Reanalysis of 32-Dose

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Contents

Reference

Dose, C., Hautmann, C., Buerger, M., Schuermann, S., Woitecki, K., & Doepfner, M. (2017). Telephone-assisted self-help for parents of children with attention-deficit/hyperactivity disorder who have residual functional impairment despite methylphenidate treatment: a randomized controlled trial. Journal of Child Psychology and Psychiatry, and Allied Disciplines, 58(6), 682–690. https://doi.org/10.1111/jcpp.12661

Notes from reading methods section

- Dependent variable: WFIRS-P (primary outcome)
- Independent variable: treatment group
  - TASH intervention (telephone assisted self-help, n=51)

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  - Control group (routine care incl. medication, n=52)
- Covariate: primary outcome at baseline
- Design: 1-way ANCOVA with group as IV and outcome at baseline as covariate
- Primary analysis was ITT

Reading data

Data is loaded, reshaped if necessary, and factors are specified.

```
PATH = file.path(path.expand("~"), "Data", "ancova") # ancova project folder
data = read.spss(file.path(PATH, "dataPrimaryStudies", "32-Dose",
                           "Dose_TASH Enhancement_Functional Impairment.sav"),
                 to.data.frame = TRUE)
```

Descriptives

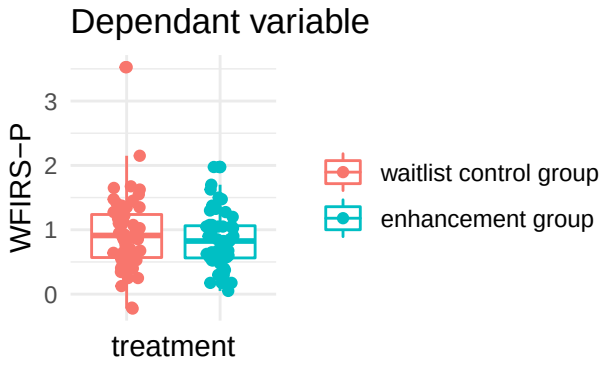
Dependent variable

Mean (SD) of primary outcome per treatment arm. Compare to Table 1, WFIRS-P total score.

```
tapply(data$WFIRS_total_t3, data$Condition, function (x) sprintf("%0.2f (%0.2f)", mean(x), sd(x)))
```

```
## waitlist control group      enhancement group
##          "0.96 (0.60)"          "0.86 (0.45)"
```

```
ggplot(data, aes(y=WFIRS_total_t3, x=Condition, color=Condition)) +
  geom_boxplot() +
  geom_point(position = position_jitter(width = 0.15, height = 0)) +
  theme_minimal() +
  theme(axis.text.x = element_blank(), legend.title = element_blank()) +
  xlab("treatment") + ylab("WFIRS-P") + ggtitle("Dependant variable")
```

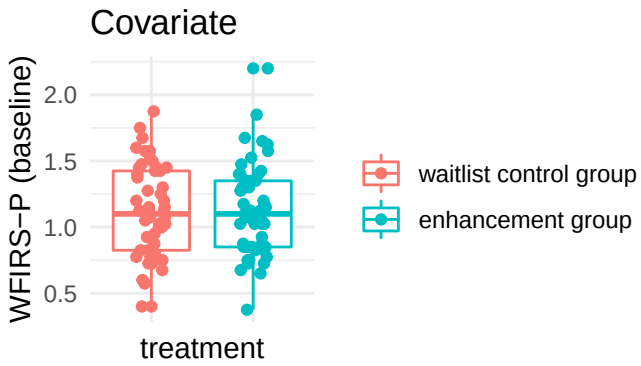


Covariate(s)

```
tapply(data$WFIRS_total_t1, data$Condition, function (x) sprintf("%0.2f (%0.2f)", mean(x), sd(x)))
```

```
## waitlist control group      enhancement group
##          "1.11 (0.35)"          "1.13 (0.35)"
```

```r
ggplot(data, aes(y=WFIRS_total_t1, x=Condition, color=Condition)) +
  geom_boxplot() +
  geom_point(position = position_jitter(width = 0.15, height = 0)) +
  theme_minimal() +
  theme(axis.text.x = element_blank(), legend.title = element_blank()) +
  xlab("treatment") + ylab("WFIRS-P (baseline)") + ggtitle("Covariate")
```



Main analysis ANCOVA

```r
# Orthogonal contrasts
contrasts(data$Condition) = contr.helmert(2)

fit.ancova = aov(WFIRS_total_t3 ~ WFIRS_total_t1 + Condition, data = data)
result = Anova(fit.ancova, type=3) # Type III
print(result)
```

```
## Anova Table (Type III tests)
##
## Response: WFIRS_total_t3
##                 Sum Sq  Df F value    Pr(>F)
## (Intercept)     1.0341   1  4.0530 0.0467795 *
## WFIRS_total_t1  3.1931   1 12.5150 0.0006139 ***
## Condition       0.2786   1  1.0919 0.2985760
## Residuals      25.5143 100
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The paper calculated Cohens'd based on ANCOVA's adjusted means.

```r
n = summary(data$Condition)
means.adj = effect("Condition", fit.ancova, se=T)
sd = tapply(data$WFIRS_total_t1, data$Condition, sd) # authors took pooled SD from abseline!
es = escalc(m1i = means.adj$fit[1], sd1i = sd[1], n1i = n[1],
            m2i = means.adj$fit[2], sd2i = sd[2], n2i = n[2],
            measure = "SMD")
SMD = es$yi
SE = sqrt(es$vi)
#ci95 = c(MD - 1.96*SE, MD + 1.96*SE)
# SE based on t-distribution because n1 and n2 < 60
t = qt(.975, df= n[1] + n[2] - 2)
```

```
ci95 = c(SMD - t*SE, SMD + t*SE)
sprintf("%.2f (%.2f, %.2f)", SMD, ci95[1], ci95[2])
```

```
## [1] "0.29 (-0.10, 0.69)"
```

Comparing ANCOVA in original study with reanalysis

Independent variable

```
tab.IV = rbind(stats.orig.IV, stats.rep.IV)
rownames(tab.IV) = c("original Study", "reanalysis")
print(t(tab.IV))
```

```
##         original Study reanalysis
## Fvalue  "1.09"         "1.09"
## df1     "1"            "1"
## df2     NA             "100"
## pvalue  "0.3"          "0.30"
## SMD     "0.29"         "0.29"
## lowerCI NA             "-0.10"
## upperCI NA             "0.69"
```

Covariate

```
tab.CV = rbind(stats.orig.CV, stats.rep.CV)
rownames(tab.CV) = c("original Study", "reanalysis")
print(t(tab.CV))
```

```
##         original Study reanalysis
## Fvalue  NA             "12.52"
## df1     NA             " 1"
## df2     NA             "100"
## pvalue  NA             "0.0006"
## SMD     NA             NA
## lowerCI NA             NA
## upperCI NA             NA
```

Assumptions

1. Homogeneity of variance

- ANOVA/ANCOVA is fairly robust in terms of the error rate when sample sizes are equal.
- When groups with larger sample sizes have larger variances than the groups with smaller sample sizes, the resulting F-ratio tends to be conservative. That is, it's more likely to produce a non-significant result when a genuine difference does exist in the population.
- Conversely, when the groups with larger sample sizes have smaller variances than the groups with smaller samples sizes, the resulting F-ratio tends to be liberal and can inflate the false positive rate.

```
tapply(data$WFIRS_total_t3, data$Condition, sd)
```

```
## waitlist control group      enhancement group
##              0.6031311              0.4506732
```

```
leveneTest(WFIRS_total_t3 ~ Condition, data = data)
```

```
## Levene's Test for Homogeneity of Variance (center = median)
##        Df F value Pr(>F)
## group   1   0.968 0.3275
##       101
```

2. Independence between covariate and IV

When the covariate and the experimental effect (independent variable) are not independent the treatment effect is obscured, spurious treatment effects can arise and the interpretation of the ANCOVA is seriously compromised.

We test whether our groups differ on the CV. If the groups do not significantly differ then is appropriate to use the covariate.

```
fit.cv = aov(WFIRS_total_t1 ~ Condition, data = data)
Anova(fit.cv, type=3)
```

```
## Anova Table (Type III tests)
##
## Response: WFIRS_total_t1
##              Sum Sq  Df   F value Pr(>F)
## (Intercept) 129.918   1 1055.1511 <2e-16 ***
## Condition     0.009   1    0.0709 0.7906
## Residuals    12.436 101
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

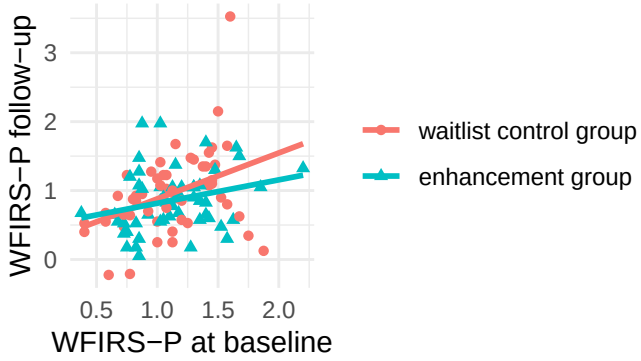
3. Homogeneity of regression slopes

```
fit.hrs = aov(WFIRS_total_t3 ~ WFIRS_total_t1*Condition, data = data)
Anova(fit.hrs, type=3)
```

```
## Anova Table (Type III tests)
##
## Response: WFIRS_total_t3
##                            Sum Sq Df F value    Pr(>F)
## (Intercept)                1.0679  1  4.1983 0.0431097 *
## WFIRS_total_t1             3.1453  1 12.3653 0.0006617 ***
## Condition                  0.1559  1  0.6128 0.4356071
## WFIRS_total_t1:Condition   0.3324  1  1.3068 0.2557255
## Residuals                 25.1819 99
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
ggplot(data, aes(y=WFIRS_total_t3, x=WFIRS_total_t1, color=Condition, shape=Condition)) +
  geom_point() +
  geom_smooth(formula = y ~ x,method=lm, se=FALSE, fullrange=TRUE) +
```

```
theme_minimal() +
theme(legend.title = element_blank()) +
xlab("WFIRS-P at baseline") + ylab("WFIRS-P follow-up")
```



Notes

- RCT using ANCOVA to calculate adjusted means for the two groups (corrected for baseline WFIRS)
- Main finding fully reproduced
- All assumptions met (equal variances, independence of covariate and homogeneity of regression slopes)

Data was analyzed according to recommendations by Field, Miles, & Field (2012).