BREATHING HABITS

Aligning Breathing Mechanics with Respiratory Chemistry[1]

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Breathing and its potential effects on our lives, positive and negative, are enormous. Appreciating this enormity is significantly enhanced by learning about the amazing physiology of breathing, which together with understanding breathing as motivated behavior, can account for the profound and far-reaching effects of breathing on health and performance (Litchfield, 2010, 2017).

Millions of people from around the world include breathing learning interventions in one way or another in their professional and/or personal lives for a multitude of reasons, e.g., relaxation. Most of them, however, focus exclusively on mechanics of breathing (external respiration), e.g., slow breathing, without understanding and addressing their profound impact on the chemistry of respiration (internal respiration), e.g., acid-base regulation (pH) of extracellular fluids (e.g., blood plasma). Understanding the regulation of this chemistry helps to (1) avoid misguided breathing interventions that can have adverse effects, (2) avoid faulty conclusions about the nature of breathing interventions and their outcomes, (3) identify dysfunctional breathing habits that can seriously compromise respiration and precipitate myriad symptoms and deficits of all kinds, (4) teach and learn breathing habits that optimize respiration, that is, align breathing mechanics with respiratory requirements (chemistry), and (5) expand the scope and effectiveness of breathing interventions for personal use as well as for practitioners consulting with clients and patients.

The effects of compromised respiratory chemistry, because of learned dysfunctional mechanics (i.e., breathing habits), can be immediate and disturbing. Statistics suggest that tens of millions of people worldwide suffer with the profound and misunderstood symptoms and deficits of learned dysfunctional breathing habits that compromise respiratory chemistry. Surveys suggest that about 60% of ambulance runs in the major USA cities are a result of acute symptoms brought on by dysfunctional habits (Fried, 1999), often learned early in life. Unfortunately, these habits are rarely identified by healthcare practitioners, their effects mistakenly attributed to other causes, and their resolutions prescriptive in nature where focus is on symptoms rather than on causes, e.g., drug prescriptions.

Breathing behavior analysis can help provide a solution to this challenge. Precisely the same principles by which people learn dysfunctional breathing habits can also be implemented for overcoming these same habits and/or learning new breathing habits that enhance health, learning, performance, awareness, creativity, and communication. Learning about how mechanics and chemistry work together is fundamental to understanding the potential effects of making conscious changes in breathing mechanics on respiratory chemistry, e.g., improving attention by enhancing blood flow to the brain. This article provides a brief overview of these considerations, while introducing some basic respiratory physiology relevant to improving the effectiveness of both personal and professional breathing learning applications and interventions.

RESPIRATION

Respiration can be subdivided into three phases: external, internal, and cellular. *External respiration* is about breathing mechanics, moving air in and out of the lungs, e.g., slow/fast, deep/shallow, mouth/nose, diaphragmatic/chest, rhythmic/dysrhythmic, exhale completed/not completed, and so on. *Internal respiration* is about oxygen distribution to tissues, carbon dioxide management, and acid-base regulation (pH and electrolyte balance) of extracellular body fluids (blood plasma, lymph, cerebrospinal, and interstitial fluids). *Cellular respiration* is about creating ATP molecules (adenosine triphosphate) in the mitochondria of cells, which are then subsequently broken down by cells for energy. Carbon dioxide generated during cellular respiration is a precious gas that ultimately makes possible precision moment-to-moment acid-base regulation (as will be described later).

BREATHING MECHANICS **(external respiration)**

Breathing and respiration are not the same phenomenon. Respiration is a subset of breathing. Besides providing for respiration, breathing serves people in many and diverse ways, e.g., speech.

Breathing is behavioral. It serves us in powerful and unsuspecting ways. Breathing habits, good and bad, are learned unconsciously, and sometimes consciously, for self-regulating emotions, cognitions, personality, coping styles, physiology, health, performance, and consciousness. This is to say that breathing is psychological in the sense that experience sets the stage for its reconfiguration. Embedded in this reconfiguration is a personal history that regulates breathing based on the principles of learning, perception, motivation, reinforcement (benefits), attention, and memory. The richness of the psychology of breathing provides for both its far-reaching benefits and for its, all too frequent, profoundly debilitating effects (e.g., 60% of USA ambulance runs).

Respiration is reflexive. External respiration is about the regulation of breathing mechanics by brainstem reflex mechanisms governed by moment to moment changes in respiratory chemistry, that is, changes in extracellular pH, oxygen concentration (PO_2), and carbon dioxide concentration (PCO_2) **(**Levitzky, 2007). Although breathing mechanics continuously shift as a function of being bored or excited, stressed or relaxed, upset or pleased, and meditative or physically challenged respiration generally remains within an optimal respiratory envelope. Unless an unconscious habit or intentional manipulation gets in the way, respiratory requirements will dictate the coordination of breathing mechanics in the context of other interacting behaviors, e.g., eating and talking. It would, of course, make little sense that breathing could serve respiration only when one is relaxed or in a positive space; if so, given what daily life is usually about, respiration would be compromised most of the time.

Practitioners from diverse disciplines and perspectives focus on manipulation of breathing for achieving beneficial outcomes, that is, ***self-interventions*** (techniques) that involve “doing the breathing” in prescribed ways. One of the outcomes of prescriptive breathing, however, is not infrequently deregulated respiration, and unfortunately even the acquisition of dysfunctional habits where both practitioners and clients misunderstand and misinterpret the associated physical and mental changes.

Healthy breathing provides for ***self-regulation*** of mechanics in the service of respiratory chemistry, except where it is intentionally manipulated for reasons such as (1) identifying breathing habits and exploring their effects (i.e., breathing behavior analysis) and (2) exploring consciousness for personal awareness and therapeutic outcomes, e.g., holotropic breathing (Grof & Grof, 2010). Self-regulatory breathing means “allowing the breathing” while simultaneously breathing for meeting other objectives, e.g., talking, meditating, relaxing, exploring.

Optimal respiratory health means maintaining a stable “chemical axis of breathing” wherein internal respiratory requirements are immediately and expeditiously addressed, despite the highly variable acrobatics of breathing mechanics during daily life that may be serving us in so many other important ways, e.g., talking. Understanding this connection of breathing mechanics with breathing chemistry points to the most fundamental, practical, and profound factors that account for:

(1) the far-reaching effects of dysfunctional breathing habits, such as disturbed extracellular pH (e.g., blood plasma) deregulated electrolyte balance (e.g., bicarbonate), compromised blood flow (e.g., brain and heart), unfriendly hemoglobin (compromised delivery of O_2), compromised muscle function (e.g., jaw tension and pain), fatigue, mood changes, and performance deficits (Fried, 1987, 1993; Laffey & Kavanagh, 2002, Maramattom & Wijdicks, 2015).

(2) the surprising benefits of good breathing habits and breathing self-interventions, such as improved physical performance (e.g., sports), symptom abatement (e.g., panic), improved cognition (learning, memory, and attention), enhanced task performance (e.g., test taking), successful management of emotions and stress (e.g., anxiety, anger), expanded consciousness (e.g., being present), improved self-awareness (e.g., sense of self), and better overall health (balanced chemistry).

RESPIRATOR CHEMISTRY **(internal respiration)**

Many people believe that good breathing is about moving as much oxygen (O_2) as possible *into the blood*, while simultaneously eliminating (excreting) as much carbon dioxide (CO_2) as possible *from the blood*, through "the right" breathing mechanics. This view is both uninformed and simplistic. Yes, O_2 delivery to body cells is essential, of course, but the best way to accomplish this is not so obvious. And yes, excretion of *excessive* CO_2 is critical, but not all of it, only some of it. Contrary to the belief of many, CO_2 is a precious body substance and its ever presence is required not only for health but for life itself.

External respiration (breathing mechanics) is regulated from breath to breath by chemo-regulatory reflexes located in the brainstem (Levitzky 2007, Khoo, 2011). These reflexes are regulated based on pH of arterial blood plasma (pHa) and cerebrospinal fluid, CO_2 concentration in blood plasma ($PaCO_2$) and cerebrospinal fluid, and by O_2 concentration in arterial blood plasma (PaO_2). These reflexes operate breathing through the diaphragm and the internal intercostal muscles while at rest. This is one reason why if chest breathing predominates, based on an unconsciously learned breathing habit (where "feeling in control" may take precedence over allowing for the reflexes), that diaphragmatic training and learning can be so fundamentally important, i.e., clients may learn to prefer mechanics that are consistent with the operational requirements of the chemo-regulatory reflexes.

Acid-base balance is about *pH regulation*, i.e., hydrogen ion concentration (pH = power of hydrogen). An *aqueous* (water) solution is neutral when the pH is 7.0. Solutions with a pH of less than 7.0 are acidic and solutions with a pH of higher than 7.0 are alkaline. The body keeps blood plasma within very tight limits of pH, optimally 7.38-7.40, but generally within a range of 7.35-7.45. Hence, as pH drops, blood plasma becomes less alkaline (not more acidic) and when it rises it becomes more alkaline. Values of less than 7.35 mean *acidemia* and values above 7.45 mean *alkalemia*.

Overbreathing, which is the most common form of learned dysfunctional breathing, leads to a CO_2 deficit (*hypocapnia*) resulting in *respiratory alkalosis* (pH higher than 7.45). *Underbreathing*, which is uncommon, leads to excessive accumulation of CO_2 (*hypercapnia*) resulting in *respiratory acidosis* (pH lower than 7.35). Both conditions can result in profound physiological changes responsible for a wide range of symptoms and deficits, short term and long term. Low arterial CO_2 concentrations, however, may not necessarily be the result of a dysfunctional habit, but rather a compensatory response to some other physiological compromise, e.g., lactic acidosis during anaerobic exercise, or cardiac insufficiency in patients with heart conditions.

The Henderson-Hasselbalch (H-H) equation (Thomson, Adams, & Cowan, 1997) describes pH regulation of blood plasma and other extracellular fluids, as follows (simplified format):

$pH = [HCO_3^-] \div PaCO_2$, *OR* $[H^+] = PaCO_2 \div [HCO_3^-]$

where, $[HCO_3^-]$ = bicarbonate ion concentration
where, $[H^+]$ = hydrogen ion concentration
where, $PaCO_2$ = arterial CO_2 concentration (partial pressure arterial CO_2)
where pH is the reciprocal of hydrogen ion concentration

Bicarbonates are regulated by the kidneys and the PCO_2 concentration by breathing. The kidneys are very slow to act, and don't even begin to significantly compensate for changes in pH for about eight hours and take two to three days to make their full contribution toward normalizing pH (Thomson, Adams, & Cowan, 1997). Breathing on the other hand can immediately effect pH level, within seconds, positively by the action of reflex mechanisms and positively OR negatively by learned breathing habits. It is here where the psychology of breathing can make its grand entry into physiology through its role in the regulation of the H-H equation. Consider the following rewrite of the equation: ***Acid-base physiology = kidney function ÷ breathing behavior***.

Breathing mechanics, controlled by brainstem reflexes (external respiration), normally regulate the pH of extracellular body fluids, including blood plasma, cerebrospinal fluid, interstitial fluid (that surround all cells), and lymph. But, learned breathing habits can get in the way of these reflexes leading to insidious and generally unidentified outcomes by both practitioners and their clients.

About 98.5% of oxygen diffused into the blood of the pulmonary capillaries surrounding the alveoli of the lungs, is carried in the blood by hemoglobin in red blood cells. Hemoglobin delivers its oxygen based on blood plasma O_2 concentration (PaO_2) as per the oxyhemoglobin dissociation curve (Levitzky 2007). As PaO_2 drops in busy tissues hemoglobin begins to deliver its oxygen. The CO_2 concentration and the pH of cytosol in red blood cells significantly affect when and where hemoglobin will deliver its oxygen (Bohr Effect) (Levitzky 2007). If a tissue is busy at work it will generate more CO_2 which diffuses into the red blood cell. The presence of more CO_2 and the reduced pH of the cytosol (CO_2 forms H_2CO_3, carbonic acid) reduces hemoglobin's affinity for oxygen (changes its conformation), leading to an earlier distribution of its oxygen as per the Bohr effect (that is, releasing oxygen at higher levels of PaO_2). Very importantly, also resulting from increased CO_2 concentration and a lower pH of cytosol in red blood cells, hemoglobin will release nitric oxide (NO) (Gross & Lane, 1999), a powerful vasodilator, providing for increased blood flow and volume in busy tissues that require more oxygen and glucose.

Brainstem reflex mechanisms regulate breathing mechanics (external respiration) such that the correct CO_2 concentration is maintained in the alveoli of the lungs (where gas exchange takes place). This ensures that blood moving through the pulmonary capillary network returns to systemic circulation with a CO_2 concentration that balances the H-H equation, thus keeping pH within normal limits. Thus, when one intentionally ventilates by taking large breaths, slow or fast, diaphragmatically or in the chest, $PaCO_2$ concentration can drop and drive up pH toward respiratory alkalosis. The result is vascular constriction and unfriendly hemoglobin (where O_2 and NO are more sparingly released), and thus a radically reduced oxygen and glucose supply to body tissues in need, e.g., to the brain and to the heart.

COMPROMISED RESPIRATION

"Taking charge of breathing" triggered by an unconsciously learned breathing habit, or brought on by a misguided conscious breathing intervention, often results in overbreathing and immediate changes in acid-base physiology as per the H-H equation. The result is hypocapnia ($PaCO_2$ deficit) and respiratory alkalosis (increased plasma pH). The rise in pH may trigger immediate and profound changes in physiology (Fried, 1987, 1993; Laffey & Kavanagh, 2002; Maramattom & Wijdicks, 2007), some of which are listed in **Table 1** (Hypocapnia: Physiological Effects).

The symptoms and deficits associated with the physiological changes listed in Table 1 can be profound, even devastating, and may include **physical** (e.g. brain fog), **emotional** (e.g., anger), **cognitive** (e.g., attention deficit), **personality** (e.g., sense of self), and **behavioral** (e.g., test taking) changes. Some of these symptoms and deficits (Fried, 1987, 1993; Laffey & Kavanagh, 2002) are listed in **Table 2** (Hypocapnia: Symptoms & Deficits).

The physiological changes listed in Table 1 can also **trigger** (e.g., epilepsy), **exacerbate** (e.g., asthma), and **prolong** (e.g., nausea during pregnancy) **symptoms and deficits** associated with numerous organic conditions. Some of these organic conditions are listed in **Table 3** (Hypocapnia: Exacerbation of Health Issues and Complaints). These effects are all too often mistakenly attributed to other causes or are identified as "unexplained symptoms" in professional work and clinical literatures.

Overbreathing is the most common form of learned dysfunctional breathing affecting respiration in unencumbered healthy people, although underbreathing habits are occasionally seen. Learned underbreathing, when it does occur, is usually the result of hyperinflation, where people continuously abort their exhales, thus moving air in and out of anatomical deadspace and preventing inhaled air from adequately reaching the alveoli of the lungs where gas exchange takes place. That is, although the breathing may be very fast, *alveolar ventilation* remains inadequate. As in the case of many dysfunctional habits, hyperinflation is usually associated with phobia about getting enough air coupled with faulty beliefs about breathing.

Some of the physiological effects of overbreathing on neurophysiology (REF) listed in Table 1 and their associated symptoms and deficits listed in Table 2, are briefly reviewed in the next section of this article from the perspective of their role in the effects of breathing on consciousness.

RESPIRATION AND CONSCIOUSNESS

Overbreathing results in reduced CO_2 concentration (hypocapnia) and alkalosis in blood plasma, cerebrospinal fluid, and the interstitial fluid that surrounds all neurons in the brain. Hypocapnia results in cerebral vasoconstriction (Laffey & Kavanagh, 2002) as a function if its direct impact on vascular smooth muscle tissue, and compromised delivery of oxygen and nitric oxide on the part of hemoglobin as per the Bohr Effect in the red blood cells (less CO_2, higher pH). The net effect is a potentially serious compromise of the delivery of oxygen (hypoxia) and glucose (hypoglycemia) to neural tissue. These compromises, along with the migration of calcium ions into smooth muscle tissue because of plasma alkalosis, can trigger vasoconstriction so significant that blood flow in the brain as a whole can be reduced up to at least 40 to 50 percent within less than a minute (Brian, 1998). It is this kind of change that can precipitate symptoms so severe that people call 911 for help (that is, emergency ambulance service for transport to the hospital) (Fried, 1999).

Respiratory alkalosis in interstitial and cerebrospinal fluids results in electrolyte changes that have profound effects on neuronal functionality (Laffey & Kavanagh, 2002). Sodium and potassium ions migrate into neurons, in exchange for hydrogen ions (H^+) which increases neuronal metabolism, excitability, and contractility (Laffey & Kavanagh, 2002). Unfortunately, this takes place at a time when there is significantly reduced oxygen availability and thus hastens and exacerbates the onset of anaerobic metabolism in neurons where intracellular lactic acidosis compromises neuronal functioning that may result in all kinds of associated psychological changes.

The basic outcomes of these changes in physiology thus include brain hypoxia (oxygen deficit), brain hypoglycemia (low blood sugar), and metabolic (lactic) acidosis in neurons, all of which can profoundly alter overall brain function (Pardo & Miller, 2018). Besides unfortunate physiological outcomes (e.g., headache, ischemia, and the possible triggering of neurological syndromes), these outcomes can have immediate effects on attention, perception, motivation, emotion, cognition, learning, memory, personality, performance, sense of self, and consciousness.

Examples of psychological changes, from a downside perspective, include: emotional vulnerability, anxiety, anger, fear, panic, phobia, apprehension, worry, crying, low mood, dissociation, disorientation, dizziness, fainting, confusion, hallucinations, attention deficit, learning deficits, poor memory, brain fog, inability to think, low self-esteem, and undesirable shifts in personality (Fried, 1987; Fried & Grimaldi, 1993). On the other hand, from a consciousness perspective these kinds of “negatives” can lay the groundwork for important “positives” through individualized guided breathing explorations, e.g., holotropic breathing.

The ways in which a specific person responds to these physiological changes are highly variable and are dependent upon personal health, life circumstances, personality, immediate social environment, and especially personal psychological history. For example, disorientation and dizziness, as a function of oxygen deficit, may trigger fear or anxiety in one person and relief or relaxation in another. These differences are based on personal histories, including emotional, perceptual, and cognitive learning.

State change and dissociation are key players in how people respond to breathing mediated physiological changes. Breathing-induced state change may serve the individual in both positive and self-defeating ways, much in the same way as do psychoactive substances that provide for access and experience of self, others, and the world from new, different, and sometimes revealing perspectives.

Intentional state change through overbreathing can set the stage for life altering and spiritual experiences, including (1) uncovering and triggering traumatic memories that provide for processing and reframing painful episodes in life and/or (2) discovering dysfunctional breathing habits and their associated effects triggered by specific places, times, people, tasks, emotions, thoughts, social circumstances, fatigue, challenges, and physical feelings based on unique personal learning histories.

Unintentional breathing-mediated state changes, brought on by dysfunctional breathing habits, are common. These state changes can serve people in powerful and unique ways, outside of their awareness, based on a personal history that gives specific meaning to such changes. These state changes can be habit-forming in the sense that they may provide for (1) avoidance of thoughts, emotions, and memories or (2) access to a different and preferable sense of self (personality). State-dependent learning and memory, and their role in drug addiction for example, have been extensively researched in both humans and animals and are described in thousands of articles in numerous behavioral science journals, e.g., *Behavioural Pharmacology*.

CONCLUDING COMMENTS

Anyone who does breathing education and/or training with clients can benefit immensely by knowing some of the basics of respiratory physiology and how changing breathing mechanics immediately, profoundly, and precisely alters breathing chemistry. A truly practical understanding, however, of the dynamics of breathing physiology, how it is ultimately governed, how it affects us, and how we interact with it *requires knowledge of its psychology*, not just the details of its mechanics and chemistry.

Breathing mechanics and breathing chemistry weave together in a dance. In this dance, however, as we embrace the daily diverse circumstances of our lives, everyday-breathing should provide for the alignment of mechanics with chemistry in the service of health, performance, and consciousness. The "chemical axis" of breathing needs to generally remain within the optimal respiratory envelope, thus meeting oxygen, carbon dioxide, and acid-base balance requirements.

Everyone has learned breathing habits, positive and negative. Habits are solutions triggered by specific experiences (stimuli) that are sustained by their outcomes (reinforcements). That is, breathing not only serves respiratory requirements (external respiration), but very importantly serves a host of other behavioral and psychological objectives, most of them unconscious. Examples of conscious objectives include: talking, emotional control, relaxation, meditation, psychotherapy, consciousness exploration, and cultivating spiritual awareness. Examples of unconscious objectives include: accessing secondary gain (e.g., headache), feeling in control, accessing emotions (e.g., anger) for controlling others, anxiety reduction, avoiding memories, disconnecting from challenges, and many others. Unconscious objectives are achieved through learning breathing habits based on specific experiences, e.g., feeling air hunger while wearing a mask during times of COVID. Everyone has learned breathing habits, good and bad, regulated by specific triggers based on their own personal histories.

The relationship between breathing and respiration, mechanics and chemistry, cannot be fully appreciated without understanding the psychological nature of physiology itself. Breathing, like any other behavior, is motivated and changes as a function of its outcomes. Breathing isn't simply mindless automation of physiology. And, it isn't simply physiology to be somehow consciously manipulated in the name of self-help. It's truly so much more than this. Simply manipulating breathing physiology for well-intended purposes, without regard to the bigger picture, does not do justice to the richness and complexity of breathing. Assisting people with compromising breathing habits requires a detailed breathing behavior analysis where both the physiology and psychology of breathing are phenomenologically explored by clients with guidance from their practitioners.

Optimal breathing might best be expressed by the two images which define the Japanese word for breathing: HEART and SELF. Another way of seeing this might be: heart + self = presence. Breathing, understood in this sense, may serve as a fundamental glue that holds the self and the heart together, making possible a greater personal presence in the world for both others and ourselves.

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FOOTNOTES

1. This article is a revised version of the authors' newsletter essay, *Breathing: alignment of mechanics with chemistry,* that appeared in the International Breath Foundation Newsletter - June 2017.

TABLE 1: HYPOCAPNIA **(respiratory alkalosis, overbreathing)**

Physiological effects

- Antioxidant reduction
- Bicarbonate deficiency (long term kidney effect)
- Bronchial constriction (airway resistance)
- Calcium migration into muscle cells (fatigue, spasm)
- Cerebral excitatory and inhibitory disturbances
- Cerebral hypoxia, hypoglycemia, ischemia
- Cerebral vasoconstriction (increased pH)
- Compromised O2 distribution (hemoglobin chemistry)
- Compromised nitric oxide distribution (hemoglobin chemistry)
- Coronary (vascular) constriction
- Dishabituation and habituation (CO2 set point?)
- Gut smooth muscle constriction
- Ionized magnesium reduction (tetany and cardiac compromise)
- Hemoglobin, compromised O2 and NO delivery
- Hypokalemia (potassium deficiency)
- Hyponatremia (sodium deficiency, long term effect)
- Increased neuronal excitability & contractility
- Increased overall vascular resistance (smooth muscle constriction)
- Myocardial electrophysiology disturbances
- Neuronal acidosis (lactic acid)
- Plasma alkalinity, effects on endothelial NO production
- Reduced ocular blood flow
- Reduced lung compliance
- Reduced splanchnic organ perfusion (hepatic and renal arteries)
- Sodium and potassium migration into cells (excitability)
- Stress hormone release (ACTH)
- Thrombosis, platelet aggregation
- Tissue inflammation

TABLE 2: HYPOCAPNIA **(respiratory alkalosis, overbreathing)**

Symptoms and Deficits

- Abdominal: nausea, vomiting, cramping, bloatedness
- Autonomic-stress: acute fatigue, chronic fatigue, headache, muscle pain, weakness
- Cardiovascular: palpitations, tachycardia, arrhythmias, angina symptoms. ECG abnormalities
- Cognitive: attention deficit, learning deficits, poor memory, brain fog, inability to think
- Consciousness: dissociation, state change, dizziness, fainting, confusion, hallucinations
- Emotional: anxiety, anger, fear, panic, phobia, apprehension, worry, crying, low mood
- Movement: diminished coordination, reaction time, balance, perceptual judgment
- Muscles: tetany, hyperreflexia, spasm, weakness, fatigue, pain, difficult to swallow, chest discomfort
- Performance: sleep apnea, anxiety, rehearsal, focus, endurance, muscle function, fatigue, pain
- Peripheral: tingling, numbness, trembling, twitching, shivering, coldness, sweatiness
- Psychological: shifts in personality, self-esteem, memory, emotion, thought
- Respiratory: shortness of breath, airway resistance, bronchial constriction, asthma symptoms
- Sensory: blurred vision, sound seems distant, reduced pain threshold, dishabituation, dry mouth
- Smooth muscles: cerebral, coronary, bronchial, gut, ocular, Splanchnic, and placental vasoconstriction

TABLE 3: HYPOCAPNIA **(respiratory alkalosis, overbreathing)**

Exacerbation of Health Issues and Complaints

- Behavioral: performance issues, speech, singing, task challenges
- Cardiovascular: angina, heart attack, arrhythmias, ECG abnormalities
- Chronic pain: injury, disease, systemic inflammation
- Cognitive: learning disabilities, ADD, ADHD
- Drug efficacy: shifts in pH and electrolyte balance alter absorption
- Emotional: anger, phobias, panic attack, anxiety, depression
- Fitness issues: endurance, muscle strength, fatigue, altitude sickness
- Gastric: irritable bowel syndrome (IBS), non-ulcer dyspepsia
- Neurological: epilepsy
- Neuromuscular: repetitive strain injury (RSI), headache, orthodontic
- Pregnancy: fetal health, premature birth, symptoms during pregnancy
- Psychological: trauma, PTSD, drug dependence
- Psychophysiological disorders: headache, chronic pain, hypertension
- Respiratory: asthma, emphysema, COPD
- Sleep disturbances: apnea
- Unexplained conditions: fibromyalgia, chronic fatigue
- Vascular: hypertension, migraine, ischemia, hypoglycemia