Research Article

Effects of Autogenic Training on Stress Response and Heart Rate Variability in Nursing Students

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S U M M A R Y

Purpose: This study was undertaken to confirm the effects of autogenic training (AT) on stress response and heart rate variability in nursing school students experiencing stress related to clinical training.

Methods: The study was carried out from September 2012 to April 2013 in a quasi-experimental nonequivalent control group using a pretest-posttest design. The participants were 40 nursing students in their third year at either of two nursing colleges. All consented to participate. Nineteen nursing students at one college were assigned to the experimental group and underwent the 8-week AT program, and the other 21 were assigned to the control group and did not undergo any training. Stress response was assessed by questionnaire and HRV was measured three times, that is, before the program, at the end of the program, and 6 months after the end of the AT program.

Results: A significant time/group interaction was found for stress response (F = 4.68, p = .012), a subjective indicator. However, no significant interaction was found for the objective indicators of heart rate variability, normalized low frequency (F = 2.59, p = .090), normalized high frequency (F = 2.59, p = .090), or low frequency to high frequency ratio (F = 1.38, p = .257).

Conclusion: The results suggest that AT provides an acceptable approach to stress reduction in nursing students.

Introduction

Nursing school students are under more stress than students studying other majors because of the burden imposed by taking courses while completing clinical training, which accounts for a large proportion of academic credits (Yoo, Chang, Choi, & Park, 2008). In particular, nursing students experience much more stress during initial clinical training. The sources of stress for these students are mainly the result of a lack of professional knowledge and skills in taking care of patients, the clinical environment, and teachers and nursing staff (Chan, So, & Fong, 2009; Shaban, Khater, & Akhu-Zaheya, 2012; Sheu, Lin, & Hwang, 2002). Furthermore, they have only knowledge of basic medicine and nursing prior to clinical training (Sheu et al., 2002). Accordingly, they do not know how to cope with the dynamic and complex clinical environments, how to establish good relationships with clinical staff and instructors or deal with sudden changes in patients’ conditions (Elliott, 2002). This stress has a negative effect on adaptation to clinical training, and thus, on student health. Furthermore, if stress is excessive or prolonged, nursing students fail to adapt to clinical training (Park, Ha, & Choi, 2004) and experience psychological difficulties, such as anxiety, a sense of anger, indifference, frustration, and depression (Chang et al., 2007), and physical health problems, such as indigestion, anorexia, backache, headache, and insomnia (Choo et al., 2002; Park & Ha, 2003).

As social concerns regarding health have increased, the need for diverse teaching methods to provide qualified nursing care skills has been suggested (Whang, 2006). Thus, as the importance of clinical training increases, nursing students need appropriate stress coping strategies to reduce the risks of physical and mental health problems.

Relaxation training provides an excellent strategy for managing stress, and autogenic training (AT) is one type of this training (Kanji, White, & Ernst, 2006; Son, 2011). AT is a psychophysiological type of psychotherapy based on autosuggestion, first developed by the German physician and psychiatrist J.H. Schultz in the early 20th century. AT consists of the phased practice of six simple relaxation exercises that addresses muscular relaxation is the first exercise that addresses muscular relaxation and heart rate variability (F = 4.68, p = .012), a subjective indicator. However, no significant interaction was found for the objective indicators of heart rate variability, normalized low frequency (F = 2.59, p = .090), normalized high frequency (F = 2.59, p = .090), or low frequency to high frequency ratio (F = 1.38, p = .257).

Conclusion: The results suggest that AT provides an acceptable approach to stress reduction in nursing students.

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heaviness in limbs, and subsequently, attention is focused inactively on sensing warmth, then on slow breathing, abdominal warmth, a calm heart beat, and a cool forehead. It has been recommended that the AT program be conducted over 8 weeks and that it be composed of one group session per week and self-training three times daily (Kanji et al., 2006; Rhee, 2008). While progressing through these exercises, most people experience passive concentration, which allows the individual to break out the vicious stress cycle (Carruthers, 1979). AT leads a high-arousal sympathetic nervous response to low-arousal parasympathetic nervous response via relaxation (Kanji et al., 2006; Rhee, 2008).

Some reports have claimed that AT has valuable effects on the mind and body, and is currently used to treat diseases related to or aggravated by stress, such as irritable bowel syndrome (Shinozaki et al., 2010), cancer (Wright, Courtney, & Crowther, 2002), and multiple sclerosis (Sutherland, Andersen, & Morris, 2005). AT is also used to treat stress. Three trials have been performed to study the effect of AT on stress in nursing students, which found that AT reduced anxiety (Charlesworth, Murphy, & Beutler, 1981; Kanji et al., 2006) and the absence rate due to illness (Bailey, 1984).

Stress is known to affect cardiovascular changes, which are usually related to autonomic nervous system activity changes (Rozanski et al., 1986). Heart rate variability (HRV) is one of the indicators of changes in the autonomic nervous system (Chandola, Heraclides, & Kumari, 2010), and has been used to measure general autonomic system function and physiological stress response degree because of its simplicity and noninvasive nature (Szatziej, 2004; Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996). Mitani, Fujita, Sakamoto, & Shirakawa (2006) measured changes in stress and autonomic nervous activity using HRV, and reported that sympathetic nervous activity increases but parasympathetic nervous activity decreases in stressful situations. Pomerantz et al. (1985) concluded that HRV is a credible and sensitive indicator of cardiac autonomic nervous activity through HRV power spectral analysis.

Studies on AT have been performed over many years overseas, but little work has been undertaken in Korea. In particular, few studies have been conducted on the AT Korean Standard developed by Ju-hee Rhee based on the original AT by Schultz (Rhee, 2006, 2008). Few HRV studies have evaluated the effects of AT.

**Purpose of study and hypotheses**

This study was undertaken to confirm the effects of AT on stress response and HRV in nursing school students experiencing stress related to clinical training. We hypothesized stress response in the experimental group, members of which were administered with AT, would be lower than that in the control group, and that normalized low frequency (LF) would be lower, normalized high frequency (HF) would be higher, and LF/HF ratio would be lower in the experimental group.

**Methods**

**Study design**

This study used a quasi-experimental, nonequivalent control group, pretest–posttest design (19 participants in the experimental group, 21 participants in the control group). Participants in the experimental group were administered the AT Korean Standard. Outcomes were measured three times: before the AT program, at the end of the standard 8-week program, and at 6 months after the end of the program.

**Setting and samples**

The participants were 40 nursing students in their third year at two nursing colleges. All consented to participate. Nineteen nursing students at one college were assigned to the experimental group and underwent the 8-week AT program, and the other 21 were assigned to the control group, members of which did not undergo any training. No participant dropped out of the study. The sample size for this study was calculated before the investigation. G-power program, version 3 (Faul, Erdfelder, Lang, & Buchner, 2007) showed that 16 students per group were required for an effect size of 0.3, at a power of 95%, and an alpha level of .05. The reasons why we decided on this small effect size were that no previous AT study has calculated sample size using the G-power program and the experimental and control groups were well matched. The selection criteria were as follows: (a) agreement to participate in the study; (b) no relaxation therapy during the previous 6 months; and (c) no cardiovascular or neurological problem.

**Ethical considerations**

This study was approved by the institutional review board of Hoseo University (approval no.: 20120009). Participants interested in this study voluntarily participated in the protocol. The study purposes and procedures were explained to participants. Participants were told that personal information would be protected and they could drop out of the study without prejudice at any time. Participants provided written informed consent and were briefed beforehand on study purposes and procedures, anticipated risks and benefits, privacy protection, compensation methods, and withdrawal from the study.

Due to their student statuses, honest answers of the participants were emphasized to avoid ethical problems during the study. In particular, the risk of making false or flattering responses by students were prevented by informing them that honest answers could enhance the quality of the study. Furthermore, participants were told that all collected data would be used for study purposes only.

**Intervention**

**Autogenic training**

AT was administered according to the AT Korean Standard (Table 1) in a lecture room by an AT facilitator certified by the Korean AT Association. AT involved the phased practice of 6 simple relaxation responses once weekly for 8 weeks. In a relaxed sitting position with eyes closed, the training involved the use of six short verbal standard formulae. The first exercise targeted muscular relaxation. The principle subject of the verbal formula used was heaviness. Right-handed students started passive concentration of “My right arm is heavy,” whereas left-handed participants started with the left arm. The second mandatory passive concentration addressed peripheral warmth using formula “My right/left arm is warm.” After learning to generate feelings of heaviness and warmth, participants were taught to concentrate on breathing, which was keyed by the instruction “My breathing is calm and regular,” and then to warm the abdominal region by using the formula “My solar plexus is warm.” The following exercise concerned the cranial region, which should be cooler than the rest of the body. Here, the formula used was “My forehead is cool.” Finally, the focus was placed on cardiac activity with the formula “My heart beat is calm and regular.” Each formula was practiced in group sessions and participants were asked to practice the learned autogenic exercises alone at least twice daily. In addition, they were asked to submit a report of their experiences and any questions
participants based on considerations of these reports. If a student
regarded their experiences while they practiced the exercises. At
each of the 8 sessions, the facilitator provided feedback to the
participants based on considerations of these reports. If a student
found it difficult to practice the exercises alone, the facilitator

<table>
<thead>
<tr>
<th>8-week sessions</th>
<th>Exercise formulae</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>My right/left arm is heavy.</td>
<td>Explain the principles of AT and the necessity of self practice. Practice the first standard procedure using the first formula, “My right/left arm is heavy.” Solve problems, support, and encourage by feedback. Give materials for self practice and explain self practice.</td>
</tr>
<tr>
<td>2</td>
<td>My right/left arm is warm.</td>
<td>Discuss self practice. Review the first standard procedure. Practice the second standard procedure using the second formula, “My right/left arm is warm.” Solve problems, support, and encourage by feedback. Give materials for self practice and explain self practice.</td>
</tr>
<tr>
<td>3</td>
<td>My breathing is calm and regular.</td>
<td>Discuss self practice. Review the first two standard procedures. Practice the third standard procedure using the third formula, “My breathing is calm and regular.” Solve problems, support, and encourage by feedback. Give materials for self practice and explain self practice.</td>
</tr>
<tr>
<td>5</td>
<td>My solar plexus is warm.</td>
<td>Discuss self practice. Review the first three standard procedures. Practice the fourth standard procedure using the fourth formula, “My solar plexus is warm.” Solve problems, support, and encourage by feedback. Give materials for self practice and explain self practice.</td>
</tr>
<tr>
<td>6</td>
<td>My forehead is cool.</td>
<td>Discuss self practice. Review the first through fourth standard procedures. Practice the fifth standard procedure using the fifth formula, “My forehead is cool.” Solve problems, support, and encourage by feedback. Give materials for self practice and explain self practice.</td>
</tr>
<tr>
<td>7</td>
<td>My heart beat is calm and regular.</td>
<td>Discuss self practice. Review the first through fifth standard procedures. Practice the sixth standard procedure using the sixth formula, “My heart beat is calm and regular.” Solve problems, support, and encourage by feedback. Give materials for self practice and explain self practice.</td>
</tr>
<tr>
<td>8</td>
<td>Final check</td>
<td>Discuss self practice. Review and practice the six standard procedures. Solve problems, support, and encourage by feedback. Advise regarding further training: once a day for a year.</td>
</tr>
</tbody>
</table>

HRV

HRV was measured by emWavePSR (HeartMath, Inc., CA, USA) for 5 minutes, and MATLAB program (The MathWorks, Inc., Kuopio, FINLAND) with Kubios HRV version 2.0 was used to obtain the indicators for frequency-domain analysis. This analysis entails the determination of power in each of these bands (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996). Power in the HF band (0.15–0.4 Hz) is an indicator of parasympathetic nervous activity, whereas power in the LF band (0.05–0.15 Hz) mostly reflects sympathetic nervous activity (Song et al., 2011). Power in the very-low-frequency (VLF) band (0.005–0.05 Hz) is an additional indicator of parasympathetic nervous activity (Pagani et al., 1986). LF/ HF ratio is a general balance indicator used to evaluate sympathetic/parasympathetic nervous system balance. A high ratio indicates intensified activity of the sympathetic nervous system or suppression of the parasympathetic nervous system (Mellman, Knorr, Pigeon, Leiter, & Akay, 2004).

In this study, normalized LF, normalized HF, and LF/HF ratio were used to analyze autonomic nervous system activity. The formula used to calculate normalized LF or HF was as follows: normalized LF or HF = (LF or HF/total power – VLF) × 100 (Dishman et al., 2000).

Data collection

Data was collected from September 2012 to April 2013. AT was conducted for 8 weeks, from September to October 2012. Data collection was performed three times: before AT, at the end of AT, and 6 months after AT completion. To control for factors affecting the autonomic nervous system when HRV was measured, participants were asked not to drink alcohol the night before the examination and not to drink caffeine or smoke for at least 4 hours before the examination. HRV was measured in a quiet, calm conference room. Participants were asked to remove jewelry and cell phones, and to adopt a comfortable posture. After applying the measurement sensor to an ear lobe, the procedure was explained and HRV was measured for 5 minutes while maintaining a respiration rate of 14–20 breaths per minute (Kim, Hwang, Kim, Sim & Lee, 2005).

Data analysis

Data analysis was performed using SPSS version 18.0 for Windows (IBM SPSS Statistics, Chicago, IL, USA). Chi-square test, Fisher’s exact test, and t test were used for testing homogeneity between the experimental and control groups. Hypothesis testing was performed using repeated measures analysis of variance.
Discussion

Several research findings related to the effects of AT training of nursing students to cope with stresses were produced by this study. These outcomes have following implications.

First, the results of this study are consistent with those of previous studies that focused on the effects of AT. In general, there are two methods of coping with stress, that is, problem-focused methods aimed at solving or changing the problem, and emotion-focused coping methods based on psychological and behavioral efforts (Lazarus & Folkman, 1984). The AT used in this study is a type of emotion-focused coping method. Yurdakul, Holttum, and Bowden (2009) analyzed the effect of AT by using grounded theory, and presented clear evidence that AT decreased anxiety levels in women by enhancing a sense of well-being in the context of stress management. Kwon (2009) also reported that AT effectively reduced stress levels in pregnant women. According to a study by Masato et al. (2006), AT supported the development of mental energy to create a positive self image and a sense of self efficiency, and reduced patient anxiety levels. Tutsusumi, Kabeya, and Ogawa (2012) also reported that AT reduced trait anxiety in patients with chronic subjective dizziness. A meta-analysis of experimental studies by Ernst and Kanji (2000) showed AT had positive effects on relieving stress in seven cases out of eight. In the present study, we found that stress response levels in the experimental group were lower than those in the control group. This finding demonstrates that the AT program had positive effects on the abilities of nursing students to cope with stress, which is in line with the studies mentioned above.

Second, this study differs from other studies with respect to the applicability of the relaxation method to university students. Song and Kim (2010) reported that AT, as applied to university students in Korea, was effective at reducing stress, which indicated AT could be applicable and effective in patients, adults, and healthy university students. However, the research method used by Song and Kim was a modified version of the traditional AT intervention, except that a tape recorder, rather than autosuggestion, was used to induce

| Note: Exp – experimental group; Cont – control group; HRV – heart rate variability; LF norm – normalized low frequency; HF norm – normalized high frequency. |
subject self relaxation. Thus, the present study differs, as it involved an expansion of AT by using traditional autosuggestion to enhance passive concentration ability.

Third, the present study differs substantially from previous studies with respect to subject selection. Kanji et al. (2006) reported that AT induced significant relief on anxiety in second through fourth year nursing students. However, Kanji et al. applied their testing methods to students regardless of their grade, whereas we used stress response measures and applied them to third year nursing students, who were experiencing clinical practice for the first time, and thus, exposed to higher levels of real stress than students in other grades.

Fourth, the results of this study showed no effect on physiological variables measured by HRV. We found normalized LF was increased and normalized HF decreased with time. In other words, the activity level of the sympathetic nervous system was elevated and the activity level of the parasympathetic nervous system was reduced in the experimental and control groups during the study period. Mitani et al. (2006) investigated the effect of AT on the autonomic nervous system and found the activity level of the sympathetic nervous system was significantly reduced and the activity level of the parasympathetic nervous system was increased in high-risk firefighters. Miu, Heilman, and Maclea (2009) also reported that AT increased HRV and facilitated vagal control of the heart in healthy volunteers under mental stress. Lee (2007) also reported that AT increased resistance to stress by alleviating the sympathetic nervous system and activating the parasympathetic nervous system in normal adults, and showed a significant difference between indicators, that is, mean HRV, standard deviation of the NN interval, and standard deviation of difference between adjacent NN intervals, which were measured by time-domain analysis. However, in this study, LF and HF were measured by frequency-domain analysis and were not found to show any significant difference. Therefore, a more elaborate study is required to check HRV by time-domain and frequency-domain analysis at the same time and to examine their relationship.

Fifth, this study provides more elaborate information for future research by presenting inconsistencies between physiological and psychological variables. Dishman et al. (2000) reported an inverse relationship between the normalized HF component of HRV and perceived stress. They found that AT when viewed as a psychological factor, was effective at relieving stress response, whereas when viewed as a physiological factor, it did not affect HRV. This lack of consistency between stress recognition and physical reactions concurs with that found by Chung and Kim (2008), who analyzed relationships between psychological stress and HRV and showed mental and physical responses were not always consistent. Chung and Kim suggested this inconsistency was due to differences in measurement times. During the questionnaire survey subjects were asked to assess their stress responses for a certain period of time, such as 1 month or 1 year, whereas they presented physical state, HRV, at the specific point of measurement time. This result demonstrated that sociopsychological indicators are not always consistent with physiological indicators. Therefore, we suggest more research be conducted to determine the reasons for this inconsistency and to develop objective and valid measurement indicators.

Sixth, this study suggests the need to manage stresses experienced by nursing students, and provides methods for coping with stress. Previous studies have shown nursing students experience various stresses in clinical practice (Kim & Lee, 2011) that affect self-efficacy, self-respect, autonomous neuro-systems, and clinical competence (Kim, 2002; Kim & Lee, 2011; Whang, 2006). However, it is regarded as the students’ responsibility to take care of their own stress in nursing school. Therefore, we recommend that more specific, concrete approaches by instructor in the nursing school be taken to address the issue of nursing students’ stress. Furthermore, nursing students should be given training guidelines, which cite active stress coping strategies that allow students to adapt to college life, accept stressful situations positively, and manage them in advance. In particular, we recommend that a relaxation program, such as, AT, designed to enable nursing students to manage stresses arising during clinical training, be incorporated into all university nursing training programs.

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**Table 4 Differences in Stress Response between Experimental and Control Groups (N = 40).**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Exp (n = 19)</th>
<th>Cont (n = 21)</th>
<th>Between group</th>
<th>Time</th>
<th>Within group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M ± SD</td>
<td>M ± SD</td>
<td>F(p)</td>
<td>F(p)</td>
<td>F(p)</td>
</tr>
<tr>
<td>Stress response</td>
<td>1st</td>
<td>2nd</td>
<td>3rd</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>68.37 ± 19.39</td>
<td>68.37 ± 18.90</td>
<td>68.00 ± 16.88</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>73.05 ± 19.54</td>
<td>87.71 ± 24.90</td>
<td>94.14 ± 30.10</td>
<td></td>
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</tr>
<tr>
<td>HRV LF norm (%)</td>
<td>1st</td>
<td>2nd</td>
<td>3rd</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>43.01 ± 16.16</td>
<td>46.64 ± 17.07</td>
<td>49.31 ± 14.12</td>
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</tr>
<tr>
<td></td>
<td>39.40 ± 11.19</td>
<td>40.32 ± 14.82</td>
<td>54.39 ± 11.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HF norm (%)</td>
<td>1st</td>
<td>2nd</td>
<td>3rd</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>57.00 ± 16.16</td>
<td>53.36 ± 18.07</td>
<td>50.69 ± 14.21</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>60.00 ± 11.19</td>
<td>59.68 ± 14.82</td>
<td>45.61 ± 11.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LF/HF ratio</td>
<td>1st</td>
<td>2nd</td>
<td>3rd</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.89 ± 0.54</td>
<td>0.87 ± 0.46</td>
<td>1.05 ± 0.48</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>0.72 ± 0.39</td>
<td>0.75 ± 0.40</td>
<td>1.04 ± 0.38</td>
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<tr>
<td></td>
<td>0.47 ± 0.48</td>
<td>0.47 ± 0.48</td>
<td>0.47 ± 0.48</td>
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</tr>
<tr>
<td></td>
<td>7.92 ± 0.00</td>
<td>7.92 ± 0.00</td>
<td>1.38 ± 0.25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Exp – experimental group; Cont – control group; HRV – heart rate variability; LF norm – normalized low frequency; HF norm – normalized high frequency; 1st – before the AT program; 2nd – at the end of the standard 8-week AT program; 3rd – 6 months after the end of the AT program.
The subjects of this study were third-year nursing students attending a four-year program at two universities. One of the limitations in this study is that convenience sampling rather than random sampling was used. The general characteristics of the two study groups, such as, religion, burden of tuition, residence type, admission motives, and satisfaction with educational environment, were similar, and the groups were well-matched in terms of gender and grade. However, clinical settings, college-related variables, such as examination and academic schedules, and personal situations could not be controlled. Accordingly, it is difficult to generalize our results to all nursing students. Furthermore, careful consideration of study design, such as, the provision of a psychologically and physically comfortable environment is needed for precise HRV measurements, because comfort is likely to affect the autonomic nervous system. We suggest future studies on AT address these limitations to enable the generalization of results.

Conclusion

The results of this study are useful and legitimate because they show AT has a positive effect on relief from stress response in nursing students, but no effect on HRV. Thus, because nursing students are expected to cope with stress resulting from their studies and clinical training, stress coping methods should be developed via further research so that student experiences of courses and clinical training are more rewarding. AT is a method that aids the achievement of these goals because it is offers a cost-effective approach that can be easily practiced.

Conflict of interest

The authors have no potential conflict of interest to declare.

Acknowledgments

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