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TEACHING DIAPHRAGMATIC BREATHING TO CHILDREN

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ABSTRACT

The process of breathing has been linked to consciousness, health, and spirit. Newborns naturally breathe using diaphragmatic breathing. However, by the age of 10, most children use a shallow thoracic breathing pattern, except when in a supine position. Adult literature indicates that patients taught diaphragmatic breathing experience significant decreases in numerous physical and psychophysiological symptoms. There is a paucity of professional or lay literature that addresses the topic of breath training in children. This article describes the use of breath training as a component of biofeedback training and the possible uses of breath training for prevention and intervention of physical and psychophysiological disorders in children. Directions for future research are proposed.

"Of all the techniques I've learned, I use that 'breathing stuff' the most."
-- Josh, age 12

There is a paucity of professional or lay literature that specifically addresses the topic of breath training in children. The purpose of this article is to describe the use of breath training for children. Practical tips for teaching breathing are provided. This article will also explore possible uses of breath training for prevention and intervention of physical and psychophysiological disorders in children primarily through extrapolation from the adult literature.

We breathe our first breath at birth and our last at death. The process of breathing has been linked to consciousness, health, and spirit. Common phrases such as I couldn't catch my breath, I need a breath of fresh air, I waited with bated breath, It was a breath taking view, and Give me some breathing room," use the concept of breath to describe the mind/body connection. One's breathing pattern varies depending upon their level of physical fitness, current activity, and awareness of their breathing. Diaphragmatic breathing can enhance relaxation and physical stamina. Dysfunctional breathing patterns such as thoracic breathing, gasping, and breath holding and hyperventilation, may contribute to discomfort from problems such as headaches, stomachaches, sleep disturbance, anxiety, asthma, and hyperventilation (Schwartz, 1995, Fried, 1990).

Diaphragmatic versus Thoracic breathing

Diaphragmatic breathing is a breathing pattern that differs significantly from the typical breathing pattern of most adults. The typical adult breathing pattern, which may

excelerate slightly just because of being measured, involves shallow thoracic movements with a respiration rate of 15-22 respirations per minute. There is also an absence of sinus arrhythmia. In contrast, diaphragmatic breathing requires slow, rhythmic inhalations and exhalations with emphasis on the diaphragm muscle moving downward on inhalation and upward on exhalation (Roland, 1987, Hendricks, 1995, Farhi, 1990). The respiration rate is 5 to 8 respirations per minute and is associated with a return of a normal respiratory sinus arrhythmia. As people slow their respiration rate, the tidal volume tends to go up and the minute volume tends to go down. The tidal volume in diaphragmatic breathing ranges from 750 to 2000 ml of air per inhalation. The exhalation phase is longer than the inhalation phase. Additionally, evidence of less stress is an increased exhalation pause time (Peper, 1992). While breathing diaphragmatically, people are encouraged to relax and give their breathing "passive attention." Erik Peper describes diaphragmatic breathing as "effortless breathing."

Thoracic or chest breathing, shallow breathing, sighing and hyperventilation are common dysfunctional breathing patterns. Thoracic breathing is a tendency to breathe in the upper chest by using the accessory breathing muscles such as the pectoralis, scalenes, and trapezius muscles. The diaphragm is pulled up on inhalation and down on exhalation. Thoracic breathing can cause dyspnea, fatigue, irritation, headaches, increased muscle tension in the upper chest as well a increased feelings of anxiety and panic (Peper, 1992). In the extreme case, breathing is paradoxical, as a person inhales the chest lifts up and the stomach tightens. With exhalation the chest collapses and the stomach looses all tone and goes out. An example of this would be a large gasp taken when someone is startled or afraid.

Thoracic breathing can result in lower CO_2 levels that leads to hyperventilation. Hyperventilation is defined as "rapid cycles of inhaling and exhaling (tachypnea) and/or breathing voluminous amounts of air in each breath (hyperpnea) (Schwartz, 1995, Fried, 1990). This is breathing beyond what the body needs to meet its immediate demands for oxygen and carbon dioxide. Acute hyperventilation commonly occurs with frightening or stressful events and resolves quickly. Chronic hyperventilation causes significant physical symptoms in every system of the body including dizziness, poor concentration, decreased peripheral temperature, muscle tension and cramps, irregular and rapid heart rate and gastrointestinal upset.

A more common pattern of dysfunctional breathing is observed when a patient exhales incompletely with every breath (Peper, 1993). This leads to hyperventilation followed by a big sigh. This can easily be assessed with the following exercise:

CLINICAL TIP:
To see if breathing affects symptoms:

For one minute, ask your patient sit quietly, inhale and then exhale only 50% of their breath before inhaling again. Many people quickly report discomfort, including pounding in their chest, dizziness or increased feelings of anxiety. When you can evoke a symptom, the power of controlling breathing is reinforced.

Another dysfunctional breathing pattern is breath holding. When people are very vigilant or fearful, they typically hold their breath. This triggers the alarm reaction or stress response. With training and practice, people can learn to focus on their exhalations and continue diaphragmatic breathing while being vigilant. For example, imagine that you are threading a thin thread into a small needle hole. Imagine holding the needle in front of you. As you push the thread through the small eye of the needle, are you holding your breath?

Diaphragmatic breathing is a core component of most relaxation and biofeedback programs. Jon Kabat-Zinn, MD, Director of the Stress Reduction Clinic at the University of Massachusetts Medical Center has reported that "the breathing" was identified as "the single most important thing" his graduates learned from the stress reduction program (Kabat-Zinn, 1990). In a survey of children who participated in a biofeedback program for a variety of psychophysiologic disorders, 80% identified "that breathing stuff" as the component of the training that they used most and retained longest (Kajander, 1997).

Relaxation/diaphragmatic breathing is taught by medical providers and many other health professionals to assist people in reducing their physiologic tension and arousal and to treat the symptoms of many physical and psychological disorders. Diaphragmatic breathing is thought to have a positive effect on every system of the body. It calms the nervous system, slows the heart rate, and lowers blood pressure. It slows brain wave rates thus "quieting the mind." It stimulates the immune system, decreases peripheral sweating and increases peripheral warming. (Schwartz, 1995, Hendricks, 1995). Clinicians who teach breathing should have considerable personal experience (Tibbets and Peper, 1993).

There are many theories regarding the physiologic mechanism of diaphragmatic breathing on pain and anxiety. Breathing in through the nose stimulates the vagus nerve endings resulting in lowering of the sympathetic response and inhibiting the fight/flight response. Additionally, the air is warmed, filtered and moisturized as it travels through the nose resulting in less irritation and turbulence in the airway. Hyperventilation is diminished because the nasal passages are small which inhibits overbreathing. Slow breathing results in mild increases in CO2 which causes slowing of the heart rate, dilation of peripheral vessels, stimulation of gastric secretions, depressed cortical activity and mild somnolence, all characteristics associated with relaxation.

Focusing attention on slow diaphragmatic breathing results in cognitive diversion which may diminish attention to negative thoughts and increase a sense of personal control (Schwartz). Shaffer has observed that if one focuses his/her attention on their abdomen or feet while breathing, the breath is more likely to be diaphragmatic than if the focus is on the chest. Focusing on the chest results in quicker, more shallow breathing (Shaffer, et al, 1993). This has significant implications for persons with asthma or panic.

CLINICAL TIP:

If a person is having difficulty breathing diaphragmatically (asthma, panic, breath holding etc.), encourage them to focus on their exhalation and to imagine exhaling their air all the way down their legs to their feet. It also helps for the clinician to stroke the client's arms or legs while they are exhaling.

Additionally, it is important to recognize that breathing patterns are contagious and can be modeled (Shafffer, 1994). This is particularly true for children who learn a great deal by imitation. If a clinician exhales in phase with their client, the client will begin to exhale longer and may shift to a more diaphragmatic pattern. If the client places his/her hands on the clinician's sides or abdomen, abdominal breathing can be easily felt. Pacing of the breath can also be demonstrated. In order for this to occur in a healthy way, the clinician must be well trained in breathing and be flexible to the demands of their client.

CLINICAL TIP:

Teach diaphragmatic breathing with verbal instruction, role modeling, and pacing.

Adult Literature on Diaphragmatic Breathing Benefits

Diaphragmatic breathing has been identified as helpful in the treatment of numerous significant health problems in adults. Peper and Tibbetts determined that teaching asthmatic adults slow diaphragmatic breathing with EMG and incentive inspirometer biofeedback resulted in improved inhalation volume and decreases in thoracic muscle effort, asthma medication use, emergency room visits and breathless episodes. The benefits persisted over a 16 month interval (Peper, 1992). Kotses' research demonstrated that facial muscle relaxation and respiratory biofeedback improved short-term pulmonary function in asthmatics (Kotes, 1981).

Ley also reported that diaphragmatic breathing may be indicated in the treatment of sympathetic arousal, anxiety, panic attacks and hyperventilation, discomfort of menopausal hot flashes, reduction of a second coronary occurrence, and enhancement of endurance and physical performance (Ley, 1995). Breath training has been cited as a beneficial intervention for dyspnea, asthmatics, COPD, hyperventilation, pain, cardiac symptoms, hypertension (Esteve, 1996, Ley, 1995).

Normal Breathing Patterns in Children

Newborns automatically use diaphragmatic breathing. The normal newborn respiration rate is 30 to 80 breaths per minute (bpm) depending on the newborn's weight. The respiratory rate decreases to 20 to 40 bpm in early infancy and to 15 to 25 bpms in late childhood and adolescence (Oske,1990). By age 10, the normal breath pattern is predominantly thoracic, with greater abdominal breathing when the child is in the supine position (Verschaakelen, 1995).

Age	Breaths/minute
Birth to 6 weeks	35-60
6 to12 weeks	40
2 to 6 years	30
6 to 10 years	25
>10 years	20

(Saunders Manual of Pediatric Practice p532)

The authors believe that simply measuring a child's rate of breathing may induce a level of stress and thereby potentially affect standard norms.

There is a growing body of literature on the clinical applications of biofeedback used successfully as either a primary or adjunctive therapy in the treatment of numerous problems in children including headaches, recurrent abdominal pain, sleep disorders, attention deficit disorder, asthma, epilepsy, and anxiety (Culbert,1996). However, few studies have investigated the specific benefits of breath training as a treatment for childhood physical and psychophysiological symptoms. Breath training is usually mentioned in the context of relaxation training. For example, in *Stress Proofing your Child* (Lewis and Lewis, 1996), "breath power" (slow deep breathing) is described as an important "stressbuster" and as an important intervention tool for children who are distraught or angry, anxious about sports performance or test taking, or who generally feel tense and need to relax . Tells et al described teaching Yoga positions that emphasized relaxation and awareness of physical and other sensations to 20 girls in a group home. In comparison to a control group, the girls taught yoga for 6 months developed significantly lower breath rates, more regular breath patterns and lower skin resistance values (Tells, 1997).

The majority of data on children's breathing is found in the asthma literature. Compromised breathing and decreased vital capacities during asthma attacks are well described. Diaphragmatic breathing is most often described as an adjunctive technique to help with relaxation and diminish the anxiety or "panic" that occurs with an asthma attack rather than a primary intervention. Most sources, when reference to breath training is included, state that breathing techniques "did not help asthma by itself" (Tinkleman, 1990, Weinberger, 1989). However, Robert and Sammut (Roberts,1996) describe breathing exercises as important for learning how to relax during an asthma attack and to prevent the unnatural breathing pattern and panic that commonly occurs during an attack. It is the authors' experience that children respond best when breath training is done in a very specific manner and the child is taught to practice and generalize their relaxation breathing to their daily life.

CLINICAL TIP:

In most cases, children are told to "just take a deep breath." This usually results in a large chest breath that stimulates the fight/flight reaction. Instead, teach children slow diaphragmatic/abdominal breathing.

Leona Kuttner, PhD, describes breathing techniques as a helpful contribution in the management of acute pain in children (Kuttner, 1997). Breathing techniques were included with other relaxation techniques in the treatment of chronic pain conditions including hemophilia, juvenile rheumatoid arthritis and sickle cell disease (Bush, 1991). Children can reduce their pain when they learn to exhale while the procedure is being done. This allows the child to both learn breathing and be in control of letting the clinician know when they are ready for the procedure. A good example is when a child gets a shot; have him/her exhale during the injection. If the child can not respond to the direct suggestion to exhale, consider telling them to sing, blow bubbles, or even blow on a parent's hair or face.

The Alexander Center Experience

The Alexander Center for Child Development and Behavior in Minneapolis, Minnesota has had a pediatric biofeedback program for four years. Biofeedback is provided by three BCIA certified clinicians including two developmental pediatricians and a pediatric nurse practitioner (Ms Kajander). The majority of children have been seen for migraine headaches or mixed headache disorders, recurrent abdominal pain, disorders of elimination, sleep disorders, and symptoms of anxiety. A survey of 90 children who graduated from the pediatric biofeedback program revealed that diaphragmatic breathing was the biofeedback technique that they remembered and used most often. When asked what part of their biofeedback training was most helpful, they stated, “that breathing stuff.” However, children do not use diaphragmatic breathing without intentionally focusing on their breathing. They quickly lapse into a shallow and rapid breathing pattern, which may in fact be very normal. It is possible that some of the shallow breathing is conditioned to the activities of the child. For example, as children focus their attention, they often hold their breath. Young athletes such as gymnasts, skiers, and tennis players tend to hold their breath when beginning a difficult task. The key is to teach them to exhale rather than hold their breath when stressed.

In a pilot study at the Alexander Center, ten children, ages 7 to 16, were monitored with strain gauges and EMG on the upper trapezius muscles, while they passively sat in a chair and received no feedback about their breathing. Their respiratory rates ranged from 9 to 24 breaths per minute, averaging 19 breaths per minute, with a very shallow thoracic/diaphragmatic pattern. Only one of the ten, a girl who was trained in singing, used diaphragmatic breathing naturally and automatically. All were able to produce slow diaphragmatic patterns when asked to do so while being provided visual and sensory feedback. All had been taught diaphragmatic breathing to help control symptoms such as migraine and chronic tension headaches, recurrent abdominal pain, anxiety, and sleep onset disorders.

During the course of taking a history, the children were asked if they had previously learned any diaphragmatic or other breathing techniques. Only a very few identified learning "deep breathing" in band or choir. None of the children reported learning breathing techniques in sports. Coaches including professional karate and tennis coaches, and volunteer soccer, baseball and skiing coaches have been informally interviewed by Kajander and all reported that they did not teach breathing techniques as part of their coaching. A music instructor and dance instructor did describe teaching their students some basic diaphragmatic breathing techniques.

Teaching diaphragmatic breathing:

Diaphragmatic breathing is very easy to teach to most children. It can be taught with verbal instructions, role modeling and imitation. The main theme is to help children become aware of their breathing and know they can control it by their actions. The term "belly breathing" is used (by Kajander) to describe diaphragmatic breathing so that children will focus their attention on their bellies as they breathe. They are asked to think about how they breathe differently depending on what they are doing-such as running, sleeping or feeling nervous. These are all concepts that can be understood by young children and adolescents alike. A child can experience diaphragmatic breathing if he lays down on the exam table, putting one hand over his chest and one hand over the abdomen. The child breathes naturally feeling how his chest and belly rises and falls with each breath cycle. He is then asked to hold his breath or take a large chest breath in order to induce the related changes in the chest and abdomen. This process also facilitates experiencing increased muscle tension and increased heart rate while doing chest breathing or breath holding.

Children can be encouraged to imagine having a balloon of their favorite color in their abdomen that expands as they breathe in and deflates as they exhale. (The color cue facilitates the child's ability to use imagery.) A little gentle pressure of one's hand over the abdomen can help those children who are having difficulty breathing in their bellies. Having them imagine blowing their air down the whole length of their body helps prolong their exhalation. As a homework assignment, children are asked notice how their breathing changes as they perform different activities and to practice "belly breathing" while they are laying down two or more times every day. After children learn the basics of breathing, strain gauges and EMG monitoring of trapezius muscles with computer feedback is used to provide kinesthetic feedback and visual images of their breathing pattern. It is helpful to let them "play" with the equipment and notice the difference on the graph when they hold their breath, take a large chest breath or do diaphragmatic breathing. The children practice slow diaphragmatic breathing until they have mastered the concepts, and feel the difference in their body. While computerized biofeedback equipment is not essential for teaching diaphragmatic breathing, it increases the child's learning curve exponentially! EMG measurement of upper trapezius muscles and capnometery and other helpful tools are useful in teaching breathing.

It is the experience of the authors that many parents are thoracic breathers and need to learn diaphragmatic breathing themselves. If children are anxious or have asthma, and

their parents breathe thoracically, it may be contagious and intensify the child's dysfuctional breathing. When parents use diaphragmatic breathing, they can practice with their children thereby giving them positive attention and reinforcement for healthy behavior.

Clinical Tip: **Here is how to do diaphragmatic or "belly breathing"**
1. Lay on the floor or sit up straight with your feet supported. 2. Put one hand on your chest and the other hand over your belly. 3. Exhale all your air, until your belly pulls in slightly.
4. Imagine you have a ballon underneath your belly button that inflates as you inhale and deflates as you exhale. 5. Breath in through your nose and pull the air deep into your lungs. Feel your belly expand, like a balloon blowing up. Exhale slowly through your mouth. Feel you belly go back in, like a balloon deflating. Say "haa" as you exhale. 6. Breath in slowly - inhale to the count of 3 seconds and exhale to the count of 6. 7. Keep your shoulders as relaxed as possible, they should not rise as you inhale.

CONCLUSION:

It is well documented that diaphragmatic breathing is a beneficial technique in promoting relaxation and treating numerous significant breathing disorders in adults. Very little research has addressed the benefits of teaching diaphragmatic breathing to children and adolescents. Clinical data indicates that young people can easily learn diaphragmatic breathing and generalize it to daily life. Peper's research has shown that it can improve endurance and reduce exercise induced asthma. Children report that it has lasting benefit over other biofeedback techniques for relieving significant disorders such as chronic tension and migraine headaches, stomach aches, sleep disorders, feelings of anxiety and panic, and anger management. Research data is necessary to document these clinical impressions. It may be helpful for people who work with children in many capacities such as schools, sports, and medical and mental health clinics to consider teaching diaphragmatic breathing as a basic technique for health and relaxation.

Future research efforts should focus on the following questions identified by the 13th International Symposium on breath retraining in adults. (Ley, 1995)

- What are the limits of normal breathing patterns?
- Have abnormal breathing patterns been documented in patients with chronic hyperventilatory complaints?
- Are there ideal breathing patterns in resting states and performance states?
- Are there characteristic breathing patterns associated with emotional states such as anger, fear, and pleasure?
- How effective is cognitive therapy without breathing retraining in the treatment of panic disorder?
- How does counseling contribute to the efficacy of breath retraining?

The following additional questions are proposed by the authors:

- How enduring are breathing retraining techniques taught to children?

- What kind of breathing pattern are healthy for the relaxed child?
- What type of imagery works best in teaching children diaphragmatic breathing?
- What affect does training family members to be "co-therapists have on children's learning?
- How could relaxation and breath training be incorporated into the “stress inoculation” portion of well-child care?
- Why isn’t breath training included as a regular feature of sports training?
- If breath retraining is helpful to adults in the treatment of significant, life threatening diseases such as asthma, hypertension, and chronic pain and in psychological conditions such as panic disorder, could teaching children healthy breathing techniques prevent some of these disorders?

"Like heart rate, breathing is regulated by a center at the very base of the brain, in the medulla oblongata, an area of our most primitive functions. Yet breathing, observed, made conscious, and controlled, can be a powerful tool for healing."

--James Gordon, MD, *Manifest For A New Medicin*e

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Clinical Tip:

SUGGESTED READING

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