

# Comparison of Measurement Accuracy Between Caliper and iPhone Apps

## Introduction

- Measurements of wild live shell and shell artifacts can help us monitor and understand past and present environmental changes. (Dong et al., 2018)
- Measuring live shell can also be useful in determining the most efficient and effective farming methods. (Capelle et al., 2020)
- Measurements of bone artifacts can give insight into the influence of ecological resources on survival and health of area inhabitants. (Grosjean et al, 1997)
- Calipers are the traditional tool used for accurate measurements in scientific settings.
- Smart phones are easily accessible, on hand always, and can save data without extra tools being needed.
- How accurate are measurement apps in measuring artifacts in comparison to calipers?

## Methods

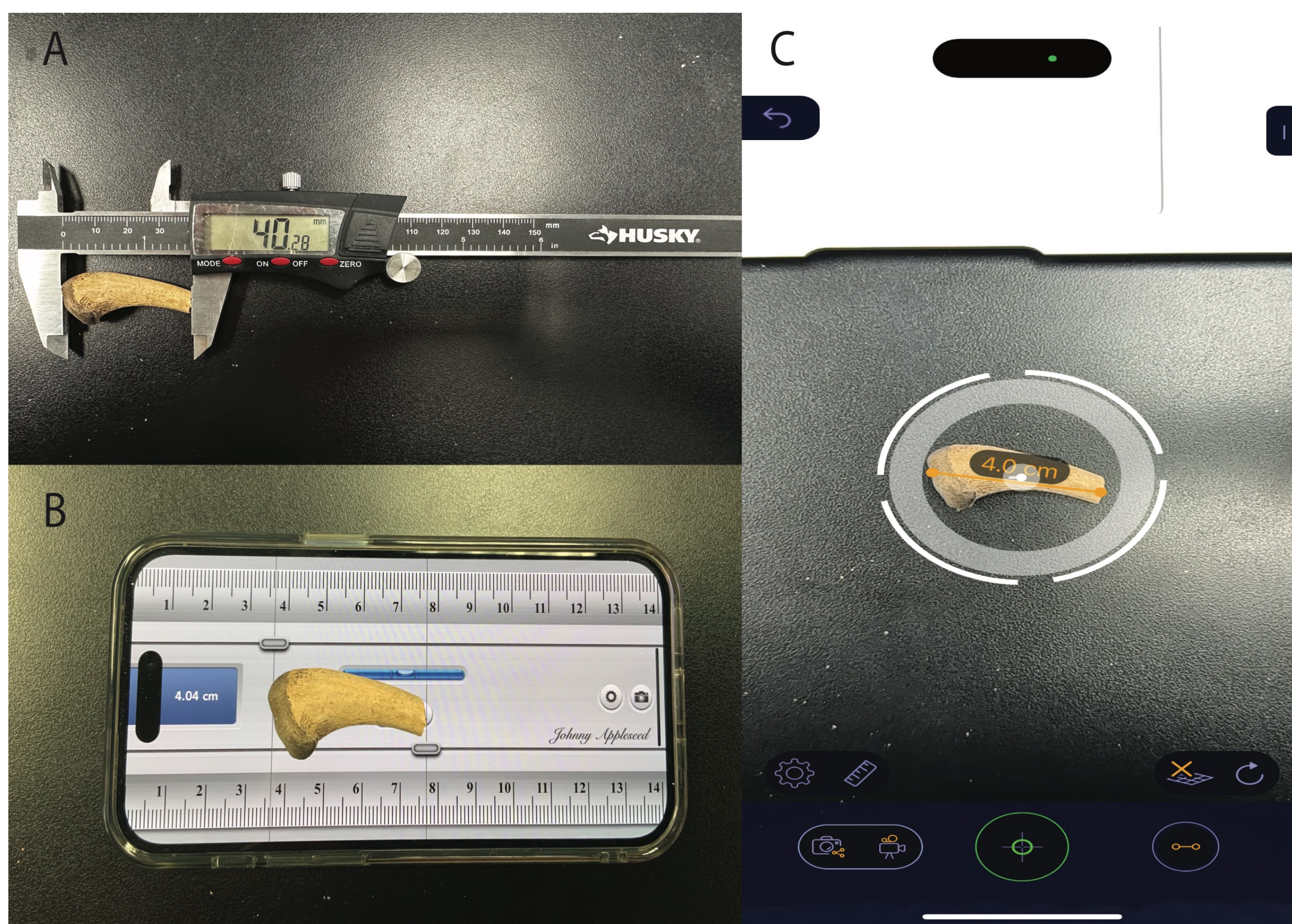
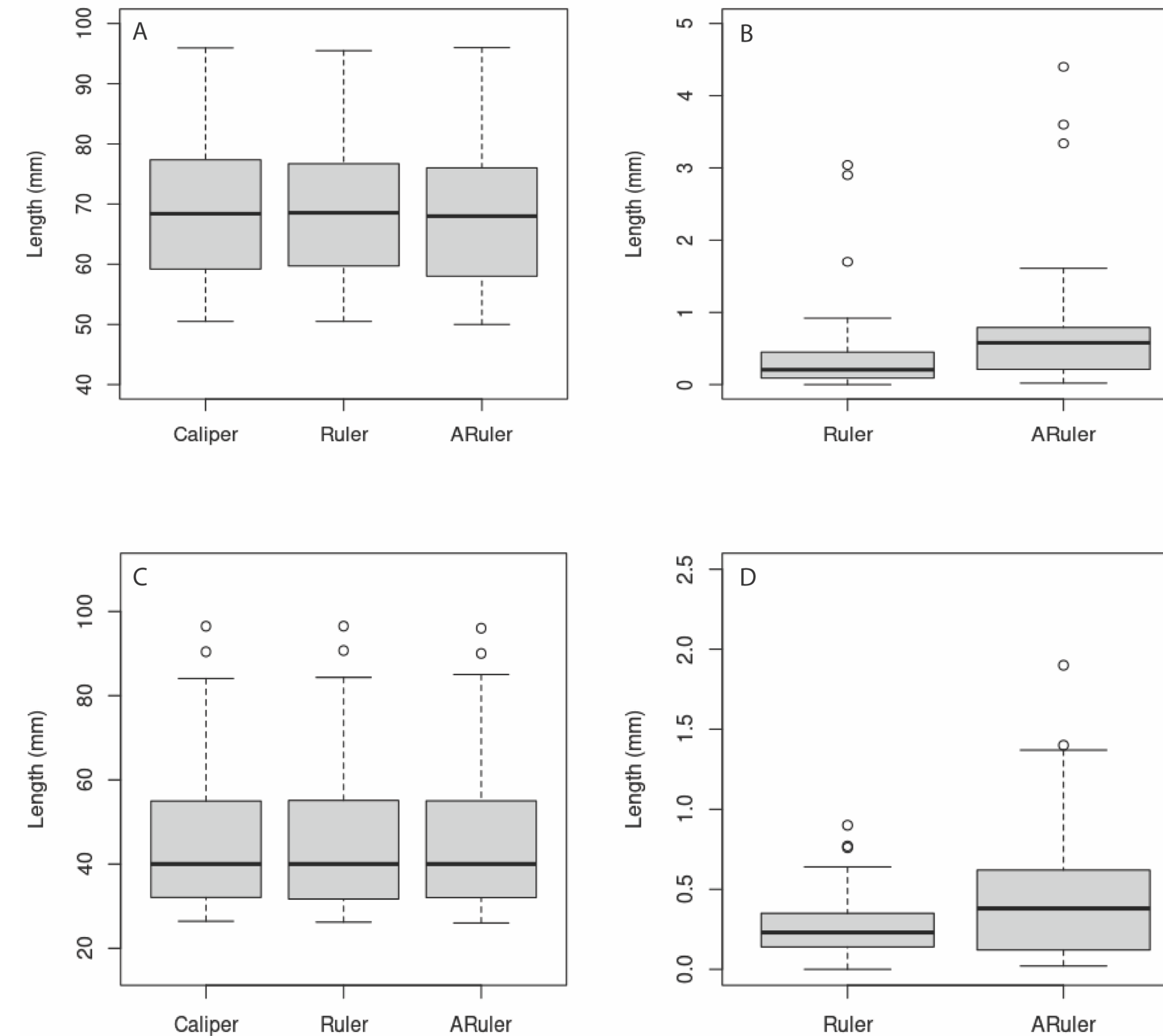


Figure 1: Samples of shell and bone artifacts that were measured with the calipers (A), Ruler app (B), and ARuler app (C). Bone artifacts were measured at longest points. Shells were measured along their mantle.

- Each shell artifact was measured with Calipers, Ruler App, and ARuler app.
- Each bone artifact was measured with Calipers, Ruler App and ARuler app.
- Box and whisker plots were used to evaluate shell data and bone data symmetry individually and see if the data means were comparable to the medians.
- Single sample T-Tests were run for both shell and bone artifacts to determine if measurement difference between each app and the caliper was significantly less than 1mm.
- ANOVA tests were run for both shell and bone artifacts to see if there was a significant difference between any of the measurement techniques.

## Results



- Box and whisker plots of both shell measurements (Fig 2A) and bone measurements (Fig 2C) were not statistically different across measurement devices.
- Box and whisker plots of difference between caliper and app measurements for both shell measurements (Fig 2B) and bone measurements (Fig 2D), differences were significantly less than 1mm.

Figure 2 (left): A) Box and whisker plot of shell measurement data from calipers, Ruler app, and ARuler app (ANOVA,  $p = 0.960$ ). B) Box and whisker plot of absolute difference data between shell measurements from caliper and Ruler app and calipers and ARuler app (t-test,  $p < 0.05$ ). C) Box and whisker plot of bone measurement data from calipers, Ruler app, and ARuler app (ANOVA,  $p = 0.999$ ). D) Box and whisker plot of absolute difference data between bone measurements from calipers and Ruler app and calipers and ARuler app (t-test,  $p < 0.001$ ).

## Conclusion

- The results of this experiment show no statistical difference in the measurements taken using a caliper vs measurements taken on iPhone apps, and that the measurements taken on the apps were significantly less than 1 mm in difference from the caliper.
- The Ruler app was closer to the caliper measurement than the ARuler app.
- Both apps are an adequate substitution for measuring artifacts.
- Study supports the UN Sustainable Development Goal 10 (reduced inequalities) by increasing accessibility of artifact measurement.

## References

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