BUTEYKO INSTRUCTOR TRAINING MANUAL

BUTEYKO CLINIC
INTERNATIONAL

To all Buteyko Instructors who I have had the privilege to work with over the years; thank you.
A special thanks to Dr Jane Wyler Harper for proof reading and editing this manual.

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DEAR BUTEYKO INSTRUCTOR

Thank you for joining our instructor training.

This manual contains the theory and practical information you need to teach the Buteyko Method to all client groups, regardless of age, state of health and control pause. Each section of the manual is supported with videos, which you will find in the Instructor Training Portal.

The most important information in the manual is:

- Instructor script: A script containing all the exercises for children, teenagers and adults
- The section titled *Teaching Children and Teenagers*: This contains the protocol, guidelines, exercises and format for teaching young people
- Classes 1 to 4 cover respiratory physiology. This involves an examination of breathing pattern disorders, guidelines for teaching and further protocols for teaching children
- The section titled *Further Material* provides information about the link between breathing patterns and women's breathing, asthma, sleep disordered breathing and anxiety

There is a lot of information in this manual. Work through it in your own time. In order to help you direct your attention, I suggest the following roadmap:

Step 1: Read through the script of exercises and the children's protocol. Practice teaching the exercises by reading from the script to family and friends.

Step 2: Recordings of past live zoom classes are available from your online training portal.

Step 3: To prepare for the exam, watch the two-hour video titled *Essential Exam Preparation Video*.

Step 4: Begin the exam. To complete the multiple-choice exam and download the case studies template, log in to the online Instructor Portal and click on the EXAM AND CASE STUDIES tab. The exam must be submitted in one sitting. If you do not pass the first time, please try again until you do. You will receive your exam result within a few minutes.

Please follow the instructions to submit your case studies on your online training portal. If you have any questions about this or the exam please contact us at certify@buteykoclinic.com

Step 5: Ongoing follow-up support and training is available via my live online Zoom classes. Dates, times and Zoom links are available in your Instructor Training Portal.

I look forward to welcoming you to our growing international network of Buteyko Instructors.

Patrick McKeown

DEFINITIONS

PaO_2: partial pressure of oxygen in the blood.

SpO_2: percentage of oxygenated hemoglobin versus total hemoglobin in arterial blood.

Blood is made up of three parts: oxygen-carrying red cells, white blood cells and plasma.

Hemoglobin is a protein found within the red cells and allows seventy times more O_2 to be carried in the blood.

Normoxia: normal levels of oxygen (SpO_2 95 to 99 percent).

Hypoxia: deficiency in the amount of oxygen entering the tissues (SpO_2 less than 91 percent).

Hyperoxia: when cells, tissues and organs are exposed to higher than normal partial pressure of oxygen.

Normocapnia: normal arterial CO_2, which is about 40 mm Hg.

Hypocapnia: below normal arterial CO_2, which is less than 37 mm Hg (recent figure is 35 mm Hg).

Hypercapnia: abnormally elevated levels of CO_2, which is levels greater than 45 mm Hg.

Tidal volume: the normal volume of air entering the lungs during one inhale at rest.

Respiratory rate: The number of breaths usually calculated per minute.

Minute ventilation: the volume of air that enters the lungs over one minute.

ABBREVIATIONS

ADHD	Attention deficit and hyperactivity disorder
AG	Asthma Group
AHI	Apnea Hypopnea Index
AT	Adenotonsillectomy
BBT	Buteyko breathing technique
BHT	Breath holding time
bpm	Beats per minute
CART	Capnometry assisted respiratory training
CF	Cystic Fibrosis
CHVS	Chronic hyperventilation syndrome
DAC	Dry air challenge
DB	Dysfunctional breathing
ENS	Empty nose syndrome
ESS	Epworth Sleep Scale
ET CO_2	End tidal CO_2
FEO_2	Fraction of expired O_2
FET CO_2	Fraction of expired CO_2
FHP	Forward head posture
FVC	Forced vital capacity
HRV	Heart rate variability
HUAR	High upper airway resistance
HVPT	Hyperventilation provocation test

HVS	Hyperventilation Syndrome
IASP	International association for the study of pain
IFL	Inspiratory flow limitation
MB	Mouth breathing
MBG	Mouth breathing group
MBS	Mouth breathing syndrome (>6months duration)
NO	Nitric oxide
NOSE	Nasal Obstruction Symptom Evaluation
NQ	Nijmegen symptom questionnaire
OSA	Obstructive sleep apnea
OSAS	Obstructive sleep apnea syndrome
Pcrit	Pharyngeal critical closure pressure
PD	Panic disorder
$PETCO_2$	Pressure End Tidal CO2
POP	Porous oral patches
PSG	Polysomnography
Rn	Nasal airway resistance
SaO_2	The percentage of how much hemoglobin is saturated with oxygen.
SDB	Sleep disordered breathing
SEN	Special educational needs

SNOT-22	Sino-nasal outcome test
T&A	Tonsillectomy and adenectomy
TMD	Temporal mandibular joint disease
UA	Upper airway
UBB	Upper Body Breath
VAS	Visual analogue scale
VE L/min	Minute Ventilation
Minute Ventilation	Respiratory Rate * Tidal Volume= Minute Ventilation
VO_2 max	The maximum amount of oxygen a person can utilize during physical exercise

BUTEYKO CLINIC EXERCISES

Ex 1

Nose unblocking exercise

Ex 2

Breathe Light to create air hunger

- Variation A: Hands On Chest And Tummy
- Variation B: Feather Breathing
- Variation C: Hands Cupping Face
- Variation D: Finger Blocking Nostril
- Variation E: Cadence Breathing (support with Buteyko Belt)

Ex 3

Breathe Light physical exercise

- Diaphragm (slow, light, deep)
- Finger blocking nostril

Ex 4

Walking with breath holds

- Increasing in increments of 5 paces

Ex 5

Steps exercise

- Breath hold to 10 paces
- Walking steps
- Running steps

Ex 6

Breathing recovery

Ex7

Mp3 Download

CATEGORIES OF CLIENT

1

Unwell, older person, CP less 10 seconds
Ex 2,3,6,7 (six by ten minute sessions daily)
Ex 6 if CP less than 10 seconds
Ex 5A (10 paces for severe asthma, COPD)

2

Sleep apnea, panic disorder, anxiety, high BP
Ex 2,3,6,7 (six by ten minute sessions daily)
Ex 2 Diaphragm (light, slow, deep)
Ex 5A (10 paces for panic disorder, anxiety)

3

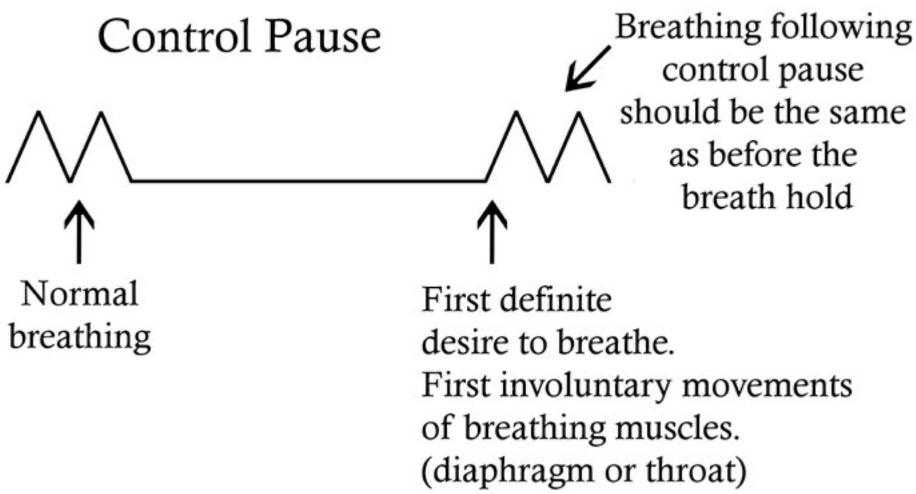
Teenagers, children
Ex 1, 3, 5, 6 (Ex 5: 12 to 18 reps daily)
Anxiety (Ex 2 Diaphragm (light, slow, deep))
Severe asthma (Ex 5 with breath control)

4

Adult in relatively good health
Any of the exercises

INSTRUCTOR SCRIPT

MEASUREMENT FOR ADULTS:

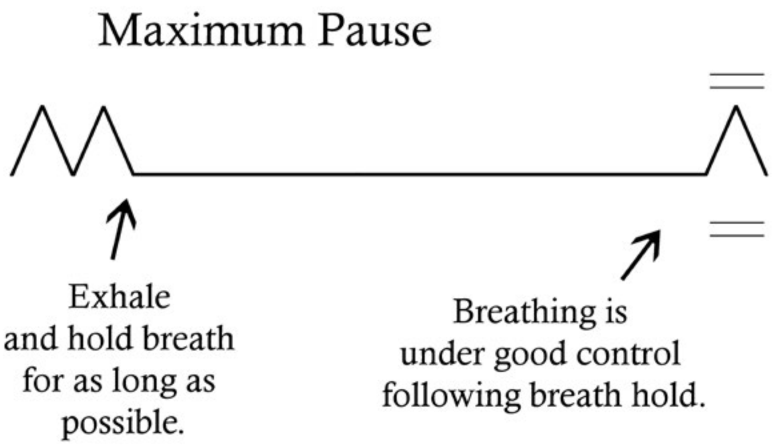


CONTROL PAUSE (CP)

- Take a normal breath in and out through your nose;
- Pinch your nose with your fingers to hold your breath;
- Time the number of seconds until you feel the first definite desire to breathe, or the first involuntary movements of your breathing muscles;
- Following the Control Pause, the first breath should be the same as prior to the measurement.

MAXIMUM PAUSE

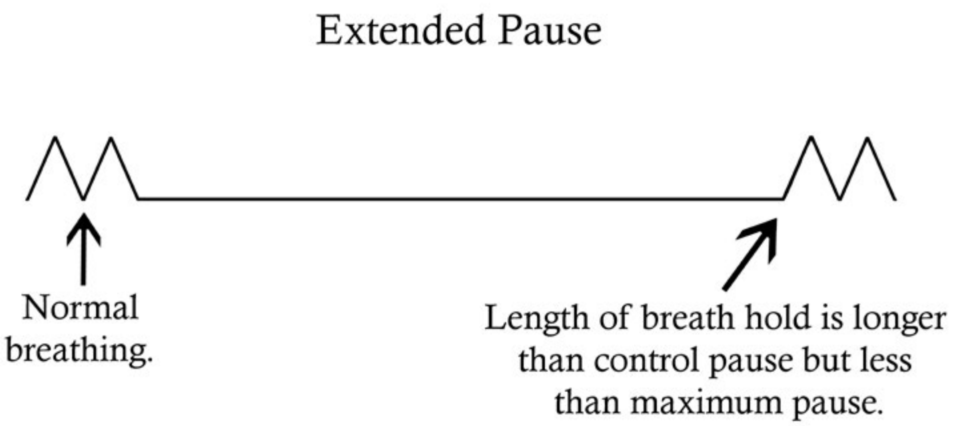
The maximum length of time that you can hold your breath following a normal exhalation. Breathing must be under good control following resumption of breathing.



- Take a normal breath in and out through your nose;
- Pinch your nose with your fingers to hold your breath;
- As you hold your breath, sway your body from side to side;
- When the air hunger is maximum, let go of your nose and breathe in through it;
- Note the maximum length of time that you can hold your breath;
- Following the Maximum Pause, breathing must be under good control.

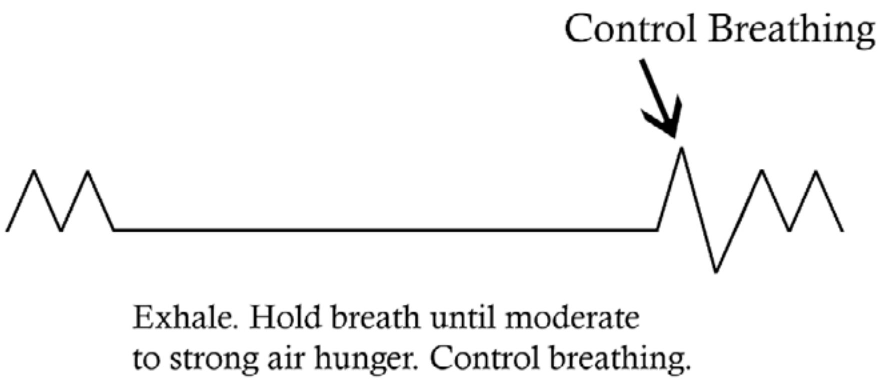
EXTENDED PAUSE

Anything greater than the Control Pause but less than the maximum pause.
For example, if the Control Pause is 10 seconds and the maximum pause is 20 seconds, then an extended pause is 15 seconds.



ADULT MEASUREMENTS	CP (sec)	MP (sec)	STEPS SCORE
Main symptoms are present: Cough, wheeze, exercise induced bronchoconstriction, nasal congestion, snoring, feeling of air hunger, frequent sighing, frequent yawning, cold hands and feet etc.	10 20	20 40	20- 40 40-60
Main symptoms are significantly reduced. A trigger could bring on symptoms.	30 40	50 60	60-80 80+

MEASUREMENT FOR CHILDREN



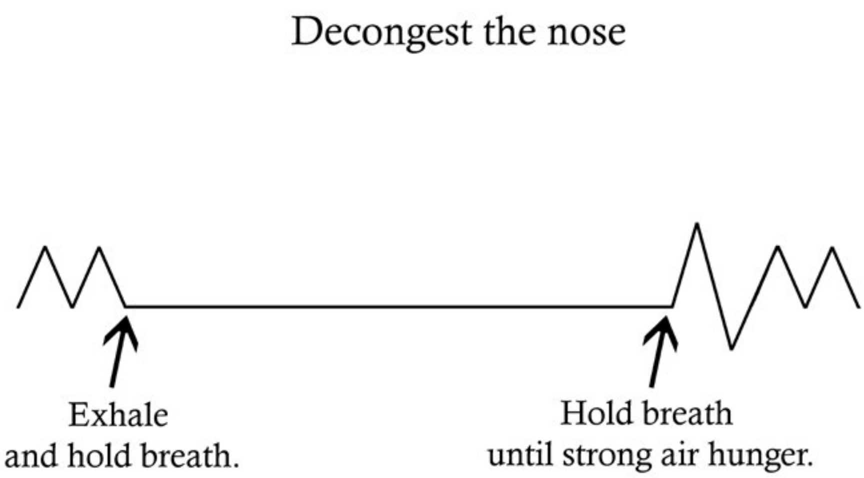
STEPS SCORE

- Take a gentle breath in through the nose;
- Allow a gentle breath out through the nose and pinch the nose with fingers to hold the breath;
- Ask the child to walk as many paces as they can until they feel a relatively **strong urge** to breathe. Count aloud every ten paces and see if they can beat their previous score each time;
- When they breathe in, it must be through their nose and breathing must be calmed immediately;
- *Note the total number of steps walked while holding the breath. (track via the ButeykoClinic app available in Android or iTunes)*

CHILD MEASUREMENTS	
AGE OF CHILD	STEPS SCORE GOAL
5 TO 7 YEARS	50-60 PACES
8 TO 9 YEARS	60-70 PACES
10 YEARS PLUS	80 PACES

EXERCISE 1: DECONGEST THE NOSE

First, check which side of the nose is more congested. Ask the student to block one nostril with a finger and breathe through the other. Then switch nostrils. This provides feedback as to how congested or decongested each side of the nose is. It is normal for one side to be more congested than the other. The instructor should listen for signs of nasal obstruction.



To decongest the nose, instruct the student to perform the following:

- *Take a normal breath in and out through your nose;*
- *Pinch your nose with your fingers to hold your breath;*
- *As you hold your breath, move your body or gently nod your head up and down;*
- *Hold your breath for as long as you can – until you feel a strong air hunger;*
- *Let go of your nose and breathe through it as calmly as possible.*

Repeat 6 times with a 30-60 second rest between each repetition.

Take care, as this exercise involves holding the breath until a strong air hunger is experienced. It is not suitable for people with high or low blood pressure, anxiety, panic disorder or cardiovascular issues, or during pregnancy.

To decongest the nose, the breath hold must be at least 30 seconds to be effective. The exercise also works to shift mucous from lungs and relieve constipation. If nostrils are very narrow, Breathe Right strips or nasal dilator (see: NasalDilator.com) can be advised during sleep.

If the nose still feels stuffy after practicing Exercise 1, then practice six repetitions of Exercise 5 (Steps) to create a strong air hunger.
After practicing 6 repetitions of Exercise 1 and Exercise 5, check if the student can breathe through their nose for one minute. The rule of thumb is that if you can breathe through your nose for one minute, you can breathe through your nose for life.

EXERCISE 2: BREATHE LIGHT

All Breathe Light exercises should be practised with mouth closed, correct tongue posture, lips together, jaws relaxed, breathing in and out through the nose. In addressing breathing pattern disorders, hyperventilation or dysfunctional breathing (terms are interchangeable), three dimensions are targeted:

Biochemistry: Reduce the chemosensitivity of the body to the build-up of carbon dioxide. (Breathe Light)
Biomechanics: Breathe using greater amplitude of the diaphragm. (Breathe Low)
Cadence or paced breathing: Stimulate vagus nerve and exercise baroreceptors with cadence of six breaths per minute. (Breathe Slow)

There are a number of variations to this exercise:
a. Hands on chest and tummy (biochemical)
b. Feather breathing (biochemical)
c. Hands cupping face (biochemical)
d. Finger blocking nostril (biochemical)
e. Cadence breathing to six breaths per minute (biochemical, biomechanical, cadence)
f. Listening to the relaxation MP3 downloadable from Buteykoclinic.com/reduced-breathing

Using Buteyko Belt - especially for those who have difficulty slowing down their breathing.

Use the acronym **PAST** for all variations:
Posture (same for all variations)
Awareness (same for all variations)
Slow down breathing/**Short** breath in
Tolerable air hunger (same for all variations)

NOTES:

Awareness of the breath is very important in order to improve breathing patterns. Only when people can see, feel, hear or follow their breath can they change it. By focusing on the area just inside the nose it is easier to soften breathing without tensing the body or deliberately interfering with breathing muscles. To help the students' awareness of their breathing, the instructor can move their hand in synchronization with the student's breath, repeating the words: *"There is your breath in, and there is your breath out."*

It may also help to ask the student to draw his or her breathing pattern across a page as they breathe. The student follows their breathing pattern, their inspiration and expiration and draws this across the page. In order to draw it, one must be able to follow and focus on the breath. In general, most people are able to follow and concentrate on their breathing pattern. However, older students or those with anxiety or a lot of mind activity may find it difficult to focus on their breath. Overly analytical people can also sometimes have difficulty following their breathing.

Awareness of breathing is important to make changes to breathing. Sometimes, it can take a couple of sessions for the student to become aware of their breathing. Wearing the Buteyko Belt can help, as it exerts a resistance to breathing muscles and brings focus to the area around the diaphragm. When the student is aware of their breath, proceed to slowing down or shortening the breath.

Slow down breathing/**Short** breath in. The goal is to allow breathing to soften, to slow down and reduce breathing using thoughts and concentration. Breathing volume should be reduced through a combination of relaxation and encouraging thoughts, not by tensing the breathing muscles.

Tolerable air hunger

With Exercise 2, students are sometimes confused with the following issues:

How much air hunger to achieve during the exercise?
How to remain relaxed while creating a hunger for air?

The air hunger felt during Exercise 2 should be similar to the air hunger achieved while measuring the Control Pause. If the air hunger is too much, the respiratory centre in the brain reacts to the build-up of carbon dioxide and sends increased signals to breathe. You are looking for the sweet spot; to achieve a degree of air hunger just below the point where the brain reacts; to be on the verge of disrupting your breathing rhythm, but not going beyond it.

When the air hunger is too much, the brain increases the signals to the diaphragm and intercostal muscles to breathe. This causes involuntary contractions of the breathing muscles, resulting in loss of breath control. If this occurs, take a rest for 15-20 seconds and begin again. With practice, it becomes easier to sustain the air hunger for longer periods of time.

Some persons prone to anxiety or panic disorder have a strong fear response to air hunger. It is important to regularly monitor their reaction to the air hunger every fifteen seconds or so. If they have a strong reaction to air hunger, then limit exercises to:
Ex 6: many small breath holds
Ex 5a: walk while holding breath for 5 to 10 paces
Ex 2: reduced volume breathing to create tolerable air hunger for 15 to 20 seconds at a time.

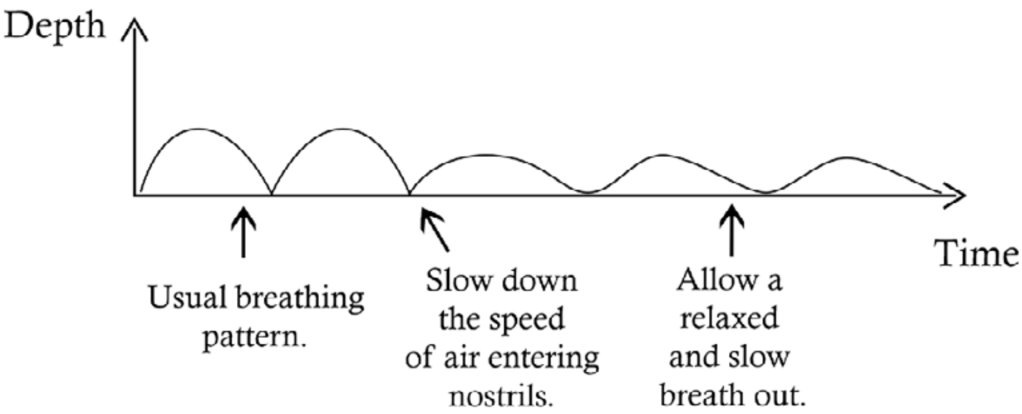
Request your student not to practice any exercises involving a strong air hunger or long duration of air hunger.

While there are a number of ways to describe the feeling of air hunger, students can interpret it differently. Some may feel they are not getting enough air. Others may feel that they would like to take in a deeper breath.

The signs to look out for while doing Exercise 2:

- Eyes go glassy
- Increased saliva in mouth
- Nose may run
- Hands get warm
- Some people feel sudden calmness, others may feel slight panic
- Instructor should see a reduction to breathing volume of their student. This is very important. Students might tell you they have air hunger. The instructor needs to be sure- by seeing less breathing movement of the student.

VARIATION A: HANDS ON CHEST AND TUMMY



After breathing in slow and light, the breath out should be very slow and relaxed. The breath out should be unforced, passive, gentle and about 1.5 times the length of the breath in. The breath in during rest is active, and the breath out is passive. Encourage the student to allow the exhalation to happen naturally.

Posture:
"Place your hands on your chest and tummy, or on your lap. I would like you to sit up straight so as not to compress the diaphragm. Imagine there is a piece of string pulling you upwards from the top of the back of your head towards the ceiling. Lengthen the distance between your navel and sternum. Widen the distance between your ribs."

Awareness:
"Pay attention to your breathing. I would like you to notice the slightly colder air coming into the nose and the slightly warmer air leaving the nose. Look down at your breathing. Can you see your breathing? Feel your breathing. Feel the slightly colder air as it enters your nostrils, and feel the slightly warmer air as it leaves your nostrils. Really concentrate on your breathing. Use this as a measure of your concentration. For how long can you hold your attention to your breathing before the mind wanders? If the mind is wandering a lot, you will get even more from this exercise. Keep bringing your attention back to your breathing. Feel the

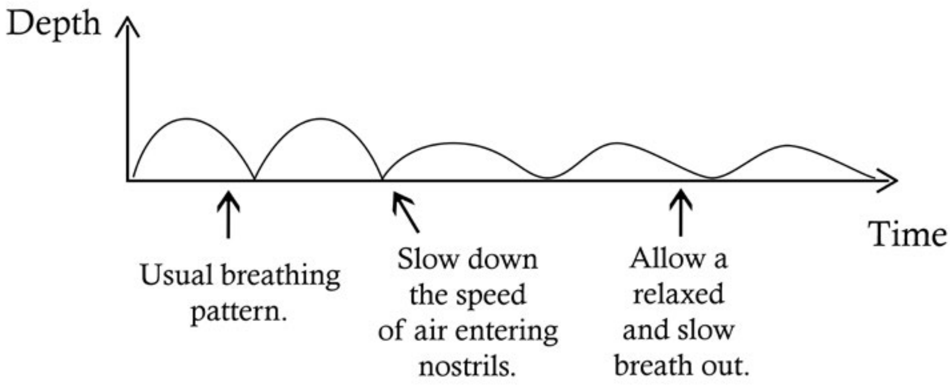
slightly colder air entering your nostrils, and feel the slightly warmer air leaving your nostrils."

Slow down your breathing:
"I would like you to slow down the speed of air as it enters your nostrils. Breathe so gentle that hardly any air enters your nose. Breathe so soft that the fine hairs within the nose do not move. Take a slow, light breath in through your nose. As you breathe out, bring a feeling of relaxation throughout your body. After you breathe out, wait until you feel the need to take a breath in again. Then take a soft, slow, gentle breath in. At the top of the breath, allow a relaxed slow gentle breath out. I would like you to really concentrate on slowing down your breathing so that you are taking less air into your body. Don't hold your breath or interfere with your breathing muscles. Instead, soften your breathing so that the amount of air you are taking into your body is less than what it was before you started."

Tolerable air hunger: *"The goal is to create a feeling that you would like to take in more air; to feel an air hunger. To create air hunger, your breathing now should be less than what it was before you started. I need you to feel a want for air; a feeling that you would like to take in a deeper breath. I would like you to feel slightly suffocated*. If your breathing muscles contract or if they start to feel tense, then the air hunger is too strong. When this happens, take a rest for 15 seconds and start again. It is normal at the beginning to take a rest a few times during the exercise. With practice, it becomes easier to sustain the air hunger for longer periods of time. Soften your breath to the point of air hunger."*
[*People don't like the word suffocated but they get it!]

Continue to repeat the sentences for (slow down your breathing, tolerable air hunger) for four to five minutes or so.

VARIATION B: FEATHER BREATHING (TRADITIONAL BUTEYKO EXERCISE)



Posture:
"Imagine there is a piece of string pulling you upwards from the top of the back of your head towards the ceiling. Lengthen the distance between your navel and sternum. Widen the space between your ribs."

Awareness:
"Place your finger underneath your nose so you can monitor the airflow from your nose. This will give you feedback about your breathing. Bring your attention to the airflow on your finger. Can you feel the warm air as it flows onto your finger? There is no need to place your attention on the movement of your chest and tummy. Instead focus on the airflow on your finger. Really concentrate on the warm air as it leaves your nostrils and blows onto your finger."

Slow down your breathing:
"As you feel the warm air on your finger, gently slow down your breathing. Take a soft breath in through your nose and allow a gentle and prolonged breath out. Breathe so softly that you feel hardly any air blowing onto your finger. Imagine that your finger is a feather, and that your breathing is so soft that the feather doesn't even flutter. Slow down the speed of air leaving your nostrils. The objective is to slow down your breathing so that you feel hardly any air leaving your nose.

There is no need to hold your breath or try to restrict your breathing. There is no need to deliberately interfere with your breathing muscles. Instead, allow your breathing to soften by concentrating on the warm air as it flows onto your finger. The more warm air you feel, the harder you are breathing. Can you quieten and soften your breathing to the point where you feel hardly any air on your finger?"

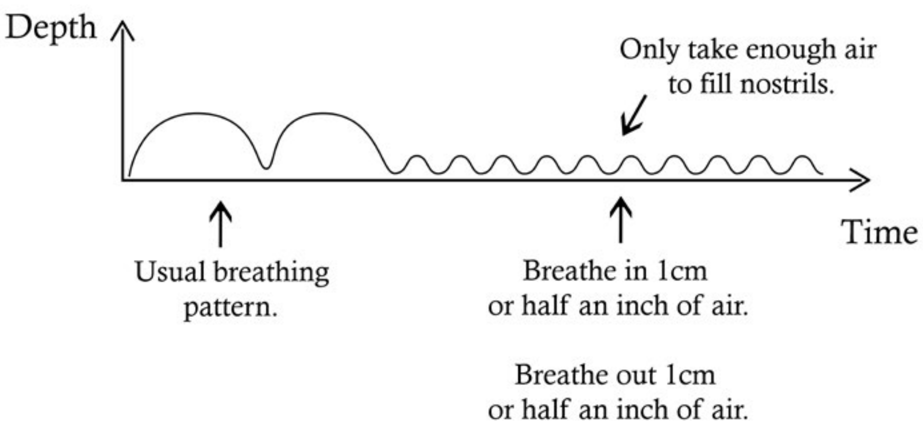
Tolerable air hunger:

"The amount you are breathing during the exercise should be less than it was before the exercise. You are doing the exercise correctly if you feel a tolerable need for air. I need you to feel like you want to breathe in more air.

The need for air should be tolerable both during the inhalation and exhalation. As you reduce the volume of air that you breathe, it is normal to feel a slight tension of your diaphragm breathing muscle. If you find you are experiencing involuntary contractions of the diaphragm, then the need for air is too much. With practice, the goal is to maintain a tolerable air hunger for 4 to 5 minutes."

Repeat the sentences for Slow down your breathing and Tolerable air hunger for around four to five minutes.

VARIATION C: HANDS CUPPING FACE



Posture: *"I would like you to sit up straight so as not to compress the diaphragm. Imagine there is a piece of string pulling you upwards from the top of the back of your head towards the ceiling. Lengthen the distance between your navel and sternum. Widen the distance between your ribs."*

Awareness: *"I would like you to cup your hands against your face. Have hardly any gaps between your fingers. This serves two purposes. Firstly, the hands provide good feedback of your breathing volume. Use the hands as a barometer of breathing. The greater the amount of warm air you feel coming into your hands, the harder you are breathing. Feel the warm air as it enters your hands. Cupping the hands pools carbon dioxide. As you breathe in, a higher pressure of carbon dioxide is brought into your lungs. This will help to create a feeling of air hunger."*

Short breath in and out: "*I would like you to take a short breath in through your nose. With your hands cupping your face, only breathe 1cm, or half an inch of air into your nose. Then breathe out 1cm. Breathe just enough air to fill your nostrils and no more. Take a tiny breath into your nose and allow a tiny breath out through your nose. It is almost as if you are hardly breathing at all. Take a flicker of air into your nostrils and no more. As the breath in is tiny, the breath out will also be tiny."*

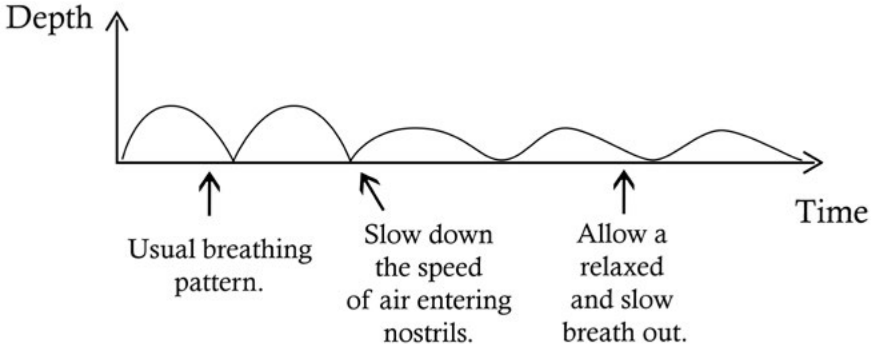
Tolerable air hunger: *"The goal is to create a feeling that you would like to take in more air; to feel an air hunger. To create air hunger, your breathing now should be less than what it was before you started. I need you to feel a want for air; a feeling that you would like to take in a deeper breath. I would like you to feel slightly suffocated*.*
The goal is not to pant. The goal is to reduce the tidal volume or the size of each breath so that less air enters the body. If your breathing muscles contract or if they start to feel tense, then the air hunger is too strong. When this happens, take a rest for 15 seconds and start again. It is normal at the beginning to take a rest a few times during the exercise. With practice, it becomes easier to sustain the air hunger for longer periods of time. Soften your breath to the point of air hunger."
[*People don't like the word suffocated but they get it!]
Continue to repeat for four to five minutes.

The student will feel air hunger straight away with this exercise. If the air hunger is too much, then encourage them to breathe a little more air into their nose.

This exercise will involve shallow breathing with the feeling of air hunger. As with all variations of Exercise 2, the aim is to reduce the sensitivity of the body to carbon dioxide. Exposing the body to a feeling of air hunger may also help to change the student's perception of breathlessness.

VARIATION D: FINGER BLOCKING NOSTRIL

The purpose of this exercise is to concentrate total airflow through one nostril. This helps to increase breathing awareness.



Posture: *"I would like you to sit up straight so as not to compress the diaphragm. Imagine there is a piece of string pulling you upwards from the top of the back of your head towards the ceiling. Lengthen the distance between your navel and sternum. Widen the distance between your ribs."*

Awareness: *"Block one of your nostrils with your finger. It doesn't matter which nostril you block. It can be your free or partially congested nostril. Feel the slightly colder air coming into your nose and feel the slightly warmer air leaving your nose. Blocking one nostril helps to concentrate air flow. This makes it easier to be aware of breathing. Pay attention to your breathing. I would like you to notice the slightly colder air coming into the nose and the slightly warmer air leaving the nose. Feel your breathing. Feel the slightly colder air as it enters your nostrils, and feel the slightly warmer air as it leaves your nostrils. Really concentrate on your breathing. Use this as a measure of your concentration. For how long can you hold your attention to your breathing before the mind wanders? If your mind is wandering a lot, you will get even more from the exercise. Keep bringing your attention back to your breathing. Feel the slightly colder air entering your nostrils, and feel the slightly warmer air leaving your nostrils."*

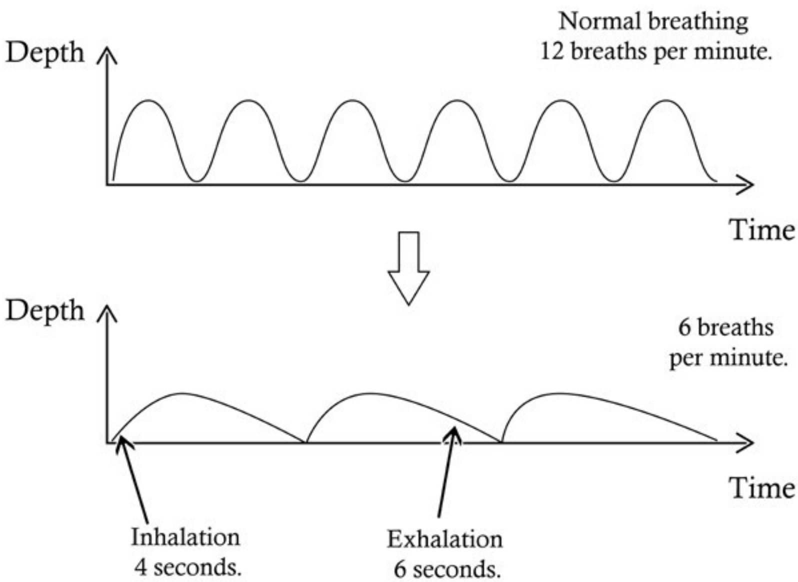
Slow: *"Slow down the speed of air entering into your nostrils. Breathe so softly that you cannot hear your breathing. Breathe so softly that the fine hairs within the nose do not move. Breathe so quietly that you feel hardly any air entering your nose. At the top of the breath, bring a total feeling of relaxation to the body and allow a relaxed, soft, slow, gentle breath out. Hide your breathing. I would like you to reduce your breathing movements by about 30%. It should be difficult for me to see your breathing. Calm your breathing. Quieten your breathing.*
Don't hold your breath. Don't freeze your breathing. Don't tense your breathing muscles, or restrict your breathing to reduce the amount of air you are taking into your body. Instead, soften your breathing so that the amount of air you are taking into your body is less than what it was before you started. "

Tolerable air hunger: *"The goal is to create a feeling that you would like to take in more air; to feel an air hunger. To create air hunger, your breathing now should be less than what it was before you started. I need you to feel a want for air; a feeling that you would like to take in a deeper breath. I would like you to feel slightly suffocated*. If your breathing muscles contract or if they start to feel tense, then the air hunger is too strong. When this happens, take a rest for 15 seconds and start again. It is normal at the beginning to take a rest a few times during the exercise. With practice, it becomes easier to sustain the air hunger for longer periods of time. Soften your breath to the point of air hunger."*
[*People don't like the word suffocated but they get it!]

Continue to repeat the sentences for (slow down your breathing, tolerable air hunger) for four to five minutes or so.

VARIATION E: CADENCE BREATHING

(Note: This is not part of the Buteyko Method, as Dr. Buteyko did not agree with counting the respiratory rate or timing breathing. The reason for this is because timing the breath can lead to an increase to minute ventilation. While timing the rate of breathing, ensure that breathing is slow (less breaths per minute), light (tolerable air hunger) and deep (diaphragmatic). A three legged stool will not stand up on two legs. Breathing also has three legs- biochemical, biomechanical and cadence.)



Slow, Light and Deep

Instruction:

"I would like you to place your hands at either side of your lower two ribs (or use Buteyko Belt). Feel the area of your diaphragm. As you breathe in, feel your ribs expanding outwards. As you breathe out, feel your ribs moving inwards.

As you breathe in, feel your ribs expanding outwards. You might also feel your tummy moving out. Don't push or pull the movements. Allow it to happen. Guide the movements with your mind.

Now I would like you to breathe slow, light and deep….

Light: *"Your breath should be smooth, silent and light. There should be very little turbulence as it enters and leaves the nose. Ideally you feel a tolerable hunger for air. This signifies that your breathing volume is slightly less than what it was before you started the exercise."*

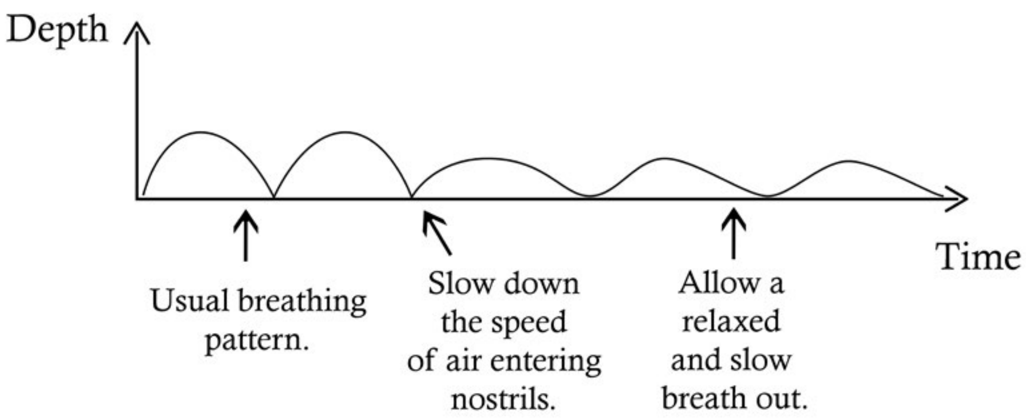
Slow: *"Slow down the number of breaths per minute so that you are taking fewer breaths than you normally do. The goal is to achieve six breaths per minute. And now, to time the breath. So, breathing slow, light and deep: In 2,3,4… out 2,3,4,5,6…"*

Deep: *"I would like you to bring the air deep into your lungs. As you breathe in, feel your ribs expanding outwards. As you breathe out, feel your ribs moving inwards."*

Continue repeating the instructions for four to five minutes.

In order to stimulate the baroreceptors, students should practice at home for 10-20 minutes, twice daily. It's important to stress the importance of feeling a light air hunger so students don't compensate by taking a greater volume of air. A light air hunger will change the student's biochemistry, biomechanics and stimulate the baroreceptors.

EXERCISE 3: WALKING WITH THE MOUTH CLOSED



Posture: *"Begin to walk with your mouth closed, correct tongue resting posture, lips together, jaws relaxed, breathing in and out through your nose. Imagine a piece of string pulling you upwards towards the ceiling or sky. Lengthen the distance between your navel and sternum. Widen the distance between your ribs."*

Awareness: *"As you walk, block one of your nostrils with your finger. It doesn't matter which nostril you block. It can be your free or partially congested nostril. Feel the slightly colder air coming into your nose and feel the slightly warmer air leaving your nose. Blocking one nostril helps to concentrate air flow. This makes it easier to be aware of your breathing.*

Pay attention to your breathing. I would like you to notice the slightly colder air coming into the nose and the slightly warmer air leaving the nose. Feel your breathing. Feel the slightly colder air as it enters your nostrils, and feel the slightly warmer air as it leaves your nostrils. Really concentrate on your breathing. Use this as a measure of your concentration. For how long can you hold your attention to your breathing before the mind wanders? If your mind is wandering a lot, you will get even more from the exercise. Keep bringing your attention back to your breathing. Feel the slightly colder air entering your nostrils, and feel the slightly warmer air leaving your nostrils."

Slow: *"As you walk, I would like you to slow down the speed of air entering your nostrils. Breathe so softly that you cannot hear your breathing. Breathe so quietly that you feel hardly any air entering your nose. At the top of the breath, bring a total feeling of relaxation to the body and allow a relaxed and slow breath out. I would like you to take about 30% less air into your body. Your breathing volume now should be less than what it was before you started the exercise.*
Quieten your breathing. Don't hold your breath. Don't tense your breathing muscles, or restrict your breathing to reduce the amount of air you are taking into your body. Instead, soften your breathing. Slow down your inhalation and allow a relaxed and prolonged exhalation."

Tolerable air hunger: *"The goal is to create a feeling that you would like to take in more air; to feel an air hunger. To create air hunger, your breathing volume now should be less than what it was before you started. I need you to feel a want for air; a feeling that you would like to take in a deeper breath. I would like you to feel slightly suffocated*. If your breathing muscles contract or if they start to feel tense, then the air hunger is too strong. When this happens, slow down your pace or breathe a little deeper.*

It is normal at the beginning that the air hunger gets too strong during the exercise. With practice, it becomes easier to sustain the air hunger for longer periods of time. Soften your breath to the point of air hunger.

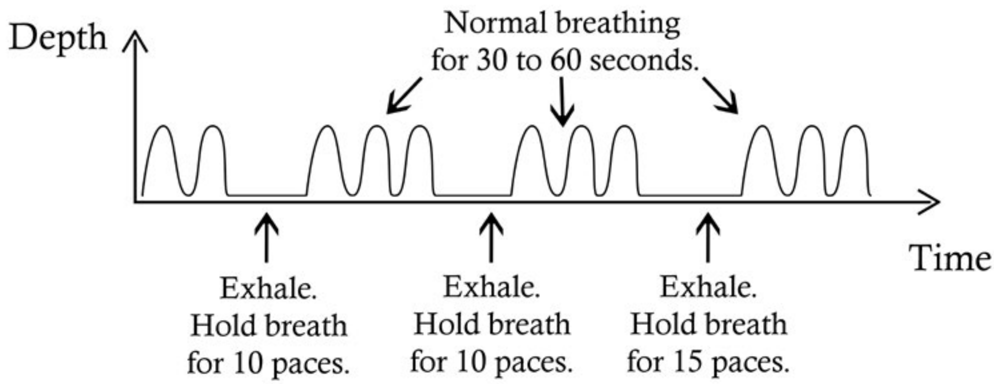
I would like you to breathe light, slow and deep. Take the air slowly into your nose, only taking the amount of air that you actually need. You will be surprised at how little air you actually need. With each breath take the air to the lower regions of your lungs. As you breathe in, feel your ribs moving outwards. As you breathe out, feel your ribs moving inwards."

Repeat the sentences above over the course of 3-4 minutes.

For children and teenagers, practise walking for one minute, jogging for one minute, walking for one minute, jogging for one minute.
(Children should wear tape across their lips for the duration of this exercise to maintain nasal breathing.)

EXERCISE 4: WALKING WITH BREATH HOLDS

Exercise 4 is often continued from Exercise 3. This exercise involves breath holding followed by normal breathing during walking. It is not suited to those with unstable asthma or unstable breathing as it may disrupt breathing and cause too much breathlessness, or bring on asthma symptoms.



"Begin by walking with your mouth closed, jaws relaxed, tongue in roof of mouth. For this exercise, I would like you to challenge yourself, but not to feel stress. It is important that your breathing remains under control throughout the exercise. When you are ready, I would like you to breathe in and out through your nose, pinch your nose with your fingers, and hold your breath for 10 paces. Then let go and breathe in through the nose."

"Continue walking with normal breathing for 30-60 seconds. Then breathe in and out through the nose, pinch the nose, and hold the breath for 10 paces;
Continue walking, breathing through the nose. Breathe normally for 30-60 seconds."

"Breathe in and out through the nose, pinch the nose, and hold the breath for 15 paces;
Continue walking, breathing through the nose. Breathe normally for 30-60 seconds.
Breathe in and out through the nose, pinch the nose, and hold the breath for 15 paces;
Continue walking, breathing through the nose. Breathe normally for 30-60 seconds."
Breathe in and out through the nose, pinch the nose, and hold breath for 20 paces…"

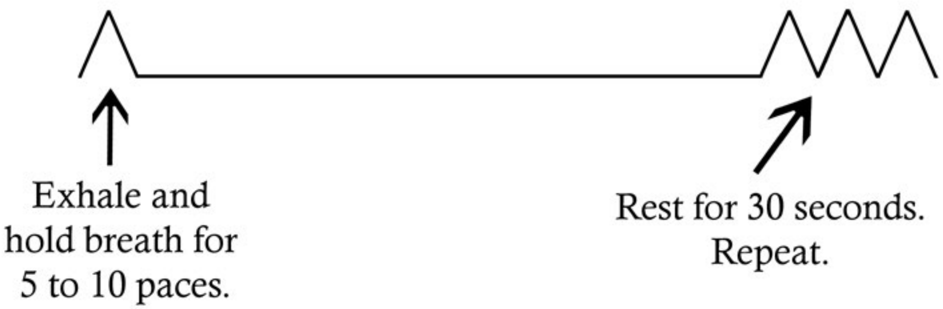
Follow this pattern repeatedly, increasing every other breath hold by five paces until a strong air hunger is achieved:
5, 5, 10, 10, 15, 15, 20, 20, 25, 25, 30, 30, 35, 35, 40, 40, 45, 45……………….

EXERCISE 5: STEPS

Variations:

5A STEPS TO 10 PACES
5B WALKING (MODERATE TO STRONG AIR HUNGER)
5C RUNNING (MODERATE TO STRONG AIR HUNGER)

Variation A: Steps to 10 paces



"Exhale through the nose. Pinch the nose with your fingers to hold the breath and walk for 5-10 paces while holding your breath. Stop walking. Breathe in through the nose and rest for 30 seconds or so while standing still."

During the session, practice up to 10 repetitions. At home, students can practice 6 repetitions of this exercise 5 times daily. Holding the breath for up to 10 paces is very suitable for persons with severe asthma, COPD, panic disorder and disproportionate breathlessness, low CP and anxiety.

VARIATIONS B & C: WALKING OR RUNNING STEPS TO ACHIEVE MODERATE TO STRONG AIR HUNGER

Exhale. Hold breath until moderate to strong air hunger. Control breathing.

"Exhale through your nose. Pinch the nose with your fingers to hold the breath. Walk or run while holding your breath. As the air hunger increases, walk or run faster. Continue to relax your body as you feel the involuntary contractions of your breathing muscles. When the air hunger is strong, let go of your nose and breathe in. Walk a few paces to recover your breathing. Try to get your breathing under control within a few breaths. Rest for about one minute and whenever you feel comfortable, repeat."

CHILD MEASUREMENTS	
AGE OF CHILD	STEPS SCORE GOAL
5 TO 7 YEARS	50-60 PACES
8 TO 9 YEARS	60-70 PACES
10 YEARS PLUS	80 PACES

Students can practice 6 repetitions of this exercise 2-3 times daily.

This exercise is suited to relatively healthy children, teenagers and adults, and those with mild/moderate asthma. This exercise is not suitable for children with pulmonary hypertension. For children and teenagers, the air hunger experienced during the Steps exercise must be strong. When a child or teenager has severe asthma, go easy for the first few repetitions to determine the child's comfort level. Challenge them to achieve more steps, without causing distress or loss of control to breathing.

EXERCISE 6: MANY SMALL BREATH HOLDS

This is an emergency exercise to help stop symptoms of coughing (even extreme coughing, in combination with the Steps exercise to 10 paces), wheezing, panic, or hyperventilation. It is also beneficial if CP is less than 13 seconds, and suitable for those with severe asthma or COPD.

"Take a normal breath in and out through the nose. Pinch the nose with your fingers to hold your breath. Hold your breath for 3-5 seconds. 5,4,3,2,1 Let go of your nose and breathe normally (through the nose) for 10 seconds." Repeat for 10 minutes or more.

The success of stopping an asthma attack depends on two factors:

Time: The sooner you commence the exercise, the more successful the exercise will be.
Control Pause: The higher the person's normal CP the easier it is to control the attack. Never hold your breath for more than ½ the control pause at that time.

Students can practise this exercise 10 minutes every hour until symptoms abate.

ADDITIONAL NOTES:

Exercises 2, 3, 6 and 7 are designed to create a tolerable air hunger that doesn't induce involuntary contractions of the breathing muscles. These exercises are generally suited to everyone (except during the first trimester of pregnancy).

Exercises 1, 4 and 5, when practised to create a medium-to-strong air hunger, involve involuntary contractions of the breathing muscles. As the air hunger progresses, these involuntary contractions or movements become faster and stronger. Movements can take place in the diaphragm or throat. The key is to relax into the contractions. Upon resumption of breathing, it is important that breathing is brought under control within 2-3 breaths. For persons with low CP (less than 13 sec), breathing may be more unstable. Therefore, breath holds must be limited to create a medium air hunger only, with full control of breathing at end of the breath hold.

TEACHING CHILDREN & TEENAGERS PROTOCOL AGED 5 TO 16 YEARS

PRECAUTION

Do not request the child to practice the Steps Exercise if the child presents with pulmonary hypertension, epilepsy or any serious medical condition.

For children with Type 1 diabetes, breath hold exercises can lower blood sugar levels, so it is important to monitor blood sugar levels frequently, and for the child to consume a snack prior to practicing the exercise.

For children with severe asthma, it is important that the child is able to control their breathing immediately after performing the exercise.

Pulmonary hypertension is very rare in children, but it is a serious health condition. The prevalance of pulmonary hypertension in the United Kingdom is 2.1 children per million,[1] and in the Netherlands 2.2 children per million.[2] In Spain, the prevalance of pulmonary hypertension is 2.9 children per million.[3] Children with pulmonary hypertension should not practice the Steps Exercise as holding of the breath to reach a strong air hunger will cause a temporary increase to the pulmonary hypertension.

For children in good health, holding of the breath to reach a strong air hunger has no reported health risks, and is comparable to a breath hold achieved while swimming under water.

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[1] Moledina S, Hislop AA, Foster H, Schulze-Neick I, Haworth SG. Childhood idiopathic pulmonary arterial hypertension: a national cohort study. Heart. 2010;96:1401–1406.

[2] van Loon RL, Roofthooft MT, Hillege HL, et al. Pediatric Pulmonary Hypertension in the Netherlands: Epidemiology and Characterization During the Period 1991 to 2005. Circulation. 2011.

[3] Cerro Marin MJ, Sabate Rotes A, Rodriguez Ogando A, et al. Assessing Pulmonary Hypertensive Vascular Disease in Childhood: Data from the Spanish Registry. Am J Respir Crit Care Med. 2014.

BREATHING SUMMARY

Request the child to wear MyoTape surrounding their lips while practising the exercises and also while at home during the day. For example – when the child is distracted while watching tv, playing ipad, iphone etc. For the child to wear MyoTape for 15 minutes to two hours daily. This is necessary to help re-establish new neural connections to change breathing behaviour.

Exercises are generally taught in the following sequence:

- Ex 6: Small Breath Hold Exercise to introduce technique to the child (3 min)
- Ex 1: Nose Unblocking Exercise (6 reps)
- Ex 5A: Beginners Steps Exercise (6 reps)
- Ex 5B or 5C: Steps Exercise – walking, jogging, running (6 reps)
- Ex 3: Physical exercise with mouth closed – walking, jogging, walking, jogging (5 to 10 min)
- Tongue pops to help ensure correct tongue posture (100 per day)

Considering that both parents and healthcare professionals can lack time, the above list of exercises are based on achieving maximum results with a minimum amount of effort.

The foundation for breathing re-education is to establish nasal breathing on a permanent basis both during wakefulness and sleep. Lips closed, jaws relaxed and tongue in the correct resting posture. Motivating children and teenagers to breathe through their nose is an important part of the processs. Typically, breathing re-education is taught to children in small groups of 3 to 6 children with one or both parents present. There are five sessions in total held about one week apart. Each session is 45 minutes to 60 minutes.

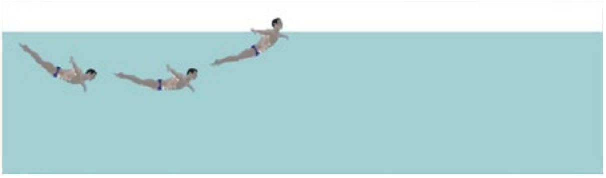
If teaching online via Zoom etc., a small group of two children with their parents is recommended.

DISCUSS WHAT THE NOSE IS FOR:

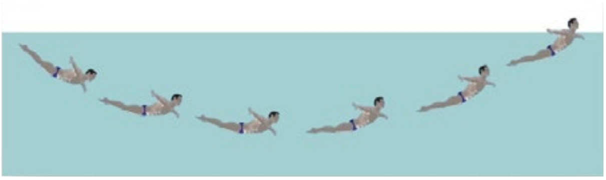
Nasal breathing looks intelligent. Explain to the child that intelligent people breathe in and out through their nose. Nasal breathing improves intelligence as the child can sleep better, and breathe better with improved oxygen delivery to the brain. The child also looks more intelligent when their lips are together. It can be worthwhile for parents to take a photo of their child on their smartphone whenever the child is mouth breathing. Then for them to take a photo of the child when they are nasal breathing and their mouth is closed. They could then ask the child to compare the two photos to see in which photo do they look more intelligent?

Sports Performance.

One swimmer can only swim a few strokes



Another can swim for a lot longer



In the example above, one swimmer swims a few strokes before they have to surface for air, while the second swimmer can swim the length of the pool. Professional athletes, olympians, military and special forces are using these breathing exercises to improve their sports performance. If a child persistently breathes through an open mouth, they will experience disproportionate breathlessness during physical exercise. For more information, see oxygenadvantage.com

Teeth and bad breath. No teenager wants to have bad breath. Nasal breathing helps prevent bad breath,[4] as well as helping to ensure good oral health.

[4] Lara Jansiski Motta, Joanna Carolina Bachiega, Carolina Cardoso Guedes, Lorena Trista˜o Laranja, Sandra Kalil Bussadoril. Association between halitosis and mouth breathing in children. CLINICS 2011;66(6):939-942.

Sleep, focus and energy levels. This might not be the motivator for children, but it is likely to be the motivator for parents. Children with poor sleep are ten times at higher risk of developing learning difficulties. Persistent mouth breathing during childhood can result in abnormal craniofacial growth; postural changes including upper chest breathing and forward head posture; and reduced quality of sleep.

It is common for children with ADHD to experience nasal congestion and hay fever.[5] Statistics show that 40% of children who experience sleep disorders, including snoring or sleep apnea, develop ADD, ADHD or a learning disability.[6] Furthermore, if a child is snoring by the age of eight years and is left untreated, there is an 80% chance that the child will have a permanent 20% reduction in mental capacity.[7] Unfortunately, doctors treating ADD or ADHD rarely consider nasal obstruction as a possible cause, and are unaware that the condition can be greatly helped without the need for medication or psychological therapy.[7]

Good Posture

Mouth breathing for a period of time can result in forward head posture.[8,9]

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[5] Brawley A, Silverman B, Kearney S, Guanzon D, Owens M, Bennett H, Schneider A. Allergic rhinitis in children with attention-deficit/hyperactivity disorder.Ann Allergy Asthma Immunol. 2004 Jun;92(6):663-7.

[6] Goyal A, Pakhare AP, Bhatt GC, Choudhary B, Patil R (2018) Association of pediatric obstructive sleep apnea with poor academic performance: A school-based study from India. Lung India 35: 132-136.

[7] Catalano P, Walker J (2018) Understanding Nasal Breathing: The Key to Evaluating and Treating Sleep Disordered Breathing in Adults and Children. Curr Trends OtolaryngolRhinol: CTOR-121.

[8] Okuro RT, Morcillo AM, Ribeiro MÂ, Sakano E, Conti PB, Ribeiro JD. *Mouth breathing and forward head posture: effects on respiratory biomechanics and exercise capacity in children.J BrasPneumol. 2011 Jul-Aug; 37(4):471-9.*

[9] Seo-Young Lee & Christian Guilleminault& Hsiao-Yean Chiu & Shannon S. Sullivan Mouth breathing, “nasal disuse,” and pediatric sleep-disordered breathing. Sleep Breath. 2015 Dec;19(4):1257-64.

This may partly be due to a compensatory mechanism. The ideal resting position of the tongue is in the roof of the mouth. One advantage of this is that the tongue is pulled out of the airway. However, during mouth breathing the tongue drops down from the roof of the mouth in order for air to be drawn into the lungs. As the tongue rests on the floor of the mouth, it is more likely to fall into the airway. This in turn will reduce airway diameter, resulting in the child or teenager pushing their head forward in order to take air into the lungs. For example, when a child breathes through their mouth during sleep, their head is often tilted back in order to take air into the lungs and compensate for an inadequate upper airway.

For younger children; what is good breathing?

For younger children; what is not-so-good breathing?

Do you ever see your cat walking around with his mouth open?

What are your eyes for, what is your mouth for, what are your ears for? What is your nose for?

BREATHING EXERCISES FOR CHILDREN AND TEENAGERS

Ten to fifteen minutes into each session, ask children, teenagers and parents to tape their lips with medical grade tape. (MyoTape.com, LipSealTape.com, 3M one inch micropore tape) This is necessary to help establish a nasal breathing habit; to check if the child is comfortable breathing through their nose; and to help determine whether adenoids may be an issue. If the child has severe nasal obstruction, they will feel air hunger when they first switch to nose breathing. Unless the air hunger is very uncomfortable, encourage the child to continue wearing the tape. If the air hunger is very uncomfortable, ask the child to remove the tape and to practice the exercises as best they can with their mouth closed. (The vast majority of children and teenagers are able to maintain nasal breathing with lips taped). Practicing the Steps Exercise will help to decongest the nose and alleviate the air hunger within a few minutes.

Begin by practicing the exercises below. Small breath holds while seated introduce the child to holding the breath. Following this, have the child practise the nose unblocking exercise to help decongest the nose, and to experience holding their breath for longer periods of time.

The third exercise to practice is called Steps. This will help decongest the nose allowing the child to breathe comfortably through it.

In order to decongest the nose, the child or teenager will need to hold their breath until a strong air hunger is established. Holding the breath for light air hunger will not decongest the nose.

In the event that the child is not comfortable breathing through their nose following the Steps Exercise (possibly due to enlarged adenoids), then maxillary expansion or ENT should be presented as an option. This is further discussed on the following pages.

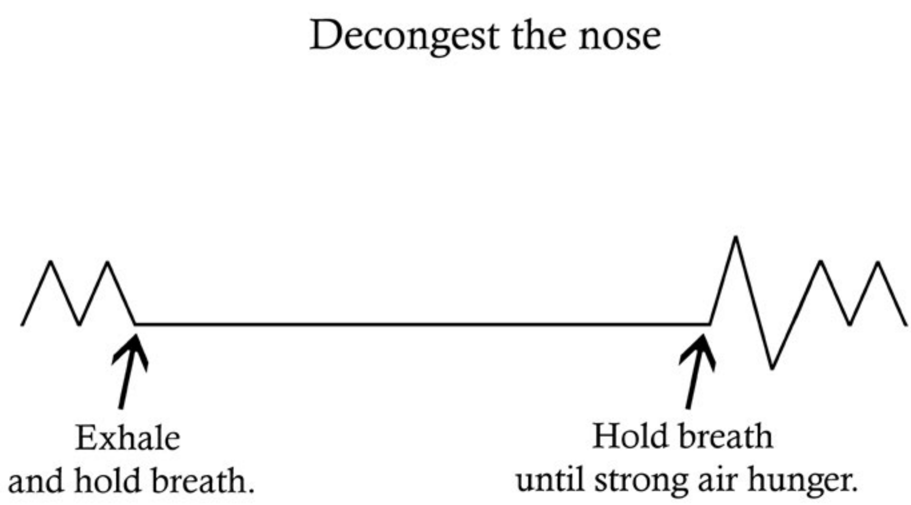
For each session begin with:

With lips taped, perform Ex 6: *Many Small Breath Holds* of 3-5 seconds each:

- *Take a gentle breath in through your nose, and a gentle breath out through your nose, and hold your breath by pinching your nose.*
- *Hold your breath for 3-5 seconds.*
- *After each breath hold, breathe normally in and out through the nose for 10-15 seconds.*

Repeat for two to three minutes. When the child is able to perform the above exercise, proceed to nose unblocking exercise.

WITH LIPS TAPED, PERFORM *EX 1: DECONGEST THE NOSE:*



To decongest the nose, instruct the student to perform the following:

- Take a normal breath in and out through your nose;
- Pinch your nose with your fingers to hold your breath;
- As you hold your breath, move your body or gently nod your head up and down;
- Hold your breath for as long as you can – until you feel a strong air hunger;
- Let go of your nose and breathe through it as calmly as possible.

Repeat 6 times with a 30-60 second rest between each repetition.

WITH LIPS TAPED, *EX 5A: BEGINNERS' STEPS EXERCISE*

Ask the child to hold their breath and walk a short distance of five paces or so. Having another adult or an older sibling to help can be useful here, with one of you standing at either end of the walking distance so that the child can walk back and forth from one to the other.

Adult 1 ⟵ Distance of five paces ⟶ Adult 2

Have parent's place tape surrounding the child's mouth. As detailed above, the child should gently breathe in, and out through their nose, pinch their nose to hold the breath while walking five paces to the second helper. When they reach the other side, they can release their nose and resume gentle nasal breathing. Wait 30-60 seconds before repeating the exercise.

When you have established that the child is able to hold their breath over a short distance, you can gradually increase the number of paces. You can do this by either increasing the distance between the two helpers, or keeping the five-pace distance and having the child walk back and forth an increasing number of times before releasing the breath. It is important to find out the maximum number of steps that the child can achieve. This is determined by asking the child to gradually increase the number of their steps. Count aloud every ten paces walked with breath held.

With lips taped, *Steps Exercise*

In addition to improving breathing patterns, the Steps Exercise is used as a measurement of progress. The Steps Exercise combines muscle activity (which increases carbon dioxide levels) with breath holding (which allows both carbon dioxide and nitric oxide to accumulate in the body).

Ex 5B & C: Steps Exercise Instructions:

- Take a gentle breath in through the nose;
- Allow a gentle breath out through the nose and pinch the nose with fingers to hold the breath;
- Ask the child to walk as many paces as they can until they feel a relatively **strong urge** to breathe. Count aloud every ten steps and see if they can beat their previous score each time;
- When they breathe in, it must be through their nose and breathing must be calmed immediately;

The first breath following the exercise will usually be bigger than normal. Make sure the child reduces or suppresses the second and third breaths to keep their breathing gentle.

The Steps Exercise should be performed six repetitions to each set, with about half a minute to one minutes' rest in between each repetition. Sets of Steps are to be practiced two to three times per day. Count aloud every ten paces walked, and record the child's score so that their progress can be monitored from week to week. Compare each week's Steps with the previous scores to evaluate improvement and encourage the child to increase the number of steps they take. The Steps Exercise can also be incorporated into other activities such as skipping or running. Children like to move, and having the child jog while holding their breath is an effective approach.

Young children have a relatively strong response to the build-up of carbon dioxide in the blood, although this reduces as the child gets older. With this in mind, the Steps Exercise should be tailored to the child's age. Children aged between five and seven should aim to achieve 50-60 paces during Steps. For children aged between eight and nine years, the goal is to reach 60-70 paces. And for children aged ten or over, the goal is to reach 80 paces.

EX 3: PHYSICAL EXERCISE WITH MOUTH CLOSED – WALKING, JOGGING, WALKING, JOGGING

The following exercise conveys the importance of breathing through the nose during physical activity. It is also a good exercise to improve respiratory muscle strength as an extra load is added to the diaphragm. Nasal breathing imposes a resistance to breathing during wakefulness which is two to three times that of the mouth. This helps maintain diaphragm function and strength.
Have the child or teenager walk for one minute with lips together and tongue in the roof of the mouth. (preferably with paper tape) After one minute of continuous walking, have the child jog lightly for one minute, followed by walking with lips together for one minute etc.
Walk one minute, jog one minute, walk one minute, jog one minute, walk to recover.

TEACHING FORMAT

First session with child

- Discuss what the nose is for
- Wear MyoTape for most of the session (also helps determine if child can nasal breathe)
- Ex 6: Small breath holds 2 – 3 minutes
- Ex 1: Nose unblocking Exercise 6 repetitions
- Ex 5A: Beginners Steps Exercise 6 repetitions
- Ex 5B or 5C: Steps Exercise 6 repetitions
- Tongue Pops 20 repetitions

Homework first lesson

- Tape mouth using MyoTape during day. Begin with 15 minutes. While watching TV, iPhone, iPad etc.
- 6 repetitions of Steps while wearing tape 2 – 3 times/day
- Record number of Steps reached into diary (or use ButeykoClinic app)
- Breathe through nose at all times
- Nose clearing as needed (using Steps Exercise)
- Use MyoTape during sleep

Second lesson onwards with child

- Observe each child as they walk into the room. (Is their mouth open or closed?)
- Ask who has been doing exercises, wearing tape across lips during the day?
- Talk about breathing awareness – Why should we breathe through our noses? What's good breathing? What's not so good breathing?
- Steps check. Check charts – give out stickers.
- Request for children to wear tape to help ensure nasal breathing
- Ex 6: Many Small Breath Holds
- Ex 5B or 5C: Steps: first two repetitions until comfortable air hunger
  – Then Steps until strong air shortage is reached
  – Introduce jogging Steps
  – Should see 10 paces per week improvement
  – Pay attention to involuntary movement in neck to monitor stress
  – Set goal for each child
- Ex 3: Walking with mouth taped. Walk one minute. Jog one minute. Walk one minute.
- Practice tongue pops to help ensure tongue resting in roof of mouth

Homework second lesson onwards

- 6 repetitions of Steps by 2-3 sets/day – record Steps
- Nasal breathing at all times
- Nose clearing as needed (using Steps Exercise)
- Tape lips during the day. 15 minutes to 30 minutes per day.
- Use MyoTape during sleep
- There is no set time for how long the child should continue with the exercises. However, to establish good breathing habits, it is necessary for the child to continue practicing the exercises for 60 to 70 days.

If child is wheezy or coughing, then limit the paces to 10 – 20. The Steps Exercise will help reduce the child's symptoms, but it is important that the child is able to control their breathing when they resume breathing.

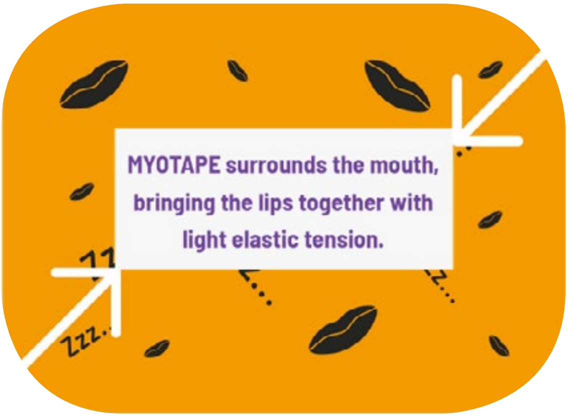
ENLARGED ADENOIDS

Enlarged adenoids are usually an issue when the airway is narrow. If a child presents with enlarged adenoids but also has a large airway, it is likely that the child should have no difficulty breathing through their nose. In this instance, practicing nasal breathing should help to reduce the size of the adenoids. On the other hand, a child presenting with enlarged adenoids and a small airway is unlikely to be able to maintain nasal breathing. The difficulties enlarged adenoids pose is relative to the size of the child's upper airway and the amount of space where the back of the nose meets the throat.

I recommend to any parent presenting a child with enlarged adenoids to look at maxillary expansion and forward development of the airways first. Try this for three months, along with continued nasal breathing and practicing the **Steps Exercise** in this book for children. In most cases, this approach will result in maxillary expansion, airway development, and restoration of nasal breathing, reducing inflammation of the adenoids and tonsils. The main benefit of using these methods is that there is little or no trauma involved, the airways are developed, and good breathing patterns are restored for the long term. In the event that the child's sleep problem persists for more than three months, then the parent can make the choice to embark on removal of the adenoids and tonsils. In this case, teaching the child to breathe through their nose is also very important post-surgery as sleep-disordered breathing may reoccur frequently within three years if they continue to breathe through an open mouth.[1]

[1] Seo-Young Lee & Christian Guilleminault& Hsiao-Yean Chiu & Shannon S. Sullivan Mouth breathing, "nasal disuse," and pediatric sleep-disordered breathing. Sleep Breath. 2015 Dec;19(4):1257-64.

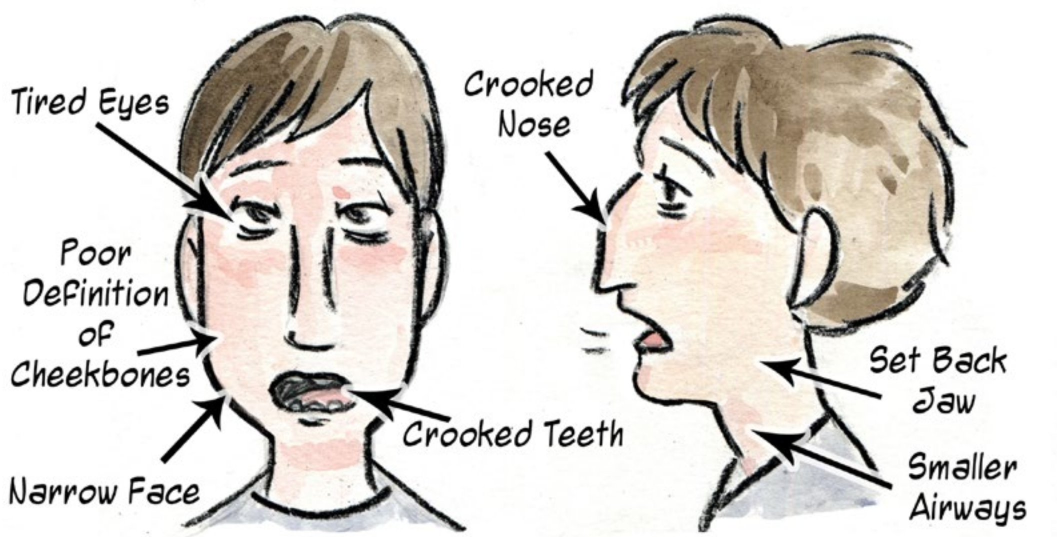
MYOTAPE

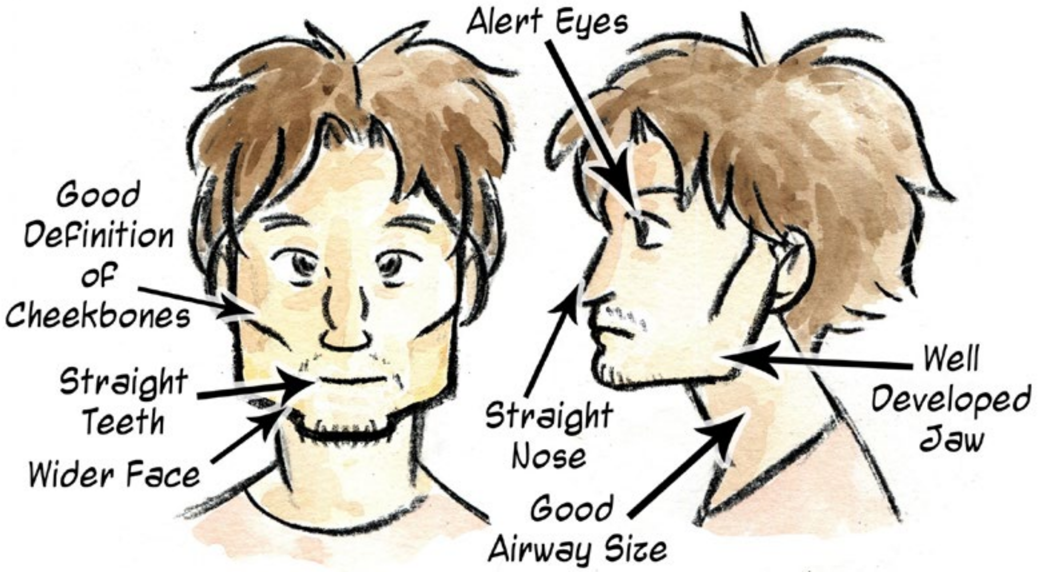


MYOTAPE does not cover the mouth. Instead, it surrounds the mouth, bringing the lips together with a light, elastic tension that helps to maintain lip closure and ensure nasal breathing. This elastic tension serves as a continuous reminder to keep the lips together. When you or your child open your mouth to breathe, the feeling of tension from the tape will prompt the mouth to close.

The tape is a training support, designed to restore nasal breathing patterns both during wakefulness and sleep. It allows the freedom to open the mouth at any time, and to communicate effectively whilst wearing the tape. To change behavioral patterns, it is recommended that the tape is worn for 60 to 90 days.

MYOTAPE is commonly used by children over four years of age during sleep. Please consult with a medical doctor prior to the child using the tape during sleep.


Tired Eyes
Crooked Nose
Poor Definition of Cheekbones
Set Back Jaw
Crooked Teeth
Narrow Face
Smaller Airways


Alert Eyes
Good Definition of Cheekbones
Straight Teeth
Wider Face
Well Developed Jaw
Straight Nose
Good Airway Size

NOTES

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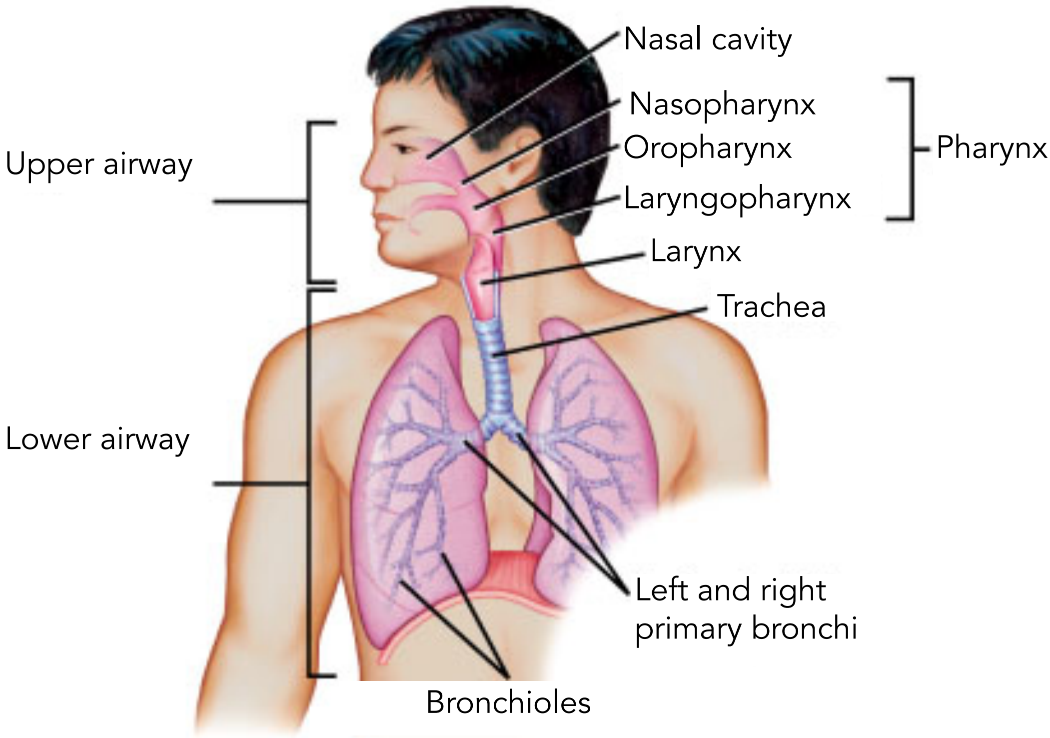
NOTES

RESPIRATORY PHYSIOLOGY



PARTIAL PRESSURES

- Oxygen is 21% of atmosphere
- 760 mm Hg x .21 = 160 mm Hg PO_2
- This mixes with "old" air already in alveolus to arrive at PO_2 of 105 mm Hg
- Carbon dioxide is .04% of atmosphere
- 760 mm Hg x .0004 = .3 mm Hg PCO_2
- This mixes with high CO_2 levels from residual volume in the alveoli to arrive at PCO_2 of 40 mm Hg
- Hypercapnia is a condition of abnormally elevated carbon dioxide (CO_2) levels in the blood. Greater than 45 mm Hg
- Hypocapnia or hypocapnea (from the Greek words **υπό** and **καπνός kapnós**), is a state of reduced carbon dioxide in the blood. Less than 35/37 mm Hg.

OXYGEN

- Hypoxia is a condition in which the body or a region of the body is deprived of adequate oxygen supply at the tissue level.

HUMAN LUNGS

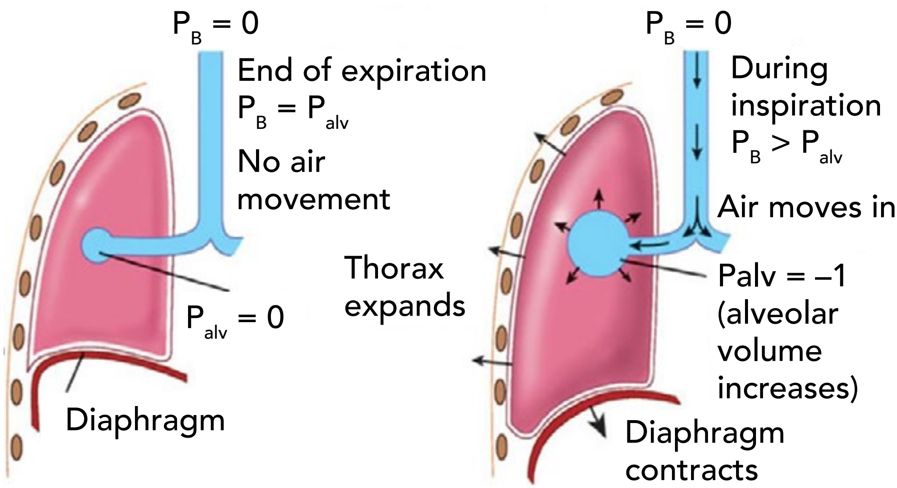
- Imagine the size of a tennis court
- 75 m^2 wrapped in a thin plastic sheet and stuffed into a 3 litre bottle

PULMONARY CIRCULATION

- Oxygen is 21% of atmosphere
- Rate of blood flow throught the lungs is quite high, because the lungs receive the entire cardiac output of the right ventricle

PRIMARY FUNCTIONS

- Supply a steady supply of oxygen for distribution to the tissues
- Remove excess carbon dioxide
- Homeostatic regulation of body pH
- Protection from inhaled pathogens
- Vocalisation



1. Barometric air pressure (P_B) is equal to alveolar pressure (P_{alv}) and there is no air movement.
2. Increased thoracic volume results in increased alveolar volume and decreased alveolar pressure. Barometric air pressure is greater than alverolar pressure, and air moves into the lungs.

CELLULAR RESPIRATION

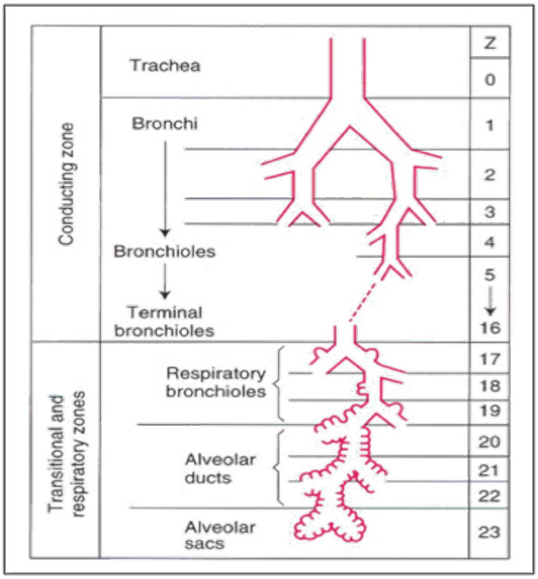
- Intracellular (occurring within cells) reaction of oxygen with organic molecules (carbohydrates, proteins, lipids, and nucleic acids) to produce carbon dioxide, water and energy in the form of ATP (Adenosine Triphosphate).

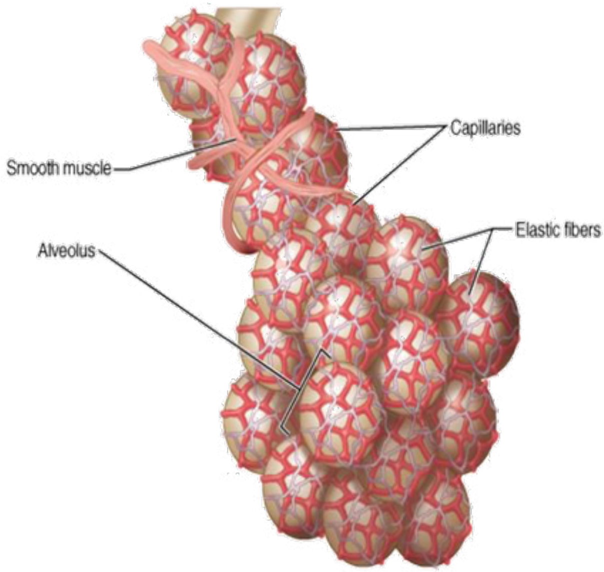
EXTERNAL RESPIRATION

- Exchange of air between the atmosphere and the lungs
- Exchange of oxygen and carbon dioxide between the lungs and the blood
- Transport of oxygen and carbon dioxide by the blood
- The exchange of the gases between blood and the cells

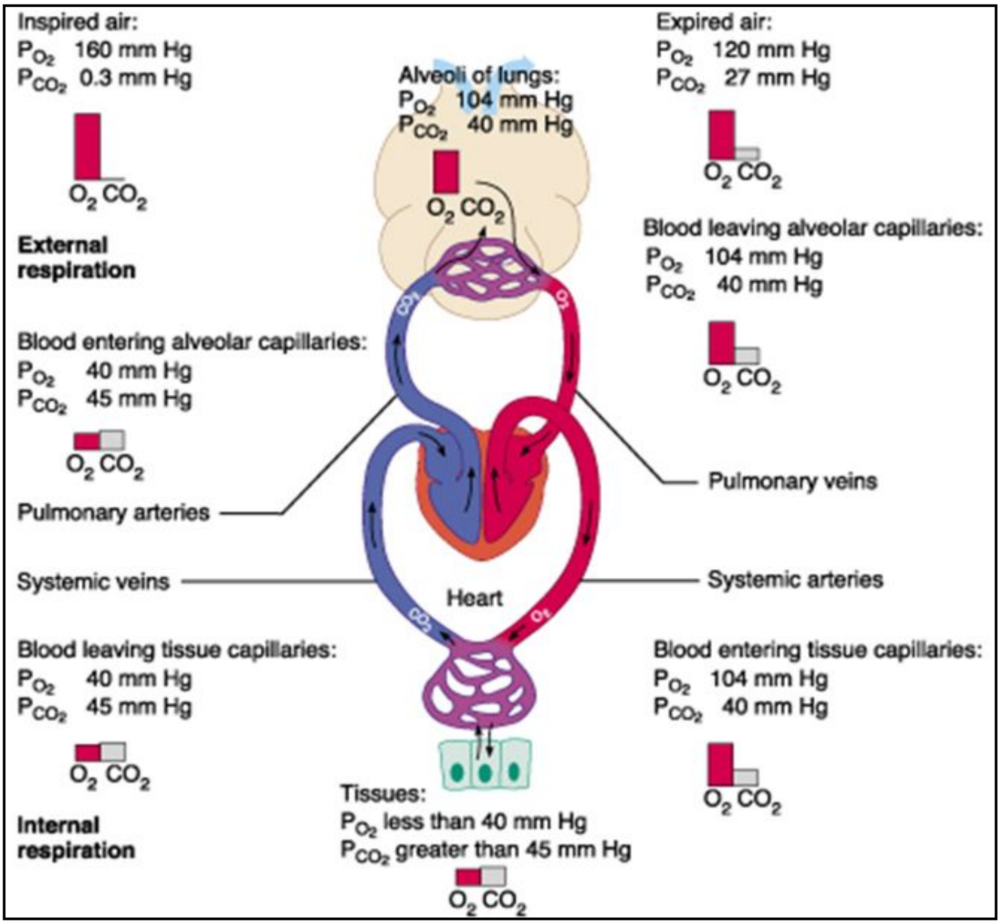
RESPIRATORY SYSTEM

- Conducting system – airways that lead from atmosphere to the exchange surface of the lungs
- The alveoli – small air sacs where oxygen and carbon dioxide transfer
- The bones and muscles of the thorax (chest)

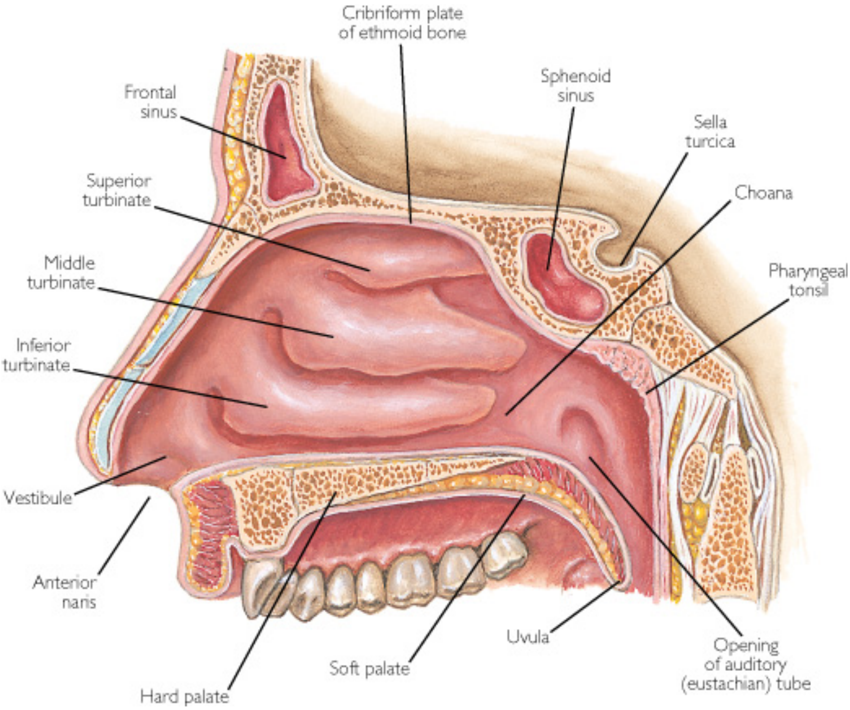




Alveoli are grapelike clusters at the ends of the terminal bronchioles. The thin walls of the alveoli do not contain muscle because muscle fibres would block rapid gas exchange.
Gas exchange occurs by diffusion through the thin walls.



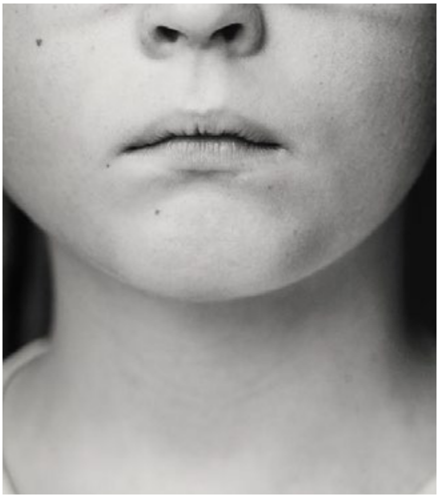
NASAL BREATHING



- Nasal breathing increases circulating blood oxygen and CO_2 levels, slows the breathing rate and improves overall lung volumes.

- Many lower respiratory tract diseases such as asthma and COPD are associated with both breathing pattern disorders as well as significant upper respiratory disease.

- Nasal cycle – alternating patent (open) and congested passages within the two nasal cavities for periods ranging from 1 to 7 hours.
- Breathing more through the right nostril- increased left brain activity – enhanced verbal performance.
- Breathing more through the left nostril – increased right brain activity – enhanced spatial performance.



Leon Chaitow, Christopher Gilbert, Dinah Bradley. Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach. November 01, 2013.

- Nose provides resistance to breathing that is twice that of the mouth. (Swift et al 1988)
- This increases total lung volume (Swift)
- In a study of arterial PaO_2, patients who were forced to breathe through their nose – PaO_2 level increased by nearly 10%. (Swift)
- ET CO_2 also increases with nasal breathing. This may be due to the increase to dead space.

Leon Chaitow, Christopher Gilbert, Dinah Bradley. Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach. November 01, 2013.

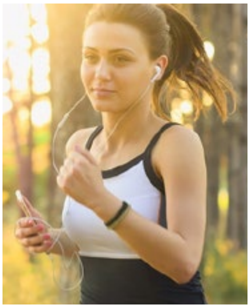
- End-tidal PCO_2 was significantly higher during nose than during mouth breathing.

	Nose	Mouth
• $PEtCO_2$ mmHg	42.7	40.6
• Ve L/min	8.55	7.77

- Breathing through the nose exhibited greater dead space than that through the mouth. Increased dead space may have induced the increased PCO_2 level.

Tanaka et al. An assessment of nasal functions in control of breathing. Journal of Applied Physiology. Volume 65, Issue 4. October 01, 1988.

- During exercise, nasal breathing causes a reduction in FEO_2, indicating that on expiration the percentage of oxygen extracted from the air by the lungs is increased, and an increase in $FECO_2$, indicating an increase in the percentage of expired air that is carbon dioxide. (Morton et al 1995)
- This equates to more efficient oxygen extraction and carbon dioxide excretion.



Leon Chaitow, Christopher Gilbert, Dinah Bradley. Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach. November 01, 2013.

NASAL BREATHING

- Volume of air during quiet breathing – Tidal volume – 500 ml
- Tidal volume will vary with age, sex, body weight and height
- Ventilation rate x tidal volume = Minute Volume
- Respiratory Rate (12 breaths/minute)
- 12 breaths/min x 500ml = 6L per minute

DEAD SPACE

- Some air which enters the respiratory system does not reach the alveoli – 150 ml
- In one breath, the first 350 ml enters into the alveoli. The last 150 ml of air remains in the dead space

SLOW BREATHING

- Decreasing respiratory rate and increasing tidal volume has been shown to improve ventilation efficiency.

Russo et al. The physiological effects of slow breathing in the healthy human. Breathe. Volume 13, No 4. December 2017.

Alveolar ventilation

- 12 breaths x (500ml- 150ml) = 4.2 litres
- 6 breaths x (1000ml- 150ml) = 5.1 litres
- 20% improved breathing efficiency by slow, light and deep.
- If minute ventilation is adequate, breathing can be lighter when through the nose, slow and deep.

SLOW BREATHING

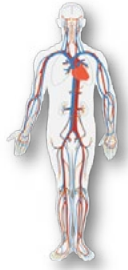
- Slow respiration at 6 breaths per min was found to be optimal for improving alveolar ventilation and reducing dead space in both groups in terms of increased arterial oxygen saturation and ease and sustainability in terms of respiratory effort.
- Follow-up of patients with chronic heart failure who practiced slow breathing displayed increased exercise performance and motivation.

Russo et al. The physiological effects of slow breathing in the healthy human. Breathe. Volume 13, No 4. December 2017.

- Diaphragmatic breathing has also been shown to facilitate slow respiration.
- Healthy subjects trained in diaphragmatic breathing demonstrated slower respiratory rates and were more likely to achieve the study goal of 3–7 breaths per min.

Stromberg et al. Diaphragmatic breathing and its effectiveness for the management of motion sickness. Aerospace Medicine and Human Performance. Volume 86, Issue 5. May 2015.

NITRIC OXIDE



- Produced at 10 parts per million (ppm) in the human sinuses, NO can diffuse to the bronchi and lungs, where it induces vasodilatory and bronchodilatory effects.

J. Martel, Y.-F. Ko, J.D. Young, D.M. Ojcius. Could nitric oxide help to prevent or treat COVID-19? Microb Infect (2020), 10.1016/j.micinf.2020.05.002

- Nitric oxide (NO) is released in the nasal airways in humans. During inspiration through the nose this NO will follow the airstream to the lower airways and the lungs.

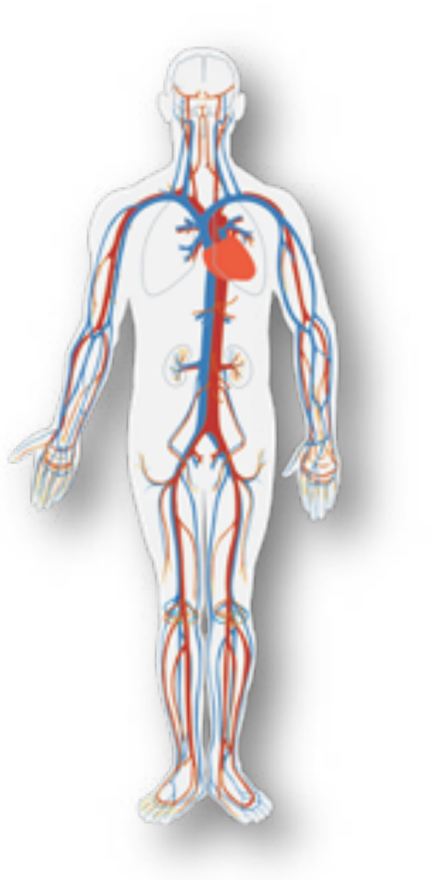
Lundberg JO. Nitric Oxide and the Paranasal sinuses. The Anatomical Record Advances in Integrative Anatomy and Evolutionary Biology. November 2008.

- Compared with oral breathing, inhalation of NO (endogenous or exogenous) caused an overall significant blood flow shift from the base of the lung toward the apex, resulting in a more homogeneous blood flow distribution along the height of the lung.

Sánchez Crespo et al. Nasal nitric oxide and regulation of human pulmonary blood flow in the upright position. Journal of applied physiology. Volume 108, Issue 1. January 2010.

- Because NO is scavenged by Hemoglobin (Hb) on diffusing into the blood and is thereby rapidly inactivated, the vasodilatory effect of inhaled NO is limited largely to the lung.

Ichinose et al. Inhaled Nitric Oxide: A Selective Pulmonary Vasodilator: Current Uses and Therapeutic Potential. AHA Journals. Volume 109, Issue 25. June 29, 2014.



- NO may help to reduce respiratory tract infection by inactivating viruses and inhibiting their replication in epithelial cells.

- NO also activates ciliary movement and mucus secretion, which can increase removal of dust and viral particles from the respiratory tract.

- NO produces antimicrobial effects against a broad range of microbes including bacteria, fungi and viruses, which may help prevent pulmonary infections.

- Clinical trials have been designed to examine the effects of inhaled nitric oxide in COVID-19 subjects.

- In humans, higher basal levels of exhaled NO are associated with fewer symptoms of the common cold, suggesting that nasally-produced NO represents one of the body's endogenous defense mechanisms against viruses in the airways.

J. Martel, Y.-F. Ko, J.D. Young, D.M. Ojcius. Could nitric oxide help to prevent or treat COVID-19? Microb Infect (2020), 10.1016/j.micinf.2020.05.002

- Nonetheless, a study showed that inhaled NO at 80 or 160 ppm failed to improve survival or viral load in mice infected intranasally with a lethal dose of influenza virus.

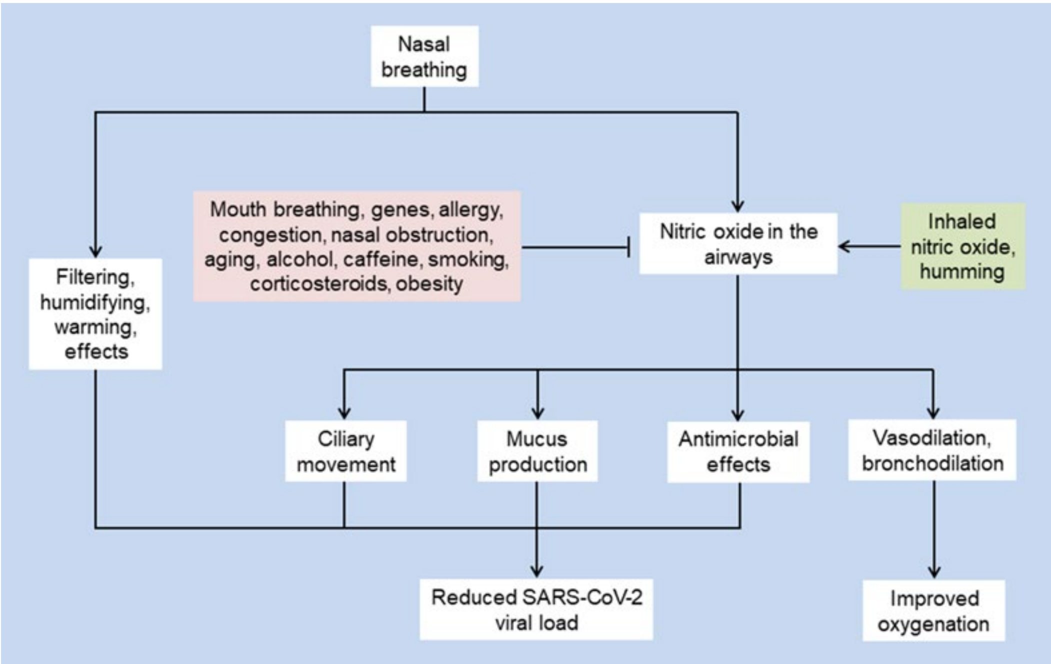
- Unknown if increasing NO levels by inhalation or treatment with NO donors may produce antiviral effects in COVID-19 subjects.

but

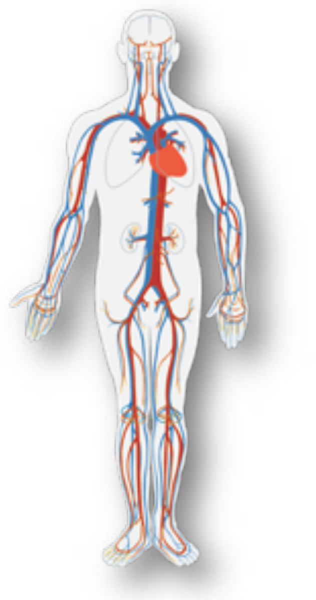
The possible effect of inhaled NO on bronchodilation and oxygenation appears promising.

- Conditions associated with reduced nasal NO production, including cystic fibrosis, are associated with recurrent respiratory infections and inflammation.

- In the general population, orally-exhaled and nasal NO levels are lower in white people (compared to Asians) and in individuals who smoke or consume alcohol, caffeine, or corticosteroids.



J. Martel, Y.-F. Ko, J.D. Young, D.M. Ojcius. Could nitric oxide help to prevent or treat COVID-19? Microb Infect (2020), 10.1016/j.micinf.2020.05.002



- Measurements indicate that mouth breathers have lower levels of NO within the respiratory tract compared to nasal breathers.
- While most people spontaneously report breathing through the nose, mouth breathing may occur during talking, exercise and sleep or in people with allergies, congestion or nasal obstruction, suggesting that it may be more prevalent than usually appreciated.
- Our anecdotal observations during sleep by sealing the mouth with adhesive tape reduces common colds.
- Filtration and humidifying effects of the nose on inhaled air and increased NO levels in the airways, which may decrease viral load during sleep and allow the immune system more time to mount an effective antiviral response.
- Mouth breathing during sleep may therefore worsen the symptoms of COVID-19, consistent with the observation that symptoms of respiratory infections are usually worse in the morning.
- Limiting the lifestyle factors that reduce endogenous NO levels in the airways – such as mouth breathing and smoking – may also help to reduce SARS-CoV-2 viral load and symptoms of COVID-19 pneumonia by promoting more efficient antiviral defense mechanisms in the respiratory tract.

J. Martel, Y.-F. Ko, J.D. Young, D.M. Ojcius. Could nitric oxide help to prevent or treat COVID-19? Microb Infect (2020), 10.1016/j.micinf.2020.05.002

BREATHING MECHANICS

1) Implications of mouth breathing on the lung function.
2) Implications of mouth breathing on the respiratory muscles.

- 18 analyzed articles – few studies reject or did not find some relation between pulmonary changes and mouth breathing.

Lopes Veron et al. Implications of mouth breathing on the pulmonary function and respiratory muscles. Revista CEFAC. Volume 18, Issue 1. Jan/Feb 2016.

- Mouth breathing caused lower diaphragmatic amplitude, compared to nasal breathing.

Trevisan et al. Diaphragmatic amplitude and accessory inspiratory muscle activity in nasal and mouth breathing adults: a cross-sectional study. Journal of electromyography and kinesiology. Volume 25, Issue 3. June 2015.

- Respiratory biomechanics and exercise capacity were negatively affected by mouth breathing.
- The presence of moderate forward head position acted as a compensatory mechanism in order to improve respiratory muscle function.

Okuro et al. Mouth breathing and forward head posture: effects on respiratory biomechanics and exercise capacity in children. Jornal brasileiro de pneumologia: publicacao oficial da Sociedade Brasileira de Pneumologia e Tisilogia. Volume 37, Issue 4. August 2011.

- The nose also provides an inspiratory resistance forcing the diaphragm to contract against a resistance. On a long term basis, this might maintain diaphragmatic muscle strength.

T. Metin Önerci. Nasal physiology and pathophysiology of nasal disorders. Chapter by Bartley and Wong. August 17, 2013.

NOTES

NOTES

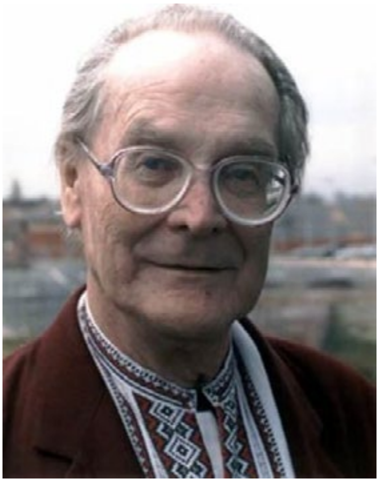
NOTES

CLASS 2

EXAMINING DYSFUNCTIONAL BREATHING PATTERNS

DR. BUTEYKO

- 1946 – commenced medical training at the First Medical Institute of Moscow.
- Practical assignment involved monitoring breathing volume of patients.
- Sicker they became – the heavier they breathe.
- 1952 – lowered his high blood pressure by reducing his breathing towards normal.



CHRONIC HYPERVENTILATION SYNDROME

- Dysfunctional breathing/hyperventilation syndrome (DB/HVS) has an estimated prevalence of 9.5% in the general adult population.

Jones et al. Breathing exercises for dysfunctional breathing/hyperventilation syndrome in adults. Cochrane Database of Systematic Reviews. Volume 18, Issue2.December 2013.

- Hyperventilation disorders affect 30% of asthmatic and up to 75% of anxiety sufferers.

Rosalba Courtney A Multi-Dimensional Model of Dysfunctional Breathing and Integrative Breathing Therapy – Commentary on The functions of Breathing and Its Dysfunctions and Their Relationship to Breathing Therapy. Journal of Yoga & Physical Therapy. 2016.

- Dysfunctional breathing/hyperventilation syndrome (DB/HVS) is a respiratory disorder, psychologically or physiologically based, involving breathing too deeply and/or too rapidly (hyperventilation) or erratic breathing interspersed with breath-holding or sighing (DB).

Jones et al. Breathing exercises for dysfunctional breathing/hyperventilation syndrome in adults. Cochrane Database of Systematic Reviews. Volume 18, Issue2.December 2013.

- Chronic hyperventilation – breathing volume is excessive during sleep, rest and physical exercise.

Jack et al. Ventilatory Responses to Inhaled Carbon Dioxide, Hypoxia, and Exercise in Idiopathic Hyperventilation. American Journal of Respiratory and Critical Care Medicine. Volume 170, Issue 2. March 31, 2004.

- Chronic hyperventilation syndrome: breathing is highly inefficient
- Uses excess energy
- Reduces oxygen uptake due to rapid shallow breathing
- Reduces oxygen delivery at the cell due to the Bohr effect

Rosalba Courtney A Multi-Dimensional Model of Dysfunctional Breathing and Integrative Breathing Therapy – Commentary on The functions of Breathing and Its Dysfunctions and Their Relationship to Breathing Therapy. Journal of Yoga & Physical Therapy. 2016.

Buteyko: hypocapnia affected the core processes of energy production in the cell known as the Krebs cycle, vital chemical reactions requiring carbon compounds and other key homeostatic processes.

Buteyko: the body created a series of defense mechanisms to retain carbon dioxide, including constriction of airways and blood vessels, and gave rise to conditions such as asthma and hypertension.
Belief that hyopcapnia is the primary or only cause of breathing related symptoms is out of step with the current thinking of respiratory physiologists, who for some time now have had doubts about the primary importance of CO2 in symptom production (Hornsveld, Garsson, Fiedeldij Dop, Van Spiegel, & De Haes, 1996; Howell, 1997).

Courtney, Rosalba (Summer 2008). "Strengths, Weaknesses, and Possibilities of the Buteyko Breathing Method". Biofeedback. 36 (2): 59–63.

Buteyko's Control Pause does not correlate with resting CO_2 levels in all individuals

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Courtney, R., & Cohen, M. (2008). Investigating the claims of Dr. Konstantin Buteyko, M.D., Ph.D.: The relationship of breath holding time to end tidal CO2 and other proposed measures of dysfunctional breathing. *Journal of Alternative and Complementary Medicine,* 14, 115–123.

- Resting carbon dioxide levels can be normal in people with symptomatic hyperventilation (Folgering, 1999; Magarian, 1982).
- Patients who in the past would have been diagnosed as symptomatic hyperventilators may not show low levels of CO2 at the onset of their symptoms (Burton, 1993; Hornsveld & Garsson, 1997).
- Disturbances in breathing pattern are not always associated with chronically decreased baseline levels of CO2 (Han, Stegen et al. 1996; Pine, Coplan et al. 1998; Caldirola 2004)
- In persons with dysfunctional breathing, instability of breathing with fluctuating levels of CO2 is more likely to be present than chronic hypocapnia (Han et al., 1996; Roth, 2005)
- Symptoms believed to be characteristic of dysfunctional breathing may only be mildly related to chronic CO2 levels or even acute changes in CO2 (Burton 1993; Hornsveld 1997)
- Capnometry biofeedback, symptom reduction is not commensurate with the person's initial levels of resting CO2 (Roth, 2005).

- Changes in breathing pattern and symptoms after breathing therapy may not be accompanied by changes in CO2 (Han 1996)

Courtney, Rosalba (Summer 2008). "Strengths, Weaknesses, and Possibilities of the Buteyko Breathing Method". Biofeedback. 36 (2): 59–63.

- Can be difficult to change resting carbon dioxide set point

Jack S, Rossiter HB, Pearson MG (2004) Ventilatory responses to inhaled carbon dioxide, hypoxia, and exercise in idiopathic hyperventilation. Am J Respir Crit Care Med 170:118–125

- Dysfunctional breathing is a complex condition with multiple dimensions
- Despite the above, the importance of CO2 depletion should not be forgotten. There is clear evidence that low CO2 plays a role in bronchoconstriction and many other types of physiological dysfunction (Bruton & Holgate, 2005; Laffey & Kavanagh, 2002).
- Breath holding time tends to be lower in individuals with established hyperventilation disorders
- Carbon dioxide, breathing pattern, presence of respiratory disease and psychological factors are of importance
- Historically, researchers and practitioners of breathing often evaluate only one aspect of breathing function. This may result in incorrect assumptions about prevalence of dysfunctional breathing patterns.

Courtney, Rosalba (Summer 2008). "Strengths, Weaknesses, and Possibilities of the Buteyko Breathing Method". Biofeedback. 36 (2): 59–63.

- Patients diagnosed with Hyperventilation Syndrome (HVS), did not consistently have low carbon dioxide levels and that onset of hyperventilation symptoms was not linked directly with CO_2 levels.
- The term dysfunctional breathing is now an umbrella term that includes abnormal breathing patterns, behaviours and symptoms as well hyperventilation disorders.
- Hyperventilation-breathing in excess of metabolic requirements of the body at that time to cause hypocapnia.

Rosalba Courtney A Multi-Dimensional Model of Dysfunctional Breathing and Integrative Breathing Therapy – Commentary on The functions of Breathing and Its Dysfunctions and Their Relationship to Breathing Therapy. Journal of Yoga & Physical Therapy. 2016.

- Cardiovascular: palpitations, missed beats, tachycardia, sharp or dull atypical chest pain, 'angina', cold extremities, raynaud's, blotchy flushing of blush area, capillary vasoconstriction.
- Neurological: dizziness, instability, faint feelings (but rarely fainting), headache, paraesthesia – (numbness, deadness, uselessness, heaviness, pins and needles).
- Respiratory: shortness of breath, irritable cough, tightness or oppression of chest, air hunger, inability to take a deep breath, excessive sighing, yawning, sniffing.
- Muscular: cramps, muscle pains – neck & shoulders, stiffness.
- Psychic: tension, anxiety, 'unreal feelings', panic, phobias, agoraphobia.
- Allergies.
- Gastrointestinal: difficulty in swallowing, globus (having a lump in ones throat), dry mouth and throat, acid regurgitation, heart burn, flatulence, belching, air swallowing, abdominal discomfort, bloating.
- General: weakness, exhaustion, impaired concentration, impaired memory and performance, disturbed sleep, including nightmares, emotional sweating,

Timmons B.H., Ley R. Behavioural and Psychological Approaches to Breathing Disorders. 1994.

- 14 patients presented complaining of nasal congestion after previous nasal surgery and who appeared to have an adequate nasal airway with no evidence of nasal valve collapse, were evaluated for HVS.
- All patients had an elevated respiratory rate (>18 breaths/minute) with an upper thoracic breathing pattern.

- An average number of 2.5 procedures had been performed on each patient.
- Conclusion: HVS should be included in the differential diagnosis of patients presenting with nasal congestion, particularly after failed nasal surgery.

Jim Bartley. Nasal Congestion and Hyperventilation Syndrome. American Journal of Rhinology & Allergy. Volume 19, Issue 6. November 2005.

TRAITS OF DYSFUNCTIONAL BREATHING

- Oral Breathing
- Faster breathing
- Upper chest movement
- Audible breathing during rest
- Frequent sighing
- Frequent yawning
- Noticeable breaths prior to talking
- Generally visible movement from breathing
- Paradoxical breathing

WHAT CAUSES DYSFUNCTIONAL BREATHING

- Hormonal changes
- Processed foods / overeating
- Lack of physical exercise
- Excessive talking
- Anxiety, stress, trauma
- Belief that it is beneficial to breathe more air
- Airtight houses
- Asthma
- Genetic predisposition/familial habits

ORAL BREATHING

- 9804, general citizens of Nagahama City, Japan.
- A self-reporting questionnaire.
- Mouth breathing was reported by 17% of the population and was independently associated with asthma morbidity.

Izuhara et al. Mouth breathing, another risk factor for asthma: the Nagahama Study. Allergy: European Journal of Allergy and Clinical Immunology. Volume 71, Issue 7. July 2016.

- Small nasal airway are much more likely to breathe through an open mouth.
- Ninety-seven percent of subjects with a small nose were mouth breathers to some extent.
- In comparison, only 12% of subjects with an adequate airway were assumed to be habitual mouth breathers.

Warren et al. The relationship between nasal airway size and nasal-oral breathing. American Journal of Orthodontics and Dentofacial Orthopedics. Volume 93, Issue 4. April 1988.

MINUTE VOLUME

- 4 – 6 litres of air per minute during rest

William D. McArdle, Frank I. Katch, Victor L. Katch. Exercise physiology : energy, nutrition, and human performance. November 13, 2009.

MINUTE VENTILATION ASTHMA

- 15 litres minute ventilation

Johnson BD, Scanlon PD, Beck KC, Regulation of ventilatory capacity during exercise in asthmatics ,J Appl Physiol. 1995 Sep; 79(3): 892-901.

- Resting minute ventilation 13.3 +/- 2.0 L/min
- Exercise minute ventilation 41.9 +/- 9.0 L/min

Chalupa DC, Morrow PE, Oberdörster G, Utell MJ, Frampton MW, Ultrafine particle deposition in subjects with asthma. Environmental Health Perspectives 2004 Jun; 112(8): p.879-882.

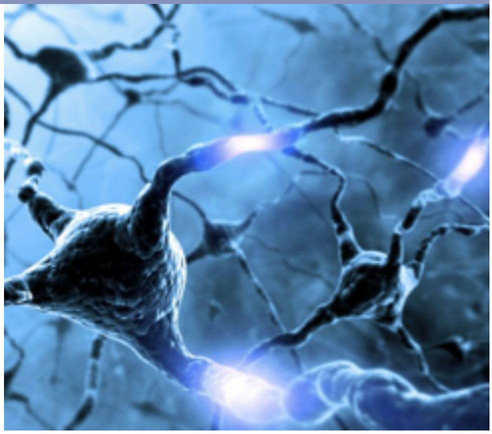
- 14.1 litres minute ventilation

Bowler SD, Green A, Mitchell CA, Buteyko breathing techniques in asthma: a blinded randomised controlled trial. Med J of Australia 1998; 169: 575-578.

CARBON DIOXIDE: NOT JUST A WASTE GAS!

PRIMARY STIMULUS TO BREATHE

- The regulation of breathing is determined by receptors in the brain which monitor the concentration of carbon dioxide along with the pH level and to a lesser extent oxygen in your blood.



PH CO_2

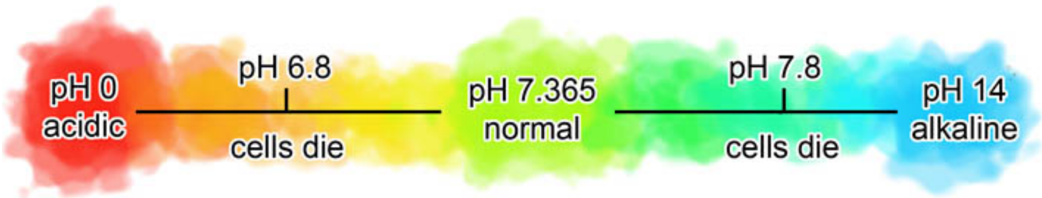
- CO_2 important in acid base balance
- Body puts out about 240 mls per minute of CO_2 all day long
- 10,000 milliequivalents (mEq) per day
- Compared to kidney - only puts out 100 (mEq) per day
- By altering ventilation – can rapidly control acid bases status
- An acid is a molecule that releases hydrogen ions in solution
- A base is a molecule that can accept a hydrogen ion
- A buffer is a substance that can reversibly bind hydrogen ions
- Bicarbonate is the most important buffer system in the blood

John West Respiratory Lectures Youtube

- Normal pH is 7.365 which must remain within tightly defined parameters. If pH is too acidic and drops below 6.8, or too alkaline rising above 7.8, death can result.

Blood, Sweat, and Buffers: pH Regulation During Exercise Acid-Base Equilibria Experiment
Authors: Rachel Casiday and Regina Frey

The pH CO2 Link



- Carbon dioxide forms bicarbonate through the following reaction:

  $CO_2 + H_2O <\!\!-\!\!-\!\!> H_2CO_3 <\!\!-\!\!-\!\!> H^+ + HCO_3^-$

- CO_2 disassociates into H^+ and HCO_3^- constituting a major alkaline buffer which resists changes in acidity.

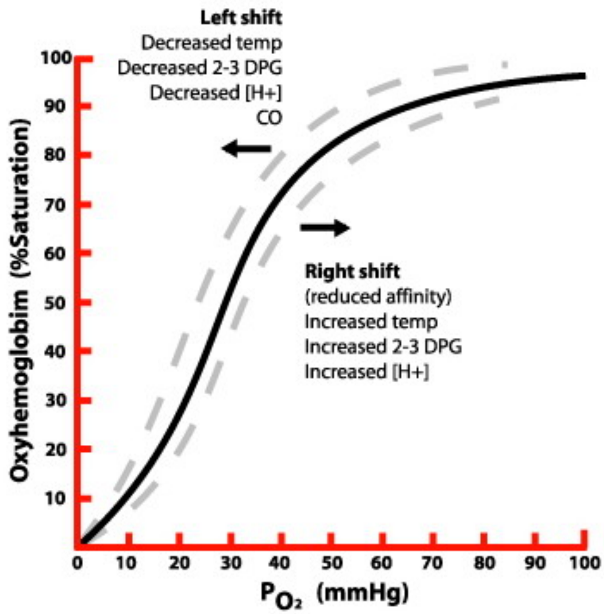
- If you offload carbon dioxide, you are left with an excess of bicarbonate ion and a deficiency of hydrogen ion.
- During short term hyperventilation – breathing volume subsequently decreases to allow accumulation of carbon dioxide and normalization of pH.

- However, when over breathing continues for hours/days, bicarbonate excess is compensated by renal excretion.
- Hypocapnia and pH shift are almost immediate; adjustment of bicarbonate takes time. (hours to days)

L.C.Lum. Hyperventilation: The tip and the iceberg. Journal of Psychosomatic Research. Volume 19, Issues 5–6. 1975.

- Thus the chronic hyperventilator's pH regulation is finely balanced: diminished acid (the consequence of hyperventilation) is balanced against the low level of blood bicarbonate maintained by renal excretion.
- In this equilibrium small amounts of over breathing induced by emotion can cause large falls of carbon dioxide and, consequently, more severe symptoms.

Jenny C King Hyperventilation-a therapist's point of view: discussion paper. Journal of the Royal Society of Medicine. 1988 Sep; 81(9): 532–536.



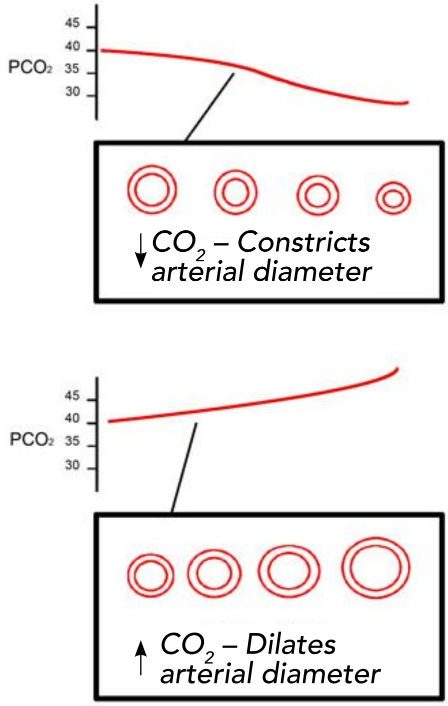
OXYGEN DISSOCIATION CURVE

- An exercising muscle is hot and generates carbon dioxide and it benefits from increased unloading of O_2 from its capillaries.

John B. West. Respiratory Physiology: the essentials. Lippincott, Williams and Wilkins. 1995.

CONSTRICTION OF CAROTID ARTERIES

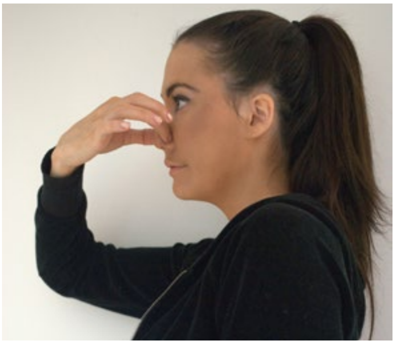
- A primary response to hyperventilation can reduce the oxygen available to the brain by one half.

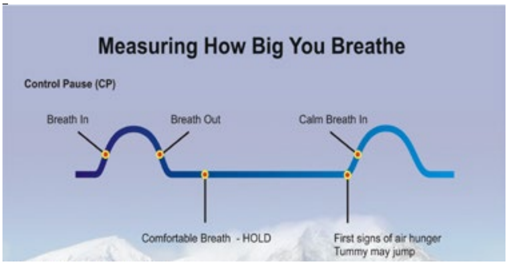


Timmons B.H., Ley R. Behavioural and Psychological Approaches to Breathing Disorders. 1994.

CONTROL PAUSE (comfortable breath hold time) MEASUREMENT

- Take a normal silent breath in through your nose.
- Allow a normal silent breath out through your nose.
- Hold your nose with your fingers to prevent air from entering your lungs.
- Count the number of seconds until you feel the first distinct desire to breathe in.





- Breath holding is one of the most powerful methods to induce the sensation of breathlessness, and that the breath hold test gives us much information on the onset and endurance of dyspnea.

Nishino T. Pathophysiology of dyspnea evaluated by breath-holding test: Studies of furosemide treatment. Respiratory Physiology & Neurobiology. Volume 167, Issue 1. May 30, 2009.

- Breath hold test reflects the sensitivity of the peripheral chemoreceptors to carbon dioxide.

Trembach et al. Breath-holding test in evaluation of peripheral chemoreflex sensitivity in healthy subjects. Respiratory Physiology & Neurobiology Volume 235, Issue 79–82. October 15, 2016.

- Thirty normal subjects, 30 patients with OSAS, and 16 snorers performed serial breath-holding maneuvres at functional residual capacity (FRC).
- Breath hold test (BHT) in OSAS was shorter than in normal subjects but not in snorers.

Taskar et al. Breath-holding Time in Normal Subjects, Snorers, and Sleep Apnea Patients. Chest Journal. Volume 107, Issue 4. April 1995.

- Patients who suffer from both disturbed sleep and lung disease are particularly vulnerable to the adverse effects of sleep disruption on breathing.

B. Phillips. Sleep, Sleep Loss, and Breathing. South Med J. Volume 78, Issue 12. December, 1985.

- Eighteen patients with varying stages of cystic fibrosis (CF) were studied to determine the value of the breath hold time as an index of exercise tolerance.
- 'That the voluntary breath-hold time might be a useful index for prediction of the exercise tolerance of CF patients'.

Barnai M, Laki I, Gyurkovits K, Angyan L, Horvath G. Relationship between breath-hold time and physical performance in patients with cystic fibrosis. European Journal Applied Physiology.2005 Oct;(95(2-3)):172-8

- Breath hold time varies inversely with the magnitude of dyspnea when it is present at rest.

Rev Invest Clin. 1989 Jul-Sep;41(3):209-13. Rating of breathlessness at rest during acute asthma: correlation with spirometry and usefulness of breath-holding time. Pérez-Padilla R, Cervantes D, Chapela R, Selman M.

PRACTICAL APPLICATION OF THE BUTEYKO METHOD

- Control Pause Measurement
- Switch to nasal breathing on a permanent basis
- Normalise breathing volume
- Various lifestyle guidelines including sleep, physical exercise and diet

- Ex 1: Nose unblocking exercise
- Ex 2: Breathe Light (five variations)
- Ex 3: Breathe Light physical exercise (two variations)
- Ex 4: Walking with breath holds
- Ex 5: Steps exercise (three variations)
- Ex 6: Breathing recovery (many small breath holds)
- Ex 7: Relaxation with reduced breathing (mp3 download ButeykoClinic.com/reduced-breathing)

What is the significance of the CP?

- A CP of less than twenty seconds indicates upper chest breathing, faster breathing rate and higher breathing volume.
- If CP less than twenty seconds: main symptoms are present – blocked nose, snoring, insomnia, fatigue, coughing, wheezing, breathlessness, exercise-induced asthma.
- CP between 20 to 40 seconds: main symptoms are gone but have symptoms if exposed to a trigger.
- CP of 40 seconds: very rarely will you have symptoms.

Note: you will feel better each time your CP increases by five seconds

Essential rules to make progress:

- Client will feel better each time the CP increases by 5 seconds.
- If the CP does not change, the client will not feel better.

Essential rules to make progress:

- CP will increase by 3 to 4 seconds during the first 2 to 3 weeks. When CP reaches 20 seconds, it is normal for the progression to slow down. It is not uncommon to remain "stuck" at 20 seconds for 8 to 10 weeks. In order to increase a CP from 20 to 40 seconds, it is necessary to perform physical exercise.
- Physical exercise is necessary to increase the CP above 20 seconds. The most accurate CP is taken first thing after waking.
- The CP as taken throughout the day will provide feedback of breathing at that time.
- The goal is to have a morning CP of 40 seconds for 6 months.

In addition to measuring Control Pause, observe breathing:

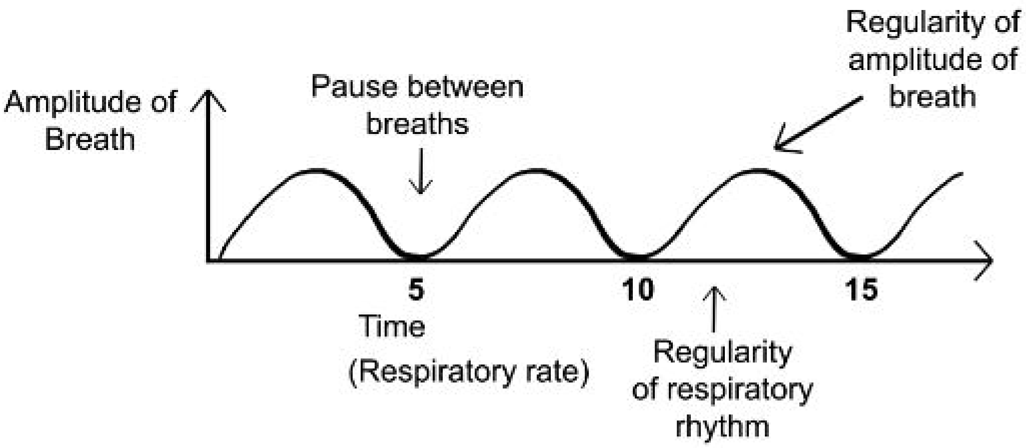
- Nose or mouth
- High or low
- Fast or slow
- Regular or irregular
- Amplitude of breathing
- Natural pause following exhalation

ADULT BREATHING CLASSIFICATION (ABC)

Observation of breathing	Normal Ventilation	Grade 1	Grade 2	Grade 3	Grade 4
Respiratory Rate per minute	10 to 12 breaths	12 to 14 breaths	14 to 16 breaths	16 to 20 Breaths	20 to 25 breaths
Regularity of breathing pattern	Regular	Regular	Relatively regular	Irregular	Rapid *Air trapping
Amplitude of breath	Normal	Normal	Higher than normal	Higher than normal	Higher or lower than normal
Natural pause following expiration	2-3 seconds	1-2 seconds	1 second	No pause	No pause
Breathing Pattern	Primarily driven by the diaphragm	Primarily driven by the diaphragm	Breathing is diaphragmatic or thoracic	Breathing is diaphragmatic or thoracic	Breathing is thoracic or clavicle
Mode of breathing*	Nasal	Nasal	Oral Nasal Oral/Nasal	Oral Nasal Oral/Nasal	Oral Nasal Oral/Nasal
Control Pause Score	30 seconds plus	20-30 seconds	15-20 seconds	10-15 seconds	5-10 seconds
PREDICTED OUTCOME					
Dyspnea at rest	No dyspnea	No dyspnea	No dyspnea	Moderate	Moderate to severe

Dyspnea during light exercise (such as walking)	Very mild sensation of breathlessness	Very mild sensation of breathlessness	Mild sensation of breathlessness	Moderate sensation of breathlessness	Moderate to severe sensation of breathlessness
Expected FEV and FVC	Normal	Normal	Normal/Lower than normal	Lower than normal	Lower than normal

INTERPRETATION OF BREATHING PATTERN CLASSIFICATION FOR ADULTS



NOTES:

A high score (Grade 3 or 4) is associated with increased breathing effort and dyspnea (breathlessness). Respiratory rate is more rapid, and the breathing pattern is irregular. Breathing may be nasal, oral or oronasal (nose and mouth combined). The Control Pause score is less than twenty seconds. The higher the grade, the more likely you are to experience periodic sighing and feelings of lack of air.

A low score (Normal Ventilation, Grade 1) indicates normal ventilation with effortless inspiratory expansion and expiratory contraction. Breathing is predominantly through the nose during rest and driven by the diaphragm. The respiratory rate and amplitude are relatively regular. Comfortable breath hold time during rest as measured following a passive expiration is greater than twenty seconds.

A Grade 2 score straddles functional and dysfunctional breathing.

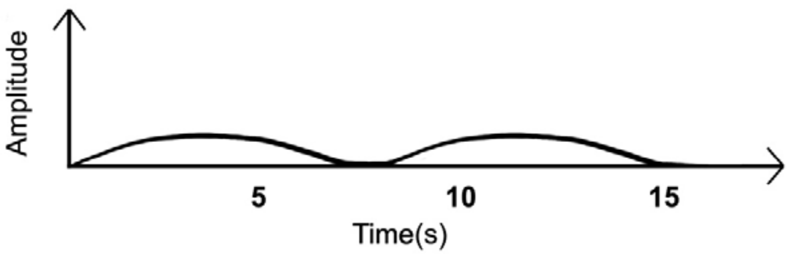
Mode of breathing: there is no definitive measurement to determine whether an individual predominantly breathes through their nose or mouth or oronasally during rest. It is my experience that if, during rest, the individual regularly breathes through an open mouth for more than one minute at a time, this is indicative of a habit of oral breathing.

The Control Pause score refers to the number of seconds, from the time of holding the breath on a passive expiration until involuntary movements of the breathing muscles are experienced.

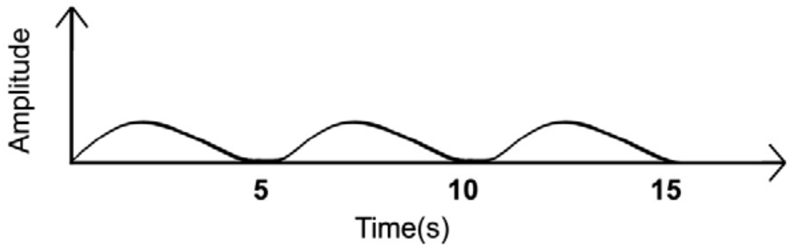
*Air trapping or hyperinflation of the lungs: This is when expiration doesn't fully take place before inspiration begins. Air becomes trapped in the lungs with each successive breath causing the lungs to overinflate.

Expected Breathing Pattern as Based on Grade

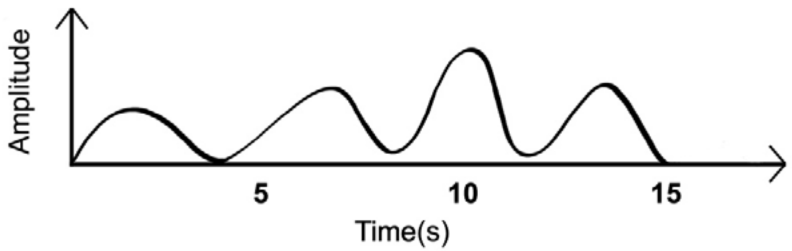
Normal Ventilation



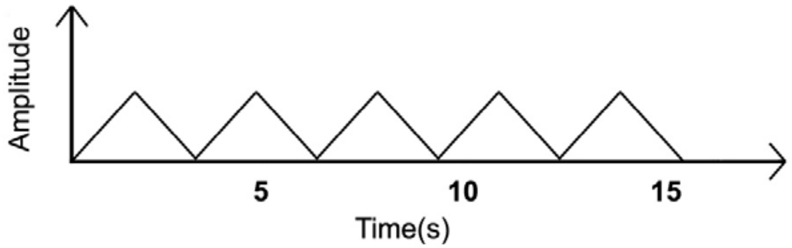
Grade 1



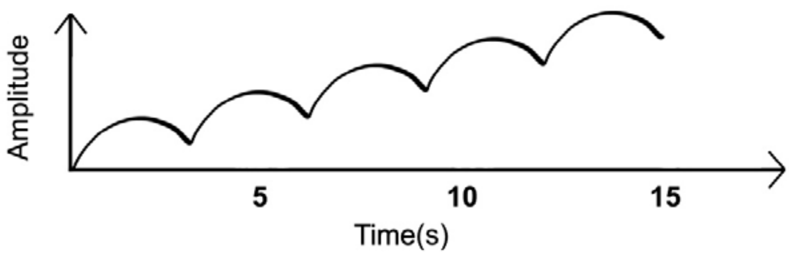
Grade 2



Grade 3



Grade 4



BUTEYKO CLINIC
INTERNATIONAL
Accredited by Prof. KP Buteyko

Please complete the questions below as accurately as possible so that your Course Instructor can assist you with your individual condition.

Name: ______________________ Contact Number: ____________________

Parent's name (if applicable) __________ Email address: ____________________

Occupation: ____________________ Does it require much TALKING or PHYSICAL EXERCISE? (Circle)

What condition / symptoms do you have? 1) ____________ 2) ____________

When were you first diagnosed with your condition? ____________ (years)

Please state which best describes your condition:

Sometimes have symptoms: ☐ Continuous symptoms (mild): ☐

Continuous Symptoms (moderate): ☐ Continuous symptoms (severe): ☐

How often have you been admitted to hospital for asthma attacks/or other, in the past three years? __________

Do you feel that deep breathing is good for you? YES / NO

Please circle answer:

Do you feel stressed, anxious regarding your condition?	Never	Sometimes	Often	Very Often
Does your nose feel congested?	Never	Sometimes	Often	Very Often
Do you breathe through your mouth during the day?	Never	Sometimes	Often	Very Often
Do you breathe through your mouth during the night? (Do you wake up with a dry mouth?)	Never	Sometimes	Often	Very Often

Have you completed a Sleep Study?
YES / NO

If yes, give approximate date: ____

Have you been prescribed a CPAP machine?
YES / NO

Do you currently use it?
YES / NO

Do you Smoke?
YES / NO

IF yes, how many cigarettes a day:
____

Do you limit your intake of dairy foods?
YES / NO

Has this helped you?
YES / NO

Approximately how many hours per week do you partake in physical exercise?	Less than one hour	1-2 hours	2-3 hours	3-4 hours	4-5 hours	5-6 hours	6-7 hours	7 or more

Please indicate √ the level of severity of any of the symptoms that you experience in list below:

1 = Mild, 2 = Moderate, 3 = Severe

Complaint	**1**	**2**	**3**	**Complaint**	**1**	**2**	**3**
Coughing				Excessive sweating			
Wheezing				High Perceived Stress			
Exercise Induced Asthma				Tummy upset / IBS			
Frequent Colds				Achy Muscles			
Breathlessness at rest				Tiredness			
Frequent Sighs				Insomnia /Broken Sleep			
Frequent Yawning				Poor Concentration			
Sleep Apnoea				Panic Attacks			
Snoring				Headaches			
Lower back pain							

Nijmegen Questionnaire: Please indicate √ the level of severity of any of the symptoms that you experience in list below:

Complaint	**Never 0**	**Rarely 1**	**Sometimes 2**	**Often 3**	**Very often 4**
Chest Wall Pains					
Feeling Tense					
Blurred vision					
Dizzy Spells					
Confusion, losing contact with reality					
Fast or deep breathing					
Shortness of breath					
Tightness in the chest					
Bloated Feelings in Stomach					
Tingling of fingers					
Unable to Breathe Deeply					
Stiffness in fingers or arms					
Stiffness around the mouth					
Cold hands or feet					
Thumping of the heart					
Feeling of anxiety					
Total:					

If you take asthma medication, please list:	
Preventer: ______________________________	Daily
Dose: ______________________________	
Reliever: ______________________________	Daily
Dose: ______________________________	

What would you like to achieve from attending Buteyko Clinic?

____

How did you hear about this course: (Please circle)

Social Media	Friend	Newspaper	GP or Consultant	Internet Search	Radio	Health Care Practitioner	Other:

For Female participants: Please tell the instructor if you are currently pregnant.

DISCLAIMER

PLEASE READ THE FOLLOWING DISCLAIMER CAREFULLY BEFORE SIGNING, AND/OR SEEK PROFESSIONAL LEGAL ADVICE IF NECESSARY.

I understand that the Course Instructor is not a registered medical practitioner nor is anyone else at (company or business name). No advice and activity presented, demonstrated or advised during the Course are in any way intended as a substitute for a medical consultation, and should not replace or interfere with any guidance offered by a medical professional.

I understand that I am free to leave the Course at any time for any reason. If at any time during the Course, I feel the need for any assistance, medical or otherwise, I agree to notify my Course Instructor immediately and take full responsibility for the same, including leaving the course and obtaining appropriate care. If I fail to seek the required medical care or ignore medical advice, including that from my Course Instructor, I understand and agree to do so at my sole risk.

I understand I will need to inform my Course Instructor about my pregnancy status, if any, before starting the Course's training and exercises. If I become pregnant or believe I may be pregnant after starting the Course, I agree to stop all technique exercises immediately and inform my Course Instructor to guide me on the next course of action.

I hereby confirm that I have carefully read this disclaimer and have fully understood that this is a release of liability. I hereby expressly agree to release and discharge my Course Instructor, and/or anybody associated with (Company name). (including its employees, directors, and/or management) from any and all claims or causes of action and agree to waive any right that I may otherwise have to bring a legal action against the said individuals for personal injury and/or damage to property.

____________________	____________________	____________________
Full Name of Participant	Signature	Date
____________________	____________________	____________________
Full Name of Guardian	Signature	Date

[N.B: Parent / Guardian's signature is mandatory if the participant is below 18 years of age]

NOTES

NOTES

NOTES

CLASS 3

BUTEYKO CLINIC EXERCISES

Ex 1

Nose unblocking exercise

Ex 2

Breathe Light to create air hunger

- Variation A: Hands On Chest And Tummy
- Variation B: Feather Breathing
- Variation C: Hands Cupping Face
- Variation D: Finger Blocking Nostril
- Variation E: Cadence Breathing (support with Buteyko Belt)

Ex 3

Breathe Light physical exercise

- Diaphragm (slow, light, deep)
- Finger blocking nostril

Ex 4

Walking with breath holds

- Increasing in increments of 5 paces

Ex 5

Steps exercise

- Breath hold to 10 paces
- Walking steps
- Running steps

Ex 6

Breathing recovery

Ex7

Mp3 Download

CATEGORIES OF CLIENT

1

Unwell, older person, CP less 10 seconds
Ex 2,3,6,7 (six by ten minute sessions daily)
Ex 6 if CP less than 10 seconds
Ex 5A (10 paces for severe asthma, COPD)

2

Sleep apnea, panic disorder, anxiety, high BP
Ex 2,3,6,7 (six by ten minute sessions daily)
Ex 2 Diaphragm (light, slow, deep)
Ex 5A (10 paces for panic disorder, anxiety)

3

Teenagers, children
Ex 1, 3, 5, 6 (Ex 5: 12 to 18 reps daily)
Anxiety (Ex 2 Diaphragm (light, slow, deep))
Severe asthma (Ex 5 with breath control)

4

Adult in relatively good health
Any of the exercises

GUIDELINES

STRONG BREATH HOLDS NOT SUITABLE IF:

- This program is not suitable for first trimester pregnancy.
- For those with high blood pressure, cardiovascular disease, type 1 diabetes, kidney disease, depression, or cancer, it is advisable to practice only nasal breathing and gentle reduced breathing.
- Persons with migraine, panic attacks, heart disease (if recent heart attack – relaxation without air shortage), or hypertension may experience stress from holding the breath. (even if measuring the CP) Instead begin with relaxation, light air shortage.
- Strong breath holds are only suitable if the heart rate normalises when measured five to ten minutes after completion of the steps or strong breath hold.

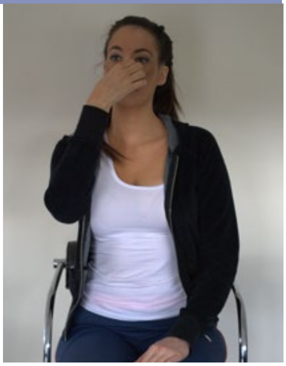
PEOPLE WITH ANXIETY OR PANIC DISORDER

- May find it difficult to focus on breathing.
- Air shortage may generate panic.
- If control pause increases too quickly, cleansing reaction may occur.
- If necessary practise exercises involving distraction. (breathing through nose, stop sighing, relaxation, small breath holds, walking with mouth closed).

PREGNANCY

- During first trimester – no reduced breathing exercises.
- Prevent hyperventilation – avoid overeating, high temperatures, stress, mouth breathing etc.
- CP should not increase by more than 2 seconds each week.
- 2nd trimester – go gently with air shortage.

IF HAVE LABOURED BREATHING



- Too difficult to reduce breathing if symptoms are present or control pause is very low.
- Do Exercise 6 (many small breath holds) until symptoms pass, or control pause reaches 12/13 seconds.
- When control pause reaches 13 seconds, practise Ex 2: Breathe Light to create air hunger.

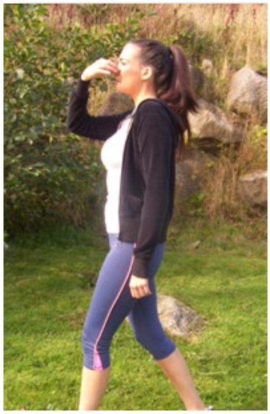
DETOXIFICATION

- May occur when CP doubles, triples or quadruples
- In general, symptoms of detox are mild and may last between a few hours and a couple of days
- Increased secretion of mucus from the lungs, a head cold with a runny nose, diarrhoea, loss of appetite, increased yawning and fatigue, insomnia, short term headache, increased irritability or anxiety, metallic or coppery taste in the mouth, increased sensation of thirst

- Drink warm water regularly (once daily drink with ½ teaspoon of Celtic sea salt)
- Continue with reduced breathing with relaxation (Exercise 2 and 6)
- Control Pause will reduce but it will normalise again when the detox. has passed

IF NOSE IS SEVERLY CONGESTED

- Ex 1: Hold breath after exhalation to generate strong air hunger (6 reps).
- Ex 5: Steps Exercise to generate strong air hunger (6 reps).
- Wear nasal dilator to help improve airflow and alleviate the feeling of suffocation during wakefulness (see NasalDilator.com).
- Practise Ex 1 and/or Ex 5 whenever the nose feels congested.



MILDLY BLOCKED NOSE AT NIGHT (TAKEN FROM "CLOSE YOUR MOUTH")

- First clear nose by completing the nose decongesting exercise and rinse your nose with saline solution (described in Close Your Mouth).
- Wear MyoTape surrounding lips.
- While wearing the Myotape, your nose will never completely block. Your nose will partially congest if control pause is low. Remember, your nose will only congest completely if you switch to mouth breathing.
- Nose will continue to congest until CP is 20 seconds.

UNCOMFORTABLY BLOCKED NOSE AT NIGHT (TAKEN FROM "CLOSE YOUR MOUTH")

- Practice Ex 5B: Steps exercise (6 reps).
- Rinse your nose with sea salt and water.
- Wear Myotape surrounding your mouth.
- Wear nasal dilator. (NasalDilator.com)
- This will help overcome the feeling of suffocation during sleep.

MEDICATION

- When the morning CP increases to above 20 seconds, persons taking medication for hypertension, diabetes or thyroid should visit their medical doctor to have their medication evaluated.
- Persons taking asthma and rhinitis medication also need to have their medication evaluated.

KNOW WHEN TO REFER TO MEDICAL DOCTOR

- Practice six repetitions of Ex 5: Steps (create a strong air hunger).
- If child or adult can breathe through their nose for one minute, they can do so for life.
- If child or adult is unable to breathe through their nose for one minute, then request they visit medical doctor.

LIFESTYLE

- Processed foods
- Overeating
- Stress
- Excessive talking
- Lack of physical exercise
- High temperatures of houses/stuffy air

- Persons working in an office who are under stress and talking all day, eating processed foods with no time to do physical exercise have more work to do!

LOW CP AND MOUTH BREATHING CONTRIBUTE TO THE FOLLOWING:

- Snoring, sleep apnea
- Disrupted sleep
- Nightmares
- Asthma symptoms (3am-5am)
- Needing to use the bathroom at during sleep
- Children wetting the bed during sleep
- Fatigue first thing in morning
- Dry mouth upon waking
- Symptoms upon waking – blocked nose, wheezing, coughing or breathlessness

TO ACHIEVE A BETTER NIGHTS SLEEP

- Nose breathe only during sleep. Waking with a dry mouth indicates mouth breathing during sleep. Wear MyoTape or other to bring lips together to ensure nasal breathing during sleep. Provide your clients with tape and demonstrate how to apply. (MyoTape is available at discounted rate to Buteyko instructors)
- If the mouth is moist upon waking, there is no need for lip taping.
- Three quarters of the tongue pressed gently against the roof of the mouth to help open the airway
- Exposure to 15 minutes of daylight first thing in the morning helps with sleep later that day
- Practise breathing softly for fifteen minutes before sleep to activate the rest response
- Bedroom should be cool, airy, silent and dark
- Avoid blue light emitted from smart phone, laptop, TV and LED lights. To reduce insomnia, wear blue light filter glasses after 8pm.
- Don't eat late at night or drink alcohol

DIET

- Don't talk about diet until session three or four
- Water has no effect on breathing
- Processed foods increase breathing
- Raw food, most fruits and vegetables have less effect on breathing
- Some people are intolerant to different foods – if so better to remove these foods from the diet

PHYSICAL EXERCISE

- Physical exercise increases production of carbon dioxide.
- Never mouth breathe if the CP is less than 20 seconds.
- You can have your mouth open during sports for short periods of time when the CP is greater than 20 seconds.
- Avoid asthma attack by warming up, and warming down.

Create an air shortage

- Go faster with your mouth closed
- Breathe less during physical exercise
- Practice breath holds as described in EXERCISE 4

Determine if you are breathing correctly during physical exercise;

- Measure your CP before exercise
- Perform physical exercise
- Your CP measurement 30 minutes after exercise should be greater than your CP measurement before exercise

TAILORING EXERCISES TO CLIENTS

Ex 1

Nose unblocking exercise

Ex 2

Breathe Light to create air hunger

- Variation A: Hands On Chest And Tummy
- Variation B: Feather Breathing
- Variation C: Hands Cupping Face
- Variation D: Finger Blocking Nostril
- Variation E: Cadence Breathing (support with Buteyko Belt)

Ex 3

Breathe Light physical exercise

- Diaphragm (slow, light, deep)
- Finger blocking nostril

Ex 4

Walking with breath holds

- Increasing in increments of 5 paces

Ex 5

Steps exercise

- Breath hold to 10 paces
- Walking steps
- Running steps

Ex 6

Breathing recovery

Ex7

Mp3 Download

CATEGORIES OF CLIENT

1

Unwell, older person, CP less 10 seconds
Ex 2,3,6,7 (six by ten minute sessions daily)
Ex 5A (10 paces for severe asthma, COPD)

2

Sleep apnea, panic disorder, anxiety, high BP
Ex 2,3,6,7 (six by ten minute sessions daily)
Ex 2 Diaphragm (light, slow, deep)
Ex 5A (10 paces for panic disorder, anxiety)

3

Teenagers, children
Ex 1, 3, 5, 6 (Ex 5: 12 to 18 reps daily)
Anxiety (Ex 2 Diaphragm (light, slow, deep))
Severe asthma (Ex 5 with breath control)

4

Adult in relatively good health
Any of the exercises

PROGRAM FOR CATEGORY ONE FOR LOW CP, OLDER OR NOT WELL

- Breathe through nose both day and night.
- Practice Exercise 2 (gentle reduced breathing) for ten minutes by six times daily. (Only if it does not disrupt breathing. Otherwise practice Exercise 6).
  or
- Practice Exercise 6 (Many Small Breath Holds) for ten minutes by six times daily.
- Exercise 3: Gentle walking each day with mouth closed.
- If having symptoms during sleep, sleep in an upright position only.
- Set alarm to break sleep every two to three hours. If no symptoms, go back to sleep. If symptoms, practice many small breath holds to help get your breathing under control. Don't go to sleep until breathing is under control.
- Avoid excessive talking or other activities that will increase breathing.
- Eat food in small quantities.
- Never push yourself during physical exercise beyond the point where you lose control of your breathing. For example, getting up out of bed, roll over very gently and slowly walk to the bathroom, or out of the room. While climbing a stairs, take it one step at a time and rest as often as necessary. (especially applicable to severe asthma and COPD).

PROGRAM FOR CATEGORY TWO PANIC ATTACK, ANXIETY, SLEEP APNEA, HIGH BLOOD PRESSURE

- Breathe through nose both day and night.
- Exercise 2: Breathe Light biochemical: 30 minutes daily
  (15 minutes before sleep)
  Breathe Light biomechanical & cadence: 10 minutes daily
- Exercise 3: Walking with Mouth Closed: 30 minutes daily
- Exercise 6: Many Small Breath Holds if feeling stressed or anxious (10 minutes every hour)
- Exercise 7: Relaxation without air shortage
- Formally: 6 x 10 minutes daily.

Sleep apnea; may show unusually high control pause

- Lost sensitivity of chemoreceptors
- Concentrate on relaxation without air shortage
- Then practise relaxation with air shortage
- Cardio issues may be present

CATEGORY THREE
SEE PROTOCOL FOR CHILDREN & TEENAGERS

PROGRAM FOR CATEGORY FOUR

- Exercise 2: Reduce your breathing for ten minutes by three times daily.
- Exercise 3: Go for 20-minute walk during your lunch break.
- Exercise 4: Do five to ten breath holds throughout the walk.
- Exercise 5: Practice 20 repetitions of Steps daily if you have no contraindications.
- Ideally, spend a cumulative 60 minutes per day reducing your breathing.
- Formally: 6 x 10 minutes daily.

TEACHING BUTEYKO

- Client completes intake form.
  (available as word document from training portal)
- Small groups of 3 to 6 children or adults is ideal.
- Have separate group for children and adults.
- Arrange to see clients for one hour to one and half hours over five sessions. Two sessions on first week, one session a week apart thereafter.
- Observe clients throughout each session – get a sense of their breathing. Check if mouth open as they walk into your clinic etc. Listen for sighs.

Explain theory as this motivates. "You can improve your blood circulation by making simple changes to your breathing!"

- Better breathing.
- Better asthma control, less colds, chest infections, phlegm and post nasal drip.
- Better speech.
- Significantly less rhinitis.
- Improved sleep.
- Reduced breathlessness during physical exercise.
- Calmer mind.
- Improved concentration, focus and productivity.
- Exercise 2: Reduced breathing is the most important exercise.
- Your client may also be suited to the stronger breath hold exercises 4 and 5. – CP over 15 seconds, no contraindications, relatively good health.
- Begin each session with more gentle breath holds.
- Ensure that they don't overdo the strong breath holds.

TYPICAL FORMAT ADULTS

FIRST SESSION – ADULTS

"You get out what you put in!!"

- Goal is to understand the importance of nose breathing and light breathing
- Traits of dysfunctional breathing
- Measure the Control Pause and give feedback
- Exercise 6: Many small breath holds (5 minutes)
- Exercise 1: How to unblock the nose (6 repetitions)
- Exercise 2: Breathe Light (biochemical)
    - – 4 minutes: Hands on Chest and Tummy
    - – 4 minutes: Feather Breathing
    - – 4 minutes: Hands Cupping Face
    - – 4 minutes: Finger Blocking Nostril

If contraindications:
Start CP, RB, CP, RB, CP, RB, CP, RB, Final CP

If no contraindications:
Start CP, RB, MP, RB, MP, RB, MP, RB, Final CP

- All physical activity with mouth closed
- Tape mouth at night (provide MyoTape)
- Homework – practice exercises six times by ten minutes daily.

SECOND SESSION – ADULTS

- Progress on day two is usually mixed.
- Review progress of the group: practice? Mouth taped? Breathing lighter? Better awareness?
- Recap briefly: importance of nose breathing.
- Measure CP after resting for ten minutes.
- Exercise 6: Many small breath holds (5 minutes)
- Exercise 1: How to unblock the nose (6 repetitions)
- Exercise 2: Breathe Light (biochemical)
  - – 4 minutes: Hands on Chest and Tummy
  - – 4 minutes: Feather Breathing
  - – 4 minutes: Hands Cupping Face
  - – 4 minutes: Finger Blocking Nostril

If contraindications:
Start CP, RB, CP, RB, CP, RB, CP, RB, Final CP

If no contraindications:
Start CP, RB, MP, RB, MP, RB, MP, RB, Final CP

- Exercise 3: Walking with mouth closed – 5 minutes.
- Exercise 4: Walking with breath holds – 10 minutes.
- Homework – practice exercises six times by ten minutes daily.

THIRD SESSION – ADULTS

- Check progress, observe breathing.
- Recap briefly: importance of nose breathing.
- Measure CP after resting for ten minutes.
- Exercise 6: Many small breath holds (5 minutes)
- Exercise 1: How to unblock the nose (6 repetitions)
- Exercise 2: Breathe Light (biochemical, biomechanical, cadence)
  - – 4 minutes: Hands on Chest and Tummy
  - – 4 minutes: Feather Breathing
  - – 4 minutes: Hands Cupping Face
  - – 4 minutes: Finger Blocking Nostril

If contraindications:
Start CP, RB, CP, RB, CP, RB, CP, RB, Final CP

If no contraindications:
Start CP, RB, MP, RB, MP, RB, MP, RB, Final CP

- Exercise 3: Walking with mouth closed (5 minutes).
- Exercise 4: Walking with breath holds (10 minutes) or
- Exercise 5: Steps (6 repetitions).
- Talk about physical exercise.
- Talk about diet.
- Homework – practice exercises six times by ten minutes daily.

FOURTH AND FIFTH SESSION – ADULTS

- Check progress, observe breathing.
- Recap briefly: importance of nose breathing.
- Measure CP after resting for ten minutes.
- Exercise 6: Many small breath holds (5 minutes)
- Exercise 1: How to unblock the nose (6 repetitions)
- Exercise 2: Breathe Light (biochemical, biomechanical, cadence)
  - – 4 minutes: Hands on Chest and Tummy
  - – 4 minutes: Feather Breathing
  - – 4 minutes: Hands Cupping Face
  - – 4 minutes: Cadence Breathing

If contraindications:
Start CP, RB, CP, RB, CP, RB, CP, RB, Final CP

If no contraindications:
Start CP, RB, MP, RB, MP, RB, MP, RB, Final CP

- Exercise 3: Walking with mouth closed (5 minutes).
- Exercise 4: Walking with breath holds (10 minutes) or
- Exercise 5: Steps (6 repetitions).
- Homework – incorporate into your daily life.

NOTES

NOTES

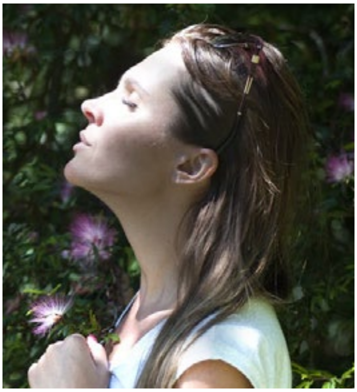
NOTES

CLASS 4

MOUTH BREATHING IN CHILDREN

MOUTH BREATHING (MB)

- The physiologic breathing mode in the human being is nasal, regardless of age.
- Any factor leading to upper airway (UA) obstruction causes nasal breathing to be replaced by mouth breathing, such as mechanical events, allergic and non allergic inflammatory diseases.



Brant TCS et al. Breathing pattern and thoracoabdominal motion in mouth-breathing children. Revista Brasileira de Fisioterapia. Volume 12, Issue 6. December, 2008.

- However, even after these mechanical factors are removed, MB continues in most cases due to patient's mouth breathing habit.

Mendez et al. Mouth breathing within a multidisciplinary approach: perception of orthodontists in the city of Recife, Brazil. Dental Press J. Orthod. Volume 16, Issue 6. 2011.

- The mouth breathing syndrome is characterized by a set of signs and symptoms, which may be present in subjects who replace an adequate and efficient nasal breathing mode by the mouth for a period equal or superior of six months.

Lopez Veron et al. Implicações da respiração oral na função pulmonar e músculos respiratórios. Revista CEFAC. Volume 18, Issue 1. Jan-Feb 2016.

- To identify the prevalence of mouth breathing in children 6 – 9 years, Portugal.
- 496 answered questionnaires from parents.
- 56.8% of children in this study breathed through their mouth.

Marques Felcar et al. Prevalence of mouth breathing in children from an elementary school. Ciênc. saúde coletiva. Volume 15, Issue 2. March 2010.

- 370 children randomly selected. Clinical assessment carried out.
- 55% of the children involved in the study were found to be mouth breathers.

Abreu et al. Prevalence of mouth breathing among children. J Pediatr (Rio J). Volume 84, Issue 5. September 29, 2008.

- 150 children in the sample, with ages ranging from 8 to 10 years.
- Two tests were carried out:
- Test 1 – breathe steam against a mirror.

- Test 2 – water remains in the mouth with lips closed for 3 minutes.
- Mouth breathing prevalence was 53.3%. There was no significant difference between gender, age and type of breathing.

De Menezes et al. Prevalence and factors related to mouth breathing in school children at the Santo Amaro project-Recife, 2005. Brazilian Journal of Otorhinolaryngology. Volume 72, Issue 3. May–June 2006.

- A questionnaire was given to parents
- 468 valid responses (45.2%)
- The prevalence's of MB Day and MB Sleep were 35.5% and 45.9%, respectively.
- Significant associations between Mouth Breathing (MBD) and atopic dermatitis.

Yamaguchi et al. Association between Mouth Breathing and Atopic Dermatitis in Japanese Children 2–6 years Old: A Population-Based Cross-Sectional Study. PLoS One. Volume 10, Issue 4. April 27, 2015.

RECOGNIZING ORAL BREATHING IN CHILDREN

- Why do children breathe through an open mouth?
- Air hunger or habit?
- Air hunger is caused by: enlarged adenoids, rhinitis, small nose, breathing pattern disorder.
- When addressing oral breathing in children, we need to eliminate the feeling of air hunger as well as change the behaviour.

- **110 orthodontists interviewed regarding clinical evaluation of MB**
- No standardization for clinical recognition of MB among orthodontists.
- The most common procedures performed were inefficient to recognize differences between MB by habit or obstruction.

Maria Christina Thomé Pacheco, Camila Ferreira Casagrande, Lícia Pacheco Teixeira, Nathalia Silveira Finck, Maria Teresa Martins de Araújo. Guidelines proposal for clinical recognition of mouth breathing children. DOI: http://dx.doi.org/10.1590/2176-9451.20.4.039-044.

GUIDELINES DEVELOPED AND TESTED IN 687 CHILDREN AGED BETWEEN 6 AND 12 YEARS

1. Visual assessment	
The dentist should assess at least the presence of the following characteristics:	
With the patient standing:	
» Lack of lip seal	( ) YES ( ) NO
» Posture changes	( ) YES ( ) NO
» Dark eye circles	( ) YES ( ) NO
» Long face	( ) YES ( ) NO

RECOGNIZING ORAL BREATHING

With the patient seated:

» Anterior open bite	( ) YES ( ) NO
» High narrow palate	( ) YES ( ) NO
» Gingivitis in maxillary incisors	( ) YES ( ) NO
2. Questions	
Questions should be directed to the child or parents	
Do you:	
» Sleep with your mouth open?	( ) YES ( ) NO
» Keep your mouth open when you are distracted?	( ) YES ( ) NO
» Snore?	( ) YES ( ) NO
» Drool on your pillow?	( ) YES ( ) NO
» Experience excessive daytime sleepiness?	( ) YES ( ) NO
» Wake up with a headache?	( ) YES ( ) NO
» Get tired easily?	( ) YES ( ) NO
» Often have allergies?	( ) YES ( ) NO
» Often have a stuffy nose and/or runny nose?	( ) YES ( ) NO
» Have difficulty in school?	( ) YES ( ) NO
» Have difficulty concentrating?	( ) YES ( ) NO

Maria Christina Thomé Pacheco et al. Guidelines proposal for clinical recognition of mouth breathing children. Dental Press J Orthod. 2015 July-Aug;20(4):39-44

3. Breathing tests

The child must be sitting. At least two tests should be performed.

a. Graded mirror test

After the second output of air on the mirror, mark the halo area with a marker (Fig 1).

(Low nasal flow: up to 30 mm; Average nasal flow: 30-60 mm; High nasal flow: above 60 mm)

b. Water retention test

Place water in the patient's mouth (approximately 15 ml) and ask him/her to hold it for 3 minutes.

c. Lip seal test

Seal the patient's mouth completely with a tape for 3 minutes.

Maria Christina Thomé Pacheco et al. Guidelines proposal for clinical recognition of mouth breathing children. Dental Press J Orthod. 2015 July-Aug;20(4):39-44

RECOGNIZING ORAL BREATHING

4. Training to eliminate the habit of mouth breathing

Training should be performed at home on a daily basis until the child is able to return to nasal breathing.

Lip seal test

Seal the child's mouth with masking tape when he/she is distracted or focusing his/her attention on another activity. Progressively increase the time each day until the child is able to breathe only through the nose for, at least, two consecutive hours.

Maria Christina Thomé Pacheco et al. Guidelines proposal for clinical recognition of mouth breathing children. Dental Press J Orthod. 2015 July-Aug;20(4):39-44

CHILDREN'S SLEEP

- Sleep disordered breathing (SDB) affects 12–15% of children, with the peak prevalence occurring during the preschool years (ages 3–5 y).

Lumeng JC, Chervin RD. Epidemiology of pediatric obstructive sleep apnea. Proc Am Thorac Soc. 2008;5:242–252. pmid:18250218

- Investigation of anatomical and sleep history risk factors that were associated with abrupt sleep-associated death in seven children with good pre-mortem history.
- History revealed presence of chronic indicators of abnormal sleep in all cases prior to death and history of an acute, often mild, rhinitis just preceding death in several.
- Four children, including three infants, were usually sleeping in a prone position. (lying on front)
- In all cases, there were features consistent with a narrow, small nasomaxillary complex, with or without mandibular retroposition.
- It was concluded that all children have died of hypoxia during sleep. Anatomic risk factors for a narrow upper airway can be determined early in life.
- Their presence should lead to greater attention to sleep-related complaints and indicate impairment of well been and presence of sleep disruption.

Rambaud C, Guilleminault C. Death, nasomaxillary complex, and sleep in young children. European Journal of Pediatrics. April 2012. 171(9):1349-58

- OSA has become widely recognized as a frequent and relatively common disorder with potentially serious clinical implications in childhood with a prevalence from 1% to 5% in the pediatric population.

Durdik et al. Sleep Architecture in Children With Common Phenotype of Obstructive Sleep Apnea. J Clin Sleep Med. Volume 14, Issue 1. January 15, 2018.

- The overall efficacy of adenotonsillectomy (AT) in treatment of obstructive sleep apnea syndrome (OSAS) in children is unknown. Although success rates are likely lower than previously estimated, factors that promote incomplete resolution of OSAS after AT remain undefined.

- Hypertrophy of adenotonsillar tissue is an undisputed major contributor to the development of OSAS in otherwise healthy children.

- Not all children with adenotonsillar hypertrophy suffer from OSAS.

Bhattacharjee et. at. Adenotonsillectomy Outcomes in Treatment of Obstructive Sleep Apnea in Children: A Multicenter Retrospective Study. American Journal of Respiratory and Critical Care Medicine. Volume 182, Issue 5. September 01, 2010.

- The amount of adenoid obstruction must be very large to affect airway resistance. However, if airway resistance in the nose is high, large adenoids would present a serious airway problem and cause predominantly mouth breathing.

Warren et al. Analysis of simulated upper airway breathing. American Journal of Orthodontics Volume 86, Issue 3.September 1984.

- Nevertheless, despite contributions by craniofacial structures, and by genetic and neuromuscular factors, the severity of OSAS has been associated, at least in part, with tonsillar and adenoidal size.
- American Academy of Pediatricians recommend adenotonsillectomy (AT) as the first line of treatment for childhood OSAS.
- Obstructive apneas are defined as the absence of airflow with continued chest wall and abdominal movement for duration of at least two breaths.
- Hypopneas are defined as a decrease in oronasal flow of greater than or equal to 50% with a corresponding decrease in SPO_2 of 3% or more or EEG arousal.
- 578 children (mean age, 6.9 ± 3.8 yr)
- 50% of included children were obese.
- AT resulted in a significant AHI reduction from 18.2 ± 21.4 to 4.1 ± 6.4/hour total sleep time.
- Of the 578 children, only 157 (27.2%) had complete resolution of OSAS (i.e., post-AT AHI <1/h total sleep time).
- AT leads to significant improvements in indices of sleep-disordered breathing in children.
- However, residual disease is present in a large proportion of children after AT, among older (>7 yr), obese children, chronic asthma.

Bhattacharjee et. at. Adenotonsillectomy Outcomes in Treatment of Obstructive Sleep Apnea in Children: A Multicenter Retrospective Study. American Journal of Respiratory and Critical Care Medicine. Volume 182, Issue 5. September 01, 2010.

The pathophysiological factors involved in OSA can be divided into:

1) anatomical factors that effectively reduce airway calibre.

2) increased upper airway collapsibility.

Airway calibre: craniofacial factors, e.g. a small or retro positioned mandible, a large or retro positioned tongue, increased pharyngeal fat pads, and hypertrophic upper airway lymphoid tissues (particularly of the adenoids and tonsils).

Airway collapsibility:

- Upper airway inflammation.
- Altered neurological reflexes involving respiratory control of upper airway muscles emerge as the most prominent.

Hui-Leng Tan, David Gozal et al. Obstructive sleep apnea in children: a critical update. Nat Sci Sleep. 2013; 5: 109–123.

- Most children with OSA have difficulty breathing through the nose. Allergic rhinitis is the most commonly cited disease, followed by hypertrophy of the tonsils and adenoids.

Popoaski et al. Evaluation from the quality of life in the oral breathers' patients. Arquivos Int. Otorrinolaringol. Volume 16, Issue 1. 2012.

- There is increasing evidence that medical therapy, in the form of intranasal steroids or montelukast, may be considered in mild OSA.

Hui-Leng Tan et al. Obstructive sleep apnea in children: a critical update. Nature and Science of Sleep Volume 5. September 25, 2013.

- Persistence of mouth breathing post T&A plays a role in progressive worsening of the AHI index.
- May frequently occur within 3 years.

Lee et al. Mouth breathing, "nasal disuse," and pediatric sleep-disordered breathing. Sleep Breath. Volume 19, Issue 4. December 2015.

- Treatment of pediatric obstructive-sleep-apnea (OSA) and sleep-disordered-breathing (SBD) means restoration of continuous nasal breathing during wakefulness and sleep.

- If nasal breathing is not restored, despite short-term improvements after adenotonsillectomy (T&A), continued use of the oral breathing route may be associated with abnormal impacts on airway growth and possibly blunted neuromuscular responsiveness of airway tissues.

Guilleminault et al.Towards Restoration of Continuous Nasal Breathing as the Ultimate Treatment. Goal in Pediatric Obstructive Sleep Apnea. Enliven: Pediatrics and Neonatal Biology. 2014.

- When teeth are absent or are extracted early in life during their growth, this can lead to bone retraction and affect the facial growth.
- 257 people age 14 – 30 years
- Extraction of wisdom teeth
- Patients had flow limitation between 50 – 90% of total sleep time
- Mean AHI of 7.5 events/h

Teeth agenesis and OSA

- 41 subjects
- Flow limitation for more than 50% of total sleep time
- Mean AHI of 7.3
- Tooth agenesis is common disorder
- 10-20% of studied population
- More common – one tooth missing
- 10% of cases – 2 teeth missing

Guilleminault et al. Pediatric sleep-disordered breathing: New evidence on its development. Sleep Medicine Reviews. Volume 24. December 2015.

- In our children recognised with SDB, at least 2 missing teeth.
- As infants – crying labelled as having colic, sleep disruption and difficulty feeding.
- Mallampati score of 3 or 4.
- High narrow palate associated with narrow maxilla.

Prematurity often associated with muscle hypotonia

- 400 premature infants.
- 292 indicated progressive development of obstructed breathing during sleep.
- Full term children – also at risk – mouth breathing.
- Some muscle activity limitations are easily recognisable at birth.
- Short anterior frenulum leading to abnormal feeding behaviour and speech development.
- All children in study with untreated short frenulum had SDB. All had narrow high palate.

Guilleminault et al. Pediatric sleep-disordered breathing: New evidence on its development. Sleep Medicine Reviews. Volume 24. December 2015.

- If the tongue is tied, then the baby may not be able to express milk from the mother.
- Very uncomfortable for the mother.
- Breast feeding causes manipulation of muscles necessary for craniofacial growth.

Guilleminault C, Bordeaux, France January 2016

- In fact restoration of nasal breathing during wake and sleep may be the only valid "complete" correction of pediatric sleep disordered breathing…

Lee et al. Mouth breathing, "nasal disuse," and pediatric sleep-disordered breathing. Sleep Breath. Volume 19, Issue 4. December 2015.

STUDY RESULTS

RESEARCH TO DETERMINE

- Controlled, randomized, single-blind study. Buteyko Method on asthmatic mouth breathing children. 35 children with mild or moderate asthma in the age group between 7 and 12 years.

- Buteyko Method group significantly improved the scores on sleep disturbances, wakefulness disorders, the number of days off school, forced vital capacity (FVC), peak expiratory flow and forced expiratory flow between 25% and 75% of FVC (FEF25-75%).

Karla M.P.P. Mendonca et al. Buteyko Method for Children with Asthma and Mouth Breathing: A Randomized Controlled Trial. American Journal of Respiratory and Critical Care Medicine 2017.

COGNITIVE AND BEHAVIORAL OUTCOMES

ADHD

- Statistically, if a child snores by the age of 8 and is untreated, there is an 80% chance the child will have a permanent 20% reduction in mental capacity.

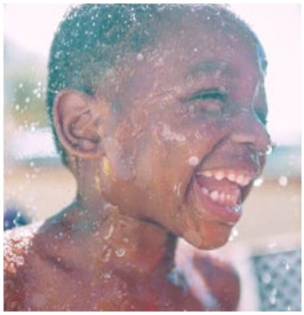
Catalano P, Walker J. (06/2018) *Understanding Nasal Breathing: The Key to Evaluating and Treating Sleep Disordered Breathing in Adults and Children*. Department of Otolaryngology, St. Medical Center, Tufts University School of Medicine Medical, MA, USA. Gavin Publishers Lisle Illinois

- Parents in the Avon Longitudinal Study of Parents and Children reported on children's snoring, witnessed apnea, and mouth breathing at 6, 18, 30, 42, and 57 months, from which SDB symptom trajectories, or clusters, were derived.
- Parent report of Special Educational Needs (SEN) at 8 years was available for 11,049 children with Sleep Disordered Breathing (SDB) data.
- SDB, overall, was associated with a near 40% increased odds of SEN.

Bonuck et al. Pediatric Sleep Disorders and Special Educational Need at 8 Years: A Population-Based Cohort Study. Pediatrics. Volume 130, Issue 4. October 2012.

- Ten healthy adults participated: five men and five women, mean age 36.2 ± 12.1 years. Not habitual mouth breathers.
- First, each participant breathed through his or her nose for 270s, with the mouth taped.
- Then participants breathed through the mouth for 270s, with nose taped.

- Deoxyhemoglobin increased with mouth breathing but decreased with nasal breathing, and the difference was significant. Mouth breathing increased oxygen load in the prefrontal cortex when compared with nasal breathing.



- It is possible that excessive oxygen consumption in the cortex causes central fatigue, and indeed, there is a report of lower transcutaneous oxygen tension during mouth breathing than during nasal breathing.

- Our results suggest that continued oxygen load on the prefrontal cortex from mouth breathing during the waking hours is one possible cause of ADHD arising from central fatigue.

Sano M, Sano S, Oka N, Yoshino K, Kato T. Increased oxygen load in the prefrontal cortex from mouth breathing: a vector-based near-infrared spectroscopy study. Neuroreport. 2013;24(17):935-940.

ACADEMIC PERFORMANCE

- Mouth breathers show cognitive impairment as well as attention deficit hyperactive disorder (memory, concentration, attention, learning disability, low perception and sensorimotor integration). It has been shown that children with excessive day time sleepiness appear to have almost 10 times the risk of learning difficulties.

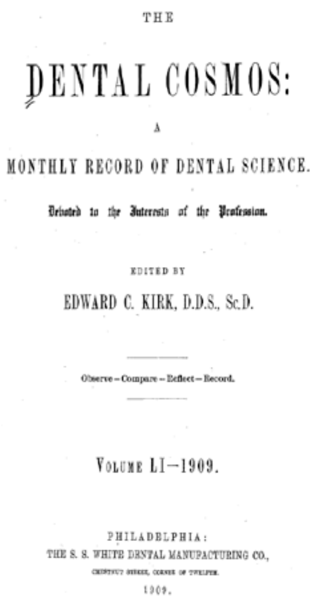
Bárbara Elena García Triana, Ahlam Hibatulla Ali, Ileana Bárbara Grau LeónMouth breathing and its relationship to some oral and medical conditions. May 2016.

- Cognitive function in children with varying severities of SDB and control children with no history of SDB.
- One hundred thirty-seven children (75 M) aged 7-12 were studied.
- There was lower general intellectual ability in all children with SDB regardless of severity (e.g. child snoring). Higher rates of impairment were also noted on measures of executive and academic functioning in children with SDB.

Bourke et al. Cognitive and academic functions are impaired in children with all severities of sleep-disordered breathing. Sleep Med. Volume 12, Issue 5. May 2011.

CRANIOFACIAL DEVELOPMENT

- The chin recedes
- The roof of the mouth is high
- The dental arches are contracted
- The teeth are in malocclusion
- Dryness of the mouth and throat in the morning
- Often accompanied by headache
- Restless sleep
- Bones of the face underdeveloped
- The face looks dull and expressionless
- Teachers will accuse children of being inattentive at the school



THE

DENTAL COSMOS:

A

MONTHLY RECORD OF DENTAL SCIENCE.

Devoted to the Interests of the Profession.

EDITED BY

EDWARD C. KIRK, D.D.S., Sc.D.

Observe—Compare—Reflect—Record.

VOLUME LI—1909.

PHILADELPHIA:
THE S. S. WHITE DENTAL MANUFACTURING CO.,
CHESTNUT STREET, CORNER OF TWELFTH.
1909.

DeLong, G.F. Habitual Mouth Breathing and Consequent Malocclusion of the Teeth. Dental Cosmos, Volume LI. 1909.

- Evidence from animal studies has been extrapolated to explain the human condition but total nasal obstruction, as produced by Harvold et al. in monkeys, is extremely rare in human beings.

K.W.Vig. Nasal obstruction and facial growth: The strength of evidence for clinical assumptions. American Journal of Orthodontics and Dentofacial Orthopedics Volume 113, Issue 6. June 1998.

Clinicians seek answers to questions such as:

- How much nasal obstruction is clinically significant?
- At what age is the onset of nasal obstruction critical?
- How long does obstruction of the nasal airway have to exist before a growth effect may be anticipated?
- Is this clinically relevant to Orthodontics?
- Is this a reversible situation and is there a time dependent relationship?
- These questions depend on the fundamental premise of being able to define nasal obstruction.

- Some years ago, Ballard and Gwynne-Evans reported their findings that lip incompetence was not necessarily associated with mouth breathing.
- Much of the data indicate that it is rare for a person to breathe 100% through the mouth and a more common mode of respiration is a combination of simultaneous oral and nasal airflow.
- Linder-Aronson reported in a group of children who had adenoidectomy that they returned to nasal breathing and demonstrated craniofacial growth changes. These changes in breathing mode and mandibular and maxillary growth were measured 5 years after adenoidectomy as was the incisor position.

- Conversely, Bushey found no relationship between nasal respiration and linear measurements of the adenoids on lateral skull cephalograms before and after surgical removal of the tonsils and adenoids.

K.W.Vig. Nasal obstruction and facial growth: The strength of evidence for clinical assumptions. American Journal of Orthodontics and Dentofacial Orthopedics Volume 113, Issue 6. June 1998.

- Clearly, more objective tests are required, and unambiguous criteria must be established if airway impairment is to be adequately defined and its etiologic significance in relationship to facial growth determined. Only when this issue is resolved will the clinical impact of respiratory function be clarified and the appropriate interventions advocated.
- We need to reliably identify nasorespiratory function and quantify the degree of obstruction.
- Comparison of persons matched for age and gender with and without nasal obstruction should provide the clinician with information of any clinically relevant differences in facial morphologic characteristics.

K.W.Vig. Nasal obstruction and facial growth: The strength of evidence for clinical assumptions. American Journal of Orthodontics and Dentofacial Orthopedics Volume 113, Issue 6. June 1998.

FURTHER MATERIAL

BREATHING FOR WOMEN

- Sex affects breathing control and vulnerability to some respiratory diseases. Women demonstrate better recovery after a severe episode of hypoxia, and there are differences in sleep apnea and heart rate variability.

Gargaglioni, Luciane H., Danuzia A. Marques, and Luis Gustavo A. Patrone. "Sex differences in breathing." Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology (2019): 110543.

- Where the influence of gender is disregarded, the progress of scientific knowledge can only be held back.

Cahill, Larry. "Why sex matters for neuroscience." Nature reviews neuroscience 7, no. 6 (2006): 477-484.

- When women take part in studies, researchers often fail to take into account the fluctuations in hormone levels that occur during the menstrual cycle. This is despite the fact that the menstrual cycle is one of the most important biological rhythms that modulates the physiological processes of living beings.
- Airflow and gas exchange are known to be among the many vital functions that change during the menstrual cycle, and studies have demonstrated, for example, that the ventilatory response to hypoxia and hypercapnia vary throughout the 28-days, in connection with hormonal fluctuations.

Farha, Samar, Kewal Asosingh, Daniel Laskowski, Jeffrey Hammel, Raed A. Dweik, Herbert P. Wiedemann, and Serpil C. Erzurum. "Effects of the menstrual cycle on lung function variables in women with asthma." American journal of respiratory and critical care medicine 180, no. 4 (2009): 304-310.

DIFFERENCES IN DEVELOPMENT AND RESPIRATORY FUNCTION

- Women have lower ventilation than men, which is in part due to factors such as smaller airway, ribcage size, lung volume, and a diaphragm that is around 9 percent shorter.

LoMauro, Antonella, and Andrea Aliverti. "Sex differences in respiratory function." Breathe 14, no. 2 (2018): 131-140

- In 1905 it was first found that the resting pressure of blood carbon dioxide was around 8 percent lower in women than in men, and this finding has been confirmed in more recent decades.
- In 1915, it was found that women hyperventilate during the luteal phase of their menstrual cycle, and in 1929, research confirmed that the cyclic variations in ventilation are no longer present in post-menopausal women. This last fact clearly links breathing with fluctuations in sex hormones.

Gargaglioni, Luciane H., Danuzia A. Marques, and Luis Gustavo A. Patrone. "Sex differences in breathing." Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology (2019): 110543.

- Female hormone progesterone, which is known to stimulate breathing, might contribute to respiratory changes seen at different times during the menstrual cycle.

Slatkovska, Lubomira, Dennis Jensen, Gregory AL Davies, and Larry A. Wolfe. "Phasic menstrual cycle effects on the control of breathing in healthy women." Respiratory physiology & neurobiology 154, no. 3 (2006): 379-388.

- The menstrual cycle influences epilepsy, bipolar disorder, migraine and rheumatoid arthritis. Respiratory symptoms such as breathlessness, coughing and wheezing vary considerably over the 28 days. These become worse between days ten and twenty-two (the mid-luteal to mid-follicular phases, possibly due to the influence of hormonal changes on the airways).

Macsali, Ferenc, Cecilie Svanes, Robert B. Sothern, Bryndis Benediktsdottir, Line Bjørge, Julia Dratva, Karl A. Franklin et al. "Menstrual cycle and respiratory symptoms in a general Nordic–Baltic population." American journal of respiratory and critical care medicine 187, no. 4 (2013): 366-373.

Macsali, Ferenc, Cecilie Svanes, Line Bjørge, Ernst R. Omenaas, Francisco Gómez Real, Hutchinson, Mathers et al. "Respiratory health in women: from menarche to menopause." Expert review of respiratory medicine 6, no. 2 (2012): 187-202.

PAIN, FIBROMYALGIA AND 'MEDICALLY UNEXPLAINED' SYMPTOMS

- Increased respiratory rates during the luteal phase of the menstrual cycle, when progesterone levels increase. At the same time as breathing increased, it was found that pain thresholds reduced. This indicates that cyclic respiratory changes may influence pain perception.
- In a 2007 paper, researchers found that several participants fulfilled the diagnostic criteria for fibromyalgia during the luteal phase of their cycle, but not during the follicular phase. As pain is the most commonly used diagnostic measure of fibromyalgia, this too indicates that pain perception differs depending on the concentration of sex hormones present in the body.

Dunnett, Alenka J., Dianne Roy, Andrew Stewart, and John M. McPartland. "The diagnosis of fibromyalgia in women may be influenced by menstrual cycle phase." Journal of Bodywork and Movement Therapies 11, no. 2 (2007): 99-105.

- Dysfunctional breathing can aggravate pain associated with fibromyalgia, especially in tender areas in the upper body. This can lead to fatigue and difficulty carrying out normal daily activities.
- One 2018 study examined the effects of breathing exercises on pain tolerance in tender points, and on quality of life in fibromyalgia patients. The trial involved thirty-five women aged between 34 and 67 years, all of whom had fibromyalgia. The women were randomly assigned either to a breathing exercise group or a control group.
- The breathing exercise participants practiced for 30 minutes every day for twelve weeks. At the end of the twelve-week period the women who had practiced breathing exercises showed significant improvements, experiencing much lower levels of pain and fatigue and becoming more able to engage with daily life.
- Researchers concluded that breathing exercises provide a "real and effective intervention" for women with fibromyalgia.

Tomas-Carus, Pablo, Jaime C. Branco, Armando Raimundo, Jose A. Parraca, Nuno Batalha, and Clarissa Biehl-Printes. "Breathing exercises must be a real and effective intervention to consider in women with fibromyalgia: a pilot randomized controlled trial." The Journal of Alternative and Complementary Medicine 24, no. 8 (2018): 825-832.

- A 2017 paper assessed the impact of an eight-week functional breathing program on 18 patients with fibromyalgia. Pain tolerance thresholds increased in all the participants after one month. Sleep quality, duration and efficiency also improved as a result of the breathing practice.

Garrido, M., M. Y. Castaño, C. Biehl-Printes, M. A. Gomez, J. C. Branco, P. Tomas-Carus, and A. B. Rodriguez. "Effects of a respiratory functional training program on pain and sleep quality in patients with fibromyalgia: a pilot study." Complementary therapies in clinical practice 28 (2017): 116-121.

- Faulty breathing does not cause fibromyalgia. However, it does play a significant role in the development and persistence of chronic pain conditions.

- The biomechanical overuse and biochemical changes typical of breathing pattern disorders can have a significant impact on pain and fatigue.

Leon Chaitow, ND, DO. "How Breath Can Impact Fibromyalgia Pain." Associated Bodywork & Massage Professionals (January 2017)
https://www.abmp.com/textonlymags/article.php?article=1639

Chaitow, Leon. "Breathing pattern disorders, motor control, and low back pain." Journal of osteopathic medicine 7, no. 1 (2004): 33-40.

- Progesterone stimulates the respiratory rate, meaning that in the luteal phase of the menstrual cycle, carbon dioxide levels drop by around 25 percent. Any extra stress can cause breathing to speed up even further when CO_2 levels are already low, and this creates a range of symptoms that are commonly interpreted as premenstrual syndrome.

- Research shows that 27 percent of people with fibromyalgia hyperventilate, that 60 percent of fibromyalgia patients suffer with dyspnea (breathlessness), and that breathlessness is far more prevalent in patients with the highest levels of pain.

Leon Chaitow, ND, DO. "How Breath Can Impact Fibromyalgia Pain." Associated Bodywork & Massage Professionals (January 2017)

Ghildiyal, A., B. Iqbal, S. Singh, D. Verma, and S. Singh. "Changes in sympathovagal balance during menstural cycle." Current Neurobiology 2, no. 1 (2011): 49-52.

Naschitz, Jochanan E., Renata Mussafia-Priselac, Yulia Kovalev, Natalia Zaigraykin, Nizar Elias, Itzhak Rosner, and Gleb Slobodin. "Patterns of hypocapnia on tilt in patients with fibromyalgia, chronic fatigue syndrome, nonspecific dizziness, and neurally mediated syncope." The American journal of the medical sciences 331, no. 6 (2006): 295-303.

Çetin, Alp, and Ayşen Sivri. "Respiratory function and dyspnea in fibromyalgia syndrome." Journal of Musculoskeletal Pain 9, no. 1 (2001): 7-15.

- Poor oxygenation of the tissues during hyperventilation contributes to the development of myofascial trigger points. And because the diaphragm is linked to the proper function of the pelvic floor, dysfunctional breathing exacerbates stress incontinence, other genitourinary symptoms, and pain in the pelvic region – all of which are common in fibromyalgia.

Haugstad, Gro K., Tor S. Haugstad, Unni M. Kirste, Siv Leganger, Slawomir Wojniusz, Inger Klemmetsen, and Ulrik F. Malt. "Continuing improvement of chronic pelvic pain in women after short-term Mensendieck somatocognitive therapy: results of a 1-year follow-up study." American journal of obstetrics and gynecology 199, no. 6 (2008): 615-e1.

PELVIC FLOOR FUNCTION AND THE BREATH

- Women with chronic pelvic pain frequently breathe into the upper chest. They have poor coordination in basic functions such as sitting, standing and walking, and very stiff muscles in the lower back and hips.

- Dr. Leon Chaitow explained that when normal diaphragmatic breathing is restored and the pelvic floor muscles are relaxed, it is actually relatively easy to re-establish function in the pelvic floor.

Leon, Chaitow. Interview with Tracy McLoughlin. "Women's health, the Pelvic Floor Paradox and a Naturopathic approach." Cam, Published September 2007: 46-48 http://blog.polestarpilates.com/hq/wp-content/uploads/2019/04/womens_health_the_pelvic_floor.pdf (accessed May 16, 2020).

PAIN, FIBROMYALGIA AND 'MEDICALLY UNEXPLAINED' SYMPTOMS

- It has been observed that women who suffer from chronic pelvic pain often have poor functional movement and tend to breathe predominantly into the upper chest.

Haugstad, Gro K., Tor S. Haugstad, Unni M. Kirste, Siv Leganger, Slawomir Wojniusz, Inger Klemmetsen, and Ulrik F. Malt. "Continuing improvement of chronic pelvic pain in women after short-term Mensendieck somatocognitive therapy: results of a 1-year follow-up study." American journal of obstetrics and gynecology 199, no. 6 (2008): 615-e1.

- Leon Chaitow: 50 years clinical experience working with fibromyalgia patients, estimated that more than 90 percent breathe dysfunctionally.
- Between 12 and 26 weeks' work may be necessary, and it takes patience to achieve behavioral change.

Leon Chaitow, ND, DO. "How Breath Can Impact Fibromyalgia Pain." Associated Bodywork & Massage Professionals (January 2017)

- The ability to exhale fully is at the root of functional breathing. Without this understanding, it is not possible to inhale correctly.
- As with exercises for any other anxiety or pain related condition, it is also important to begin the practice gently. If you suffer with fibromyalgia, your sensitivity to carbon dioxide may be very high. This can trigger too much air hunger, muscular tension and feelings of panic. As your tolerance to CO_2 increases, and your Control Pause score improves, these feelings will ease.

Han, J. N., K. Stegen, Chris De Valck, J. Clement, and K. P. Van de Woestijne. "Influence of breathing therapy on complaints, anxiety and breathing pattern in patients with hyperventilation syndrome and anxiety disorders." Journal of psychosomatic research 41, no. 5 (1996): 481-493.

Leon Chaitow, ND, DO. "How Breath Can Impact Fibromyalgia Pain." Associated Bodywork & Massage Professionals (January 2017)

TEMPOROMANDIBULAR JOINT DISORDER

- Gender differences in pain sensitivity are sometimes almost dismissed as matters of psychosocial and social conditioning. Increasingly, however, it is believed that hormonal and other biological factors also contribute.

- Temporomandibular joint disorder is around 1.5 to 2 times more prevalent in women and can be much worse than in men.

Bartley, Jim. "Breathing and temporomandibular joint disease." Journal of Bodywork and movement therapies 15, no. 3 (2011): 291-297.

Craft, Rebecca M., Jeffrey S. Mogil, and Anna Maria Aloisi. "Sex differences in pain and analgesia: the role of gonadal hormones." European journal of pain 8, no. 5 (2004): 397-411.

Wiesenfeld-Hallin, Zsuzsanna. "Sex differences in pain perception." Gender medicine 2, no. 3 (2005): 137-145.

Warren, Michelle P., and Joanna L. Fried. "Temporomandibular disorders and hormones in women." Cells Tissues Organs 169, no. 3 (2001): 187-192.

- The estrogen hormone, estradiol (E2), which is the primary female sex hormone, has been found to be a risk factor for temporomandibular pain in rats. And incidence in women is thought to peak between 20 and 40 years, coinciding with reproductive function and decreasing in menopause when ovarian estrogen production declines.

Wikipedia contributors, "Estradiol," Wikipedia, The Free Encyclopedia, https://en.wikipedia.org/w/index.php?title=Estradiol&oldid=954929458 (accessed May 30, 2020).

Tashiro, A., Keiichiro Okamoto, and David A. Bereiter. "NMDA receptor blockade reduces temporomandibular joint-evoked activity of trigeminal subnucleus caudalis neurons in an estrogen-dependent manner." Neuroscience 164, no. 4 (2009): 1805-1812.

Warren, Michelle P., and Joanna L. Fried. "Temporomandibular disorders and hormones in women." Cells Tissues Organs 169, no. 3 (2001): 187-192.

LeResche, Linda, Lloyd Mancl, Jeffrey J. Sherman, Beatrice Gandara, and Samuel F. Dworkin. "Changes in temporomandibular pain and other symptoms across the menstrual cycle." Pain 106, no. 3 (2003): 253-261.

- Scientists have demonstrated that hyperventilation during the second part of the menstrual cycle can contribute to temporomandibular pain.
- This is partly due to hyperventilation-induced adaptations in posture, and to changes in the blood acid-base balance.
- For instance, the respiratory alkalosis that occurs when blood CO_2 drops is known to cause muscle pain, and over-breathing can cause a forward head posture.
- The pain associated with temporomandibular disorder increases towards the latter part of the menstrual cycle, peaking in the first three days of menstruation when progesterone levels peak and then decline.

- Hyperventilation, both during rest and following physical exertion "may cause severe, acute, 'explosive' headaches," and that these could be prevented with the use of relaxation exercises and physical therapy.

Hoff, J. I., B. R. Bloem, M. D. Ferrari, and G. J. Lammers. "A breathtaking headache." Journal of Neurology, Neurosurgery & Psychiatry 75, no. 3 (2004): 509-509.

- A pilot study from 2018 explored whether migraines were caused by poor oxygen delivery to the brain.
- Hypercapnia (high blood CO_2) increases cerebral oxygenation by dilating the blood vessels in the brain. This has been found to stop the onset of migraines.

Fuglsang, Cecilia H., Troels Johansen, Kai Kaila, Helge Kasch, and Flemming W. Bach. "Treatment of acute migraine by a partial rebreathing device: A randomized controlled pilot study." Cephalalgia 38, no. 10 (2018): 1632-1643.

MIGRAINE IN WOMEN

- Partial re-breathing device increased end tidal CO_2 by 24 percent and maintained oxygen saturation at over 97 percent.
- The intensity of headache symptoms after two hours was significantly less with the re-breathing device. What's more the device became more effective the more it was used, with even better results for consecutive treatments.
- Hyperventilation provoked by "excitement, anxiety, or expectation of physical or sexual activity" could trigger migraine by constricting the blood vessels.

Fuglsang, Cecilia H., Troels Johansen, Kai Kaila, Helge Kasch, and Flemming W. Bach. "Treatment of acute migraine by a partial rebreathing device: A randomized controlled pilot study." Cephalalgia 38, no. 10 (2018): 1632-1643.

SLEEP DISORDERED BREATHING IN WOMEN

- There is a higher prevalence of sleep apnea in men.
- But once women reach menopause, there is an increase in incidence of around 200 percent.

Gargaglioni, Luciane H., Danuzia A. Marques, and Luis Gustavo A. Patrone. "Sex differences in breathing." Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology (2019): 110543.

- Research has shown that premenopausal women with severe OSA have a much lower progesterone concentration than healthy women and women with mild OSA.
- According to a 2018 study, the fact that the gender difference in sleep apnea prevalence decreases after menopause indicates that the menopausal status itself plays a part in OSA phenotypes.

Stavaras, C., C. Pastaka, M. Papala, S. Gravas, V. Tzortzis, M. Melekos, G. Seitanidis, and K. I. Gourgoulianis. "Sexual function in pre-and post-menopausal women with obstructive sleep apnea syndrome." International journal of impotence research 24, no. 6 (2012): 228-233.

Perger, Elisa, Paola Mattaliano, and Carolina Lombardi. "Menopause and sleep apnea." Maturitas (2019).

- Another contributing factor is a change in the way body fat is distributed. After the menopause, women are likely to have more body fat, and this tends to be concentrated in the upper body, where fat on the tongue, neck and abdomen is a common anatomical factor in sleep apnea.
- The results of a 1988 study comparing incidence of sleep-disordered breathing in obese men and women found that obese women have increased chemosensitivity to hypoxia and hypercapnia when compared with women of a healthy weight.

ANXIETY DISORDERS

- Women are between two and three times more likely to develop panic disorder than men.

Gargaglioni, Luciane H., Danuzia A. Marques, and Luis Gustavo A. Patrone. "Sex differences in breathing." Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology (2019): 110543.

- According to a 2019 review, studies have demonstrated that women with panic disorder experience worsening of their panic symptoms and anxiety during the pre-menstrual phase of their cycle.
- Studies in rats have shown that withdrawal of the female hormone progesterone increased susceptibility to panic-related anxiety, indicating that the lower levels of progesterone during the days before the period may be a trigger.

Nillni, Yael I., Kelly J. Rohan, and Michael J. Zvolensky. "The role of menstrual cycle phase and anxiety sensitivity in catastrophic misinterpretation of physical symptoms during a CO 2 challenge." Archives of women's mental health 15, no. 6 (2012): 413-422.

Sigmon, Sandra T., Diana M. Dorhofer, Kelly J. Rohan, Lisa A. Hotovy, Nina E. Boulard, and Christine M. Fink. "Psychophysiological, somatic, and affective changes across the menstrual cycle in women with panic disorder." Journal of consulting and clinical psychology 68, no. 3 (2000): 425.

Doornbos, Bennard, Dirk S. Fokkema, Margo Molhoek, Marit AC Tanke, Folkert Postema, and Jakob Korf. "Abrupt rather than gradual hormonal changes induce postpartum blues-like behavior in rats." Life sciences 84, no. 3-4 (2009): 69-74.

- Research has shown an increase in panic symptoms (often interpreted as hot flashes) and anxiety in women experiencing the menopausal transition, suggestion that panic disorder may be linked to fluctuations in sex hormones.

Bromberger, Joyce T., Howard M. Kravitz, Yuefang Chang, John F. Randolph Jr, Nancy E. Avis, Ellen B. Gold, and Karen A. Matthews. "Does risk for anxiety increase during the menopausal transition? Study of Women's Health Across the Nation (SWAN)." Menopause (New York, NY) 20, no. 5 (2013): 488.

- Onset of panic symptoms with heightened sensitivity to blood carbon dioxide, it makes sense that hyperventilation, which occurs at certain points in the menstrual cycle, may produce cyclic exacerbations of anxiety.
- When all the connections between hyperventilation, hormones and panic disorder are taken together, it is logical that sex hormones can contribute to anxiety in women.

- One recent paper concluded that it is of great importance that future research examines anxiety in females, so that results can be more accurate and applicable to women.

Marques, Alessandra Aparecida, Mário Cesar do Nascimento Bevilaqua, Alberto Morais Pinto da Fonseca, Antonio Egidio Nardi, Sandrine Thuret, and Gisele Pereira Dias. "Gender differences in the neurobiology of anxiety: focus on adult hippocampal neurogenesis." Neural Plasticity 2016 (2016).

FEMALE SEX HORMONES AND THE BREATH PMS

- The symptoms of premenstrual syndrome (PMS) are directly related to hyperventilation.
- In a 2006 study it was found that women with PMS experience a much greater decline in blood carbon dioxide in the premenstrual phase than women who do not experience symptoms.
- As progesterone increases and blood CO_2 decreases, symptoms appear. When the luteal phase ends, progesterone decreases, CO_2 levels normalize, and symptoms disappear.
- The study concluded that women with PMS have a higher-than-normal sensitivity to CO_2, perhaps caused by progesterone, resulting in "pronounced hyperventilation" – and that the hyperventilation is responsible for the symptoms.
- The authors commented that because the breath can be easily manipulated using a variety of techniques including respiratory and biofeedback training, it would be promising to explore this phenomenon in more detail in order to understand the mechanisms underlying PMS, and to find more effective ways to treat it at least for some women.

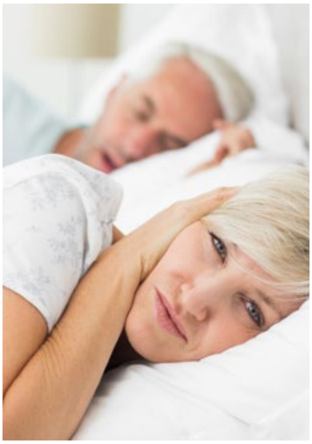
Ott, Helmut W., Verena Mattle, Ulrich S. Zimmermann, Peter Licht, Kay Moeller, and Ludwig Wildt. "Symptoms of premenstrual syndrome may be caused by hyperventilation." Fertility and sterility 86, no. 4 (2006): 1001-e17.

NOTES

ASTHMA

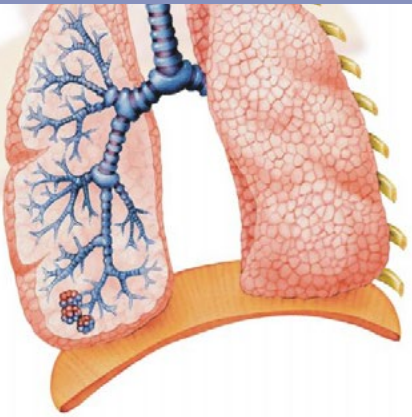
- "Noisy and deep" breathing of an asthmatic had always been considered an outcome of the disease. Nobody could even suspect that "deep breathing" was the cause of bronchial asthma, and increased depth of breathing could provoke the appearance of the symptoms of the disease".

  K P Buteyko MD



BREATHING MINUTE VOLUME

- Normal breathing minute volume is 4-6 litres (W.H.O.)



MINUTE VENTILATION ASTHMA

- 15 litres minute ventilation

Johnson BD, Scanlon PD, Beck KC, Regulation of ventilatory capacity during exercise in asthmatics ,J Appl Physiol. 1995 Sep; 79(3): 892-901.

- Resting minute ventilation 13.3 +/- 2.0 L/min
- Exercise minute ventilation 41.9 +/- 9.0 L/min

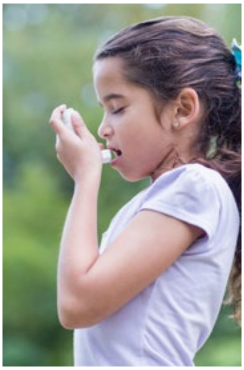
Chalupa DC, Morrow PE, Oberdörster G, Utell MJ, Frampton MW, Ultrafine particle deposition in subjects with asthma. Environmental Health Perspectives 2004 Jun; 112(8): p.879-882.

- 14.1 litres minute ventilation

Bowler SD, Green A, Mitchell CA, Buteyko breathing techniques in asthma: a blinded randomised controlled trial. Med J of Australia 1998; 169: 575-578.

ORAL BREATHING AND ASTHMA

- We speculate that asthmatics may have an increased tendency to switch to oral breathing, a factor that may contribute to the pathogenesis of their asthma.



Kairaitis K, Garlick SR, Wheatley JR, Amis TC. Route of breathing in patients with asthma. Chest. 1999 Dec;116(6):1646-52.

- Enforced oral breathing causes a decrease in lung function in mild asthmatic subjects at rest, initiating asthma symptoms in some. Oral breathing may play a role in the pathogenesis of acute asthma exacerbations.

Hallani M, Wheatley JR, Amis TC. Enforced mouth breathing decreases lung function in mild asthmatics. Respirology. 2008 Jun;13(4):553-8.

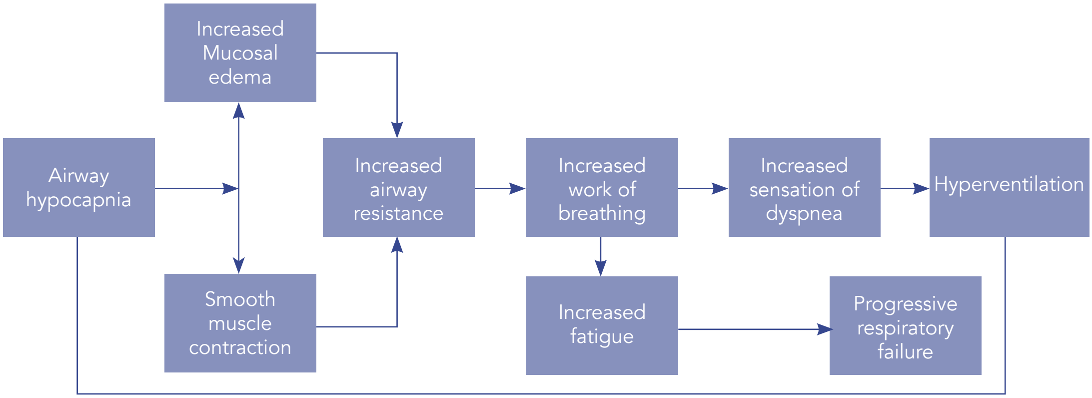
- Enhanced perception of nasal loading may trigger increased oral breathing in asthmatics, potentially enhancing exposure to nonconditioned inhaled gas and contributing to the occurrence and/or severity of bronchoconstrictive exacerbations.

Hallani M, Wheatley JR, Amis TC. Initiating oral breathing in response to nasal loading: asthmatics versus healthy subjects. Eur Respir J. 2008 Apr;31(4):800-6.

- Most subjects spontaneously breathed with their mouths open when instructed to breathe "naturally."
- The instruction to breathe only through the nose during exercise led to an almost complete inhibition of the post-exercise bronchoconstrictive airway response.
- When instructed to breathe only through the mouth during exercise, an increased bronchoconstrictive airway response occurred, as measured by spirometry, flow-volume relationships, and body plethysmography. These findings suggest that the nasopharynx and the oropharynx play important roles in the phenomenon of exercise-induced bronchoconstriction.

Shturman-Ellstein R, Zeballos RJ, Buckley JM, Souhrada JF. The beneficial effect of nasal breathing on exercise-induced bronchoconstriction. Am Rev Respir Dis. 1978 Jul;118(1):65-73.

HYPOCAPNIA AND ASTHMA



Laffey, J. & Kavanagh, B. Hypocapnia, New England Journal of Medicine. 4 July 2002.

- Asthmatic group had a significantly higher resting respiratory frequency and minute ventilation, and had lower mean end-tidal carbon dioxide (ET CO_2) [37 mm Hg] than the other two groups (40 mm Hg and 41 mm Hg,respectively).

Hormbrey, J, Jacobi, MS, Patil, CP, Saunders, KB. CO2 response and pattern of breathing in patients with symptomatic hyperventilation, compared to asthmatic and normal subjects. Eur Respir J. 1988; 1:846-51.

- 30 asthmatic and 15 healthy volunteers. Asthmatic group had lower mean resting ET CO_2 when compared to the healthy subjects (36 mm Hg v's 40 mm Hg).

F.J.J. van den Elshout, C.L.A. Van Herwaarden, H.T.M. Folgering. Effects of hypercapnia and hypocapnia on respiratory resistance in normal and asthmatic subjects. Thorax; 1991; 46(1): 28-32.

- "Hypocapnia due to voluntary hyperventilation in man causes increased resistance to airflow." Furthermore, when subjects inhaled an air mixture containing five per cent carbon dioxide "bronchoconstriction was prevented, indicating that it had been due to hypocapnia, not to mechanical factors associated with hyperventilation."

G.M. Sterling. The Mechanism of Bronchoconstriction due to hypocapnia in man. Clin Sci. 1968; 34(2), 277-85.

- Mild asymptomatic asthma is not associated with clinically significant hyperventilation, but is associated with a significant reduction in both arterial and end tidal PCO_2, which relates to airway hyperresponsiveness rather than to the degree of airway obstruction or mucosal inflammation. Anxiety and depression appear not to be implicated.

C A Osborne, B J O'Connor, A Lewis, V Kanabar, W N Gardner. Hyperventilation and asymptomatic chronic asthma. Thorax. 2000 Dec; 55(12):1016-22.

- Maximum expiratory flow decreased significantly when the alveolar CO_2 tension was below 30 – 35 mm Hg, while there was only slight or no influence of CO_2 on the maximal flow when the tension was above 35 mm Hg. The decrease is taken as evidence of a constrictor effect on peripheral bronchi of hypocapnia

Nielsen TM, Pedersen OF. The effect of CO_2 on peripheral airways. Acta Physiol Scand. Oct 1976;98(2):192-9.

- It is possible that hypocapnia creates symptoms that asthma patients cannot control by using their anti-asthmatic medication, thus compromising their perceived control over the management of their asthma, and consequently their perceived health. Behavioural interventions should address the problem of hyperventilation in asthma.

Ritz T, Rosenfield D, Meuret AE, Bobb C, Steptoe A. Hyperventilation symptoms are linked to a lower perceived health in asthma patients. Ann Behav Med. Feb 2008;35(1):97-104.

- With the severe load, minute ventilation and respiratory frequency were significantly lower and $PETCO_2$ was significantly higher during nasal breathing than during oral breathing.

Nishino T, Kochi T. Department of Anesthesia, National Cancer Center Hospital East, Chiba, Japan. Breathing route and ventilatory responses to inspiratory resistive loading in humans. Am J Respir Crit Care Med. Sep 1994;150(3):742-6.

CHRONIC HYPERVENTILATION & ASTHMA

Why does chronic hyperventilation syndrome receive very little attention in the treatment of asthma?

1) It is very difficult to make a diagnosis of hyperventilation in laboratory tests.

2) Secondly "no mention is made of any link" between hyperventilation syndrome and asthma.

Demeter SL, Cordasco EM. Hyperventilation Syndrome and Asthma. The American Journal of Medicine; December 1986; 81(6): 989-94.

3) "Hyperventilation, leading to airways cooling, will cause bronchoconstriction in vulnerable individuals" but, "because attacks of asthma are accompanied by hyperventilation of physiological origin, the role of hyperventilation in causing asthma attacks may be overlooked".

Hibbert et al. British Journal of Psychiatry; 1988; 153, 687-689; Demonstration and treatment of hyperventilation causing asthma.

- Resulting in "patients may be experiencing avoidable morbidity because of inappropriate diagnoses and ineffective treatment."

Thomas M, McKinley RK, Freeman E, Foy C. Prevalence of dysfunctional breathing in patients treated for asthma in primary care. BMJ. 2001;322:1098–1100.

COOLING OR DEHYDRATION OF THE AIRWAYS

- Significant bronchoconstriction was induced in asthmatic children by voluntary hyperventilation of 3-min and 10-min duration.
- In both hyperventilation and exercise, nasal breathing inhibited the bronchoconstrictive responses, whereas mouth breathing potentiated the bronchoconstrictive response.
- In the asthmatic children, 10 min of voluntary isocapnic (carbon dioxide remains constant) hyperventilation did not represent a greater bronchoconstrictive stimulus than did 10 min of exercise or 3 min of isocapnic hyperventilation.
- Finally, this study indicates that it is the stimulation of upper airway receptors by relatively cold and dry air, rather than hyperventilation per se, that provokes exercise-induced bronchoconstriction.

Zeballos RJ, Shturman-Ellstein R, McNally JF Jr, Hirsch JE, Souhrada JF. The role of hyperventilation in exercise-induced bronchoconstriction. Am Rev Respir Dis. 1978 Nov;118(5):877-84

- Repeated dry air challenge in dogs in vivo causes persistent airway obstruction and inflammation not unlike that found in human asthma.
- Winter athletes have an increased incidence of asthma, suggesting that repetitive hyperventilation with cold air may predispose individuals to airways disease. We conclude that repeated dry air challenge (DAC) causes peripheral airways inflammation, obstruction, hyperactivity, and impaired Beta agonist-induced relaxation.

Davis and Freed American Journal of Respiratory Care Vol: 164, Num5, Sept. 2001.

- Airway dehydration triggers exercise-induced bronchoconstriction in virtually all patients with active asthma. Dehydration of the expired air is present in asthmatic patients in the emergency department. The bronchoconstriction triggered by dry-air tachypnea challenge in the laboratory can be prevented by humidifying the inspired air.

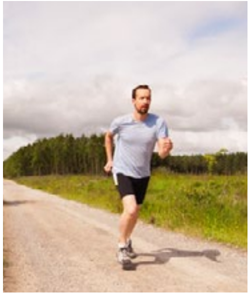
Moloney E, O'Sullivan S, Hogan T, Poulter LW, Burke CM. Airway Dehydration - A Therapeutic Target in Asthma? Chest. 2002 Jun;121(6):1806-11.

PROLONGED OVERBREATHING

- "Prolonged hyperventilation (for more than 24 hours) seems to sensitize the brain, leading to a more prolonged hyperventilation."
- Hyperventilation becomes habitual or long term, so even when the primary cause is removed, the behaviour is maintained.

Demeter SL, Cordasco EM. Hyperventilation Syndrome and Asthma. The American Journal of Medicine; December 1986; 81(6): 989-94.

BUTEYKO TRIAL RESULTS FOR ASTHMA



- The Buteyko Method is not an 'alternative' to the medical management of asthma. It complements it and allows the patient to exercise a significant amount of control over their asthma. It also results in an additional benefit for the high percentage of asthma sufferers who also suffer from anxiety.

At 12 weeks, Buteyko Breathing Technique (BBT)

- 70% less symptoms
- 90% less need for reliever medication
- 49% less need for inhaled corticosteroids (ICS)
- Lung function – no change

Control group – In-house hospital program:

- No change

Minute Volume Pre trial:

- Buteyko Breathing Technique (BBT): 14 Litres per minute
- Control Group: 14.2 Litres per minute

At three months:

- Buteyko Breathing Technique (BBT): 9.6 Litres per minute
- Control Group: 13.3 Litres per minute
- The relative reduction in beta2-agonist use in the BBT group was related to the proportionate reduction in minute volume ($r = 0.51$; $P = 0.04$)

Bowler SD, Green A, Mitchell CA, Buteyko breathing techniques in asthma: a blinded randomised controlled trial. Med J of Australia 1998; 169: 575-578.

End-tidal CO_2

No significant difference in mean ET CO_2 existed between BBT and control groups either at run-in (BBT, 33 ± 5 mm Hg; control, 32 ± 4 mm Hg) or at three months (BBT, 35 ± 3 mm Hg; control, 33 ± 3 mm Hg). The normal subjects had significantly higher mean ET CO_2 levels (41 ± 4 mm Hg) than both the BBT and the control groups.

Bowler SD, Green A, Mitchell CA, Buteyko breathing techniques in asthma: a blinded randomized controlled trial. Med J of Australia. Dec 1998; 169(11-12): 575-78.

Preventer medication was halved in the BBT. Unrealistic to expect an improvement to lung function while at the same time reducing preventer medication.

Law of diminishing returns. The Buteyko group are under conventional care so it is reasonable to expect that medication has already improved lung function.

Our results demonstrated a significant improvement in quality of life among those assigned to the BBT compared with placebo, as well as a significant reduction in inhaled bronchodilator intake.

Opat AJ, Cohen MM, Bailey MJ, Abramson MJ. A clinical trial of the Buteyko Breathing Technique in asthma as taught by a video. J Asthma. 2000;37(7):557-564.

Results at six months:

Buteyko Group

- Beta agonist decrease 85%
- ICS decrease 50%

Control Group (general asthma education and relaxation techniques)

- Beta agonist decrease 37%
- ICS no change

McHugh P, Aitcheson F, Duncan B, Houghton F.. Buteyko Breathing Technique for asthma: an effective intervention. The New Zealand Medical Journal.2003 Dec 12;116(1187)

Buteyko breathing technique and asthma in children: a case series

Buteyko Group at six months

Bronchodilators use decrease 66%

Inhaled steroids use decrease 41%

Patrick McHugh, Bruce Duncan, Frank Houghton. Buteyko breathing technique and asthma in children: a case series. The New Zealand medical journal. May 2006;119(1234): U1988.

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130 persons with moderate asthma

Six month follow up

Asthma control improved from 40% to 79% in the Buteyko group and 44% to 72% in the control group with no difference between the groups.

At six months

- Both groups had been using similar daily doses of inhaled corticosteroid on entry to the study.
- Buteyko group at 6 months had reduced their average daily dose from 865 to 548 micrograms.
- Beclomethasone 818 mg down to 762 mg for the control group.

Cowie RL, Conley DP, Underwood MF, Reader PG. A randomised controlled trial of the Buteyko technique as an adjunct to conventional management of asthma. University of Calgary, Canada. Respiratory Journal. 2008 May;102(5):726-32. Epub 2008 Jan 31.

- 4-week training aimed at normalizing basal and acute levels of end-tidal carbon dioxide. Basal levels of PCO_2 increased from hypocapnic to normocapnic range. Improvements were accompanied by improvements in lung function and reductions in diurnal lung function variability. Improvements remained stable throughout followup.

Jeter AM, Kim HC, Simon E, Ritz T, Meuret AE. Hypoventilation Training for Asthma: A Case Illustration. Appl Psychophysiol Biofeedback. 2012 Mar; 37(1): 63–72.

ASTHMA EXPERT BODIES

- A review of breathing exercises for asthma, carried out by Professor Anne Bruton and Professor Mike Thomas, was published in the December 2014 issue of the journal *Breathe*.

(a) Patients whose asthma continues to cause symptoms and quality-of-life impairment, despite adequate pharmacological treatment, or who have high bronchodilator use, should be offered access to an effective breathing training programme as a part of holistic, integrated asthma care.

(b) Breathing exercises can improve patient-reported outcomes and psychological state.

(c) Breathing exercises should be offered to all asthma patients with symptoms or impaired quality of life despite standard treatment.

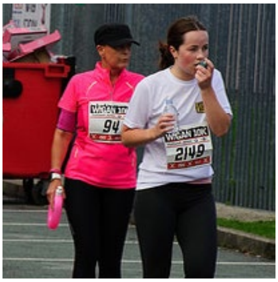
(d) The breathing training techniques most frequently investigated have been physiotherapist-administered breathing exercises, as well as alternative techniques, such as the Buteyko breathing method and yogic breathing. Of these, physiotherapy and Buteyko have the higher level of evidence and are now mentioned in several guidelines for asthma management.

(e) We feel that all clinics providing care to those with difficult-to-control asthma should....have routine access to breathing training programmes for suitable patients.

(f) There is, however, also potential for this approach to benefit many patients treated in the community whose asthma is mild to moderate but who have on-going health impairment.

ASTHMA & SLEEP APNEA

- Approximately 74% of asthmatics experience nocturnal symptoms of airflow obstruction secondary to reactive airways disease.



Bonekat HW, Hardin KA, Severe upper airway obstruction during sleep. Clin Rev Allergy Immunol. 2003 Oct;25(2):191-210.

- Obstructive sleep apnea (OSA) and asthma are highly prevalent respiratory disorders and are frequently co-morbid.
- Undiagnosed or inadequately treated OSA may adversely affect control of asthma and vice versa.

Prasad B, Nyenhuis SM, Weaver TE. Obstructive sleep apnea and asthma: associations and treatment implications. Sleep Med Rev. 2014 Apr;18(2):165-71.

- Obstructive sleep apnea-hypopnea was significantly more prevalent among patients with severe compared with moderate asthma, and more prevalent for both asthma groups than controls without asthma.
- 88% of patients in the severe asthma group, 58% of patients in the moderate asthma group, and 31% of patients in the controls without asthma group had more than 15 apneic events per hour.

Julien JY et al. Prevalence of obstructive sleep apnea-hypopnea in severe versus moderate asthma. J Allergy Clin Immunol. 2009 Aug;124(2):371-6.

- In 472 asthmatic patients with poorly controlled asthma, there was a three fold increase in the risk of obstructive sleep apnea.

Teodorescu M, Polomis DA, Hall SV, Teodorescu MC, Gangnon RE, Peterson AG, Xie A, Sorkness CA, Jarjour NN. Association of obstructive sleep apnea risk with asthma control in adults. Chest. 2010 Sep;138(3):543-50

- Prevalence between asthma and OSA ranges from 38% up to as high as 70%.
- Based on the current concepts of bidirectional relationship of OSA and asthma, it is sensible to assume that treating one disorder will result in the other's better control and vice versa.

Abdul Razak MR, Chirakalwasan N.Obstructive sleep apnea and asthma. Asian Pac J Allergy Immunol. 2016 Dec;34(4):265-271.

- Because the upper airway dilator muscles also receive respiratory input, hypocapnia reduces the activity of the upper airway dilator muscles and could lead to collapse of the airway.

Amy S. Jordan, PhD, David G. McSharry, MB, and Prof. Atul Malhotra, MD Adult obstructive sleep apnea Lancet. 2014 Feb 22; 383(9918): 736–747

ASTHMA & RHINITIS

- Inflammation in the nasal mucosa results in lower airway inflammation and vice versa.
- Inflammatory mediators and/or infectious pathogens may also be transported along the respiratory mucosa or through the airways.
- Nitric oxide and carbon dioxide may also act as aerocrine messengers. Physiological, epidemiological, and clinical evidence support a "unified airway" model.

James Bartley, Conroy Wong. Nasal Physiology and Pathophysiology of Nasal Disorders pp 559-566. Date: 27 June 2013

- Clinical studies indicate that the majority of patients with asthma have rhinitis. One study showed that 100% of subjects with severe (steroid-requiring) asthma and 77% of subjects with mild to moderate asthma had abnormal results on computed tomographic scans of the sinuses.

Michel Alkhalil, M.D., Edward Schulman, M.D., and Joanne Getsy, M.D. Obstructive Sleep Apnea Syndrome and Asthma: What Are the Links? J Clin Sleep Med. 2009 Feb 15; 5(1): 71–78.

NOTES

NOTES

BREATHING RE-EDUCATION IN SLEEP

ORAL BREATHING

- Increased inflammation of upper and lower airways
- Increased stickiness of upper airways
- Reduced lung volume
- Reduced nasal NO
- Reduced messages to upper airway dilator muscles
- Reduced ventilation/perfusion
- Decreased $ETCO_2$
- Increased ventilatory response to CO_2
- Lighter sleep

NASAL BREATHING

- More moist upper and lower airway
- Reduced stickiness of upper airways
- Improved lung volume
- Nasal NO
- Increased messages to upper airway dilator muscles
- Improved ventilation/perfusion
- More normal ET CO_2
- Reduced ventilatory response to CO_2
- Deeper sleep

SNORING AND BREATHING

- Snoring is a sound created from turbulent airflow. It is noisy breathing during sleep caused by the exchange of a large volume of air through a narrowed space, which in turn causes the tissues of the nose and throat to vibrate.

TYPES OF SNORING

- **Mouth snoring:** vibration of the soft palate
  Stops when mouth is closed during sleep (MyoTape)

- **Nose snoring:** turbulent airflow in the nasopharynx and oropharynx
  Hard and fast breathing contribute to nose snoring

To reduce nasal snoring:

- Decongest the nose using Ex 1
- Restore nasal breathing during wakefulness and sleep
- Reduce flow of breathing using Ex 2 (10 minutes by 4 times daily)
- Increase control pause to above 20 seconds
- For many people, nasal snoring can be eliminated.
- For some people, nasal snoring will continue at a lower intensity if airway is narrow

OBSTRUCTIVE SLEEP APNEA

- During wakefulness, the airway is held open by the high activity of the numerous upper airway dilator muscles, but after the onset of sleep, when muscle activity is reduced, the airway collapses.

Jordan et al. Adult Obstructive Sleep Apnea. Lancet. February 22, 2014.

- Collapse of the upper airway occurs if the negative upper airway pressure generated by inspiratory pump muscles exceeds the dilating force of these upper airway muscles.

Remmers et al. Pathogenesis of upper airway occlusion during sleep. J Appl Physiol Respir Environ Exerc Physiol. Volume 44, Issue 6. June 1978.

- Obstructive sleep apnea is a common disorder of repetitive pharyngeal collapse during sleep. Pharyngeal collapse could be complete (causing apnea) or partial (causing hypopnea).

- The best test for obstructive sleep apnea is overnight polysomnography in a laboratory with the primary outcome measure of apnea–hypopnea index (number of apneas plus hypopneas per h of sleep).

Jordan et al. Adult Obstructive Sleep Apnea. Lancet. February 22, 2014.

- Breathing stoppages (apneas)
- Periods of reduced airflow (hypopneas)
- Lasting greater than 10 seconds that result in a brief awakening (arousal) or reduced oxygenation that occur per hour of sleep.
- Adults: Mild sleep apnea is typically defined as an apnea hypopnea index (AHI) of 5 – 15, moderate 15 – 30, and severe more than 30 respiratory events per hour of sleep.
- Despite the quantity of neurophysiological signals obtained during an overnight polysomnography (PSG), most of the data collected is ignored and treatment decisions rely heavily on the AHI.

Osman et al. Obstructive sleep apnea: current perspectives. Nature and Science of Sleep. January 2018.

AHI LIMITATIONS

- AHI is not without limitations and should be, at best, considered a crude and imprecise metric of OSA.
- Apneas and hypopneas are not fundamentally equal in their biologic effects, yet are bundled together.
- Hypopnea the threshold for the desaturation is arbitrary, and little evidence supports a specific cut point (i.e., 3%, 4%).
- A hypopnea with a 4% desaturation is considered biologically equivalent to a hypopnea that has an 8% or a 10% oxygen desaturation.
- Certainly, greater degrees of hypoxemia are likely to have greater effects.
- Apneas and hypopneas can occur evenly across the night, or they can cluster during a particular segment of the sleep period.

Naresh M. Punjabi. Is the Apnea-Hypopnea Index the Best Way to Quantify the Severity of Sleep-Disordered Breathing? 2016.

- A patient with very long respiratory events may experience substantial hypoxemia but have a relatively low AHI.
- Another patient may have more frequent events and therefore a much higher AHI, but minimal exposure to hypoxemia.

Osman et al. Obstructive sleep apnea: current perspectives. Nature and Science of Sleep. January 2018.

- Furthermore, the total AHI correlates poorly with the key causes and consequences of the disease.

Weaver et al. Polysomnography indexes are discordant with quality of life, symptoms, and reaction times in sleep apnea patients. Otolaryngol Head Neck Surg. Volume 132, Issue 2. February 2005.

RISK OF MORTALITY

- 5712, participants, 1290, deaths occurred over 11 years of follow-up.
- After adjusting for demographic factors (mean age 63 years old; 52% female), apnea-hypopnea index (mean 13.8; standard deviation 15.0), smoking, and prevalent cardio-metabolic disease.
- Individuals with the shortest duration events had a significant hazard ratio for all-cause mortality.
- This relationship was observed in both men and women and was strongest in those with moderate sleep apnea.
- Short respiratory event duration, a marker for low arousal threshold, predicts mortality in men and women.

Butler et al. Apnea–Hypopnea Event Duration Predicts Mortality in Men and Women in the Sleep Heart Health Study. American Journal of Respiratory and Critical Care Medicine. Volume 199, Issue 7. October 17, 2018.

DIAGNOSIS

- Obstructive sleep apnea (OSA).
- 9% of women and 26% of men in the 30 to 49-years-old category.
- 27% of women and 43% of men aged 50 to 70 years.

Subramani et al. Understanding Phenotypes of Obstructive Sleep Apnea: Applications in Anesthesia, Surgery, and Perioperative Medicine. Anesth Analg. Volume 124, Issue 1. January 2017.

- Most people with OSA are undiagnosed and untreated.

Appleton et al. Undiagnosed obstructive sleep apnea is independently associated with reductions in quality of life in middle-aged, but not elderly men of a population cohort. Sleep Breath. Volume 19, Issue 4. 2015.

Simpson et al. High prevalence of undiagnosed obstructive sleep apnea in the general population and methods for screening for representative controls. Sleep Breath. Volume 17, Issue3. 2013.

Kapur et al. Underdiagnosis of sleep apnea syndrome in U.S. communities. Sleep Breath. Volume 6, Issue 2. 2002.

- Perceived lack of enthusiasm with existing treatment options, and, in some cases, concern that driving licenses will be revoked.
- Primary care physicians may not be prompted to explore an early diagnosis of OSA – especially true if patient does not present with sleepiness and classically high BMI.
- Up to 50% of people with OSA are not obese.
- 25% of individuals with moderate OSA have neither subjective nor objective sleepiness.

Osman et al.Obstructive sleep apnea: current perspectives. Nature and Science of Sleep. January 23, 2018.

MOUTH VERSUS NOSE

- 95 patients with established OSA (65 males and 30 females)
- 11.6% had mouth breathing
- 51.6% had oronasal breathing
- 36.8% had nasal breathing

AHI, events/hr

- Mouth Breathing: 52.15
- Oronasal Breathing: 42.09
- Nasal Breathing: 27.40

Minimal SaO_2, (%)

- Mouth Breathing: 64.18
- Oronasal Breathing: 77.10
- Nasal Breathing: 78.15

Yen-Bin Hsu et al. Association Between Breathing Route, Oxygen Desaturation, and Upper Airway Morphology. Laryngoscope: 2020. DOI: 10.1002/lary.28774

Percentage of total time with oxygen saturation level < 90%)

- Mouth Breathing: 36.41
- Oronasal Breathing: 15.97
- Nasal Breathing: 5.76
- Mouth breathing was significantly associated with worse oxygen desaturation and increased degree of upper airway collapse.

Yen-Bin Hsu et al. Association Between Breathing Route, Oxygen Desaturation, and Upper Airway Morphology. Laryngoscope: 2020. DOI: 10.1002/lary.28774

- ~ 2.5-fold increase in upper airway resistance during sleep while mouth breathing as compared with nasal breathing in normal subjects.

Fitzpatrick et al. Effect of nasal or oral breathing route on upper airway resistance during sleep. European Respiratory Journal. Volume 22, Issue 5. December 2003.

- Lung volume might also be a causative factor. In animals and man, the area of the upper airway increases when lung volume increases.
- Conversely, the airway is smaller and collapses more easily when lung volume is small.
- This relation probably exists because the lower and upper airways are mechanically linked, so that with increased lung volumes, resulting in stiffening and dilation of the pharyngeal airway.

Jordan et al. Adult obstructive sleep apnea. Lancet. February 22, 2014.

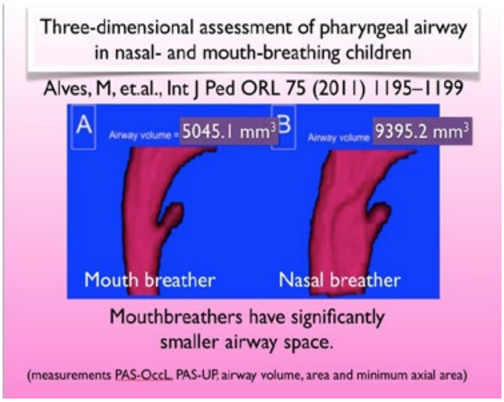
- A correlation exists between the amplitude of diaphragm movement during tidal breathing and lung volume ($r = 0.876$).

Kolar et al. Analysis of Diaphragm Movement During Tidal Breathing and During Its Activation While Breath Holding Using MRI Synchronized With Spirometry. Physiol Res. Volume 58, Issue 3. 2009.

- 28 subjects. Mouth being open or closed on the results in lateral cephalometry.
- Open-mouth breathing is associated with reduction of the retropalatal and retroglossal areas.

Lee et al. How does open-mouth breathing influence upper airway anatomy? Laryngoscope. Volume 117, Issue 6. 2007 June 2007

- Pharyngeal airway dimensions are higher in nasal-breathers than mouth-breathers.



Robert J. Ruben. International Journal of Pediatric Otorhinolaryngology. Volume 75, Issue 3. September 2011.

- 10 normal men had full night recordings before and during nasal obstruction.
- During nasal obstruction, time spent in the deep sleep stages decreased from 90 to 71 min, whereas significantly more time was spent in Stage 1 sleep.
- Twofold increase in sleep arousals and awakening resulting from an increased number of apneas (34 during control sleep versus 86 during obstructed sleep).

Zwillich et al. Disturbed sleep and prolonged apnea during nasal obstruction in normal men. Am Rev Respir Dis. Volume 124, Issue 2. August 1981.

- Apneas of 20 to 39s in duration became 2.5 times more frequent during obstruction.
- Desaturation (SaO_2 less than 90%) occurred 27 times during control sleep compared with 255 times during obstructed sleep.
- All men complained of poor sleep quality during nasal obstruction. Apneas, sleep arousals and awakenings, and loss of deep sleep occur during nasal obstruction and may explain complaints of poor sleep quality.

Zwillich et al. Disturbed sleep and prolonged apnea during nasal obstruction in normal men. Am Rev Respir Dis. Volume 124, Issue 2. August 1981.

- Data on nasal congestion history and sleep problems were obtained by questionnaire (n = 4927) and by objective in-laboratory measurement (n = 911).
- Participants who reported nasal congestion due to allergy were 1.8 times more likely to have moderate to severe sleep-disordered breathing than were those without nasal congestion due to allergy.

Young et al. Nasal Obstruction as a Risk Factor for Sleep-Disordered Breathing. The University of Wisconsin Sleep and Respiratory Research Group. J Allergy Clin Immunol. Volume 99, Issue 2. February 1997.

- 30 Patients with > 5 events hourly but < 15 hourly on the apnea-hypopnea index (AHI) were enrolled. All patients slept with their mouths closed by using the porous oral patch (POP).

	Before POP	Using POP
ESS	8.1 ± 1.5	5.2 ± 1.6
VAS	7.5 ± 2.0	2.4 ± 1.4

- The median AHI score was significantly decreased by using a POP from 12.0 per hour before treatment to 7.8 per hour during treatment ($P < .01$). (Median AHI reduced by 33% by closing mouth).

Huang et al. Novel porous oral patches for patients with mild obstructive sleep apnea and mouth breathing: a pilot study. Otolaryngol Head Neck Surg. Volume 152, Isuue 2. February 2015.

- Nine trials. External nasal dilators in five studies, topically applied steroids in one, nasal decongestants in two, and surgical treatment in one study.
- Chronic nasal obstruction seems to play a minor role in the pathogenesis of obstructive sleep apnea.

Kohler et al. The role of the nose in the pathogenesis of obstructive sleep apnea and snoring. Eur Respir J. Volume 30, Issue 6. December 2007.

- Subjects > or = 40 yrs were approximately six times more likely than younger subjects to spend > 50% of sleep epochs utilising oro-nasal breathing.

Madronio et al. Older individuals have increased oro-nasal breathing during sleep. Eur Respir J. Volume 24, Issue 1. July 2004.

PHENOTYPES OF SLEEP APNEA

FOUR KEY TRAITS

- OSA is due to the interaction of several key traits of upper airway anatomy and neuromuscular control that contribute to varying degrees within individuals, yet each form of treatment currently available primarily targets one trait.
- Thus, choice of treatment is essentially an educated guess, often developed on a trial-and-error basis starting with the gold-standard treatment and trialing others as needed.
- Four physiological traits causing obstructive sleep apnea that may be targeted with future personalized treatment modalities.

Four key traits of upper airway anatomy and neuromuscular control interact to varying degrees within individuals to cause OSA.

1. Pharyngeal critical closing pressure (Pcrit).
2. Stability of ventilator chemoreflex feedback control (loop gain).
3. The negative intraesophageal pressure that triggers arousal (arousal threshold).
4. The level of stimulus required to activate upper airway dilator muscles (upper airway recruitment threshold).

Deacon et al. Treatment of Obstructive Sleep Apnea Prospects for Personalized Combined Modality Therapy. Ann Am Thorac Soc. Volume 13, Issue 1. January 2016.

- 69% of patients with OSA have one or more predisposing physiological traits.

Eckert et al. Defining phenotypic causes of obstructive sleep apnea. Identification of novel therapeutic targets. Am J Respir Crit Care Med. Volume 188, Issue 8. October 15, 2013.

PCRIT

- Air pressure at which the passive airway collapses is considered as the gold standard approach to quantify "functional anatomy" during sleep.
- How much suction pressure is required to close the upper airway during sleep?

Osman et al. Obstructive sleep apnea: current perspectives. Nature and Science of Sleep. January 23, 2018.

- Fat deposition around the pharynx and torso both increase airway collapsibility. Abdominal obesity compresses the abdomen and thoracic cavities, reducing lung volume which reduces tracheal tension and thus impairs pharyngeal mechanics.

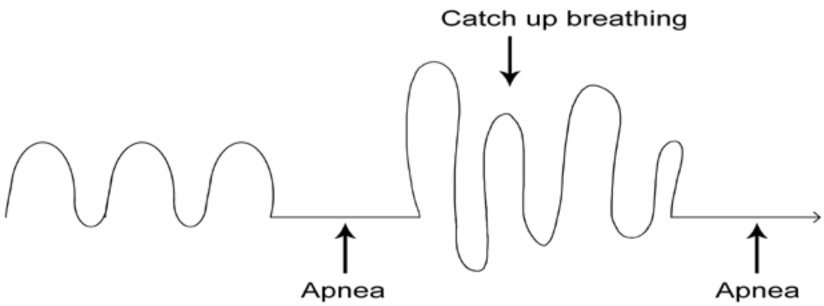
Deacon et al. Treatment of Obstructive Sleep Apnea Prospects for Personalized Combined Modality Therapy. Ann Am Thorac Soc Volume 13, Issue 1. January 2016.

- Airways need to be able to withstand a high suction pressure.
- Increased OSA if low suction pressure causes collapse.
- Reduce the suction pressure – by slowing respiratory rate and normalising breathing volume.
- Improve lung volume by breathing through the nose with greater amplitude of the diaphragm.

LOOP GAIN

- Aside from anatomical compromise, arguably the strongest determinant of OSA is a hypersensitive ventilatory control system or elevated "loop gain."
- Approximately one-third of OSA patients have high loop gain.

Messineo et al. Breath-holding as a means to estimate the loop gain contribution to obstructive sleep apnea. J Physiol. Volume 596, Issue 17. September 2018.



- People with high loop gain have exaggerated ventilatory responses to minimal changes in CO_2.
- High loop gain indicates a >5 L/min increase in minute ventilation in response to 1 L/min reduction in minute ventilation.
- In respiratory physiology, loop gain is the ventilatory response to ventilatory disturbance ratio.

It comprises three principal components:

1) Plant gain (i.e., tissues, blood, and lungs where CO_2 is stored)

2) Delays in circulation (i.e., time it takes for a change in CO_2 to mix with the existing blood to arrive and be detected by the chemoreceptors)

3) Controller gain (i.e., chemosensitivity).

- People with high loop gain have exaggerated ventilatory responses to minimal changes in CO_2.

Osman et al. Obstructive sleep apnea: current perspectives. Nature and Science of Sleep. January 23, 2018.

- Stopping of the breath causes carbon dioxide to accumulate in the blood as the gas cannot leave the blood through the lungs.
- Upon resumption of breathing, persons with high loop gain have exaggerated ventilation post apnea, resulting in arterial carbon dioxide changing from hypercapnia to hypocapnia.
- During hypocapnia the drive to breathe is lower resulting in central apnea.
- Practicing breathing re-education can reduce the ventilatory response to CO_2 and lower high loop gain.

- Exposed to sustained mild hypercapnia (3 mmHg above baseline) for twelve by 4 min episodes daily, for 10 days.
- The AHI on day 10 was significantly less than measures obtained during baseline and day 1 in the mild hypercapnia control group.
- Repeated daily exposure to mild sustained hypercapnia may lead to a decrease in breathing events.

Yokhana SS, Gerst DG 3rd, Lee DS, Badr MS, Qureshi T, Mateika JH (2012) Impact of repeated daily exposure to intermittent hypoxia and mild sustained hypercapnia on apnea severity. J Appl Physiol 112:367–377

- The activity of the upper airway dilator muscles varies accordingly so that periods of low central respiratory drive are associated with low upper airway dilator muscle activity, high airway resistance, and a predisposition to airway collapse.

Jordan et al. Adult Obstructive Sleep Apnea. Lancet. Volume 383, Issue 9918. February 22, 2014.

- Twenty individuals (10 OSA, 10 controls) participated in a single overnight study with voluntary breath holding maneuvers performed during wakefulness.

- Assessed:

  (1) maximal breath hold duration.

  (2) Ventilatory responses in the first two breaths following 20-second breath-holds (a duration we expected all individuals could tolerate).

- Higher loop gain during sleep was associated with:

  (1) a shorter maximal breath hold duration and

  (2) a larger ventilatory response to 20-s breath holds during wakefulness.

- Together these factors combine to predict high loop gain.

- Chemoreflex sensitivity (a key determinant of loop gain) can be estimated simply by measuring how long participants can voluntarily hold their breath for ("maximal breath hold duration").

Messineo et al. Breath-holding as a Means to Estimate the Loop Gain Contribution to Obstructive Sleep Apnea. J Physiol . Volume 596, Issue 17. September 2018.

- Thus, high loop gain contributes to perpetuating apneas. Supporting this concept is evidence that patients with OSA have higher loop gain than patients without OSA and that loop gain predicts AHI.

Deacon et al. Treatment of Obstructive Sleep Apnea Prospects for Personalized Combined Modality Therapy. Ann Am Thorac Soc Volume 13, Issue 1. January 2016.

AROUSAL THRESHOLD

- Another potentially important factor is the propensity to arouse from sleep (the arousal threshold).
- Individuals with low arousal thresholds might arouse before the dilator muscles are able to reopen the airway.

Jordan et al. Adult Obstructive Sleep Apnea. Lancet. Volume 383, Issue 9918. February 22, 2014.

- Over 40% of OSA patients may also have insomnia.
- Continual unnecessary arousals can worsen OSA and contribute to OSA Pathophysiolgy – can perpetuate blood-gas disturbances and cause sleep fragmentation to promote cyclical breathing and prevent establishment and maintenance of more stable, deeper stages of sleep-increased sleepiness.

Osman et al. Obstructive sleep apnea: current perspectives. Nature and Science of Sleep. January 23, 2018.

Low arousal threshold may be identified from

- AHI < 30 events/h
- Nadir (Lowest) Spo2 > 82.5%
- Frequency of hypopneas > 58%

Individuals with a low arousal threshold wake up

- Before developing a very low oxygen saturation
- More likely to have a mild to moderate OSA.
- Increased frequency of hypopneas rather than apneas due to milder airflow obstruction

Subramani et al. Understanding Phenotypes of Obstructive Sleep Apnea: Applications in Anesthesia, Surgery, and Perioperative Medicine. Anesth Analg. Volume 124, Issue 1. January 2017.

- Stanford researchers proved that the preBötC neurons that express Cadh9 and Dbx1 not only project to the locus coeruleus — a new finding — but activate its long-distance-projections, promoting brainwide arousal.
- The investigators surmised that rather than regulating breathing, these neurons were spying on it instead and reporting their finding to another structure in the brainstem. This structure, the locus coeruleus, sends projections to practically every part of the brain and drives arousal: waking us from sleep, maintaining our alertness and, if excessive, triggering anxiety and distress. It's known that neurons in the locus coeruleus exhibit rhythmic behavior whose timing is correlated with that of breathing.

Breathing control center neurons that promote arousal in mice" by Kevin Yackle, Lindsay A. Schwarz, Kaiwen Kam, Jordan M. Sorokin, John R. Huguenard, Jack L. Feldman, Liqun Luo, and Mark A. Krasnow in Science. Published online March 31 2017 doi:10.1126/science.aai7984

- Delay of arousal with sedatives might help to treat the condition if the upper airway muscles are sufficiently responsive to respiratory stimuli <u>to stabilise the airway before arousal</u>.

Jordan et al. Adult Obstructive Sleep Apnea. Lancet. Volume 383, Issue 9918. February 22, 2014.

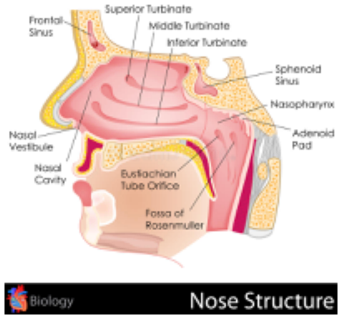
- Patients with high respiratory arousal thresholds, often have prolonged respiratory events, particularly if these patients also have poor upper airway muscle responsiveness.

Jordan et al. Adult Obstructive Sleep Apnea. Lancet. Volume 383, Issue 9918. February 22, 2014.

- Obstructive events terminated by arousal result in a greater degree of hyperventilation and consequent hypocapnia and reduction in ventilatory drive, including drive to upper airway muscles.

Deacon et al. Treatment of Obstructive Sleep Apnea Prospects for Personalized Combined Modality Therapy. Ann Am Thorac Soc Volume 13, Issue 1. January 2016.

UPPER AIRWAY RECRUITMENT THRESHOLD



- The human pharynx is unique in that it lacks rigid bony support. Depending on the dynamic balance of intraluminal pressure and neural drive to the upper airway dilator muscles, the human pharynx is vulnerable to collapse during sleep.
- Over 20 muscles in the upper airway-involved in respiratory and non-respiratory tasks (speech, mastication, swallowing, and breathing). A subset of these muscles plays a predominant role in airway stability during breathing.
- In healthy individuals and people with OSA during wakefulness, activation of the upper airway dilator muscles is effective in opposing the collapsing pressures generated during inspiration.

Osman et al. Obstructive sleep apnea: current perspectives. Nature and Science of Sleep. January 23, 2018.

- However, during sleep reductions in muscle activity combined with narrow airway can induce collapse.

Osman et al. Obstructive sleep apnea: current perspectives. Nature and Science of Sleep. January 23, 2018.

- <u>The magnitude of stimuli</u> (both negative pressure stimuli and chemostimulation) <u>required to recruit upper airway dilator muscles</u> adequately to overcome negative intrapharyngeal closing pressures is called the upper airway recruitment threshold.

Deacon et al. Treatment of Obstructive Sleep Apnea Prospects for Personalized Combined Modality Therapy. Ann Am Thorac Soc Volume 13, Issue 1. January 2016.

- Approximately 30% of OSA patients have poor genioglossus muscle responsiveness to airway narrowing during sleep.

Osman et al. Obstructive sleep apnea: current perspectives. Nature and Science of Sleep. January 23, 2018.

- Strategies to improve pharyngeal muscle function include regular didgeridoo playing and myofunctional therapy exercises can reduce snoring and OSA severity (~50% reduction in AHI) and daytime sleepiness.

Ieto et al. Effects of oropharyngeal exercises on snoring: a randomized trial. Chest. Volume 148, Issue 3. 2015

Guimarães et al. Effects of oropharyngeal exercises on patients with moderate obstructive sleep apnea syndrome. Am J Respir Crit Care Med. Volume 179, Issue 10. 2009.

Puhan et al. Didgeridoo playing as alternative treatment for obstructive sleep apnea syndrome: randomised controlled trial. BMJ. Volume 332, Issue 7536. 2006.

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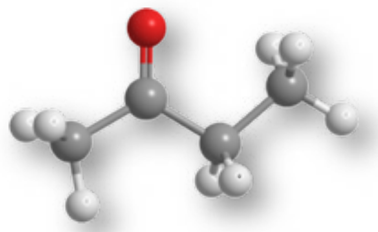
BREATHING AND TEMPOROMANDIBULAR JOINT DISEASE



- The hyperventilation seen in TMD (Carlson et al., 1998) can be regarded as part of the "fight-or-flight" response (Von Schéele and von Schéele, 1999).
- The increased pH enhances the likelihood of motor unit neuron depolarisation or excitation (Schleifer et al., 2002) contributing to increased central nervous system arousal.
- Central nervous system consists of the brain and spinal cord. The CNS integrates received information and coordinates and influences the activity of all parts of the body.
- The increased neural excitation associated with the central nervous system arousal contributes to increased muscle tension and muscle spasm (Schleifer et al., 2002).
- The distance between the upper and lower teeth with the mandible in rest position is the freeway space (Woda et al., 2001). A forward head posture (FHP) leads to a decrease in freeway space (Woda et al., 2001).
- Dental splints increase the freeway space and reduce the pressures on the TMJ generated by clenching (Nitzan, 1994). Correspondingly a reduction in freeway space through mandibular elevation results in an increased pressure on the temporomandibular joint itself (Hruska, 1997).
- Correction of head and cervical posture which increases freeway space (Woda et al., 2001) is considered important in TMD treatment (Olivo et al., 2006).

Bartley J. Breathing and temporomandibular joint disease. Journal of Bodywork and Movement Therapies. Volume 15, Issue 3. July 2011.

- The restoration of diaphragmatic breathing is also an important musculoskeletal and psychological therapy used in correcting the FHP (Simons et al., 1999), and in helping patients suffering from TMD (Hruska, 1997; Sherman and Turk, 2001).
- The systemic loss of bicarbonate compromising the body's ability to buffer the build up of metabolic byproducts such as lactic acid in muscle tissue leading to muscle fatigue (Von Sche´ele and von Sche´ele, 1999; Schleifer et al., 2002) and muscle pain (Mense, 2008).
- Females are able to generate significantly higher TMJ pressures during clenching than males (Nitzan, 1994). During the second part of the menstrual cycle after ovulation has occurred women have a greater tendency to hyperventilate lowering arterial pCO_2 by 6.5 mm Hg (Hadziomerovic et al., 2008).
- TMD pain occurs at the time of low or fluctuating estrogen (LeResche et al., 2003). Estrogen and progesterone both influence minute ventilation and arterial pCO_2 levels (Slatkovska et al., 2006).
- The hormonal intricacies relating to pain and the menstrual cycle are still being untangled (Sherman and LeResche, 2010), but alterations in breathing pattern during the menstrual cycle could contribute to TMD.

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BREATHING RE-EDUCATION AND PHENOTYPES OF SLEEP APNEA, A REVIEW

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Abstract

Purpose: Four phenotypes of obstructive sleep apnea (OSA) have been identified. Only one of these is anatomical. As such, anatomically based treatments for OSA may not fully resolve the condition. Equally, compliance and uptake of gold-standard treatments is inadequate. This has led to interest in novel therapies that provide the basis for personalized treatment protocols. This review examines each of the four phenotypes of OSA and explores how these could be targeted using breathing re-education from three dimensions of functional breathing; biochemical, biomechanical and resonant frequency.

Conclusion: Breathing re-education and myofunctional therapy may be helpful for patients across all four phenotypes of OSA. More research is urgently needed to investigate the therapeutic benefits of restoring nasal breathing and functional breathing patterns across all three dimensions in order to provide a treatment approach that is tailored to the individual patient.

Keywords: Obstructive sleep apnea. Breathing re-education. Dysfunctional breathing. Myofunctional Therapy.

Introduction

Obstructive sleep apnea (OSA) is a chronic sleep-related breathing disorder that is increasingly widespread and represents significant cost to health[1,2]. In recent years it has been found that OSA is not merely an anatomical issue, but that factors including arousal threshold, unstable breathing control and poor upper airway recruitment contribute. There is evidence to suggest that individuals who experience mixed apneas may have fundamental differences in respiratory control, and that these present as greater breathing pattern variability during wakefulness[3]. A bi-directional relationship exists between dysfunctional breathing during wakefulness and disordered breathing during sleep[4]. Equally, breathing during wakefulness is a strong determinant of breathing during sleep[5]. It stands to reason that if breathing is dysfunctional during the day, it will not be functional at night. Jack et al. surmised that abnormal ventilatory responses may, in fact, become part of the respiratory "make-up" of the individual[6].

Dysfunctional breathing patterns affect 9.5% of the general population[7], increasing to 30% in the asthma population and 75% in the anxiety population[8]. It is well documented that the presence of asthma increases the risk of obstructive sleep apnea, and that as asthma severity increases so does sleep apnea severity[9,10]. In one study, 88% of participants in the severe asthma group and 58% in the moderate asthma group had an apnea-hypopnea index (AHI) of more than 15 events per hour[11].

It is possible to manipulate breathing patterns during wakefulness using exercises that target the biochemistry, biomechanics and frequency[12,13,14]. In this way, the breath can be 'trained' to restore nasal breathing, improve diaphragm function, slow the respiratory rate and increase tolerance to changes in arterial carbon dioxide (CO_2) pressure. If poor breathing patterns during wakefulness can be addressed, it is likely that this may provide a mechanism whereby sleep-disordered breathing can also benefit.

Prevalence of OSA

Sleep disordered breathing is a widespread condition with significant public health outcomes[15] and it is becoming ever more prevalent[16]. Incidence also increases with age[17].

In the 30-49-year age group, OSA is present in 9% of women and 26% of men. In the 50-70-year age group, it affects 27% of women and 43% of men[18]. While these figures are alarming, research suggests that the majority of people with OSA still remain undiagnosed and untreated[19,20,21].

There is a lack of enthusiasm for existing treatment options, and this contributes to poor treatment uptake. The gold standard treatment for OSA is continuous positive airway pressure (CPAP) but many factors can play a role in non-adherence. Claustrophobia, nasal obstruction and poor social support can all negatively impact CPAP use[22]. Mouth leaks are a common problem, potentially contributing to arousals and drying the mucosa in the airways[23]. Chin straps are used to counter this issue, but there is limited data to indicate their efficacy[23]. In some instances, patients refuse treatment due to fears that a diagnosis will prompt the withdrawal of their driving license[18]. Sleep deprivation contributes to around 109,000 road traffic collisions resulting in injury and 6,400 fatal traffic accidents annually in the US[24] and laws for drivers prohibit patients with uncontrolled OSA from driving.

In recent years, there has been an uptake in the use of mandibular advancement devices (MAD) in treating OSA[25]. MADs prevent airway collapse by protruding the mandible, to alter the position of the tongue and jaw. These devices can cause side effects including excessive salivation, dry mouth, dental pain, gingival irritation, myofascial pain and temporomandibular joint pain[26,27,28].

A further concern is that primary care physicians may fail to sufficiently explore the avenue of early OSA diagnosis, especially if the patient does not present with daytime fatigue and a high body mass index[16]. As many as half of all people with OSA are not obese and 25% of those with moderate OSA demonstrate neither subjective nor objective sleepiness [16].

The four phenotypes of OSA

The field of sleep medicine has changed radically in the last seven years with the recognition that OSA is not simply an anatomical issue [29]. Upper airway collapsibility and craniofacial anatomy remain fundamentally important in the development of OSA [29]. However, the cause of OSA differs from one individual to another.

Three non-anatomical phenotypes have now been identified, indicating that OSA can develop due to multiple contributing factors. It is likely that the combination of these factors varies significantly between patients[16].

The four phenotypes, as defined in 2013 research by Eckert et al., are pharyngeal critical closing pressure (Pcrit), loop gain, upper airway recruitment and arousal threshold[29].

Treatment outcomes for the patient are strongly influenced by whether or not treatment is tailored to the phenotypes of the individual. For instance, a patient with high loop gain will not respond favorably to MAD[5]. The importance of this should not be underestimated. Eckert demonstrated that pathophysiological traits varied substantially between patients with the same condition. Of those patients with OSA, 36% had minimal genioglossus muscle responsiveness during sleep, 37% showed low arousal threshold, 36% had high loop gain and 26% demonstrated compound nonanatomic features[29]. Craniofacial structure and pharyngeal anatomy play an important role. Overall, the upper airway is more collapsible in patients with OSA. However, Eckert found that 19% of his OSA subjects had a comparatively non-collapsible upper airway, similar to many of the controls. In these patients, loop gain was almost two times higher than it was in patients with a highly collapsible airway [29].

Pharyngeal critical closing pressure (Pcrit)

Pcrit is the gold standard of OSA assessment in terms of functional anatomy. It is used to measure the collapsibility of the airway in sleep disordered breathing conditions from snoring to OSA[16,30]. Pcrit is defined by the level of negative suction pressure required to close the airway during sleep. A narrow airway creates greater resistance and is therefore more vulnerable to collapse[31]. Equally, airflow must be taken into account. When breathing is hard and fast, the flow of air increases. This adds to the negative suction pressure present in the airway and therefore increases the likelihood of airway collapse. A patient is considered to have a high Pcrit when the airway collapses easily.

Factors that contribute to high Pcrit include deposits of fat around the pharynx and torso. Abdominal obesity compresses the abdomen and thoracic cavities causing an anatomical reduction in lung volume. This reduces tracheal tension and thus impairs the function of the upper airway dilator muscles. Abdominal fat also compromises the function of the diaphragm, reducing the amplitude of diaphragm movement. It is known that reduction in diaphragm amplitude reduces lung volume[32], and that a reduced lung volume leads to greater collapsibility of the throat.

Loop gain

Loop gain is a measure of the stability of ventilatory chemoreflex control. In other words, it reflects chemosensitivity to CO_2. Patients with high loop gain have an exaggerated response to minimal changes in CO_2. Messineo et al. assessed loop gain using breath holding and found that high loop gain is directly related to low breath-hold time (BHT)[5].

When the breathing stops during an apnea, CO_2 is unable to leave the body via the lungs and so builds up in the bloodstream. The respiratory process is controlled by the levels of oxygen, CO_2 and hydrogen ions in the arterial blood. Of the three, CO_2 provides the most significant ventilatory stimulus. Rassovsky states that an increase in pCO_2 of just 2-5 mmHg can increase ventilation more than twofold[33].

When breathing resumes after an apnea, individuals with high loop gain demonstrate exaggerated ventilation in response to minimal increases in carbon dioxide[34]. A fast respiratory rate and high tidal volume cause the depletion of CO_2 and the switch from hypercapnia to hypocapnia. When the level of blood CO_2 is too low, the brain is unable to send appropriate signals to breathe, and this can result in a central apnea[35]. At the same time, when the respiratory signals are inhibited, the respiratory muscles designed to open the airway become less effective. Jordan et al. state that the activity of these airway dilator muscles alters so that when central respiratory drive is low, upper airway dilator muscle activity is also low. This creates high levels of resistance in the airway and increases the risk of airway collapse[36].

High loop gain can lead to a vicious cycle in which breathing resumes with such exaggerated force that the respiratory signals are inhibited. This can cause a central apnea to occur. At the same time, increased collapsibility of the throat produces an obstructive apnea. For this reason, high loop gain contributes to perpetuating apneas. This is supported by evidence that loop gain predicts apnea-hypopnea index (AHI) scores[32].

Messineo et al. tested 20 patients in an overnight study using breath-hold time during wakefulness to determine loop gain during sleep. The study tested maximal breath-hold duration and ventilatory response in the first two breaths following a 20-second breath-hold; a duration that it was expected all participants could tolerate. Higher loop gain during sleep correlated with both a shorter maximal breath-hold time and a larger ventilatory response to a 20-second breath hold during wakefulness[5].

Upper airway recruitment

The human pharynx is unique in that it lacks rigid, bony support[16]. Depending on the dynamic balance that exists between negative suction pressure within the airway and neural drive to the upper airway dilator muscles, the pharynx is susceptible to collapse during sleep[16].

Osman et al. state that there are more than 20 muscles in the upper airway. These are involved in both respiratory and non-respiratory functions including breathing, chewing, speech and swallowing. In healthy people, activation of the upper airway muscles effectively opposes the negative suction pressure created during inhalation. This is also the case in patients with OSA during wakefulness. However, during sleep, reduced activity of these dilator muscles combined with a narrow airway can prompt airway collapse[16]. Upper airway recruitment threshold is defined by the level of stimulus required to activate the upper airway dilator muscles. A poor muscle responsiveness to upper airway collapse during sleep - low upper airway recruitment threshold - may increase the severity of OSA[37,38].

Arousal threshold

In the simplest of terms, arousal threshold refers to whether the patient is a light sleeper or a deep sleeper. The propensity to wake frequently from sleep correlates with insomnia, another sleep disorder that is commonly linked to autonomic imbalance[39]. Insomnia is known to increase the risk for both incidence and severity of depression, depressive episodes and suicide, and studies have demonstrated that OSA can also contribute to the pathology of depression[39]. When insomnia and OSA presented comorbidly in the same patient, depression scores were higher than in insomnia patients without OSA. Grandner suggests that since the prevalence of insomnia in OSA patients may be as high as 67%, many individuals with OSA may also be vulnerable to depression due to comorbid symptoms of insomnia. He speculates that the mechanism by which OSA and insomnia may add to the severity of depression is arousal threshold. A key characteristic of insomnia is cortical hyperarousal which "likely results in a decreased arousal threshold"[39]. Fatigue is a known marker of depression[40]. However, it is important to note that the exhaustion experienced by some patients with depression may actually be caused by OSA and poor sleep quality. Poor sleep quality is known to cause poor emotional regulation[41], so it is possible that poor sleep alone could contribute to the onset and severity of depression.

Arousal threshold is defined by the level of intra-esophageal pressure and the amount of change in the concentration in arterial CO_2 required to trigger arousal[32]. Patients with low arousal threshold and poor upper airway recruitment will wake before the dilator muscles have activated to open the airways, meaning they experience frequent, unnecessary arousals. This kind of light sleep is problematic because continuous arousals lead to sleep fragmentation, fatigue and poor daytime function. It has also been proven that individuals with the greatest risk of all-cause mortality are those with a low arousal threshold[42]. Butler et al. found that short duration of respiratory events, which is indicative of low arousal threshold, predicts mortality in both men and women.

If the upper airway dilator muscles are not functioning properly, sleep that is too deep can also present a problem. If the arousal threshold is so high that the patient fails to arouse during an apnea, the breathing can stop for a long time, leading to greater oxygen desaturation. High arousal threshold has, for instance, been implicated in sudden infant death syndrome (SIDS)[43].

Sleep disordered breathing in women

Breathing pattern disorders and chronic hyperventilation are more prevalent in women than men. This may be due to hormonal influences. Progesterone stimulates the respiratory rate in the luteal phase of the menstrual cycle (the phase after ovulation and prior to menstruation). During this time, levels of CO_2 can drop by up to 25%. Stress can further increase hyperventilation when CO_2 is already low[44].

It has been proven that OSA and sleep-disordered breathing (SDB) increase in postmenopausal women. LoMauro and Aliverti suggest that sex hormones play a protective role in airway health in women[45]. The literature in this area is sparse, but Ott et al. found significant correlations between symptoms of pre-menstrual syndrome and hyperventilation[46]. Gargaglioni et al. reported that while OSA is more prevalent in men, the incidence of OSA in women increases 200% once menstruation ceases[47]. Pre-menopausal women with severe OSA have a much lower progesterone concentration than healthy women in the same demographic and pre-menopausal women with mild OSA. Stavaras et al. suggest that the menopausal state itself plays a part in OSA phenotypes[48], as indicated by the fact that gender differences in the prevalence of OSA decrease in postmenopausal women.

Changes in body fat distribution are likely to contribute to OSA in postmenopausal women. After menopause, women tend to have more fat on the tongue, neck and abdomen. Fat in these areas is a common anatomical factor in sleep apnea, contributing to Pcrit. However, excess weight affects men and women differently in terms of respiration[49,50]. Kunitomo et al. examined the incidence of SDB in obese men and women[51] and reported that obese women have a heightened chemosensitivity to hypoxia and hypercapnia compared to women of a healthy weight. The same was not the case in men. This suggests a greater vulnerability to high loop gain in women who are overweight.

What is breathing re-education?

Breathing re-education is a therapeutic intervention based on the following fundamentals[52].

- Establishing full-time nasal breathing during wakefulness and sleep
- Correcting the resting posture of the tongue
- Slowing the respiratory rate
- Using breath hold time (BHT) to establish chemosensitivity to carbon dioxide
- Restoring diaphragm function and the lateral expansion of the lower ribs
- Reducing the minute volume towards normal to regulate levels of CO_2

The key to treating dysfunctional breathing lies in viewing breathing pattern disorders from a three-dimensional perspective. Dysfunctional breathing can be triggered by biomechanical, biochemical or psychological factors. As such; it can be treated from a biomechanical or biochemical dimension or using cadence/coherent breathing. Cadence/coherence is the practice of slowing the breathing rate to 6 breaths per minute (bpm), a respiratory rate proven to optimize parameters including heart rate variability, respiratory sinus arrhythmia, baroreflex function and blood gas exchange[53], to reduce dead space in the lungs[54] and to improve sympathovagal balance[53].

Applying the three dimensions of breathing re-education to each of the four phenotypes of OSA

OSA is caused by the interaction of several key traits of upper airway anatomy and neuromuscular control[55]. These contribute to the condition in varying degrees from one individual to another.

Current treatment options each primarily target a single phenotype of OSA. It seems important, therefore, to examine novel treatment opportunities so that treatments can be personalized depending on which phenotypes present, ensuring successful treatment outcomes.

There is currently limited research into the relationship between breathing pattern disorders and the phenotypes of sleep apnea. Equally, the application of breathing re-education for OSA has not been studied. It is known, however, that mouth breathing during sleep increases the severity of OSA[56], and techniques integral to breathing re-education correlate with concepts directly relevant to the various phenotypes. Approaches involving breathing re-education that have been investigated for OSA all incorporate some type of breathing modulation and/or control. Methods have included wind instrument playing (including orofacial myofunctional therapy and didgeridoo playing, which is known to strengthen the pharyngeal muscles)[57,58], singing exercises, respiratory muscle strengthening exercises, diaphragmatic breathing pattern training and the Buteyko Method[4]. Courtney describes the reported outcomes and quality of this research as highly variable[4].

In a 2019 review of 14 articles, Courtney describes an interest in treatments that address the four phenotypes of OSA, emphasizing the bi-directional relationship between breathing during the day and breathing at night[4]. This relationship exists in people with panic disorder and severe daytime dysfunctional breathing. These patients also display poor breathing patterns at night[59]. There is also evidence that some OSA patients who have high chemosensitivity to CO_2 and high loop gain during sleep maintain these characteristics during wakefulness[5].

Breathing re-education and PCrit

The foundation of breathing re-education includes switching from oral breathing to nasal breathing during rest, exercise and sleep. Oral and oro-nasal breathing is common in sleep apnea and increases with age. Once an individual reaches the age of 40 years, he or she is six times more likely to spend at least 50% of sleep time breathing through an open mouth[60].

In a recent study of 65 males and 30 females with established OSA[56], 36.8% breathed nasally during sleep, 11.6% had oral breathing, and 51.6% had oro-nasal breathing.

The anatomical size of the airway is influenced by whether the mouth is open or closed. During nasal breathing, it is possible for the tongue to rest in the roof of the mouth[61]. In this position the tongue is less likely to encroach on the airway. Mouth breathing is typically thoracic rather than diaphragmatic[62,63]. Yi et al. used fluoroscopy to analyze diaphragm excursion in children who breathed nasally and those who breathed orally. Diaphragm amplitude was less in children who mouth breathed. The researchers also found that when significant nasal obstruction is present, as it is during mouth breathing, there is a conscious effort to overcome the obstruction to breathing involving increasing inspiratory effort by means of the accessory muscles[63].

When the diaphragm is not properly engaged, diaphragmatic excursion is less[64]. When the amplitude of diaphragm movement is compromised, there is a subsequent reduction in lung volume[65]. When lung volume decreases, the throat collapses more easily. In this way, mouth breathing causes a reduction in lung volume and increases collapsibility of the throat[36].

Nose breathing has been shown to produce greater amplitudes of diaphragm movement and increase lung volume[66,67]. The consequent increase in functional residual capacity (the volume of air that remains in the lungs after a passive exhalation) is believed to improve gas exchange and therefore the pressure of arterial oxygen[68].

It has also been suggested that intensive practice of diaphragm breathing exercises prevents the collapse of the airway by improving the strength of the entire respiratory tract and enhancing the central nervous system's ability to organize breathing[69].

Conversely, mouth breathing is linked with greater severity of OSA. Fitzpatrick et al. examined healthy subjects to compare nasal and oral breathing routes. The study found that when breathing was through the mouth, upper airway resistance during sleep was 2.5 times greater than when breathing was through the nose[70].

Hsu et al. reported that mouth breathing was strongly associated with greater oxygen desaturation and more significant upper airway collapse. The AHI during mouth breathing was 52.15. For those patients with oro-nasal breathing it was 42.09, and for those who breathed nasally it was 27.40[56].

This finding is in line with the results of 1997 research by Young et al., which used data from subjective questionnaires and objective in-laboratory measurements to examine history of nasal congestion and sleep problems. Those participants who reported nasal congestion due to allergy were 1.8 times more prone to moderate or severe SDB than those patients with no nasal congestion due to allergy[71].

Furthermore, it has been demonstrated that mouth breathing is a cause of CPAP non-compliance[72]. It has also been found in research investigating the treatment of the nose using intranasal steroids, that chronic nasal obstruction plays a minor role in SDB. These studies failed to establish whether or not participants were breathing through the nose. In not one of nine trials involving external nasal dilators, topically applied nasal steroids, nasal decongestant and surgical treatments[73], did the researchers ask whether, having had a procedure to open up the nose, the patients were actually using the nose to breathe during wakefulness and sleep. It is vital that the post-surgical follow-up for ENT patients and children undergoing adenotonsillectomy should include a period of breathing rehabilitation. Typically, when patients undergo turbinate reduction surgery, surgery for a deviated septum or removal of the adenoids, mouth breathing will continue in most cases due to the patient's mouth breathing habit[74].

In children, persistence of mouth breathing post tonsillectomy and adenoidectomy plays a role in the worsening of the AHI, frequently within three years[75]. The fact that perceived nasal obstruction does not preclude the ability to breathe nasally was demonstrated by Zaghi et al. who reported that 80% of 633 mouth-breathing study participants including 315 children aged 3-11 years, were able to comfortably breathe through the nose for at least three minutes when their lips were taped[76].

Mouth breathing is an important factor, especially in older patients. It is well known that mouth breathing contributes to snoring as well as apneas and hypopneas[77]. Mouth breathing is also associated with a compromised response to hypoxia of the genioglossus[78] – the primary muscle responsible for protruding the tongue.

My own empirical evidence indicates that the only way to ensure nasal breathing during sleep is to use supports such as paper tape across the lips, chin up strips or MyoTape (elasticated cotton tape designed to surround the mouth).

There is an argument for taping the mouth during sleep regardless of whether breathing is through the mouth, nose or oro-nasally. Meurice et al. found that just opening the mouth increases the collapsibility of the upper airway independently of any nasal obstruction and without changes in the breathing route[79]. This is thought to be due to mechanical obstruction of the upper airways caused by a combination of upper-airway narrowing, and a reduction in the efficiency of contraction in the upper airway dilator muscles. The increase in collapsibility was not large enough to be of clinical significance in individuals with normal airway collapsibility, but in patients with OSA the changes could have significant clinical implications[79].

Breathing re-education and loop gain

Chemosensitivity to CO_2 can be estimated by measuring breath-hold time (BHT)[5,80]. One of the fundamentals of breathing re-education is the use of a breath-hold on exhalation as an objective measure of breathlessness. It is known that high loop gain during sleep is determined by a low breath-hold time during wakefulness[5]. Short breath holding time is a known trait of individuals with chronic idiopathic hyperventilation and other types of dysfunctional breathing[81-83]. Keisel et al.[84] proposed a test consisting of four questions from the Functional Movement Screen (FMS™) and a BHT of 25 seconds and confirmed that dysfunctional breathing can be predicted by the patient's ability to hold the breath for 25 seconds.

The important thing to note is that by using breathing exercises that reduce the respiratory rate to lower minute ventilation for periods of time during rest it is possible to improve BHT, and to reduce chemosensitivity to CO_2. Since chemosensitivity to CO_2 and BHT are both predictors of loop gain, breathing re-education may reduce loop gain by increasing BHT and lowering chemosensitivity to CO_2[85,86].

It is apparent that treatment of loop gain is important in the treatment of OSA, especially in patients who do not respond to CPAP and MAD. CPAP does nothing to decrease loop gain[87] and MADs are less effective when loop gain is present[88].

Breathing re-education, myofunctional therapy and upper airway recruitment

Nasal breathing harnesses the gas nitric oxide, which plays a role in the maintenance of muscle tone and regulation of neuromuscular pathways in the pharyngeal muscles[52]. According to Courtney, individuals with OSA tend to have minimal or poorly coordinated upper airway muscle dilation during inhalation[89]. The upper airway muscles and breathing are "neurologically and functionally linked."[90] Brown found that subjects with the highest AHI "typically had little movement of the tissues surrounding their airway during wakefulness."

It has been found that individuals with OSA have reduced respiratory muscle strength compared with individuals of the same age and gender without OSA[4]. According to Courtney, this may be of clinical significance "given that the magnitude and stability of respiratory motor output" to the muscles of the upper airway and chest wall are "major contributors to all types of sleep apnea."[4]

Breathing re-education includes exercises to improve the strength and function of the inspiratory muscles, in particular, the diaphragm. Because of the small size of the nostrils relative to the mouth, breathing through the nose during wakefulness imparts a resistance to airflow that is at least 50% greater than the resistance from mouth breathing[91]. It may appear that lower resistance might be a positive thing, but the increased pressure in the lungs during nasal exhalation causes the air to be denser, simulating a lower altitude where the oxygen level in the air is higher. This improves perfusion into the alveoli[91]. The healthy diaphragm amplitude associated with nasal breathing improves venous return to the heart[53], reducing cardiac effort[91]. Breathing through the nose during wakefulness may also help to improve and maintain diaphragm strength[62,64].

The resting posture of the tongue is relevant in OSA. Individuals who mouth-breathe have habitually poor tongue posture and increased likelihood of the tongue falling back into the airway. For these patients it may be beneficial both to re-educate the tongue muscles and to improve the tone and function of the upper airways[92]. A review by Camacho et al. suggests that Myofunctional Therapy (MT) exercises may increase tone in the oral and/or oropharyngeal muscles and even reduce the amount of fat deposited on the tongue. This indicates that there may be a place for MT in the treatment of OSA. Wishney et al. state that MT offers a potential way to treat the upper airway muscles and restore nasal breathing and that it can provide a successful adjunct therapy for OSA in adults and children[93]. The debate surrounding MT remains unresolved due to a lack of quality research. At present, there is insufficient evidence to recommend MT as a one-size-fits-all treatment for OSA[87], but there is data to suggest that it can be effective in improving the function of the upper airway dilator muscles and resting tongue position.

In a review of the relevant literature, Camacho et al. concluded that MT yields a reduction in AHI of around 50% in adults and 62% in children[94]. The review reveals that studies with control groups report little or no improvement in AHI for controls compared with improvements in participants treated with MT. Research described by Camacho et al. also clearly demonstrates improvements in lowest oxygen saturation of between 3 and 4%, with data from a number of independent studies recording a mean difference in SPO_2 before and after MT of 4.19%[94].

More research is needed to identify the pathophysiology and mechanisms whereby MT is effective for patients with OSA.

The review recommends that future studies utilize the standardized exercises that have been developed and used by Guimaraes et al.[95] who have the most experience with the therapy. As with breathing re-education, MT is based on an integrative approach involving several exercises, and so it is not possible to define which of the exercises contribute most significantly to treatment outcomes. The review concludes that lowest SPO_2, sleepiness and snoring all improved in adults as a result of MT and that the therapy could provide a useful adjunct to other forms of OSA treatment[95].

In 2019 Huang et al. published the first study to indicate that MT can restore nasal breathing during sleep[96]. All-night nasal breathing is the only marker of successful upper airway treatment. In a 0.5-year follow-up of children who had undergone surgery to remove the tonsils and adenoids it was found that those with good MT compliance breathed nasally during sleep.

Diaféria et al. studied 100 men with a mean age of 48.1 years, BMI of 27.4, Epworth sleepiness scale (ESS) score of 12.7 and AHI of 30.9. The men were divided into three groups and treated using MT, CPAP or combined MT and CPAP. All participants showed a decrease in ESS and snoring, but these improvements were maintained in the MT group after the “washout period” whereas readings returned to pre-treatment levels in the CPAP and combined groups. AHI was reduced in all the patients. The MT and combined groups demonstrated improved soft palate and tongue muscle strength. Where MT was offered in conjunction with CPAP, participants showed increased CPAP adherence compared with those patients who were using CPAP alone[97].

A review from de Felício, et al. showed that MT is successful in reducing snoring and OSA and improving quality of life in adults. It is also effective in treating children with residual apnea, and it improves CPAP compliance and adherence. Study of MT is rare, and it is necessary to analyze the long-term effects of treatment to discover whether it contributes to changes in the musculature[98].

Breathing re-education and arousal threshold

During nose breathing, sleep is deeper. In 1991, Smith et al. identified a neural circuit within the brainstem called the preBötzinger complex (preBötC)[99]. This neural circuit was thought to be responsible for generating respiratory rhythm. In 2017, Yackle et al. found a small, molecularly defined neuronal subpopulation in the mouse preBötC, the primary breathing rhythm generator, believed to regulate the balance between calm and arousal behaviors[100]. This indicates that fast breathing can cause arousal from sleep. Nose breathing creates greater resistance to airflow (10-20%)[101], slowing the respiratory rate. It follows that nasal breathing could protect against unnecessary arousals.

Low arousal threshold and insomnia often go hand in hand[91]. Both are frequently treated with sedatives. In 1991, around 4% of Americans were taking prescribed hypnotic sleep aids[102]. drugs that alongside a wealth of unpleasant and unhealthy side effects can be habit-forming and cause disturbed sleep patterns[103]. One in six adults with a diagnosed sleep disorder and one in eight adults with trouble sleeping use pharmaceutical sedative and hypnotic medications[104].

Low arousal threshold represents perhaps the greatest risk for OSA patients of all the phenotypes. The risk of all-cause mortality is inversely proportional to the duration of apneic events[42]. Butler et al. studied 5,712 men and women with sleep apnea. 1,290 deaths occurred over the 11-year follow up. After adjusting for demographic factors (a mean age of 63 years, a mean AHI of 13.8 (standard deviation 15.0) smoking and cardiometabolic disease) it was observed that individuals with the shortest apneic events had a "significant hazard ratio for all-cause mortality". This relationship was seen in both men and women and was strongest in patients with moderate sleep apnea[42]. The short duration of respiratory events, which is a marker of low arousal threshold, predicts mortality. It is important to perhaps state the obvious, that the reason apneic events are shorter is because the individual wakes up.

Slow, nasal breathing activates the parasympathetic nervous system via the vagus nerve[105]. Mouth breathing involves fast, upper chest breathing, which is associated with sympathetic activation[106]. Breathing re-education uses exercises to reduce the respiratory rate and activate the diaphragm in order to achieve homeostatic balance between the parasympathetic and sympathetic branches of the ANS, therefore reducing sympathetic activation. Acetylcholine, which is secreted by the vagus nerve, the main driver of the parasympathetic nervous system, is instrumental in sleep, performing functions including the activation of neurons that induce REM muscle atonia[107]. Individuals with high anxiety and chronic stress can have difficulty falling asleep and staying asleep[107]. By practicing a breathing rate of 6 bpm, sympathetic tone is reduced, and parasympathetic tone is optimized[53]. This is also beneficial for patients with comorbid depression and sleep disorders.

Breathing re-education involves re-establishing nasal breathing during rest, exercise and sleep. This includes the practice of taping the mouth during sleep to ensure nasal breathing. To date, only one pilot study exists to confirm the effectiveness of mouth taping. Thirty patients with an AHI of between 5 and 15 events per hour slept with their mouth closed using a porous oral patch (POP). The median AHI score was significantly decreased by using a POP from 12.0 per hour before treatment to 7.8 per hour during treatment[108]. Taping raises patient concerns that covering the mouth during sleep may be unsafe[109]. One recent product on the market, MyoTape, does not cover the mouth. Instead, it surrounds the mouth, bringing the lips together with light elastic tension to help ensure nasal breathing. If at any time, the user needs to open their mouth, they can do so easily.

Discussion

It is important to examine OSA with an awareness of all four phenotypes. This is not just an anatomical issue. Even in terms of Pcrit, the speed and volume of airflow is as relevant as the collapsibility of the airway. It is necessary to open the airway in order to help the anatomy.

Equally, it is necessary to reduce breathing rate and flow to minimize airway turbulence during sleep.

While the only studies of the Buteyko method in relation to OSA are considered poorly controlled and anecdotal[4], their suggestion that correction of chronic hyperventilation may improve symptoms of sleep-disordered breathing may not be unfounded[110,111].

An interesting point to note in terms of research history is that when Evans and Lum began examining hyperventilation syndrome in the mid 1970s, their work roused considerable resistance and even hostility. It was suggested that they had misdiagnosed asthma, allergies and "non-disease"[112]. This underlines the need to keep an open mind.

Hyperventilation is now known to contribute to conditions including anxiety disorder and asthma [113-116]. Patients with hyperventilation and breathing pattern disorders demonstrate chronic abnormalities in breathing control, heightened chemosensitivity to CO_2 and increased responses to CO_2[81,83,117,118]. Hyperventilation is also associated with both weakness and hyperactivity of the breathing muscles[119-121].

Chronic behavioral hyperventilation has also recently been identified in the pathophysiology of OSA, central apnea and mixed apnea[4]. Practicing reduced volume breathing to raise CO_2 levels during wakefulness could impact the chemoreceptor response to CO_2 during sleep. Current treatment protocols center on administration of CO_2 after an apnea[122]. However repeated exposure to intermittent hypoxia/ hypercapnia on a daily basis over the course of ten days resulted in a decrease in AHI scores in patients with OSA[123]. Some studies have also reported improved oxygen levels after breathing training[69,124]. However, this is not an overnight fix. Those breathing re-education protocols that have successfully raised resting CO_2 tend to be intensive and long-term[125,126].

There is a role for breathing re-education and Myofunctional Therapy in sleep disordered breathing, both as a support for existing treatments including CPAP and MAD and for individuals with poor CPAP compliance or who fail to respond to MAD. The foundation of breathing re-education is full-time nasal breathing.

This alone can make a significant difference in the severity of sleep apnea. In order to ensure nasal breathing during sleep, props such as MyoTape provide an essential aid when it comes to re-educating the body and addressing the habitual nature of mouth breathing. With nasal breathing comes correct tongue resting posture. The tongue cannot rest in the roof of the mouth when the mouth is open. Mouth breathers keep their tongue in a lowered position[127], and habitual mouth breathing is often accompanied by a habitual tongue thrust[128].

Restoration of diaphragm function helps support lung volume and protect against airway collapse. In terms of loop gain, chemosensitivity to CO_2 can be lowered and BHT increased. Arousal of the sympathetic nervous system can be lessened.

OSA is a serious condition that greatly impacts quality of life. Nasal breathing during sleep has been found beneficial in improving quality of life in SDB[129]. Existing treatment options for OSA are limited, cause side-effects and can be subject to non-compliance. More to the point, they fail to accommodate the fact that four distinct phenotypes of OSA exist.

Conclusion

More research is urgently needed to investigate the therapeutic benefits of restoring nasal breathing and functional breathing patterns across all three dimensions (biomechanical, biochemical and resonant frequency). This involves:

- Nasal breathing during rest and sleep
- Practicing reduced breathing volume during wakefulness to expose the body to slightly elevated carbon dioxide in order to reduce the chemosensitivity to CO2
- Low breathing with greater amplitudes of the diaphragm and improved respiratory muscle strength

For individuals with sleep apnea, the goal should be to reach a comfortable breath hold time after an exhalation of 25 seconds. While mouth taping is effective, merely taping the mouth during sleep is not enough. Nor is it sufficient to target only one dimension of breathing.

Breathing re-education needs a tailored approach to the individual. Managed in this way, it could offer substantial therapeutic intervention across all four phenotypes of sleep apnea. It would seem much of the groundwork has been done. It is time to follow the research to its logical conclusion.

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SUBMISSION AND CORRESPONDENCE INFORMATION

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DISCLOSURE STATEMENT

The author is a Buteyko Breathing Educator, the inventor of MyoTape and the owner of MyoTape.com and The Oxygen Advantage®

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HEART RATE VARIABILITY

- HRV is largely a product of parasympathetic and sympathetic nervous system activity.
- HRV is a qualitative index of "sympathovagal balance", reflecting the weight of parasympathetic versus sympathetic autonomic control.

Russo et al. The physiological effects of slow breathing in the healthy human. Breathe. Volume 13, Issue 4. December 2017.

- Autonomic function is altered in depression, as evidenced by impaired baroreflex sensitivity, changes in heart rate, and reduced heart rate variability (HRV).
- Decreased vagal activity and increased sympathetic arousal have been proposed as major contributors to the increased risk of cardiovascular mortality in participants with major depression and baroreflex gain is decreased.

Karavidas et al. Preliminary results of an open label study of heart rate variability biofeedback for the treatment of major depression. Appl Psychophysiol Biofeedback.
Volume 32, Issue 1. March 2007.

- The baroreceptor reflex (baroreflex) is a negative feedback mechanism involving stretch receptors, present primarily in the aortic arch and carotid sinuses, that monitor arterial blood pressure and respond to acute changes via central–neural–autonomic pathways.
- Arterial baroreceptors are activated by an increase in blood pressure and fire signals via afferent nerves to the cardiovascular centre in the medulla oblongata, which relays fast parasympathetic efferent signals via the vagus nerve to the sinoatrial (SA) node to decrease heart rate.

Russo et al. The physiological effects of slow breathing in the healthy human. Breathe. Volume 13, Issue 4. December 2017.

- Produces vasodilation and a decrease in heart rate when blood pressure increases and vasoconstriction and an increase in heart rate when blood pressure decreases.

https://www.merriam-webster.com/medical/baroreflex

- HRV and baroreflex activity are influenced by the phasic effects of respiration, with the rate of respiration modulating the relationship between the HRV and blood pressure oscillations. (phasic: occurring in phases rather than continuously)

Russo et al. The physiological effects of slow breathing in the healthy human. Breathe. Volume 13, Issue 4. December 2017.

- Chronic diseases-associated with changes in the reflex regulation of the cardiorespiratory system, there is reduced tolerance to changes in blood pressure.

Trembach et al. Breath-holding test in evaluation of peripheral chemoreflex sensitivity in healthy subjects. Respiratory Physiology & Neurobiology. Volume 235, Issue 79–82. 2017.

- Slow breathing causes the pulse harmonics of blood flow (i.e. blood pressure oscillations) to synchronize with the rhythm of the heart.
- Slow breathing increases amplitudes of blood pressure oscillations and HRV, and this is particularly significant at a respiration rate of 6 breaths per min.

Russo et al. The physiological effects of slow breathing in the healthy human. Breathe. Volume 13, Issue 4. December 2017.

- The sensitivity of the arterial baroreflex is inversely proportional to the sensitivity of the peripheral chemoreflex.
- Evaluating the sensitivity of the peripheral chemoreflex, we are able to predict the likelihood of developing respiratory and cardiovascular disorders during the treatment of these patients, disorders during surgery under general anaesthesia, and predict the outcome of the disease.
- Breath holding after inhalation can potentially provide information on the status of reflex regulation of the cardiorespiratory system.

Trembach et al. Breath-holding test in evaluation of peripheral chemoreflex sensitivity in healthy subjects. Respiratory Physiology & Neurobiology. Volume 235, Issue 79–82. 2017.

- When the breathing rate was paced at a slower frequency, the responses to hypoxia and hypercapnia were both markedly blunted compared with those under spontaneous breathing despite a similar decrease in SaO_2 or increase in ET CO_2 being attained during spontaneous breathing in all participants.
- Breathing at 6 b.p.m. Depressed both hypoxic and hypercapnic chemoreflex responses, compared with spontaneous or 15 b.p.m. controlled breathing.
- All participants reported that this breathing rate allowed them to tolerate the stimulus better (they experienced fewer subjective feelings of headache and dizziness).
- An enhanced baroreflex inhibits the chemoreflex, whereas the chemoreflex is augmented by a depressed baroreflex (such as in conditions associated with increased sympathetic activity).
- Respiration is one of the most powerful modulators of the arterial baroreflex, as the change in venous return induced by respiration alters stroke volume, which in turn produces phasic changes in SBP, which modulate heart rate through the baroreflex.

Bernardi et al. Slow breathing reduces chemoreflex response to hypoxia and hypercapnia, and increases baroreflex sensitivity.Journal of Hypertension. Volume 19, Issue 12. January 2002.

- It is therefore possible that differences in tidal volume (due to different ventilatory rates) modify the baroreflex, which in turn modifies the chemoreflex.

- Training individuals with chronic heart failure to breathe slowly (in the range of 6 b.p.m.) has several favourable effects:

  1) Increasing oxygen saturation at rest
  2) Increasing exercise tolerance
  3) Reducing dyspnoea

- Reducing the breathing rate might also reduce the chemoreflex sensitivity and thus help in reducing the exaggerated/inappropriate ventilation in these individuals.

- The increased baroreflex sensitivity observed in response to a reduction in the breathing rate may increase the baroreflex and reduce the chemoreflex hyperactivity.

Bernardi et al. Slow breathing reduces chemoreflex response to hypoxia and hypercapnia, and increases baroreflex sensitivity.Journal of Hypertension. Volume 19, Issue 12. January 2002.

EXHAUSTION, ANXIETY, PANIC & BREATHING

BREATHING TO EVOKE RELAXATION

- Slowed respiration in combination with prolonged exhalation may be particularly effective for reducing arousal. This maneuver for reducing arousal has been suggested by many yogi masters.

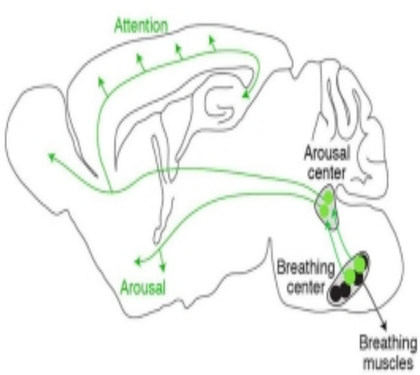
Three groups of people practiced different breathing patterns:

- Inhaled quickly and exhaled slowly
- Inhaled slowly and exhaled quickly
- Equal times inhaling and exhaling

- The researchers found that inhaling quickly and exhaling slowly was consistently effective for reducing physiological and psychological stress during confrontation periods.

Cappo et al. The utility of prolonged respiratory exhalation for reducing physiological and psychological arousal in non-threatening and threatening situations. Journal of Psychosomotic Research. Volume 28, Issue 4. 1984.

- Stanford scientists have identified a small group of neurons that communicates goings-on in the brain's respiratory control center to the structure responsible for generating arousal throughout the brain.



- Rather than regulating breathing, these neurons were spying on it and reporting their finding to another structure in the brainstem.
- This structure, the locus coeruleus, sends projections to practically every part of the brain and drives arousal: waking us from sleep, maintaining our alertness and, if excessive, triggering anxiety and distress.

Yackle et al. Breathing control center neurons that promote arousal in mice.Science. Volume 355, Issue 6332. March 31, 2017.

STRESS	RELAXATION
• Faster	• Slow down
• Sigh more (irregular)	• Regular
• Oral breathing	• Nose breathing
• Noticeable breathing	• Soft breathing
• Upper chest breathing	• Diaphragm breathing

HYPERVENTILATION SYNDROME

- It has been known for many years that respiratory acidosis and alkalosis have profound effects on cerebral function.
- Foerster, for example, reported in 1924 that hyperventilation can provoke seizures in epileptic patients and Lennox, Gibbs & Gibbs in 1936, that elevation of the inspired CO_2 concentration can suppress them.

Balestrino et al. Concentration of carbon dioxide, interstitial pH and synaptic transmission in hippocampal formation of the rat. Journal of Physiology, 396, pp. 247-266. 1988.

- A biochemical feature of strong emotion is a rise in adrenaline and noradrenalin and that has been shown (Heistad 1972) to boost the body's sensitivity to CO_2 by about 30%, which results in increased hyperventilation.

Leon Chaitow, Dinah Bradley and Christopher Gilbert. Recognising and treating breathing pattern disorders. 2014.

EXHAUSTION

- Chronic stress is among the most common diagnoses in Sweden, most commonly in the form of exhaustion syndrome.
- Severe stress symptoms occur if an imbalance between investing and regaining energy persists over a long period of time. Chronic stress symptoms usually occur within three areas: emotional exhaustion, physical tiredness and cognitive difficulties.
- The majority of patients with this syndrome also have disturbed breathing (hyperventilation).

Ristiniemi et al. Hyperventilation and exhaustion syndrome. Scand J Caring Sci. Volume 28, Issue 4. December 2014.

- Thirty patients with exhaustion syndrome and 14 healthy subjects were evaluated with the Nijmegen Symptom Questionnaire (NQ).
- The patients reported significantly higher levels of hyperventilation as compared to the healthy subjects. All patients' average score on NQ was 26.57, while that of the healthy subjects was 15.14.

- The brief Grounding training contributed to a near significant reduction in hyperventilation and to significant reductions in exhaustion scores and scores of depression and anxiety.
- The conclusion is that hyperventilation is common in exhaustion syndrome patients and that it can be reduced by systematic physical therapy such as Grounding.

Ristiniemi et al. Hyperventilation and exhaustion syndrome. Scand J Caring Sci. Volume 28, Issue 4. December 2014.

INSOMNIA, SLEEP APNEA AND DEPRESSION

- Insomnia is a known risk factor for incidence and severity of depression, recurrence of depressive episodes and even suicide.
- Several studies have also shown that OSA can contribute to the development of depression.
- When insomnia and OSA co-occurred, depression scores were higher than those with insomnia alone.
- As estimates of the prevalence of insomnia among OSA patients are as high as 67%, this finding suggests that many OSA patients may be at risk of depression by virtue of the co-morbid insomnia symptoms.

Grandner et al. Connecting insomnia, sleep apnea and depression. Respirology. Volume 22, Issue 7. October 2017.

- The presence of daytime sequelae such as fatigue, irritability and cognitive symptoms (e.g. difficulty concentrating) are part of the diagnostic criteria for insomnia disorder. These daytime symptoms are often what prompt patients to seek treatment.
- Daytime sleepiness, irritability, fatigue and cognitive dysfunction are also well-characterized consequences of OSA.

Grandner et al. Connecting insomnia, sleep apnea and depression. Respirology. Volume 22, Issue 7. October 2017.

CHILDHOOD ANXIETY

- To examine the relationship between respiratory regulation and childhood anxiety disorders: (104 children aged 9-17 years).
- Childhood anxiety disorders, particularly separation anxiety disorder, are associated with CO_2 hypersensitivity. Carbon dioxide hypersensitivity is associated with physiological changes similar to those found in panic disorder.
- Carbon dioxide sensitivity is postulated to be a familial risk marker of panic disorder. During CO_2 inhalation, offspring with anxiety disorders, relative to offspring without anxiety disorders, experienced significantly more panic symptoms and panic attacks, as well as elevated respiratory rates.

Pine et al. Differential carbon dioxide sensitivity in childhood anxiety disorders and nonill comparison group. Arch Gen Psychiatry. Volume 57. Issue 10. October 2000.

PANIC AND AGORAPHOBIA

- 41 patients with panic disorder (PD) and agoraphobia.
- 4 weeks of training aimed at altering either respiration (capnometry – assisted respiratory training (CART)) or panic-related cognitions (cognitive training (CT)).
- Changes in respiration (PCO_2, respiration rate), symptom appraisal, and a modality – nonspecific mediator (perceived control) were considered as possible mediators.
- Capnometry – assisted respiratory training, but not cognitive training, led to corrections from initially hypocapnic to normocapnic levels.

Meuret et al. Respiratory and cognitive mediators of treatment change in panic disorder: evidence for intervention specificity. J Consult Clin Psychol. Volume 78, Issue 10. October 2010.

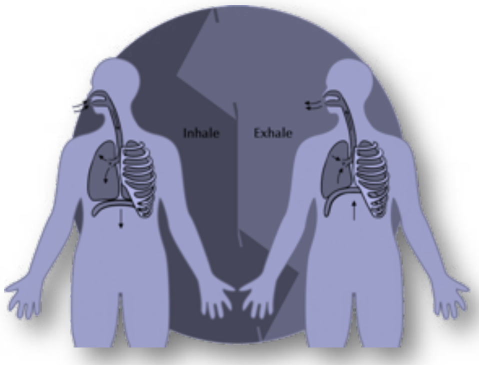
- Patients learn to breathe in such a way as to reverse hyperventilation, a highly uncomfortable state where the blood stream operates with abnormally low levels of carbon dioxide, said Meuret, one of the researchers conducting the study.
- "Most panic-disorder patients report they are terrified of physical symptoms such as shortness of breath or dizziness," Meuret said.
- "In our study, cognitive therapy didn't change respiratory physiology, but CART did effectively reduce hyperventilation.
- CART was proved an effective and powerful treatment that reduces the panic by means of normalizing respiratory physiology."
- "We found that with CART it's the therapeutic change in carbon dioxide that changes the panic symptoms – and not vice versa," Meuret said.

New breathing therapy reduces panic and anxiety by reversing hyperventilation. Science News. December 22, 2010

- During the treatment, patients undergo simple breathing exercises twice a day. A portable capnometer device supplies feedback during the exercises on a patient's CO_2 levels.
- The goal of these exercises is to reduce chronic and acute hyperventilation and associated physical symptoms.
- This is achieved by breathing slower but most importantly more shallowly. Contrary to lay belief, taking deep breaths actually worsens hyperventilation and symptoms.
- With CT, Meuret said, if a patient reports shortness of breath, the therapist challenges the assumption by asking how often the person actually has suffocated during a panic attack, then hopes that will reverse the patient's thinking.
- "I found that process very challenging for some of my patients because it acknowledges the symptom but says it's not a problem," Meuret said.
- "CART, however, tells us a patient's CO_2 is very low and is causing many of the symptoms feared, but it can also show how to change these symptoms through correct breathing.
- There has been an assumption that if people worry less about symptoms it will also normalize their physiology, but this study shows that this is not the case," she said.
- "Hyperventilation remains unchanged, which could be a risk factor for relapse down the road. Apart from hyperventilation being a symptom generator, it is an unhealthy biological state associated with negative health outcomes."

New breathing therapy reduces panic and anxiety by reversing hyperventilation. Science News. December 22, 2010

- Most investigators reported an exaggerated response among individuals with PD on at least some of the respiratory parameters however, some studies have failed to observe this effect.

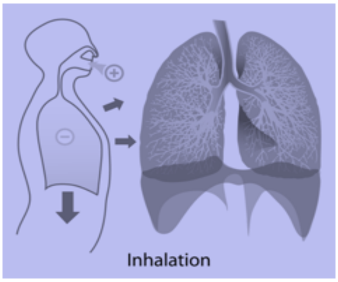


- An important link between respiration and arterial blood CO_2 levels. Specifically, three parameters are responsible for controlling respiratory processes: arterial blood levels of oxygen, CO_2, and hydrogen ions. Among these, CO_2 provides the strongest stimulus to ventilation. For example, a slight increase (e.g., 2–5 mm Hg) in arterial blood pCO_2 can more than double the ventilation.

- Findings showing that individuals with panic disorder are prone to experience panic attacks when inhaling CO_2 enriched air have given rise to the hypothesis that physiological systems underlying the experience of suffocation may be important in the etiology of PD.

- Forty individuals with PD and 32 controls underwent both a breath holding challenge and a CO_2 rebreathing challenge.

- Individuals with PD experienced elevated physiological reactivity to both challenges and greater levels of suffocation sensations during the rebreathing challenge.



Rassovsky et al. Suffocation and respiratory responses to carbon dioxide and breath holding challenges in individuals with panic disorder. Journal of Psychosomatic Research. Volume 60, Issue 3. March 2006.

- Furthermore, PD individuals who experienced a panic attack in response to the rebreathing challenge exhibited faster but shallower breathing during the challenge than did other PD individuals.
- Findings are consistent with theories linking PD to hypersensitive brain systems underlying the experience of suffocation.

Rassovsky et al. Suffocation and respiratory responses to carbon dioxide and breath holding challenges in individuals with panic disorder. Journal of Psychosomatic Research. Volume 60, Issue 3. March 2006.

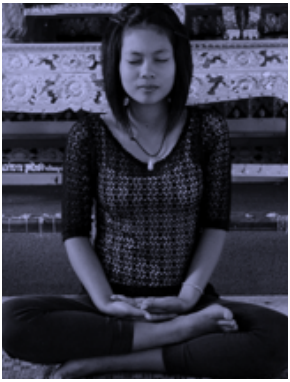
- For hyperventilation, there is accumulating evidence that at least some panic attacks are accompanied by drops in alveolar (and arterial) carbon dioxide pressure. Between 61 and 83% of patients with agoraphobia with panic recognize the similarity of symptoms of voluntary hyperventilation and their usual panic attacks.

De Ruiter et al. Breathing Retraining, Exposure and a Combination of Both, in the Treatment of Panic Disorder With Agoraphobia. Behav Res Ther. Volume 27, Issue 6. 1989.

- Hyperventilation (HV) may take place chronically or in response to a provoking stimulus, such as being in a stressful environment, exercise, pain etc.

Tweeddale, P.M., Rowbottom, I., McHardy, G.J.R. Breathing retraining: Effect on anxiety and depression scores in behavioural breathlessness. Journal of Psychosomatic Research, Volume 38, Issue 1, January 1994

NORMALIZING BREATHING VOLUME



- The effect of breathing therapy was evaluated in patients with hyperventilation syndrome (HVS).
- Efforts to reduce ventilation through exclusive attention to a reduction in respiration frequency may not only be unsuccessful in reducing ventilation, but may, as in the study in question, produce a paradoxical increase in ventilation, an effect opposite to the express purpose of breathing retraining.
- Since ventilation is measured in terms of minute volume (the sum of the tidal volumes of each breath for 1 min), a decline in pCO_2, accompanied by a decrease in respiration rate can only be accomplished by means of an increase in minute volume.

Ronald Ley. The efficacy of breathing retraining and the centrality of hyperventilation in panic disorder: A reinterpretation of experimental findings.Behaviour Research and Therapy. Volume 29, Issue 3. 1991.

- The influence of breathing retraining on complaints has been studied extensively in patients with HVS and with anxiety disorders. The findings display a decrease of frequency and intensity of panic attacks, and improvement of coping ability in stressful situations after breathing therapy.
- Carbon dioxide not always shown to improve.
- Breathing retraining appears to be an effective therapy, for a number of complaints and the anxiety encountered in HVS and in anxiety disorders, because of its effects on breathing, mainly on breathing frequency.

NORMALIZING BREATHING VOLUME Ronald Ley. The efficacy of breathing retraining and the centrality of hyperventilation in panic disorder: A reinterpretation of experimental findings. Behaviour Research and Therapy. Volume 29, Issue 3. 1991.

- Several investigators have proposed that panic attacks are the direct result of chronic hyperventilation. Conversely, others have argued that hyperventilation does not play a central role in panic disorder and is better understood as a consequence of panic sensations triggered by hypersensitive CO_2 receptors.
- Panic is the result of an evolved, but maladaptive, suffocation alarm system that is hypersensitive to CO_2. When activated, this alarm mechanism is thought to result in respiratory distress, hyperventilation, panic, and the urge to flee.

Asmundson et al. Triggering the false suffocation alarm in panic disorder patients by using a voluntary breath-holding procedure The American Journal of Psychiatry. Volume 151, Issue 2. February 01, 1994.

- May be at least two subgroups of individuals with PD, only one of which experiences panic attacks with pronounced respiratory distress.
- This group may possess a deranged suffocation monitoring system as a key etiological substrate. It may be, therefore, that the hypersensitivity to central CO_2 build-up found among some of our PD subjects may have marked them as belonging to a particular PD subtype.

Rassovsky et al. Suffocation and respiratory responses to carbon dioxide and breath holding challenges in individuals with panic disorder. Journal of Psychosomatic Research. Volume 60, Issue 3. March 2006.

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NASAL BREATHING

- Nasal obstruction was induced experimentally in new born rat pups.
- Performed on postnatal day 8 by bilaterally closing the external nares.
- Early nasal obstruction period was associated with delayed craniofacial development in both male and female pups.
- Mortality nil in control group.
- Mortality 23% – 72h in blocked nose group.
- 21st postnatal day, mortality reached 37%.

- Nasal obstruction affects young infants' behaviour, for instance increasing crying episodes and sleep perturbed by more apneic spells, and can be involved in the sudden infant death syndrome.

Trabalon et al. It Takes a Mouth to Eat and a Nose to Breathe: Abnormal Oral Respiration Affects Neonates' Oral Competence and Systemic Adaptation.International Journal of Pediatrics. July 2012.

DECONGESTING THE NOSE

NASAL BREATHING

- To determine if mucosal surface heat and water loss influence the nasal functional response to cold air, we measured nasal resistance by posterior rhinomanometry.
- During the challenge period, the subjects breathed either in and out of the nose or in through the nose and out through the mouth.
- No changes in nasal resistance developed when subjects breathed exclusively through the nose;
- However, when subjects breathed in through the nose and out through the mouth, nasal resistance increased 200% at 1 min after the challenge and returned to baseline values by 10 min after cessation of the challenge.

Strohl KP, Arnold JL, Decker MJ, Hoekje PL, McFadden ER. Nasal flow-resistive responses to challenge with cold dry air. J Appl Physiol (1985). 1992 Apr;72(4):1243-6.

- To compare the difference in respiratory water loss during expiration through the nose and through the mouth, in healthy subjects.
- 19 healthy volunteers.
- Net water loss increased by 42% when the breathing mode was switched from nasal to oral expiration during tidal breathing in healthy subjects. Increased water and energy loss by oral breathing could be a contributing factor to the symptoms seen in patients suffering from nasal obstruction.

Svensson S1, Olin AC, Hellgren J. Increased net water loss by oral compared to nasal expiration in healthy subjects. Rhinology. 2006 Mar;44(1):74-7.

- Nasal resistance is also inversely related to end tidal CO_2 levels (Bartley 2006).
- People who are anxious typically have lower ET CO_2, and thus are more likely to experience nasal congestion.

Recognizing and Treating Breathing Disorders: A Multidisciplinary Approach,
Leon Chaitow, Christopher Gilbert, Dinah Bradley

- The response of nasal airway resistance (Rn) to various degrees of hypoxia and hypercapnia was measured in six subjects using active posterior mask rhinomanometry.
- Hypercapnia, induced by breathing gas mixtures of various contents of carbon dioxide, significantly decreased Rn. The reduction in Rn was proportional to the inspired partial pressure of carbon dioxide over a range of 0 to 50 torr.
- Breathing gas mixtures of high and low contents of oxygen produced no significant change in Rn. These results indicate that the nasal airway is actively involved in the respiratory response to hypercapnia but not to moderate hypoxia.

Ann Otol Rhinol Laryngol. 1979 Mar-Apr;88(2 Pt 1):247-52. Response of nasal airway resistance to hypercapnia and hypoxia in man. McCaffrey TV, Kern EB.

- Holding of the breath for 30 seconds or longer helped to open up the nose to make breathing easier in most of the subjects tested. Furthermore, it was found that physical exercise also decreased nasal resistance.
- Nasal resistance decreases linearly as expired CO_2 levels and exercise levels increase.

Hasegawa M, Kern EB. The effect of breath holding, hyperventilation, and exercise on nasal resistance. Rhinology. 1978 Dec;16(4):243-9.

- Nasal resistance decreases linearly as expired CO_2 levels and exercise levels increase.
- The constant relationship between nasal resistance and minute ventilation during hypercapnia and exercise suggests that nasal resistance is regulated by the respiratory center to match the level of respiratory demand.

Otolaryngol Head Neck Surg. 1984 Jun;92(3):302-7.Role of the nasal airway in regulation of airway resistance during hypercapnia and exercise. Second-Place Resident Award at 1982 Research Forum.

- Nasal airway resistance was decreased during breath holding in man and during experimentally induced asphyxia in animals.

Tatum AL (1923) The effect of deficient and excessive pulmonary ventilation on nasal volume. Am J Physiol 65 : 229-233

- When nasal breathing takes place in the presence of significant obstruction, there is an increase in FCO_2, a decrease in FO_2, and a decrease in nasal airway resistance. In other words, when nasal breathing is forced to push against significant obstruction, the effect of this obstruction appears to be that of decreasing the nasal resistance.

Hoshino, T., Takeyasu, Y. & Koizumi, N. Changes in nasal airway resistance in response to controlled external respiratory obstruction. *Arch Otorhinolaryngol* 245, 112–115 (1988).

Factors which may play a role in nasal decongestion:

- Increased Carbon Dioxide
- Increased Nitric Oxide
- Increased heat
- Activation of SNS

NASAL OBSTRUCTION STUDY

- A study to investigate the effectiveness of the Buteyko technique on the nasal symptoms of patients with asthma.

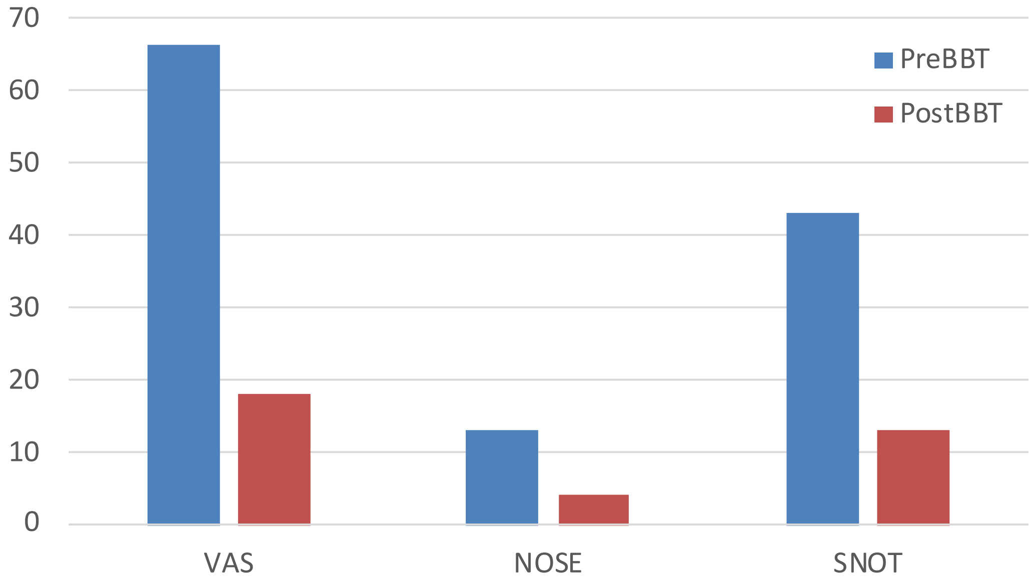

Fig.1. Pre- and post-test Mean scores of Visual analogue scale (VAS), Nasal obstruction symptom evaluation (NOSE) and Sinonasal outcome test (SNOT-22)

Adelola O.A., Oosthuiven J.C., Fenton J.E. Role of Buteyko breathing technique in asthmatics with nasal symptoms. Clinical Otolaryngology.2013, April;38(2):190-191

- For example, NOSE evaluation surveys nasal congestion or stuffiness, poor sense of smell, snoring, nasal blockage or obstruction, trouble breathing through the nose, trouble sleeping, having to breathe through the mouth, unable to get enough air through the nose during exercise or exertion and feeling panic that one cannot get enough air through the nose.

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CLIENT HANDOUT FOR ASTHMA AND RESPIRATORY DISORDERS

The protocol in this course employs Dr. Konstantin Buteyko' s teachings and the traditional Buteyko Method.

Since 2002, people attending Buteyko Clinic have reported significant reduction in symptoms such as:

- Nasal congestion
- Coughing
- Wheezing
- Breathlessness
- Colds

These symptoms noticeably lessen each time the Control Pause score improves by five seconds.

In 1998, the BBC television channel aired a documentary investigating the Buteyko Method for asthma. As part of your Buteyko training, I believe this is worth viewing. You will see Control Pause, Breathe Light, and Maximum Pauses employed in this video. You can access the BBC documentary on youtube by searching Buteyko BBC QED or from this link: https://youtu.be/vtb65UQ3E1c

Important Note Before Starting

The following exercises for asthma and respiratory complaints can be powerful. Maximum Pauses and Steps exercise for adults are part of this teaching but are not suitable for everyone.

If you are pregnant and in your first trimester, please do not practice any of the breathing exercises. In your second trimester, you can practice gentle nose breathing and breathe light with Relaxation.

If you have any medical condition(s), including high blood pressure, heart complaints, anxiety, panic disorder, or any serious medical condition, please do not practise holding the breath for long periods of time. Exercises involving long breath holds which should be avoided include Maximum Pauses and Steps exercise.

Tracking Progress with the Control Pause

The Control Pause measures the number of seconds you can comfortably hold your breath after an exhalation. It will increase as your breathing improves and can be used to track your progress as you move through the program outlined in this course. You must not try to push beyond the first distinct urge to breathe. This isn't a competitive challenge.

Continually practicing the Control Pause will not change the result either. Your Control Pause score will only increase when you use the exercises and begin to reduce your breathing volume towards normal. Be aware that people with asthma and COPD demonstrate significantly lower breath hold times than those with normal breathing. This is because breath hold time is related to measures of lung function.

The best way to get an accurate representation of your breathing is to measure your Control Pause score in the morning just after waking. When you are fast asleep, breathing continues subconsciously and without interference. For this reason, the morning Control Pause score gives a truer measure because it indicates how well you breathe when you can't possibly be thinking about your breathing.

During your first few weeks with the breathing exercises, you should notice an improvement of three to four seconds in your Control Pause score each week. After that, progress will continue at a slower pace. Physical exercise can be gradually introduced to increase the Control Pause score above 20 seconds.

When the breathing exercises in this course are practiced correctly, your breathing pattern can be retrained. If your very first Control Pause score is 10 seconds, it will take at least three weeks to reach a Control Pause score of 20 seconds and six months to reach a Control Pause score of 40 seconds. Improvement will depend on the severity of your symptoms and on how much attention you bring to reducing your breathing. The more focus you give to your breathing each day, the better.

At the same time, there is no need to become obsessed with your breathing. Allow the changes to gradually occur. The breath cannot be forced into compliance. Many of the exercises involve breathing less air for periods of time during the day. Allow the breath to gradually reduce by paying attention to the airflow entering and leaving the nostrils, slowing it down without tensing up the breathing muscles.

Practice the breathing exercises formally for the first few weeks and then incorporate them into your way of life. Your progress will be reflected in a higher Control Pause score. You will also have lighter breathing and begin to feel better.

The Importance of Nose Breathing

In order to achieve maximum benefits from the Buteyko exercises in this course, it's vital that you breathe through your nose at all times while awake and asleep. Breathing through the mouth does not serve any purpose other than allowing unfiltered, cold, dry air into the lungs, and this irritates the airways. This is especially relevant to people with asthma.

The nose is the only organ to condition air and it serves to:

- Filter airbourne particles and clean the air before arriving at the lungs
- Moisten air
- Warm air
- Regulate breathing volume
- Release Nitric Oxide
- Support better recruitment of the diaphragm while breathing

- Increase Co2 in the blood during exercise
- Increase the partial pressure of oxygen (PO2 mmHg) by nearly 10% (Swift 1989)

Nasal breathing during wakefulness slows and draws the air into the lower parts of the lungs. This may help to maintain the strength and function of the breathing muscles and reduce breathlessness. Healthy nasal breathing can also minimize symptoms of nasal congestion. Another noteworthy benefit of nasal breathing is that it harnesses a gas called nitric oxide, which is produced in the nasal cavity. Nitric oxide has antiviral and antibacterial qualities, so it protects against infections.

The high concentration of nitric oxide in the sinuses is instrumental in keeping the nose and lungs free of disease and inflammation. It is likely that the reduction in inhaled nitric oxide (NO) caused by mouth breathing during sleep contributes to the negative effects of nocturnal mouth breathing. When we breathe nasally, NO is released into the nasal cavity and carried down to the lungs in concentrations that are between 5 and 20 times higher than during mouth breathing. When nasal breathing is combined with slow breathing, this allows an even greater concentration of NO to be carried into the lungs.

As the Control Pause score increases, breathing becomes slower, and it is likely that a higher Control Pause score leads to improved uptake and use of NO. Regardless of your current Control Pause score, you should breathe only through your nose during rest, physical exercise, and sleep.

Daily Practice Program Instructions

Alongside your practice of full-time nasal breathing, follow the program below which is suitable for your Control Pause. As your Control Pause score improves, progress to the next level.

Practise the Following Daily When Your Control Pause Score is Less Than 10 Seconds:

- Measure your Control Pause at least once per week, soon after waking.
- Nasal breathe during rest, exercise, and sleep.
- Practice Breathing Recovery, Sitting for 10 minutes every hour.

or

- Practice Breathing Recovery, Walking, and do 5 to 10 repetitions, two times per hour during the day.

Practise the Following Daily When Your Control Pause Score is Between 10 and 15 Seconds:

- Measure your Control Pause at least once per week, soon after waking.
- Nasal breathe during rest, exercise, and sleep.
- Breathe Light with air hunger for 4 minutes, six times daily.
- Walk with mouth closed for 10 minutes daily.
- Practice Breathing Recovery, Sitting for 10 minutes, two times per day (and any time you experience symptoms such as wheezing, coughing, or chest tightness).

or

- Practice Breathing Recovery, Walking, and complete five repetitions of this exercise, three times per day.

Practise the Following Daily When Your Control Pause Score is 15 Seconds Plus:

- Measure your Control Pause (CP) at least once per week, soon after waking.
- Nasal breathe during rest, exercise, and sleep.

- Practise the Breathe Light set as described below. The first Breathe Light routine is suitable for everyone and the second one which includes Maximum Pauses is only for people who DO NOT have severe medical conditions or contraindications.

Breathe Light Set (suitable for all people):

- Control Pause and Breathe Light 1 (hands on chest and tummy)
- One minute rest
- Breathe Light 2 (relaxation)
- One minute rest
- Breathe Light 3 (relaxation)
- One minute rest
- Breathe Light 4 (finger under nose)
- Final Control Pause

Each set takes about twenty minutes. (BL 4 min by 4 reps)

Practise 3 sets of the above Breathe Light daily

Breathe Light with Maximum Pauses Set (not suitable for people with contraindications):

Please note, if you are over 60 years old or have a medical condition(s), including high blood pressure, heart complaints, anxiety, panic disorder, or any serious medical condition, please do not practise Maximum Pauses.

- Control Pause and Breathe Light 1 (hands on chest and tummy)
- Maximum Pause 1
- Breathe Light 2 (relaxation)
- Maximum Pause 2
- Breathe Light 3 (relaxation)
- Maximum Pause 3

- Breathe Light 4 (finger under nose)
- Final Control Pause

Each set takes about twenty minutes. (BL 4 min by 4 reps with maximum pause between each) Practise 3 sets of the above Breathe Light daily

If you have symptoms such as wheezing, coughing, or chest tightness, practice the small breath holds in Breathing Recovery, Sitting for 10 minutes every hour. Or, practice Breathing Recovery, Walking for five to ten repetitions, two times per hour during the day.

Breathing Exercise Instructions

Breathe Light Directions:

This is the most important exercise to help improve breathing patterns during wakefulness and sleep. Using it will help with insomnia, snoring, and sleep apnea.

- Place one hand on your chest and one hand on your abdomen.
- Gently soften and slow down your breathing to create a slight hunger for air.
- Slow down the speed of air as it enters your nostrils.
- Allow the breath out to be slow and relaxed.
- The goal is to breathe softly so that about 30% less air enters your lungs.
- You are doing it correctly when you feel a tolerable air hunger.
- If the air hunger is too much, take a rest for 15 seconds and start again.
- Continue the practice for approximately 15 minutes.

Breathing Recovery, Sitting Directions (also called Many Small Breath Holds):

- Sit up straight and take a normal breath in and out through your nose.
- Pinch your nose with your fingers to hold your breath for up to five seconds. Count: 5, 4, 3, 2, 1.
- Let go of your nose and breathe normally through your nose for 10 seconds.
- Repeat the sequence for 10 minutes.

You can increase your breath-hold length as your Control Pause increases. However, for the purpose of this exercise, your maximum breath hold should be no longer than half your Control Pause score at the time.

Breathing Recovery, Walking Directions:

- In a standing position, make sure you have space to walk freely.
- Exhale gently through your nose.
- Pinch your nose with your fingers to hold your breath.
- Walk for 5 to 10 paces while holding your breath.
- Stop walking, release your nose and breathe in through it.
- Rest for 30 to 60 seconds while standing still.
- When breathing is comfortable, repeat 6 to 10 times.

If you are practicing at home, you can repeat this exercise six times, five times per day. Holding the breath for up to 10 paces is very suitable for anyone with severe asthma, COPD, or panic disorder. It is also ideal if you have disproportionate breathlessness, anxiety, a racing mind, or a low Control Pause score.

Maximum Pause Directions (also called Nose Unblocking):

Please note, if you are over 60 years old or have a medical condition(s), including high blood pressure, heart complaints, anxiety, panic disorder, or any serious medical condition, please do not practise Maximum Pauses. Instead, practise the Breathe Light exercise.

- Sit upright on a straight-backed chair.
- Take a small, light breath in through your nose if you can and a small breath out through your nose. If you are unable to inhale through your nose, take a tiny breath in through the corner of your mouth.
- After exhaling, pinch your nose and hold your breath. Keep your lips sealed.
- Gently nod your head or rock your body until you feel that you cannot hold your breath for any longer. You should feel a relatively strong need for air.
- At this point, let go of your nose, and breathe in gently through it.
- Breathe gently in and out with your mouth closed. When you first breathe in, try to avoid taking a deep breath. Instead, keep your breathing calm and focus on relaxation. Use the mantra: "Relax and breathe less," if it helps.

An additional use for this exercise is to decongest the nose. To decongest the nose, repeat the exercise 6 times with one minutes rest between each.

Breathe Light Exercises: Two Variations

Breathe Light exercises help to normalise breathing biochemistry, resulting in improved oxygen uptake and delivery and reduced sensitivity to CO2, while working toward normalising breathing volume. The goal of Breathe Light is to slow down the speed of your breathing, to take about 30% less air into your body. This creates a sensation that you are not getting enough air.

The first Breathe Light exercise set is suitable for everyone and the second one which includes Maximum Pauses is only for people who DO NOT have severe medical conditions or contraindications.

1. Breathe Light Directions (suitable for all people):

- Control Pause and Breathe Light 1 (hands on chest and tummy)
- One minute rest
- Breathe Light 2 (relaxation)
- One minute rest
- Breathe Light 3 (relaxation)
- One minute rest
- Breathe Light 4 (finger under nose)
- Final Control Pause

Practise 3 sets of Breathe Light daily (each set consists of BL 4 min by 4 reps as described above).

2. Breathe Light with Maximum Pauses Directions (not suitable for people with contraindications):

- Control Pause and Breathe Light 1 (hands on chest and tummy)
- Maximum Pause 1
- Breathe Light 2 (relaxation)
- Maximum Pause 2
- Breathe Light 3 (relaxation)
- Maximum Pause 3
- Breathe Light 4 (finger under nose)
- Final Control Pause

Practise 3 sets of Breathe Light daily (each set consists of BL 4 min by 4 reps with Maximum Pause between each). Ideally, practise one set in the morning, one in the afternoon, and one in the evening. It's best not to practise directly after eating. Ideally, your final Control Pause should be 25% higher than your first. Don't forget to rest for a couple of minutes with normal breathing before measuring your final Control Pause.

How to Help Stop Coughing, Wheezing, and Chest Tightness

The practice of many small breath holds (using the Breathing Recovery, Sitting exercise outlined above) helps calm down the breathing. It is a very effective exercise to help stop asthma symptoms such as wheezing and coughing, to reduce stress levels, and to help control breathing during a hyperventilation or anxiety attack. For people who have experienced severe trauma in their lives, frequent practice of this exercise throughout the day offers considerable relief.

This exercise is an "emergency" exercise. It is very hard to slow your breathing down when it is out of control because the air hunger or sense of suffocation during asthma or panic attack can be quite strong. Instead of trying to slow your breathing, calm it using this exercise. As you repeat the small breath holds, it is important not to try holding your breath for longer than two to five seconds. Longer breath holds in these circumstances may destabilize your breathing.

Between the breath holds, try to avoid shallow, fast breathing as this will only intensify the feeling of air hunger and breathlessness. It is much more efficient to breathe low and slow to optimize the amount of air that reaches the small air sacs in the lungs. This allows more oxygen to reach the blood. The exercise helps gently calm breathing, open up the blood vessels, and increase the amount of oxygen released to tissues and organs, including the brain.

If you have asthma and your symptoms continue for as long as five minutes, take your medication. If you are having a severe attack, take your rescue medication immediately. If your symptoms do not respond to your medication within a few minutes, seek medical attention.

How to Stop a Coughing Attack

Coughing is one of the most common symptoms of asthma. Persistent coughing is very disruptive to breathing, so it is important to reduce its effects and prevent an attack from taking hold.

Coughing is a reflex action caused by irritated airways. It's the body's way of clearing the airways of mucus and other irritants. Overbreathing can make the airways dry and inflamed, triggering a cough, and this, in turn, can lead to further overbreathing. When you cough, you take in a deep breath followed by a forced expiration of air. This action causes cooling and drying of the airways which inevitably leads to another cough and another forced expiration. If you don't stop the cycle, you will soon find yourself having a coughing fit.

The following approach can help you stop a coughing attack:

- Try to suppress the cough if possible. You will experience a ticklish feeling in your throat, but after a while, the urge to cough should decline. Swallowing will help curb the need to cough.
- Don't try to force out mucus. Instead, reduce your breathing, and allow the mucus to come up naturally.
- Try to cough only through your nose.
- Perform Breathing Recovery, Sitting for between three and five seconds until your cough has passed.
- The main point to remember is that the deep breathing and forced exhalations that occur during coughing will only perpetuate the cycle.

It is important to note that breathing exercises will only help alleviate a coughing fit when applied during the early stages of an attack. If symptoms have been occurring for more than five minutes, they will be a lot more difficult to control using breathing exercises, especially if your Control Pause score is less than 20 seconds.

If breathing difficulties continue for as long as five minutes, take your medication. If you are having a severe attack, take your medication immediately. If your symptoms do not respond to your medication within a few minutes, seek medical attention.

How to Decongest the Nose

If you find it difficult to breathe nasally because of congestion or obstruction in your nose, the Nose Unblocking exercise (also called the Maximum Pause) outlined above is very effective. Please note that holding the breath to generate a strong hunger for air is not suitable during pregnancy or if you have serious medical conditions. If your nose does not become fully unblocked, wait around one minute and practise the exercise steps again. You may need to do the exercise up to five times.

After practising this exercise, your nose will be clear. However, your nose will continue to become congested again until you have normalised your breathing with a Control Pause score of at least 20 seconds. With regular practice of the exercises in this book, your nose will eventually remain clear.

It is my experience with thousands of students that the more the nose is used for breathing, the better it works. When the nose is stuffy, the normal response is to switch to breathing through an open mouth, but this only increases nasal congestion, causing a vicious cycle of mouth breathing. If you feel air hunger when you first switch to nasal breathing, it is important to continue breathing through the nose.

Practise the Nose Unblocking (Maximum Pause) exercise as often as necessary, and wear a nasal dilator during rest, exercise, and sleep to alleviate the feeling of suffocation. In time, with sustained practice of the breathing exercises and a better Control Pause score, the feeling of nasal congestion will dramatically reduce. Until that happens, you can use this exercise whenever you need to, even when you have a stuffy nose because of a bad cold!

As many as 90% of people have a deviated septum. This is where the bone and cartilage dividing the nostrils is crooked. It is a common complaint in people playing sports, in mouth breathing during childhood, and in people who have had trauma to their nose, and it can occur in newborn babies too. The good news is that the vast majority of people with a deviated septum can still make the change from mouth breathing to nose breathing.

To determine whether you can physically breathe through your nose:

- Practise five repetitions of the Nose Unblocking (Maximum Pauses) exercise.
- Can you breathe through your nose yet?

The rule of thumb is, if you can breathe through your nose for one minute, you can do so for life. The Nose Unblocking exercise is the same for adults and children. If you need help introducing breathing exercises to your child, free training videos are available. You can find these on YouTube by searching "Patrick McKeown, exercises for children."

Nasal Breathing & Respiratory Infections

We already looked at the connection between nitric oxide and respiratory illness. However, I'd like to add that over the years, I have observed many students experience a significant reduction in head colds and chest infections after they changed to light nasal breathing. Unfortunately, it is often those people who are most vulnerable to chest infections, those with asthma, bronchiectasis, bronchitis, and cystic fibrosis, who mouth breathe because they feel that they cannot get enough air through their nose.

Nasal breathing serves to filter the air before it enters the body, but as we discussed, nasal nitric oxide also has intrinsic qualities that form a first line of defence for the immune system. Optimal protection of the lungs takes the coordinated action of multiple cell types, and the tissue cells of the airway secrete a variety of antimicrobial substances.

Respiratory infections, such as cold, flu, and more recently SARS and COVID-19, commonly travel from person to person in droplets of mucus or saliva. The virus disperses when an infected person sneezes or coughs and droplets are expelled into the air and onto surfaces. Droplets from these airborne illnesses can travel several feet in a cough or sneeze and stay suspended in the air for up to 10 minutes making it easy for infection to spread. Nasal breathing and the nitric oxide it produces help minimise the risk of the virus entering and taking hold in the body.

Asthma and Sleep Quality

Sleep is often very difficult for persons with asthma. Asthma symptoms commonly worsen overnight, particularly in the early hours of the morning, and nighttime exacerbations are extremely common. The detrimental effect of poorly controlled asthma on sleep has long been recognized, but in recent years there has been a growing interest in the way asthma interacts with sleep and sleep disorders. People with asthma frequently suffer with sleep disturbances and poor-quality sleep, particularly when asthma is severe. Lack of sleep or impaired sleep quality is linked with worse asthma control. Poor sleep also negatively impacts quality of life and can lower physical and mental resilience.

It's essential that you breathe nasally during sleep. If you wake up with a dry mouth it is a sign you are breathing through your mouth, and taping your mouth shut can prevent this. If you do tape your mouth shut, do not place the tape directly across your lips. Instead, use a support like MyoTape which surrounds the lips, gently keeping the lips together and reminding your mouth to close. This provides a safe way to ensure nasal breathing during the night when you cannot consciously control your breathing. MyoTape is available from ButeykoClinic.com (use promo code Myo10 to receive a 10% discount).

Asthma - A Vicious Cycle

The airways of people with asthma are particularly prone to narrowing. This is due to a combination of factors including inflammation, increased mucus secretion, and constriction of the smooth muscle surrounding the airways. When the airways narrow, a feeling of breathlessness occurs. As the body tries to compensate for the lack of air, breathing becomes faster, and the volume of inhaled air increases. The sensation of air hunger may encourage the switch from nasal to oral breathing. Breathing faster, harder and through the mouth contributes to drying and cooling of the airways.

Mouth breathing bypasses the nose and the beneficial effects of nitric oxide from the nose. Normal breathing volume for a healthy adult is between five and eight litres per minute. In contrast, in studies of people with asthma, resting ventilation is typically between 10 and 15 litres per minute. While it is common for the narrowing of the airways to cause breathing to become faster and harder, breathing too much air will itself cause the airways to narrow. Thus, overbreathing can easily become a vicious cycle. Fortunately, switching to nasal breathing and practising the exercises in this course, can help to put a stop to overbreathing, restore nitric oxide levels, widen narrowed airways, and reverse the vicious cycle.

CLIENT HANDOUT FOR INSOMNIA, SNORING AND SLEEP APNEA

If your breathing during the day is less than optimal, your breathing during sleep will be dysfunctional too. If you suffer with snoring, insomnia, or sleep apnea, breathing exercises can help significantly reduce your symptoms. Above all, it is vital to restore nasal breathing during sleep, because breathing through an open mouth activates the stress response, and it leaves the airways more vulnerable to collapse, which can trigger snoring and even cause the breathing to periodically stop altogether.

Following the exercise protocol in this course will allow you to enjoy a much better sleep, wake up feeling refreshed, and improve your concentration during the day.

Tracking Progress with the Control Pause

The Control Pause measures the number of seconds you can comfortably hold your breath after an exhalation. It will increase as your breathing improves and can be used to track your progress as you move through the program outlined in this course. When measuring your Control Pause, you must not try to push beyond the first distinct urge to breathe. This isn't a competitive challenge. Nor is it a measure of willpower.

The best way to get an accurate representation of your breathing is to measure your Control Pause score in the morning just after waking. When you are fast asleep, breathing continues subconsciously and without interference. For this reason, the morning Control Pause score gives a truer measure because it indicates how well you breathe when you can't possibly be thinking about your breathing.

During your first few weeks with the breathing exercises, you should notice an improvement of three to four seconds in your Control Pause score each week. After that, progress will continue at a slightly slower pace. Physical exercise can be gradually introduced to increase the Control Pause score above 20 seconds.

When the breathing exercises in this course are practiced correctly, your breathing pattern can be retrained. If your very first Control Pause score is 10 seconds, it will take at least three weeks to reach a Control Pause score of 20 seconds and six months to reach a Control Pause score of 40 seconds. Improvement will depend on how much attention you bring to reducing your breathing. The more focus you give to your breathing each day, the better.

At the same time, there is no need to become obsessed with your breathing. Allow the changes to gradually occur. The breath cannot be forced into compliance. Many of the exercises involve breathing less air for periods of time during the day. Allow the breath to gradually reduce by paying attention to the airflow entering and leaving the nostrils, slowing it down without tensing up the breathing muscles.

Practice the breathing exercises formally for the first few weeks and then incorporate them into your way of life. Your progress will be reflected in a higher Control Pause score. You will also have lighter breathing and feel better.

The Importance of Nose Breathing

In order to achieve maximum benefits from the Buteyko exercises in this course, it's vital that you breathe through your nose at all times while awake and asleep.

The nose is the only organ to condition air and it serves to:

- Filter airbourne particles and clean the air before arriving at the lungs
- Moisten air
- Warm air

- Regulate breathing volume
- Release Nitric Oxide
- Support better recruitment of the diaphragm while breathing
- Increase Co2 in the blood during exercise
- Increase the partial pressure of oxygen (PO2 mmHg) by nearly 10% (Swift 1989)

Nasal breathing during wakefulness slows and draws the air into the lower parts of the lungs. This may help to maintain the strength and function of the breathing muscles and reduce breathlessness. Healthy nasal breathing can also minimize symptoms of rhinitis and moderate a range of conditions that lead to nasal congestion. Another noteworthy benefit of nasal breathing is that it harnesses a gas called nitric oxide, which is produced in the nasal cavity. Nitric oxide has antiviral and antibacterial qualities, so it protects against infections.

The high concentration of nitric oxide in the sinuses is instrumental in keeping the nose and lungs free of disease and inflammation. It is likely that the reduction in inhaled nitric oxide (NO) caused by mouth breathing during sleep contributes to the negative effects of nocturnal mouth breathing. When we breathe nasally, NO is released into the nasal cavity and carried down to the lungs in concentrations that are between 5 and 20 times higher than during mouth breathing. When nasal breathing is combined with slow breathing, this allows an even greater concentration of NO to be carried into the lungs.

As the Control Pause score increases, breathing becomes slower, and it is likely that a higher Control Pause score leads to improved uptake and use of NO. Regardless of your current Control Pause score, you should breathe only through your nose during rest, physical exercise, and sleep.

Daily Practice Program Instructions

- Breathe only through your nose during rest, physical exercise, and sleep.
- Adopt the correct tongue resting posture. Three-quarters of your tongue should rest on the roof of your mouth, with the tip of your tongue placed behind, but not touching, your top front teeth.
- Achieve a minimum Control Pause score of 20+ seconds.
- Practise Breathe Light for five minutes, and repeat four to six times daily. Schedule the five-minute intervals throughout the day, and schedule in a full 10 minutes of this practice before sleep.
- Walking or any physical exercise with the mouth closed is a tremendous practice for improving sleep quality. Walk for 30 minutes to one hour daily at an intensity where you feel comfortably breathless. If you need to breathe through an open mouth, slow down the pace of your walk.
- To ensure you're breathing through your nose, tape your mouth closed while sleeping using MyoTape. If you feel anxious about wearing tape around your mouth, wear the tape for 20 minutes before sleep to become comfortable with it. Please note, a dry mouth signifies open-mouth breathing during sleep, and if your mouth is naturally moist in the morning, there is no need for the tape.

Breathing Exercise Instructions

Breathe Light Directions:

This is the most important exercise to help improve breathing patterns during wakefulness and sleep. Using it will help with insomnia, snoring, and sleep apnea.

- Place one hand on your chest and one hand on your abdomen.
- Gently soften and slow down your breathing to create a slight hunger for air.

- Slow down the speed of air as it enters your nostrils.
- Allow the breath out to be slow and relaxed.
- The goal is to breathe softly so that about 30% less air enters your lungs.
- You are doing it correctly when you feel a tolerable air hunger.
- If the air hunger is too much, take a rest for 15 seconds and start again.

Breathe Slow Directions:

Insomnia and obstructive sleep apnea exert stress on the body and mind. Slowing down breathing helps to bring balance to the automatic functioning of the body. Research over the past 30 years reports that slowing breathing rate to between 4.5 and 6.5 breaths per minute helps to bring the body and mind into balance.

- Breathe in silently through your nose for a count of five seconds.
- Breathe out silently through your nose for a count of five seconds.
- This Breathe Slow practise amounts to a respiratory rate of six breaths per minute.
- Try to incorporate this breathing as much as possible into your everyday life.

Breathe Nose, Slow and Low Directions:

To improve breathing patterns, practise for five minutes one to two times daily. An ideal time to practise is when you first go to bed.

- Lie on your back with knees bent (this helps to engage the diaphragm breathing muscle).
- Place your hands on the sides of your lower ribs.
- As you breathe in through your nose, feel your lower ribs moving out.
- As you breathe out through your nose, feel your lower ribs gently moving in.

- The goal is for about 80% of the movement to be driven by the diaphragm and 20% from the upper chest.
- Ideally, breathing is nose, light, slow and deep. Breathe deep and light at the same time.

Note, there is no need to fill your lungs with air. The key to good breathing is breathing softly, silently, and through the nose into the lower regions of the lungs.

Nose Unblocking Exercise Directions:

If the nose is congested, you are likely to revert to mouth breathing and this will inhibit a restful night's sleep. To decongest the nose, practise the following exercise. Take care, as this exercise involves holding the breath until a strong air hunger is experienced. It is not suitable for people with high or low blood pressure, anxiety, panic disorder, or cardiovascular issues, or during pregnancy. If you do have any of these conditions, only hold your breath for a maximum of 15 seconds.

- Take a normal breath in and out through your nose.
- Pinch your nose with your fingers to hold your breath.
- As you hold your breath, move your body or gently nod your head up and down.
- Hold your breath for as long as you can – until you feel a moderate to strong air hunger.
- Let go of your nose and breathe through it as calmly as possible.
- Repeat six times with a 30-60 second rest between each repetition.

Practise the Nose Unblocking exercise as often as necessary, and wear a nasal dilator during rest, exercise, and sleep to alleviate the feeling of suffocation. In time, with sustained practice of the breathing exercises and a better Control Pause score, the feeling of nasal congestion will dramatically reduce. Until that happens, you can use this exercise whenever you need to, even when you have a stuffy nose because of a bad cold!

Tips for Better Sleep Hygiene

Whether you have insomnia, poor sleep quality, snoring, sleep apnea, or all four, practising sleep hygiene is critical for enjoying a restful night's sleep.

- Avoid alcohol and screen time before bed. Most of us know that less screen time and alcohol just before bed is supportive of a good night's sleep, but many of us resist the idea because watching TV with a glass of wine is a nice way to wind down. Unfortunately, this habit doesn't help you relax. In reality, it stimulates the nervous system, preventing you from sleeping well.
- Don't eat or drink alcohol late in the evening. Enjoy a glass with dinner if you like, but then set it aside to give your body time to digest. If you regularly drink late into the evening, you will feel noticeably less groggy in the morning if you give it a miss.
- Exposure to 15 minutes of daylight first thing in the morning helps with sleep later that day.
- Avoid blue light. If you must use your smartphone, TV, or laptop before bed, it is a good idea to wear blue light-filtering glasses for at least two hours before sleep. If you spend all day in front of a computer screen, you may find that wearing blue light-filtering glasses throughout your working day helps you sleep and relieves eyestrain and headaches.
- If you use your mobile phone as your alarm clock, switch it to flight mode in the settings before you sleep.
- Your bedroom should be cool, airy, silent, and dark.

Insomnia

A racing mind and breathing irregularities both contribute to insomnia. When you find yourself lying awake in the middle of the night, this can be partly due to dysfunctional breathing during sleep. However, the hyperarousal caused by poor daytime breathing patterns is also to blame. To tackle insomnia, it is necessary to activate the body's relaxation response. It is also essential to improve breathing patterns during sleep so that the airway can function without causing the breath to stop or adding resistance to breathing.

If you have difficulty falling asleep:

- Make sure you breathe only through your nose during rest, physical exercise, and sleep.
- Practise the Breathe Light exercise to achieve air hunger for 15 minutes before sleep.

If you frequently wake up after four or five hours of sleep:

Waking up after a few hours of sleep is challenging - you're not quite fully alert to get up and start the day, yet not tired enough to fall back asleep easily. Disturbances to breathing during sleep, including partial or total collapse of the throat, can cause awakening. If you experience this, practise the steps below.

- Bring your attention to your breathing to help calm racing thoughts.
- Practise the Breathe Light exercise to help activate your body's relaxation response.
- Improve your Control Pause by continuing with the daily practices in this course. Once your Control Pause score is greater than 20 seconds, air turbulence in your nose and throat will reduce. You will sleep more deeply and be less likely to wake during the night.

Snoring

Mouth snoring is the result of a large volume of air passing through a collapsible airway, causing the soft palate to vibrate. It stops when the mouth is closed during sleep.

Nose snoring is caused by turbulent airflow in the nasal airway, where the nose meets the throat (the nasopharynx). Obstruction of the nose caused by nasal stuffiness, a deviated septum, or an anatomically smaller nose can increase resistance to breathing. However, hard fast breathing also contributes to nose snoring.

To illustrate the impact of faster and harder breathing during nasal snoring, I often ask my students to make the sound of a snore through the nose. To do this, it is normal to tighten the throat at the back of the nose and speed up breathing. Now, begin to slow down the speed of your breathing, in and out through the nose. Slow down your breathing until it is almost imperceptible. Breathe hardly any air in and out of the nose. Now, try and snore when your breathing is light and slow. You will find it more difficult.

Snoring is not solely due to a compromised nasal airway. Breathing patterns can also play a role. Having a low Control Pause score with a faster respiratory rate and increased volume of air per minute contributes to turbulence in the upper airway. While most interventions target the airway, the missing piece of the puzzle is flow. Any engineer investigating resistance to flow in a pipe will not only consider the diameter of the pipe but will also take into account the speed and volume of the flow.

It's important to get snoring under control, not only for the sake of a better night's sleep (and the sake of your sleeping partner) but also because if left untreated, it can become more severe and progress to Obstructive Sleep Apnea.

To stop mouth snoring:

- Use MyoTape to keep the mouth closed during sleep. You simply cannot snore through the mouth when breathing is through the nose.

To significantly reduce nasal snoring:

- Decongest your nose using the Nose Unblocking exercise.
- Restore nasal breathing during wakefulness and sleep.
- Reduce the flow of breathing by practising Breathe Light for 10 minutes, four times a day.
- Increase your Control Pause score to above 20 seconds.

For many people, nasal snoring can be eliminated altogether. For others, particularly those with a narrow airway, nasal snoring will continue but at a lower intensity, meaning it won't be so loud and problematic.

Obstructive Sleep Apnea (OSA)

Obstructive sleep apnea (OSA) is becoming increasingly widespread. Statistics suggest that the condition affects up to 9% of women and 26% of men between 30 and 49 years old, and up to 27% of women and 43% of men aged between 50 and 70. OSA is characterised by breathing that stops during sleep. People with OSA tend to snore very loudly, and they experience frequent episodes of shallow breathing (hypopnea) and pauses in breathing (apnea) lasting 10 seconds or more.

The first step in addressing OSA is to make the switch to nasal breathing during sleep. This is important even if you use a CPAP or mandibular advancement device to treat your sleep apnea. Mouth breathing is a common factor for CPAP noncompliance because air that is meant to keep the airways open leaks out through your open mouth instead.

To help reduce the severity of obstructive sleep apnea, there are two considerations:

1. **You need to open your airway so that it is less likely to collapse during sleep.**

- Breathe through your nose during sleep with the tongue resting on the roof of your mouth.
- Breathe low with optimal recruitment of the diaphragm.
- Lose some weight as this helps to reduce fat deposits in the throat allowing for a wider airway.

2. **You need to normalise your breathing volume.**

- Improve your everyday breathing as reflected in a higher Control Pause. Every five-second improvement to your Control Pause indicates that your breathing volume is normalising.
- With improved breathing patterns, breathing becomes more light, slow and deep through the nose. Also, with a higher breath hold time, breathing is more stable during sleep.
- Breathing light and slow during sleep reduces negative pressure in the airway thereby reducing the risk of collapse.

For a scientific explanation of the link between your everyday breathing and obstructive sleep apnea, read Patrick McKeowns co-authored paper available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7865730/

CLIENT HANDOUT FOR RACING MIND, HIGH STRESS, ANXIETY, PANIC DISORDER AND TRAUMA

We are all a little different when it comes to breathing. The most important thing as you embark on your breathing journey is to go slowly at first. Dip your toes into the water and progress over time.

As you practise the exercises, maintain a level of comfort and bring a feeling of relaxation throughout your body. Don't worry about doing the exercises perfectly. Adapt a passive approach. The main thing is that you don't feel stressed during the exercise. If at any time you feel stressed - take a rest.

For stress, a racing mind, or panic disorder, it is best to begin with the Breathing Recovery Sitting and Breathing Recovery Walking exercises. These are simple exercises to help activate the body's relaxation response. What's more, you can practise these breathing exercises without having to pay attention to your breathing. If you are comfortable with paying attention to your breathing, Breathe Light is also an excellent exercise. It focuses on gently softening the breath to take in about 30% less air.

The instructions for these exercises are outlined below. I hope you enjoy the exercises and if some are not quite suited to you, that is okay. With a little practise, you will find the ones that work best for you.

Tracking Progress with the Control Pause

The Control Pause measures the number of seconds you can comfortably hold your breath after an exhalation. It will increase as your breathing improves and can be used to track your progress as you move through the program outlined in this course. You must not try to push beyond the first distinct urge to breathe. This isn't a competitive challenge. Continually practicing the Control Pause will not change the result either. Your Control Pause score will only increase when you use the exercises and begin to reduce your breathing volume towards normal. While the control pause is a helpful indicator of your breathing pattern, don't worry if improvement is slow. More important is regular practise of the breathing exercises.

The best way to get an accurate representation of your breathing is to measure your Control Pause score in the morning just after waking. When you are fast asleep, breathing continues subconsciously and without interference. For this reason, the morning Control Pause score gives a truer measure because it indicates how well you breathe when you can't possibly be thinking about your breathing.

During your first few weeks with the breathing exercises, you should notice an improvement of three to four seconds in your Control Pause score each week. After that, progress will continue at a slightly slower pace. Physical exercise can be gradually introduced to increase the Control Pause score above 20 seconds.

If your very first Control Pause score is 10 seconds, it will take at least three weeks to reach a Control Pause score of 20 seconds and six months to reach a Control Pause score of 40 seconds. Improvement will depend on how much attention you bring to reducing your breathing. The more focus you give to your breathing each day, the better.

At the same time, there is no need to become obsessed with your breathing. Allow the changes to gradually occur. The breath cannot be forced into compliance. Many of the exercises involve breathing less air for periods of time during the day. Allow the breath to gradually reduce by paying attention to the airflow entering and leaving the nostrils, and slowing it down without tensing up the breathing muscles.

Practice the breathing exercises formally for the first few weeks and then incorporate them into your way of life. Your progress will be reflected in a higher Control Pause score. You will also have lighter breathing and begin to feel better.

The Importance of Nose Breathing

In order to achieve maximum benefits from the Buteyko exercises in this course, it's vital that you breathe through your nose at all times while awake and asleep.

The nose is the only organ to condition air and it serves to:

- Filter airbourne particles and clean the air before arriving at the lungs
- Moisten air
- Warm air
- Regulate breathing volume
- Release Nitric Oxide
- Support better recruitment of the diaphragm while breathing
- Increase Co2 in the blood during exercise
- Increase the partial pressure of oxygen (PO2 mmHg) by nearly 10% (Swift 1989)

Breathing through the nose triggers the relaxation response and helps to prevent overbreathing which is a major fueler of anxiety and panic. Nasal breathing during wakefulness slows and draws the air into the lower parts of the lungs. This may help to maintain the strength and function of the breathing muscles and reduce breathlessness.

Healthy nasal breathing can also minimize symptoms of rhinitis and moderate a range of conditions that lead to nasal congestion. Another noteworthy benefit of nasal breathing is that it harnesses a gas called nitric oxide, which is produced in the nasal cavity. Nitric oxide has antiviral and antibacterial qualities, so it protects against infections. The high concentration of nitric oxide in the sinuses is instrumental in keeping the nose and lungs free of disease and inflammation.

Breath-Mind Connection

Our everyday breathing patterns are often overlooked in the management of stress, anxiety, and panic. However, the way we breathe every day influences how we feel and how much stress we experience. It also dictates how we breathe and how our bodies respond during high-stress situations. This breath-mind connection is not new-age woo-woo. It has long been accepted by the scientific community that how we breathe affects which branch of the Autonomic Nervous System (ANS) is activated - the 'fight or flight' Sympathetic branch responsible for the stress response, or the Parasympathetic 'rest and digest' relaxation branch.

A new study by Stanford University School of Medicine and published in the journal Science helps to shed some light on how this happens. The scientists found there are a handful of nerve cells in the brainstem that connect breathing to states of mind. In other words, part of the brain is spying on our breathing and when we breathe a little harder and faster, the brain goes into Sympathetic stress mode to protect the body. This creates a snowball effect of more stress and more dysfunctional breathing.

Perhaps not surprisingly, studies show as many as 75% of people with anxiety have dysfunctional breathing patterns. Also worth noting is that most people with anxiety have a low Control Pause (CP) score. This is significant because when our CP is low (less than 20 seconds, and especially if less than 15 seconds), breathing is typically faster, harder, irregular, and predominantly limited to the upper chest. When we breathe this way, the body is telling the brain that we are under threat and the brain reacts to protect us.

When we are feeling stressed:

- Breathing becomes faster
- Sighing becomes more frequent
- More air is breathed with each breath

- Breathing tends to be primarily limited to the upper chest
- We tend to breathe through the mouth
- There is a sensation of air hunger or suffocation

Fortunately, we can use the fact that our brain is spying on our breathing to our advantage. By softly and silently breathing in and out through the nose with a relaxed and prolonged exhalation, we tell the brain that our body is safe. The brain, in turn, sends signals of calm to the body. The breathing patterns below allow us to better cope with situations as they arise helping to get to the root cause of anxiety and panic disorder.

Relaxation Breathing:

- Slow breathing
- More regular breathing (less frequent sighing and yawning)
- Lighter breathing
- Breathing low into the diaphragm
- Breathing in and out through the nose
- Effortless breathing with no feeling or sensation of air hunger

Normalizing Carbon Dioxide to Help Address Anxiety

Buteyko Clinic International Breathing Exercises help to normalise the volume of air that is breathed every minute, every hour, every day. This is achieved by breathing a little less air to allow carbon dioxide to accumulate a little in the body. As carbon dioxide accumulates, it helps to improve blood flow and oxygen delivery to the brain. Traditionally, breathing in and out of a paper bag to rebreathe carbon dioxide back into the body was used to help calm a panic attack. Practising Buteyko helps restore normal carbon dioxide in the body, to help prevent the attack from occurring in the first place.

Daily Practice Program Instructions

Chronic and acute stress cause faster and harder breathing. Even when the stress is removed, our faulty breathing pattern can continue. By improving our everyday breathing patterns with the exercises below, we boost our Control Pause score and activate the body's Parasympathetic relaxation response which allows us to better cope with challenging situations. With a calmer mind, life is softer and we are more content.

If you are a little uncomfortable paying attention to your breathing, then practise the following daily:

- Breathing Recovery Sitting for five-minute intervals, five times daily
- Breathing Recovery Walking for five reps, once daily
- Walk or do any physical exercise with mouth closed for 30 minutes
- Hum for one-to-two minutes, five times throughout the day. A great place to hum is in the shower!
- Listen to the 20-minute Achieve Deep Relaxation audio

If you feel comfortable placing attention on your breathing, practise the following during the first week or two:

- Breathe through your nose as often as you can during the day - both while at rest and while engaging in physical exercise.
- If your nose feels a little congested, practise the Breathing Recovery Walking exercise. This exercise can help open your nose for easier breathing. Anytime that your nose feels stuffy, practise this exercise five times with about 30-60 seconds of rest in between.
- Practise the Breathing Recovery Sitting exercise for three-to-five minutes, five times daily. Do this when sitting quietly, watching TV, waiting for the kettle to boil, etc.
- Practise the Breathe Light exercise for 30 seconds, followed by one minute of rest, for a total of five reps.

- Go for a walk with your mouth closed for 20 minutes daily. Walk at a pace where you find it comfortable to breathe in and out through your nose.
- Listen to the 20-minute Achieve Deep Relaxation recording daily. Listening to the recording after lunch provides an excellent energy boost for the rest of the day.
- After a week or two of practise, when you are comfortable with the above exercises proceed with the exercises below.

Week two and onward:

- Ensure nose breathing during sleep. This is very important and will allow you to wake up feeling refreshed with a calmer mind. A sign that you are breathing through an open mouth during sleep, is waking with a dry mouth in the morning. Wearing MyoTape can be a helpful support to ensure nasal breathing during sleep. MyoTape is available on ButeykoClinic.com (use Promo code Myo10 to receive a 10% discount).
- Anytime you are feeling stressed, breathe out gently through your nose with a slow and relaxed exhalation. Practise this exercise in your normal everyday life so you can access it when you are feeling a little stressed.
- Another exercise that is very helpful to calm the mind is Breathing Recovery Sitting. A two-to-five-minute practise can be very helpful. And if you are feeling stressed, you can practise this for up to 10 minutes every hour.
- Practise the Breathe Light exercise (reduced volume breathing) to help with high stress, racing mind, anxiety, and panic disorder. Practise this for four minutes, two to six times daily. To fall asleep quickly and wake up feeling alert, try practising this for two intervals of five minutes (10 minutes total).
- Go for a 20-minute walk at least three days per week with your mouth closed.

- Listen to the Achieve Deep Relaxation 20-minute audio each day. A good time is straight after lunch to help activate the rest and digest response.
- Practise the Breathe Nose, Slow, and Low exercise for five minutes daily to help activate the diaphragm.
- If you have difficulty feeling your breathing or would like some support with the Breathe Nose, Slow and Low exercise, the Buteyko Belt is a helpful tool. Buteyko Belt is available from ButeykoClinic.com
- Bring your attention to your breath during your everyday life. By changing your physiology, you will be calmer, more focused, and more productive. Above all else, you will be happier.

Breathing Exercise Instructions

Breathe Light Directions:

This is the most important exercise to help improve breathing patterns during wakefulness and sleep. This involves softening and slowing down breathing to take in about 30% less air and create a sensation of slight air hunger for short periods of time. An important consideration is relaxation. Allow your breath to gently soften to create a comfortable need for air.

At first, the air hunger may cause you to feel uncomfortable. Therefore, begin gently and only create air hunger for 30 seconds. Then take a rest from the exercise for one minute. You have plenty of time, so there is no need to rush. With practise, you will find it comfortable to lengthen the duration of the exercise to between two to five minutes at a time.

- Place one hand on your chest and one hand on your abdomen.
- Gently soften and slow down your breathing to create a slight hunger for air.
- Slow down the speed of air as it enters your nostrils.
- Allow the breath out to be slow and relaxed.

- The goal is to breathe softly so that about 30% less air enters your lungs.
- You are doing it correctly when you feel a tolerable air hunger.
- If the air hunger is too much, take a rest for 15 to 60 seconds and start again.

Practising this for four minutes, twice daily is a good start. Four minutes, four times daily is better. And four minutes, six times daily is best. To fall asleep quickly and wake up feeling alert, try practising this for two intervals of five minutes (10 minutes total).

Breathing Recovery, Sitting Directions:

- Sit up straight and take a normal breath in and out through your nose.
- Pinch your nose with your fingers to hold your breath for up to five seconds. Count: 5, 4, 3, 2, 1.
- Let go of your nose and breathe normally through your nose for 10 seconds.
- Repeat the sequence for five-minute intervals, five times daily.
- However, for the purpose of this exercise, your maximum breath hold should be no longer than half your Control Pause score at the time.

Breathing Recovery, Walking Directions:

- In a standing position, make sure you have space to walk freely.
- Exhale gently through your nose.
- Pinch your nose with your fingers to hold your breath.
- Walk for 5 to 10 paces while holding your breath. Take small paces, not great big strides. The aim is not to see how far you can walk.
- Stop walking, release your nose and breathe in through it.
- Rest for 30 to 60 seconds while standing still.
- When breathing is comfortable, repeat 5 to 10 times

Exercises to Help Stop a Panic Attack

When breathing becomes faster, harder, and from the upper chest it feeds into feelings of panic and suffocation. To alleviate this, it is important to breathe slowly through the nose and deeply into the diaphragm. The following exercises can be helpful during a panic or hyperventilation attack, and the sooner you can spot the symptoms of panic and utilize one of these exercises, the better.

1. Breathing Recovery Sitting

Practice holding the breath for three seconds followed by normal breathing (not changing your breathing) for 15 to 20 seconds.

2. Hands Cupping Face

With hands tightly cupped over the mouth and nose, breathe in and out 6-12 times. Similar to using a paper bag, this helps normalise carbon dioxide and improves blood flow and oxygen delivery to the brain.

3. Breathe Nose, Slow and Low

Fast and shallow breathing feeds into the stress response. To activate the relaxation response breathe through the nose, slow and low. By breathing slow and low into the diaphragm, carbon dioxide normalises, and oxygen transfers easier and quicker from the lungs to the blood.

To do this, lie on your back with knees bent and your hands placed either side of your lower ribs. Inhale and exhale slowly through your nose. Feel your ribs move outwards as you breathe in and inwards as you breathe out. The goal is for about 80% of the movement to be driven by the diaphragm and 20% from the upper chest. There is no need to fill your lungs with air. The key to good breathing is breathing softly, silently, and through the nose into the lower regions of the lungs.

4. Slow Exhalation to Bring Down Stress

With a slow exhalation, the brain interprets that your body is safe and sends signals of calm throughout the body. If you ever feel anxious or stressed, then focus on slowing down the speed of your exhalation. Simply, take a soft gentle breath in through your nose and allow a slow, prolonged, and relaxed breath out. This is a very simple exercise that can be practised at any time.

Breathing From a Multidimensional Point of View

Breathe only through your nose to assist with light, slow and low breathing. Some of the benefits are as follows:

Breathe Light

- ↑ blood flow to the brain
- ↑ O2 delivery to the brain
- Stimulate vagus nerve
- Slow down breathing
- Balance body and mind

Breathe Slow

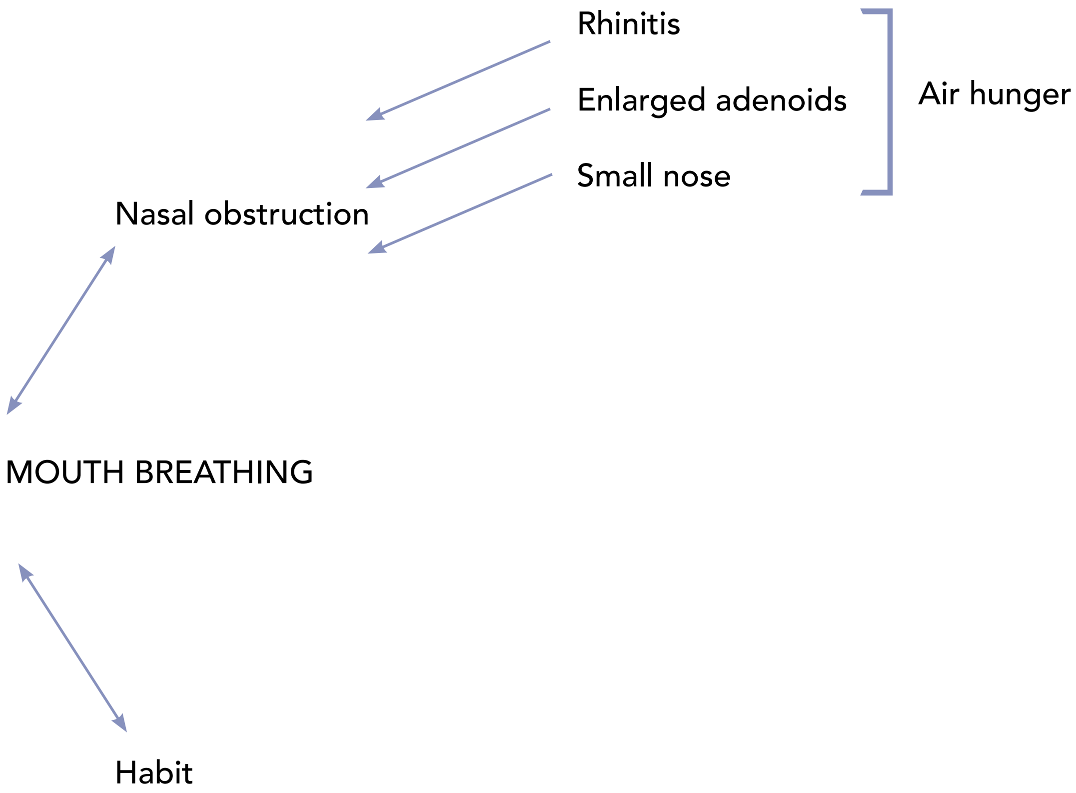
- Improves oxygen uptake in the body
- Stimulate vagus nerve
- Balance body & mind

Breathe Low

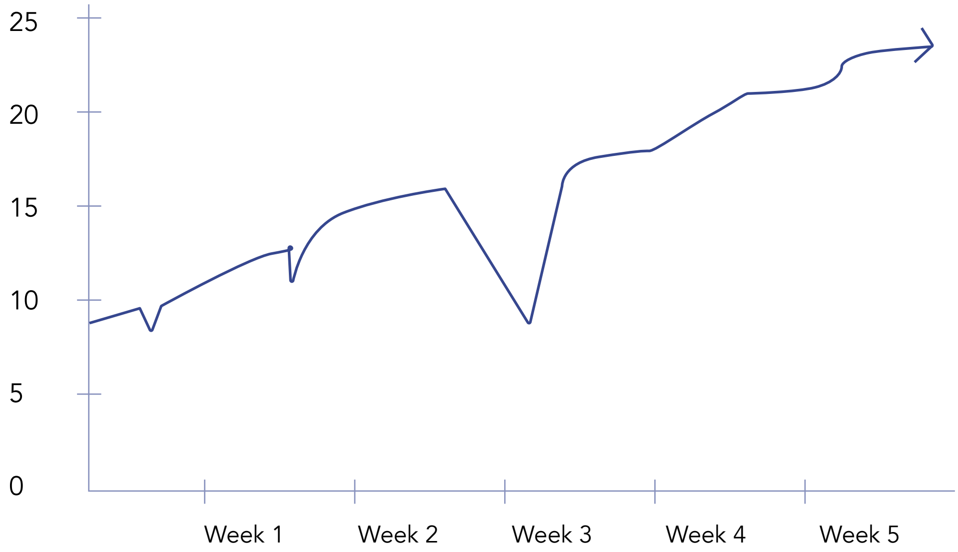
- Stimulate vagus nerve
- Help improve sleep quality
- Provide stabilisation of the spine
- Breathe Slow

SLIDES

MOUTH BREATHING



CONTROL PAUSE GROWTH



- Detox can occur during week 1 and other weeks. Symptoms include head cold, increased mucus, fatigue, insomnia, increased sensation of thirst, loss of appetite etc.
- Control pause score lowers for the period of detox.
- During detox, continue with Exercise 2; reduced volume of breathing (10 minutes every hour). Drink warm water.

FUNCTIONS OF RESPIRATION

- Bring in O_2
- Get rid of excess CO_2

Gas exchange only takes place in alveoli. How to breathe to improve alveolar ventilation?

	RR	X	TV	MV
Body	20	X	300 ml	= 6 litres
Alveoli	20	X	(300 – 150)	= 3 litres
Body	12	X	500 ml	= 6 litres
Alveoli	12	X	(500 – 150)	= 4.2 litres
Body	6	X	1000 ml	= 6 litres
Alveoli	6	X	(1000 – 150)	= 5.1 litres

TAILORING BREATHING EXERCISES: DOSE & DURATION

Tailoring Breathing Exercises
in the order below:

With all persons, consider:

Dose of air hunger
Duration of air hunger

Unwell, CP less than 10/13 seconds, Panic Disorder, sleep apnea, high blood pressure, migraine, headache, serious medical conditions.	Low dose of air hunger Short duration of air hunger No stress due to air hunger Ex 2, 3, 5a, 6 Relaxation MP3
Healthy, fit and relatively young people	High dose of air hunger Long duration of air hunger All breathing exercises

REDUCING INSOMNIA

INSOMNIA

Difficulty falling asleep

- Ex2: Reduce volume of breathing for 15 minutes before sleep
- Improve Control Pause
- Slow respiratory rate
- Breathe low using diaphragm

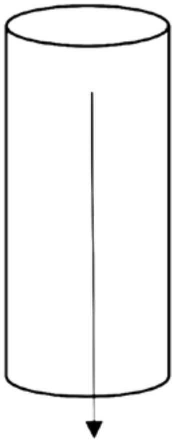
Wake up after four or five hours sleep

- Focus on breathing
- Slow down breathing
- Breathe light, slow & low
- Help activate PNS

1. Open The Airway

Breathe through the nose	Breathe Low using the Diaphragm	Lose some weight
Helps opens airway Allows correct tongue resting posture	↑ Lung Volume ↑ Stiffening of the Throat	Reduces fat pads in the throat Reduces tongue size Allows abdominal breathing

2. Reduce Flow Of Breathing



Breathing is lighter

Breathing is slower

Breathing is deeper

Negative pressure in the upper airway reduces

Loop gain reduces and breathing becomes more stable

PHENOTYPES OF SLEEP APNEA

1. Pharyngeal critical closing pressure (Pcrit) Suction pressure at which the airway collapses Higher Pcrit (airway is more collapsible) Not ideal if airway collapses at a low suction pressure
2. Stability of ventilator chemoreflex feedback control (loop gain) Low control pause indicates high loop gain High loop gain–exaggerated ventilation to minimal increases to CO_2 causing unstable breathing
3. The negative intraesophageal pressure that triggers arousal (arousal threshold) Light or deep sleeper? <u>Low arousal threshold</u>: easy arousal from negative pressure or chemical drive, before the upper airway dilator muscles are able to reopen the airway <u>High arousal threshold</u>: respiratory events are often prolonged, particularly if poor upper airway muscle responsiveness
4. Upper airway recruitment The level of stimulus required (negative pressure & chemostimulation) to activate upper airway dilator muscles How well do the muscles in the upper airways function to maintain an open airway? - Nitric oxide - plays a role in the maintenance of muscle tone - Low CO_2 - brain doesn't send the signal to breathe - low upper airway dilator muscle activity Regular didgeridoo playing and myofunctional therapy exercises (~50% reduction in AHI)

EXERCISES FOR SLEEP APNEA

1) Nose breathe day & night (MYOTAPE)

2) Tongue in correct resting posture – roof of mouth

3) Practice slow breathing with air hunger for 15 minutes before sleep (insomnia, snoring, OSA)

4) Practice slow breathing with air hunger 10 minutes by three times daily

5) Practice diaphragm (Breathing slow) with an inhalation of 4 seconds & an exhalation of six seconds. 15 minutes daily.

↑ sensitivity of baroreceptors
↑ achieve better use of diaphragm

Breathe light, slow and deep

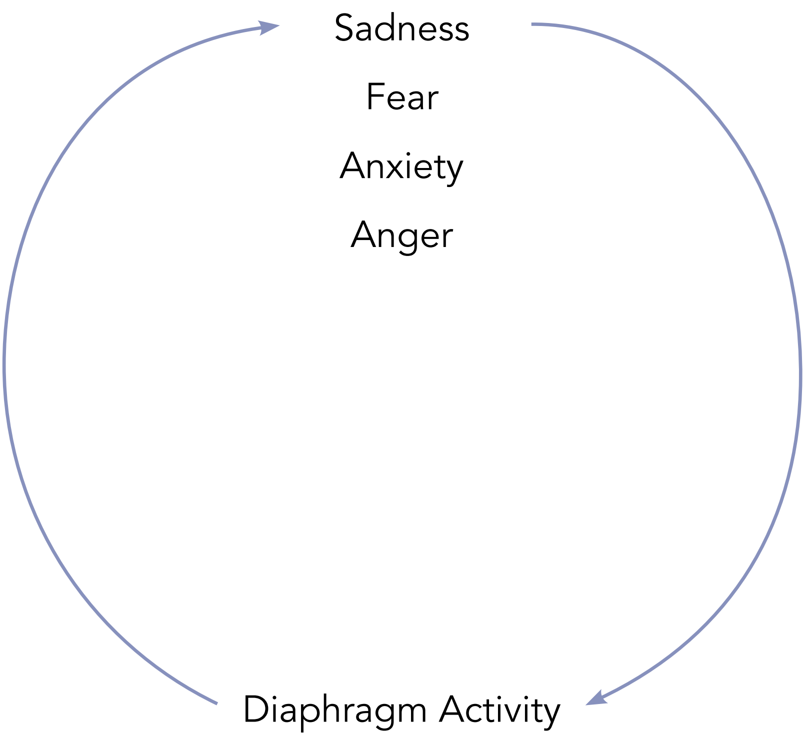
ATTENDING A SLEEP CLINIC

1) CP must be higher than 20 seconds for at least 2 weeks
2) Habitual nose, slow, and low breathing
3) Habitual correct tongue resting posture

During Sleep Study

1) Slow breathing with air hunger for 20 minutes before going asleep
2) Tape mouth closed using MyoTape
3) Don't sleep on back

DIAPHRAGM AND EMOTIONS



HELPING ANXIETY & PANIC DISORDER

DIMENSIONS OF BREATHING	ANXIETY, PANIC DISORDER
Biochemical (light) ↑ CO_2 for short periods during wakefulness	Exposing to controlled air hunger (short duration, low dose) Reduces chemosensitivity to CO_2 ↓ Respiratory rate ↑ Blood flow & O2 delivery to brain Calming effect on CNS
Biomechanical (deep) Lateral expansion & contraction of lower ribs	Low breathing calms the mind Deep breath ≠ Big breath
Resonant frequency (slow) Cadence. Respiratory rate to 4.5 - 6.5 breaths per minute	Activates PNS Achieve sympathovagal balance ↑ Sensitivity of baroreceptors ↑ Vagus nerve tone ↑ Heart rate variability

DESENSITIZATION TO SUFFOCATION

- Suffocation is a common symptom in asthma, anxiety, panic disorder
- Exercise 2, 3, 5a, 6 generate a small dose of suffocation
- This helps reduce the perception of suffocation

HELP STOP PANIC ATTACK

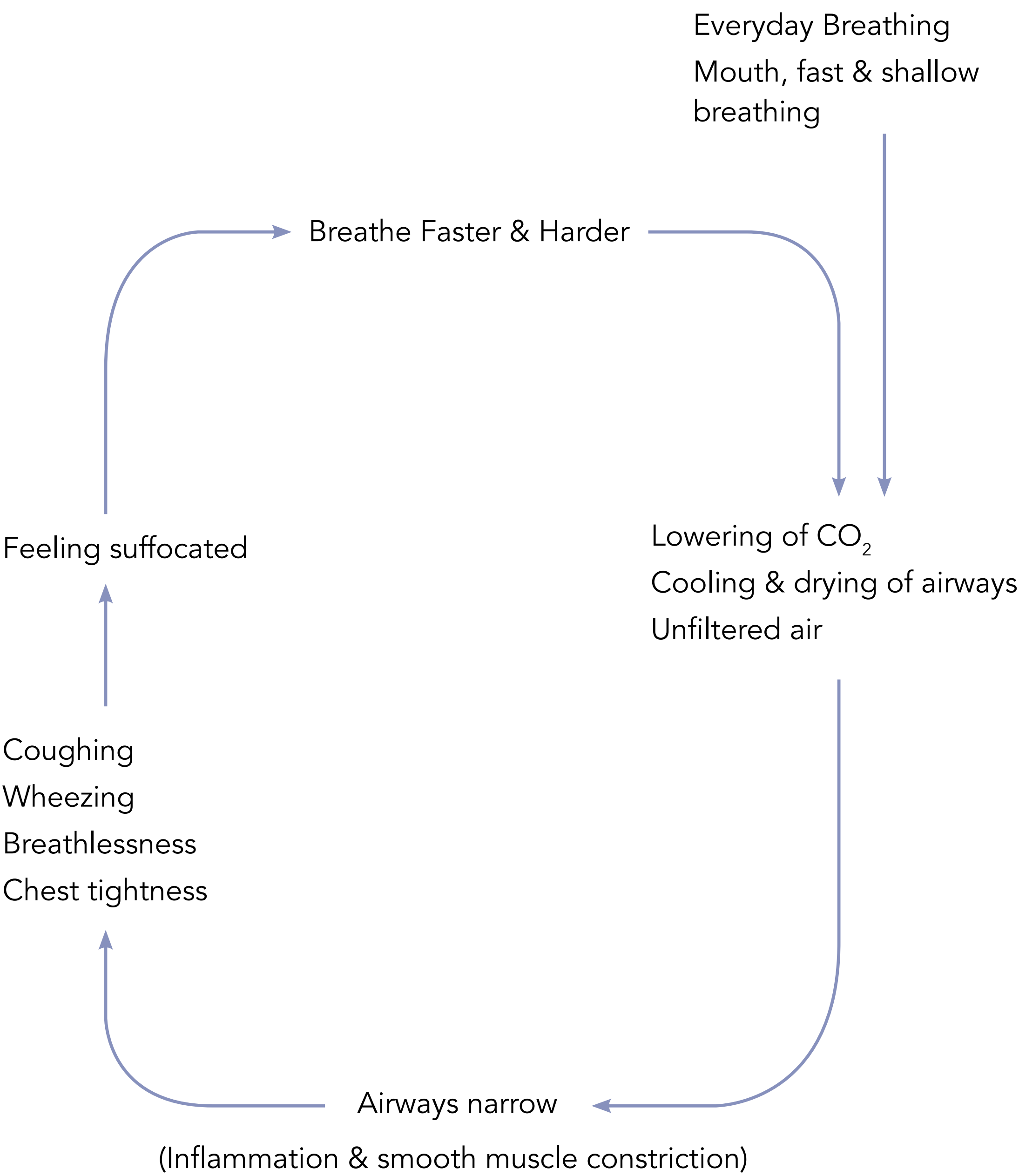
1) Ex 6: Many small breath holds

3 sec 10 sec 3 sec 10 sec 3 sec 10 sec

2) Cup hands on face to rebreathe CO_2. (Paper bag not safe as O_2 drop)

3) Switch breathing from fast & shallow to slow & deep.
Place hands either side of lower ribs.
- Breathe in 5 seconds
- Breathe out 5 seconds

ASTHMA


Everyday Breathing
Mouth, fast & shallow breathing
Breathe Faster & Harder
Lowering of CO_2
Cooling & drying of airways
Unfiltered air
Airways narrow
(Inflammation & smooth muscle constriction)
Coughing
Wheezing
Breathlessness
Chest tightness
Feeling suffocated

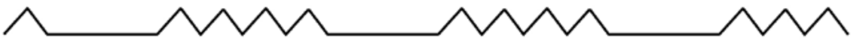
Example: CP 6 seconds

Ex 6	10 minutes every hour
Or	
Ex 5a Ex 6	5 reps x 4 times daily + 10 min x 4 times daily

Ex 6: Length of breath hold is half the control pause at that time

CP: 4 seconds

CP: 6 seconds

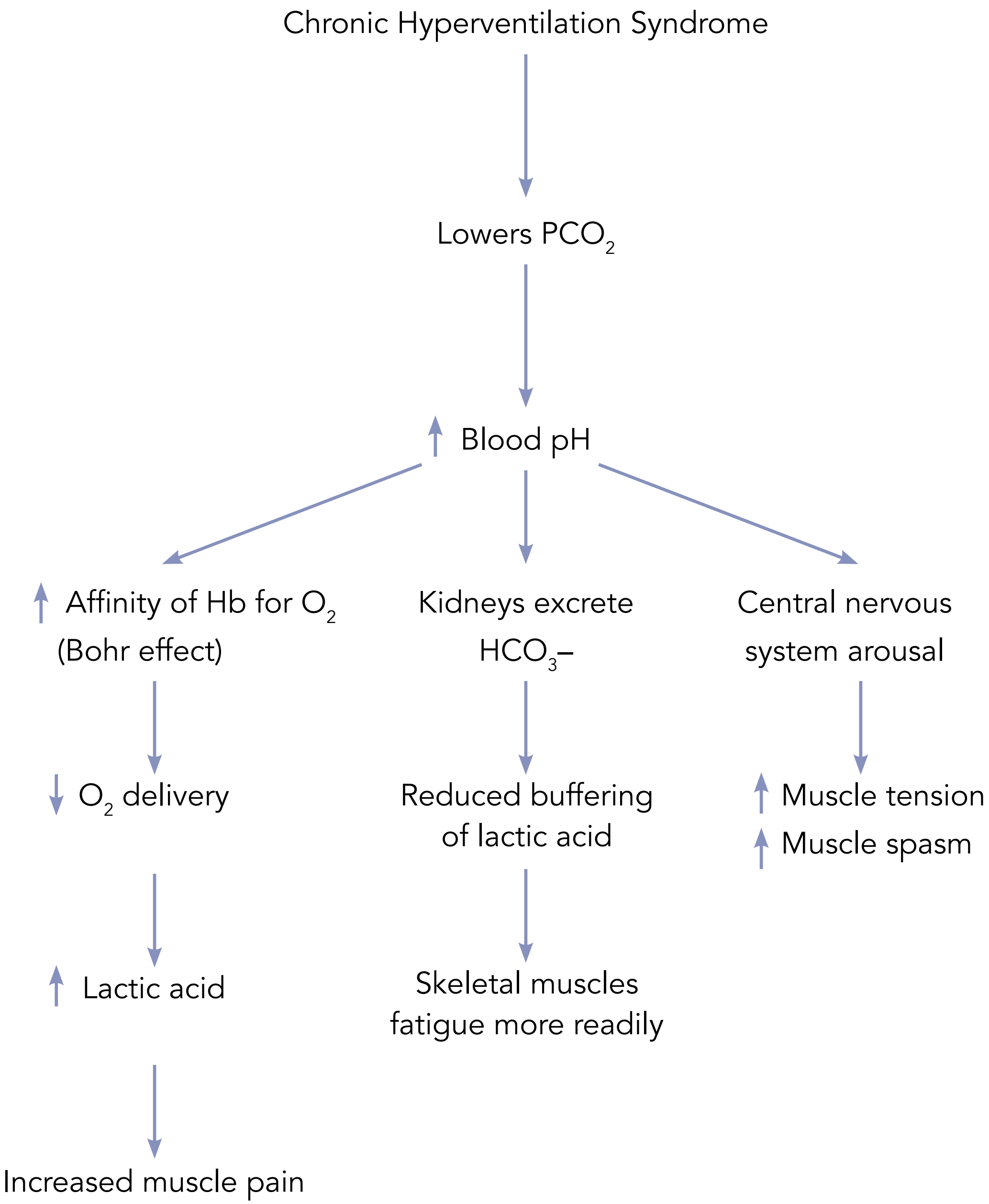


CP: 8 seconds

CHRONIC FATIGUE SYNDROME

MP3 → Listen (Relaxation, nose breathing)		
Week	**Exercise**	**Program**
Week 1	Ex 6: Many Small Breath Holds	5 minutes by 4 times daily
Week 2	Ex 6: Many Small Breath Holds	5 minutes by 8 times daily
Week 3	Ex 2a: Breathe Light (air hunger)	4 minutes by 6 times daily
Week 4	Ex 2a: Breathe Light (air hunger)	4 minutes by 6 times daily
Week 5	Ex 2a: Breathe Light (air hunger) Ex 2e: Breathe Low (diaphragmatic)	4 minutes by 4 times daily 4 minutes by 2 times daily
Week 6	Ex 2a: Breathe Light (air hunger) Ex 2e: Breathe Low (diaphragmatic) Ex 5a: Steps to 10 Paces	4 minutes by 4 times daily 4 minutes by 1 time daily 5 reps by 3 times daily
Week 7	Ex 2a: Breathe Light (air hunger) Ex 2e: Breathe Low (diaphragmatic) Ex 5b: Steps (moderate air hunger)	4 minutes by 4 times daily 4 minutes by 1 time daily 5 reps by 3 times daily

BREATHING AND PAIN



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WHOLESALE PRODUCTS

Instructor Product Orders and Rates:

To place your order please email us at wholesale@buteykoclinic.com with your detailed order and shipping address. We will respond within 24 hrs and provide a secure payment link. Prices are in US dollars or equivalent in your currency.

MYOTAPE

Designed by Patrick McKeown, author of The Oxygen Advantage, MYOTAPE safely brings the lips together to help ensure nasal breathing. The tape can be worn by adults, teenagers and children aged 4 years and up.

Each packet contains 90 strips
(a 3-month supply for one person)

Sizes:

Small: Ages 4-16
Medium: teenagers and adults
Large: Ages 16-upwards

Tape for beards

Sample packs

BUTEYKO CLINIC BOOKS & MANUALS

Breathing for Yoga (2023)

A detailed book explaining the science and practical application of functional breathing exercises for Yoga. Suitable for yoga students and instructors. (540 pages)

Atomic Focus (2021)

Full coloured easy to read book with practical exercises to improve focus, concentration and attention span. Suitable for teenagers studying for exams, athletes, corporate workers, first responders, military personnel and more. (330 pages)

The Breathing Cure (2021)

Detailed exploration of the science and practical application of 26 breathing exercises for a variety of conditions including asthma, anxiety, epilepsy, diabetes, sleep disorders and more. (520 pages)

Close Your Mouth: Stop Asthma, Hay Fever and Nasal Congestion Permanently (2004)

Close Your Mouth is the client manual provided to clients attending Buteyko Clinic workshops for asthma and respiratory conditions.

Buteyko Clinic Client Manual for high blood pressure, fatigue, insomnia, chronic hyperventilation, asthma, snoring and sleep apnea. (2017)

This is a compact and easy to use step by step instructional manual of how to apply the complete Buteyko Clinic method to restore nasal breathing, and to address high blood pressure, fatigue, insomnia, chronic hyperventilation, asthma, snoring and sleep apnea.

Buteyko Breathing Belts:

Achieve healthy, effortless breathing the easy way. Reduces snoring, sleep apnea, asthma, stress, anxiety & other breathing related conditions. Enhance and Support your Buteyko Practice.

Sizes:

Extra Small: midriff measures 22 inches -27 inches (55cms-70cms)

Small: midriff measures 26 inches -34 inches (67cms-87cms)

Medium: midriff measures 35 inches – 41 inches (89cms – 105cms)

Large: midriff measures 41 inches – 47 inches (105cms – 120cms)

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