

Effects of Delta-9-THC (Marijuana)

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Summary

In this report, we analyse the effect of marijuana on the level of spontaneous activity and the change in body temperature. The report uses exploratory methods such as summary statistics and graphical techniques. The results indicate that the higher the dose of marijuana, the lower body temperature and spontaneous activity.

Introduction

This study investigates the potential relationships between Delta-9-THC (marijuana), spontaneous activity levels, and body temperature. In order to examine the effects of marijuana, mice are used in the experiment as they are physiologically and genetically similar to humans. Previous studies have suggested that mice that were affected by marijuana tend to become less active and have lower body temperatures. In this report, we aim to analyze the effects of different doses of marijuana on the changes in activity levels and body temperature. The data was collected from a sample of 60 mice. The data available are, for each dosage of Delta-9-THC (mg/kg) injected into the mice, the level of spontaneous activity and the change in body temperature.

Methods

A group of 60 mice were randomly assigned to one of five treatment groups, with 12 mice in each group. Four groups received a dose of Delta-9-THC (marijuana) and one group received no dose to act as a control. The four marijuana groups received 1, 2.5, 5, and 10 mg/kg doses, respectively, of Delta-9-THC.

Observers recorded the level of spontaneous activity and the change in body temperature in each mouse. Spontaneous activity is defined as the number of times a photocell beam was interrupted by the mouse during a 10 minute period, and the change in body temperature is defined as the difference between the body temperature measured 1 hour post treatment and that measured just prior to treatment.

To examine the control group, we use a 1-sample t-test to check the hypothesis that the change in body temperature is zero. We construct a 95% confidence interval for the measure of spontaneous activity.

In this report we establish the distribution of each of the measured variables using histograms and QQ plots. We provide summary statistics of the measured variables for each of the groups. To graphically show potential relationships between the measured variables and marijuana, we use a series of boxplots, one for each treatment group.

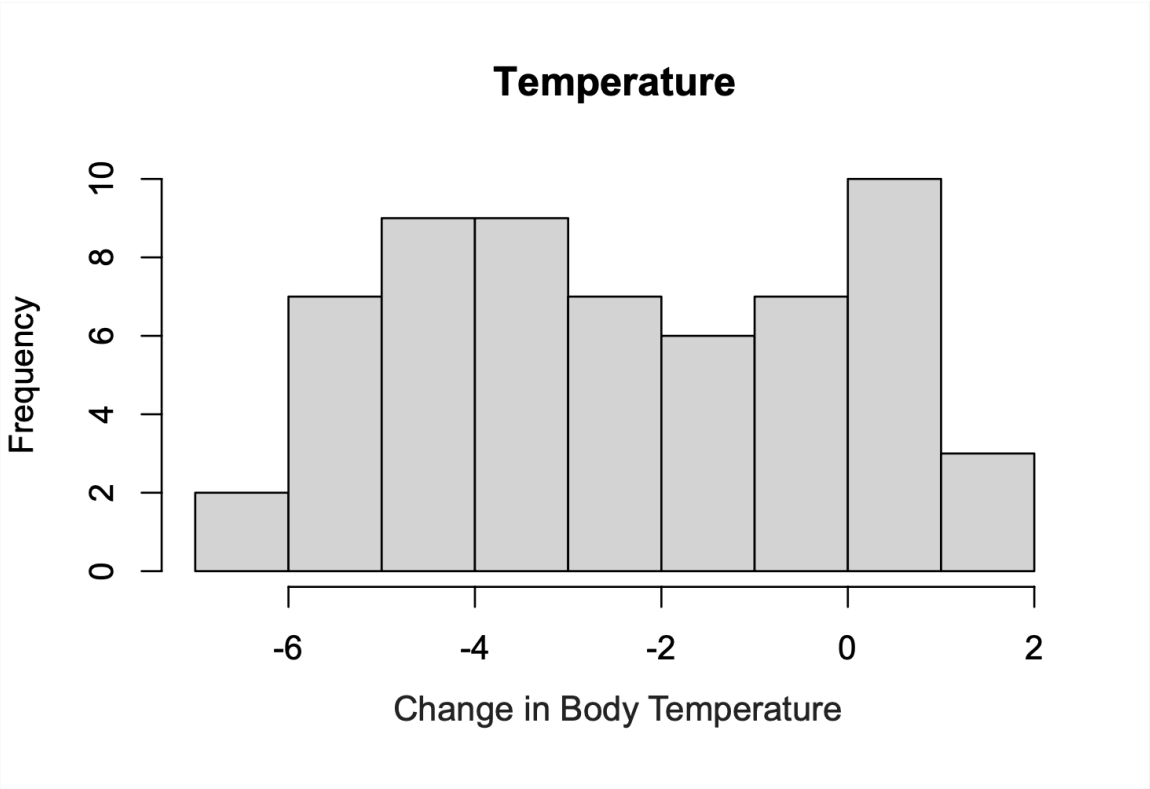
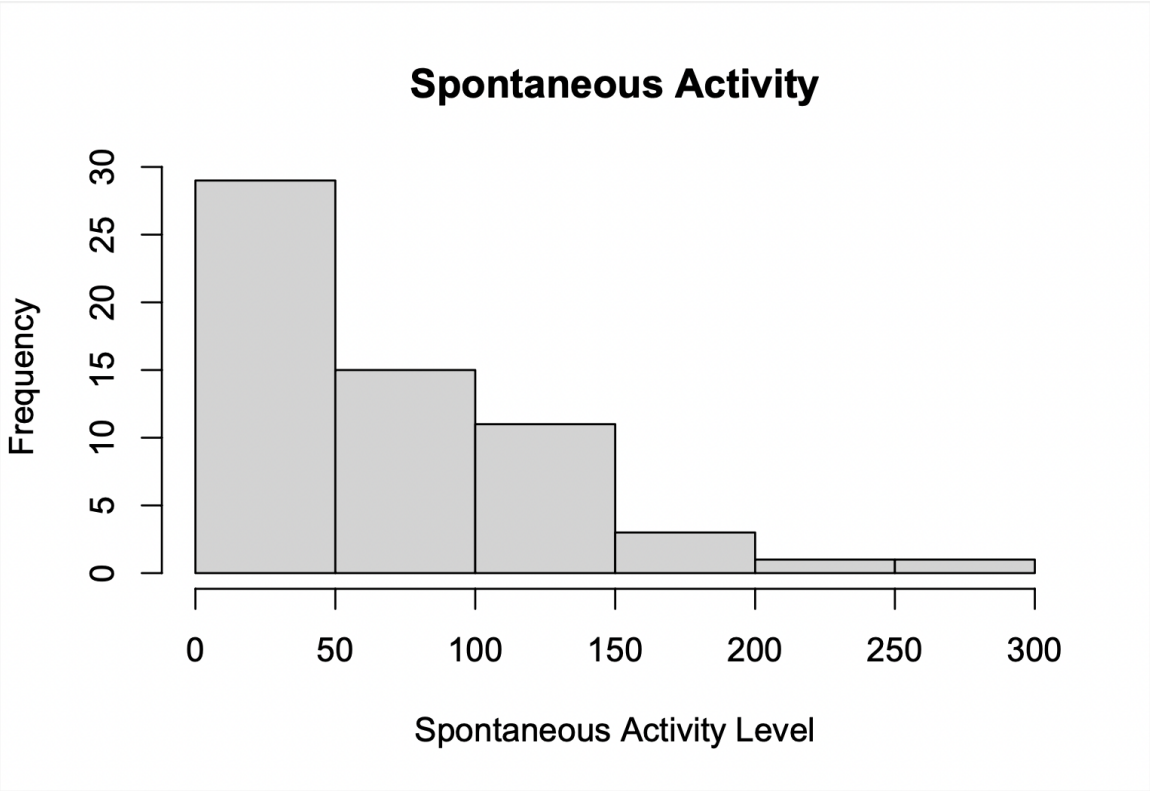
To examine the effect of marijuana, we conduct 2-sample t-tests between the control group and each of the marijuana groups to identify any significant changes in the measured variables. The validity of the t-tests is discussed with reference to their underlying assumptions.

All hypothesis tests are 2-sided and use a 5% significance level, with test statistics and p -values reported in all cases. Calculations are performed using R statistical software.

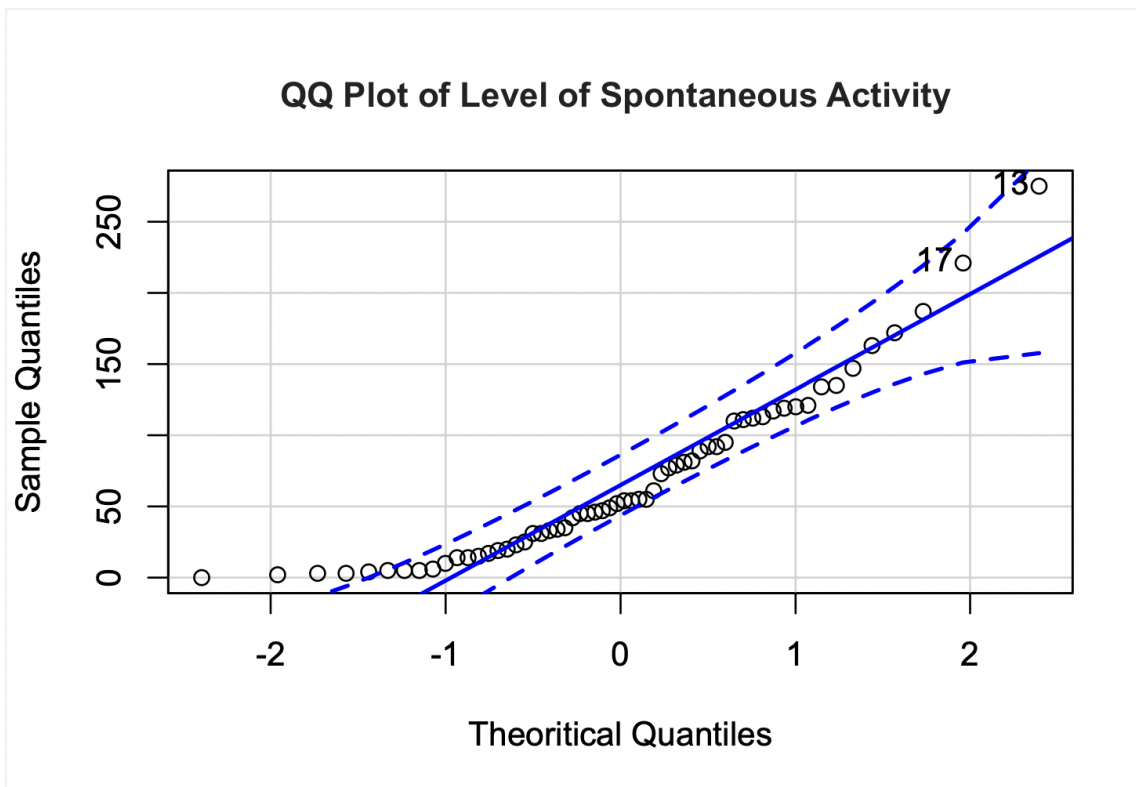
Results

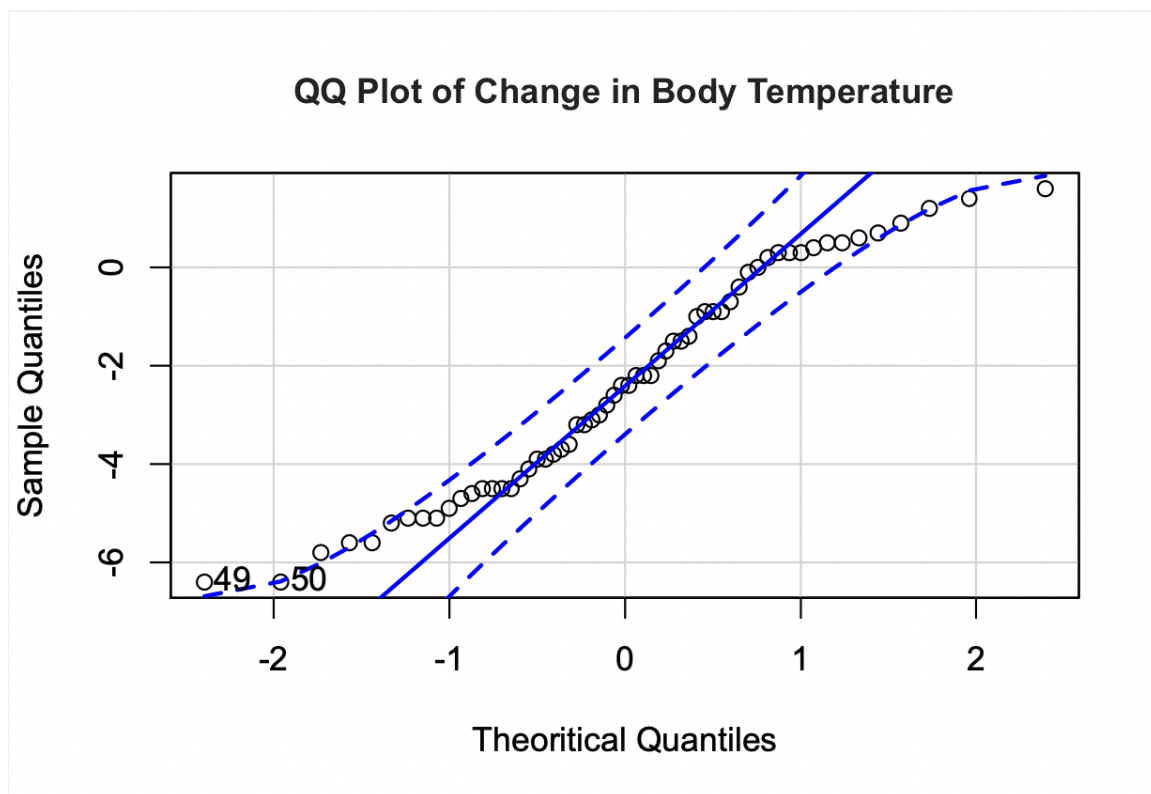
According to the conducted 1-sample t-test, the change in body temperature of the control group of mice ($M=-0.058$, $SD=0.965$) is zero, $t(11)=-0.21$, $p\text{-value}=0.838$. In fact, with a p -value greater than the significance level alpha of 0.05, it suggests that there is no evidence against the null hypothesis. We are 95% confident that the proportions of all the measured spontaneous activity belonging to the control group lie between 61.0 and 100.4.

The histograms below describe the frequency of each measured variable in this experiment. From the graphs below, we can see that the histogram for measured spontaneous activity level and change in body temperature follows a right-skewed and a bimodal distribution respectively.



The QQ plots below agree that spontaneous activity is a right-skewed distribution and change in body temperature is a bimodal distribution. However, since most of the points in the two graphs lie in the range of the positively associated line, as has been illustrated by the graphs, both can be approximated as a normal distribution.





The summary statistics below generally signify a negative correlation between the dose of marijuana and the change in temperature as well as the level of spontaneous activity. This means that the higher the amount of marijuana dose, the lower the body temperature and the lower the level of spontaneous activity of the mice.

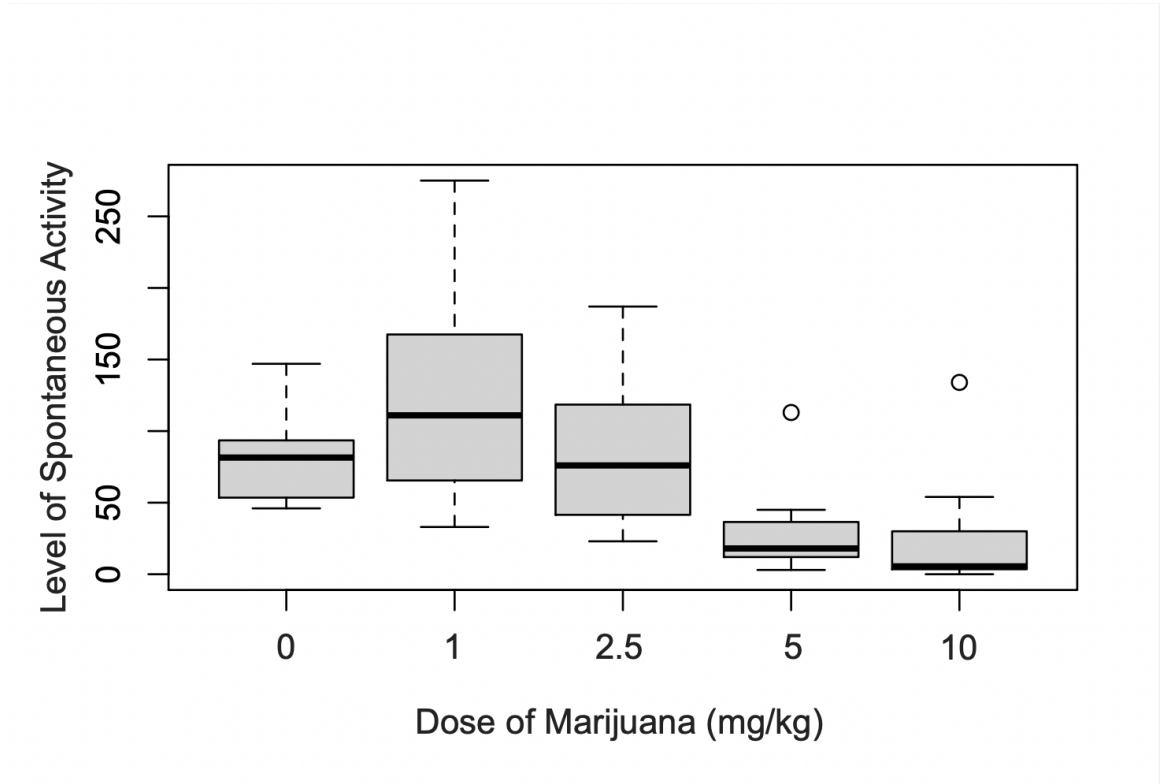
Table 1: Change in Body Temperature Summary Statistics

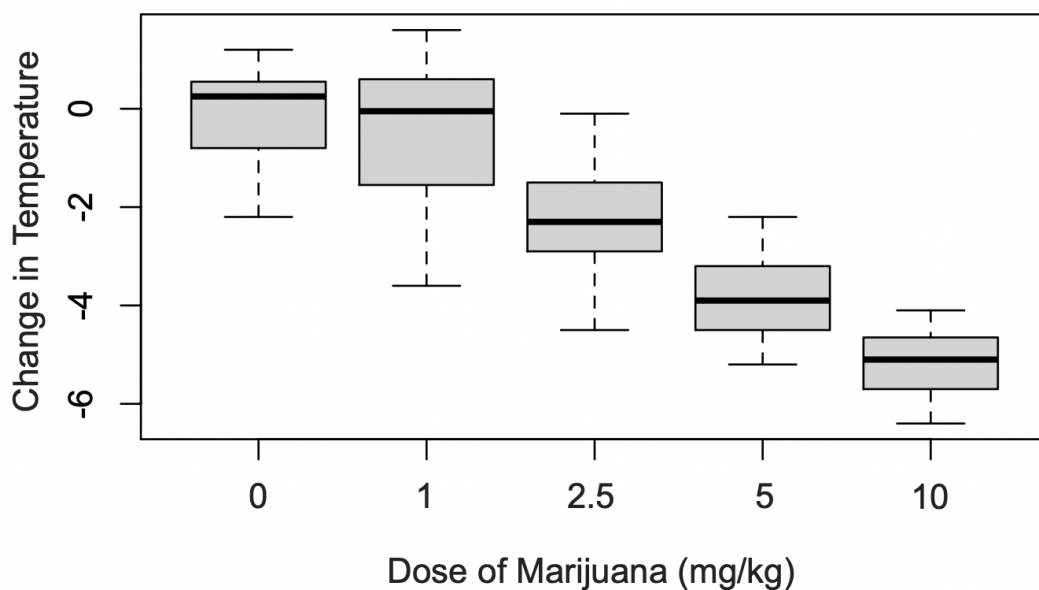
	Marijuana Dose (mg/kg)				
	0	1	2.5	5	10
St. Dev.	0.965	1.577	1.201	0.880	0.736
Mean	-0.058	-0.466	-2.258	-3.908	-5.233

Table 2: Level of Spontaneous Activity Summary Statistics

	Marijuana Dose (mg/kg)				
	0	1	2.5	5	10
St. Dev.	30.949	73.455	48.924	29.890	38.339
Mean	80.750	123.833	83.333	27.833	23.917

Based on the boxplots below, we can further see the relation between the measured variables and marijuana. The spontaneous activity level boxplot, implies that taking doses of marijuana exceeding 1mg/kg resulted in decreasing levels of spontaneous activity with notable outliers in a dose of 5 mg/kg and 10mg/kg. Without these outliers, the mean of respective groups will be smaller. Similarly, the boxplot for the change in temperature also indicates that higher doses of marijuana result in larger negative-valued changes in body temperature.





Since the results of the QQ plots implies that the two measured variables can be approximated using a normal distribution, the t-test is valid for use. The results from the 2-sample t-test done with the data from the temperature change proved that there was no significant effect of 1mg/kg marijuana, $t(18.2)=0.76$, $p=0.454$ despite the control group ($M=-0.058$, $SD=0.965$) having a higher temperature value than the group which received 1 mg/kg of marijuana ($M=-0.466$, $SD=1.577$). The next result shows that the group that received 2.5 mg/kg of marijuana ($M=-2.258$, $SD= 1.201$) compared to the control group ($M=-0.058$, $SD=0.965$) has a significantly lower temperature, $t(21.026)=4.95$, $p=6.789e-05$. The next two results indicated even more evidence of a drastically lower temperature, $t(21.817)=10.21$, $p=9.059e-10$ and $t(20.57)=14.77$, $p=2.052e-12$ in the group of mice receiving 5 mg/kg of marijuana($M=-3.908$, $SD=0.880$) and 10 mg/kg of marijuana ($M=-5.233$, $SD=0.736$) respectively, when compared to the control group($M=-0.058$, $SD=0.965$). These results denote that the effects are more evident after taking at least 1mg/kg of marijuana.

On the other hand, the results of the 2-sample t-test data done with the data from the level of spontaneous activity shows that there is no significant difference $t(14.79)=-1.87$, $p=0.081$ between the control group ($M= 80.750$, $SD=30.949$) and the group with 1mg/kg of marijuana ($M=123.833$, $SD=73.455$) despite the latter having larger value of spontaneous activity levels. The next group of mice with 2.5 mg/kg of marijuana ($M=83.333$, $SD=48.924$) also implies no significant differences, $t(18.58)=-0.16$, $p=0.879$, when compared to the control group ($M=80.750$, $SD=30.949$). However, the results from the group induced with 5

mg/kg of marijuana ($M=27.833$, $SD=29.890$) suggests a significant effect of lower level of spontaneous activity, $t(21.97)=4.26$, $p=3.201e-4$, compared to the control group ($M= 80.750$, $SD=30.949$). Lastly, the group induced with 10 mg/kg of marijuana ($M=23.917$, $SD=38.339$) also signify drastically lower levels of spontaneous activity, $t(21.06)=4.00$, $p=6.533e-4$, compared to the control group ($M= 80.750$, $SD=30.949$). Therefore, this indicates that the effects of marijuana are more apparent after taking at least 2.5 mg/kg of marijuana.

Conclusions

We conclude that overall, marijuana results in lower body temperature and lower level of spontaneous activity. The higher the dosage of marijuana, the stronger and clearer the effects.

The study has several limitations such as unknown units of measurements of temperature, which made it hard to interpret the definite magnitude of the measurement and hence, making our analysis less reliable.

Further work would include defining a unit of measurement for temperature and performing similar experiments on a larger sample size to increase our data accuracy.

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