MTH1004 summative coursework: report 2

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Introduction

Arthritis is a widely prevalent medical condition affecting a vast number of adults worldwide, leading to stiffness, pain, and reduced mobility of joints. It is crucial to identify effective treatment options that can manage arthritis symptoms and enhance the patients' quality of life. In this report, we present the results of a study aimed at comparing the efficacy of two arthritis treatments among adults in the United Kingdom. The study included arthritis patients referred for treatment in Devon during a specific month and randomly assigned them to either a control group, receiving standard treatment, or an intervention group, receiving a new treatment. The study's primary outcome measure was the improvement in joint flexion, which serves as an indicator of the patients' condition after three weeks of treatment. This report aims to analyze the study's design critically, evaluate the effects of the two treatments using point estimates and confidence intervals, and establish whether there is a significant difference in the effectiveness of the standard and new arthritis treatments.

Analysis of design of the study

Strengths:
• By including all adult patients in Devon who were referred for arthritis treatment during a specific month, the study reduces the likelihood of selection bias, which is a significant advantage.
• Randomly allocating patients to the control and intervention groups minimizes confounding factors, which allows for a cause-and-effect relationship to be inferred about the treatment effects. This is an important factor in research design as it helps to establish a direct link between the intervention and the outcome variable.
• The use of degrees of flexion as an objective and continuous measure of the patient's condition is appropriate for comparing the effectiveness of the two treatments. This means that the measurements are not subjective, and the data can be analyzed statistically.

Weaknesses:
• Since the study is limited to a specific geographical region (Devon), the generalizability of the results to other regions or populations may be limited. Therefore, caution should be exercised when extrapolating the results to other areas or groups.
• The unequal allocation of patients to the control and intervention groups could affect the precision of the estimates for the treatment effects. This is because the results may be skewed towards the treatment with more patients, which could influence the overall study outcomes.
• The study does not mention whether it was conducted in a double-blind manner, which could lead to biases in the measurements or assessments of the treatment effects. A double-blind design

means that both the researchers and the participants are unaware of which treatment the participant is receiving, which helps to minimize biases in the study. Without this measure, there could be a risk of bias in the measurement or assessment of the treatment effects.

Effects and Differences of the treatments

The arthritis dataset was examined to assess the impact of the control and intervention treatments on the Before and After values. The study calculated point estimates and confidence intervals to determine the treatment effects and whether they differed.

For the control treatment, the mean difference between the Before and After values was 3.38, with a 95% confidence interval ranging from 1.13 to 5.62. This indicates that the control treatment had a moderate impact on the symptoms of arthritis.

In contrast, the mean difference for the intervention treatment was 6, with a 95% confidence interval between 4.22 and 7.78. This suggests that the intervention treatment had a more significant effect on the arthritis symptoms compared to the control treatment.

The study also computed the difference between the two treatments, revealing a mean difference of 11.04, with a 95% confidence interval ranging from 7.44 to 14.64. This implies that the intervention treatment was considerably more effective than the control treatment, with a moderate to large effect size.

In conclusion, these results suggest that the intervention treatment was more effective in reducing the symptoms of arthritis than the control treatment. However, it's important to note that this conclusion is based on a small sample size, and further research with larger sample sizes may be necessary to confirm these findings.

Appendix

R code:

```
# T-test for Before and After values in Control Group

control_before <- arthritis$Before[arthritis$Group == "Control"]
control_after <- arthritis$After[arthritis$Group == "Control"]
control_diff <- control_after - control_before
control_diff_mean <- mean(control_diff)
control_diff_ci <- t.test(control_diff)$conf.int

# T-test for Before and After values in Intervention Group

intervention_before <- arthritis$Before[arthritis$Group == "Intervention"]
intervention_after <- arthritis$After[arthritis$Group == "Intervention"]
intervention_diff <- intervention_after - intervention_before
intervention_diff_mean <- mean(intervention_diff)
intervention_diff_ci <- t.test(intervention_diff)$conf.int

# Compare of t-tests

treatment_diff <- intervention_after - control_after
treatment_diff_mean <- mean(treatment_diff)
treatment_diff_ci <- t.test(treatment_diff)$conf.int

# Print confidence intervals and point estimates

cat("Mean difference of control treatment effect: ", round(control_diff_mean, 2), "95% CI:",
round(control_diff_ci[1], 2), "-", round(control_diff_ci[2], 2))
cat("Mean difference of intervention treatment effect: ", round(intervention_diff_mean, 2),
"95% CI:", round(intervention_diff_ci[1], 2), "-", round(intervention_diff_ci[2], 2))
cat("Mean difference between treatments: ", round(treatment_diff_mean, 2), "95% CI:",
round(treatment_diff_ci[1], 2), "-", round(treatment_diff_ci[2], 2))
```