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VAPING'S HIDDEN TOLL: NICOTINE RISKS, ACUTE LUNG INJURY AND DYSFUNCTION

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Abstract: While often perceived as a safer alternative to conventional cigarettes, emerging evidence suggests e-cigarettes are far from harmless. This review examines the link between e-cigarette use and both acute lung injury and sub-clinical lung dysfunction. Though long-term consequences remain under investigation, current findings reveal concerning effects. E-cigarettes trigger blood vessel constriction, immune system hyperactivity, and a thinning of the lung's inner lining. Notably, their design facilitates efficient nicotine delivery, comparable to conventional cigarettes, raising concerns about nicotine dependence in non-smokers and increased severity in existing users. The composition of e-liquids and the hardware itself can further influence nicotine exposure. In conclusion, a growing body of evidence challenges the myth of e-cigarette safety, urging further research and potential re-evaluation of public health policies

Index Terms - e-cigarette, vaping, e-liquid, nicotine retention , addiction

I.INTRODUCTION

In recent years, vaping devices or electronic cigarettes have gained immense popularity, especially among young people. However, there are mounting apprehensions about their safety. These devices operate by heating a liquid, commonly known as e-juice or vape juice, which is then inhaled as a vapour. This liquid is a mixture of vegetable glycerin and propylene glycol, along with nicotine and a variety of flavorings.

While vegetable glycerin and propylene glycol are generally safe for consumption, studies have revealed that when heated, they can break down into toxic chemicals such as formaldehyde and acetaldehyde**[1][2][3]**. Moreover, the presence of nicotine in these devices can be particularly pernicious, as it is a highly addictive substance that can lead to various health problems, including heart disease**[4]** and lung cancer. The vast array of alluring flavors available with electronic cigarettes can also make them all the more enticing to young people, leading to nicotine addiction and potential long-term health consequences.

Therefore, individuals who use electronic cigarettes must be conscious of the possible risks associated with these devices. It is imperative to exercise caution when using electronic cigarettes and take these risks seriously, especially for young people. Ensuring the safety of those who use electronic cigarettes should be a top priority, and we must continue to research and assess the potential risks linked with these devices to ensure their safe use.

Nicotine is a compound that can be found naturally in the tobacco plant. It is the main substance that is responsible for the addictive properties of tobacco and tobacco products. Nicotine acts as a stimulant that affects the central nervous system, resulting in a wide range of physiological responses, such as an increase in heart rate, blood pressure, and respiration. Despite the potential for negative health effects and the addictive properties of nicotine, it is still a common ingredient in different tobacco products, such as chewing tobacco, cigars, and cigarettes**[5]**.

Nicotine can also make the body release a hormone called cortisol. Cortisol can make people feel more anxious and alert. Some studies suggest that nicotine can help with memory and attention, but other studies suggest that it can make it harder for people to learn and think.

Using nicotine for a long time can be bad for people's health. It can make people more likely to have heart problems and lung problems. Nicotine can also make people more likely to get cancer. Pregnant women who use nicotine can have problems with their babies.

E-cigarettes are a type of device that people can use to get nicotine. E-cigarettes are often said to be safer than regular cigarettes, but they can still be harmful. E-cigarettes can be just as addictive as regular cigarettes, and they can still cause health problems**[6]**.

People need to understand how nicotine works and the risks of using it. People need to make informed choices about their health and protect themselves, especially young people, from the risks of nicotine.

II.Literature Review

"Patrice Marques, Laura Piqueras & Maria-Jesus Sanz."**[7]**-E-cigarettes were introduced as a smoking cessation but the study reflects otherwise. The main components of e-liquids are Propylene Glycol and Glycerol heating generates new harmful compounds such as formaldehyde, and acetaldehyde. It may also contain nicotine and flavoring. According to the directives of the EU, nicotine concentration ranges from 0mg/ml to 20mg/ml, which is comparable to conventional cigarettes, but some liquids contain as much as 54mg/ml. Flavors such as cinnamon and methanol result in cytotoxicity and pro-inflammation in cells. Due to flavoring many non-smokers are using e-cigarettes which results in an acute oppressive immune system. Tiny Metal Particles from heating elements and silica can become part of aerosol vapor and may have potential health consequences.

"Gideon St. Helen, Christopher Havel, Delia Dempsey et al.**[8]**" -E-cigarettes are known to deliver nicotine levels with high efficiency, which can be comparable to or sometimes higher than that of combustion cigarettes, owing to different vaping habits. The nicotine levels in plasma and e-liquids are determined using mass spectrometry. It has been observed that e-cigarette users have low expired CO levels, while the average saliva cotinine levels produced after the metabolism of nicotine post-ingestion are similar to those of combustion cigarettes. The retention levels of nicotine, glycerin, and propylene glycol are, on average, 93.8%, 84.4%, and 91.7%, respectively. The absorption sites for nicotine include the lungs, mouth, and gastrointestinal tract. Nicotine-deprived users have reported an increase in heart rate with e-cigarette use, and the devices seem to subjectively reduce withdrawal symptoms and cravings. Young people find e-cigarettes more convenient to use and less pungent than tobacco cigarettes. However, it's important to note that nicotine addiction and secondhand exposure remain a concern.

"Miliano C, Scott ER, Murdaugh LB, et al.**[9]**"-Exposure to drug vapor via Electronic Nicotine Delivery Systems (ENDS) can impact both the peripheral and central nervous systems. Nicotine has been shown to alter the body's metabolism and temperature regulation, while cannabinoids have been found to affect heart rate and lung function. In regards to the central nervous system, nicotine has the potential to rewire reward pathways and impair cognitive function. Conversely, cannabinoids and stimulants have been linked to increased activity and pleasure, which may lead to dependence. While studies on opioids are limited, they suggest a similar potential for addiction through ENDS. Further research is necessary to fully comprehend sex-specific differences and long-term effects. Nevertheless, ENDS offers a promising avenue for understanding the mechanics of drug addiction.

"Elise E. DeVito* and Suchitra Krishnan-Sarin**[10]**"-The use of e-cigarettes can lead to varying levels of nicotine exposure, influenced by both the e-liquid's characteristics and user behavior. Nicotine, a primary additive in tobacco cigarettes, can contribute to dependence and abuse liability depending on the amount absorbed and exposed. In some cases, nicotine levels found in e-cigarette aerosols can surpass those in tobacco cigarettes. Higher nicotine concentrations can increase nicotine delivery, assuming that all other contributing factors remain constant. The appeal of flavors like fruits or coffee, as well as those with mysterious names like "snake oil" and "unicorn blood," can spark interest in young people to try e-cigarettes, and peer pressure can lead to continued use. The PG/VG ratio of the e-liquid also affects the rate of nicotine delivery. Additionally, secondhand exposure to nicotine from e-cigarettes can occur for non-users.

"Hunter T. Snoderly,1,2 Timothy R. et al.**[11]**"-E-cigarettes have evolved significantly over the years, with several generations of advancements. In their early days, they were disposable and resembled traditional cigarettes. The subsequent pen-style generation came in vibrant hues to appeal to younger audiences. Mechanical mods and variable voltage devices were then introduced, providing vapers with more personalized experiences. Finally, pod systems like JUUL gained popularity for their convenience and pre-filled cartridges.

While some devices may incorporate features from multiple generations, this overview provides a broad depiction of the evolution of E-cigarettes.

III.METHODOLOGY

In this methodology, we aim to explore the benefits of human studies over other methods and their limitations. By conducting human studies, we can gain a comprehensive understanding of the effects of vaping on human health. These studies aid in detecting both immediate and sub-clinical changes in different bodily systems, enabling early diagnosis and treatment. Additionally, human studies provide a realistic representation of the effects of vaping on human health under real-world conditions, making them highly relevant to practical scenarios. Moreover, specific groups, such as people with pre-existing medical conditions, can be observed through human studies to understand the effects of vaping on their health.**[12]**

Despite the benefits of human studies, they also encounter limitations. One of the significant challenges is the standardization of the use of e-cigarettes, making it difficult to control the frequency of use and the type of e-liquids. Additionally, human studies depend on users' accurate reporting and compliance by the subjects, which may not always be achievable. Moreover, since e-cigarettes are relatively new, it is challenging to study their long-term effects on human health.

The Human Procedure involves several steps, starting with gathering information about the individual's smoking status, cigarettes per day, E-cig puff per session, e-cigarettes design, and information about e-liquid, including nicotine concentration and flavor. Once collected, we calculate the e-liquid vaped and nicotine retained, followed by checking the saliva cotinine level to detect nicotine presence. Further, we look for nicotine pharmacokinetic details such as Tmax, Cmax, and AUC(0 -> ∞).

In pharmacokinetics, Tmax represents the time after administration of a drug when the maximum plasma concentration is reached. When the drug is administered intravenously, Tmax is typically the time taken for the drug concentration to reduce by half. However, when the drug is administered orally, Tmax represents the time it takes for the drug to be absorbed and reach peak plasma concentrations. In the context of a DataFrame column, Tmax would likely represent the time at which each observed substance in the dataset reached its maximum concentration in the plasma.

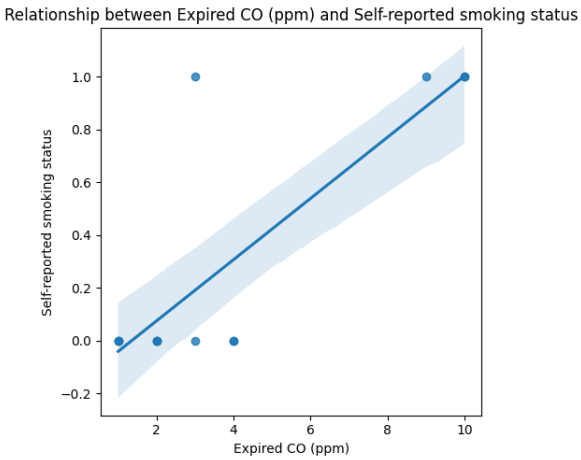
Cmax, on the other hand, is the maximum (or peak) serum concentration that a drug achieves in a specified compartment or test area of the body after the drug has been administered and before the administration of a second dose. It is a crucial factor in assessing the bioavailability of a drug, along with other parameters such as AUC (Area Under the Curve) and Tmax (time to reach Cmax). In the context of a DataFrame column, Cmax would likely represent the maximum observed concentration of each substance in the dataset.

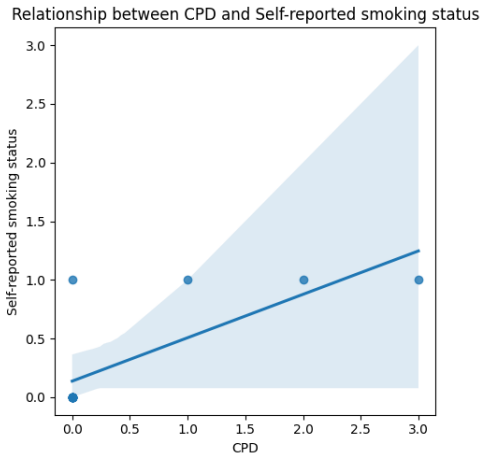
AUC (Area Under the Curve) from 0 to infinity, often denoted as AUC(0 -> ∞), is a pharmacokinetic parameter representing the total drug exposure over time. It is calculated as the area under the drug concentration-time curve from the time of dosing (t=0) to an infinite time, effectively covering the entire lifespan of the drug in the body. AUC(0 -> ∞) is used to compare the bioavailability of different drugs or different formulations of the same drug. It is also used to calculate other pharmacokinetic parameters such as clearance and volume of distribution. In practical terms, AUC(0 -> ∞) is usually estimated by adding two components - AUC(0 -> t) and AUC(t -> ∞). The former is the area under the curve from time zero to the last measurable concentration, calculated using the trapezoidal rule or other numerical integration methods. The latter is the area from the last measurable concentration to infinity, which is estimated as Ct/Ke, where Ct is the last measurable concentration, and Ke is the elimination rate constant.

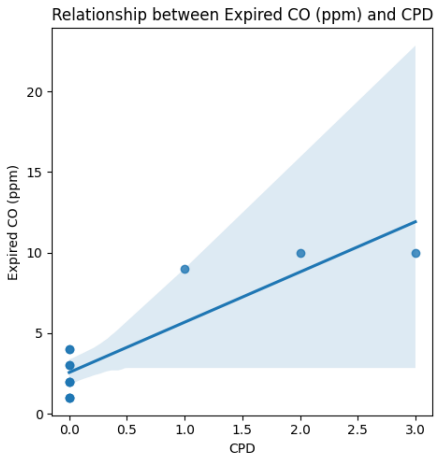
IV.RESULT

A. The comparisons of variables yielded the following results:

1. 'Self-reported smoking status' and 'Expired CO (ppm)'
2. 'Self-reported smoking status' and 'CPD'







3. 'CPD' and 'Expired CO (ppm)'

The obtained p-values for these comparisons are as follows:

- 'Self-reported smoking status' and 'Expired CO (ppm)': The p-value is approximately 0.000625, which is close to 0, indicating a statistically significant correlation.
- 'Self-reported smoking status' and 'CPD': The p-value is approximately 0.00349, less than 0.05, also signifying a statistically significant correlation.
- 'CPD' and 'Expired CO (ppm)': The p-value is approximately 0.000048, close to 0, indicating a statistically significant correlation.

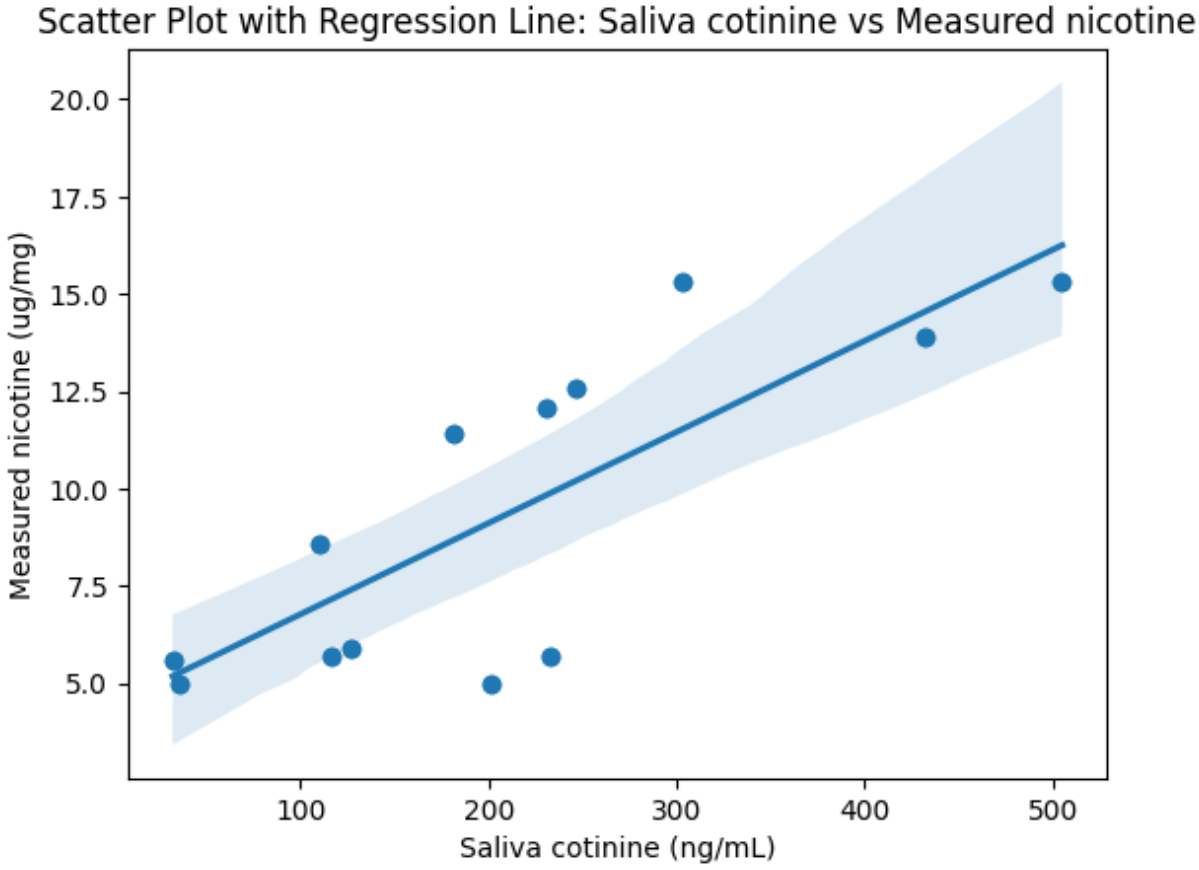
All three p-values are less than 0.05, signifying statistically significant correlations and suggesting that the observed correlations are unlikely to have occurred by chance.

B. However, in the case of 'E-cig puffs per day' and 'Saliva cotinine (ng/mL)', the p-value is 0.137, greater than 0.05, indicating a failure to reject the null hypothesis, suggesting no significant correlation in the given dataset.

C. The Pearson correlation coefficient of 0.794 between 'Saliva cotinine (ng/mL)' and 'Measured nicotine (ug/mg)' indicates a strong positive linear relationship, implying that as 'Saliva cotinine (ng/mL)' values increase, 'Measured nicotine (ug/mg)' values also tend to increase.

With a p-value of 0.001, indicating statistical significance, we reject the null hypothesis of no correlation between 'Saliva cotinine (ng/mL)' and 'Measured nicotine (ug/mg)'.

In conclusion, the analysis suggests a strong and statistically significant positive correlation between 'Saliva

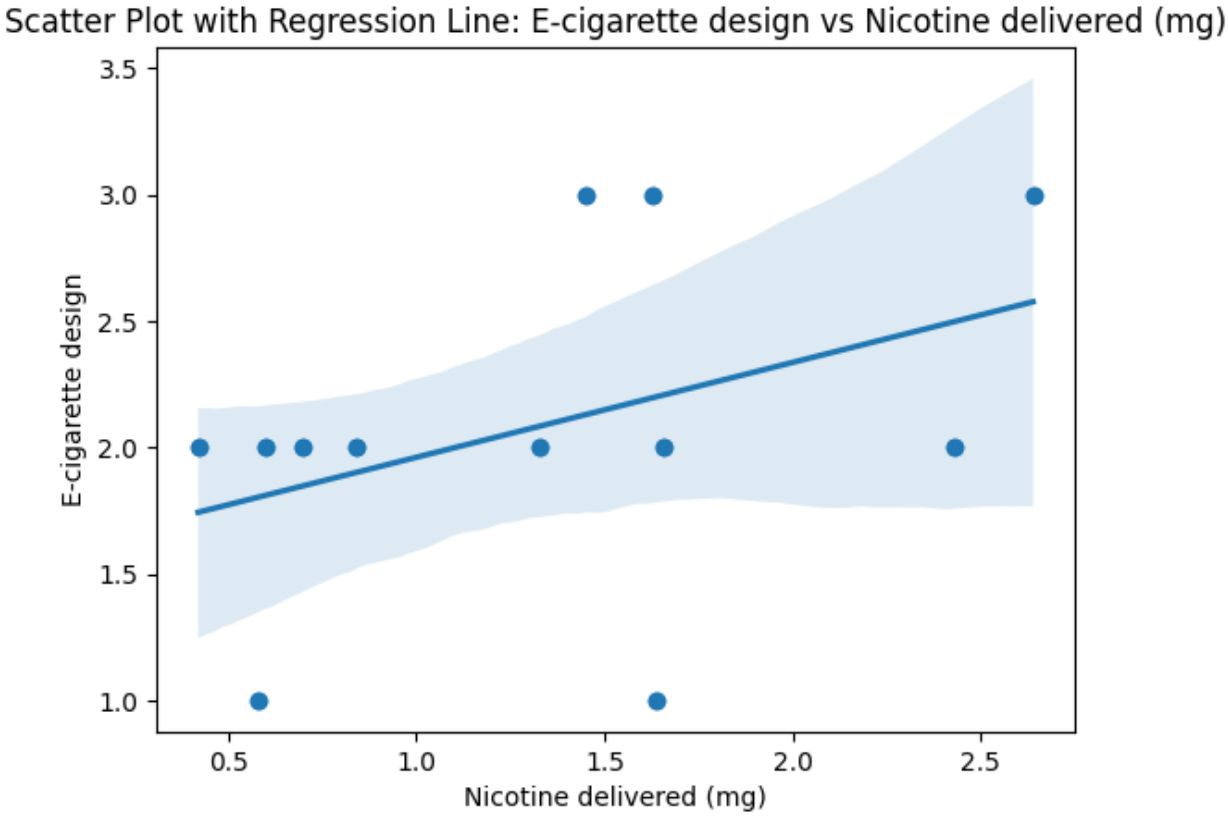


cotinine (ng/mL)' and 'Measured nicotine (ug/mg)'.

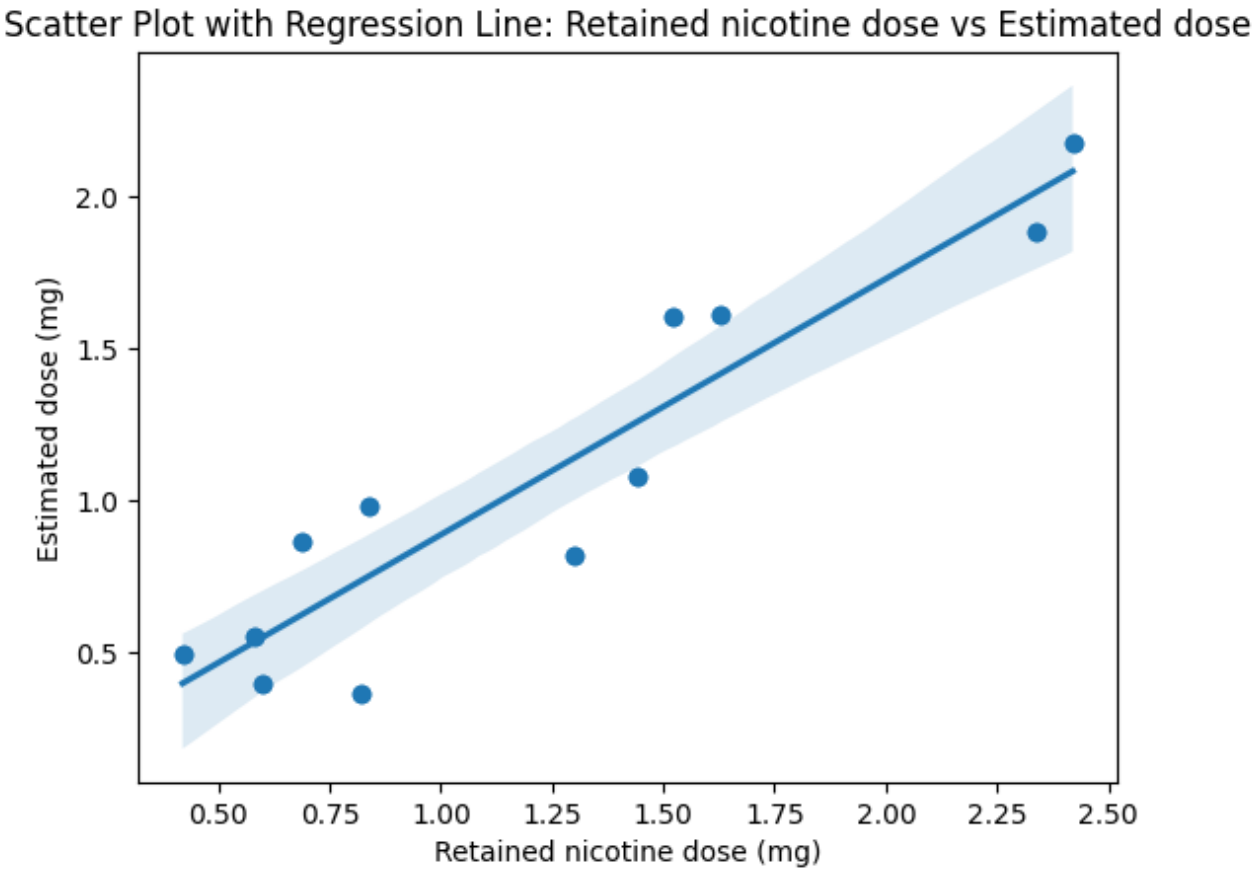
D. In the case of 'Nicotine delivered (mg)' and 'E-cigarette design', the Pearson Correlation is 0.407. This suggests a moderate positive correlation, meaning that as the 'E-cigarette design' value increases, the 'Nicotine delivered (mg)' tends to increase as well.

The p-value is used in hypothesis testing to help you support or reject the null hypothesis. It represents the probability that the results of your test occurred at random. If p-value is less than 0.05 (5%), you reject the null hypothesis. If p-value is greater than or equal to 0.05, you fail to reject the null hypothesis.

In this case, the p-value is 0.189, which is greater than 0.05. Therefore, we fail to reject the null hypothesis. This means that the correlation you observed (0.407) could have happened by chance, and it's not statistically significant.

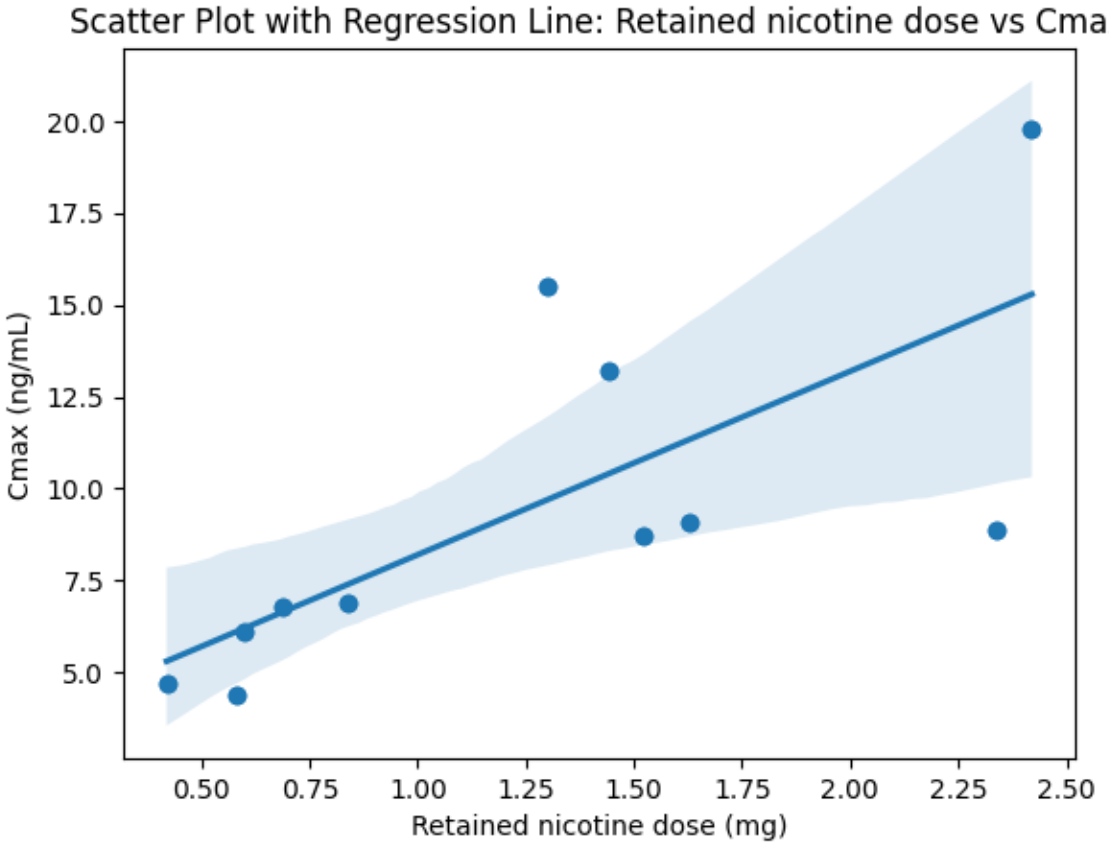


E. Furthermore, Pearson correlation coefficient of 0.930 and a p-value of 0.000 for the correlation between 'Retained nicotine dose (mg)' and 'estimated_dose (mg)', indicating a strong positive correlation that is statistically significant.



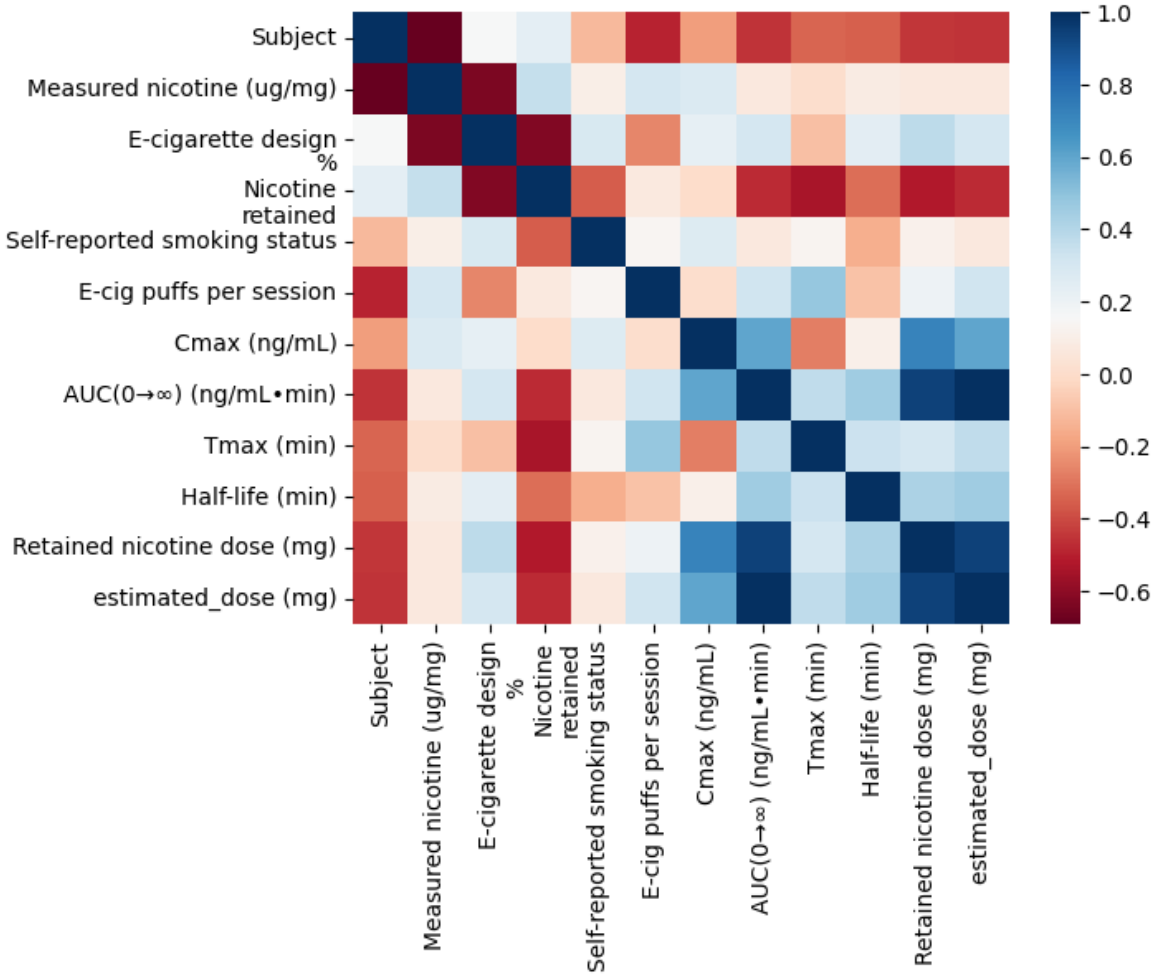
F. The Pearson correlation coefficient of 0.722 between 'Retained nicotine dose (mg)' and 'Cmax (ng/mL)' indicates a moderately strong positive linear relationship. This means that as the 'Retained nicotine dose (mg)' increases, 'Cmax (ng/mL)' values also tend to increase.

With a p-value of 0.012, indicating statistical significance, we reject the null hypothesis of no correlation between 'Retained nicotine dose (mg)' and 'Cmax (ng/mL)'.



In conclusion, the analysis suggests a statistically significant positive correlation between 'Retained nicotine dose (mg)' and 'Cmax (ng/mL)'. This means that there is evidence for a relationship between higher retained nicotine doses and higher peak concentrations of nicotine in the bloodstream.

G. A



Correlation Matrix for Nicotine pharmacokinetic profiles from various electronic cigarettes.

V. Conclusion

In conclusion, electronic cigarettes or vaping devices have become increasingly popular, especially among young people. However, the safety concerns surrounding these devices cannot be ignored. The presence of nicotine and the potential breakdown of vegetable glycerin and propylene glycol into toxic chemicals when heated are some of the hazards associated with these devices. It is critical to exercise caution and be aware of these risks, especially for young people, who may be more susceptible to the addictive properties of nicotine. As responsible individuals, we must make informed choices about our health and take steps to protect ourselves and others from the potential dangers of electronic cigarettes.

VI. Conflict Of Interest

The authors have declared that no competing interests exist.

References

1. Bitzer Z.T., Goel R., Reilly S.M., Foulds J., Muscat J., Elias R.J., Richie J.P., Jr. Effects of solvent and temperature on free radical formation in electronic cigarette aerosols. Chem. Res. Toxicol. 2018;31:4–12. doi: 10.1021/acs.chemrestox.7b00116.
2. Lechasseur A., Altmejd S., Turgeon N., Buonanno G., Morawska L., Brunet D., Duchaine C., Morissette M.C. Variations in coil temperature/power and e-liquid constituents change size and lung

deposition of particles emitted by an electronic cigarette. Physiol. Rep. 2019;7:e14093. doi: 10.14814/phy2.14093.

3. Reilly S.M., Bitzer Z.T., Goel R., Trushin N., Richie J.P., Jr. Free radical, carbonyl, and nicotine levels produced by juul electronic cigarettes. Nicotine Tob. Res. 2019;21:1274–1278. doi: 10.1093/ntr/nty221.
4. Writing Group Members, Mozaffarian D, Benjamin EJ et al. (2016) Heart disease and stroke statistics-2016 update: a report from the American Heart Association. Circulation 133, e38–e360.
5. Benowitz NL, Porchet H, Sheiner L, Jacob P. Nicotine absorption and cardiovascular effects with smokeless tobacco use: comparison with cigarettes and nicotine gum. Clin Pharmacol Ther. 1988;44(1):23–8.
6. Helen G.S., Ross K.C., Dempsey D.A., Havel C.M., Jacob P., Benowitz N.L. Nicotine Delivery and Vaping Behavior during ad libitum E-cigarette Access. Tob. Regul. Sci. 2016;2:363–376. doi: 10.18001/TRS.2.4.8
7. Marques P, Piqueras L, Sanz MJ. An updated overview of e-cigarette impact on human health. Respir Res. 2021;22(1):151. doi:10.1186/s12931-021-01737-5
8. St Helen G, Havel C, Dempsey DA, Jacob P, 3rd, Benowitz NL. Nicotine delivery, retention and pharmacokinetics from various electronic cigarettes. Addiction. 2016;111(3):535–544. doi: 10.1111/add.13183.
9. Miliano C, Scott ER, Murdaugh LB, et al. Modeling drug exposure in rodents using e-cigarettes and other electronic nicotine delivery systems. J Neurosci Methods 2020;330:108458.
10. DeVito E.E., Krishnan-Sarin S. E-cigarettes: Impact of E-Liquid Components and Device Characteristics on Nicotine Exposure. Curr. Neuropharmacol. 2018;16:438–459. doi: 10.2174/1570159X15666171016164430.
11. Snoderly H.T., Nurkiewicz T.R., Bowdridge E.C., Bennewitz M.F. E-Cigarette Use: Device Market, Study Design, and Emerging Evidence of Biological Consequences. Int. J. Mol. Sci. 2021;22:12452. doi: 10.3390/ijms222212452.
12. Yingst J.M., Veldheer S., Hrabovsky S., Nichols T.T., Wilson S.J., Foulds J. Factors Associated with Electronic Cigarette Users 'Device Preferences and Transition from First Generation to Advanced Generation Devices. Nicotine Tob. Res. 2015;17:1242–1246. doi: 10.1093/ntr/ntv052.