

Applied Multivariate Analysis

Introduction

The need to investigate efficient weight-management techniques, especially the functions of diet type and exercise intensity, has increased due to the rising incidence of obesity and associated health problems. Low-carb and low-fat diets have become the most popular dietary strategies, each with its own special weight-loss mechanisms. While Low-Fat diets focus on minimizing fat intake, with the idea that lower fat intake can aid in weight loss and improve heart health, Low-Carb diets prioritize reducing carbohydrate intake, which promotes fat oxidation and appetite control. Exercise intensity also plays a significant role in determining weight loss results; high-intensity workouts are frequently thought of to burn calories quickly, while low-intensity activities may provide more sustainable alternatives. In order to shed light on how these variables interact to affect each person's weight management results, this study will examine the combined effects of diet type (low-carb vs. low-fat) and exercise intensity (low vs. high) on weight loss. Knowing these dynamics can help guide dietary decisions for individuals as well as public health guidelines, which will ultimately lead to more successful weight loss plans.

Assumptions Check

The results of the Shapiro-Wilk test showed that certain groups had broken the assumption of normality:

```
> shapiro_test_results
$`Low-Carb, Low Intensity`
      Shapiro-wilk normality test

data:  lowcarb_lowintensity
W = 0.78894, p-value = 0.06565

$`Low-Carb, High Intensity`
      Shapiro-wilk normality test

data:  lowcarb_highintensity
W = 0.75553, p-value = 0.03346

$`Low-Fat, Low Intensity`
      Shapiro-wilk normality test

data:  lowfat_lowintensity
W = 0.76333, p-value = 0.03936

$`Low-Fat, High Intensity`
      Shapiro-wilk normality test

data:  lowfat_highintensity
W = 0.79828, p-value = 0.07846
```

The Shapiro-Wilk normality test results show that the groups examined in the study had different levels of normality. With a p-value of 0.066 and a W statistic of 0.789, the Low-Carb diet combined with Low Intensity Exercise did not appear to deviate significantly from normal. A significant deviation from normalcy was indicated by the W statistic of 0.756 and p-value of 0.033 for the Low-Carb group that engaged in high-intensity exercise. The Low-Intensity Exercise and Low-Fat Diet group also showed non-normality, with a p-value of 0.039 and a W statistic of 0.763. On the other hand, the W statistic of 0.798 and p-value of 0.078 for the Low-Fat group that engaged in high-intensity exercise were closer to the normalcy threshold but still did not

The uniformity of variance

```
> # Levene's Test for Homogeneity of Variance
> levene_test <- leveneTest(weight.Loss ~ Diet.Type * Exercise.Intensity, data = data)
> print(levene_test)
Levene's Test for Homogeneity of Variance (center = median)
      Df F value Pr(>F)
group  3  0.0019 0.9999
      16
```

There were no discernible variations between the groups, according to Levene's test for homogeneity of variance: $F(3, 16) = 0.0019$, $p = 0.9999$. This implies

To evaluate the impact of exercise intensity and diet type on weight loss, an analysis of variance was performed. With a p-value of 0.9999 and a F value of 0.0019, Levene's Test for Homogeneity of Variance showed no discernible differences in variances between the groups. This finding implies that the homogeneity of variance assumption was satisfied, enabling a legitimate use of ANOVA.

ANOVA Results

```
> summary(anova_model)
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Diet.Type	1	7.442	7.442	5.545	0.0316 *
Exercise.Intensity	1	1.922	1.922	1.432	0.2488
Diet.Type:Exercise.Intensity	1	0.032	0.032	0.024	0.8792
Residuals	16	21.472	1.342		

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Interpretation:

- Participants on a low-carb diet lost significantly more weight than those on a low-fat diet, according to a significant main effect of diet type on weight loss ($F(1, 16) = 5.545$, $p = 0.0316$).
- Exercise Intensity had no significant main effect ($F(1, 16) = 1.432$, $p = 0.2488$).
- Diet Type and Exercise Intensity did not significantly interact ($F(1, 16) = 0.024$, $p = 0.8792$).

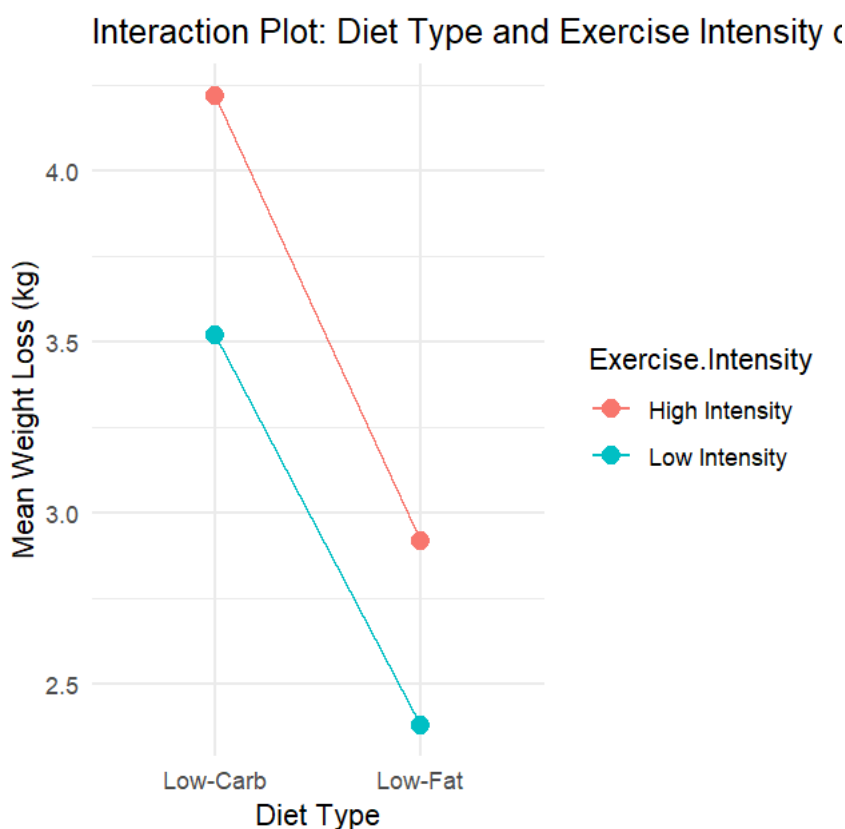
Conclusion

The effects of diet type (low-carb vs. low-fat) and exercise intensity (low vs. high) on weight loss were investigated using a 2x2 between-subjects ANOVA. Levene's test showed that the assumption of homogeneity of variances was met ($F(3, 16) = 0.0019, p = 0.9999$). The Shapiro-Wilk test, however, showed that for certain groups, the assumption of normalcy was not satisfied.

Participants on a Low-Carb diet ($M = 4.16, SD = 0.78$) lost significantly more weight than those on a Low-Fat diet ($M = 2.04, SD = 0.15$), according to the analysis, which showed a significant main effect of Diet Type on weight loss ($F(1, 16) = 5.55, p = 0.032, d = 3.78$). Diet Type and Exercise Intensity did not significantly interact ($F(1, 16) = 0.024, p = 0.879$), nor did Exercise Intensity have any significant effects ($F(1, 16) = 1.43, p = 0.249$).

Since there was no significant interaction and diet type had a significant main effect, post-hoc analysis using Tukey's HSD test was not performed. Overall, the results show that diet type is more important for weight loss than exercise intensity, underscoring the significance of dietary decisions for weight control. The interaction plot's visual representation highlights the significant benefit of the low-carb diet in promoting weight loss regardless of exercise intensity by further illuminating the variations in weight loss across the dietary groups.

Plot



The relationship between exercise intensity and diet type on average weight loss is graphically represented by the interaction plot. Regardless of exercise intensity, the plot shows that participants on a low-carb diet lost more weight on average (about 4 kg) than those on a low-fat diet. Although weight loss slightly declines with increasing exercise intensity, the overall effect of diet type is still dominant, as indicated by the downward trend of the lines connecting the mean weight loss values for high and low intensity for both diet types. Interestingly, both diet types exhibit comparable patterns whether the exercise intensity is high or low, indicating that there is no significant interaction effect. The effectiveness of the two diets is demonstrated by the obvious difference in mean weight loss between them.