

BREATHING+



Pursed Lip Breathing
Respiratory Training Device

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1 BREATHING DYNAMICS

- ❑ Fast and intense breathing shows distress, panic, fear or hostility, while slow breathing shows a state of relaxation.
- ❑ Open mouth makes breathing worse as it does not allow an efficient exhalation. The most efficient exhalation (most air is released from the body) is through semi-closed lips (it is also much more efficient than exhalation through nose alone).
- ❑ Most people keep air trapped inside, not allowing for new air to enter. Such “breath holding” behaviour is inefficient in terms of gas exchange and thus leads to faster and more intense breathing.
- ❑ In asthma (and other respiratory obstructions) airways sometimes collapse making it even more difficult to breathe. Such a collapse can be prevented by exhaling against the resistance of pursed lips, a technique commonly known as “Pursed Lip Breathing”.
- ❑ Breathing is the only autonomous function that we can control consciously, therefore it provides a way to regulate our autonomous body processes such as heart rate, digestion and endocrine glands.
- ❑ Breathing affects heart rate in such a way that each inhalation speeds up the heart, while each exhalation slows it down, this phenomena is observed as “Heart Rate Variability” and is commonly explained as “Respiratory Sinus Arrhythmia”.
- ❑ When exposed to stress, humans inhale air in order to prepare for a “fight or flight” activity. It speeds up heart rate and starts secretion of stress hormones such as cortisol and epinephrine.
- ❑ People who breathe fast often overeat. Breathing more slowly reduces your appetite. Making exhalations longer is also known to improve digestion and is being used as a “Long Breath Diet” in Japan and many other countries.

2 BREATHING PROBLEMS

2.1 Shortness of breath

Difficulty in breathing (also known as shortness of breath, breathlessness, or dyspnea) is the result of inefficient breathing. In one’s lifetime, one may experience rare episodes of shortness of breath as part of high levels of activity like exhaustive exertion, or during

environmental conditions such as high altitude or very warm or cold temperatures. Other than these extreme conditions, shortness of breath is commonly a sign of a medical problem. Some of the causes of shortness of breath are asthma, bronchitis, tuberculosis, COPD and emphysema. These problems can be treated with breathing exercises such as Pursed Lip Breathing.¹

2.2 Asthma and COPD

Asthma is most common chronic disease among children, and affects more than 253 million people around the world. Pursed lip breathing is most recommended to manage asthma and COPD as it makes breathing more efficient, improves oxygenation and reduces breathing rate². Additionally Pursed Lip Breathing is recommended during an asthma attack by most asthma specialist organisations worldwide.^{3 4 5}.

2.3 Emphysema

In emphysema the alveoli and lung tissue are destroyed. With this damage, the alveoli cannot support the bronchial tubes. Consequently the airway collapses which causes an "obstruction" (a blockage), which traps air inside the lungs. Too much air trapped in the lungs can give some patients a barrel-chested appearance. Pursed Lip Breathing helps emphysema sufferers exhale more efficiently and allows them to prevent airway collapse by maintaining a positive pressure inside airways⁶.

2.4 Stress and Anxiety

The stress response can be viewed as an interactional process that causes psychophysiological reactions that are immediate and can occur up to and including physiologic events 3 weeks after confrontation with the stressor⁷. Pursed lip breathing helps in coping with stress and anxiety related disorders. It can be used as a 10-20

¹ Bozkurt, Biykem, and Douglas L Mann. "Shortness of breath." *Circulation* 108.2 (2003): e11-e13.

² Bott, Julia, and British Thoracic Society Physiotherapy Guideline Development Group. *Guidelines for the physiotherapy management of the adult, medical, spontaneously breathing patient*. BMJ Publ. Group, 2009.

³ "Asthma Action Plan - American Lung Association." 2012. 26 Nov. 2014

<<http://www.lung.org/associations/states/colorado/asthma/asthma-action-plan.html>>

⁴ American Association of Cardiovascular & Pulmonary Rehabilitation. *Guidelines for pulmonary rehabilitation programs*. Human Kinetics, 2010.

⁵ Bott, Julia, and British Thoracic Society Physiotherapy Guideline Development Group. *Guidelines for the physiotherapy management of the adult, medical, spontaneously breathing patient*. BMJ Publ. Group, 2009.

⁶ Fregonezi, GA de F, VR Resqueti, and R Güell Rous. "Pursed lips breathing." *Archivos de Bronconeumología ((English Edition))* 40.6 (2004): 279-282.

⁷ Robinson, Linda. "Stress and anxiety." *The Nursing clinics of North America* 25.4 (1990): 935-943.

minutes daily systematic respiratory exercise to train breathing in combination with other rehabilitative activities⁸.

2.5 Attention Deficit Disorder

Attention deficit hyperactivity disorder (ADHD, similar to hyperkinetic disorder in the ICD-10) is a developmental neuropsychiatric disorder in which there are significant problems with executive functions (e.g., attentional control and inhibitory control) that cause attention deficits, hyperactivity, or impulsiveness which is not appropriate for a person's age. ADHD usually appears first in childhood, but can also now be diagnosed in adults (as long as some symptoms were present in the individual's childhood, but simply never diagnosed). Breathing exercises have been recommended to patients suffering from ADHD⁹

2.6 Speech Disorders

Speech disorders or speech impediments are a type of communication disorder where 'normal' speech is disrupted. This can mean stuttering, lisps, etc. Someone who is unable to speak due to a speech disorder is considered mute. In many cases the cause is unknown. However, there are various known causes of speech impediments, such as "hearing loss, neurological disorders, brain injury, intellectual disability, drug abuse, physical impairments such as Cleft lip and palate, and vocal abuse or misuse." As speech is fundamentally linked to breathing, breathing exercises act as a basis for good articulation, projection and tone.¹⁰

⁸ "Principles and Practice of Stress Management, Third Edition ..." 2012. 7 Dec. 2014

<<http://www.amazon.com/Principles-Practice-Stress-Management-Edition/dp/160623000X>>

⁹ "Attention Deficit Disorder (ADD and ADHD) - Psych Central." 2004. 9 Apr. 2015 <<http://psychcentral.com/disorders/adhd/>>

¹⁰ "Speech and Language Disorders and Diseases." 2003. 9 Apr. 2015 <<http://www.asha.org/public/speech/disorders/>>

3 TREATMENT AND PREVENTION

3.1 Breathing exercises

Breathing Exercises should be advised to patients with a variety of medical respiratory conditions, with the aim of breathlessness management and symptom control, mobility and function improvement or maintenance, and airway clearance and cough enhancement or support.¹¹

3.2 Pursed Lip Breathing

Pursed Lip Breathing (PLB) is a breathing technique that aims to make exhalations longer and more efficient, PLB helps people cope with asthma, COPD, emphysema, and stress related disorders. It is described in the American Thoracic Society guidelines as 'a nasal inspiration followed by expiratory blowing against partially closed lips, avoiding forceful exhalation'. PLB reduces breathing rate, helps make exhalation more efficient, reduces dyspnoea (shortness of breath), and improves cellular oxygenation. PLB is gaining recognition in medical community since mid 60s when its positive effects had been first observed. Today there are over 2000 articles indexed in google scholar, pubmed and similar medical databases describing its clinical benefits. According to Cleveland Clinic¹², its effects as are:

- ❑ Improves ventilation
- ❑ Releases trapped air in the lungs
- ❑ Keeps the airways open longer and decreases the work of breathing
- ❑ Prolongs exhalation to slow the breathing rate
- ❑ Improves breathing patterns by moving old air out of the lungs
- ❑ Relieves shortness of breath
- ❑ Causes general relaxation

3.3 Technology Review

Technology for breathing exercises range in respiratory detection principles, biofeedback principles and its methods of operation (Table 1).

Table 1: Review of technology for breathing exercises

¹¹ Bott, Julia, and British Thoracic Society Physiotherapy Guideline Development Group. *Guidelines for the physiotherapy management of the adult, medical, spontaneously breathing patient*. BMJ Publ. Group, 2009.

¹² "Pursed Lip Breathing - Cleveland Clinic." 2014. 9 Apr. 2015

<http://my.clevelandclinic.org/health/diseases_conditions/hic_Understanding_COPD/hic_Pulmonary_Rehabilitation_Is_it_fo_r_You/hic_Pursed_Lip_Breathing>

Device	Respiratory Detection System	Description	Advantages and Disadvantages
eRATE device InterCure Ltd	Mechanic principle (lung detection)	<ul style="list-style-type: none"> -Non-drug therapy -Guidance system: visual -For the treatment of high blood pressure -Portable computerized device 	<ul style="list-style-type: none"> ✓ Guidance provided ✗ Does not require exhalation against pressure, therefore it is a beneficiary
VO Device Promed	Mechanic principle (lung detection)	<ul style="list-style-type: none"> -High Frequency Chest Oscillation device -Guidance system: N/A -Positive pressure air pulses applied to the chest wall 	<ul style="list-style-type: none"> ✓ Therapy session lasts about 15 minutes ✗ Not entertaining
VO device	Pneumatic principle (using mouth to force air into device)	<ul style="list-style-type: none"> -Oral High Frequency Oscillation -Guidance system: N/A -Developed from the technique of high frequency jet ventilation -Provides a practical and simple method of supplemental breathing in conscious subjects 	<ul style="list-style-type: none"> ✗ Used only in USA ✗ Not entertaining ✗ Unhygienic
VO device Missionaire	Pneumatic principle (using mouth to force air into device)	<ul style="list-style-type: none"> -Intrapulmonary Percussion Ventilation -Guidance system: N/A -Utilizes high frequency -Combines aerosol inhalation and internal thoracic percussion applied via mouthpiece 	<ul style="list-style-type: none"> ✗ Unhygienic ✗ Not entertaining
VO device Sella by Snelcal	Pneumatic principle (using mouth to force air into device)	<ul style="list-style-type: none"> -Combines the benefits of both CPAP therapy and airway vibrations -Guidance system: N/A -Improves clearance of secretions -Can accommodate virtually any patient's lung capacity 	<ul style="list-style-type: none"> ✓ Allows inhalation and exhalation without removing from mouth ✗ Unhygienic ✗ Not entertaining
VO device Sella GmbH & Co	Pneumatic principle (using mouth to force air into device)	<ul style="list-style-type: none"> -Adapter with mouthpiece -Guidance system: N/A -Reduces unproductive cough -Increases the vital capacity 	<ul style="list-style-type: none"> ✗ Unhygienic ✗ Not entertaining

<p>er by Ap ma US, Inc</p>	<p>Pneumatic prin (using mouth to f air into device)</p>	<p>-Mucus Clearance Device -Guidance system: audio -Provides PEP -Ability to vibrate the airways, intermittently increase endobronchial pressure, accele expiratory airflow -Changing inclinations makes higher or lower frequency</p>	<p>✗ Unhygienic ✗ For single patient use only</p>
<p>v breathin mika ia</p>	<p>Pneumatic prin (using mouth to f air into device)</p>	<p>-A type of intermittent hyperca hypoxic training -Guidance system: visual -Exposure to the short- hypoxia (the state of oxy deficiency) -Cures asthma, pneumo tuberculosis and helps with spo</p>	<p>✗ Unhygienic ✗ Not entertaining</p>
<p>erlung erLung Inc.</p>	<p>Pneumatic prin (using mouth to f air into device)</p>	<p>-Strength training techniques -Guidance system: N/A -Expanding lung capacity -Different models</p>	<p>✗ Unhygienic ✗ Not entertaining</p>
<p>-Ball nton, Barce fen oration)</p>	<p>Pneumatic prin (using mouth to f air into device)</p>	<p>-Volumetric/Spirometric Exerci -Guidance system: visual -Shows inspiratory volume</p>	<p>✓ Easy usage ✗ Unhygienic ✗ Not entertaining</p>
<p>e-ball nton, Barce fen oration)</p>	<p>Pneumatic prin (using mouth to f air into device)</p>	<p>-Restores and maintains capacity -Guidance system: visual?? -Enhances inspiratory expiratory muscles</p>	<p>✓ Easy usage ✗ Unhygienic ✗ Not entertaining</p>
<p>shold /IMT ironics chscan</p>	<p>Pneumatic prin (using mouth to f air into device)</p>	<p>PEEP -Designed for therapy with pos expiratory pressure -Guidance system: N/A</p>	<p>PEEP ✓ Promotes effective breat patterns improves gas exch and central and peripheral ai function.</p>

		<p>-PEEP therapy helps reducing amount of air that is trapped in lungs</p> <p>-Resistance is provided by spring-loaded valve</p> <p>-Forced pressure opens airways and helps mobilize secretions</p> <p>IMT</p> <p>-Provides consistent and specific pressure for inspiratory muscle strength and endurance training</p>	<p>✗ It is only meant for expiratory exercise</p> <p>✗ Unhygienic</p> <p>✗ Not entertaining</p> <p>IMT</p> <p>✓ Increases respiratory muscle strength and endurance</p> <p>✓ Increases exercise tolerance</p> <p>✗ Effects of IMT have not been adequately tested</p> <p>✗ Only meant to be used as inspiratory exercise</p>
Feedback Mental GmbH	Pneumatic principle (using mouth to blow air into device)	<p>-For functional disturbances of heart and cycles</p> <p>-Guidance system: visual, auditory</p> <p>-Influence on blood pressure</p>	<p>✗ Difficult to use</p>
D C2 by Engineering	Mechanic principle (measuring expansion)	<p>-12 channel capability</p> <p>-Guidance system: visual</p> <p>-Supports simultaneous monitoring of signals</p> <p>-More options for analyses (HRV, Respiration, Resistance...)</p>	<p>✓ Two people can use it at same time</p> <p>✗ Hard to use</p> <p>✗ Very expensive</p>
onica onica Tech	Pneumatic principle (using mouth to blow air into device)	<p>-It produces deep, resonant meditative sounds that can be vibrating in the lungs and sinuses</p> <p>-Guidance system: N/A</p> <p>-It is meant to promote airway clearance, oxygenation and strengthening of respiratory muscles</p>	<p>✓ Usage does not require much skill</p> <p>✓ Activation of diaphragm breathing</p> <p>✗ Forcing air</p> <p>✗ Detaining water inside device usage</p> <p>✗ Unhygienic</p>
by Alvio	Pneumatic principle (using mouth to blow air into device)	<p>-An all-in-one breathing training symptom tracker and mobile app controller</p> <p>-Guidance system: visual</p>	<p>✓ Wirelessly communication phones/tablets</p> <p>✓ Cloud sharing information</p> <p>✗ Forcing air</p>

		-Controlling a video game or smartphone or tablet	<ul style="list-style-type: none"> ✗ Unhygienic ✗ Danger for open mouth breathing
Controlled by Respiration	Pneumatic principle (using mouth to force air into device)	<ul style="list-style-type: none"> -For preventing or reducing asthma attacks -Guidance system: visual -Disposable mouth tube -Proper body posture -Smartphone laser sensors -GPS for ascertaining dangerous areas for asthmatics -Analyzed data sent to physician 	<ul style="list-style-type: none"> ✓ Linked to smart phone ✓ Hygienic ✗ Forcing air ✗ No positive side effects (relaxation, longer exhalation)
Controlled by Time	Pneumatic principle (using mouth to force air into device)	<ul style="list-style-type: none"> -For promoting deep, rhythmic breathing to increase oxygen levels -Guidance System: visual -Scientifically engineered -Comes with an application -Sharing experiences on social media -Dongle is connected via bluetooth 	<ul style="list-style-type: none"> ✓ Lightweight dongle ✗ Unhygienic use (you hold device with bare hands) ✗ Water collecting on the device
Controlled by Spiro	Pneumatic principle (using mouth to force air into device)	<ul style="list-style-type: none"> -Mobile spirometer -Guidance System: visual -Connected, ultraportable flow meter -Measures how much air is passing out of users' lung -My Spiroo Pro: version for doctors to see patients data -My Spiroo Home: version for patients 	<ul style="list-style-type: none"> ✓ For assessing what is causing bronchial flare-up ✗ Unhygienic
Controlled by Zephyr	Pneumatic principle (using mouth to force air into device)	<ul style="list-style-type: none"> -For disabled people or hands -Mobile phone makers -Guidance system: visual -Senses pressure variations -The chip into which user exhales 	<ul style="list-style-type: none"> ✓ Chipset can be integrated into hardware (mp3 players, phones, laptops) ✓ Fun

			<ul style="list-style-type: none"> ✗ Non-medical purpose (does not describe how should people improve breathing) ✗ Dizziness if one breaths incorrectly
by Arshad gi	Pneumatic principle (using mouth to force air into device)	<ul style="list-style-type: none"> -Exhales with varying intensities for converting them into electrical signals -Guidance system: visual -Signals processed by microprocessor (Morse engine) -Morse code: converting signals into words 	<ul style="list-style-type: none"> ✓ For people with developmental disabilities ✗ Not entertaining ✗ Non-medical purpose (does not describe how should people improve breathing)
erbreather erbreather	Pneumatic principle (using mouth to force air into device)	<ul style="list-style-type: none"> -Inspiratory Muscle Trainer -Guidance system: N/A -For strengthening the muscles used to breathe -Optimisation of airflow -3 variable resistance levels 	<ul style="list-style-type: none"> ✓ Suitable for beginners ✗ Not entertaining ✗ Mostly designed for athletes
THING+ hingLabs	Non-contact/pneumatic principle (using mouth to force air into device)	<ul style="list-style-type: none"> -Making exhalations longer and more efficient - Guidance system: Visual and auditory - operates on Android, Windows and Mac devices -Includes numerous "breathing games" and accessibility tools for pulmonary rehabilitation -Clinically tested "Pursed Lip Breathing" technique 	<ul style="list-style-type: none"> ✓ Fun, entertaining ✓ Medical purpose ✓ Non-contact operation ✓ Realtime feedback ✓ Progress tracking ✗ Does not operate standalone requires phone or computer to operate

4 OUR PRODUCTS

4.1 Breathing Games

Breathing games are based on a breathing technique called Pursed Lip Breathing and they are designed to train kids to exhale longer. Breathing games run on computers and

mobile devices. Breathing guidance is being provided and breathing rate is being monitored.

4.2 Breathing Toys

Breathing Toys are electronic toys that are played with your breathing exercise implementation and offer the excitement of real life interaction of two competitive players.

4.3 Breathing Video

Breathing Video is a tool to improve breathing by watching television. It is designed to most efficiently reduce users' breathing rate. It does so by synchronising video content with the act of exhaling through pursed lips. It has been tested against the control group and it showed a consistent improvement in breathing rate reduction in less than 5 minutes of use.

4.4 Breathing Scrolling

Breathing Scrolling is a new healthy way to scroll websites or pdf documents - without using computer mouse or keyboard. Just blow into the headset to scroll any website or pdf document. Scrolling speed can be adjusted to your preference. Breathing scrolling is available as a Chrome extension on Google Chrome browser or as a bookmarklet that can be easily dragged and dropped into bookmarks bar in other web browser.

4.5 Breathing Headset

BREATHING+ headset is built out of soft and comfortable polyethylene plastic. It is adjustable for different head sizes, durable and washable. It is designed to provide maximum comfort and best possible PLB detection in a quiet or loud environment. Additionally BREATHING+ headset provides hands-free operation, firm position in front of mouth and a superb signal-to-noise ratio resulting in the most accurate breathing detection.

4.6 Abs Trainer

Breathing Labs Abs Trainer is a neuromodulated electrical muscle stimulator for functional recruitment of abdominal muscles. It is a clinical product that uses electrical muscle stimulation (EMS, TENS) during exhalation to train abdominal muscles for more efficient breathing and more powerful movement.

5 ADVANTAGES

5.1 Comparison with other technology for breathing exercises (table 1)

- ❑ Blowing air into the mouthpiece does not require a physical contact with users' mouth or lips, therefore it provides less possibilities for infection.
- ❑ It is not required to use tubes or pipes to achieve resistance during exhalation as kids eventually learn to provide such a resistance by exhaling through pursed lips
- ❑ Breathing games provide an enhanced motivation and lead to a more efficient learning process that keeps kids entertained and motivated as they practice
- ❑ Audio feedback allows kids to perform exercises with their eyes closed, resulting in a more relaxing experience
- ❑ Breathing games make kids track their breathing progress which improves commitment and provides a more efficient long term learning process
- ❑ Users eventually learn to implement exhalation through pursed lips into their daily routine and thus change their breathing behavior without raising dependence on technology or drugs. Such a behavior can already be observed in humans, for example when a person exhales through pursed lips as a sign of relief.

5.2 Comparison with other game controllers (keyboard, mouse, joystick, touchpad)

Typing on a keyboard/mouse or on screen causes tension in hands and upper back resulting in a tense posture and possibly leading to injuries like “carpal tunnel syndrome”. Thus kids start breathing shallow, with upper parts of their lungs which is leading to shortness of breath and low oxygenation. With breathing games kids learn to breathe deeper and slower and also improve speaking skills so they consequently become more assertive, confident and socially active.

5.3 SWOT - Strengths, Weaknesses, Opportunities, Threats

Strengths	Weaknesses
<ul style="list-style-type: none"> ❑ video games enhance motivation which leads to greater compliance of breathing exercises ❑ better hygiene due to non-invasive detection of breathing ❑ improves breathing without raising dependence on technology (because user provides pressure by exhaling through pursed lips and not by exhaling into a tube or pipe) ❑ higher long term motivation due to weekly new breathing games on Android, iOS, Windows and Mac devices 	<ul style="list-style-type: none"> ❑ cannot be used standalone, requires mobile phone or personal computer to work ❑ kids under 7 years should be assisted by their parents, caregivers or respiratory physiotherapist
Opportunities	Threats
<ul style="list-style-type: none"> ❑ healthier way to use computers, for example “breathing scrolling” or “breathing television” ❑ improves speaking and singing skills ❑ “breathing scrolling” may reduce repetitive strain injuries such as carpal tunnel syndrome 	<ul style="list-style-type: none"> ❑ drink water before and after exercise to prevent dehydration ❑ short-term dizziness is possible, in that case user should rest between breaths and after exercise

6 EXPERT OPINIONS

6.1 American Lung Association

"Keep using the pursed-lip breathing until the breathless feeling goes away. Rest in between breaths if you feel Dizzy. Give sips of room temperature water."

6.2 Cleveland Clinic

"Pursed lip breathing is one of the simplest ways to control shortness of breath. It provides a quick and easy way to slow your pace of breathing, making each breath more effective."

6.3 University of Iowa Children's Hospital

"Pursed lip breathing helps you use less energy to breathe. It can help you relax. When you are short of breath, it helps you slow the pace of your breathing and can help you feel less short of breath."

6.4 The Ohio State University Medical Center

"Pursed Lip Breathing keeps airways open longer during exhalation. This helps release trapped air from your lungs and allow fresh air to come in. Practise PLB while you are resting so you can use this technique when you are feeling short of breath."

6.5 University of Minnesota Medical Center

"Inhaling through the nose and exhaling through pursed lips makes breathing easier. Pursed-lip breathing can also help you regain control if you're having trouble catching your breath. You can practice breathing this way anytime, anywhere. If you're watching TV, practice during the commercials. Try to practice several times a day. Over time, pursed-lip breathing will feel natural."

6.6 University Health Service, University of Michigan

"Pursed-lip breathing helps you breathe more air out so that your next breath can be deeper."

6.7 Vanderbilt University Medical Center

"Pursed-lip breathing can help you get more oxygen into your lungs when you are short of breath. When you start to feel short of breath, use pursed-lip breathing to control

your breathing. Breathing in through the nose and exhaling through pursed or closed lips makes breathing easier.”

6.8 UTMB, The University of Texas

“It is often helpful to have a patient with asthma or COPD exhale through "pursed lips," a maneuver that increases resistance to exhalation at the mouth. This maneuver is believed to transmit an early expiratory back pressure to the bronchial tree and the back pressure is believed to prevent early collapse of small bronchioles and improve exhalation from alveoli (specifically COPD patients).”

6.9 American Thoracic Society

“Pursed-lip breathing attempts to prolong active expiration through half-opened lips, thus helping to prevent airway collapse. Compared with spontaneous breathing, pursed-lip breathing reduces respiratory rate, dyspnea, and PaCO₂, while improving tidal volume and oxygen saturation in resting conditions.

7 CONTACT AND MORE INFORMATION

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