

On a Reading Aloud to Relieve the Decrease in Blood Oxygen Saturation when Jogging

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Abstract

Recently, the problem of hypoxia caused by jogging is attracting attention. To solve this problem, this paper proposed a new solution. This paper proved that as a vocalization method of reading aloud, it is possible to increase air intake and activate lung function to exchange more air and obtain more oxygen. Then, blood oxygen saturation was used as an evaluation index for the body's oxygen content level to prove its effectiveness. A photoelectric pulse oximeter developed on the basis of different light absorption principles in blood was used to test blood oxygen saturation. Experimental results show that a certain degree of hypoxia is induced when a lot of oxygen is required due to jogging. Therefore, it was proved that the new vocal breathing method by reading books can increase the blood oxygen saturation of the body and improve the hypoxia of the body. Reading vocal breathing is a simple and efficient oxygen saturation recovery breathing method.

Keywords: Blood Oxygen Saturation, book reading, Pulse Oximeter, vocal breathing Method, lung, jogging, COVID-19.

1. INTRODUCTION

While COVID-19 outbreaks around the world have proven the role of masks in blocking the virus, jogging while wearing a mask can lead to problems such as breathing difficulties and hypoxia. Past studies have shown that blood oxygen saturation decreased significantly in masked and quietly sedentary experiments, but rarely below the threshold for hypoxia. However, people who jog frequently in their daily life increase oxygen consumption in the brain and muscles. At this point, blood oxygen saturation may drop below a threshold, increasing the risk of hypoxia. [1] [2]

Blood oxygen saturation represents the ratio of an individual's oxygenated red blood cells to total hemoglobin. This refers to the proportion of degraded oxygenated hemoglobin bound with oxygen to form oxygenated hemoglobin. Red blood cells Oxygen is carried by red blood cells to body organs such as the brain and heart. The normal operation of various organs of the human body requires sufficient oxygen as a prerequisite. The calculation function of blood oxygen saturation is as follows, $SpO_2 = HbO_2 / (HbO_2 + Hb)$. Where HbO₂ is oxygenated hemoglobin, and Hb is non-oxygenated hemoglobin. Hypoxia is the degree of hypoxia in the blood. Common symptoms are dizziness and drowsiness, inability to use power while working, being angry and irritable. When the blood is deprived of oxygen for a long time, the cerebral cortex first suffers direct damage. There can be a series of serious consequences, such as heart attack, myocardial failure, and poor circulation. Table 1 below shows the effect of reducing oxygen saturation. [3] [4]

This paper investigates the effect of reading vocal respiration after jogging on the improvement of blood

oxygen saturation. This is to solve the problem of insufficient blood oxygen saturation caused by jogging by changing the normal breathing of people who read aloud. The first chapter introduced the research objectives of this paper and blood oxygen saturation. Chapter 2 explains the function of the lungs, and Chapter 3 explains the effect of reading aloud vocal respiration on lung function. Chapter 4 introduces the detection principle of a pulse oximeter and the calculation of blood oxygen saturation. Chapter 5, blood oxygen saturation detection experiment and results. Chapter 6, Conclusion.

TABLE 1. THE EFFECT OF REDUCED OXYGEN SATURATION. [5]

SpO2	Effect
95%~100%	Normal
< 95%	It is defined as hypoxia
< 80%	Impaired mental function
< 75%	Loss of consciousness

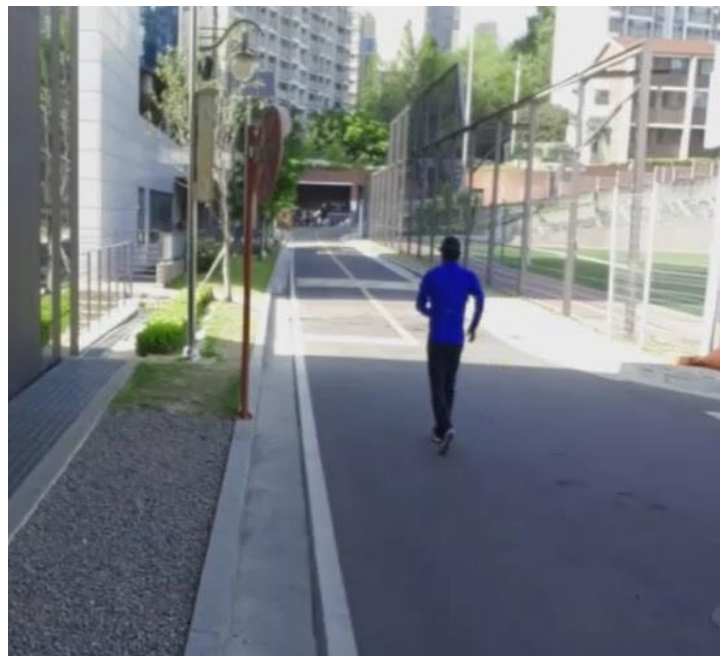


Fig. 1. Jogging with oxygen saturation test.

2. LUNG FUNCTION

The main function of the lungs is gas exchange. It has an air circulation function, a gas exchange function, and a closed circulation function. The air circulation function refers to the process of gas exchange between the lungs and the outside world. The human chest and abdomen have intercostal and diaphragmatic muscles. When relaxed, the volume of the lungs expands, causing the air pressure in the lungs to become lower than the external atmospheric pressure, pushing air into the lungs. When the intercostal and diaphragmatic muscles contract, the lungs contract. The gas pressure inside the lungs increases and is above the outside atmospheric pressure to expel gas. This period completes the breathing process.[6]

The gas exchange function refers to the process of gas exchange between the lung cells and blood in the lung capillaries. After the outside air enters the lungs, the oxygen concentration in the air is high and the capillary carbon dioxide concentration is high, forming a partial pressure difference, whereby oxygen diffuses into the capillaries and carbon dioxide diffuses into the lung cells. This completes the gas exchange function.

The function of the pulmonary circulation is that venous blood drained from the right ventricle enters the pulmonary artery, passes through the pulmonary artery, reaches the pulmonary artery branch of the lung, and flows into the surrounding capillary network to maintain respiratory function. At this time, gas exchange

proceeds in the lung cells, and the reduced hemoglobin in the capillaries binds to oxygen, along with blood circulation, oxygen is transported to the cells throughout the body, and the carbon dioxide produced by the cells is removed from the lungs.[7]

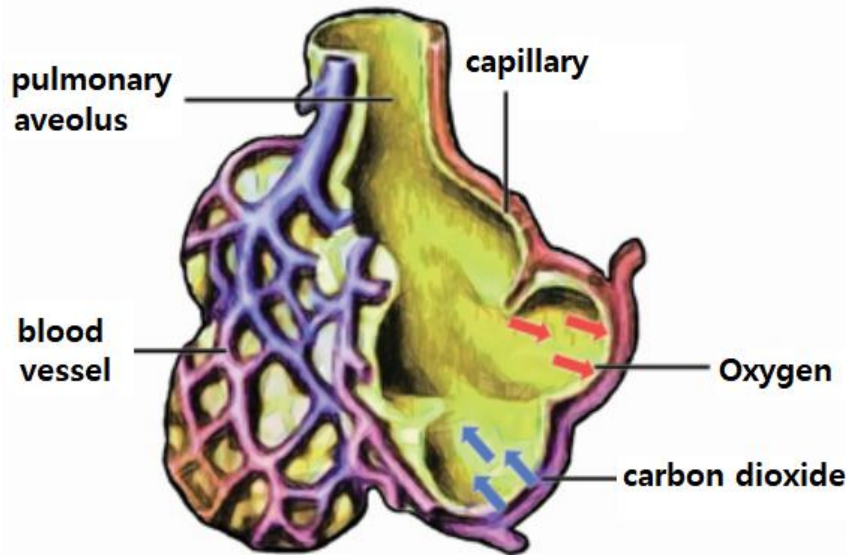


Figure 2. Composition of the lungs.[7]

3. THE EFFECT OF READING VOCALIZATION ON LUNG FUNCTION

The vocal breathing of reading aloud is breathing in through the nose and exhaling through the mouth. Usually, the breathing rate is 8-12 times per minute, 1 second deep breathing, and the air exhaled during the vocalization process for 4-11 seconds vibrates the vocal cords, making the sound of reading a book. This is similar to breathing slowly and deeply. Deep breathing when reading a book has longer inhalation and breathing times than regular breathing, which strengthens the lungs' air circulation function and allows more air to enter the lungs. This is because it waits a few seconds between inhalation and ventilation. A residence time of seconds can ensure that more gases participate in the exchange, which also strengthens the gas exchange function of the lungs.[8]

Moreover, reading vocal breathing is a loud vocalization technique. Sound is produced by the air in the lungs passing through the glottis. The vocal cords vibrate due to the pressure of the air by the vocal cords. The sounds of the vocal cords are finally emitted through resonance in the oral cavity, nasal cavity, airways, lungs, and other organs. In other words, vibrations of the vocal cords can cause resonance in other organs. Resonance generated in the lungs can stimulate the lungs and stimulate the function of the lungs, and the resonances of the organs can reduce airway resistance and improve ventilation by removing foreign objects from the organs. [9] [10]

4. THE DETECTION PRINCIPLE OF A PULSE OXIMETER

The principle of a pulse oximeter is to detect changes in blood absorption of light. Oxyhemoglobin (HbO_2) and Deoxyhemoglobin (Hb) in the blood have different absorption rates for incident light of different wavelengths. Typically, a set of monochromatic red light (about 750nm) and infrared (about 1000nm) LED lights are used as illuminants, which pass through suitable translucent areas with good blood flow, such as fingers, toes, and earlobe.

Oxidized hemoglobin absorbs more infrared light and allows more red light to pass through.

Deoxyhemoglobin allows more infrared light to pass through and absorb more red light. Blood oxygen saturation can be calculated by measuring the transmittance of two types of light using these principles. High oxygen saturation: infrared absorption > red light absorption. Low oxygen saturation: infrared absorption < red light absorption. [11]

The most commonly used measurement method is the transmission method, which detects transmitted light. At the other end of the LED is a photo detector that collects the light that is absorbed and transmitted by the

$$A = \ln \frac{I_o}{I}$$

capillary. The following is the formula to calculate transmittance according to Beer-Lambert law [12].

Where A is the absorbance, it is the amount of light absorbed when passing through the filter. I is the intensity of transmitted light. I_o is the original intensity of the light before passing through the filter. Use the Beer-Lambert law to calculate the transmittance of red light and infrared light, and then calculate the ratio.

$$R = \frac{A_r}{A_{Ir}}$$

Where A_r is the transmittance of red light and A_{Ir} is the transmittance of infrared light. R represents the ratio between them, and this ratio is obtained by finding the empirical table formula to obtain SpO₂. In general, an R ratio of 0.5 is about 100% SpO₂, 1.0 to about 82% SpO₂, and a ratio of 2.0 is 0% SpO₂. [13]

5. EXPERIMENT AND RESULTS

Soongsil University's playground track was used for the sound test site. The test subjects were 12 healthy college students aged 20-30 years, including 6 men and 6 women. All subjects wore a wireless pulse oximeter and ran the playground. Blood oxygen saturation data is recorded under two different conditions, with an average of 5 minutes before jogging. Then have them jog one round on the 400m playground track. Upon arrival, take a break and record the subject's oxygen saturation in 10-second increments for 5 minutes. Second, let the subject jog for one more lap, then rest and read aloud while measuring the oxygen saturation recovery characteristic for 5 minutes in 10 seconds increments. During the experiment, the pulse oximeter should be fixed and the part wearing the pulse oximeter should not be excessively shaken to prevent excessive errors in the detection data. Table 2 shows the experimental results on blood oxygen saturation recovery before and after jogging. [2] [14]

The experimental results in Table 2 are the average values of blood oxygen saturation measured 1 minute after jogging. Jogging requires a lot of oxygen, but you can see that your blood oxygen saturation is still within the normal range. After jogging, the resistance to air inhalation increased and the oxygen saturation in the blood decreased significantly, and 9 patients had less than 95%, that is, mild hypoxia. Others are also close to the threshold. However, after jogging, the values below the threshold when using the aloud book reading vocal respiration method disappeared, and blood oxygen saturation, which had decreased during jogging, rapidly recovered. It also indicates that reading vocal breathing is very well improving blood oxygen saturation.



Fig. 2. A machine of pulse oximeter.

TABLE 2. RESULTS OF THE BLOOD OXYGEN SATURATION TEST.

	Before Jogging	After Jogging		Difference
	Normal Breathing Pattern (%)	Normal Breathing Pattern(%)	Book Reading Vocal	+/- (%)
	SpO_2	SpO_2	SpO_2 Breathing Pattern(%)	ΔSpO_2
1	96	93	97	4
2	97	95	97	2
3	96	93	97	4
4	98	94	97	3
5	97	92	96	4
6	97	93	96	3
7	96	92	97	5
8	98	95	98	3
9	97	94	98	4
10	95	92	97	5
11	98	95	98	3
12	96	92	96	4

6. CONCLUSION

It has been found that jogging for long periods of time can lead to shortness of breath and hypoxia, which can become more serious as exercise increases oxygen consumption in muscles and brain. To improve this problem, a new book reading vocal breathing method was proposed. In this paper, the effect of the new method was theoretically analyzed on aloud reading vocalization and lung activation in order to prove the effect of the aloud reading vocalization method, and the effect of the new breathing method on blood oxygen saturation using blood oxygen saturation measurement data was studied.

Experimental results show that high oxygen exercise is very dangerous for joggers, causing hypoxia and harming human health. The new reading vocal breathing technique can quickly improve these problems. In the experiment, jogging subjects below the threshold value (95%) quickly recovered their blood oxygen saturation value after using the reading vocal breathing method and recovered to a normal range higher than the threshold value. In other words, according to the results of the experiment, if you use the aloud reading breathing method, it can be said that it is very effective in rapid improvement of hypoxia caused by jogging.

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