# Effect sizes for paired data should use the change score variability rather than the pre-test variability.

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# Full Citation

Dankel, SJ and Loenneke, JP. Effect sizes for paired data should use the change score variability rather than the pre-test variability. J Strength Cond Res 35(6): 1773–1778, 2021—}

# What is effect size

- Variable that provides an overall measure for magnitude of change (Dankel and Loenneke (2021))
- Differs from a T-statistic because sample size is not included
- Used in various baseline-post-treatment comparison
  - Specifically, they are looking at this comparison from the lens of meta-analyses for exercise science and sports medicine

# Authors' Aims

- To convince the audience through analysis that baseline and post-test standard deviations (study sample measures of variability) don't tell the full story on the overall variability of the intervention.
- To convince the readers that the heterogeneity of the study sample can play a part in unintentionally influencing effect size measurements.

How would one describe the two types of aforementioned variability?

# Variability of the Study Sample

- Any measure of difference between subjects in a given treatment group
- Represented by the Baseline and Post-treatment Standard Deviation.
- Dankel(Dankel and Loenneke (2021)) and his team claim that the use of this type of variability in paired-sample studies is useless as it has nothing to do with the treatment itself

# Variability of the Intervention

- Any measure of difference between baseline and post-treatment measure
- Represented in this case by the Standard Deviation of Change Scores (I will elaborate on this later)
- Dankel and his team prefer this method of assessing variability

# Dr. Scott Dankel

- Professor at Rowan University, a public research university in New Jersey
- Attended the University of Mississippi to pursue a Masters and PhD in Exercise Science
- Research Interests include acute and chronic adaptations to blood flow restricted exercise (2024a)

# Jeremy Paul Loenneke

- Professor at The University of Mississippi
- Attended Southeast Missouri State for his Bachelors and Masters in Nutrition and Exercise Science
- Eventually got his PhD in Exercise Physiology at the University of Oklahoma
- Research Discipline is in Skeletal Muscle Plasticity (2024b)

## General Comments

- Regarding the disciplines of the authors, this paper was published in The Journal of Strength and Conditioning Research
- Good example of the use of statistics as an interdisciplinary tool

# Introduction

## Specific Effect Size Measures

The author's claim that the common effect size measures listed below are used exhaustively in meta-analyses in the exercise science discipline.

- Cohen's d (Cite)
- Hedge's g (Cite)
- Glass delta (Cite)
- Each use some combination of baseline standard deviation and post-treatment standard deviation.
- Measures of variability of the study sample

# Paired Data vs. Independent Data

## Independent Data

- Data collected through an Independent design
  - Each subject is only measured once
  - Subjects are allocated into a baseline group and a post-treatment group
  - Study sample variability is more important
  - The pooled standard error is the way to assess this variability

## Paired Data

- Data that is collected through a Paired Sample design
  - Same subject is assessed at both time points.
  - Since its based on the same subject, this data is not independent
  - In this type of Design, study sample variability is irrelevant
  - Variability of assessed by standard error of the change scores

Since most meta-analysis data is paired, Dankel's analysis focuses on primarily paired-sample designs. Therefore, the authors believe that intervention variability is the best measure for this specific analysis.

# Methods

## Preliminary measures

$M_{change}$ = Difference between means of Posttreatment group and baseline group in

$SD_{bsl}$ = Standard Deviation of the baseline group in an independent design

$SD_{post}$ = Standard Deviation of the posttreatment group in an independent design

$n_{bsl}$ = The sample size of the baseline group

$n_{post}$ = The sample size of the posttreatment group

$$SD_{\text{pooled}} = \sqrt{\frac{(n_{\text{bsl}} - 1)SD_{\text{bsl}}^2 + (n_{\text{post}} - 1)SD_{\text{post}}^2}{n_{\text{bsl}} + n_{\text{post}} - 2}}$$

# Calculations of Common Effect Size measures

Cohen's $d = \frac{M_{\text{change}}}{SD_{\text{pooled}}}$

Glass's $\delta = \frac{M_{\text{change}}}{SD_{\text{bsl}}}$

Hedge's $g = C * \frac{M_{\text{change}}}{SD_{\text{pooled}}}$

Where $C$ is a constant multiplied to account for small sample sizes

Based off these measures, we can calculate an Independent $t$ test statistic:

$T_{\text{indep}} = \frac{es^*}{\sqrt{n^*}}$

Where $es^*$ is whatever effect size above is being used and $n*$ is the total sample size of the group we are trying to prove the significance of. From this it is apparent how using the incorrect effect size can be detrimental to a given analysis.

# Analysis and Procedure

Figure 1

Figure 2

# Results

# Discussion

# References

2024b. https://hesrm.olemiss.edu/people/jeremy-paul-loenneke/.

———. 2024a. https://research.rowan.edu/research-areas/hes/dankel/about.html.

Dankel, Scott J., and Jeremy P. Loenneke. 2021. "EFFECT SIZES FOR PAIRED DATA SHOULD USE THE CHANGE SCORE VARIABILITY RATHER THAN THE PRE- TEST VARIABILITY." *Journal of Strength and Conditioning Research* 6 (35): 1773–78.