STOPPD cortical thickness analysis (left hemisphere only)

Contents

This script analyses cortical thickness in the left hemisphere.

```r
#make sure that STUDYID is an interger not a number
  df$STUDYID <- as.character(df$STUDYID)

#make sure that dateDiff is a number, not an interger
  df$dateDiff <- as.numeric(df$dateDiff)

#make a difference score
  df$LDifference <- df$LThickness_02 - df$LThickness_01 #we're only concerned with left thickness (as p

df$RandomArm <- factor(df$randomization,
                       levels = c("O", "P"),
                       labels = c("Olanzapine", "Placebo"))

#restructure data for RCT completers' only (N=41)
  RCT_CT <- df[(df$category == "RCT"),]

#restructure data for RCT & Relapse participants (N=74)
  RCTRelapse_CT <- df %>%
    gather(thick_oldcolname, thickness, LThickness_01, LThickness_02) %>%
    mutate(model_days = if_else(thick_oldcolname == "LThickness_01", 1, dateDiff))

#write out clean dataframe
 # write.csv(RCT_CT, '../generated_data/df_leftCT.csv', row.names=FALSE)
```

Print the N's

RCT only

```r
RCT_CT %>% count(randomization) %>% knitr::kable()
```

randomization	n
O	26
P	14

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RCT_CT %>% count(randomization) %>% knitr::kable()
```

randomization	n
O	26
P	14

```r
#boxplot of difference in thickness (y axis) by randomization group (x axis)
  (plot <- ggplot(RCT_CT, aes(x= RandomArm, y = LDifference)) +
    geom_boxplot(outlier.shape = NA) +
    geom_dotplot(binaxis = 'y', stackdir = 'center') +
    geom_hline(yintercept = 0) +
    ggtitle("Cortical thickness (left hemisphere)") +
    xlab(NULL) +
    ylab("Change in Cortical Thickness (mm)")) +
  theme_minimal()
```

```
## `stat_bindot()` using `bins = 30`. Pick better value with `binwidth`.
```


Cortical thickness (left hemisphere)
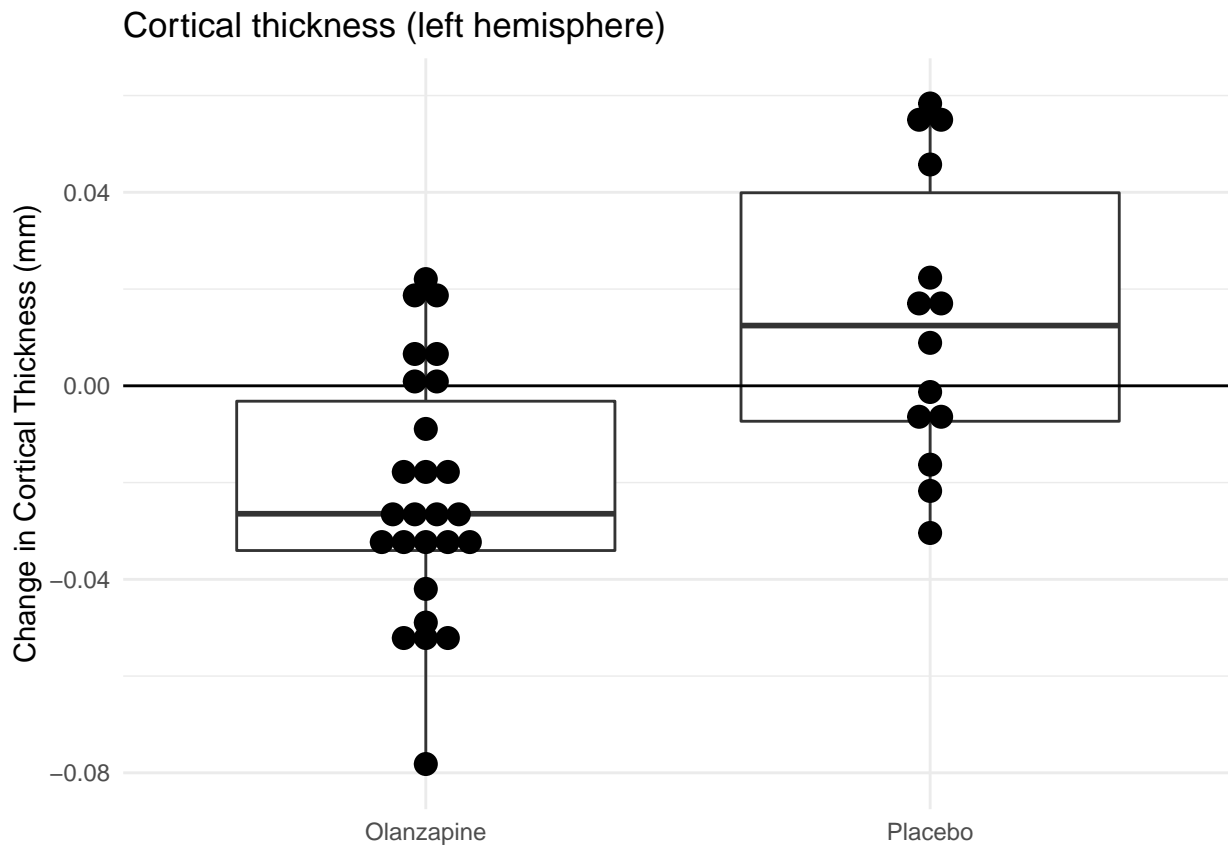
```r
#run linear model without covariates
  fit_rct <- lm(LDifference ~ RandomArm, data= RCT_CT)
  print(fit_rct)
```

```
##
## Call:
## lm(formula = LDifference ~ RandomArm, data = RCT_CT)
##
```

```
## Coefficients:
##     (Intercept)  RandomArmPlacebo
##        -0.02253          0.03659
```

```r
summary(fit_rct)
```

```
##
## Call:
## lm(formula = LDifference ~ RandomArm, data = RCT_CT)
##
## Residuals:
##       Min        1Q     Median        3Q       Max
## -0.055651 -0.018822 -0.003541  0.022344  0.044589
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)       -0.022529   0.005294  -4.255 0.000131 ***
## RandomArmPlacebo   0.036591   0.008949   4.089 0.000217 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.027 on 38 degrees of freedom
## Multiple R-squared:  0.3055, Adjusted R-squared:  0.2873
## F-statistic: 16.72 on 1 and 38 DF,  p-value: 0.0002168
```

```r
#run linear model with covariates of sex and age
fit_rct <- lm(LDifference ~ RandomArm + sex + age, data= RCT_CT)
print(fit_rct)
```

```
##
## Call:
## lm(formula = LDifference ~ RandomArm + sex + age, data = RCT_CT)
##
## Coefficients:
##     (Intercept)  RandomArmPlacebo             sexM              age
##      -0.0053535         0.0389342        0.0087658       -0.0004063
```

```r
summary(fit_rct)
```

```
##
## Call:
## lm(formula = LDifference ~ RandomArm + sex + age, data = RCT_CT)
##
## Residuals:
##       Min        1Q     Median        3Q       Max
## -0.054543 -0.019130 -0.001897  0.019599  0.050858
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)       -0.0053535  0.0168885  -0.317 0.753081
## RandomArmPlacebo   0.0389342  0.0090734   4.291 0.000128 ***
## sexM               0.0087658  0.0087344   1.004 0.322272
## age               -0.0004063  0.0003132  -1.297 0.202857
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## Residual standard error: 0.02691 on 36 degrees of freedom
## Multiple R-squared:  0.3465, Adjusted R-squared:  0.292
## F-statistic: 6.363 on 3 and 36 DF,  p-value: 0.001424
```

```r
#run linear model with covariates of sex and age
  fit_rct <- lm(LDifference ~ RandomArm + sex + age + site, data= RCT_CT)
  print(fit_rct)
```

```
##
## Call:
## lm(formula = LDifference ~ RandomArm + sex + age + site, data = RCT_CT)
##
## Coefficients:
##       (Intercept)  RandomArmPlacebo              sexM              age
##         0.0003982         0.0404923         0.0127657        -0.0003164
##           siteMAS           siteNKI           sitePMC
##        -0.0193116        -0.0212567        -0.0287115
```

```r
  summary(fit_rct)
```

```
##
## Call:
## lm(formula = LDifference ~ RandomArm + sex + age + site, data = RCT_CT)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.045029 -0.013484 -0.001428  0.017054  0.052285
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)       0.0003982  0.0177658   0.022   0.9823
## RandomArmPlacebo  0.0404923  0.0086868   4.661 4.99e-05 ***
## sexM              0.0127657  0.0083335   1.532   0.1351
## age              -0.0003164  0.0003244  -0.975   0.3365
## siteMAS          -0.0193116  0.0110783  -1.743   0.0906 .
## siteNKI          -0.0212567  0.0105872  -2.008   0.0529 .
## sitePMC          -0.0287115  0.0130066  -2.207   0.0343 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.02527 on 33 degrees of freedom
## Multiple R-squared:  0.4717, Adjusted R-squared:  0.3757
## F-statistic: 4.911 on 6 and 33 DF,  p-value: 0.001094
```

RCT & Relapse (with time as factor)

```r
RCTRelapse_CT %>% filter(model_days == 1) %>% count(randomization) %>% knitr::kable()
```

randomization	n
O	38
P	34

4

```
#plot all data, including outlier (participant 210030)
  RCTRelapse_CT %>%
  ggplot(aes(x=model_days, y=thickness, colour=RandomArm)) +
  geom_point() +
  geom_line(aes(group=STUDYID), alpha = 0.5) +
  geom_smooth(method="lm", formula=y~poly(x,1)) +
  ggtitle("Cortical thickness in left hemisphere over time") +
  labs(x = "Days between MRIs", y = "Cortical Thickness (mm)", colour = NULL) +
  theme_minimal()
```
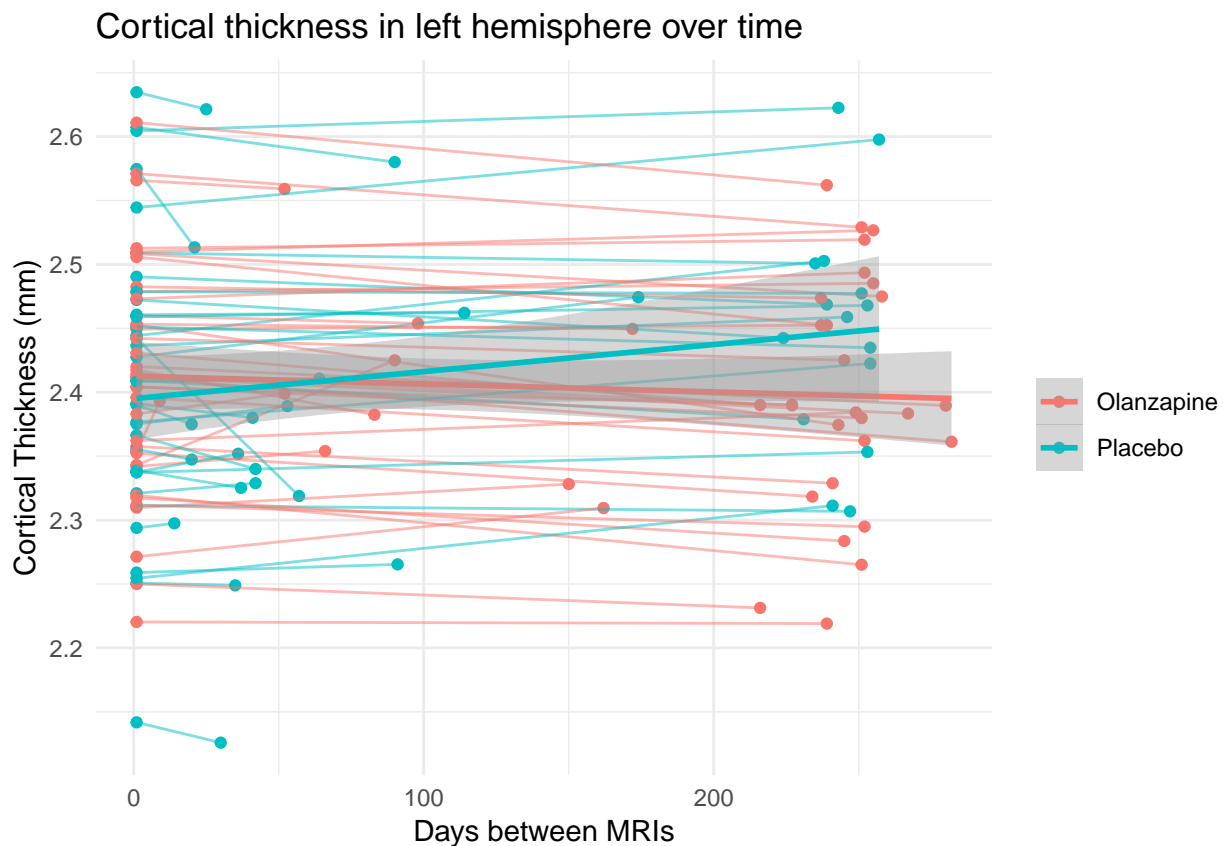
Cortical thickness in left hemisphere over time


```
#run mixed linear model, with covariates
  fit_all <- lmer(thickness ~ RandomArm*model_days + sex + age + (1|STUDYID), data= RCTRelapse_CT)
  summary(fit_all)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: thickness ~ RandomArm * model_days + sex + age + (1 | STUDYID)
##    Data: RCTRelapse_CT
##
## REML criterion at convergence: -396
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.89073 -0.39603 -0.02082  0.40944  2.76834
##
## Random effects:
##  Groups   Name         Variance  Std.Dev.
```

```
##  STUDYID  (Intercept) 0.0054535 0.07385
##  Residual             0.0004953 0.02225
## Number of obs: 144, groups:  STUDYID, 72
##
## Fixed effects:
##                            Estimate Std. Error       df t value
## (Intercept)                2.639e+00  3.484e-02  6.864e+01  75.756
## RandomArmPlacebo          -2.035e-03  1.816e-02  7.233e+01  -0.112
## model_days                -8.012e-05  2.340e-05  7.056e+01  -3.424
## sexM                      -6.099e-03  1.792e-02  6.784e+01  -0.340
## age                       -4.053e-03  5.853e-04  6.785e+01  -6.924
## RandomArmPlacebo:model_days  1.297e-04  3.942e-05  7.148e+01   3.291
##                            Pr(>|t|)
## (Intercept)                 < 2e-16 ***
## RandomArmPlacebo            0.91106
## model_days                 0.00103 **
## sexM                       0.73470
## age                        1.96e-09 ***
## RandomArmPlacebo:model_days  0.00155 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##            (Intr) RndmAP mdl_dy sexM   age
## RndmArmPlcb -0.206
## model_days  -0.077  0.133
## sexM        -0.171  0.036  0.001
## age         -0.901 -0.053  0.008 -0.079
## RndmArmPl:_  0.043 -0.176 -0.594  0.004 -0.003
```

```r
#run mixed linear model, with covariates
  fit_all <- lmer(thickness ~ RandomArm*model_days + sex + age + site + (1|STUDYID), data= RCTRelapse_CT
  summary(fit_all)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: thickness ~ RandomArm * model_days + sex + age + site + (1 |
##     STUDYID)
##    Data: RCTRelapse_CT
##
## REML criterion at convergence: -380.4
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.93368 -0.37860 -0.00129  0.40530  2.72488
##
## Random effects:
##  Groups   Name        Variance  Std.Dev.
##  STUDYID  (Intercept) 0.0055987 0.07482
##  Residual             0.0004952 0.02225
## Number of obs: 144, groups:  STUDYID, 72
##
## Fixed effects:
##                            Estimate Std. Error       df t value
## (Intercept)                2.640e+00  3.703e-02  6.556e+01  71.309
```

```
## RandomArmPlacebo              -1.963e-03  1.863e-02  6.894e+01  -0.105
## model_days                    -8.021e-05  2.341e-05  7.051e+01  -3.427
## sexM                          -8.192e-03  1.840e-02  6.485e+01  -0.445
## age                           -4.101e-03  5.970e-04  6.486e+01  -6.869
## siteMAS                       -6.325e-03  2.335e-02  6.486e+01  -0.271
## siteNKI                        1.359e-04  2.587e-02  6.486e+01   0.005
## sitePMC                        2.516e-02  2.662e-02  6.485e+01   0.945
## RandomArmPlacebo:model_days    1.296e-04  3.942e-05  7.143e+01   3.286
##                              Pr(>|t|)
## (Intercept)                  < 2e-16 ***
## RandomArmPlacebo             0.91640
## model_days                   0.00102 **
## sexM                         0.65759
## age                          2.98e-09 ***
## siteMAS                      0.78731
## siteNKI                      0.99582
## sitePMC                      0.34814
## RandomArmPlacebo:model_days  0.00158 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##            (Intr) RndmAP mdl_dy sexM   age    sitMAS sitNKI sitPMC
## RndmArmPlcb -0.145
## model_days  -0.074  0.129
## sexM        -0.130  0.054  0.002
## age         -0.880 -0.064  0.009 -0.076
## siteMAS     -0.291 -0.145  0.009 -0.066  0.108
## siteNKI     -0.174 -0.119 -0.010 -0.119  0.010  0.357
## sitePMC     -0.153 -0.088  0.000 -0.144 -0.009  0.343  0.319
## RndmArmPl:_  0.040 -0.172 -0.594  0.003 -0.003  0.000  0.009  0.002
```