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Nested anova analysis on the effect of alcoholic drinks on the body temperature and heart beat

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Abstract

This paper examines effects alcoholic drinks on heartbeat and body temperature of mouse A, B and C. Three brand of alcohol, trophy, regal and origin were administered to them on each day for three days. Trophy was administered to each mouse on day1, Regal dry gin on day2 and Origin on day3 with their heartbeat rates and body temperatures recorded for each day after thirty minutes the alcohols were administered. Nested Analysis of variance was used to examine the effect of alcohol and mouse nested in alcohol on body temperature and heartbeat on mouse and also Independent two sample t-test was used to compare effects of two different alcoholic drinks on the heart beat rate and body temperature of three mouse. Conclusively the result shows that alcohol drinks likewise mouse nested in alcohol has no significant effect on the body temperature and heartbeat of mouse and the effect of any two alcoholic drinks on heart beat rate and body temperature of mouse will always be not significant and comparison of effect of any two alcoholic drinks on heart beat rate and body temperature of mouse are not significant.

Keywords: Alcohol; Mouse; Temperature; Heartbeat; Nested

1. Introduction

Alcohol is a catch-all word for a collection of chemical molecules with a carbon atom linked to the hydroxyl (-OH) functional group. Alcohol especially refers to ethanol when used in reference to beverages.

There are various kinds of alcohol. In addition to being utilized in skin lotions and home cleaning goods, isopropanol or isopropyl alcohol is also referred to as "rubbing alcohol" in modern processes.

Industrial solvents like methanol, often known as methyl alcohol or wood alcohol, are frequently found in the form of methylated spirit. It can be found in anti-freeze solutions, photocopier developer, paint removers, and cleaning solvents. This is comparable to ethanol, but when the body digests it, the end result is poisonous. The cause of "alcohol poisoning" is this. Strong or even modest doses of methanol have been documented to cause poisoning that results in blindness, Room, *et al. (*2002).

Ethyl alcohol, usually referred to as ethanol, is another form of alcohol that people use for its intoxicating and mind-altering properties. Unless otherwise stated, the term "alcohol" refers to ethanol or ethyl alcohol. It has a high flux, a severe burning taste, and is a thin, clear liquid.

Shaw (2002) discussed that beers, wines, and spirits are the three main categories of alcoholic drinks (ethyl alcohol), and they can all be consumed lawfully in the majority of nations as long as they follow the regulations that govern their manufacturing, sale, and use. Alcohol does not care about a person's social, professional, or intellectual standing. Both the wealthy and the poor, the learned and the uneducated, found themselves in the same ruin. Some people take

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pleasure in social drinking without clearly endangering themselves or others. There may be more occasions to drink alcohol as a result of a challenging day, stress and worry, bad news, and good news.

Amberley (2021) talked about the more severe effects of alcohol consumption. Yet, alcohol temporarily interferes with our regular biological functioning even when it is ingested in moderation.

According to Aayushi Gupta (2022), consuming alcohol in a continuous stream may cognitively calm you down, but it may actually make you feel hotter physically because it alters and unbalances your body in many ways. He asserts that a variety of factors, including the quantity of alcohol consumed, can contribute to this issue. No points for figuring out that the main offenders here are elevated body temperature and elevated heart rate.

Alcohol use is related devastatingly destructive to many cardiovascular outcomes, including hypertensive disease (Taylor, *et al*., 2009), hemorrhagic stroke (Patra, *et al.,* 2010) and (Samokhvalov, Irving and Rehm, 2010).

Studied on the effect of alcoholic drinks on the body of mouse related down to their temperature and heart beat is presented in this paper with nested anova and independent two sample t- test used for the analysis. In this paper, experiments were carried out with three different alcoholic drinks (Trophy Regal, Origin) administered to three different mouse to determine the effects of alcohol on the body temperature and heartbeat.

Aim and objective of the study

To the aim of this study is to determine the effects of alcohol on the body using mouse with objectives of

- Examine its effect of on body temperature and heartbeat.
- Comparism of effects of two alcohol drinks on body temperature and heartbeat.

2. Material and methods

A nested ANOVA (also called a hierarchical ANOVA) is an extension of a simple ANOVA for experiments where each group is divided into two or more random subgroups. It is a statistical technique in which at at least one factor is nested inside another factor used to analyze the effects of two or more categorical independent.

2.1. Models in nested ANOVA

$$Y_{ijk} = \mu + \alpha_i + \beta_{ijk} + \in_{ijk}$$

Where,
μ = Overall mean
α_i = "Effect" for ith treatment (alcohol)
β_{ijk} = "Effect" for jth block (mouse)
$\in_{ijk}$ = Random error

$$\text{CF} = \frac{(\Sigma_{i=1}^{g}\Sigma_{j=1}^{s_i}\Sigma_{k=1}^{n_{ij}}X_{ijk})^2}{N}$$

$$SS_{total} = \Sigma_{i=1}^{g}\Sigma_{j=1}^{s_i}\Sigma_{k=1}^{n_{ij}}X_{ijk} - \text{CF}$$

$$SS_{groups} = \Sigma_{i=1}^{g}\frac{(\Sigma_{j=1}^{s_i}\Sigma_{k=1}^{n_{ij}}X_{ijk})^2}{s_i n_{ij}} - \text{CF}$$

$$SS_{subgroups}(group\ i) = \Sigma_{i=1}^{s_i}\frac{(\Sigma_{k=1}^{n_{ij}}X_{ijk})^2}{n_{ij}} - \frac{(\Sigma_{j=1}^{s_i}\Sigma_{k=1}^{n_{ij}}X_{ijk})^2}{s_i n_{ij}}$$

Where
N = total number of observation
n_{ij} = the number of observations in the jth subgroup of the ith group
X_{ijk} = the kth observation from the jth group subgroup of the ith group,

g = the number of groups,
SS_{total} = the total sum of squares
SS_{groups} = the sum of squares due to the group factor
$SS_{subgroups}(group\ i)$ = the sum of squares due to the subgroup factor of group i
s_i = the number of subgroups in the ith group

Independent two sample T test is a statistical test that is used to compare the means of two groups when sample is small.

Hypothesis Statement

$$H_0: \mu_1 = \mu_2$$

$$H_1: \mu_1 \neq \mu_2$$

Level of significance α = 0.05

$$T = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{(n_1-1)\sigma_1^2+(n_2-1)\sigma_2^2}{n_1+n_2-2} \times \frac{1}{n_1}+\frac{1}{n_2}}}$$

Where $\bar{x}_1$ and $\bar{x}_2$ are the means of two samples and σ_1 and σ_2 are the samples standard deviations and n_1 and n_2 are the samples number

Reject H_0 if p value is less than α value

2.2. Data Analysis

Three different alcoholic drinks which are trophy, regal and origin were administered through ingestion to mouse A, Band C for three days and observations were made and recorded. . Trophy was administered to each mouse on day1, Regal dry gin on day2 and Origin on day3 with their heartbeat rates and body temperatures recorded for each day after thirty minutes the alcohols were administered. Nested design was used in analyzing the data.

Table 1 Data for Nested Design

	Mouse A			**Mouse B**			**Mouse C**		
	Day 1	**Day 2**	**Day 3**	**Day 1**	**Day 2**	**Day 3**	**Day 1**	**Day 2**	**Day 3**
Alcoholic drinks	**Trophy**	**Regal**	**Origin**	**Trophy**	**Regal**	**Origin**	**Trophy**	**Regal**	**Origin**
Heartbeat	49.50BPM	57.50BPM	44.25BPM	53.25BPM	55.25BPM	56.50BPM	54.50BPM	54.75BPM	61.25BPM
Temperature	36.95 ℃	37.13 ℃	36.70 ℃	32.8 ℃	38.13 ℃	37.90 ℃	37.45 ℃	36.75 ℃	38.25 ℃

2.2.1. Hypothesis Statements

- H_0**:** Alcohol has no significant effect on the body temperature and heartbeat of the three mice.
- $\boldsymbol{H_1}$: Alcohol has a significant effect on the body temperature and heartbeat of the three mice.
- H_0**:** Mouse A/B/C nested in alcohol has no significant effect on the body temperature and heartbeat of mouse
- $\boldsymbol{H_1}$: Mouse A/B/C nested in alcohol has significant effect on the body temperature and heartbeat of mouse

Table 2 Nested Anova Table

Source of Variation	Degree of Freedom	Sum of Square	Mean Square	F value	Pr(>F)
Alcohol	2	2.7108	1.36	0.008	0.992
Mouse (alcohol)	6	47.7242	7.95	0.046	0.999
Residuals	9	1560.3262	173.37		

Decision rule: reject H_0 if p-value is less than α-value

Decision: since alcohol p-value (0.992) is > α-value (0.05), therefore there is no sufficient reason to reject H_O since mouse (alcohol) p-value (0.999) is > α-value (0.05), therefore there is no sufficient reason to reject H_O

Conclusion: alcohol drinks and mouse nested in alcohol both have no significant effects on the body temperature and heartbeat of mouse.

3. Comparison of effects of two alcohol drinks

- $\boldsymbol{H_0}$: There is no significant difference on the effect of two alcoholic drinks on mouse A/B/C heartbeat
- $\boldsymbol{H_1}$: There is a significant difference on the effect of two alcoholic drinks on mouse A/B/C Heartbeat

Table 3 Analysis showing effects of alcoholic drink on Mouse heartbeat

	Heartbeat Rate			
Alcoholic drink	**T-test**	**Degree of Freedom**	**P-value**	**Conclusion**
Trophy and Regal(Mouse A)	-1.131	8	0.3066	Not Significant
Trophy and Regal(Mouse B)	-17.858	8	0.0001	Significant
Trophy and Regal(Mouse C)	-0.16917	8	0.8701	Not Significant
Trophy and Origin(Mouse A)	-2.420	8	0.46	Not Significant
Trophy and Origin (Mouse B)	-1.352	8	0.213	Not Significant
Trophy and Origin (Mouse C)	-1.832	8	0.104	Not Significant
Regal and Origin(Mouse A)	-1.132	8	0.291	Not Significant
Regal and Origin (Mouse B)	-.750	8	0.475	Not Significant
Regal and Origin (Mouse C)	-1.890	8	0.095	Not Significant

- $\boldsymbol{H_0}$: There is no significant difference on the effect of two alcoholic drinks on mouse A/B/C temperature
- $\boldsymbol{H_1}$: There is a significant difference on the effect of two alcoholic drinks on mouse A/B/C temperature

Table 4 Analysis showing effects of alcoholic drink on Mouse body temperature

	Body Temperature			
Alcoholic drink	**T-test**	**Degree of Freedom**	**P-value**	**Conclusion**
Trophy and Regal(Mouse A)	0.0889	8	0.9314	Not Significant
Trophy and Regal(Mouse B)	-0.5015	8	0.6302	Not Significant
Trophy and Regal(Mouse C)	0.8538	8	0.4242	Not Significant
Trophy and Origin(Mouse A)	0.587	8	0.573	Not Significant
Trophy and Origin (Mouse B)	-0..741	8	0.480	Not Significant

Trophy and Origin (Mouse C)	-0..836	8	0.427	Not Significant
Regal and Origin(Mouse A)	.0.706	8	0.500	Not Significant
Regal and Origin (Mouse B)	-.0. 129	8	0.900	Not Significant
Regal and Origin (Mouse C)	-2.504	8	0.37	Not Significant

4. Discussion and Result

It is discovered from the above Nested ANOVA table that administered of alcohol drinks to mouse does not show any significant changes to previous measurement of body temperature and heartbeat of mouse, also mouse nested in alcohol does not show any significant changes to previous measurement of body temperature and heartbeat of mouse. However from above table results, compares of effects of two different alcoholic drinks showed that the effects two alcoholic drinks on the heartbeat rate of three mouse are not significant for all the three alcoholic drinks compared except between trophy and regal for mouse B which is significant. Also, the effects two alcoholic drinks on the body temperature of three mouse are all not significant.

5. Conclusion

From the result above it is concluded that alcohol drinks has no significant effect on the body temperature and heartbeat and mouse nested in alcohol has no significant effect on the body temperature and heartbeat of mouse, also, effect of any two of the alcoholic drinks on the body temperature and heartbeat rate been compared are not significant

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that they have no known competing financial interest or personal relationship that could have appeared to influence the work reported in this paper.

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