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# Acute Effects of Non-Nicotine Vaping on Vo2max, Blood Pressure, Heart Rate, and Lung Volume

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**Abstract**

Finding a healthy alternative to tobacco smoking has been a topic of interest to health physicians and smokers for many years. Vaping is an increasingly popular smoking alternative that claims to be the healthier alternative that people have been looking for. However, little research has been done on the topic of non-nicotine vaping. This study examines the acute effects of non-nicotine vaping on predicted VO2 max, blood pressure, heart rate, and lung volume. The study will be conducted through a series of 5 days which includes a paperwork day. Willing participants will run the Cooper's Mile and a ½ Test, and vape while having bodily measures taken throughout the study. This study aims to find a better understanding of vaping and the effects it has on the human body.

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## Introduction

A vaporizer is one of the items that fall under electronic cigarettes. Their producers claim to be a healthier alternative to cigarette or tobacco smoking. There is, however, limited research on whether or not it is truly a healthier alternative. Due to the lack of research, there are conflicting opinions on whether or not vaping is actually safer for the average person than tobacco smoking. We do not attend to try to answer that question with this research study, but we do intend to add data into the bigger picture in hopes to hopefully answer it someday. We also don't want this study to convey that people should or should not vape, but rather aim to gain an objective look at the data collected. To achieve this goal, we studied the acute effects of non-nicotine vaping on heart rate, blood pressure, lung volume, and VO2max. We chose to study non-nicotine vape solution due to the gap in the literature on that topic. Our study followed a pretest-posttest design that used repeated measures for statistical analysis. We compared pretest resting heart rate, resting blood pressure, lung volume, 1.5 mile run time, VO2max, and final blood pressure (blood pressure at the end of the 1.5 mile run) to posttest data of the same measurements. We also compared heart rate and blood pressure values before and after vaping. Since vaping is becoming much more popular, we have attached some additional information on what vaping is and its history.

### History

Despite a boom in recent popularity, vaping has an interesting history that takes its roots back to 1963 when a man named Herbert Gilbert started looking for a smoking alternative. In 1965 he patented his idea for a device that replaced tobacco with flavored steam that didn't contain nicotine. Unfortunately for Gilbert his product was never commercialized due to it being

ahead of its time. In 2003 a Chinese pharmacists named Hon Lik invented the modern vaporizer and it was introduced into the Chinese market in 2004 and into the US market in 2006. Since their release, there have been many different producers and designs.

**How vaporizers work**

Vaporizers contain four main parts: the battery, atomizer, tank and mouthpiece. The battery is essentially the powers source for the vaporizer. They are normally lithium-ion making which allows them to be recharged. There are two different battery styles on the market today, the first is an automatic battery, which activates itself when someone starts to puff or take a "drag" on the mouthpiece of the vaporizer. The second style, and most common one, is where the operator needs to press a small button to activate the battery in order to heat the coil and produce the vapor.

In addition to the battery, a vaporizer also contains an atomizer. This is the part that heats up the liquid and turns it into vapor. The battery normally screws onto the bottom of the atomizer providing it power. Within the atomizer is a coil that is in constant contact with the liquid. When the coil is heated, intern heating the liquid, vapor is produced without combustion. In most models the coil is replaceable due to the fact that they eventually burn out.

Connected to the top of the atomizer is the tank that holds the liquid. Many of the tanks can unscrew from the atomizer in order to be refilled with more liquid. Lastly, on top of the tank is the mouthpiece. Here the vapor is funneled from the atomizer into the user's mouth as they draw on the mouthpiece. (Vaping and health: 3/9)

**Purpose of vaping**

Initially vaping was designed to help cigarette smokers quit smoking, however in recent years vaping has become a hobby for many and is still viewed as a "safer" alternative to smoking

cigarettes. Many people also enjoy the variety of flavors the juice can come in. They range from mint chocolate truffle, whisky, and even gummy bear. “A congressional report from spring 2014 accused e-cigarette manufacturers of using these flavors to appeal to youth.” This marketing technique is prohibited for tobacco companies (vaping and health pg. 3/9).

### The Juice

The liquid solution that is put into the tank of the vaporizer is a mixture of four ingredients. Those four ingredients are propylene glycol (PG), vegetable glycerin (VG), artificial or natural flavorings, and nicotine (optional). The PG and VG are both FDA approved ingredients and are commonly used in pharmaceuticals, food products, and cosmetics. Both glycerin and glycol are used in industrial and personal fog machines. The flavorings are used based on the juice maker's choice; however, most flavors are of food grade quality.

## Literature Review

### Cigarette (Tobacco) Smoking and Vaping

To begin our overview of the effects that tobacco smoking has on the human body, as well as a few articles on what vaping has shown to do to the human body, here are quick facts on tobacco smoking.

- Over 40 million people in the United States are cigarette smokers.
- One out of every five deaths in America has been to smoking.
- Roughly, 42,000 people have died per year from secondhand smoke.
- There are over 4,000 know chemicals in a cigarette.
- 70 of those chemicals are known to cause cancer.
- 87% of lung cancer deaths, 32% of CHD deaths, and 79% of COPD deaths are all caused by smoking

- Smoking has been linked to causing a disease in almost every organ in the human body.

All the listed statistics can be found in the General Surgeon Report that was published by the U.S. Department of Health and Human Services (2014). The American Council on Science and Health stated "The cigarette is the most deadly product sold for human consumption, killing two out of three long-time users prematurely" (Laugesen, 2013).

There have been many research projects done to examine the effects that cigarettes have on human function. Some of these studies also studied the acute effects of vaping on the body. One study showed that the acute effects of tobacco smoking caused a delay in myocardial relaxation. This is worthy to note because a delay in myocardial relaxation can increase risk of a heart attack. The same study found no acute effects on the heart related to vaping ((Farsalinos, 2014). A study conducted in 2015 showed that acute effects of cigarette smoking included a 29.57% increase in average heart rate, decreased systolic filling, and decreased diameter in blood vessels (Mrkaić, 2014). A study revealed that a single cigarette would cause impairment to the lungs (Kougias, 2013). Another study showed that lung function was not impaired by the usage of electronic cigarettes. This same study showed that tobacco cigarettes did impair the lungs (Flouris, 2013).

**Physiology of VO2 Consumption and the 1 and a ½ Mile Run (Cooper Test) (1.5 mile run)**

The purpose of the study is to observe the effects that vaping has on exercise physiology. VO2 max is one of the most essential elements of exercise physiology. VO2 Max refers to the maximal amount of oxygen that a person can use. For our study we are using the 1 and a ½ Mile Run, also known as the Cooper test, to measure the predicted VO2 Max for each of participants. We chose the 1 and a ½ Mile Run Test for a variety of reasons. Firstly, the 1 and a ½ Mile Run Test is more appealing to the participant. The Max Bruce Protocol would require two Max

treadmill runs within five days. That can be physically exhausting to the participants and also dangerous. Secondly, the 1 and a ½ Mile Run Test is a lot safer than the Max Bruce Treadmill Protocol. Lastly, the 1 and a ½ Mile Run Test provides an accurate and reliable predicted measure for VO2 Max.

## Methods

To understand the acute effects of vaping on exercise physiology, three senior Exercise Science Researchers conducted a research experiment that followed a Pretest-Posttest design. The study lasted four days each (not including the orientation day) for each participant. The goal was to have each researcher do all the measuring with one participant, but due to scheduling conflicts, some researchers had help with the same participant. The orientation day and the initial testing day (Day 1) could happen non-consecutively, whereas the final three days had to be consecutive. We recruited participants by email. The email stated that the study was looking for participants who did not have food allergies, were over the age of 18, were not regular vapers, and didn't have any present lung issues such as asthma. Once participants responded with interest toward the study, they were brought in to do initial paperwork, which we called orientation day. Participants were asked to fill out a PAR-Q, Health History Questionnaire, and an Informed Consent form. The Informed Consent was read to each participant so that they would fully understand the study. Time was made available for questions. Once they understood and agreed to do the study, they signed the informed consent form. Then, we measured their blood pressure. This was to get a baseline to allow us to check for hypertension in the participant. We did not allow anyone with hypertension to participant in the study. We then scheduled the participants for the remainder of the required days.

On Day 1, the participants were required to come into the exercise science lab and get baseline measurements measured. They were not allowed to have eaten within three hours of testing, due to our usage of the bod pod. Resting Heart Rate and Resting Blood Pressure were taken first, after the participant sat in a comfortable chair for five minutes. Participants would then get into approved clothing for the Bod Pod and have the Bod Pod test completed. We used the Bod Pod to get a measurement on Lung Volume. In order to get that, participants had to have their body composition measured (by Bod Pod) and then breathed into a tube that was attached to the Bod Pod machine. Following this, participants had a heart rate monitor attached to them and were brought down to the 200 meter indoor track to run the 1.5 Mile Run to get a predicted VO2 max score. It should be mentioned that food was available if a participant felt like they needed some food since they had to fast for three hours beforehand. However, no one in the study ended up requiring food. During the 1.5 Mile Run, heart rate was monitored. This was to ensure safety for the participant as well as to make sure they were running at a vigorous effort. A final heart rate and blood pressure were measured at the end of the run. Using exrx.com, the participants 1.5 Mile Run was converted into a VO2 max score. Participants were then given to option to try vaping, that way they were ready to use it the following three research days.

On Day 2, participants attended four different sessions at the exercise science lab. Each session would require a resting heart rate check and blood pressure measurement. After that, the participant would vape for ten minutes. The participant would breathe in the solution every thirty seconds. After the ten minutes were over, the participant would have their heart rate and blood pressure measured. The participant would come in three other times during the day. Sessions were spread out at least by two hours. Day 3 followed the exact same procedure as Day 2.

On Day 4, the Participant would come in for the final test. They would enter the exercise science lab and sit in a chair for five minutes. Then, the participant would have their resting heart rate and blood pressure measured. The participant would then vape for 10 minutes, breathing the solution in every 30 seconds. Heart rate and blood pressure was measured following the 10 minutes. After this, the participant would enter the Bod Pod with approved clothing (and after not eating for at least three hours). They would have their body composition measured as well as their lung volume. The participant would then get a heart rate monitor attached to them and proceed to run the 1.5 Mile Run on the 200 meter indoor track. Heart rate was monitored again during the run. A final heart rate and blood pressure was measured at the end of the run. Following this, the 1.5 Mile Run was converted into a VO2 max score. After the completion of the 1.5 Mile Run, the participant was finished with the study.

**Data Collection**

Our study used a pretest-posttest design. One goal of the study was to examine initial pretest measurements (day 1) with final posttest measurements (day 4). The measurements that were compared in the pretest-posttest design were resting heart rate, resting blood pressure, final blood pressure (blood pressure at the end of 1.5 mile run), 1.5 mile run time, VO2max, and lung volume. The data was collected the same both times. Heart rate was measured manually using the radial pulse. Blood pressure was measured using a sphygmometer. The 1.5-mile run was timed with a stopwatch and then converted into a VO2max score using exrx.com. Finally, lung volume was measured using the bod pod. After that data collection, data was inputted into SPSS software and a repeated measures test was run. Blood pressures had to be separated into systolic and diastolic measurements due to the nature of the software. This had to be done because the software would read the blood pressure measurement as a number divided by another number

and would give us a decimal. To avoid that problem, we compared systolic to other systolic blood pressures as well as diastolic to other diastolic blood pressures.

Another aspect we were able to measure was heart rate and blood pressure before and after directly vaping. We collected data on participants every time they vaped on days 2, 3, and 4. We then inputted that data into SPSS software and ran a repeated measures test. Each day was compared individually, meaning that the heart rates and blood pressures collected before vaping on Day 2 were only compared to heart rates and blood pressures collect after vaping on Day 2. Day 3 and Day 4 followed the same procedure. Blood pressure was also separated into systolic and diastolic blood pressures due to the nature of the software.

## Results

Our study used SPSS software (v.24) that used repeated measures to conduct statistical analysis. We used repeated measures to compare the pretest data of resting heart rate, resting blood pressure, 1.5 mile run time, VO2 max score, lung volume, and final blood pressure to the posttest data of the same components. We also used repeated measures to compare the heart rate and blood pressure before and after vaping during Days 2, 3, and 4. The following charts show the repeated measure statistics for resting heart rate and resting blood pressure that we collected on the pretest and posttest days:

Resting Heart Rate (Pretest-Posttest)

| Heart Rate (rest): | n=7 |
|---|---|
| Pretest: | 63.83 ± 10.889 |
| Posttest: | 62.00 ± 3.578 |
| P-Value: 0.05 | Sig: (.614) |

Resting Systolic Blood Pressure (Pretest-Posttest)

| | |
|---|---|
| Systolic BP (rest): | n=7 |
| Pretest: | 116.86 ± 8.235 |
| Posttest: | 114.29 ± 10.547 |
| P-Value: 0.05 | Sig: (.150) |

Resting Diastolic Blood Pressure (Pretest-Posttest)

| | |
|---|---|
| Diastolic BP (rest): | n=7 |
| Pretest: | 70.86 ± 7.381 |
| Posttest: | 73.43 ± 6.997 |
| P-Value: 0.05 | Sig: (.272) |

As shown, SPSS calculated significant values for heart rate, systolic blood pressure, and diastolic blood pressure all greater than the p-value: 0.05. That means that there was no significant difference in the pretest to posttest for those measurements. Using that SPSS data, we concluded that non-nicotine vape solution had neither a positive or negative effect on resting heart rate and resting blood pressure in the pretest to posttest test

The following charts show the repeated measures statistics for final blood pressure (the blood pressure measured directly after the 1.5 mile run) that was collected during the pretest and posttest days:

Final Systolic Blood Pressure (Pretest-Posttest)

| | |
|---|---|
| Systolic BP (final): | n=6 |
| Pretest: | 152.00 ± 20.823 |
| Posttest: | 157.00 ± 24.682 |
| P-Value: 0.05 | Sig: (.328) |

Final Diastolic Blood Pressure (Pretest-Posttest)

| Diastolic BP (final): | n=6 |
|---|---|
| Pretest: | 73.76 ± 7.633 |
| Posttest: | 70.33 ± 8.981 |
| P-Value: 0.05 | Sig: (.378) |

As shown, SPSS calculated significant values for final systolic blood pressure and final diastolic blood pressure that were all larger than the p-value: 0.05. This means that there was no significant change in the pretest to posttest measurements. Using that SPSS data, we concluded that non-nicotine had neither a positive or negative impact on the final blood pressures in the pretest to posttest test. It should be noted that only six participant's data sets were inputted for these tests. This was due to the 200meter track being closed, and one participant was unable to finish the posttest measures that involved the 1.5-mile time, Vo2max score, and final blood pressure.

The following charts show the repeated measures statistics for the participant's 1.5-mile time (in seconds) and their Vo2max score (calculated using exrx.com) that was collected during the pretest and posttest days:

1.5 Mile Run Time (Pretest-Posttest)

| 1.5 Mile Run Time (sec): | n=6 |
|---|---|
| Pretest: | 619.83 ± 61.61 |
| Posttest: | 624.17 ± 64.459 |
| P-Value: 0.05 | Sig: (.606) |

Vo2Max Score (Pretest-Posttest)

| Vo2max Score: | n=6 |
|---|---|
| Pretest: | 50.619 ± 4.554 |
| Posttest: | 50.320 ± 4.542 |
| P-Value: 0.05 | Sig: (.644) |

As shown, SPSS calculated significant values for the 1.5-mile time and Vo2max score statistics and all were greater than the p-value: 0.05. That means that there was no significant difference in the pretest to posttest for those measurements. Using that SPSS data, we concluded that non-nicotine vape solution had neither a positive or negative effect on 1.5-mile time or Vo2max in the pretest to posttest test. It should be noted that only six participant's data sets were inputted for these tests. This was due to the 200meter track being closed, and one participant was unable to finish the posttest measures that involved the 1.5-mile time, Vo2max score, and final blood pressure.

The following charts show the repeated measures statistics that were collected on heart rate and blood pressure before and after vaping on Days 2:

Day 2 (Before and After Vaping)

| Heart Rate: | n=28 |
|---|---|
| Before Mean: | 63.39 ± 6.154 |
| After Mean: | 63.39 ± 5.446 |
| P-Value: 0.05 | Sig: (1.000) |

Day 2 (Before and After Vaping)

| Systolic Blood Pressure: | n=28 |
|---|---|
| Before Mean: | 116.14 ± 8.588 |
| After Mean: | 114.57 ± 9.008 |
| P-Value: 0.05 | Sig: (.09) |

Day 2 (Before and After Vaping)

| | |
|---|---|
| Diastolic Blood Pressure: | n=28 |
| Before Mean: | 73.07 ± 6.939 |
| After Mean: | 72.93 ± 6.7 |
| P-Value: 0.05 | Sig: (.821) |

As shown, SPSS calculated significant values for heart rate and blood pressure statistics and all were greater than the p-value: 0.05. That means that there was no significant difference in the pretest to posttest for those measurements. Using that SPSS data, we concluded that non-nicotine vape solution had neither a positive or negative effect on heart rate and blood pressure before and after vaping on Day 2.

The following charts show the repeated measures statistics that were collected on heart rate and blood pressure before and after vaping on Days 3:

Day 3 (Before and After Vaping)

| | |
|---|---|
| Heart Rate: | n=28 |
| Before Mean: | 64.18 ± 6.372 |
| After Mean: | 63.32 ± 6.135 |
| P-Value: 0.05 | Sig: (.679) |

Day 3 (Before and After Vaping)

| | |
|---|---|
| Systolic Blood Pressure: | n=28 |
| Before Mean: | 115.00 ± 7.688 |
| After Mean: | 112.93 ± 9.008 |
| P-Value: 0.05 | Sig: (.046) |

Day 3 (Before and After Vaping)

| | |
|---|---|
| Diastolic Blood Pressure: | n=28 |
| Before Mean: | 72.71 ± 6.188 |
| After Mean: | 73.29 ± 7.143 |
| P-Value: 0.05 | Sig: (.302) |

As shown, SPSS calculated significant values for heart rate and blood pressure statistics and two of them (heart rate and diastolic blood pressure) were greater than the p-value: 0.05. That means that there was no significant difference in the pretest to posttest for heart rate and diastolic blood pressure before and after vaping. Using that SPSS data, we concluded that non-nicotine vape solution had neither a positive or negative effect on heart rate and diastolic blood pressure before and after vaping on Day 3. Also, as shown, SPSS calculated a significant value for systolic blood pressure that was lower than the p-value: 0.05. That means that there was a significant change from pretest systolic blood pressure to posttest systolic blood pressure. After looking at the data, we interpreted the significant change to be a decrease in systolic blood pressure from before vaping to after vaping. More information on this decrease is located in the discussion section.

The following charts show the repeated measures statistics that were collected on heart rate and blood pressure before and after vaping on Days 4:

Day 4 (Before and After Vaping)

| | |
|---|---|
| Heart Rate: | n=7 |
| Before Mean: | 61.71 ± 3.352 |
| After Mean: | 62.00 ± 2.646 |
| P-Value: 0.05 | Sig: (.703) |

Day 4 (Before and After Vaping)

| | |
|---|---|
| Systolic Blood Pressure: | n=7 |
| Before Mean: | 114.29 ± 10.547 |
| After Mean: | 104.57 ± 17.915 |
| P-Value: 0.05 | Sig: (.311) |

Day 4 (Before and After Vaping)

| | |
|---|---|
| Diastolic Blood Pressure: | n=7 |
| Before Mean: | 73.43 ± 6.997 |
| After Mean: | 73.71 ± 7.793 |
| P-Value: 0.05 | Sig: (.604) |

As shown, SPSS calculated significant values for heart rate and blood pressure statistics and all were greater than the p-value: 0.05. That means that there was no significant difference in the pretest to posttest for those measurements. Using that SPSS data, we concluded that non-nicotine vape solution had neither a positive or negative effect on heart rate and blood pressure before and after vaping on Day 4.

It should be noted that there are no lung volume statistics shown. Due to complications with the bod pod, we did not use any of the lung volume statistics for the study. This will be expounded upon in the next section.

## Discussion

As the results show, non-nicotine vaping had little to no effect on the pretest to posttest measurements as well as the measurements before and after vaping. As SPSS showed, however, vaping seemed to decrease systolic blood pressure on Day 3. We concluded that there are a couple possibilities to why this happened. One possibility is that the act of sitting in a chair for ten minutes is a relaxing activity by itself. It is possible that by sitting there, the participants lowered their blood pressure and it affected the results. Another possibility could be that non-nicotine vaping has a relaxation effect. Neither one of these possibilities can be proven true; more research will have to be done to find a correlation.

The results that we found are very interesting and are great additions to the relatively small literature done on the topic of non-nicotine vaping. There are a couple applications that

could potentially be built upon with further research. A healthier cessation technique could be developed. As mentioned above, cigarette smoking contains many chemicals that are harmful to the person smoking as well as the people around smokers. And cigarette smoking is a very addictive hobby. Vaping has the potential to provide the nicotine effect minus the chemicals that a cigarette has to offer. As mentioned above, a correlation may exist between relaxation and non-nicotine vaping. More research needs to be done to examine if there is a correlation between non-nicotine vaping and relaxation.

One advantage to our specific study is the rate in which the participants vaped. We understand that people will not realistically vape for 10 minutes at one lung full every 30 seconds. However, we believe that this method will better saturate the lungs with vapor than would a slower consumption rate. This would increase the chances of seeing immediate effects on vaping on all measured factors.

**Limitations**

We understand that there were some limitations. The first was due to the lack of a large sample size. We were able to test only 7 individuals throughout the project. A lack of diversity was also absent of our sample size. We only had males participant in the research study and, adding to the lack of diversity, six of those seven males were Caucasian. Another limitation to our study was our bod pod machine. The lung volume measurement was an important data set we were hoping to collect, but due to inaccuracies, the lung volume measurements are not reliable. As mentioned in the results section, we ended up not using any of the lung volume statistics. This was due to inaccurate measurements given by the bod pod multiple times. There were some realistic measurements given, but these were either preceded or followed by many inaccurate measurements. More limitations were due to our inability to control a lot of outside

factors like stress, sleep, and caffeine intake. Those three factors listed had an effect on blood pressure and heart rate, and thus had an unknown effect on the statistical analysis. We were also unable to schedule some participants at the same time of the day which also has unknown effects on blood pressure and heart rate. Due to those limitations, we have recognized a few ways that future research could be done to gain a better understanding of non-nicotine vaping on the human body. A larger and more diverse sample size is needed. Accurate and reliable equipment for testing is necessary. Future projects need to find ways to enable consistent scheduling with participants as well as finding a method for controlling outside factors such as sleep, stress, and caffeine intake.

## Conclusion

To summarize, our study found that non-nicotine vaping has minimal acute effects on resting heart rate, resting blood pressure, 1.5 mile run time, final blood pressure (blood pressure after 1.5 mile run) and Vo2max score. We determined this over a five-day study, in which students (male and female) at Cedarville University were recruited by email and over sixty responded with interest. However, due to time availabilities, only seven males were able participated in the study. After responding with interest, participants would come to the lab and fill out paperwork. After signing the informed consent form, we then scheduled the participants for the remaining four testing days.

On Day 1, participants would complete the pretest portion of the study which included measurements of: resting heart rate, resting blood pressure, lung volume, 1.5 mile run time, Vo2Max score, and final blood pressure. On Day 2, participants would come to the lab and complete four separate, ten-minute, vape sessions. Participants would vape once every thirty seconds. For each session, heart rate and blood pressure were measured before and after vaping.

On Day 3, participants followed the exact same procedure for Day 2. On Day 4, participants would enter the lab and perform one vape session. Following that, participants would follow the same procedures for Day 1.

For statistical analysis, SPSS software (v. 24) was used to run two repeated measures test. These tests were used to determine whether or not changes occurred in the measured data. The first repeated measures test analyzed pretest to posttest (Day 1 to Day 4) data. The second repeated measures test analyzed before and after vaping session (Day 2, Day 3, Day 4). The results showed no significant difference in any of the tests except for one instance. A repeated measures test showed that there was significant difference in before and after systolic blood pressure measurements. After looking at the data, we determined that the significant change was to due a decrease in systolic blood pressure. This decrease could be explained in a couple ways. One possibility is that the act of sitting in a chair for ten minutes is quite relaxing, which can lower blood pressure. Another possibility could be due to the relaxing nature of non-nicotine vaping. We, however, cannot determine from our results which one is the cause of it. Also, due to disappointing difficulties that the participants experienced with the bod pod, the lung volume data was not included in the final report.

Further research should include a larger and more diverse sample size, accurate equipment that has a low margin of error for the participant should be utilized, a consistent scheduling plan for the participants, as well as a method for controlling stress, sleep, and caffeine. In conclusion, our study found that non-nicotine vaping agreed with our hypothesis in that there would be no increase in heart rate, blood pressure, 1.5-mile time, Vo2max score, or final blood pressure. Our study also found that there might be a correlation to relaxation and non-nicotine vaping. However, much more research needs to be done to finalize that correlation. Our

study also provided some objective data that can be added to the bigger pool of data on whether or not vaping is healthier or not compared to cigarette (tobacco) smoking. As stated before, more research needs to be done to have a better understanding of vaping.

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