

Part II - Stress and stress management strategies in adolescents

Stephanie J Stockburger¹, MD, Hatim A Omar¹, MD

¹ Kentucky Children's Hospital, UK Healthcare, Department of Pediatrics, University of Kentucky College of Medicine, Lexington, KY 40536, United States.

Address for correspondence: Professor Hatim A Omar: haomar2@uky.edu

Received: 19/1/2015; Revised: 12/3/2015; Accepted: 15/3/2015

Abstract

It is well known that adolescents experience stress. In this article, sources of adolescent stress will be discussed as well as the physiological effects of stress on the body. Stress disorders will also be briefly reviewed. Mainly, research on stress management strategies that have been evaluated in adolescents will be presented. Many studies have a small number of participants and lack control groups. Therefore, there is a need for ongoing research in this important area.

Introduction

It is well known that adolescents experience stress. In Part I (see Volume 2, Issue 1) of this article, sources of adolescent stress were discussed as well as the physiological effects of stress on the body. Part II of this article will provide a discussion of methods of managing and coping with stress.

Methods of coping with stress

It is important to manage stress because stress impacts the immune, circulatory, and nervous systems (8,9,10). There are stress-related disease processes related to each of these systems (11). As mentioned previously, the body adapts in stressful situations to ultimately survive. If stress is ongoing, there is an overexposure to the neural, endocrine, and immune stress mediators. These mediators may negatively affect the body systems listed above and play a role in the onset or the progression of disease (8,9,10,12). It has been hypothesized that one of the by-products of the stress response is high nitric oxide release (11). These high levels of nitric oxide have a negative effect on disease processes. It is also postulated inducing a "relaxation response" lowers levels of nitric oxide and therefore has a protective or ameliorative effect on the body (11).

Inducing the relaxation response is similar to flipping a light switch. Either the body's stress response can be activated or the relaxation response can be activated. They cannot be activated at the same time. During times of stress, there are a number of techniques that may be used to "trick" the body into "flipping the switch" back to the relaxation response, thus decreasing negative effects of stress, especially chronic stress, on the body and mind.

In modern Western medicine, techniques to induce the relaxation response are typically classified as types of complementary and alternative medicine (13). The term "complementary" refers to a non-mainstream approach applied together with conventional medicine (13). The term "alternative" refers to using a non-mainstream approach in place of conventional medicine. Another term that may be used is "mind and body practices." This is a large and diverse group of procedures or techniques that are taught by a trained practitioner or teacher (13). Deep breathing, meditation, yoga, progressive relaxation, and guided

imagery may all be classified as mind and body practices as well as CAM (13). Relaxation techniques such as breathing exercises, guided imagery, and progressive muscle relaxation are particularly intended to induce the body's naturally-occurring relaxation response (13).

Mindfulness and meditation techniques originate from traditional contemplative practices which were usually religious or spiritual (14). These practices are used today in clinical settings without the original religious or spiritual overtones (14). There have been few randomized clinical trials conducted in children and adolescents regarding the use of mindfulness and meditation techniques (14). Therefore, more studies are needed (14). There are five types of meditation that have been systematically examined in children and adolescents (14). These include focused attention, open monitoring, automatic self-transcending (transcendental meditation), mind-body techniques, and body-mind techniques (14).

Focused attention and open monitoring are based on Zen, Vipassana, and Tibetan Buddhist meditation techniques (14). Focused attention is "concentration training" that involves focusing on an object to keep the mind from wandering (15). Open monitoring is a mindfulness technique. It involves having moment to moment awareness of any thought or feeling that occurs and learning to be less judgmental of these sensations (15). The Western versions of the techniques are meant to target dysfunctional states of mind, like anxiety (14).

Focused attention

There are five techniques based on using focused attention as a mindfulness-based intervention (14). The first technique is mindfulness-based stress reduction. This was developed by Kabat-Zinn in 1990 for the general Western public as an easy meditation technique (14, 16). The second technique is mindfulness cognitive-behavioral therapy (14). This was developed by Segal to treat clinical depression (14). The third technique is dialectical behavior therapy which was developed by Linehan (14) for treating borderline personality disorder. Acceptance and commitment therapy is the fourth technique. This therapy was developed by Hayes (14) to increase psychological flexibility. The fifth and final technique is mindfulness-based relapse prevention. This was designed specifically for substance abusers (14).

A review and meta-analysis by Regehr, Glancy, and Pitts looked at interventions to reduce stress in university students (17). Twenty-four studies, with a total of 1431 participants were included in the meta-analysis. Of the twenty-four studies, 24.0% of the participants were male. Stress-reduction interventions were grouped into three categories: arts-based interventions, psycho-educational interventions and cognitive/behavioral/mindfulness-based interventions (17). Of note, the meta-analysis revealed that cognitive, behavioral and mindfulness interventions were significantly associated with decreased symptoms of anxiety. Lower levels of depression and cortisol were secondary outcomes of the interventions (17).

A study by Sibinga and colleagues evaluated the use of a mindfulness-based stress reduction program for human-immunodeficiency virus (HIV)-infected and at-risk urban youth (18). Youth ages 13-21 years old were recruited from the pediatric primary care clinic of an urban tertiary care hospital to participate in four mindfulness-based stress reduction groups (18). Twenty-six (79%) youth completed the majority of the sessions and were considered "program completers" (18). Of these participants, 11 were HIV-infected, 77% were female, and all were African American (18). The average age of the participants was 16.8 years (18). Both quantitative and qualitative data were obtained. Quantitative data show that following the program, participant had a statistically significant reduction in

hostility, general discomfort, and emotional discomfort (18). Qualitative data show perceived improvements in interpersonal relationships (including less conflict), school achievement, physical health, and reduced stress (18). Therefore, this mindfulness-based stress reduction program appears to have been successful in decreasing negative feelings while improving stress levels, health, and academic achievement. Again, this is a small study with no controls. Further research needs to be completed in this field.

Open monitoring

As mentioned previously, the open monitoring mindfulness technique is used to monitor experiences that occur from moment to moment (14). This is done nonjudgmentally so the meditator is detached from the experiences and is able to increase his or her awareness and insight (14). There are three types of open monitoring meditation including Sahaja meditation, Sahaja Samadhi meditation, and Sahaja Yoga meditation (14,19). Of the three techniques, only Sahaja Yoga meditation is researched in adolescents (14).

A study by Harrison, Manocha, and Rubia evaluated Sahaja Yoga mediation as a family treatment program for children with attention deficit-hyperactivity disorder (ADHD) (19). A total of 31 children ages 8-12, along with their parents, were enrolled in the study. Of these children, 20 were on medication for ADHD. One child's medication status was unknown. All children met the DSM-IV criteria for ADHD. The treatment program consisted of twice-weekly 90-minute clinics (19). For the first three weeks, parents attended one session and week and the children attended the other. During the sessions, meditation techniques were taught and practiced. There were usually two periods of meditation, each lasting 5-15 minutes per session. Participants were invited to share their experiences during the sessions. Participants were helped to achieve "a state of thoughtless awareness" (19). In addition, parents and children were asked to conduct shorter meditation sessions at home twice a day. During weeks 4-6, one of the weekly sessions was a joint parent-child meditation. During these sessions parents were trained in guiding their child's meditation. Parents were instructed to continue medication management for their child's ADHD as the normally would. Pre- and post- intervention surveys were completed and analyzed. The post-intervention surveys found that parents found the children to be "more confident in him/herself," to have "improved sleep patterns," and to be "more cooperative" (19). Children described better sleep patterns, less anxiety, being better able to concentrate at home, and having less conflict at home (19). Parents reported that they, themselves, felt happier, less stressed, and more able to manage their child's behavior (19). This study was small and lacked formal control group. The study also had a high drop-out rate (about a third of participants dropped out) which may have been due to lack of seeing a positive effect with the meditation intervention (19). While this study shows some promise, larger studies are necessary.

Transcendental meditation

The third technique studied in children and adolescents is transcendental meditation (14). Transcendental meditation arises from the Indian (Vedic) or Chinese origins (14). It involves relaxing the body and letting mental activity subside (14,20). In contrast to the previously mentioned techniques, it does not involve focusing directly on objects or awareness (14,20). While practicing transcendental meditation, one repeats a mantra to block

distracting thoughts (14,20). The goal is to reach increased alertness while reducing physiologic arousal (14,20).

There have been a number of studies focusing on the physiologic and neurobiological effects of transcendental meditation (14). EEG studies have found that during transcendental meditation, there are no brain wave activities to suggest a state of sleep (21). Instead, EEG patterns indicate a state of alertness despite physiologic rest (21). Transcendental meditation may also increase brain plasticity. When adult meditators were compared with controls, there were pronounced differences that indicated larger gyrification in the left precentral gyrus, right fusiform gyrus, right cuneus, and left and right anterior dorsal insula (22). The gyrification increased as the number of meditation years were increased in the right anterior dorsal insula (22). It is thought that this gyrification may reflect an integration of autonomic, affective, and cognitive processes (22).

A small study by Grosswald and colleagues tested the feasibility of using transcendental meditation to reduce stress and anxiety in order to reduce symptoms of ADHD (23). Students ages 11-14, attending a private school for children with language-based learning disabilities, and had a diagnosis of ADHD were instructed in transcendental meditation (23). The transcendental meditation technique was taught by certified Transcendental Meditation teachers. The students received one meeting of individual instruction followed by a meeting each day for the next three days to verify correct technique. Each meeting lasted approximately one hour. During the rest of the study period, the students meditated in a group at the beginning of the school day and again at the end of the school day. Pre-testing was administered to teachers and students prior to the study and after three months post-testing was administered (23). The students reported a statistically significant decrease in anxious/depressed symptoms, withdrawn/depressed symptoms, affective problems, anxiety problems, and attention problems (23). The teachers reported a statistically significant decrease in the student's anxious/depressed symptoms (23). The study concluded that transcendental meditation can be learned and successfully practiced by children with ADHD (23). Also, transcendental meditation has the potential to reduce stress, anxiety, and stress related ADHD symptoms within three months. Transcendental meditation may contribute to improved behavior regulation and executive function (23). This study had several limitations. There were a small number of subjects, no control group, and some students were on ADHD medication and medication for their mood (23). However, given the fact that medication for treatment for ADHD is potentially dangerous, transcendental meditation is a potentially effective non-pharmacological intervention that may reduce anxiety and stress associated with ADHD (23).

Mind-body techniques

The fourth technique studied in children and adolescents is the category of mind-body techniques (14). This includes relaxation techniques, progressive muscle relaxation or relaxation therapy, deep-breathing meditation, a combination of posture, breathing, attention, and visualization, and electromyographic (EMG) biofeedback (14).

Examples of these techniques:

Breathing exercises

Deep breathing is the easiest way to “trick” your body into the relaxation response (24). To do this, one must breathe deeply and slowly. Breathe slowly in through the nose until the abdomen is full and back out slowly through the mouth. Doing this ten times usually results in the body feeling more relaxed. It is helpful to focus on the breath,

acknowledge and then ignore any thoughts that come into your mind. As each breath is released, it can be helpful to think a particular word such as “relax” or “peace” (25). Participating in a yoga class or meditation class also teaches breathing skills that can be quickly and easily applied during stressful situations (24).

Guided imagery

Using guided imagery takes your mind away on a “mini-vacation.” There are a variety of guided imagery techniques available.

1. Instant vacation: Visualize a place where you feel relaxed. It may be a nature setting such as a forest or the ocean, or a favorite chair in your home, or wherever you feel relaxed. Sit down, take deep breaths, close your eyes, and imagine yourself in this place. Think of the different senses involved: what do you see, hear, smell, and feel. Make this as real as possible (24).
2. Bubble technique: Imagine that you are floating underwater. You have air to breathe and the water is supporting your body so that you do not have any tension. Visualize your thoughts and worries inside of air bubbles and watch as they float away (25).
3. Sandbag technique: Sit quietly with your eyes closed. Imagine that you are standing in a hot air balloon. The hot air balloon is still on the ground. There are bags of sand in the basket with you which represent your worries. Imagine that you are tossing the bags onto the ground and that as you do this, the balloon becomes lighter and lifts off the ground. When you have thrown all the bags out, you float freely without any worries. Continue floating until you are ready to return (25).

Progressive muscle relaxation

Progressive muscle relaxation involves lying (or sitting) in a comfortable position and progressively tensing and relaxing muscles throughout your body. The most popular sequence is: right foot (or left foot if left-handed), left foot, right calf, left calf, right thigh, left thigh, hips and buttocks, stomach, chest, back, right arm and hand, left arm and hand, neck and shoulders, and face (26).

Body scan meditation

This is similar to progressive muscle relaxation except you focus in the sensations in each part of the body instead of tensing and relaxing your muscles (26). Initially, focus on your breath, take deep breaths, and pay attention to your stomach as it rises and falls. After about two minutes, turn your focus to the toes of your right foot. Notice the sensations you feel while also focusing on your breathing. Imagine that the deep breaths flow all the way down to your toes, after one to two minutes, move our focus to the right foot. Continue moving up the body in the same sequence as in progressive muscle relaxation (26)

A study completed by Catani and colleagues showed that narrative exposure therapy (a talking and counseling technique) and meditation-relaxation techniques both resulted in significant improvement in symptoms in children with post-traumatic stress disorder (PTSD). This study compared narrative exposure therapy and meditation-relaxation in North East Sri Lanka (27). Of note, this area of Sri Lanka had already been affected by two decades of civil war when the region was hit by a Tsunami wave in 2004 (27). As a result, there were high rates of PTSD in children living in this area (27). Catani and colleagues completed a

randomized treatment comparison in a refugee camp in a severely affected community (27). All 71 eligible children who were present at the camp the day of the interview were interviewed. The interviews were three weeks after the tsunami. A preliminary diagnosis of PTSD was given to thirty-one children. All thirty-one of these children agreed to participate in the study. Their caregivers also gave permission for the children to participate. The children were randomly assigned to either six sessions of Narrative Exposure Therapy for children or six sessions of meditation-relaxation (27). Narrative Exposure Therapy involves constructing a narrative that covers the patient's entire life, including detailed accounts of past traumatic experiences. Mindfulness-relaxation techniques included breathing exercises and mantra chanting. Counselors had received 76 days of formal training and were also supervised by local trainers. Training topics included basic counseling skills, mental health diagnosis, and trauma treatment with a focus on Narrative Exposure Therapy as well as a meditation-relaxation protocol developed by a team of clinical experts (27). Counselors took a 4-day refresher course following the tsunami (27). The children were randomized to sixteen children in the Narrative Exposure Therapy Group and fifteen in the meditation-relaxation therapy group (27). The study found that six months after treatment, 81% of the Narrative Exposure Therapy group and 71% of the meditation-relaxation group no longer met diagnostic criteria for PTSD (27). Both groups had statistically significant improvement with no difference being found between the two therapy groups in any outcome measure (27).

Paul, Elam, and Verhulst used a longitudinal study of deep breathing meditation to reduce testing stresses in 64 premedical minority students (28). During the study, 32 students participated each year for a total of two academic years and a total of 64 students (28). Of the participants, 53 were women and 11 were men (28). In addition, 58 students were Black, 4 were Hispanic, one was Asian, and one was Native American (28). Students participated in Deep Breathing Meditation exercises in two classes and completed pre-, post- (6 weeks after start of classes) and follow-up (after MCAT) surveys (28). The students reported having decreased test anxiety, nervousness, self-doubt, and concentration loss (28). They believed the technique would help them academically and would also help them as a physician (28). The study is limited by small sample size and lack of control group. However, students gained an overall increased sense of control over anxiety-provoking situations. Further studies that include a larger number of participants and that have a control group are necessary.

Body-mind techniques

The fifth and final technique that has been studied in children and adolescents is called body-mind (14). These are body-centered techniques and are intended to increase mental focusing, and induce calming effects (14). Body-centered techniques often overlap with focused attention, open monitoring, and transcendental meditation because they use similar methods for instruction (14). There are five subtypes of body-mind therapy. These are exercise, movement or dance therapy (relatively new), Qi Gong, Tai Chi, and Yoga (14).

A study by Wall evaluated the use of Tai Chi and mindfulness-based stress reduction in a Boston public middle school. In this program, the groups met for one hour weekly for five weeks (29). A combination of Tai Chi and mindfulness-based stress reduction were taught to a group of six 6th-grade girls and a group of five 8th grade boys who were selected by the school nurse and faculty (29). Of note, the students selected did not have serious behavioral issues. The students all attended a large inner-city middle school. During group sessions, Tai Chi was taught using a method that broke down the movements into smaller component pieces (29). Mindfulness based stress reduction techniques were taught in

combination with Tai Chi (29). During the process, students made statements that suggested that they felt increased well-being, calmness, relaxation, improved sleep, less reactivity, increased self-care, self-awareness, and a sense of interconnection or interdependence with nature (29). Limitations of this study include that it is a small study with lack of a control group. Larger controlled studies are needed. However, there may be a benefit to teaching combined Tai Chi and mindfulness-based stress reduction for teaching increased self-awareness and self-regulation.

A study by West and colleagues evaluated perceived stress, affect, and salivary cortisol in college students following 90 minutes of African dance, Hatha yoga, or a biology lecture (the control group) (30). Sixty-nine healthy college students participated. The students were already enrolled in the classes but were recruited for study participation by offering a chance to win money in a small lottery (30). Both pre- and post- class salivary cortisol levels were measured and a 14 item perceived stress scale (PSS) was completed (30). The study found statistically significant decreased levels of *perceived* stress in both the African dance group and the Hatha yoga group. However, the Hatha yoga group had a statistically significant decrease in salivary cortisol whereas the African dance group had a statistically significant increase in salivary cortisol levels. The group attending the biology lecture had no change in perceived stress or salivary cortisol levels (30). The study concluded that even when interventions produce similar positive psychological effects (such as African dance and Hatha yoga), the effect on physiological stress may be very different (30). The difference between the salivary cortisol levels may be attributed to increased physiological arousal (30). Therefore, body-mind therapies produce different levels of psychological and physiological changes depending on the intervention technique.

A Cochrane review, published in 2009, assessed the effects of exercise interventions in reducing or preventing anxiety or depression in children and young people age 20 and younger (31). The review included randomized trials of vigorous exercise interventions with outcome measures for depression and anxiety (31). A total of sixteen studies were included with a total of 1191 participants (31). The review found that six small trials indicated that exercise decreases reported anxiety scores in healthy children as compared to a control group with no intervention. There were five small trials that indicated that exercise decreases reported depression scores when compared to no intervention. The review concluded that research on the subject is sparse, and mostly includes college students (31). Although exercise is widely promoted to reduce or prevent anxiety and depression, the data in children and adolescents is limited (31).

Psychoeducation

These techniques are taught and practiced through psychoeducation (32). Typically, knowledge and skills are attained either individually, in group sessions, and/or through homework assignments (32). These groups may be formed in school classes, primary health care groups, religious-based organizations, companies, associations, as well as through the internet (32). The group or individual encounter creates the framework for learning about stress and stress-reduction techniques such as relaxation but the participants must also process and implement this information. A meta-analytic review evaluated the effectiveness of psychoeducational interventions in reducing stress (32). Studies were selected from 1990 to 2010 (32). A total of nineteen studies met inclusion criteria. Interestingly, as opposed to the author's hypothesis, interventions that were shorter in duration provided better results (32). This review also found that women appeared to achieve greater benefit than men in

stress reduction (32). It is important to note that this meta-review did not specifically focus on adolescents, but the population in general.

Self-help websites are an increasingly common way of receiving information about stress as well as other mental health concerns. The United World Internet Project reported that in the United States, of survey participants ages 18-24 years, 99% currently use the internet. Of participants ages 25-34 years (in all participating countries except Cyprus and South Africa) 85% currently use the internet (34). An article by Williams, Gatién, and Hagerty evaluated the elements of the website Stress Gym which was developed as a first-level, evidence-based website intervention for U.S. military members to learn how to manage mild to moderate stress as well as depressive symptoms (33). As the article states, self-help websites may present information in a variety of formats including reprinting published flyers, PowerPoint presentations, and reporting published papers (33). There may be questionnaires to take the results to a health care provider (33). Other interventions may be “prescriptive” and explain what “to do” and what “not to do” (33).

The authors comment on the many strengths of Stress Gym, which was demonstrated to be effective, with significant decreases in reported perceived stress levels from baseline to follow-up assessment (33). Stress Gym contains a set of interactive modules that the user “drives.” It is reported to be simple and easy to use. Since it is an internet site, it is available 24 hours a day, all around the world. It is compatible with popular computer platforms, web browsers, and adobe flash software. There is no software to install. The site is anonymous. There are two required logins which function to collect data for ongoing research on the site as well as a function that saves the user’s information for future uses. A benefit is that it is self-paced. This site lets users revisit, repeat, and switch between the modules at any time. Users may either go through a list of modules or pick modules that best suit their needs.

Most importantly, the website is reported to provide evidence-based intervention strategies. Evidence is increasing that Internet intervention websites based on cognitive behavioral therapy strategies are effective (33). Each module in Stress Gym was grounded in Lazarus and Folkman’s model of cognitive appraisal in previous research (33). The modules that the Stress Gym includes are: stress and emotion, reacting to stress, sleep, problem solving, change your thinking, belonging, relationships, team work, and balance. The website includes features to increase engagement and interactivity (33). It includes practice exercises, animations, game-like activities (i.e. PTSD Jeopardy), pop ups, a stress chart, interactive ratings (i.e. users can rage their anger), printable reminders, text input boxes (act as a journal for users), and a variety of drop-down selection menus, radio buttons, and check boxes (33). A version of this website has reportedly been adapted for civilian use (35)

There are limitations to web-based interventions as mentioned in the article by Williams, g and h. The sites may or may not be monitored. Stress Gym is not monitored but has a “Need Help Immediately?” button on the home page to help users recognize and address issues such as suicidality (33). Web-based interventions are not substitutes for individual in-person counseling or therapy. Self-help websites (including Stress Gym) are not recommended for people with severe depression or stress. They tend to target individuals with mild to moderate symptoms. Another limitation is that self-help websites require user motivation. The user must find the website, logon, and actively participate.

Self-help evidence-based websites, such as Stress Gym, are likely to become more and more important for our adolescents. In a study by Strom et al, 25% of teens reported that they learned best from the internet and 29% said Internet learning was helpful because it allowed them to proceed at their own pace (36). Important future research should evaluate evidence-based self-help websites for stress intervention specifically targeted towards adolescents.

A study by Day and colleagues also completed a randomized controlled clinical trial to evaluate internet-based guided self-help for university students with anxiety, depression, and stress (37). Participants were recruited from three universities in Halifax, Canada. They were recruited mainly via email, advertisements, campus newspaper, and recruitment posters (37). Participants were randomized to either the immediate-access group or the delayed-access group (control group). Participants completed a self-report questionnaire at baseline and again at 6 weeks. In addition, participants in the delayed-access group who chose to complete the program were assessed after program completion. All participants who completed the program were re-assessed 6 months after program completion. The internet-based self-help program was based on cognitive-behavior therapy strategies and addressed depression, anxiety, and stress. It consisted of five core modules: introduction and assessment, activity and mood, motivation, thoughts and feelings, and advanced thoughts and feelings. The program was titled "Feeling better" (37). There were also optional modules including: social relationships, stress management, sleep, irritability and anger, medication, and premenstrual syndrome and mood (37). Sixty-six students participated in the program. Sixty-one percent of immediate access participants completed all 5 core modules. Eighty percent of participants completed the second assessment (6 weeks post completion follow-up). Participants in the immediate access group reported significantly greater reduction in depression, anxiety, and stress (according to the Depression, Anxiety and Stress Scales-21) compared to the delayed access group. In addition, these improvements were maintained at the six month follow-up (37). It is hypothesized that students may be concerned about stigma, cost, convenience, etc. and therefore do not seek psychological treatment (37). Internet-based self-help is a way to provide access to needed information without concern of stigma, cost, or convenience.

In conclusion, it is important to connect adolescents that experiencing stress to appropriate resources for stress management. Chronic, unresolved stress may lead to a number of mental and medical problems including anxiety disorders, chronic headaches, abdominal pain, cardiovascular, neurological, or immunological disorders. Methods that have been evaluated for stress management in teens include focused attention, open monitoring, transcendental meditation, mind-body, and body-mind techniques. In most cases, these techniques can be completed with low costs and low risks. Initial results are promising. However, there is a lack of large, randomized-controlled trials showing benefits. Options that maintain privacy, are available 24-hours a day, and completed at one's preferred pace are internet-based interactive evidence-based websites which provide psychoeducation. However, these websites are not recommended to substitute for individual or group counselling or therapy. Overall, it is critically important to connect adolescents to resources that will meet their unique needs for stress management.

References

1. American Academy of Child and Adolescent Psychiatry. Facts for Families: Helping Teenagers Deal with Stress. [Internet]. 2005 May[cited 2014 Aug 4];66:[about 2 p.]. Available from: http://www.aacap.org/AACAP/Families_and_Youth/Facts_for_Families/Facts_for_Families_Pages/Helping_Teenagers_With_Stress_66.aspx
2. American Academy of Pediatrics. A teen's personalized guide for managing stress. [Internet]. [cited 2014 Aug 4] [about 15 p.]. Available from: <http://www2.aap.org/stress/buildreshelp-teen.htm>

3. TeensHealth.org. Stress. [Internet]. Reviewed 2010 Aug. [cited 2014 Aug 4]. [about 4 p.]. Available from: http://teenshealth.org/teen/your_mind/emotions/stress.html?tracking=81452_A
4. Lupien SJ, McEwen BS, Gunnar MR, Heim C. Effects of stress throughout the lifespan on the brain, behavior and cognition. *Nat Rev Neurosci*. 2009 June;10:434-45.
5. Gunnar MR, Wewerka S, Frenn K, Long JD, Griggs C. Developmental changes in hypothalamus-pituitary-adrenal activity over the transition to adolescence: Normative changes and associations with puberty. *Dev Psychopathol*. 2009 Winter;21(1):69-85.
6. Dorn LD, Campo JC, Thato S, Dahl R, Lewin D, Chandra R, et al. Psychological comorbidity and stress reactivity in children and adolescents with recurrent abdominal pain and anxiety disorders. *J Am Acad Child Adolesc Psychiatry*. 2003 January;42(1):66-75.
7. Compas BE, Connor-Smith J, Jaser SS. Temperament, stress reactivity, and coping: implications for depression in childhood and adolescence. *J Clin Child Adolesc Psychol*. 2004;33(1):21-31.
8. Esch T, Stefano GB, Fricchione GL, Benson H. An overview of stress and its impact in immunological diseases: *Mod Asp Immunobiol*. 2002;2:187-92.
9. Esch T, Stefano GB, Fricchione GL, Benson H. Stress in cardiovascular diseases. *Med Sci Monit*. 2002;8:93-101.
10. Esch T, Stefano GB, Fricchione GL, Benson H. The role of stress in neurodegenerative diseases and mental diseases. *Neuroendocrinol Lett*. 2002;23:199-208.
11. Esch T, Fricchione GL, Stefano GB. The therapeutic use of the relaxation response in stress-related diseases. *Med Sci Monit*. 2003;9(2):RA23-34.
12. Flier JS, Underhill LH, McEwen BS. Protective and damaging effects of stress mediators. *N Engl J Med*. 1998 Jan;338:171-9.
13. National Center for Complementary and Alternative Medicine. Complementary, alternative, or integrative health: what's in a name? [Internet]. [updated 2013 May; cited 2014 Aug 4]. [about 5 p.] Available from: <http://nccam.nih.gov/health/whatiscam>
14. Simkin DR, Black NB. Meditation and mindfulness in clinical practice. *Child Adolesc Psychiatr Clin N Am*. 2014;23:487-534.
15. Ivanovski B, Malhi GS. The psychological and neurophysiological concomitants of mindfulness forms of meditation. *Acta Neuropsychiatr*. 2007;19:76-91.
16. Kabat-Zinn J. Mindfulness-based interventions in context: past, present, and future. *Clin Psychol*. 2003 June;10(2):144-156.
17. Regehr C, Glacy D, Pitts A. Interventions to reduce stress in university students: a review and meta-analysis. *J Affect Disord*. 2013 May;148(1):1-11.

18. Sibinga EM, Kerrigan D, Stewart M, Johnson K, Magyari T, Ellen JM. Mindfulness-based stress reduction for urban youth. *J Altern Complement Med*. 2011;17(3):213-8.
19. Harrison LJ, Manocha R, Rubia K. Sahaja yoga meditation as a family treatment programme for children with attention deficit-hyperactivity disorder. *Clin Child Psychol Psychiatry*. 2004;9(4):470-97.
20. Travis F, Shear J. Focused attention, open monitoring and automatic self-transcending: categories to organize meditations from Vedic, Buddhist and Chinese traditions. *Conscious Cogn*. 2010. doi:10.1016/j.concog.2010.01.007
21. Travis F, Wallace RK. Autonomic and EEG patterns during eyes-closed rest and transcendental meditation (TM) practice: the basis for a neural model of TM practice. *Conscious Cogn*. 1999;8:302-18.
22. Luders E, Kurth F, Mayer EA, Toga AW, Narr KL, Gaser C. The unique brain anatomy of meditation practitioners: alterations in cortical gyrification. *Front Hum Neurosci*. 2012 Feb;6(34):1-9. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3289949/>
23. Grosswald SJ, Stixrud WR, Travis F, Bateh MA. Use of the transcendental meditation technique to reduce symptoms of attention deficit hyperactivity disorder (ADHD) by reducing stress and anxiety: an exploratory study. *Current Issues in Education*. [internet] 2008;10(2) Available from: <http://cie.ed.asu.edu/volume10/number2/>
24. American Academy of Pediatrics. Create a personal stress management guide. [Internet]. [cited 2014 Aug 4] [about 11 p.]. Available from: <http://www2.aap.org/stress/teen2-A.cfm>
25. Virginia Department of Behavioral Health and Developmental Services [Internet]. Stress management for teenagers. [updated 2009 Jun 12; cited 2014 Aug 4]. Available from: http://www.dbhds.virginia.gov/documents/cwd/cwd-stress_management.doc
26. Robinson L, Segal R, Segal J, Smith M. Relaxation techniques for stress relief. [updated 2013 Jan; cited 2014 Aug 4]. Available from: http://www.helpguide.org/mental/stress_relief_meditation_yoga_relaxation.htm
27. Catani C, Kohiladevy M, Ruf M, Schauer E, Elbert T, Neuner F. Treating children traumatized by war and Tsunami: a comparison between exposure therapy and meditation-relaxation in North-East Sri Lanka. *BMC Psychiatry*. 2009;9(22). Doi: 10.1186/1471-244X-9-22
28. Paul G, Elam B, Verhulst SJ. A longitudinal study of students' perceptions of using deep breathing meditation to reduce testing stresses. *Teach Learn Med*. 2007;19(3):287-92.
29. Wall RB. Tai Chi and mindfulness-based stress reduction in a Boston public middle school. *J Pediatr Health Care*. 2005 July/Aug;19(4):230-7.
30. West J, Otte C, Geher K, Johnson J, Mohr DC. Effects of Hatha yoga and African dance on perceived stress, affect, and salivary cortisol. *Ann Behav Med*. 2004;28(2):114-8.

31. Larun L, Nordheim LV, Ekeland E, Hagen KB, Heian F. Exercise in prevention and treatment of anxiety and depression among children and young people (review). *Cochrane Database Syst Rev.* 2009;1.
32. Van Daele T, Hermans D, Van Audenhove C, Van den Bergh O. Stress reduction through psychoeducation: a meta-analytic review. *Health Educ Behav.* 2012;39(4):474-85.
33. Williams RA, Gatien G, Hagerty B. Design element alternatives for stress-management intervention websites. *Nurs Outlook.* 2011;59:286-91.
34. Cold JI, Suman M, Schramm P, Zhou L, Reyes-Sepulveda E, Lebo H. The world internet project: international report-fifth edition [Internet]. 2013[cited 2014 Aug 6]. Available from: <http://www.digitalcenter.org/world-internet-project/>
35. University of Michigan Depression Center. DepressionToolkit.org [Internet]. [cited 2014 Aug 6]. Available from: <http://www.depressiontoolkit.org/stressgym/>
36. Strom P, Strom R, Wing C, Beckert T. Adolescent learning and the internet: implications for school leadership and student engagement in learning. *Nassp Bulletin* [Internet]. 2009 Jun [cited 2014 Aug 6];93:111-21. Doi: 10.1177/0192636509340436. Available from: <http://bul.sagepub.com/cgi/reprint/93/2/111>.
37. Day V, McGrath PJ, Wojtowicz M. Internet-based guided self-help for university students with anxiety, depression and stress: a randomized controlled clinical trial. *Behav Res Ther.* 2013;51:344-51.