Stress Management in Children: A Pilot Study in 7 to 9 Year Olds

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ABSTRACT: ***Objective:*** **At present, school-age children suffer high levels of chronic stress that could produce potentially long-lasting effects. The aim of this pilot study was to evaluate the effects of mind-body integration practices and cooperative activities on stress levels and social interaction in 7- to 9-year-old children.** ***Methods:*** **We performed an intervention program once a week during 2 months in which children performed mind-body integration practices and cooperative activities.** ***Results:*** **Our findings showed that these practices reduced cortisol levels and increased social connectedness. Moreover, we found that most of the children used the learned mind-body integration practices in stressful situations in their homes, even 5 months after the intervention.** ***Conclusions:*** **Our results demonstrated the positive impact of these helpful tools and the great plasticity of children's behavior, which enabled them to incorporate healthy habits. Overall, the intervention enhanced health at an individual level and favored social network diversity at a group level. Our research illustrates how children can incorporate techniques that help them cope with stressful moments and reveals the effectiveness of this experience in reducing cortisol levels. This study contributes to the understanding of how mind-body integration practices and social connectedness can be helpful in reducing chronic stress, a topic that, to the best of our knowledge, has been little studied in children.**

*(J Dev Behav Pediatr 35:*144–147, 2014) **Index terms:** chronic stress, salivary cortisol, childhood, mind-body integration, social connectedness.

High levels of chronic stress have been extensively reported in children, which could produce potential long-lasting effects.[1] In children, anxiety disorders and depression are related to the hypothalamic-pituitary-adrenal (HPA) axis deregulation and are affected by several factors, for example, bullying, family life, school environment, and health problems.[2,3] Since the school environment and peers are key factors during childhood,[4,5] studies performed in this context have produced interesting results, highlighting a wide spectrum of problems experienced by school-age children.[2,3]

Increasing evidence demonstrates the positive impact of social network diversity on health.[6,7] Social connectedness has been shown to improve physiological and psychological parameters, contributing to stress reduction[8,9] and improving the immune system.[6,7,10,11] These studies were conducted in adults, but to the best of our knowledge, not in children.

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Received June 2013; accepted November 2013.

Supported in part by Universidad Nacional del Comahue and CONICET.

Disclosure: The authors declare no conflict of interest.

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Numerous investigations in adults have shown how mind-body integration practices, which include a large diverse group of techniques eliciting a relaxation response, contribute to health and well-being.[12] More recently, it was found that these practices help decrease anxiety and enhance attention, social skills, self-regulatory processes, self-esteem, and metacognition in children.[13–16]

Several studies have demonstrated that social connectedness is influenced by experience and social contexts. Over a wide range of ages, playing cooperative games has been found to increase sociability and cooperation while decreasing aggression.[17] This evidence illustrates the high plasticity of social connectedness in children, emphasizing the key role played by experience.

Childhood stress has frequently been evaluated by measuring salivary cortisol.[1,18,19] Several studies have shown that salivary cortisol levels can be used as a reliable indicator of the hypothalamic-pituitary-adrenal axis activity.[1] There is little consensus on how to assess cortisol levels, because reference concentrations, awakening response in children, and sampling factors are still a matter of controversy.[1,20,21]

The objective of this study was to evaluate the effectiveness of mind-body integration practices and cooperative activities in reducing stress and increasing social connectedness. We hypothesize that participation in mind-body integration practices and cooperative activities will lead to a decrease in children's cortisol levels and an increase in their social network diversity.

METHODS

Participants

The research was conducted with children aged 7 to 9 years in a private school in San Carlos de Bariloche, Argentina. All participants were in good health, and there were no significant differences in the body mass index or socioeconomic level. We randomly chose one class as the experimental group, which consisted of 26 participants (54% boys and 46% girls) from second grade (7 years old on average) and another class of 18 children (54% boys and 46% girls) from third grade (8 years old) as the control group, which followed the usual school program. Both groups belonged to the same school. Experiments were conducted in accordance with the Helsinki Declaration. All procedures were performed with the adequate understanding and written consent of the parents and school authorities. Caregivers did not play any role in either group. Children chose whether to participate or not. Parents of the control group were informed that their children's participation in the study would not involve the actual intervention procedure.

Design

Cortisol sampling

Participants' salivary cortisol was collected in each group at 3 points: previous to and immediately after the intervention program, and again 5 months after the intervention had finished. The samples were collected on a normal school day between 8 and 8.30 AM, that is, 60 to 90 minutes after awakening. The children's parents had previously been given written instructions to guarantee certain conditions before the cortisol collection. The children were asked to spit or passively drool saliva into a collection tube. The samples were analyzed blind using spectrophotometric methods (Chemiluminiscence, CLIA, Siemens).

Social variable measurement.

Social connectedness was analyzed by means of a sociogram[17] in which children were asked to say which peers they would like to play with and which they would not like to play with. This was performed previous to and after the intervention. We used the social preference index (i.e., total number of positive choices minus the number of negative choices) to measure the changes affected by the intervention.

Intervention

While in the control group, regular classes were conducted; in the experimental group, the intervention was performed once a week, for 10 sessions of 60 minutes. The intervention involved 3 consecutive stages: breathing and tai chi practices, cooperative games, and to close a reflective moment while sitting in a circle.

Interventionists

Three researchers conducted the program together with the class teacher. Data analysis of cortisol and sociograms was performed blind by a researcher. The interventionists were biologists, specialists in education, had been previously trained in the techniques implemented, and had previously participated in a similar intervention.

Procedure

The first part of each class included tai chi and breathing techniques, performed as mindfulness practices. We taught tai chi–inspired slow, flowing movements, and children had to focus on each movement, change of posture, and synchronization. During the guided breathing techniques, children kept their eyes closed and concentrated on each breath, perceiving inspirations and exhalations, and counting them quietly. We started with 2 to 3 minutes and then extended the time gradually.

During the cooperative games, children were invited to play and achieve group goals requiring collaboration, after which there was a time of reflection.[17] Both at the end of the intervention and 5 months later, the children were asked, by means of a standard questionnaire, whether they had practiced the learnt exercises in their homes and in what kind of situation.

Statistical Analysis

Since we were interested in the cortisol level change within each group (i.e., experimental and control) at the 3 sample points, we examined the data using a 2×2 factorial analysis of variance test. We compared the performance of each group by analyzing the interaction between variables (sample collection point and group). We expected to find a significant interaction between variables, that is, cortisol levels would diminish in the experimental group, whereas no such tendency would be observed in the control group. Furthermore, we evaluated the differences in cortisol levels between groups at each sample point using t test. The social preference index before and after the intervention was compared using Wilcoxon matched pair test.

RESULTS

Salivary Cortisol

When comparing the relative levels of cortisol before the program started, at the end of the intervention and 5 months after it had finished, a significant decrease was found in the experimental group (Friedman analysis of variance [ANOVA], $\chi^2 = 7.52$, $df = 2$, $p < .023$) whereas mean cortisol levels were 0.47 μg/dL, 0.34 μg/dL, and 0.27 μg/dL, respectively (Table 1), that is, the relative decrease in the cortisol levels was 27.7% at the end of the intervention and 42.6% 5 months later (Fig. 1). However, in the control group, no significant changes were observed (Friedman ANOVA, $\chi^2 = 5.25$, $df = 2$, $p > .05$). When analyzing the 2×2 ANOVA, we found a significant interaction ($df = 2$, $F = 3.1$, $p < .05$) between month (of sample collection) and treatment (experimental or control). Therefore, a significant decrease in cortisol was

Table 1. Mean Cortisol Levels (μg/dL) (± SE) in the Three Sample Collection Points (August, November, and April) in the Experimental and Control Groups; *t* Test Describes Statistical Comparison Between Groups at Each Sample Point

	Experimental	*t* Test	Control
August 2011	0.47 (0.14)	NS	0.17 (0.02)
November 2011	0.34 (0.05)	NS	0.35 (0.05)
April 2012	0.27 (0.06)	$p < .05$[a]	0.50 (0.09)

[a]Significant differences. NS, no significant differences.

found in the experimental but not in the control group throughout the entire study period. Moreover, we found significant differences in the cortisol levels between the experimental and control groups in April, which was the final sample collection point ($t = 2.76$, $p < .01$). However, no significant differences were observed in the previous collection points ($t = 1.58$, $p > .12$; $t = 0.04$, $p > .97$, August and November, respectively).

Social Connectedness

The intervention program promoted significant changes in children's social connectedness, reflected in an increase in the social preference index. Thus, in the experimental group, children increased their social network, choosing more peers to play with after the intervention than before ($p < .019$); Wilcoxon pair test ($Z = 2.33$; $p < .002$). In contrast, nonsignificant changes were observed in the control group ($Z = 1.5$, $p > .13$).

Mind-Body Integration Practices

When children were asked immediately after the intervention whether they had practiced the learnt exercises out of school, most (93%) answered in the affirmative. They mentioned having used these practices in stressful situations, for example, when they were frightened, anguished, angry, in pain, when trying to sleep, to regulate aggressive emotions, or to calm down.

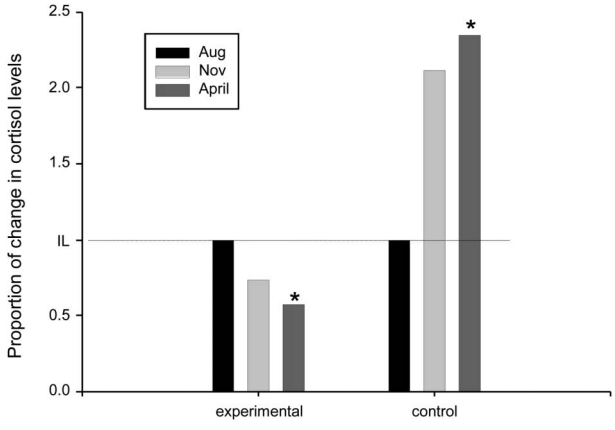

Figure 1. Proportion of change in the cortisol levels in the experimental and control groups, before the intervention (August), immediately after the intervention (November), and 5 months later (April). IL, initial level. **t* test significant level ($p < .05$) when comparing the experimental and control groups at each collection point.

When children were asked the same question 5 months after the intervention, 85% of the children reported having practiced the learnt exercises in their homes, in stressful circumstances. In both cases, most of the children mentioned having practiced tai chi exercises and 2 reported having focused on counting their breaths.

DISCUSSION

This study shows how children's health and well-being can be favored by mind-body integration practices and cooperative activities. Experiences that implied integrating mind and body and working with peers to attain shared goals reduced cortisol levels and positively modulated social interactions among children. After the intervention, cortisol decreased in the experimental group; whereas in the control group, this result was not observed and cortisol levels actually tended to increase. Interestingly, most of the children from the experimental group reported that they had continued practicing the learnt techniques during stressful situations in their daily lives, even 5 months later. Our results demonstrate that the applied program was efficient in the transmission of useful tools for stress management in this group.

The intervention seems to have promoted greater social network diversity. Several studies have demonstrated the beneficial effects of social connectedness on physiological and psychological parameters, which help to decrease stress levels.[7–9] The quality and extent of social networks have an impact on the immune system.[6,10,11] These studies demonstrate the association between social connectedness and stress levels. Although we did not specifically measure this correlation, we will further evaluate this positive relationship in future studies.

In our intervention, mind-body integration practices, which included tai-chi exercises and breathing techniques performed as mindfulness practices, could have fostered relaxation responses. Mindfulness practice in children is helpful in promoting serenity and self-regulatory and social skills.[15,16] Positive effects of tai chi practices have been demonstrated for children and adolescents, associated with enhanced vagal activity, decreased stress hormones, and increased production of antipain and antidepressant neurotransmitters such as serotonin.[22] Furthermore, a mindfulness and yoga intervention with 10 to 11 year olds reported positive impact on stress responses and emotional arousal.[23] The benefits of combining tai chi with other practices such as mindfulness-based stress reduction have also been reported.[24] In accordance with these studies, our results also suggest that the implementation of diverse mind-body practices might be of value when working with children, as they can apply the learnt exercises in moments of stress outside school. It is noteworthy that most of the children continued practicing mindful tai chi more frequently than mindful breathing, suggesting that practices involving more movement seem to be preferred by this age group.

A previous similar intervention, conducted on a public school in first grade for 10 weeks, showed an increase in prosocial behavior. Moreover, children tended to settle down, becoming calmer.[25] The results of this study on cortisol level reduction could be associated with the behavioral changes found in the previous research. A major debate exists regarding cortisol assessment, and much has been proposed in relation to time compliance and sampling.[20,21] Although some studies propose cortisol awakening response (CAR) as a robust parameter for analyzing stress levels in children,[20] recent studies found that the CAR rise was only present in 35% of children.[21] In this study, samples were collected at least 1 hour after the children had awoken, thus we were not evaluating CAR. In addition, as we compared average group cortisol levels and its relative changes throughout the study, the potential deviation introduced by within- and between-person variability was most probably diminished. However, the high deviation of the data obtained suggests that future studies might benefit from incorporating a larger sample, which will help improve our preliminary findings. The major contribution of this study is related to the positive effects, which seem to be long lasting and multifaceted, a short intervention can promote in 7- to 9-year-old children. The experience helped children to incorporate these practices into their daily lives to cope with stressful situations. Given the high levels of chronic stress in our society, this kind of experience might contribute to reduce stress levels early in life. We believe that this study might show how desirable processes such as stress reduction and higher sociability can be favored in children.

ACKNOWLEDGMENTS

We are grateful to Laura Margutti and Nancy Gallego for their assistance in the execution of the study and Sergio Taussig for his invaluable help. We also acknowledge Audrey Shaw for revising the written English and 2 anonymous reviewers who contributed improvements to a previous version of the article.

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