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## **Definitions**

- **Electronic Cigarettes (E-Cigarettes):** Devices that heat a liquid to create a vapor, which is inhaled. They often contain nicotine.
- **Combustible Cigarettes:** Traditional cigarettes that are burned to produce smoke.
- **Smokeless Tobacco (ST):** Tobacco products that are chewed or placed in the mouth rather than smoked.
- **Volatile Organic Compounds (VOCs):** Harmful chemicals found in tobacco products and other sources, which can be measured in urine.
- **Nicotine Metabolites:** Substances produced when the body breaks down nicotine, including cotinine and 3-hydroxycotinine.

## **Key Findings**

- E-cigarette users had lower nicotine levels in their urine compared to cigarette smokers.
- Cigarette smokers had higher levels of harmful VOCs in their urine compared to e-cigarette and smokeless tobacco users.
- E-cigarette users had higher levels of certain VOCs, like xylene and acrylonitrile, compared to non-tobacco users.

## **Introduction**

This study examines how different types of tobacco products, including e-cigarettes, combustible cigarettes, and smokeless tobacco, affect levels of harmful chemicals in the body. Researchers measured nicotine and VOCs in the urine of users to compare the exposure levels from these products.

## **Main Content**

### **Background**

The use of various tobacco products can lead to exposure to harmful chemicals, increasing the risk of diseases like cardiovascular disease. This study aims to understand how e-cigarettes, which are thought to be safer, compare to traditional cigarettes and smokeless tobacco in terms of chemical exposure.

### **Methods**

- **Participants:** 48 healthy adults who use tobacco products were recruited, including cigarette smokers, e-cigarette users, and smokeless tobacco users. Additionally, 12 healthy non-tobacco users were included as a control group.
- **Study Design:** Participants abstained from using tobacco products for 48 hours before the study. They then used their assigned tobacco product while researchers collected urine samples over a 3-hour period.
- **Urine Analysis:** Urine samples were tested for nicotine, its metabolites (cotinine and 3-hydroxycotinine), and VOC metabolites.

## Results

- **Nicotine Exposure:**
  - Nicotine levels were lower in e-cigarette users and smokeless tobacco users compared to cigarette smokers.
  - Cotinine and 3-hydroxycotinine levels were similar across all tobacco users.
- **VOC Exposure:**
  - Cigarette smokers had higher levels of VOC metabolites such as acrolein and crotonaldehyde compared to e-cigarette users and smokeless tobacco users.
  - E-cigarette users had higher levels of certain VOC metabolites (like xylene and acrylonitrile) compared to non-tobacco users.
  - Smokeless tobacco users had VOC levels similar to non-tobacco users, except for xylene metabolite, which was higher.

## Conclusion

The study shows that while e-cigarettes deliver lower levels of nicotine compared to combustible cigarettes, they still result in exposure to certain harmful VOCs. Cigarette smoking leads to the highest levels of harmful chemicals, whereas smokeless tobacco appears to result in lower exposure to these harmful substances. These findings suggest that while e-cigarettes may be less harmful than traditional cigarettes, they are not completely free of harmful exposures, emphasizing the need for further research and caution in their use.

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