The Effects of a Stress Management Intervention in Elementary School Children

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ABSTRACT: ***Objective:*** **This preliminary study tests the effectiveness of an elementary school-based stress management technique on anxiety symptoms and heart rate variability (HRV) in children.** ***Methods:*** **In this controlled prospective longitudinal study, children in third-grade classroom participated in a teacher-led daily 10-minute stress management intervention for 4 months. The control class teacher read from a children's book for 10 minutes daily. A standardized anxiety scale and HRV (using computer biofeedback program) were measured before the 4-month intervention, immediately after, and 1 year later.** ***Results:*** **The intervention class showed significant improvement from baseline to the immediate postintervention period in total anxiety ($N = 14$, $F = 12.95$, $p = .002$), with 1-year follow-up scores maintaining improvement ($N = 13$, $F = 5.88$, $p = .025$). The intervention class had small improvement in HRV using the biofeedback program in the immediate postintervention period, with significant improvement at 1-year follow-up ($N = 13$, $F = 10.61$, $p = .005$). The control class showed no improvements. Qualitatively, children reported that the intervention was helpful during stressful times at school and at home, even after the study period.** ***Conclusion:*** **An elementary school-based short daily stress management intervention can decrease symptoms of anxiety, and improve HRV, a measure of relaxation. Ultimately, these children found this skill continued to help them cope better with everyday stressors.**

*(J Dev Behav Pediatr 35:*62–67, 2014) **Index terms:** stress management, pediatric hypnosis/self-regulation, coping skills, school children, biofeedback.

Many children are negatively affected by biological and psychological stressors. The term stress is commonly used to express feeling overwhelmed, with difficulty managing daily stressors. There is increasing recognition that toxic stress in the early years has many negative implications throughout life.[1] Impacts of stress can be observed in symptoms of somatic complaints, poor emotional regulation, anxiety, depression, and health problems. Many children are experiencing excess anxiety and somatic complaints as well as emotional/behavioral and physical health problems. A total of 13% to 20% of children living in the United States experience a mental disorder in a given year, and CDC surveillance during 1994 to 2011 has shown the prevalence of these conditions to be increasing. Suicide, which can result from the interaction of mental disorders and environmental stressors, was the second leading cause of death among adolescents aged 12 to 17 years in 2010.[2] Stressors that children encounter can include family disruption, family moves, violence (experienced by the child or observed), school changes, school pressures, competition, and peer pressure.[3–5] School pressures (e.g., required proficiency testing) have continued to increase, whereas school activities that may be relaxing (e.g., recess, physical education, art, and music) have decreased in many schools.[6] Children's fears and stress reactions can manifest in many different ways, such as behavior changes, anxiety, depression, psychosomatic complaints,[7–10] sleep problems,[11,12] and illness.[13]

Although coping skills are necessary for adequate adjustment to stressors of childhood, there is limited evidence concerning the percentage of children who develop coping skills. Learning ways to manage stressors can reduce the negative impact of stress (e.g., psychological and physical symptoms). Self-regulation techniques that use relaxation and imagery can be effective tools to help children improve well-being and health-related issues.[14,15] Hypnosis is a self-regulation technique that often has a goal in addition to the relaxation, such as reducing pain (i.e., headaches).[16] During meditation, one is instructed to clear the mind, which leads to relaxation. Mindfulness-based stress reduction, or mindfulness meditation, is another technique described in the literature during which one aims to keep the mind in the present moment by letting thoughts enter and leave the mind and can also lead to comfort and relaxation.[17] One study showed mindfulness meditation to be helpful in reducing symptoms of anxiety in adults.[18] A recent small study found mindfulness training to be helpful in improving

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parent-reported symptoms of attention-deficit hyperactivity disorder in children.[19] All these techniques involve some form of self-regulation to help achieve better cognitive and emotional control.[20]

The World Health Organization has encouraged mental health promotion activities in schools.[21] School-based studies using relaxation training have been shown to be effective in improving classroom "on task" behavior.[22] One study found improvements after a 2-year emotional self-management skills course on psychosocial functioning and autonomic recovery (using the Freeze Framer biofeedback tool)[23] to stress in middle school children and these benefits were sustained after 6 months.[24] Many studies, while effective in helping children, used complex and time-consuming programs that are difficult to implement into a daily school program. Many also focus on children with specific issues, such as headaches, asthma,[25] anxiety, or depression.[26,27] A recent study performed in an area affected by the second Lebanon War showed that Israeli children who did a yoga program in the school setting improved in concentration, mood, and ability to function under pressure.[28] A few studies have looked at such techniques with typical children in the school setting and have found benefits with well-being, psychosocial functioning, and autonomic control.[29,30]

The aim of this pilot study was to test the effectiveness of a daily short stress management technique (SMT) based on hypnosis techniques delivered in the classroom school setting on self-reported anxiety and autonomic reactivity using a biofeedback computer program that measures heart rate variability (HRV) as a measure of relaxation.[31] This preliminary study provides additional information to the current literature evidence by examining a brief intervention in a typical school setting and provides long-term follow-up data to assess whether teaching children an SMT provides them with an effective coping skill that transfers into their daily lives. Our hypothesis was that children who learned an SMT would have fewer symptoms of anxiety and improved HRV, a physiologic measure of autonomic control as it relates to relaxation in comparison with children who did not learn an SMT, and that their improvements would continue into their next year of school.

METHODS

Participants

Permission was obtained from the Institutional Review Board at University Hospitals in Cleveland, OH, and from the elementary school principal. This school was selected because it was within a reasonable distance of the hospital and because the principal was agreeable to the proposed study. Third-grade children were selected because by the age of 8 years, children are capable of noticing specific mind-body links and are able to see how shifts in thinking and images will lead to a physiologic change. They are also able to use these abilities to generalize the self-regulation into their life outside of formal biofeedback practice.[32,33] After a meeting describing the study, 2 third-grade teachers in a rural/suburban school agreed to participate. A letter giving a brief description of the study, the standard consent form, and the Health Insurance Portability and Accountability Act form were sent home with each child from these 2 classes for their parents to sign. The letter explained that those children who did not assent or whose parents did not consent would still participate in their assigned classroom activity but would not experience assessments. Parents were invited to attend a meeting during which the study was explained. Only a small percentage (5%) of parents in both classes attended, and overall 60% returned their signed consent forms. Each child whose parents signed the consent form was offered an assent form to sign after the study was explained in class and all agreed to sign the assent. The classes were randomly assigned to the intervention group or the control group. Each child was assigned an identification number. All results are reported as group data. Data were collected before and after the 4-month stress management intervention period and again during the next school year (1 year after the start of the intervention) to measure long-term effects of the intervention. Covariates of children's gender and age were included to make sure they did not have any effect on the results. The consent and assent forms were signed by 28 parents and children, respectively, to participate in the study (15 in the intervention group; 13 in the control group); 14 and 11, respectively, completed the intervention, and long-term data were obtained on 13 intervention and 9 control class children.

Measures and Procedure

The Revised Children's Manifest Anxiety Scale (RCMAS) was used as a measure of anxiety level, using the Total Anxiety scores averaged as a group. Average T-score was also checked to be sure both groups were within the average range. Average T-score for the RCMAS is 50 with one SD being 10. The RCMAS has good internal consistency reliability (.85)[34] and strong construct validity.[35] HRV was used as an autonomic measure of each child's ability to control the state of his/her body's relaxation. HRV has been used as a biofeedback tool extensively in recent years and has been shown to be a good measure of autonomic function and relaxation. HRV is described as beat-to-beat variations in heart rate that include both sympathetic and parasympathetic elements and thus is an autonomic measure. A good HRV is consistent with regularity to the increase and decrease of the heart rate. Medium and high coherence are both indicative of a range of regular variability in heart rate and a physiological sign of good autonomic control and relaxation, whereas low coherence indicates irregular heart rate variability, which is a physiological sign of poor autonomic control and lack of relaxation.[36] In this study, HRV was measured using the Freeze Framer computer biofeedback program.[23] The program was run for 3 minutes with each child while each placed his\her finger on a sensor that measured heart rate. Before starting the computer program, each child was

encouraged to relax to positively change the screen image. HRV was then calculated by the computer by measuring increases and decreases of HRV as reflected by changes in the curves. Medium and high coherence scores were added together for the total percentage of time each child spent in a relaxed state.

As qualitative data, the teacher was asked to complete a questionnaire at the end of the study to get feedback on whether she felt the stress management intervention was helpful to her class and if it was feasible to integrate the technique into the school day. At the end of the intervention period and at 1-year follow-up, children were individually asked a series of questions, including whether they enjoyed the intervention, if and when they used it on their own, and in what situations inside and outside of school.

The principal investigator (PI) trained the teacher assigned to the intervention group during a 2.5-hour session, which reviewed stress responses, stress management, and the intervention techniques to be used. We spent this time presenting and discussing the definitions of "stress" and "relaxation" and how the body reacts to and responds to stressors and relaxation. We discussed the research protocol and discussed how to best carry it out in the classroom setting so that it would be the least disruptive to the teacher's schedule. We then reviewed the self-regulation technique in detail. The PI and the research assistant carried out two 30-minute teaching sessions with the intervention class. The first session was to discuss definitions of stress and relaxation and how our bodies react to both, and during the second session we reviewed the details of the self-regulation technique they would be practicing. (Details of this teaching can be obtained from study investigators.) Early in the intervention period, each child was also instructed 5 to 10 minutes individually by the PI and the research assistant on the technique of diaphragmatic breathing. The stress management technique was done with the children standing or seated at their desk in the classroom and consisted of 3 parts: deep breathing, movement, and guided imagery. The guided imagery was similar to what would be used in teaching self-hypnosis as previously described.[37] These parts were divided as follows: about 1 minute of diaphragmatic breathing, 4 minutes of simple stretches and movements designed to help the children focus, another minute of deep breathing, and then 4 minutes of an imaginary journey. Examples of movements include growing like a flower and reaching up to the sky and standing like a tree while focusing on a point in front of them. The imagery scripts included muscle relaxation and variations of using their imaginations to go to their favorite place where they felt safe and happy. The teacher was provided with several different combinations of movements or stretches to use, and 4 imaginary journeys from which to choose, all similar in format. Suggestions were placed in the scripts, such as about feeling comfortable before tests. (The imagery scripts are available by contacting the study investigators.) The teacher in the control classroom spent 10 minutes per day at the same time reading aloud from a children's book.

The teacher did the intervention daily for 10 minutes during class time after the lunch/recess period. There is not much data on timing and length of this type of intervention. This time of day over 4 months was chosen to allow it to be a part of their daily routine. Because it was reasonable to offer the intervention to all study subjects at the same time, the period after lunch was convenient for the teachers, and it was a time when students needed to refocus on schoolwork. The investigators were present in the intervention class each day during the first week, then weekly for 2 weeks, and then monthly. The teacher kept a daily log documenting participation in the intervention. After the study was completed, results were shared with the teachers in the school.

Data Analysis

The Statistical Package for the Social Sciences was used to analyze data.[38] Repeated-measures multivariate analysis of variance was performed to assess the change in each group over time between baseline (preintervention) and 4 months (postintervention period), and again the next school year (long-term follow-up). One year later, the children were in fourth grade in the same school with different teachers and different classmates. Due to the fact that some children had moved out of the school at various points, the analyses include only those children present at each postintervention phase. Because age and gender had no effect on the results of the analysis, the data were then analyzed without those variables.

RESULTS

Revised Manifest Anxiety Scale

Baseline raw scores were compared between the control and intervention groups. The control group had a statistically higher raw score than the intervention group ($p = .03$), but baseline T scores for both groups were within the nonclinical range (Table 1). From preintervention to immediate postintervention, there

Table 1. Means Total Anxiety Score Revised Children's Manifest Anxiety Questionnaire

	Preintervention		4 mo		1 yr	
Group	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Intervention						
T[a]	49.20	11.23	43.00	12.06	41.85	11.38
Raw	12.6	5.83	8.0		7.15	
n	15		14		13	
Control						
T	58.69	9.87	57.70	11.51	56.00	11.13
Raw	17.8	6.16	17.0		16.11	
n	13		11		9	

[a]Baseline T scores were not in the clinical range for either group. Statistical difference in baseline raw scores between the control and intervention groups ($p = .03$).

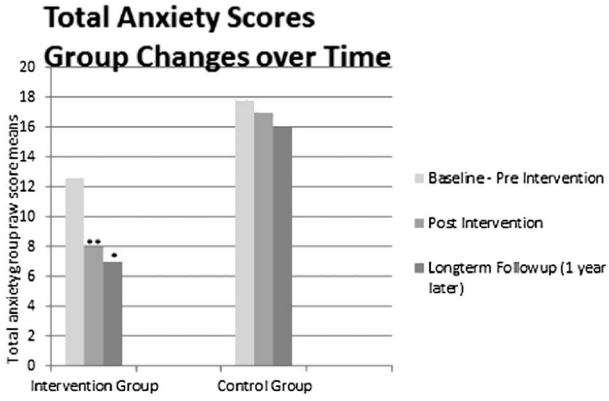

Figure 1. $^{**}p = .002$ indicating reduced scores from baseline to postintervention. $^{*}p = .025$ indicating scores from baseline to long-term follow-up.

was a significant decrease in the total anxiety raw scores in the intervention class (N = 14, F = 12.95, effect size [ES] = .93, $p = .002$), and there was no change in the control class (N = 11). At 1-year follow-up, a similar pattern was found, with continued significantly lower levels of anxiety in the intervention group (N = 13, F = 5.88, ES = .634, $p = .025$) versus control group (N = 9) (Fig. 1; Table 1).

Heart Rate Variability

Baseline scores for HRV were the same for the intervention and control groups. Immediately postintervention, neither group showed a statistically significant change in heart rate variability (HRV) coherence; although the intervention group improved, the change was not statistically significant (N = 15). At long-term follow-up, the HRV coherence of the intervention group showed statistically significant improvement (F = 11.92, $p = .003$, ES = .906, N = 13). In the control group, there was a decrease in their HRV at long-term follow-up that was a statistical trend (F = 3.65, ES = 0.15, $p = .07$, N = 9), indicating that the control children were less able to relax during the biofeedback measurement than they were at baseline (Fig. 2; Table 2).

Qualitative Data

On the questionnaire completed at the end of the intervention period, the intervention class teacher felt that there was some benefit in calming the children after recess and in helping them return to their work. She also noted some of the children used the breathing technique before tests. She noted the redundancy of doing the intervention daily and that it might become boring.

Of the 15 children participating in the intervention group, 14 responded they enjoyed doing this in the classroom, 13 reported that it helped them during the school day, and 12 reported that they used the techniques during stressful times outside of school. In their comments about how the technique helped them during the school day, they noted benefits during recess, relaxing with tests, and focusing on schoolwork better. When asked how the technique helped them outside of the school day, the children noted benefits in various aspects of life, such as when dealing with times of difficulty in relationships, such as with friends, siblings, or parents, when angry or upset, helping to sleep, and helping with asthma (Supplemental Digital Content 1, http://links.lww.com/JDBP/A53) At 1-year follow-up, the students were asked if they continued to use the stress management technique since the last school year. Fourteen of 15 students reported that they continued to use all or part of the techniques during stressful times in and outside of school. One reported that he or she taught his or her parents how to do the technique.

DISCUSSION

The results of the current study support the hypotheses that a school-based stress management intervention can result in reduced reported anxiety symptoms and improved autonomic function (measured by heart rate variability [HRV]), and that these effects continued at long-term follow-up the next school year. This study demonstrated that a 10-minute daily stress management technique (SMT) was helpful for reducing anxiety scores and improving ability to relax in school age children. These results are consistent with previous work that demonstrated SMTs delivered in the classroom setting can help children, but this study examined an intervention that was short and relatively easy to incorporate into an average school day. The long-term benefits of this school based stress management intervention are also an important addition to the literature. The comments by the teacher and students are consistent with the objective results of the study. The children perceived that the SMT was useful to them in managing some of their daily stressors. The stress management skills learned by the students were practiced and remembered during the long-term follow-up period,

Table 2. Comparison Means Freeze Framer Biofeedback Program Heart Rate Variability Medium + High Coherence

	Preintervention			4 mo			1 yr		
Group	**Mean, %**	**SD**	**n**	**Mean, %**	**SD**	**n**	**Mean, %**	**SD**	**n**
Intervention	18.47	19.29	15	25.33	25.76	15	33.62[a]	27.10	13
Control	18.23	13.37	13	16.00	15.75	11	8.89[b]	9.38	9

[a]Significant improvement in heart rate variability at the long-term follow-up (F = 11.92, effect size [ES] = .906, $p = .003$). [b]Decrease in the control group heart rate variability at 1-year follow-up with a trend toward significance (F = 3.65, ES = .15, $p = .07$).

suggesting that the children learned a coping skill, which they continued to use during future stressful experiences. School-based programs are appealing because they can reach many children and be cost-effective. Realizing the limited time for extra activities in the school day, a school program promoting well-being or teaching stress management skills must be brief yet effective. Daily practicing of self-regulation techniques over a period is reinforcing and may be more likely to offer long-term benefits.

The children in the intervention group continued to improve significantly into the next school year, with a different teacher, different classmates, and no further intervention, suggesting that the described outcomes were due to the intervention and not to teacher and student interactions. The improvements in HRV that became highly significant at 1-year follow-up are an indication that this group of children was better able to get their body into a relaxed state more consistently. A possible explanation is that students continued to practice the intervention on their own, which is supported by the comments made by the children. Practice of techniques has been documented to maintain the ability to achieve relaxation.[39] The decrease in HRV in the control group at 1-year follow-up is concerning because the children may have actually worsened in their ability to relax over the following year. A recent study found poor HRV to be associated with difficulty regulating emotions.[40]

The biggest limitation of this pilot study is the small sample size. However, the effect size was large enough to conclude that a short daily intervention delivered in the classroom setting in elementary school can decrease feelings of anxiety and improve a child's ability to relax as shown by improved autonomic function using HRV. Although the daily in-class time was short to minimize time away from class learning, 4 months may have been longer than necessary. Frequent practicing of these techniques leads to improved performance. There are no current studies comparing variable training periods but this would be important in future studies. Another limitation of this study is the lack of information about the participants' previous mental health status. It would be important in future studies to obtain information about potential behavioral, emotional, or mental health issues of the participants. Likely related to small sample size, there was a statistically significant difference between groups at baseline for the total anxiety raw and T-scores, although neither group was in the clinical range. Although the control group started higher within the normal range, one would expect regression toward the mean over time, but this did not happen.

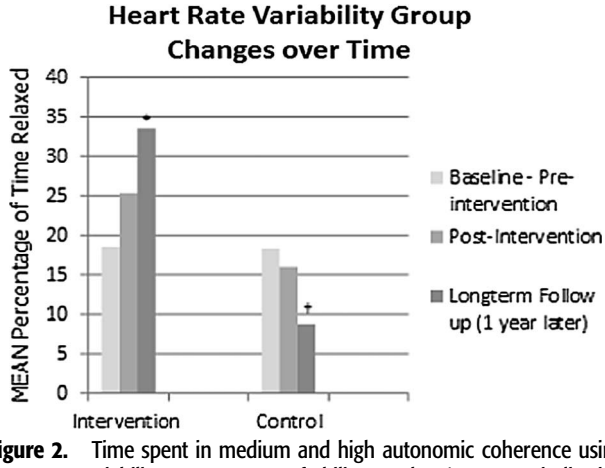

Figure 2. Time spent in medium and high autonomic coherence using heart rate variability as a measure of ability to relax. *$p = .003$ indicating significant improvement from baseline preintervention to 1-year follow-up. †$p = .07$ indicating a trend toward worsening heart rate variability in control group from baseline preintervention to 1-year follow-up.

Replicating this study with a larger group using several classrooms is necessary to confirm these results. Future research could include a multilevel model to assess student, class, and teacher effects. Increased connections between schools and clinicians may be an effective tool for interventions supporting health benefits. The advantage of using the school setting to teach stress management is that schools provide a practical and natural teaching environment and would impact a larger number of children. School-based interventions that emphasize teaching children "emotion focused" skills to better deal with stressors have been discussed in the literature.[41] The World Health Organization recommendations to increase mental health activities in schools and the evidence demonstrating the detrimental effects of toxic stress support large-scale efforts to teach children skills to manage stressors.[42,43] In future studies, additional measures may give helpful information regarding differences in response and behavior of children who learn the SMT. It would also be important to include tools on preferred learning style and measures of attention. Data on whether a child has any medical issues and learning disorders should be collected because it could impact results of this intervention. Learning disabilities, such as memory limitations or auditory processing abnormalities, are likely to impact the response of a child to this training. A child with these types of learning disabilities might require a longer training period, use of recordings, or a multisensory approach just as they would benefit from with any learning. Children with chronic medical conditions may have different responses to stressors.[44] The potential benefits from learning stress management at a young age are important. By age 8 years, most children are capable of noticing specific mind-body links and are able to see how shifts in thinking and images will lead to a physiologic change. They are also able to use these abilities to generalize the self-regulation into their life outside of formal stress management practice. Although this study had long-term results 1 year following the intervention, long-term follow-up studies of mental and physical health are needed to determine if children who learn these techniques early in life will continue to benefit.

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