

## A retrospective review on the health consequences of electronic cigarettes

### Introduction:

Much has been written about the potential for adverse health effects of electronic cigarettes and their potential for harm reduction. The literature focuses on the toxins found in e-cigarette vapor, and their known consequences in long term exposure, or it looks at how e-cigarette vapor affects human or animal cell cultures. Newer studies are ongoing to see if there are genetic changes in airway cells that are similar to those found in combustible tobacco products that have been tied to cancer. There are studies that look at short term changes in respiratory and cardiovascular function. But little to no information has been done to look at what the actual health effects of e-cigarettes have been in those who have been using them for several years. Electronic cigarettes have been available in the modern form since about 2007. Ideally this would give us an eight year window to look for people who have been vaping or dual using and to see how their health has changed, or how the health of those people compares to both those who do not smoke, and those who have continued to smoke.

The reason for this study was to attempt to gather at least some basic information on vaping health. There are 4 primary goals in this study

1. To try to isolate those who have 3 or more years of vaping exposure, and see how their health had been affected by changing to e-cigarettes. While it might take longer than this to see some adverse health effects, it is extremely difficult to get many people who have been using e-cigarettes longer simply because of the limited time they have been available.
2. To look at those smokers who had no known health effects prior to switching to vaping and see what adverse health effects developed subsequent to starting to vape.
3. To see if those who never smoked before vaping were more likely to develop adverse health consequences as a result of vaping.
4. To measure demographics of users as a way to compare to smokers.

### Methods:

The primary source of information was an electronic survey distributed through social media to groups of electronic cigarette users. Participation was random. Several members of the social media groups shared the survey with friends or other groups. A few paper surveys were distributed to local vapor stores for additional input, but the majority of returned surveys were from the on line format.

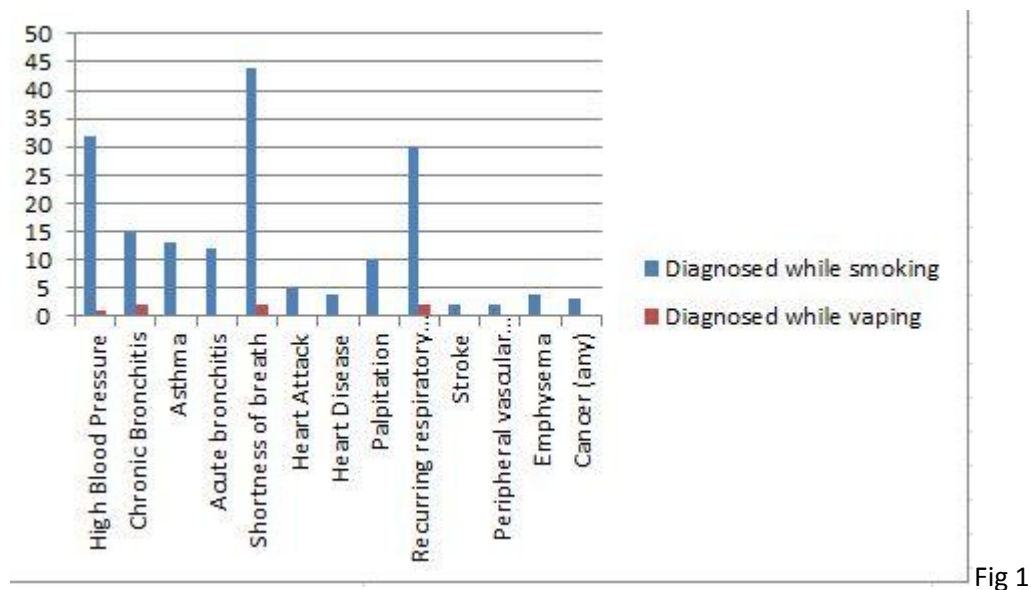
### Results:

The survey asked participants "While smoking cigarettes, were you diagnosed with any of the following health conditions?" They were allowed to select as many of the following as applied.

High Blood Pressure (hypertension), Diabetes, Irregular heart beat, Palpitations, Heart disease, Heart attack, Stroke, Cancer of any sort, asthma, emphysema, Chronic bronchitis, acute bronchitis, peripheral vascular disease, amputations related to circulation problems, shortness of breath, recurring respiratory infections

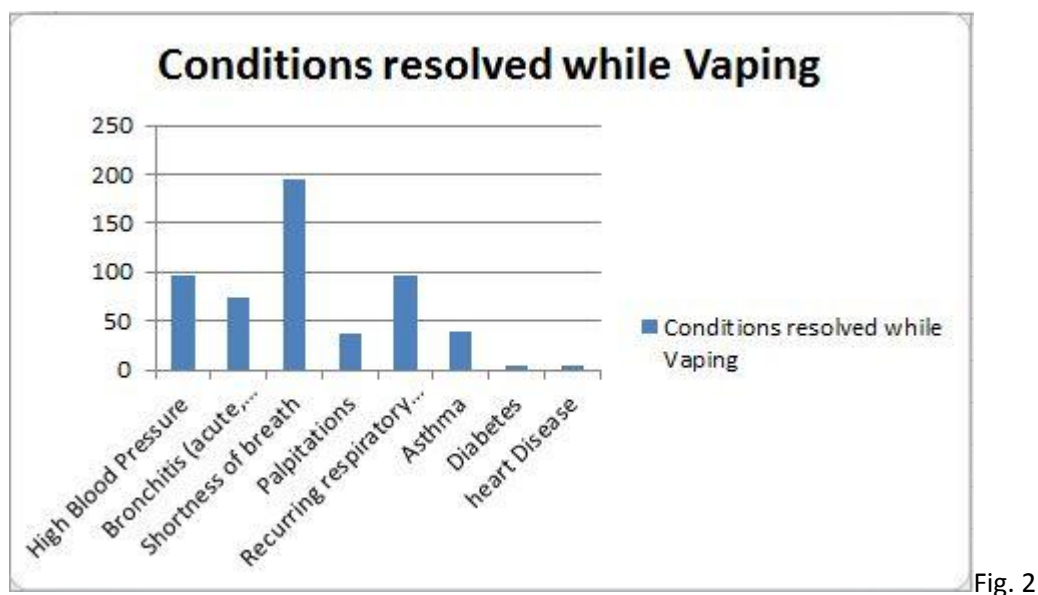
Then they were asked "Since starting to use vapor products, have you been diagnosed with or had any of the following health conditions?" The same health conditions were listed and they could select as many that applied

to them. There were 99 participants who had been vaping for 3 or more years. The results are shown in Figure 1. On average, while smoking they had 1.78 acute or chronic adverse events while smoking. While vaping, they admit to an average event rate of 0.07 per individual.



There were 120 previous smokers surveyed who had no adverse events documented while smoking. Of these 120 people there were two who developed adverse effects after beginning to use electronic cigarettes. One was in a 48 year old female who had been a half pack a day smoker and who had switched to vaping approximately one year prior. Her adverse effects were shortness of breath, acute and chronic bronchitis, and recurring respiratory infections. The other was in a 50 year old male who developed diabetes after vaping for less than a year. This represented 1.6% of the survey subgroup.

Additionally we also inquired as to resolution of any previous health problems developed while smoking. On average respondents improved on or had resolution of 1.1 events. The breakdown is shown in Figure 2. The largest change was in the subjective category of breathing (shortness of breath). There were also significant resolutions or improvements in Hypertension, recurring respiratory infections, palpitations and Acute or Chronic bronchitis.



We wanted to also assess the respondents subjective feelings of health while smoking and after switching to vaping. These results were fairly consistent from the main group of respondents to both subgroups. They were asked to rate their perception of health on a 10 point scale with 1 being poorest and 10 being the best. For the general group, they rated their health while smoking as a 3.93, and after they switched to vaping they had an improvement in their subjective health to 8.27. There were small variations between the subgroups, but the trend was the same. The group that started vaping with no prior cigarette use, also perceived their health as having improved by a similar margin, although they did have a slightly higher initial assessment of health at 4.25. This might be from the dopaminergic effect of nicotine. Or possibly other underlying issues that caused them to start vaping as self medicators, such as depression, anxiety, or ADD.

It was problematic surveying the previous non-smokers who were using electronic cigarettes. There were only 8 out of the 540 people surveyed who admitted to be non-smokers prior to vaping. This represented only 1.6% of our survey group. None of this group developed any adverse events while vaping. The numbers surveyed though, were too small to be meaningful. This result does go along with others who have shown that there are very few people who start to use electronic cigarettes who were not already using combustible tobacco products.

#### Demographics:

In addition to health questions, the survey was designed to capture demographics of those who use e-cigarettes. The demographics of smokers have been well studied, but as yet, there is little information on the makeup of those who have made the switch. Questions were asked regarding race, education level, income and gender. Those who identify as white or Caucasian make up 90.5% of respondents. Asians made up 1.6%, Blacks or African Americans made up 1.2%, and Native Americans made up 1.4%. Both Caucasians and Native Americans made up more than their relative percentage of the population in the vaping demographics (Fig. 3)

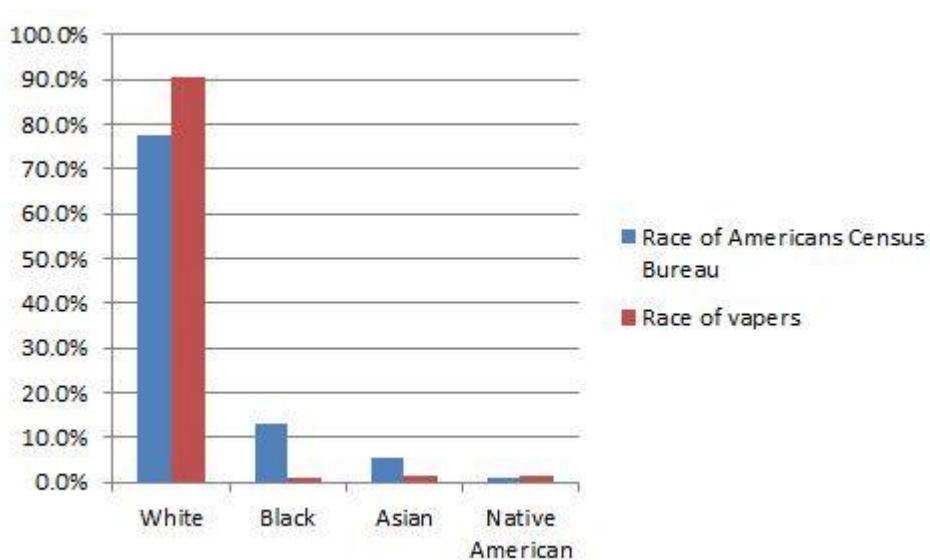


Fig. 3

This issue of racial disparity in vaping can be of consequences if vaping is definitively shown to reduce the harm of combustible tobacco products as African Americans and other minorities have a higher prevalence of hypertension and cardiovascular disease than other racial or ethnic groups. Smoking is a major contributor to both of those diseases, thus swaying those minorities to switch to vaping can potentially save lives.

The gender distribution is shown in Figure 4. There is no surprise that males make up the majority of those using electronic cigarettes, as they are also in the majority in combustible tobacco products. However the disparity

between genders is greater in use of electronic cigarettes. There is a 13.3% difference between men and women smokers, but a 27% difference between men and women vapers.

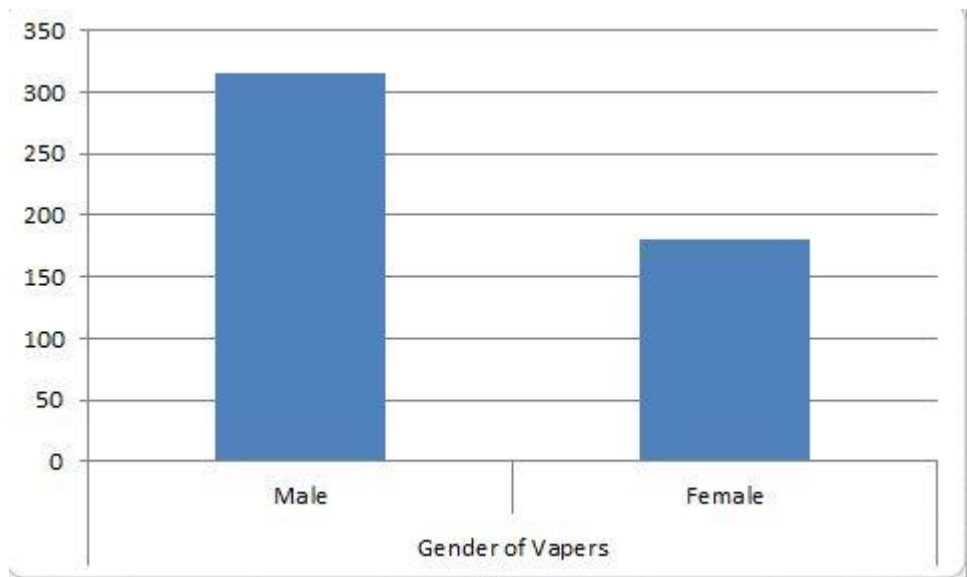


Fig. 4

The age distribution varied between the main group and the 2 subgroups measured. As measured among all respondents, the average age of all vapers was 36.38 years. Those who had 3 or more year's experience were more than 3 years older with an average age of 39.36. Those who started vaping with no prior smoking were the youngest group by almost 6 years, with an average age of 30.63.

Education level also varied from the main group to the 3 year or more group. There was not enough data to draw conclusions from the previous non smokers group because of the limited responses we got. The individuals who had 3 or more years of vaping tended to be better educated than the group in general with a higher percentage of college graduates and masters or doctoral degrees. See figures 5 and 6.

### Education level of vapers (all)

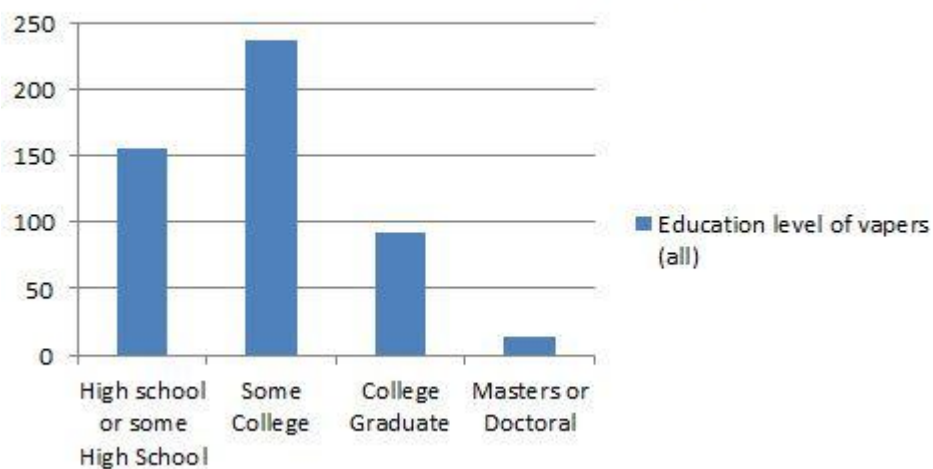


Figure 5

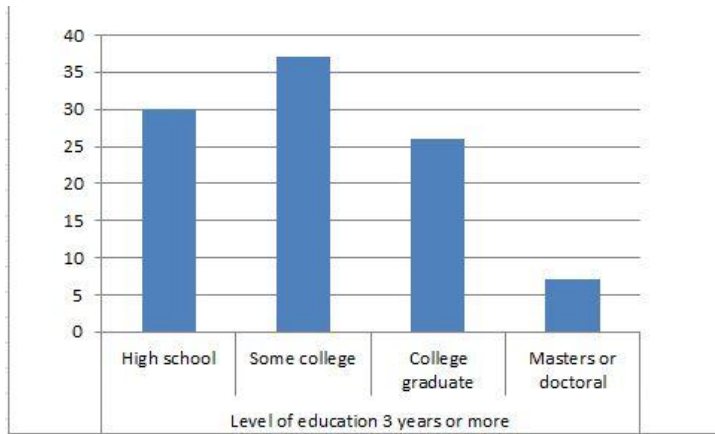


Figure 6

There was also an income difference between all vapers and those vaping 3 years or more. Figure 7 and 8

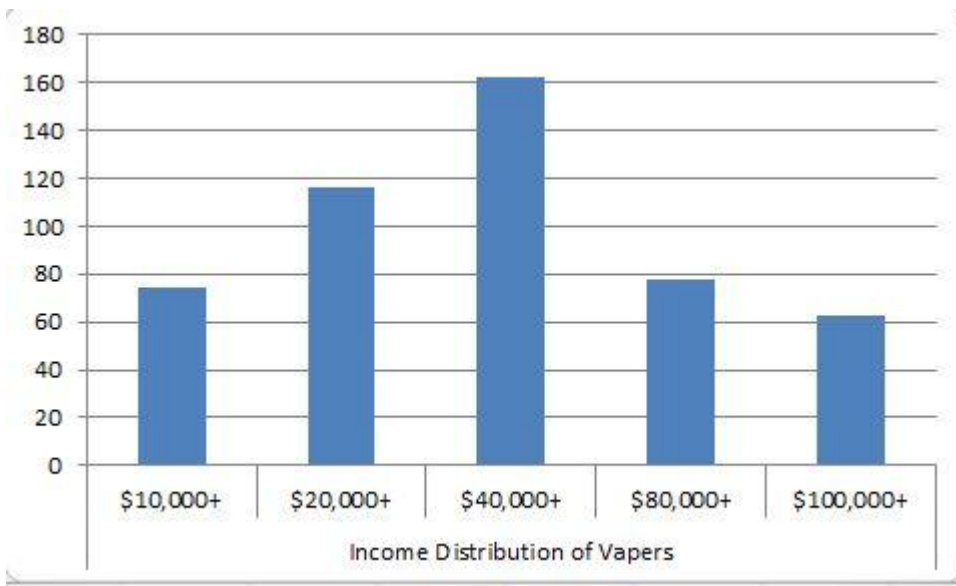


Figure 7

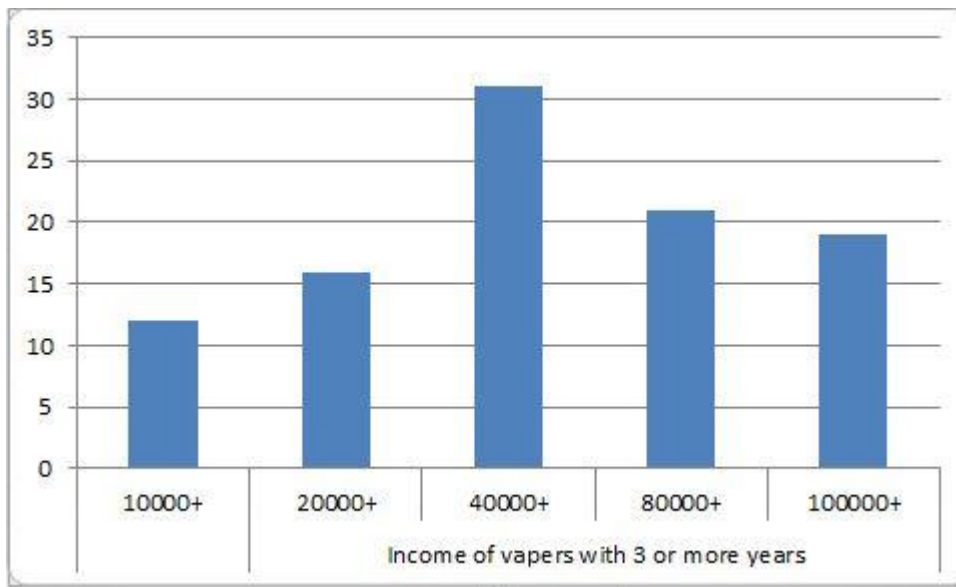


Figure 8

Vapers with 3 or more years of vaping experience tended to be older, have a higher level of education, and greater annual income than the general vaping population.

## Conclusion:

Most studies to date regarding the health effects of vapor products have focused on the toxins found in e-cigarette vapor, how those toxins affect the physiology of certain organ systems, how they impact cells in vitro, projecting harm based on how cigarettes affect the body with higher levels of toxins assuming there is a linear progression of health events related to a linear decline in toxins. There have been few to no studies to show how vaping has actually affected the health of people who have been using these products over the last several years. It is important to study the physiology, but it is equally important to see what the outcomes have already been in vivo. Electronic cigarettes have been around long enough to identify individuals who have extensive time using these products. In this study we surveyed people using these products, found a significant subset who had been using them for in excess of 3 years and found out how their health had been affected, good or bad.

In the subgroup of vapers with 3 or more years of use, adverse health events decreased from 1.78 while smoking to 0.07 after starting to vape. This subgroup was older, better educated and had higher income than the general group. In the group as a whole, individuals who began vaping reported on average a decline of 1.1 adverse health events (resolution of existing condition, or improvement) after starting to vape.

There is an inequity in distribution of vapers between gender and race. Many of the groups who would benefit from the harm reduction of e-cigarettes are not using them in significant numbers. This review shows a significant reduction in hypertension in people who are able to successfully switch to vaping. In minority groups who have a higher incidence of hypertension and hypertensive related heart disease, using electronic cigarettes could result in a tremendous savings of life, medical expenses, and lost time from work. Keeping these products inexpensive, avoiding punitive taxes and encouraging smokers to try vaping if they have been unable to quit using other methods are going to be important to reverse the impact of years of combustible tobacco products.