A Biostatistical Evaluation of Recent Smoked Tobacco Usage on Serum Triglyceride Levels and Cardiovascular Risk Indicators in Adults and Adolescents.

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Introduction

The use of tobacco products has grown a lot around the world in recent years. This is especially true among adults and teens. Also, the use of tobacco products among adolescents in the U.S. continues to cause many health risks (Centers for Disease Control and Prevention, 2024b). In response to this predicament, many scientists started researching the dangers of smoking in the respiratory system. The effects of recent tobacco and nicotine usage on the cardiovascular health of the population, however, is not studied as much. The hypothesis of this paper is to evaluate if the average triglyceride levels are higher in recent smoked-tobacco users.

To completely understand the impact of smoked-tobacco products on the human body, it is important to examine the impact of tobacco and nicotine on the cardiovascular system. Triglycerides are a type of body fat that is stored in the human body as a source for excess energy from food intake (American Heart Association, 2026). These fats circulate in the bloodstream, and the cells in the body use these fats as an energy source. Increased lipid levels can cause various diseases like hypertriglyceridemia, arteriosclerosis, and other long-term cardiovascular diseases (Lau, 2020).

Various hormones are released as nicotine enters the body because nicotine triggers the release of various hormones, including epinephrine and norepinephrine (Benowitz, 2016). Due to the increase of hormonal activity caused by nicotine, the process known as lipolysis (the breakdown of stored fats) occurs. Lipolysis floods the bloodstream with free fatty acids that the liver eventually repackages into triglycerides (Andersson & Arner, 2001). Even with this clear pathway however, there is limited data that directly connects recent tobacco use to changes in blood fat levels. This study uses national data from the CDC to evaluate whether recent tobacco exposure is associated with increased serum triglyceride levels, which helps examine a clear link to cardiovascular risks.

Methodology

The data used in this research paper is from the National Health and Nutrition Examination Survey (NHANES), which is a program by the Centers for Disease Control and Prevention (CDC) made for assessing the health status of adults and children in the United States (CDC, n.d.). Using three public-use datasets by the CDC, the relationship between recent tobacco usage and metabolic markers has been analyzed. The three public datasets used were Demographics, Smoking/Vaping Behavior, and Laboratory Biochemistry (specifically measuring serum triglycerides). SEQN was the unique identification number marking every individual participant, and every participant was marked with an SEQN number in the CDC study.

Data processing was performed using Jamovi software. The independent variable is the survey response SMQ681, which identifies whether a participant smoked tobacco products in the past five days, such as cigarettes, cigars, pipes, water pipes, or hookah with tobacco (CDC, 2024a). In the original questionnaire dataset, this item included 935 self-reported tobacco users ("Yes") and 5,330 non-users ("No") (CDC, 2024a). This variable measures smoked tobacco use and this study focuses on recent smoked tobacco exposure rather than all nicotine products.

The serum triglyceride dataset (LBXTLG) was separate from the questionnaire and contained a total of 3,480 participants with complete blood lipid values, while 516 individuals had missing data (CDC, 2024c). Because the lab work required specific fasting conditions, a significant portion of the survey respondents did not have corresponding blood drawn.

To make sure every individual had complete records for both variables, the serum triglyceride dataset and the “used smoked tobacco in the past five days” questionnaire were merged in Jamovi software using listwise deletion. The final dataset (a master dataset combining the "used smoked tobacco in the past five days” questionnaire and the serum triglyceride dataset) contained 3,055 adults and teenagers, as well as some children under the age of 13. This final group of the merged dataset was divided into two different groups. The first group was the recent smoked-tobacco-use group (which included 420 participants), and the second group was the non-recent smoked-tobacco-use control group (which included 2,635 participants). The dependent variable was the amount of serum triglyceride levels (shown in mg/dL).

In order to compare the average serum triglyceride levels between recent tobacco users and non-recent users, I used an independent samples t-test. The SMQ681 variable classified participants as either tobacco users or non-users. NHANES has a complicated system for choosing participants, so therefore this study does not use NHANES survey weights. As a result, the findings of this paper should be thought of as an analysis of the CDC data and not as a representation for all of the U.S. population. The independent samples t-test was performed using Jamovi software, and the alpha level of 0.05 was used to evaluate whether the data was statistically significant or not. Furthermore, the analysis considered parametric assumptions. These parametric assumptions included whether the data followed a normal pattern and whether the spread of values was similar between the two groups. After checking these conditions, it was found that the variability between the groups was not equal based on Levene’s test. Because of this, a slightly adjusted version of the t-test, known as Welch’s correction, was used to make sure the comparison between groups was more accurate and reliable.

Results

The analyzed sample includes 3,055 individuals with 420 recent smoked-tobacco users and 2,635 participants who didn’t report using smoked-tobacco within the past five days (will be referred to as non-users throughout this paper for simplicity). Using the independent samples t-test, this paper compares the serum triglyceride levels between the two groups. The group of participants that smoked tobacco within the past 5 days of the study had an average serum triglyceride level of 138 mg/dL with the standard deviation of 127. The average serum triglyceride level of the group of participants that didn’t smoke within the last 5 days was 113 mg/dL with a lower standard deviation of 78.5. An independent samples t-test showed that the difference between the smoking and non-smoking group is statistically significant. The difference between the average triglyceride level of non-users and smoked tobacco users is 25 mg/dL, with recent smoked-tobacco users having a higher triglyceride level than non-users.

Because Levene’s test showed statistical significance, it showed that the groups did not have equal variances. Because of this, the standard t-test could not be used for the final interpretation, and Welch's t-test was used instead for a more accurate result. The Welch’s independent samples t-test showed that there was a significant difference in triglyceride levels between participants who had recently used smoked tobacco compared to the non-user

participants. The test result was t(472) = -3.95, with a p-value less than .001. Since the p-value of this test is lower than the limit of 0.05, the difference is very likely not due to coincidence or arbitrarily. This suggests that people who reported recent smoked-tobacco use had higher triglyceride levels compared to non-users in this NHANES sample data.

Discussion

The result of this study suggests that recent smoked tobacco usage is associated with higher serum triglyceride levels. Participants who stated that they smoked tobacco within 5 days of the questionnaire had an average triglyceride level of 138 mg/dL, and participants who stated that they did not smoke tobacco recently had an average triglyceride level of 113 mg/dL. This means that the group of recent tobacco-smokers had an average triglyceride level that was 25 mg/dL higher than the group of participants that hadn't smoked tobacco recently.

The results support this conclusion as Welch's independent samples t-test showed a statistically significant difference between the two groups. Welch's independent samples t-test showed that t(472) = -3.95 and $p < .001$, making the findings statistically significant. The p-value was lower than the standard alpha level of 0.05, and as a result, the difference between the groups was unlikely to have occurred solely due to random chance. This supports the idea that recent smoked-tobacco use can be connected to higher triglyceride levels in the body. High triglyceride levels in the bloodstream are associated with atherosclerosis and increased risk of coronary heart disease, so therefore if participants who recently used smoked-tobacco products have higher triglyceride levels and higher triglyceride levels increase the risk of various heart conditions, smoked-tobacco usage may be associated with cardiovascular conditions (Nordestgaard et al., 2007; Zeller et al., 2024).

These findings connect to the background ideas discussed earlier in this research paper. Catecholamines, epinephrine, norepinephrine, and other hormones can be stimulated and released by nicotine, and this can increase lipolysis and release free fatty acids into the bloodstream (Benowitz, 2016; Andersson & Arner, 2001). The liver is the organ that converts fatty acids into triglycerides, and this process may explain why recent smoked-tobacco users showed higher average triglyceride levels in the CDC study.

The difference in standard deviation between the two groups is also very important. While the non-user group had a standard deviation of 78.5, the smoked-tobacco group had a standard deviation of 127. This shows us that triglyceride levels varied more among recent smoked-tobacco users compared to non-users. Triglyceride levels varied more in recent smokers than non-smokers, but age, diet, and lifestyle variables likely affected the data.

Although the results are of statistical significance, they do not prove causation here. The causation in this case is tobacco usage causing triglyceride levels in the bloodstream to increase. This study also analyzed existing survey and laboratory data instead of surveying more participants for more data. As a result, other factors may play a role in the difference in triglyceride levels.

Limitations

Multiple limitations exist in this research study. The main problem is the data adjustments. NHANES adjusted survey values to be more representative of the entire US population while this study doesn't take into account the adjustments used. As a result, the findings of this paper should be considered an analysis of existing data instead of a representation.

Design choices of the study also limit conclusions. The results of this paper show that recent-smoked tobacco use is associated with higher triglyceride levels. However, the results of this paper cannot prove that smoked-tobacco use directly caused the higher triglyceride levels. There are other factors that cause high amounts of triglycerides including age, sex, body mass index, diabetes, etc.

Furthermore, the independent variable (SMQ681) mainly measures recent smoked-tobacco use. Specifically, it doesn't represent every type of nicotine exposure like vaping and nicotine pouches, so it doesn't fully represent every type of nicotine exposure and only represents smoked tobacco. This makes the results focusing on recent smoked-tobacco exposure instead of all nicotine products, and therefore this means the results apply specifically to recent smoked-tobacco products instead of all nicotine products.

Naturally, triglyceride values are different between different individuals. They also vary based on many factors. The large standard deviations of both groups show how varied triglyceride levels in the bloodstream among individuals can be. Since biological and lifestyle factors can effect triglyceride levels, future research should use variables I have not to better understand the connection between tobacco and triglyceride levels.

Conclusion

This research study found smoked-tobacco product users had higher average triglyceride levels compared to the non-users. Participants who recently used smoked-tobacco products had an average triglyceride level of 138 mg/dL, while non-user participants had an average triglyceride level of 113 mg/dL. Welch's test confirms statistical significance as the p-value is less than 0.001, which is very low.

Recent smoked-tobacco use relates to elevated triglyceride levels, which suggests a connection to various biological cardiovascular problems. However, proving cause and effect requires extreme caution. This analysis bypassed NHANES survey weights and ignored important variables. Because this study didn't take into account these survey elements, it would be an error treating these findings as proof of causation. The data from this paper is introductory rudimentary and not evidential. Instead, empirical studies in the future can use this study as a foundation. Future investigations must take into account the survey weights of NHANES and account for additional factors such as lifestyle variables to find the exact physiological impact of tobacco exposure.

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