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Public Links to Data:
Excel Data Table: https://wlu.box.com/s/nmfa1o46gqmsp4qybnfh1h8mrn9o77x9
Two Way ANOVA with Repeated Measurements data table:
https://wlu.box.com/s/0vf52ptxwwc6e5zu7vgkweu0vdyan2jp

Technical Report

Our Power Analysis to determine sufficient n-value:
Blood pressures of men and women were assumed to have similar variances and standard deviations within their respective age ranges. Our Power analysis was conducted using a type 1 error of 0.01 and a standard type 2 error of 0.2, based on the literature (Sharman et al, table 2 cited in main paper) we expect an increase in MAP of 17 mmHg. The analysis yielded a required n-value of 1.67, rounded up to 2 to observe the MAP increase in subjects.

$d = \frac{103-86}{4\sqrt{3}}$. We found $n = \frac{(Z_{\alpha} - Z_{\beta})}{d} = 1.67 \approx 2$

Thus, even with our limited sample size (3 men, 6 women) we should still be able to observe a statistically significant increase in MAP

One limitation of our power analysis is that we only have the expected increase in MAP due to exercise for men, and not for women.

Details of the LSE:
A sample size (n) of 3 men and 6 women in BIOL-201 was used. Each subject completed the LSE, which consisted of jogging down and back up 8 flights of stairs to the bottom floor of Leyburn Library. The Leyburn Stairwell consists of 8 flights of 12, 7-inch tall, stairs each (96 steps in total). Each subject's blood pressure was measured before and after the LSE. We used the Amazon Basics Lovia Digital Blood Pressure Monitor model #502 to measure blood pressure.

Formula for MAP:
MAP = DBP + (⅓)(SBP-DBP)

Statistical Analysis:
Two-way ANOVA test with Repeated Measures:

The two-way ANOVA test with repeated measurements was selected to examine the interaction between sex and LSE treatment. We used “Gender” (M or F) and “LSE” (Before or After) as our factors.

Our two-way ANOVA assumes Blood Pressure of both groups (men and women) are normally distributed with roughly equal variance, and that samples are drawn independently of one another.

Our statistical test has three sets of null and alternative hypotheses:

1. H_0: $Gender\ has\ no\ significant\ impact\ on\ blood\ pressure$

   H_A: $Gender\ does\ have\ significant\ impact\ on\ blood\ pressure$
2. H_0: $The\ LSE\ has\ no\ significant\ impact\ on\ blood\ pressure$

   H_A: $The\ LSE\ does\ have\ significant\ impact\ on\ blood\ pressure$
3. H_0: $There\ is\ no\ significant\ interaction\ between\ gender\ and\ the\ effects\ of\ the\ LSE$

   H_A: $There\ is\ significant\ interaction\ between\ gender\ and\ the\ effects\ of\ the\ LSE$

We cannot run this particular ANOVA in Excel, because the number of men and women in our data is different. Instead, we will use the annova_test() function from the “rstatix” package in r. To do so we begin by loading our ANOVA data table (linked at the top of this document) into r using read_csv(). Then, we run the annova_test() and get_anova_table() functions as follows:

```
res.aov <- anova_test(
  data = data, dv = MAP, wid = Subject.ID,
  within = LSE, between = Gender)

get_anova_table(res.aov)
```

Which results in the following ANOVA table:

```
       Effect DFn DFd     F     p p<.05   ges
1      Gender   1   7 0.257 0.628       0.032
2         LSE   1   7 9.844 0.016     * 0.136
3  Gender:LSE   1   7 3.544 0.102       0.054
```

Note that in this example the two-way ANOVA was carried out for MAP. Similar ANOVA analysis could be carried out for systolic and diastolic blood pressure by changing the dv parameter to “Systolic” or “Diastolic” respectively

For MAP, we find that only the LSE has a significant impact on blood pressure. Thus we may only reject our second null hypothesis, and conclude there is only a 1.6% chance that the LSE does not have a significant impact on Blood pressure.

When ANOVA is run using “Systolic” and “Diastolic” as the dependent variable (dv parameter) LSE remains the only significant indicator of change in BP.

Student T-Test

Assuming: Variance of resting MAP may differ slightly, but not greatly, among men and women, and that both of these populations are normally distributed. We made the same assumptions for post-exercise populations of elevated MAP blood pressures

Null Hypothesis: Before-LSE MAP level means for men and women will be the same or greater than after-LSE MAP level means for men and women

Alternative Hypothesis: Before-exercise MAP level means for men and women will be less than after-exercise MAP level means for men and women

We ran a student t-test in Excel, using the t-test command to give us a p-value directly, comparing the before-LSE vs after-LSE MAP values for men and women. We used a 1-tailed (because we know the values increase) and paired (both before and after values come from the same individual) t-test. MAP increased after LSE in both men ($p = 0.0126$) and women ($p = 0.0012$). Thus, in our t-test, with alpha as 0.05, we can reject our null hypothesis in both men and women that there was no change in BP after the LSE.

Confidence Intervals

Using our data from Appendix A, we used Excel to calculate sample standard deviations and standard error for the increase in MAP for men and women. We then calculate confidence intervals at the 95% confidence level. Because we do not know the population variance of MAP for men or women but can assume they are comparable, we must use a t-distribution confidence interval.

Using excel’s CONFIDENCE.T(alpha, st.Dev, size) command, we arrive at the following confidence intervals:

95% confidence interval for men for MAP increase after completion of the LSE: [5.12, 18.66]

95% confidence interval for women for MAP increase after completion of the LSE: [12.74, 30.81]

We then reproduced this method of analysis for systolic and diastolic measures of blood pressure for men and women resulting in the following upper and lower bounds:

MAP			SYSTOLIC			DIASTOLIC		
sample mean	st dev	conf interval	sample mean	st dev	conf interval	sample mean	st dev	conf interval
11.88888889	2.726187589	6.7722254	28.33333333	7.760297818	19.27764846	3.666666667	7.40870359	18.40423998
Men	low:	5.116663491	Men	low:	9.05568487	Men	low:	-14.73757332
	high:	18.66111429		high:	47.6109818		high:	22.07090665
21.77777778	8.608063977	9.033609128	36	15.51343504	16.28035163	14.66666667	7.226494463	7.583740841
Women	low:	12.74416865	Women	low:	19.71964837	Women	low:	7.082925826
	high:	30.8113869		high:	52.28035163		high:	22.25040751