

# *BreathSlim Device Study: Its Influence on the Body Mass Index and Body Fat Percentage.*

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## **Purpose of the study**

- Physiological test study of the BreathSlim device application based on the original technology.
- Physiological control performance during BreathSlim device application.
- Study of the BreathSlim device influence on external respiration function and respiratory metabolism.
- Study of the BreathSlim device's influence on body mass index and body fat percentage changes.

## **Introduction**

The Laboratory of the Functional Reserves of the Human Body of the Institute of Physiology of the Russian Science Academy, in co-operation with the Innovative Technologies Department, BreathSlim Inc., performed an original study dealing with physiological methods of adaptation to different respiratory training techniques and adaptation to breathing with increased resistance. After thorough observation, the lungs' adaptation has been shown to be dependent on the human somatotype, with relations to the respiratory metabolism, as well as muscle and fat tissue at a relaxed state during physical exercises at the anaerobic threshold zone. It is predicted that there are differences in ventilation sensitiveness in different human somatotypes which are released by the respiratory metabolism and energy supply of muscle activity variances [16].

Breathing regulation system training with forced impacts caused various spectrum changes in the human organism. Changes in oxygen absorption and transportation took place in the first days of impact training.

Adaptive changes are based on the strategy of modifying the regulation mechanism, providing development of adaptive anti-hypoxia mechanisms. These adaptive changes included breath metabolism and breathing functions. Changes in breathing patterns influenced the mechanisms of general regulation of the central nervous system regulation and metabolism. Changes in metabolism caused breaks in breathing regulation and the breath metabolism.

Studies have shown that correlations between breathing problems and the risk of asthma occurrence was 50% higher in overweight people in comparison with people in a normal weight range [1]. The same correlation between breathing and breath metabolism is shown in the fact that breathing metabolism in the lungs of obese women depends on their ratio of waist and hip volume. Heart rate and blood volume is higher in obese women and saturation is lower when comparing women's normal body weights. In addition, normalization of weight changed these parameters to normal ones [2].

Worsening of ventilation and breath metabolism caused worsening of saturation and led to obesity, especially if the person suffered from hypodynamia or misbalanced nutrition. Excessive weight caused progressive lung dysfunction. Growing fat tissue diminishes lung ventilation, decreases lung vital capacity, causes a metabolism disorder in lung tissue, and causes high diaphragm positioning and loss of its mobility. All these factors diminish reserves of the respiratory system and lead to dysfunction of the cardiovascular system, endocrine system, and eventually could cause obesity.

Taking all these factors into consideration, we suggest that respiratory training is one of the most important and natural methods of physiological correction of respiratory system dysfunction and metabolism in the organism as a whole. The positive influence of anaerobic training on metabolism is widely known [3, 4, 5, etc.].

Specialists also mention the positive influence of breathing techniques on other physiological functions by paying attention to the structure of the breathing cycle, including the importance of physiological diaphragm breathing [6,7,8].

Study data from Dr. Reuven Viskoper and his colleagues (Medical Centre Barzilai, Ashkelon, Israel) proved that slow breathing with special devices improved blood pressure results and had no side effects [9].

Taking into consideration possible worsening of ventilation in people with obesity, it is reasonable to apply breathing techniques that improve the lungs' ventilation, for example, by breathing with additional resistance while breathing in.

It is known that our breathing system adapts (to a certain extent) to changes in resistance on inhalation and exhalation [10]. It has been shown that additional aerodynamic resistance causes deceleration of gas flow in the breathing pathways [11]. It is important that all breathing characteristics change in proportion to the additional resistance value [12]. During these phases of the respiratory cycle, breathing resistance is longer. The main factors that influence oxygen blood saturation as well as carbon dioxide evacuation are alveolar ventilation, lung perfusion and lung

diffusion ability and the correlation of former to latter [13, 14]. Compensation of higher breathing resistance happens because of shifts in voluminous breathing speed [15].

However, changes in the breathing pattern (a prolonged breathing cycle with a production of additional resistance) may improve ventilation and breathing metabolism and influence the metabolism process, including metabolic dysfunctions. In this connection, study and application of breathing training techniques seems to correct external breathing functions, breath metabolism, and other types of metabolism to prevent fat metabolism disorders and to fight obesity.

All these facts have led to an experimental study whose purpose was to estimate physiological effects of respiratory training using the BreathSlim device with recommended technology.

### **Materials and methods**

Study of the BreathSlim device application with original technology was performed from September 2009 until December 2009 in the Laboratory of the Functional Reserves of the Human Body, Institute of Physiology of the Russian Science Academy (Novosibirsk).

During the three months, volunteers daily had respiratory training using the BreathSlim device while using original technology in a three-phase breathing experiment. The first phase used breathing through the nose, the second phase used pauses after inspiration ( inspiration pause), and the third phase used expiration through the mouth with resistance. During the experiment, different proportions of breathing phases were used . For instance, the phase of inspiration was 5 seconds, the pause was 5 seconds, and the phase of expiration was 10 seconds.

One trial lasted on an average of 20 minutes. On expiration, additional resistance was created with a 50 mm water column, providing pressure growth in the lungs in physiologically safe boundaries. Inspiration resistance was created with the BreathSlim device.

Examination included three stages: basic, after one month, and after three month of training. The entire study at all stages was performed on 10 people. Several methods were used during the study:

- anthropometry, including measurements of height, weight, % of body fat, body mass index, control of blood pressure, and heart rate;
- spirometry study on gas analyzer Oxyon-Pro ( Jaeger) with estimation of breath volume, speed characteristics of breath, and total gas analysis.

Measurements were performed in a relaxed state and during hypoxia tests (inhalation of 10% hypoxic gas mix) with registration of breathing pattern, heart rate, and saturation of ox hemoglobin

in arterial blood. The measured parameters of gas analysis were ventilation, breath rate, breath volume, oxygen consumption, carbon dioxide exhalation, concentration of carbon dioxide in exhaled air, and breath coefficient.

## **Results**

Analysis of study results has shown reliable proof that individual changes occurred in bodily functions while following the original training technique with the BreathSlim device. It was found that differences of reciprocal reactions were bonded with individual features of energy metabolism changes and regulation of the gas transportation system of an organism. More complete results have reported people who achieved weight loss.

During the three-month trial, the general group of 10 people were dissected into two groups due to the results of medical examinations.

Group 1: 5 people with a body mass index which changed insignificantly. This group included people with normal weight (BMI: 25.9).

Group 2: 5 people with excessive body mass loss (BMI: 31.4) as a result of training with the BreathSlim device, applying original technology. Lost body weight was on average 2.5 kg per month.

Working factors through respiratory training using the BreathSlim device were additional resistance to breathe and changed breathing with prolonged exhalation.

### *Conventions in tables*

Mean 1: average means at the baselines

Mean 2: average means at the second month

Mean 3: average means at the end of the training cycle

Group 1: 5 people with body mass index changed insignificantly. This group included people with a normal weight range ( BMI: 25.9).

Group 2: 5 people with excessive body mass (BMI: 31.4) as a result of training with the BreathSlim device applying original technology. This group had lost an average of 2.5 kg body weight per month.

Anthropometry (measurements) of weight, % fat, BMI index, means of systolic and diastolic pressure, heart rate, % - dynamics of main parameters at the beginning (Mean1) and at the end of

the study ( Mean3) in the whole group had a general tendency of improvement ( diminishing) during the trainings on BreathSlim device with original technology (Table1).

Table 1.

	Mean 1	Mean 3	%
Weight	85,3	79,8	6,4
Height	172,8	172,8	-
Systolic □pressure	142,6	129,8	8,9
Diastolic □Pressure	89,4	82,5	7,7
%Fat	26,2	23,7	9,5
BMI	28,6	26,7	1,9

Anthropometric data for Group 1 at the beginning (Mean1) and at the end of the study (Mean 3), dynamic of main parameters –(%) represented in Table 2.

Table 2.

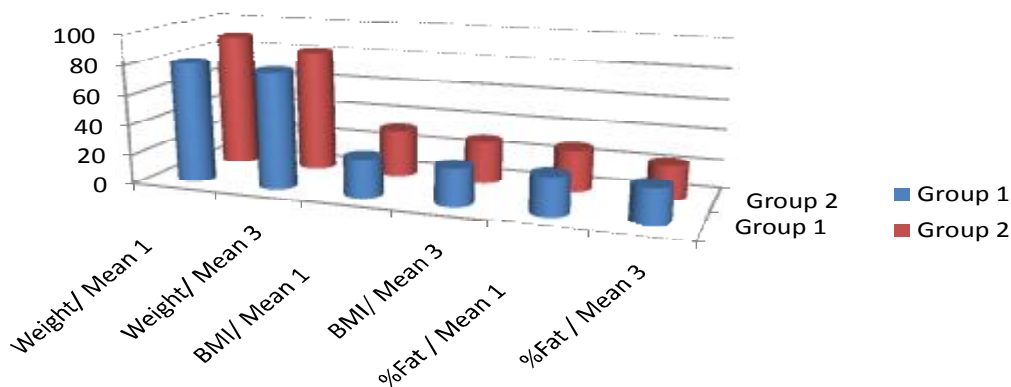
	Mean 1	Mean 3	%
Weight	80,4	77,8	3,2
Height	176,2	176,2	-
Systolic □pressure	138,7	122,6	11, 6
Diastolic □Pressure	88,7	81,2	8,4
% Fat	25,1	23,8	5,2
BMI	25,9	25,1	3,1

Anthropometric data for Group 2 at the beginning (Mean1) and at the end of the study (Mean 3), dynamic of main parameters –(%) represented in Table 3.

Table 3.

	Mean 1	Mean 3	%
Weight	90,2	81,8	9,3
Height	169,4	169,4	-
Systolic □ pressure	146,6	135,2	7,8
Diastolic □ Pressure	90,2	83,8	7,1
%Fat	27,8	22,9	17,6
BMI	31,4	28.5	9,2

#### Anthropometry



The spirometry study did not show any significant changes because people with severe breathing pathology were not included in the study.

Gas exchange data analysis included 3 conditions: gas exchange at relaxation stage, gas exchange during the hypoxia test, and gas exchange during the phase of restoration.

The hypoxia test was performed according to schedule. Tested people were breathing with a hypoxia mix of 10% oxygen until saturation of ox hemoglobin in arterial blood had dropped to 80 %, then they were breathing in air from the examination room until saturation of ox hemoglobin rose to a initial level. Two comparison tests were performed: gas exchange at the relaxation stage before the hypoxia test and gas exchange at the phase of restoration. The hypoxia test was estimated by the

duration of the drop phase and the phase of oxygen restoration during the test.

### Achieved results

The total of groups in the relaxation phase (before hypoxia influence) after one month of training, and also after three months of training, had shown positive changes in growth of oxygen saturation (SpO<sub>2</sub>), growth of lung ventilation (V'E), and oxygen utilization (V'O<sub>2</sub>).

Comparison of means in the relaxation state (before hypoxia influence) in general in stages 1, 2, and 3, and the dynamic of the main parameters –(%), at the beginning ( Mean1) and at the end ( Mean 3) are represented in Table 4:

Table 4.

	Mean 1	Mean 2	Mean 3	%
<b>SpO<sub>2</sub>%</b>	95,7	97,9	98,4	2,8
<b>HR</b>	71,3	67,5	64,2	9,9
<b>V'E</b>	7,4	8,3	8,8	18,9
<b>BF</b>	14,5	12,1	12,2	15,8
PETCO <sub>2</sub>	4,7	4,8	4,9	
FETCO <sub>2</sub>	5,2	5,0	5,1	
RER	0,7	0,8	0,8	
t-in	2,7	2,4	2,2	
t-ex	2,5	3,2	3,4	
t-tot	5,2	5,6	5,6	
ti/tot	51,9	42,8	39,3	
<b>FEO<sub>2</sub></b>	16,8	16,3	16,1	4,1
FECO <sub>2</sub>	3,5	3,6	3,9	
<b>V'O<sub>2</sub></b>	270,8	304,8	342,9	26,6
<b>V'CO<sub>2</sub></b>	215,3	242,4	275,7	28,1

<b>EqO2</b>	27,4	27,1	25,6	6,5
<b>EqCO2</b>	34,3	32,2	31,8	7,3

Through the division into the groups, the analysis of results showed the following: gas exchange in Group 1 at the relaxation stage showed no significant changes.

Comparison of the means at the relaxing stage (before hypoxia influence) in Group 1 at stages 1, 2, and 3, and the dynamics of the main parameters –(%) at the beginning (Mean1) and at the end of the study (Mean 3) are presented in Table 5:

Table 5.

	Mean 1	Mean 2	Mean 3	%
<b>SpO2(%)</b>	97,3	98,2	98,7	1,4
<b>HR</b>	68,4	64,3	61,9	9,5
<b>V'E</b>	7,8	8,2	8,4	7,7
<b>BF</b>	13,5	12,6	11,8	12,6
PETCO2 (%)	4,8	4,5	4,6	
FETCO2 (%)	5,1	4,8	4,9	
RER	0,8	0,8	0,8	
t-in (c)	2,2	2,3	2,0	
t-ex (c)	3,6	3,7	3,4	
t-tot (c)	5,8	6,0	5,4	
ti/tot (c)	37,9	38,2	37,1	
<b>FEO2 (%)</b>	16,9	16,4	15,8	6,5
FECO2(%)	3,8	3,3	3,7	
<b>V'O2</b>	282,2	312,8	330,7	17,1

<b>V'CO2</b>	227,6	243,2	262,4	15,3
<b>EqO2</b>	27,6	26,2	25,4	7,9
<b>EqCO2</b>	34,2	33,7	32,1	6,1

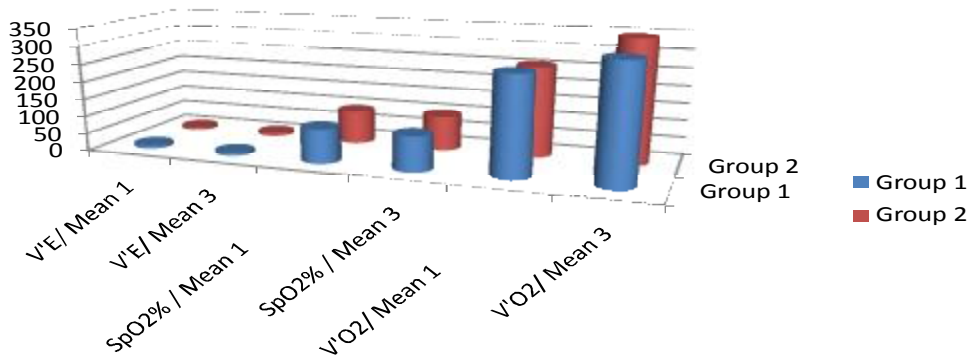
Comparison of means in the relaxation stage (before hypoxia influence) in Group 2 of people with obesity who had lost weight as the result of using the BreathSlim device application with the suggested technology at the stages 1, 2, and 3, dynamics of the main parameters – (%) at the beginning ( Mean1) and at the end of the study ( Mean 3), presented in Table 6:

Table 6.

	Mean 1	Mean 2	Mean 3	%
<b>SpO2(%)</b>	94,3	97,8	98,2	4,1
<b>HR</b>	74,0	70,2	67,3	9,0
<b>V'E</b>	6,7	7,4	7,9	17,9
<b>BF</b>	14,8	12,3	11,7	20,9
PETCO2 (%)	5,0	5,1	5,1	
FETCO2 (%)	5,3	5,5	5,4	
RER	0,8	0,7	0,8	
<i>t-in</i>	2,2	2,1	2,1	
<i>t-ex</i>	2,3	3,0	3,3	
<i>t-tot</i>	4,5	5,1	5,4	
<i>ti/tot</i>	48,8	41,2	38,9	
<b>FEO2 (%)</b>	16,4	16,2	15,9	3,0
FECO2(%)	3,8	3,7	3,7	
<b>V'O2</b>	258,3	298,4	347,6	34,5
<b>V'CO2</b>	214,3	220,4	236,9	10,5

<b>EqO2</b>	26,2	24,7	22,9	12,6
<b>EqCO2</b>	31,2	33,6	33,4	7,0

## Gas exchange at relaxation stage



During the process of training Group 2, being obese, had lost body weight with the BreathSlim device and had increased oxygen saturation, SpO2 (from 94.3% to 98.2%), improved lung ventilation (V'E up to 7.9 l/min), and increased oxygen utilization (V'o2: up to 314.6 ml/min).

These results give us the ability to say that application of the BreathSlim device with original technology in people who are overweight could improve the means in ventilation and the breath metabolism to its optimal physiological values.

Through analysis of the hypoxia test, several trends were found: in general, the group of people had significant adaptive changes after three months of training (Table7). The phase of restoration became shorter: this means faster restoration of SaO2 to the initial level that can be interpreted as improvement of hypoxia stability.

Table 7.

	Mean 1	Mean 3	%
Time of decrease	6,1	5,5	22,9
Time of restoration	1,4	0,9	35,7

The most significant changes happened after three months in Group 1: the phase of restoration become shorter and the phase of saturation decrease had grown (Table 8).

Table 8.

	Mean 1	Mean 3	%
Time of decrease	8,4	9,5	13,1
Time of restoration	1,6	0,9	42,8

In Group 2, along with the shortening of the restoration phase, the shortening of the oxyhemoglobin saturation phase was also found (Table 9).

Table 9.

	Mean 1	Mean 3	%
Time of decrease	4,7	3,1	34,0
Time of restoration	1,3	1,0	23,1

The means of the hypoxia tests in Group 2, where overweight people had weight loss as the result of using the BreathSlim device, showed that when using the BreathSlim device during training, Group 2 achieved stable improvements to their gas exchange process and with the body mass loss, this caused stable metabolic improvement.

## Conclusions

The general study groups showed improvement of the respiratory metabolism parameters, body weight parameters, fat percentage, and BMI during the BreathSlim training with the application of original technology. Results of the study demonstrated individual reactions of the organism to the respiratory training with the BreathSlim device.

The group was divided into two sub-groups: Group 1 with sub-normal body weight (BMI: 25.9) who had insignificant weight loss and Group 2 with excessive body weight (BMI: 31.4). Maximal improvement of BMI parameters (BMI of 3-5% and %Fat 4.4-5.1%) was shown as the result of the BreathSlim device application with original technology in people who were obese (88.2-95.4 kg; BMI 27.4 -32.1)

The results of the hypoxia test in Group 2 with people who were obese showed weight loss as the result of BreathSlim training, and thus demonstrated that the BreathSlim device training provides stable improvement in the gas exchange process, following weight loss and stable improvement of the metabolism.

The testing proved that application of the BreathSlim device with original technology promoted energy metabolism in a more economical way. As a result, the system of physiological regulation of energy exchange is prepared for reduced energy nutrition requests. These changes lead to a reduced request for food consumption. It allows obese people to lower excess weight due to use of unnecessary fatty tissues and does not require strict diets.

Achieved results suggest that the BreathSlim device ideal for metabolic corrections in people with obesity. Also, application of the BreathSlim device with the original technology improves cardiovascular functions ( blood pressure and heart rate).

There were no side effects of the BreathSlim application found through the time of testing.

The suggested original technology of respiratory training with a BreathSlim device does not have analogs, and that allows us to call this approach to breathing training and overweight correction a truly scientific innovation.

## **Addendum**

SpO<sub>2</sub> (arterial O<sub>2</sub> saturation) %

HR (heart rate)

V'E (minute ventilation) (l/min).

BF (Breathing Frequency) (1/min).

PetCO<sub>2</sub> (end tidal CO<sub>2</sub> fraction): volume of carbon dioxide in the last portion of the exhaled air

FetCO<sub>2</sub> (end tidal CO<sub>2</sub> fraction): % volume of carbon dioxide in the last portion of the exhaled air

RER: Respiratory Exchange Ratio—correlation of exhaled CO<sub>2</sub> to utilized O<sub>2</sub>

t-in (time inhalation) sec, inhalation time in one breathing cycle

t-ex (time exhalation) sec, exhalation time in one breathing cycle

t-tot (time total) sec, time of the one breathing cycle

ti/tot (time inhalation/time total ratio)

FEO<sub>2</sub> (expired O<sub>2</sub>) %

FECO<sub>2</sub> (mixed expired CO<sub>2</sub>) %

V'O<sub>2</sub> (O<sub>2</sub> uptake) (l/min)

V'CO<sub>2</sub> (CO<sub>2</sub> production) (l/min)

EqO<sub>2</sub> (breathing equivalent O<sub>2</sub>)  
EqCO<sub>2</sub> - (breathing equivalent CO<sub>2</sub>)  
BMI (body mass index)

## Literature

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