Analysis Report for Essential Oils Project

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1 Introduction

A study regarding the efficacy of aromatherapy on individuals who had recently gone into cardiac arrest was conducted to determine if there were benefits to mental well-being (both of recovery from cardiac arrest related depression and general anxiety and depression) and sleep quality. The goals of said study was to determine if any of the two chosen essential oils (lavendar and rosemary) caused better outcomes in participants when compared to no aromatherapy, and to determine whether or not there were interactions between the two essential oils when used in conjunction with one another.

2 Methods

A double-blind experiment was performed in which participants were assigned to one of four groups, with group one being a placebo, group two being lavendar based aromatherapy, group three being rosemary based aromatherapy, and group four being both lavendar and rosemary based aromatherapy. Subjects adhered to an administering schedule for 4 weeks of the experiment and survey responses were recored before and after these 4 weeks to demonstrate changes. Subjects were administered 3 surveys, encompassing cardiac depression, depression and anxiety, and sleep quality.

Once these results were collected, analysis was performed in Python. First, within subject differences for each of the surveys was calculated, taking the scoring of their post treatment and substracting their scoring of their pre treatment. From here, one sample t-tests were run within each group for each groups mean difference for the three surveys (totalling 12 t-tests). The hypotheses for these t-tests were:

$$H_0 : \Delta\mu = 0 \tag{1}$$

$$H_A : \Delta\mu \neq 0 \tag{2}$$

Upon running these t-tests, one way ANOVAs were run for each of the three features of interest, where the mean differences were predicted by group (totalling 3 ANOVAs). Due to the findings of these ANOVAs, further analysis was performed to provide better explainability into the differences between groups. The hypotheses for the ANOVAs are shown below:

$$H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4 \tag{3}$$

$$H_A : \text{At least one } \mu_i \neq \mu_j \text{ where } i \neq j \tag{4}$$

This lead to Tukey HSDs being ran for each of the three features of interest (totalling 3 Tukey HSDs and 18 comparisons in total). Tukey HSDs perform group to group comparisons once an ANOVA has been found to be statistically significant. The hypotheses for Tukey are as follows:

$$H_0 : \mu_i - \mu_j = 0 \tag{5}$$

$$H_A : \mu_i - \mu_j \neq 0 \tag{6}$$

Finally, effect size calculations were performed to determine the extent of the effect group had on outcome of each of these features of interest.

3 Results

As previously mentioned, the features worked with were of the form feature = post − pre. A figure of the mean differences of each group for each of the three features of interest is provided below.

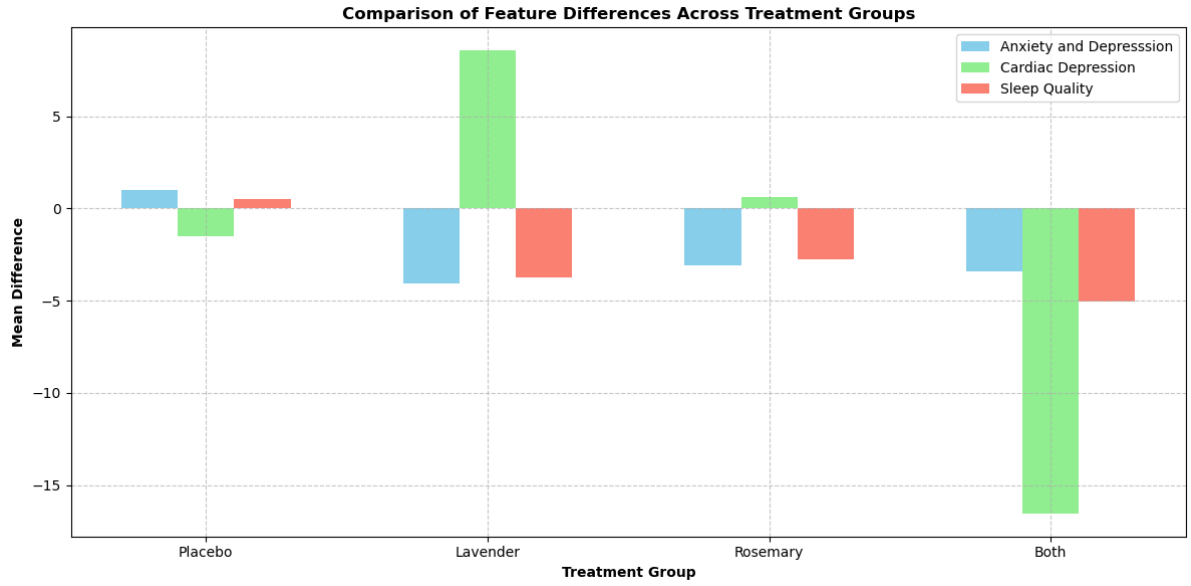

Figure 1: Mean Differences by Group for Survey Responses

Additionally, a table detailing the results of the t-tests ran is provided below.

	Group 1	Group 2	Group 3	Group 4
HADS_diff	t = 2.5480, p = 0.0164	t = -6.0869, p = 0.0000	t = -6.9402, p = 0.0000	t = -6.7950, p = 0.0000
CDS_diff	t = -3.1324, p = 0.0039	t = 4.0203, p = 0.0003	t = 0.4614, p = 0.6480	t = -6.2800, p = 0.0000
PSQI_diff	t = 1.7873, p = 0.0843	t = -8.8034, p = 0.0000	t = -7.1297, p = 0.0000	t = -10.1687, p = 0.0000

Table 1: One-sample t-tests for HADS_diff, CDS_diff, and PSQI_diff (horizontal format)

Each of the ANOVAs ran were considered significant under any reasonable α (all p-values were $< 1*10^{-8}$), meaning the Tukey HSD was ran. For the HADS survey, group one was considered significantly different from groups two, three and four, with no other groups being considered significantly different. For the CDS survey, every group was considered significantly different from one another, except for groups one and three. Finally, for the PSQI survey, all groups were significantly different from one another, except for group two between groups three and four.

4 Discussion

Revisiting the hypotheses that this study hoped to answer regarding aromatherapy as a treatment for various types of mental-wellbeing measurements following cardiac arrest, it can be shown through the variety of statistical tests performed that there is a significantly different outcome between the placebo group and any of the experimental groups for one if not all of the features of interest. Additionally, the estimated true differences between the placebo and the experimental groups tended to be negative, indicating an overall improvement in mental well-being. Thus, hypothesis one is demonstrated as plausible for the experimental groups, for the HADS and PSQI survey, and the CDS survey for group four. Additionally, for hypotesis two, The effectiveness between groups is significantly different in certain aspects as demonstrated by the Tukey HSD, with group four having the largest significant improvement in all categories. Finally, due to group four being significantly different than groups two and three for several of the features of interest, it is reasonable to believe there may be interaction effects between Rosemary and Lavendar when used in conjuction. It is important to note that this study may be limited due to the fact that it is not completely controlled, and different lifestyle habits may have manifested and been confounding over the course of the month in regards to the effects it may have had on mental well-being. A proper future direction for this research would be to perform this experiment in a completely controlled environment, in order to account for any lifestyle differences amongst the groups. Another way would be to increase the sample sizes of each group, in an attempt to limit the confounding effects as much as possible.

A repository of all the code and supplementary materials is housed in https://github.com/otdossett/STA475_miniproject.