"Smoking and the Affects on Pulmonary Function"

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Lab Report #1

Introduction:

Tobacco Smoking is a major problem facing society. Its affects the health of millions of people and has been one of the most extensively studied problems in respiratory medicine. Tobacco is known to cause severe lung problems, emphysema, multiple types of cancers; it can produce terrible birth defects and many other problems. The question posed by this laboratory experiment is to see the affects of smoking related to immediate pulmonary functions on young adults.

The direct inhalation of tobacco smoke occurs first at the mouth, the smoke travels down the trachea, through the bronchi to each lung, then down to the bronchioles and into the alveolar and alveoli. The alveoli are where the greatest destruction is caused by tobacco smoke.

This experiment is a perfect opportunity to study the affects of smoking on young adults in particular, and tobacco's initial health effects on the user. If smoking is directly related to a decrease in pulmonary function, then people who smoke more than one pack a week or heavy smokers will show a dramatic difference in pulmonary measurements such as vital capacity (VC), functional residual capacity (FRC), forced vital capacity (FVC), and the ratio of forced expired volume in one second (FEV_1) to forced vital capacity (FEV_1/FVC), Compared to mild-smokers (less than or equal to one pack of cigarettes per week) or non-smokers. These will be the hypotheses tested in this lab report. If smoking does in fact affect these pulmonary functions then there will be a noticeable difference in these values between the heavy smokers, mild-smokers, and non-smokers.

The expected results of these tests would be anticipated to yield a great difference in the pulmonary functions to be tested among the groups of individuals. Greater differences among these results should be present in the data for after exercise was preformed in the group of smokers.

A previous study indicated that "Abnormal spirometry (*i.e.*, limitation of expiratory airflow, airways obstruction, or a low FEV_1/FVC ratio the degree of airways obstruction correlates closely with pathologic changes in the lungs of smokers and patients with COPD (Chronic Obstructive Pulmonary Disease)" (Fergusson et al. 2000). This provides more evidenced that the tests should provide noticeable differences in the FEV_1/FVC ratio. Another study specifies that "smokers, ex-smokers, and never-smokers had similar FVC and static lung volumes" (Heijdra et al. 2002). Which indicates this lab report should not yield any differences in FVC values between the groups of individuals studied. An alternative study also suggested that "mean FRC and RV were higher of smokers had a significantly reduced FEV_1" (Clark et al. 2001). This provides more support for the hypotheses presented in this lab report will yield expected results. The final piece of supportive data states that "Smokers tended to have a greater reduction in VC, FVC, and FEV_1/FVC relative to nonsmokers and an elevated RV/TLC ratio" (Johnson et al. 2001). All of these previous experiments clearly support the hypotheses stated in this laboratory experiment report, except for FVC which shouldn't be affected by tobacco smoke according to this support data, this information goes against what was previously hypothesized for the affects of smoking on FVC values.

The data was gathered using a spirometer connected via Powerlab software and measured a broad range of pulmonary functions.

Materials and Methods:

This experiment was preformed to examine the lung volumes and capacities, and many other pulmonary functions. The experiment was conducted on the students from all sections of biology 153 at the University of Kentucky. A spirometry test was preformed while at rest and after exercise, all data was collected with Powerlab software. All data was correlated and compiled using Microsoft Excel. This data should be relatively precise given that it was all gathered and collected by computer software. Procedures were followed as prescribed by the respiration bulletin-experimental guide.

As detailed previously many pulmonary functions were tested and correlated using data gathered by the spirometer, and Powerlab software. It effectively measured all of the values that are to be examined in this lab report (FVC, VC, and FEV_1/FVC ratio). FRC was calculated using information gathered by the spirometer.

The level of treatment in this experiment was the amount of smoking. The three categories included level 1 (heavy smokers) and is indicated by the consumption of more than one pack per week, level 2 (mild smokers) who consume less than but up to one pack per week, and level 3 (non-smokers) which consume zero cigarettes per week.

The data was not replicated among individuals but was replicated 62 times over the entire Bio 153 department among the students; two measurements of pulmonary function were conducted on each student that preformed the test once at rest and once after exercise. The control group for this experiment was the non-smoker group, since they should have normal and unaltered pulmonary functions, given that none of the students measured have any restrictive or obstructive disorders.

The population studied contained 62 individuals, 36 females and 26 males. 34 non-smokers, 19 heavy smokers, and 5 mild smokers, this population size and characteristics were sufficient for the experiment conducted. Data was correlated into their respective groups and measured for each of the values to be tested; graphs were used to make it easy to see immediate differences among the group's variables.

Results:

All data contains very large standard deviations relative to the means of the multiple values, this is not a good sign of data quality. Figure 1.1 has no apparent correlation between the results obtained, Heavy smokers have a higher ratio, than mild smokers, and non-smokers have the greatest ratio. This data is conflicting just at a glance. There is no apparent trend amongst the data. Figure 1.2 shows much better data quality by demonstrating a very nice positive trend up the slope of the graph, without any interpretation this data can be seen as good and most likely acceptable. Figure 1.3 displays lower values for one of the smoking levels but the other two are almost identical, Figure 1.4 shows similar findings. However, this data appears to yield some findings that could produce favorable findings if the large standard deviations can be ignored, these large standard deviations are most likely due to poor data sorting when the data was collated by the laboratory personnel.

Figure 1.1: Smoking vs. (FEV1/FVC) Ratio:

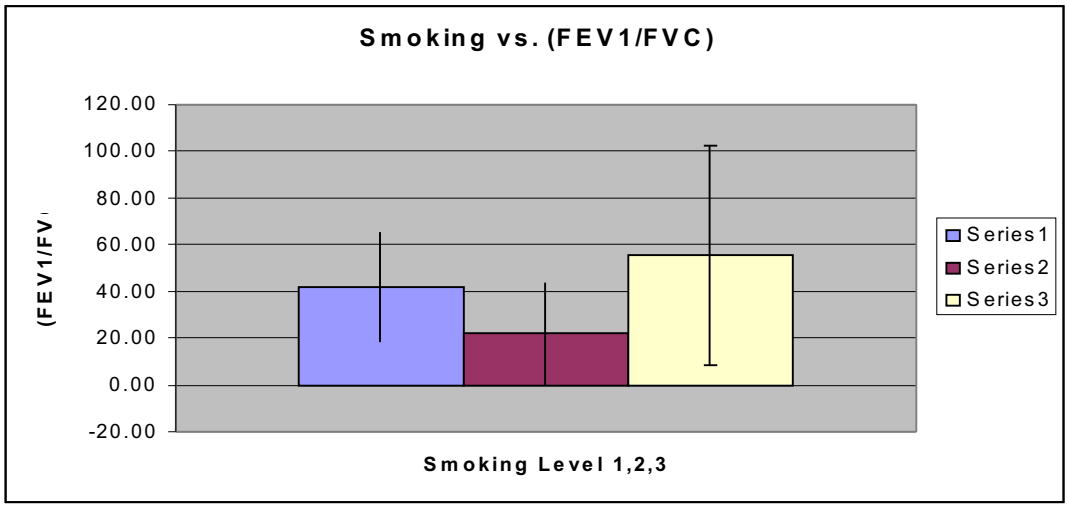


Figure 1.2: Smoking Level vs. Functional Residual Capacity (FRC):

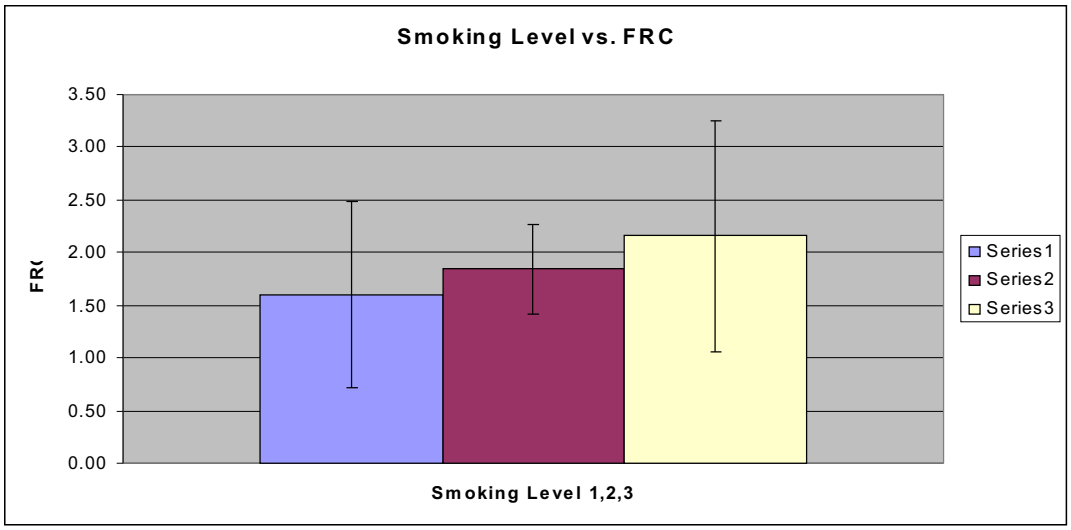


Figure 1.3: Smoking Level vs. Vital Capacity (VC):

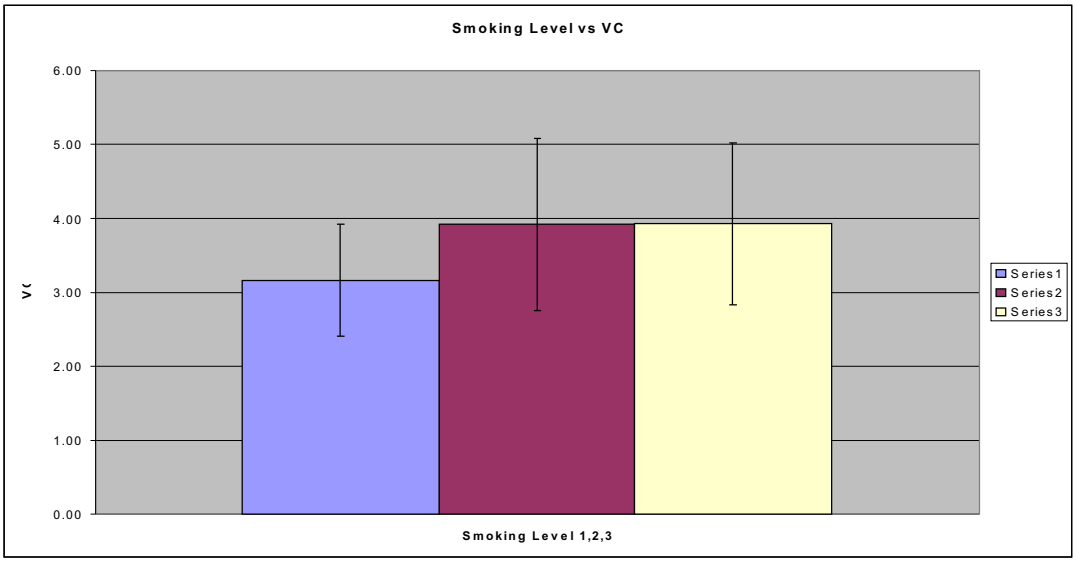
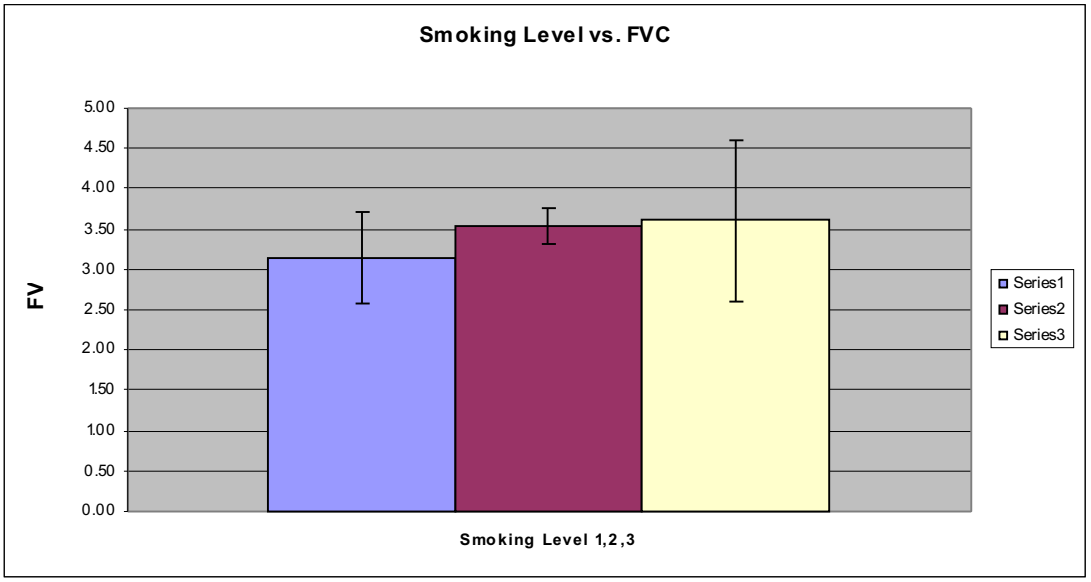


Figure 1.4: Smoking Level vs. Forced Vital Capacity (FVC):



Discussion:

Heavy smoking was hypothesized to decrease all of the measured values (FVC, VC, FRC, and FEV1/FRC Ratio) below the normal non-smoker values. All predictions were correct except for those of Figure 1.1 (FEV1/FVC) ratio, the mild smokers showed a greater decrease in (FEV1/FVC) ratio than heavy smokers, which doesn't make much since, there is however a very large deviation among the groups so it could be due to large experimental error or since this is a forced expiration the results could be skewed in the sense that each person has a different idea of how hard to expel their air, it is almost impossible to get a equal excretion of air from each person.

Figure 1.2 shows a much greater decrease amongst smokers than mild or no-smokers. This is a measure of how much air is left in the lungs after a normal exhale. This is profound evidence that heavy smoking does disturb normal pulmonary function even for young adults that presumably have not been smoking for that long of period.

Figure 1.3 determined that Vital capacity (VC) which is the volume change that occurs between maximal inspiration and maximal expiration is also greatly affected by heavy smoking, mild and non smokers do not show that great if any difference but the heavy smokers have considerably lower values than the other two groups. More evidence that heavy smoking does seriously upset the pulmonary functions of young adults. Which also in turn shows a disturbance in many other pulmonary functions since the subdivisions of the vital capacity include tidal volume, inspiratory reserve volume, and expiratory reserve volume.

Figure 1.4 shows very little difference among the smoking groups but again the heavy smokers still show a decreased forced vital capacity (FVC), which is the volume of air exhaled during a forced maximal expiration following a forced maximal inspiration. A previous experiment determined that smoking doesn't play a role in FVC so maybe these findings are correct and are supported by the previous experiment by (Heijdra et al. 2002). This does however mean the hypothesis for this experiment must be rejected.

This data does show large standard deviation as mention earlier, however this is most likely due to a number of possible errors. Incorrect body position, people being uncomfortable breathing through a spirometer and actually breathing to hard or not hard enough, improper sorting of data, miscalculated results for values that had to be calculated by hand and many others. However this does not mean that the data must be rejected in still can be used in retrospect; many other experiments out there have already determined that smoking does inhibit these pulmonary functions and the data can still be used if it matches other results.

This data does support the hypotheses except for the first hypothesis represented by Figure 1.1, which was proven to be affected by smoking in the experiment by (Fergusson et al. 2000) and (Clark et al. 2001), also FVC was proven to be unaffected by smoking which goes against the hypothesis but is supported by other data. Most likely this is the one set of data that should be rejected or perhaps a second trial should be preformed and the results might be rectified. All other hypotheses appeared to be correct and follow other results previously found in other experiments. Figure 1.2 matches data obtained by (Clark et al. 2001). Figure 1.3 was supported by the experiment by (Johnson et al. 2001). Overall 2 Hypotheses were accepted and two were rejected but were supported by others experiments.

This data is shows strong effects of smoking on young adults, further studies could now show the effects of smoking on elderly people, and then compare those results to see how time and smoking compound on each other to disturb the pulmonary functions of people from young to old.

This experiment was effective in demonstrating the effects of smoking on pulmonary function. It is clear and concise data that should show people that smoking tobacco is extremely hazardous to your health but there are still millions of people worldwide that smoke themselves to death every year. The best thing would be to devise an experiment powerful enough to scare people enough to start quitting worldwide, to find that data would truly be a scientific miracle. However is highly unlikely to ever happen.

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