<td>73.1 ± 10.1*</td>
<td>71.1 ± 10.3</td>
<td>73.9 ± 9.9*</td>
<td>75.4 ± 6.7*</td>
</tr>
<tr>
<td>Heart rate (BPM)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>77.5 ± 15.5</td>
<td>78.8 ± 13.7</td>
<td>79.4 ± 16.6</td>
<td>76.3 ± 12.8</td>
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<tr>
<td>Post</td>
<td>70.9 ± 13.3*</td>
<td>72.9 ± 13.1*</td>
<td>73.6 ± 14.5*</td>
<td>69.1 ± 11.1*</td>
</tr>
</tbody>
</table>

Table I. Male students

Notes: Pre, pre modality dependent variable score; post, following modality dependent variable score; BPM, beats per minute (mean ± standard deviation). *Significant reduction from pre- to post-stress relief modality (p < 0.05)
(p < 0.001), SBP (p < 0.001), DBP (p < 0.001), and HR (p < 0.001). Sitting meditation significantly reduced PS (p = 0.03) and HR (p < 0.001), but not SBP (p = 0.09) or DBP (p = 0.21). The rejuvenation lounger similarly reduced PS (p < 0.001) and HR (p < 0.001), but there was no significant reduction in SBP (p = 0.30) or DBP (p = 0.46) (Table III).

No differences were found between relaxation modalities regarding gain scores of PS (p = 0.66) or HR (p = 0.08). However, there was a significant difference between relaxation modalities regarding gain scores for SBP and DBP. The massage chair, chi machine, and sitting meditation (modalities of massage chair, chi machine, and sitting meditation (− significantly reduced PS (p < 0.001), SBP (p < 0.001), and HR (p < 0.001), but not SBP (p = 0.09) or DBP (p = 0.21). The rejuvenation lounger similarly reduced PS (p < 0.001) and HR (p < 0.001), but there was no significant reduction in SBP (p = 0.30) or DBP (p = 0.46) (Table III).

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Comparison of four stress reduction modalities

<table>
<thead>
<tr>
<th>Male Student’s Gain Scores (post-pre score)</th>
<th>n = 2,537</th>
<th>n = 45</th>
<th>n = 173</th>
<th>n = 12</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perceived stress (0-10)</strong></td>
<td>−1.9 ± 1.5</td>
<td>−2.2 ± 1.3</td>
<td>−2.1 ± 1.6</td>
<td>−2.2 ± 1.3</td>
</tr>
<tr>
<td><strong>Systolic BP (mmHG)</strong></td>
<td>−4.1 ± 12.3</td>
<td>−7.3 ± 12.5</td>
<td>−4.7 ± 10.7</td>
<td>−3.5 ± 7.2</td>
</tr>
<tr>
<td><strong>Diastolic BP (mmHG)</strong></td>
<td>−3.1 ± 9.6</td>
<td>−2.3 ± 10.4</td>
<td>−3.2 ± 8.8</td>
<td>−2.7 ± 4.8</td>
</tr>
<tr>
<td><strong>Heart rate (BPM)</strong></td>
<td>−6.6 ± 9.6</td>
<td>−5.9 ± 8.7</td>
<td>−5.9 ± 8.4</td>
<td>−7.3 ± 8.7</td>
</tr>
</tbody>
</table>

**Notes:** BPM, beats per minute (mean ± standard deviation). No significant difference in gain scores for any dependent variable between stress reduction modality (p > 0.05).

<table>
<thead>
<tr>
<th>Female students' gain scores (post-pre score)</th>
<th>n = 2,490</th>
<th>n = 74</th>
<th>n = 187</th>
<th>n = 8</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perceived stress (0-10)</strong></td>
<td>−2.0 ± 1.4</td>
<td>−2.2 ± 1.6</td>
<td>−2.0 ± 1.5</td>
<td>−2.3 ± 2.8</td>
</tr>
<tr>
<td><strong>Systolic BP (mmHG)</strong></td>
<td>−4.0 ± 10.5</td>
<td>−0.6 ± 9.7*</td>
<td>−4.3 ± 9.8</td>
<td>−4.1 ± 7.9</td>
</tr>
<tr>
<td><strong>Diastolic BP (mmHG)</strong></td>
<td>−3.5 ± 9.0</td>
<td>−0.1 ± 8.4*</td>
<td>−3.1 ± 8.3</td>
<td>−5.1 ± 16.6</td>
</tr>
<tr>
<td><strong>Heart rate (BPM)</strong></td>
<td>−7.9 ± 10.0</td>
<td>−8.1 ± 9.2</td>
<td>−6.0 ± 10.4</td>
<td>−10.1 ± 8.0</td>
</tr>
</tbody>
</table>

**Notes:** BPM, beats per minute (mean ± standard deviation). *Significant difference in gain scores between stress reduction modality (p < 0.05)
Discussion
The presence of stressors in college is normal and inevitable. High levels of stress can negatively affect student academic performance, health conditions, and increase the risk of illness (Matheny et al., 2005). Introducing stress reduction strategies to college students may be effective at reducing stress symptoms, increasing student productivity, improving psychological wellbeing, and enhancing physical health. As such, the purpose of this study was to compare four stress reduction modalities on the amount of physiologic and PS reduction over one session in the Weber State University stress relief center. The hypothesis was that PS, HR, and blood pressure would transiently decrease over one session in a relaxation center. The results partially support this hypothesis. In both males and females PS ($p < 0.001$) and HR ($p < 0.001$), were reduced significantly in all modalities over a single session in the stress relief center.

Hudd et al. (2000) studied 225 college students, the majority of them thought that their health was either excellent, very good, or good. Our data concurred with the findings of Hudd et al. (2000) as the participants exhibited healthy average values in both males (PS = 5.4; SBP = 119.1 mmHg; DBP = 77.5 mmHg; HR = 78 BPM) and females (PS = 5.4; SBP = 107.2 mmHg; DBP = 72.3 mmHg; HR = 79.2 BPM). Despite reports of feeling healthy, many also noted not eating well and drinking alcohol in large quantities (Hudd et al., 2000). Dressler (1991) found that students who experienced higher levels of stress, or new kinds of stressors, developed new ways of coping that may or may not have been effective. It is important to replace these negative coping skills with positive ones (Blake and Vandiver, 1988) in order to reduce symptoms of stress. This study demonstrated significant improvement in stress-related symptoms, including PS and HR in both males ($p < 0.001$) and females ($p < 0.01$).

Stress reduction modalities have been effective in alleviating symptoms of stress in many sample populations in a variety of contexts (Cady and Jones, 1997) and has resulted in positive physiological and psychological health benefits. The modalities used in this study demonstrated a decrease in DBP and SBP for both males and females. Additionally, the modalities used in this study demonstrated a decrease in HR for both males and females. Reducing SBP and DBP to ranges of 90-114 mmHg and 60-74 mmHg have been shown to have the lowest risk of cardiovascular disease (Rapsomaniki et al., 2014). Our study also adds to literature by Cady and Jones (1997) showing that seated chair massage may be used to reduce HR and increase feelings of relaxation.

This data further supports the hypothesis that college student stress and blood pressure would decrease over one session in a relaxation center. The findings suggest that any amount of time a student could put aside to sit and meditate, whether using a modality or not, would reduce their PS and HR, creating a more relaxed state (Cady and Jones, 1997). The clinical significance of this data is enhanced by using over 5,000 college students. These interventions could be easily implemented at any university. Consistent with previous research, relaxation modalities are an effective method in reducing PS in college students (Field et al., 1996; Inoue, 1990; Olpin and Bracken, 2014).

This study was limited by using archival data that contained small errors in collection and transcription, as well as human error. Some of the errors include incomplete recordings of PS, blood pressure, or HR levels. Students may have checked into the center and stated they were planning to do one modality and then changed their mind and did a different one. Participant selection limitations also exist. Most of the participants were from Northern Utah and attending Weber State University. Participants were mostly white Caucasian and may not fully represent other diverse populations. Furthermore, there was not a control group per se. We made the assumption that sitting meditation was
the nearest control group that was achievable given the nature of the archived data (which of course is not strictly a control condition).

Further research may consider following students over time, instead of over one day at the stress relief center. The addition of a true control group and the inclusion of other activities that may have stress reduction benefits (i.e. exercise, socializing, reading, or movie watching) would also be of interest. It also may be beneficial to see what times during the semester are most stressful for students and see if that correlates with number of students using the stress relief center’s resources.

Practical applications
Stress in college students is normally not handled well. College students do not think that alternate ways of managing stress are beneficial because of lack of knowledge or awareness. Education and training about tools and interventions, like those provided in the stress relief center at Weber State University, need to become more widespread (King et al., 2012).

The stress relief center is a model that can be implemented at any university campus, business, health center, etc. While some may have a different opinion, recent research indicates that the cost of investing in stress modalities, such as mentioned in this study, outweigh the costs of the time and money spent on stress-related problems as reported by Olpin and Bracken (2014). Universities are ideal places for stress relief centers to exist and may then expand beyond the university to meet a greater purpose.

Conclusions
The American College Health Association (2015) reports that stress is prevalent in university students, faculty, and staff throughout the USA. The need to find more intervention options that address student problems with stress that are inexpensive, easy to access and use, and used in different settings continues to exist (Dyson and Renk, 2006). Stress management techniques are beneficial for reducing student stress (Baghurst and Kelley, 2014), however, some students lack the knowledge or training to implement these techniques. An approach to help college students reduce stress effectively was the stress relief center at Weber State University. This center included various modalities that are easy to use and are effective in reducing symptoms of stress, as shown in this study. Education and training about tools and interventions, like those provided in the stress relief center at Weber State University, need to become more widespread (King et al., 2012). College students’ wellbeing is important to their academics and life skills, and because college students experience such high stress levels, education on stress as well as modalities to help reduce and prevent stress are needed at universities (Baghurst and Kelley, 2014).

References

American College Health Association (2015), National College Health Assessment II: Reference Group Executive Summary Spring 2015, American College Health Association, Hanover, MD.


Further reading

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