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How safe is vaping?

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Abstract

Did you know that most people who vape are teens? E-cigarette (e-cig) companies market vaping as a safe alternative to traditional smoking. Well, vaping is safer than traditional smoking, but it is still dangerous to human health. We wanted to summarize the effects that vaping has on the body's cells. We reviewed scientific studies about vaping and the human body. We found that vaping causes inflammation of the mouth and lungs. It also damages DNA. Long-term inflammation and high levels of DNA damage can cause cancer. Some e-cig users have reported mouth cancer, but not many yet. That is because cancer formation takes a long time. We will need more studies to know the long-term effects of vaping. But current studies show that using e-cigarettes is not safe.

Introduction

Smoking cigarettes is dangerous for human health. A traditional tobacco cigarette contains more than 4,000 harmful or potentially harmful substances. That is why some smokers have switched to e-cigarette (e-cig) vaping (see Fig. 1). In fact, the original purpose of vaping was to help adults quit smoking. But only 6.7% of adults use e-cigarettes. Most e-cig users are teens. As of 2019, about 30% of high schoolers reported that they used e-cigarettes.

E-cigarettes produce an **aerosol** by heating a liquid, sometimes called **vape juice**. The liquid contains many chemicals, including nicotine and flavorings. Users breathe the aerosol into their lungs. E-cigarettes contain less harmful substances than a traditional tobacco cigarette. But they do still contain **carcinogens**. Carcinogens are substances that can cause **cancer**. Also, e-cigarettes contain **nicotine**. Nicotine is not a carcinogen. But when the body **metabolizes** nicotine, it can change it into a carcinogen. It is also very addictive.

We wanted to know how vaping affects the body's cells. There are many studies that focus on how vaping affects different types of cells. So, we read them and put together a summary of the negative health effects of vaping.

Figure 1: E-cig vaping devices come in different shapes and sizes, but they all contain vape liquid and a heating device.
Image: U.S. Centers for Disease Control and Prevention

Methods

We reviewed more than a hundred scientific papers. They focused on the effects of e-cig vaping on the body's cells. We then summarized their findings by the type of effect. The three main effects were **inflammation**, **DNA** damage and repair, and cancer formation.

Results

Vaping has different negative impacts on the body's cells.

Inflammation

Inflammation is a natural response by the body. The immune system uses it to defend against bacteria, viruses, and cell damage. Inflammation is a short-term response. If parts of the body become inflamed for too long, they can become damaged. Vaping causes inflammation in the user's mouth and gums. This inflammation causes a gum disease called **periodontitis**. It causes the gums to pull back, and eventually the user's teeth may loosen and fall out.

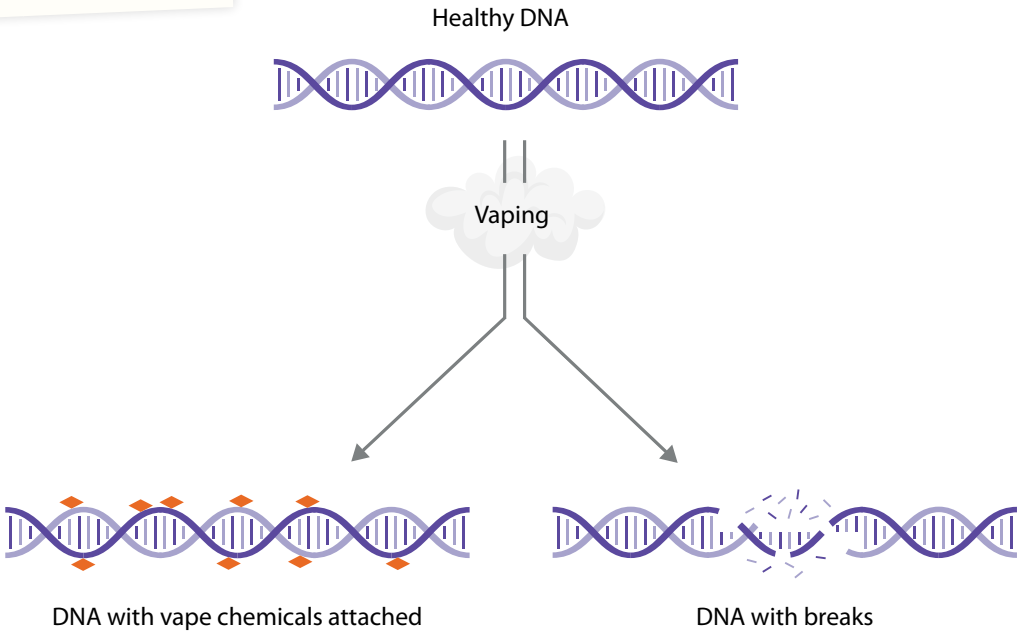
Vaping also causes inflammation in the lungs. That is because the chemicals cause damage to the cells. In one study, scientists exposed lung cells to e-cig aerosols and traditional cigarette smoke. The cells exposed to the e-cig aerosols had more damage. Also, the cell damage was greater when they used flavored e-cig aerosols.

DNA Damage and Repair

Some vaping chemicals change when heated by the vaping device. Others change when the body processes them. Sometimes these chemicals bond to the DNA in the body's cells. When the chemicals attach to the DNA, they can cause damage. Other vaping chemicals cause breaks in the DNA. (See Fig. 2.) There is a link between damaged DNA and the

How is DNA damaged by the chemicals inhaled when vaping?

Figure 2:
Different ways that e-cigarette vaping damages DNA.



formation of cancer cells. E-cig users who used sweet-, mint- or menthol-, and fruit-flavored vape juice had the highest levels of DNA damage.

The body has a way to fix the DNA. But when there is too much damage, it cannot fix all the errors that form. Studies found that vaping caused reduced DNA repair in lung, heart, and bladder cells.

Cancer Formation

As of 2019, there were three cases of oral cancer reported in e-cig users. One study also observed the effect of e-cig aerosols on animal lung cells. Both flavored and unflavored aerosols caused cancer to form.

Discussion

E-cig vaping is dangerous for the human body. Our review showed that vaping causes inflammation and DNA damage. We also noted that the amount of DNA repair decreased. Long-term inflammation and DNA damage can both lead to cancer formation.

Vaping changes the mouth's **microbiome**. That means there are changes in the number and type of bacteria in the mouth. These changes cause bad breath and most likely cause gum inflammation. Some of the e-cig chemicals prevent the growth of the bacteria that work with the body to keep the gums healthy. These same chemicals promote the growth of bacteria that inflame the gums. One of these bacteria is carcinogenic and prefers environments high in sugar. So, e-cig vape juice with sweet flavorings makes a good environment for this carcinogenic bacterium.

Our review also showed that nicotine and nicotine-free e-cigarettes cause DNA damage. We know that e-cig users have more DNA damage than non-users. But we don't know how **much** more damage. That is because e-cigs have only been in use for about 15 years.

There is still a lot to learn about the negative health effects of vaping. That is because cancer formation is a long-term health effect. More information about the effect of vaping on cancer formation will be available in the next ten years. But there is already evidence that vaping is causing changes to the body's cells. These changes can lead to cancer formation. That means many people, especially teens, are at risk for preventable cancers.

Conclusion

Vaping may be less harmful than traditional smoking. But it is not safe. To stay healthy, do not use regular or e-cigarettes. Instead, eat healthy foods, exercise, and spend time with friends. These choices will help you stay physically and emotionally healthy. And check in with your friends to make sure they know about the dangers of vaping. Help them make healthy choices so that you all can enjoy a healthy future!

REFERENCES

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Tobacco Education Resource Library: Vaping 101 – Learn the Facts About Vaping **https://digitalmedia.hhs.gov/tobacco/educator_hub/vaping_101?locale=en**

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Glossary of Key Terms

Aerosol - fine solid particles or liquid droplets suspended in air or another gas.

Cancer - a disease caused by the uncontrolled growth of abnormal cells in a part of the body.

Carcinogen - a substance capable of causing cancer.

DNA - a complex molecule inside the body's cells that contains the information needed for an organism to grow and develop.

Inflammation - natural response by the body to heal after an injury and to defend against bacteria and viruses.

Metabolize - the process that changes substances in the body to a different, more usable form.

Microbiome - the community of microorganisms, such as bacteria, that naturally live on the body or inside the body. The largest microbiomes in the human body are in the gut and in the mouth.

Nicotine - a chemical naturally found in tobacco that causes an increase in heart rate and a sense of well-being and relaxation. It can also be made in a laboratory.

Periodontitis - inflammation of the tissue around the teeth. This can cause the gums to shrink and the teeth to loosen.

Vape juice - a liquid containing many chemicals, including nicotine and flavorings. Also known as e-juice or e-liquid. When someone vapes, they use an e-cigarette to heat the vape juice and create an aerosol, and then they breathe the aerosol into their lungs.

Check your understanding

1. What are two ways that chemicals in e-cigarettes can change into a substance that is harmful to the body?

2. How does vaping affect the bacteria in a person's mouth?

3. How do we think the number of cancer cases connected to e-cig vaping will change over time? Why?

4. Many people vape because of the happy feeling they get from the nicotine. Brainstorm a list of activities that could provide you with a happy feeling – without negative health consequences.

5. With a partner, develop a plan to encourage students in your area not to use e-cigarettes.