조절효과_ANOVA

2023-08-23

파일 불러오기

```
setwd('C:\\Users\\phl02\\Desktop\\P\\bio_sas')
library(readxl)
effect <- read_excel("data\\metaanova1.xlsx")
effect
```

```
## # A tibble: 10 x 8
##    study       m1    s1    n1    m2    s2    n2 group
##    <chr>    <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
##  1 Study_1     99    19   100    92    21   100 2
##  2 Study_2     91    11    50    95     9    50 2
##  3 Study_3    118    17   100   111    20   100 2
##  4 Study_4    104    24   200   100    24   200 4
##  5 Study_5     92    19    30    98    17    30 4
##  6 Study_6    119    22   200   115    19   200 4
##  7 Study_7    101    15   500    98    17  5000 4
##  8 Study_8    105    20    75    99    25    75 6
##  9 Study_9    123    24   150   105    18   150 6
## 10 Study_10   119    18   100   101    20   100 6
```

분석 진행

```
library(meta)
meta_anova <- metacont(n1,m1,s1,n2,m2,s2,data=effect,sm='SMD',
                        method.smd ='Hedges',study)
meta_anova
```

```
## Number of studies: k = 10
## Number of observations: o = 7510
##
##                          SMD            95%-CI    z  p-value
## Common effect model  0.2636 [0.1997; 0.3275] 8.09 < 0.0001
## Random effects model 0.2797 [0.0329; 0.5266] 2.22   0.0263
##
## Quantifying heterogeneity:
##  tau^2 = 0.1368 [0.0537; 0.5676]; tau = 0.3699 [0.2317; 0.7534]
##  I^2 = 86.3% [76.7%; 91.9%]; H = 2.70 [2.07; 3.52]
##
## Test of heterogeneity:
##      Q d.f.  p-value
##  65.57    9 < 0.0001
##
## Details on meta-analytical method:
## - Inverse variance method
## - Restricted maximum-likelihood estimator for tau^2
## - Q-Profile method for confidence interval of tau^2 and tau
## - Hedges' g (bias corrected standardised mean difference; using exact formulae)
```

subgroup은 하위 집단에 따라 비교하라는 의미

```r
meta_anova1 <- metacont(n1,m1,s1,n2,m2,s2,data=effect,sm='SMD',
                        method.smd ='Hedges',study, subgroup = group)
meta_anova1
```

```
## Number of studies: k = 10
## Number of observations: o = 7510
##
##                          SMD            95%-CI    z  p-value
## Common effect model  0.2636 [0.1997; 0.3275] 8.09 < 0.0001
## Random effects model 0.2797 [0.0329; 0.5266] 2.22   0.0263
##
## Quantifying heterogeneity:
##  tau^2 = 0.1368 [0.0537; 0.5676]; tau = 0.3699 [0.2317; 0.7534]
##  I^2 = 86.3% [76.7%; 91.9%]; H = 2.70 [2.07; 3.52]
##
## Test of heterogeneity:
##      Q d.f.  p-value
##  65.57    9 < 0.0001
##
## Results for subgroups (common effect model):
##              k    SMD           95%-CI     Q   I^2
## group = 2    3 0.2110 [0.0342; 0.3878] 11.26 82.2%
## group = 4    4 0.1676 [0.0918; 0.2435]  3.76 20.2%
## group = 6    3 0.7314 [0.5718; 0.8910] 11.04 81.9%
##
## Test for subgroup differences (common effect model):
##                     Q d.f.  p-value
## Between groups 39.51    2 < 0.0001
## Within groups  26.06    7   0.0005
##
## Results for subgroups (random effects model):
##              k    SMD             95%-CI    tau^2    tau
## group = 2    3 0.1284 [-0.3470; 0.6038]   0.1498 0.3871
## group = 4    4 0.1676 [ 0.0917; 0.2435] <0.0001 0.0028
## group = 6    3 0.6924 [ 0.2876; 1.0972]   0.1069 0.3270
##
## Test for subgroup differences (random effects model):
##                    Q d.f. p-value
## Between groups 6.29    2  0.0430
##
## Details on meta-analytical method:
## - Inverse variance method
## - Restricted maximum-likelihood estimator for tau^2
## - Q-Profile method for confidence interval of tau^2 and tau
## - Hedges' g (bias corrected standardised mean difference; using exact formulae)
```

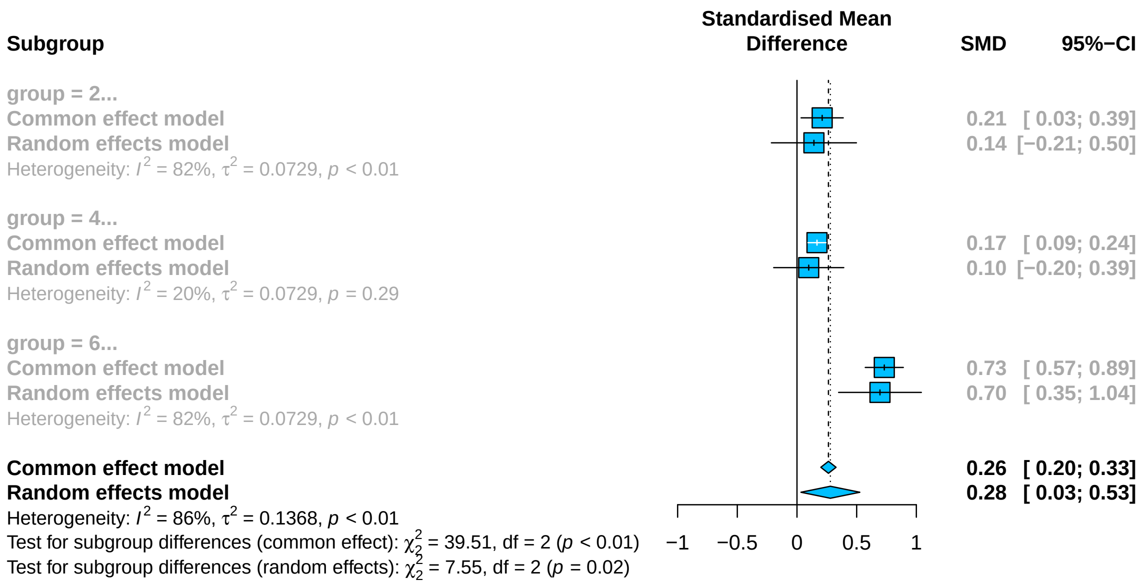
tau.common을 추가하여 동일한 분산으로 가정해서 분석

```
meta_anova2 <- metacont(n1,m1,s1,n2,m2,s2,data=effect,sm='SMD',
                        method.smd ='Hedges',study, subgroup = group,
                        tau.common = T)
meta_anova2
```

```
## Number of studies: k = 10
## Number of observations: o = 7510
##
##                            SMD            95%-CI    z  p-value
## Common effect model  0.2636 [0.1997; 0.3275] 8.09 < 0.0001
## Random effects model 0.2797 [0.0329; 0.5266] 2.22   0.0263
##
## Quantifying heterogeneity:
##  tau^2 = 0.1368 [0.0537; 0.5676]; tau = 0.3699 [0.2317; 0.7534]
##  I^2 = 86.3% [76.7%; 91.9%]; H = 2.70 [2.07; 3.52]
##
## Quantifying residual heterogeneity:
##  tau^2 = 0.0729; tau = 0.2701; I^2 = 73.1% [45.2%; 86.8%]; H = 1.93 [1.35; 2.76]
##
## Test of heterogeneity:
##      Q d.f.  p-value
##  65.57    9 < 0.0001
##
## Results for subgroups (common effect model):
##                 k    SMD            95%-CI     Q   I^2
## group = 2    3 0.2110 [0.0342; 0.3878] 11.26 82.2%
## group = 4    4 0.1676 [0.0918; 0.2435]  3.76 20.2%
## group = 6    3 0.7314 [0.5718; 0.8910] 11.04 81.9%
##
## Test for subgroup differences (common effect model):
##                     Q d.f.  p-value
## Between groups 39.51    2 < 0.0001
## Within groups  26.06    7   0.0005
##
## Results for subgroups (random effects model):
##                 k    SMD             95%-CI  tau^2    tau
## group = 2    3 0.1419 [-0.2146; 0.4983] 0.0729 0.2701
## group = 4    4 0.0984 [-0.1953; 0.3921] 0.0729 0.2701
## group = 6    3 0.6953 [ 0.3486; 1.0420] 0.0729 0.2701
##
## Test for subgroup differences (random effects model):
##                     Q d.f. p-value
## Between groups  7.55    2  0.0230
## Within groups  26.06    7  0.0005
##
## Details on meta-analytical method:
## - Inverse variance method
## - Restricted maximum-likelihood estimator for tau^2
##   (assuming common tau^2 in subgroups)
## - Q-Profile method for confidence interval of tau^2 and tau
## - Hedges' g (bias corrected standardised mean difference; using exact formulae)
```

하위 집단 메타분석 결과

```
forest(meta_anova2,test.subgroup.random = T,resid.hetstat = F,
       layout = 'subgroup',calcwidth.tests = T,
       col.diamond = 'deepskyblue1',col.square = 'deeppink1')
```



회귀분석으로 메타분석의 설명력과 QM을 확인

```
metareg<- metareg(meta_anova2,group)
metareg
```

```
##
## Mixed-Effects Model (k = 10; tau^2 estimator: REML)
##
## tau^2 (estimated amount of residual heterogeneity):     0.0729 (SE = 0.0499)
## tau (square root of estimated tau^2 value):             0.2701
## I^2 (residual heterogeneity / unaccounted variability): 84.03%
## H^2 (unaccounted variability / sampling variability):   6.26
## R^2 (amount of heterogeneity accounted for):            46.70%
##
## Test for Residual Heterogeneity:
## QE(df = 7) = 26.0599, p-val = 0.0005
##
## Test of Moderators (coefficients 2:3):
## QM(df = 2) = 7.5479, p-val = 0.0230
##
## Model Results:
##
##           estimate      se     zval    pval    ci.lb   ci.ub
## intrcpt     0.1419  0.1819   0.7802  0.4353  -0.2146  0.4983
## group4     -0.0435  0.2356  -0.1845  0.8536  -0.5053  0.4184
## group6      0.5534  0.2537   2.1814  0.0292   0.0562  1.0507  *
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

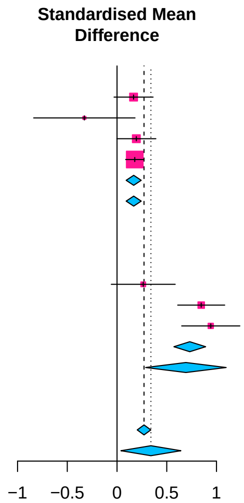
사후 검정

```r
meta2 <- subset(effect,group!='2 ')
meta4 <- subset(effect,group!='4 ')
meta6 <- subset(effect,group!='6 ')

meta2_anova <- metacont(n1,m1,s1,n2,m2,s2,data=meta2,sm='SMD',
                        method.smd ='Hedges',study, subgroup = group)
meta4_anova <- metacont(n1,m1,s1,n2,m2,s2,data=meta4,sm='SMD',
                        method.smd ='Hedges',study, subgroup = group)
meta6_anova <- metacont(n1,m1,s1,n2,m2,s2,data=meta6,sm='SMD',
                        method.smd ='Hedges',study, subgroup = group)
```

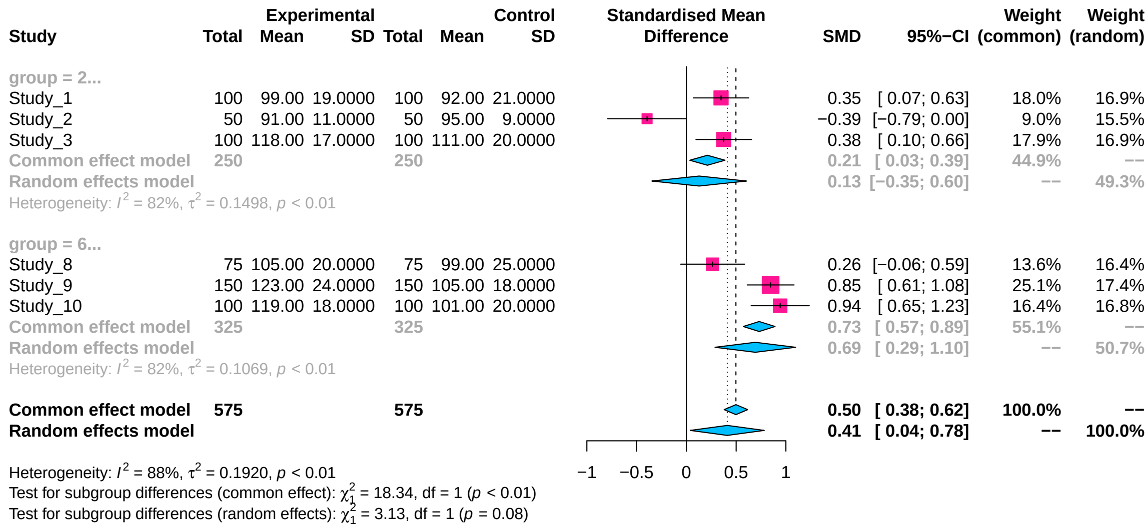
```r
forest(meta2_anova,col.diamond = 'deepskyblue1',col.square = 'deeppink1')
```

Study	Experimental Total	Experimental Mean	Experimental SD	Control Total	Control Mean	Control SD	SMD	95%−CI	Weight (common)	Weight (random)
group = 4...										
Study_4	200	104.00	24.0000	200	100.00	24.0000	0.17	[−0.03; 0.36]	12.2%	15.2%
Study_5	30	92.00	19.0000	30	98.00	17.0000	−0.33	[−0.84; 0.18]	1.8%	11.1%
Study_6	200	119.00	22.0000	200	115.00	19.0000	0.19	[−0.00; 0.39]	12.2%	15.2%
Study_7	500	101.00	15.0000	5000	98.00	17.0000	0.18	[0.09; 0.27]	55.4%	16.0%
Common effect model	930			5430			0.17	[0.09; 0.24]	81.6%	−−
Random effects model							0.17	[0.09; 0.24]	−−	57.5%
Heterogeneity: $I^2 = 20\%$, $\tau^2 = < 0.0001$, $p = 0.29$										
group = 6...										
Study_8	75	105.00	20.0000	75	99.00	25.0000	0.26	[−0.06; 0.59]	4.5%	13.7%
Study_9	150	123.00	24.0000	150	105.00	18.0000	0.85	[0.61; 1.08]	8.4%	14.8%
Study_10	100	119.00	18.0000	100	101.00	20.0000	0.94	[0.65; 1.23]	5.5%	14.1%
Common effect model	325			325			0.73	[0.57; 0.89]	18.4%	−−
Random effects model							0.69	[0.29; 1.10]	−−	42.5%
Heterogeneity: $I^2 = 82\%$, $\tau^2 = 0.1069$, $p < 0.01$										
Common effect model	**1255**			**5755**			**0.27**	**[0.20; 0.34]**	**100.0%**	**−−**
Random effects model							**0.34**	**[0.04; 0.64]**	**−−**	**100.0%**

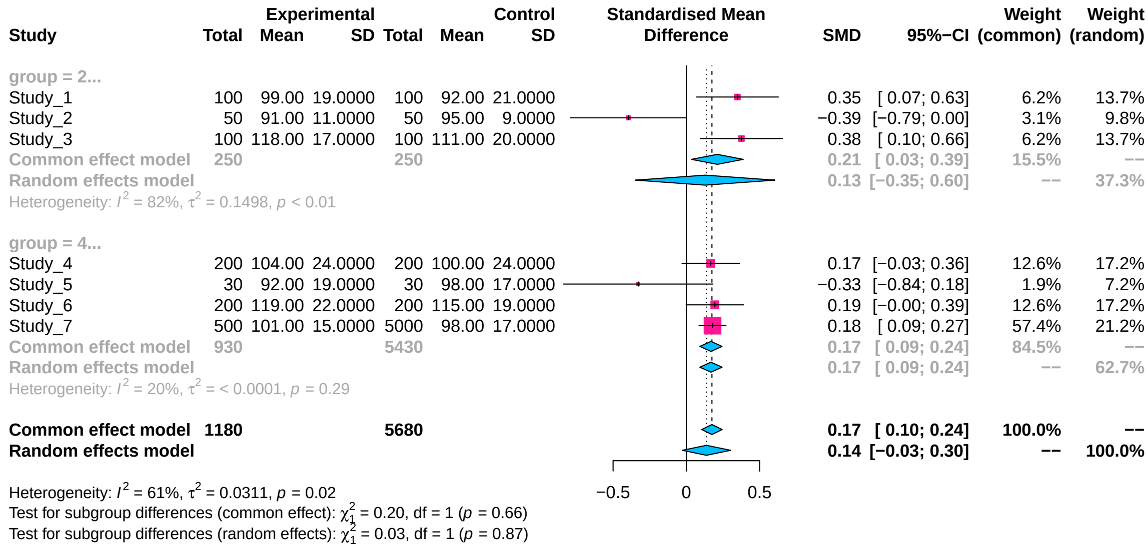


Heterogeneity: $I^2 = 89\%$, $\tau^2 = 0.1457$, $p < 0.01$
Test for subgroup differences (common effect): $\chi^2_1 = 39.11$, df = 1 ($p < 0.01$)
Test for subgroup differences (random effects): $\chi^2_1 = 6.24$, df = 1 ($p = 0.01$)

```r
forest(meta4_anova,col.diamond = 'deepskyblue1',col.square = 'deeppink1')
```



```r
forest(meta6_anova,col.diamond = 'deepskyblue1',col.square = 'deeppink1')
```



결과 정리

```
library(kableExtra)
result <- matrix(0,3,7)
colnames(result) <- c('k','ES','95% CI_low',
                      '95% CI_up','Q(df)','R^2','P')
row.names(result) <- c('2 ','4 ','6 ')
result[,1] <- meta_anova2$k.w
result[,2] <- round(meta_anova2$TE.random.w,3)
result[,3] <- round(meta_anova2$lower.random.w,3)
result[,4] <- round(meta_anova2$upper.random.w,3)
result[,5] <- paste(round(meta_anova2$Q,2),'(', meta_anova2$df.Q,')')
result[,6] <- round(metareg$R2/100,3)
result[,7] <- round(meta_anova2$pval.random,3)
kable(result)
```

	k	ES	95% CI_low	95% CI_up	Q(df)	R^2	P
2주	3	0.142	-0.215	0.498	65.57 (9)	0.467	0.026
4주	4	0.098	-0.195	0.392	65.57 (9)	0.467	0.026
6주	3	0.695	0.349	1.042	65.57 (9)	0.467	0.026