Cantaurus, Vol. 19, 26-28, May 2011 © McPherson College Division of Science and Technology

What is the Distribution of Lung Capacity Amongst the McPherson College Students?

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ABSTRACT

This experiment was conducted to find an average lung capacity of students on the McPherson College campus. The lung capacity is typically based on the size of the individual. The subjects were asked if they would like to take part in the experiment, then asked to take a survey. The survey consisted of a series of simple questions regarding to: sex, height, weight, and fitness. After the survey was finished, the subjects were then instructed how experiment was going to work. They were directed to take several deep breaths, then to exhale with as much force as possible into a spirometer that was plugged into the Iworx software. They were asked to replicate this process two more times. Once the subject had completed the physical test, the data were gathered and organized so that it could be analyzed. The data were plugged into the computer for analysis. The averages lung capacities for the subjects are as follows: 5.516 L, 2.139 L., 3.877 L., 2.202 L., 2.298 l., 2.529 L., 4.399 L., 4.297 L., 3.76 L., 2.951 L., 4.393 L., 4.128 L., 3.841 L., 2.733 L., and 2.263 L. After analysis some outliers were discovered such as abnormal lung capacities for a relatively large healthy individual. However besides this one instance the rest of the data came back within the relative expected norms. Therefore a hypothesis that lung capacity is related closely to size is still very possible.

Keywords: *Lung capacity, lung volume, size-Lung capacity ratio, spirometry, vital capacity.*

INTRODUCTION

The objective of this research project is to establish the distribution of overall lung capacity of the McPherson College student body. A broad spectrum of factors that contribute to a general population's overall lung capacity will be investigated. In doing this study, hopefully a better understanding of which individuals have a significant respiratory advantage, i.e. the ability to have a larger capacity for oxygen uptake, due to past exposures, genetic factors, and overall fitness will be obtained

This project will be modeled after several others. The most influential on this project will be that of Cui, et al (2008). This specific article provides a basis for the methods that will be used to gather the data need to fulfill the experiment. It involves a spirometer to measure the FEV (Forced Expiratory Volume) which will be the basis of how my project will measure the same data, except I am using the FVC (Forced Vital Capacity). Cui, et al (2008) also describes in detail the process of finding a background to the individuals involved, by asking for an extensive medical history. By asking for a general medical history, I will be further able to determine the origins from which certain respiratory conditions came.

There are also many articles that show the effects of external factors on individuals' respiratory health such as Meo, et al (2009) and Hernandez, et al (2008). These articles include exposure to oil spills, city pollution, and other factors that may have contributed to certain environments and how they affected the inhabitants of that region. This is important because not every region has the same environmental factors that may affect the lung capacity of the inhabitants. These factors are just some of the contributing details to the overall health of certain inhabitants. Even though these are significant variables I will be unable to link them unless the subjects have prior knowledge of being exposed.

There are also articles like that of Pieters, et al (2000), that show more biological reasons for different lung capacities, such as malnutrition and the effects it has on the individuals who do not receive the proper amount of nutritional value recommended. Another factor that affects the lung capacity of a population is the overall fitness and health of individuals. A more physically fit individual will have a better lung capacity than that of a non-exercising individual. One other basic area that may affect the lung capacity of an individual are respiratory conditions such as asthma and allergic rhinitis, which inhibit a natural breathing function. The make-up of the body may also play a role, such as size i.e. 6'6" 330 lbs. vs. 5'4" 110 lbs. These two individuals would have a difference in chest circumference; therefore the lung capacity should be different. The gender of the participant could also yield different results.

All of the variables discussed would have a dramatic effect on the lung capacity of an individual. Therefore all of these variables will be taken into account when analyzing the data.

MATERIALS AND METHODS

This project is based off an experiment conducted by Cui, et al (2008) on lung function and cytokine levels.

Surveys were given to the subjects before they participated in the experiment, these surveys asked for: sex, height, weight, chest circumference, a brief personal history, and an account on personal physical fitness.

After the survey was completed, the subject was ready for the experiment using the spirometer and the I-worx program. The data were gathered. Disposable, detachable mouth pieces were used for sanitary reason.

The subjects perform a FVC test that is given to them at a state of rest, this way I can take data points of individuals and not push any ethical issues that may harm the subject. Also in doing the tests at rest I hope to avoid any unknown variables that I could not have foreseen. The subjects inhaled a couple of deep breaths, and then took one final one and exhaled with full force into the spirometer head and the data was recorded.

After all the data was collected, it was analyzed through the Sigma Plot software. With the best fit being a multiple linear regression.

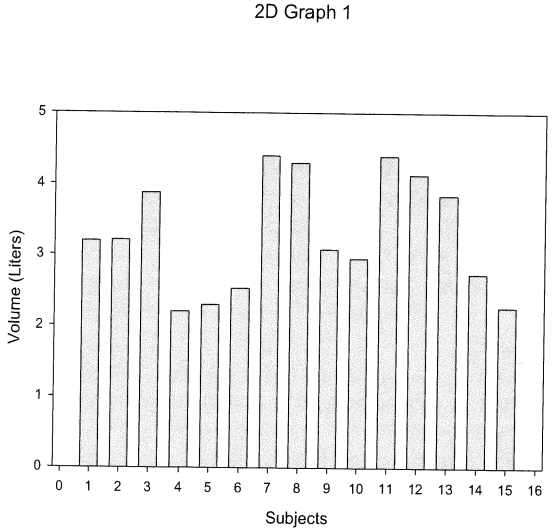

Figure 1: Volume exerted by the subjects.

Table 1 Survey of Subjects (9 Men and 6 Female)

	Sum of H	Sum of W	Sum of F	Sum of B.T.
Large	5	5	4	4
Medium	5	5	6	6
Small	5	5	5	5
Grand Total	15	15	15	15

The surveys yielded a broad spectrum of subjects. The student had a vast range in height, the extremes being 6'5" and 5'2". Also when it came to fitness, most of the subject considered themselves rather fit. The results of this experiment seemed to take a normal pattern. After procuring several samples from the subjects, I found that the larger a body the more likely that individual is to have a larger lung capacity. All 15 subjects went through the same process so if there was an error it had to be either because of the method or because of technical error from the Iworx system.

The average lung capacity of the subjects was 3.376L, with the maximum of 5.805L and a minimum of 2.004L in respect to all the subjects. There were a few outliers however with the normal idea of larger equaling a higher lung capacity. Subject D was a male, 20 years of age, 6'2" and weighing 220 lbs, and he is an athlete at the college. However his maximum exhalation only came to 2.202L which I found to be rather low for someone in his situation, I do not however have an explanation for this, after speaking to him about the low results; he stated that his doctors had also been a little confused by his low lung capacity.

Table 2: Statistical Analysis between two subjects

Subject D		*Subject F*	
Mean	2.202	Mean	2.528667
Standard Error	0.013503	Standard Error	0.047959
Median	2.215	Median	2.544
Mode	#N/A	Mode	#N/A
Standard Deviation	0.023388	Standard Deviation	0.083068
Sample Variance	0.000547	Sample Variance	0.0069
Kurtosis	#DIV/0!	Kurtosis	#DIV/0!
Skewness	-1.72849	Skewness	-0.80234
Range	0.041	Range	0.164
Minimum	2.175	Minimum	2.439
Maximum	2.216	Maximum	2.603
Sum	6.606	Sum	7.586
Count	3	Count	3
Confidence Level (95.0%)	0.058099	Confidence Level (95.0%)	0.206353

Here is a comparison of Subject D and subject F who are both relatively the same in every physical category except lung capacity. So the two subjects in theory show have been similar yet, they their lung capacities are far different. I did find that males generally have a high lung capacity than females, and that usually the larger one is the more likely they are to have a larger lung capacity.

Normality Test: passed (P=0.132), constant variance test passed (p=0.514)

Table 3: Analysis of Variance Table

	DF	SS	MS	F	P<
Reg.	2	7.874	3.937	38.527	.001
Res.	12	1.226	0.102		
Total	14	9.1	0.65		

DISCUSSION

The results of this experiment seemed to have followed the path I had hypothesized originally. For most of the subjects size had the most impact on the lung capacity. There were a few exceptions that led me to believe that maybe the lung capacity of individuals may not merely depend on size but as for the most part they do. In previous experiments size had been the main contributor to capacity. The one outlier subject I had also could not provide an explanation as to why their lung capacity was so low for their size. They stated that previous medical examinations have been confused by the subject's volume exerted into a spirometer. This is one subject that I could not find an explanation for. The rest of the subjects seemed to keep with size and gender, i.e. a large male would have a high lung capacity whereas a small female would have a lower lung capacity.

After completing this experiment, I have come to realize that a few things should have been handled differently. For example, the sample size should have been increased dramatically. By doing this it would have provide a better foundation for analysis. Another thing that would have helped this project greatly would have been to narrow down the subject field, say to a certain group on campus. By simplifying the search and allowing for a more intricate study of lung capacity, I believe that future scientist will be able to follow my work and make a better analysis of the study.

ACKNOWLEDGEMENTS

I would like to thank the McPherson College Natural Science Department, Dr. Jonathan Frye and Dr. Allan Ayella, and all of my subjects for without whom none of this would have been possible.

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