THE STUDY OF HOW ASTHMA AFFECTS THE TOTAL LUNG CAPACITY AND MAXIMUM LUNG VELOCITY OF A HUMAN

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ABSTRACT

The purpose of this experiment was to see how much of an affect asthma has on the bronchi and how it affects human’s breathing. The lungs are a complex group of organs that are used in the respiratory system. The most common disease for the lungs is asthma, and every one out of four Americans have it. The method for the first experiment was to take volunteer’s (with and without asthma) average lung velocity (L). The results were that the volunteers with asthma had a lower lung velocity than the volunteers without asthma. Asthma had a lower lung capacity because asthma makes the bronchi constrict, letting less air come in at once.

INTRODUCTION

The lungs are a group of complex organs and tissue that are put together and used in the respiratory system. The lungs are made up of bronchi, bronchioles, and alveoli. The bronchi are large tubes that take the air from the trachea and transport them further into the lungs. The bronchioles are smaller tubes that take the air from the bronchi, and bring it further into the lungs. Finally, there are the very small alveoli. The alveoli give the oxygen and get back carbon dioxide, which is created by the blood cells. Each lung can hold as much air as a party balloon can. Without the lungs, the body can’t get oxygen and would die, too much carbon dioxide would build up in the body and the body would explode, or the body would run out of blood cells and would die.
In the lungs, there is a disease called asthma. It is a chronic lung disease. It takes place in the bronchi and the bronchioles. Asthma affects people when they are exercising or when they are exposed to allergens. Some common allergens that affect asthma are pollen, cats or dogs, dust, or anything else that has to do with inhaling something that would inflame the bronchi or lungs. Asthma is pretty common. As a matter of fact, every one out of four Americans have it, 40,000 Americans are sick or late for work or school because of asthma, and 11 people and counting die every day because of asthma. Humans can get asthma at a young age, then have it disappear for a couple of years, then have it come back, or vice versa.

Having asthma isn’t really harmful unless it is severe or there is an asthma attack involved. Asthma attacks are the things that happen when somebody is affected by allergies. The first thing that happens in an asthma attack is that the tissue, bronchi, and bronchioles get infiltrated, or tightened, making it harder to breathe since there is less air coming into the lungs at one time. Then, the airways (bronchi) start to constrict, or get tightened even more, making it even harder to breathe since there is less air coming in at one time. Finally, the airways get filled with mucus, making it extremely hard to breathe, sometimes resulting in death. There are some ways to prevent or decrease the chance of having a severe asthma attack. First, use prescribed medicine. Next, if the prescribed medicine doesn’t help, use an inhaler. An inhaler sprays a medication into the mouth. Inhalers contain a drug that relaxes the muscles in the bronchi, opening the airways so that air can flow freely. Inhalers are used for small asthma attacks. If the asthma attacks are severe or the inhaler doesn’t work, then one should use a nebulizer. Nebulizers are larger and are used for more severe asthma attacks.

Many asthma attacks are created because of something that was inhaled. When humans inhale, the oxygen goes through their nose or mouth and passes down through the Trachea. The Trachea is then split into two parts, one for each lung. The air passes to one of the tubes to a new, smaller tube called the bronchi which are in the lungs. Next, the oxygen passes through the bronchioles, which are smaller than the bronchi, and finally moves to the alveoli. In the alveoli, there are alveoli sacs, which is where the carbon dioxide and the oxygen are exchanged. In the alveoli
sacs, the new oxygen is put into the lungs to create red blood cells, which then pass through the whole body to keep it alive. While the lungs are creating the new red blood cells, the used cells give off carbon dioxide, which is traded in for the oxygen. The alveoli take the carbon dioxide and reverse the path all the way out of the body. When humans do that, it is called exhaling.

When humans breathe, they are using the respiratory system. The respiratory system is the way and process used so that the oxygen and the carbon dioxide get exchanged for one another and the way that the body creates red blood cells. The important body parts used in the respiratory system is the Pharynx, the Trachea, the Larynx, the Bronchi, the alveoli, the Bronchioles, and the Lungs. The Pharynx is otherwise known as the throat, and that is the tube adjacent to the Trachea, which is the windpipe. The Trachea is important because that is where the oxygen goes through to get to the lungs and that is where the carbon dioxide goes through to get to the mouth or nose to be exhaled. The larynx is also called the voice box. It protects the trachea from getting damaged. The bronchi are also known as the airways in the lungs. The help the air get to the alveoli sacs and get exchanged. The bronchioles are smaller than the bronchi and they branch off of them. On the end of each bronchiole, there are alveoli. On each alveolus, there is an alveoli sac, which is where the main respiration takes place. There are three parts to the respiratory system; the ‘cleaning’, the ‘traveling’, and the ‘exchanging’. The cleaning is where the oxygen is ‘cleaned’. That means that the oxygen and other particles are stopped, and all of the dirt and other particles stick to the small hairs on the sides of the nasal cavities so that none of the dirt goes into the lungs and infects any part of the lungs. The second part of the respiratory is the ‘traveling’. The ‘traveling’ is the oxygen going through the trachea, bronchi, bronchioles, the alveoli, and finally the alveoli sacs. The third part is the exchanging. The oxygen reaches the alveoli sacs, it is deposited into the lungs and body, going on to make red blood cells, and is exchanged for carbon dioxide, which is taken out of the body and exhaled. The body works hard to keep humans alive.

In a previous experiment done by a 6th grader (Keegan Kerns) at Cary Academy, people were put into different positions after activities to see what position should be used to cool down after
exercise A lung capacity probe, a timer, a tablet, and volunteers were used in the experiment. It was found that standing upright was the best position by a good amount.

MATERIALS AND METHODS

Materials: Timer, Lung Capacity Probe, Hard surface, Volunteers, Index cards.

In the first experiment, an index card was rolled up into a tube and placed onto the ‘Inlet’ of the lung capacity probe. This is what a lung capacity probe looks like (as shown in Figure 8):

![Lung Capacity Probe Diagram](image)

**Figure 8. This is a diagram of a lung capacity probe.**

Volunteers with and without asthma were tested. The volunteers first looked away from the lung capacity probe, drew in a deep breath, turned towards the probe, and blew into the mouthpiece fast and hard. The volunteers were tested for their lung velocity three times each; three volunteers were tested that had asthma and that didn’t have asthma. The results were analyzed,
using the maximum velocity (L/s). An average was taken from each volunteer (An average of the three that one volunteer did, then all three volunteer’s average’s average was taken).

In the first follow-up experiment, the same things were used except for a timer. In the follow-up experiment, the same thing happened, except for the volunteer ran in place for one minute.

In the second follow-up, the same procedures happened, except the Total Lung Capacity (TLC) was tested instead of the max lung velocity.

In the third follow-up experiment, the same procedures happened except there was no running was involved.

In the fourth follow-up experiment, the same thing happened except only volunteers with asthma were used and volunteers did different exercises such as jumping jacks before testing their max lung velocity.

In the fifth follow-up experiment, the same procedures were executed, except the test was using total lung capacity.

**RESULTS AND DISCUSSION**

In the first experiment, the data was similar as shown in Figure 2, with volunteers that have asthma at 5.7 (L/s) as an average maximum lung velocity and volunteers without asthma at 6 (L/s), but the volunteers with asthma had less maximum lung velocity because people with asthma have a smaller airway due to asthma. Asthma constricts the bronchi a little, making less air come in and out in one breath.
Figure 1. This graph shows a comparison between asthma and no asthma when breathing hard. In the first follow-up experiment, the volunteers with asthma were way less (5.7 LpS) than the volunteers without asthma (6.9 LpS) as shown in Figure 3 because asthma usually starts to roll in after running since running is a harsh type of exercise that is a common cause of asthma attacks.

Figure 2. This shows a comparison of the lung velocities between volunteers with asthma and volunteers without asthma after running for a minute.
In the second follow-up experiment, the average lung capacity for the volunteers with asthma was 2.4(L) and the average lung capacity for the volunteers without asthma was 3.1(L) as shown in Figure 4. The average lung capacity for the volunteers with asthma was less because the bronchi can’t breathe out as much air when it has asthma.

Figure 3. This is a comparison of the lung capacity when volunteers with and without asthma breathe out hard.

In the third follow-up experiment, the same results came in as follow-up experiment two, except the volunteers with asthma’s average lung capacity was a little higher, as shown in Figure 5. The data is the same because the volunteers only had to run for a minute and could run at any pace, and that is not much different when running at a slow pace.
Figure 4. This shows a comparison of the average lung capacity of volunteers with and without asthma after running in place for a minute.

In the fourth follow-up experiment, the average lung velocity for regular breathing was 5(LpS), the lung velocity for jumping jacks was 5.25, the lung velocity for push-ups was 5.1, the lung velocity for stretching was 4.9, and the lung velocity for running in place was 4.75 as shown in Figure 6. The physical workouts had larger lung velocities because the workouts required energy, and when energy is used, humans start breathing heavily, which would change the results. As for regular breathing and stretching, not much energy is burned, so there is no heavy breathing.
Figure 5. This shows the lung velocity of a person with asthma when performing different activities.

In the fifth follow-up experiment, the average lung velocity for regular breathing was 2.25(L), the lung velocity for jumping jacks was 2.9(L), the lung velocity for push-ups was 3(L), the lung velocity for stretching was 2.25(L), and the lung velocity for running in place was 3.1 as shown in Figure 7. Again, the reason why the physical activities were high and the regular and stretching results were moderate was because the physical activities burn energy and the others don’t.
CONCLUSION

The results of the experiments show that the volunteers that had asthma had a lower lung velocity and lung capacity than the volunteers without asthma. This data is important to the world because it shows that even if humans with asthma don’t feel it, the asthma is still there and it affects human’s breathing. It was expected that the volunteers with asthma would have a lower lung capacity than the volunteers without asthma. Some follow-up experiments that could be done in the future could be to test the heart rate of volunteers with and without asthma.

CITATIONS


