# Hearing loss meta-analysis

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## Contents

# Methods

## Eligibility Criteria

We included peer-review publications in English, involving patients with bilateral congenital and mixed hearing loss and controls with structural Magnetic Resonance Imaging. We included cross-sectional studies with control groups, that investigated the structural relation between MRI changes and the hearing loss. The most common MRI measures were **volume, FA, VBM and thickness.** Each measure was assignated to a specific ROI and to a big brain area. (eg. HG and superior temporal lobe belong to **temporal lobe**). A total of 59 studies were included, 6 of them contained incomplete information. A total of 2778 patients and 4214 controls.
Notes for inclusion:

1. I excluded Xia et al. Chin J Rad, 2008 because I don't understand chinese and it appears to be the same data as Xia et al. Chin J Med Img Tech, 2008.
2. Kim et al. Hear Res 2014 used two groups prelingual deaf and post lingual deaf, I used the average for the main table.
3. Xia et al. Chin J Med Img Tech, 2008 had a total of 40 patients, two groups 9-12 years and 19-22 years, no controls.
4. Zheng et al. Sci Rep, 2017 this variables change; Con rangeLow Con rangeHigh. Why? I didn't find them on the orignal paper.

Effect size direction was directly include in the Cohen's D value by mutipliying by -1 if the effect was decrease and by 1 if it was none of increased. Forests plots were generated form the meta-regression with subgroups left and right. We measure a general regression for white and gray mater by Etiology (congenital and acquired) with subgroups (left and right).

Effects were summarized across studies using the generic inverse-variance weighting method with DerSimonian and Laird random effects. Studies were weighted by $1/SE$š (where SE is the standard error). For the effect size we used Hedges'G, wich takes into account the sample size.

$$Hedges'G = \frac{X_1 - X_2}{\sqrt{\frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2}}}$$

**Assumptions:**

1. We assume that the calculation of the cohen's D is correct.
2. We assume that the direction of the effect is correct.

3. Variance was estimated using the cohen's D and sample size of each study. Our estimated variance was used for all meta-regressions, therefore we could have and additional bias in-between studies variance and heterogeneity calculations. We should have calculated the effect size from the mean and standard deviation from each study. Variance was estimated using the following formula:

$$Variance = \frac{n1 + n2}{n1 \times n2} + \frac{Hedges'G^2}{2 \times (n1 + n2 - 2)}$$

## Estimatimation of heterogeneity per model

We estimated heterogeneity in results using the $\tau$ statistic, which represents the standard deviation in the meta-regression models, we used the heterogeneity test $x2$ and $I2$.
We performed a multi-level meta-analytic model, over our multiple effect size estimates nested withing variables: Etiology, side and Big brain area. We expected that the underlying true effects are more similar for the same level of the grouping variables than thrue effects arising from different levels.
We can account for the correlation in the true effects by adding a random effect to the model at the level corresponding to the grouping variable.
The dataset contains the result from 54 studies, each comparing different measurements between patients and controls. The diference of between groups was quantified in terms of Hedges'G and Cohen's D.

## Total included studies

Table 1: Total unique studies 54

| | Hearing Loss | Healthy |
|---|---|---|
| **Total number of patients** | 2778 | 4214 |
| **Number mean** | 47.08 | 71.42 |
| **Number sd** | 128.5 | 250.6 |
| **Age mean** | 33.07 | 30.96 |
| **Age SD** | 22.66 | 20.5 |
| **%Female mean** | 50.02 | 55.71 |
| **%Female sd** | 12.05 | 12.78 |

Table 2: Acquired studies 13

| | Hearing Loss | Healthy |
|---|---|---|
| **Total number of patients** | 1766 | 3146 |
| **Number mean** | 110.4 | 196.6 |
| **Number sd** | 239 | 468.2 |
| **Age mean** | 64.6 | 55.27 |
| **Age SD** | 7.863 | 13.85 |
| **%Female mean** | 45.1 | 56.52 |
| **%Female sd** | 15.09 | 12.9 |

Table 3: Congenital studies 41

| | Hearing Loss | Healthy |
|---|---|---|
| **Total number of patients** | 1012 | 1068 |
| **Number mean** | 23.53 | 24.84 |
| **Number sd** | 17.18 | 15.04 |
| **Age mean** | 21.06 | 20.99 |
| **Age SD** | 12.48 | 13.06 |
| **%Female mean** | 51.83 | 55.41 |
| **%Female sd** | 10.37 | 12.88 |

# Table of included studies (Figure 1.A)

Table 4: Studies with incomplete information (NA)

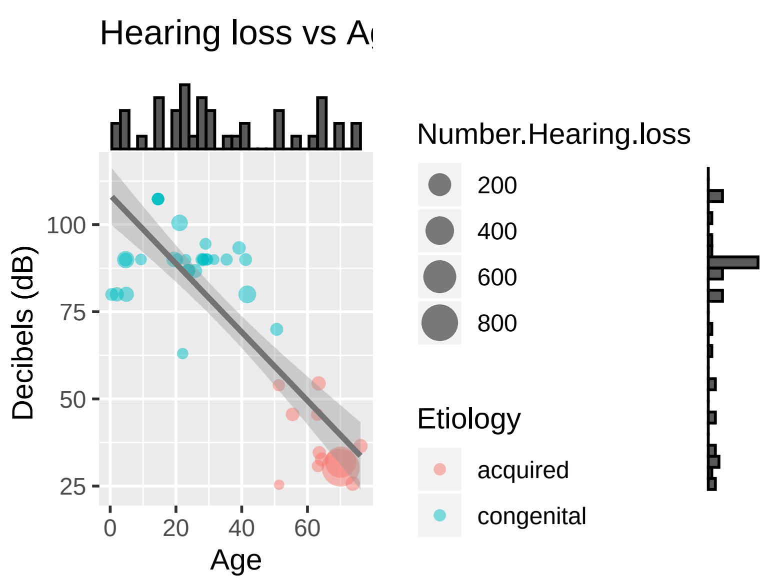
| | Source | MRI Tesla | all.techniques | all.measures |
|---|---|---|---|---|
| **5** | 2006, Kara et al. J Neuroradiol | 1.5 | VBM | length, Thickness, volume |
| **9** | 2008, Xia et al. Chin J Med Img Tech | 1.5 | VBM | volume |
| **12** | 2010, Husain et al. Brain Res | 3 | DTI, VBM | FA, volume |
| **26** | 2014, Lyness et al. Neuroimage | 1.5 | DTI | FA, MD, RD |
| **41** | 2017, Karns et al. Hear Res | 3 | DTI | AD, FA, RD, volume |
| **48** | 2018, Kumar U, Mishra M. Brain Res | 3 | VBM | Thickness, VBM |

Table 5: Included studies

| | Source | MRI Tesla | all.techniques | all.measures |
|---|---|---|---|---|
| **1** | 2000, Bavelier et al. J Neurosci | 1.5 | VBM | volume |
| **2** | 2003, Emmorey et al. PNAS | 1.5 | VBM | asymmetry, GM+WM, ratio GM/WM, volume |
| **3** | 2003, Penhune et al. Neuroimage | 1.5 | VBM | asymmetry, ratio GM/WM, volume |
| **4** | 2004, Chang et al. Neuroreport | 3 | DTI | asymmetry, FA |
| **6** | 2007, Meyer et al. Restor Neurol Neurosci | 3 | VBM | volume |
| **7** | 2007, Shibata DK. Am J Neuroradiol | 1.5 | VBM | volume |
| **8** | 2008, Allen et al. J Neurosci | 1.5 | VBM | asymmetry, ratio GM/WM, Vol proportion, volume |
| **10** | 2009, Kim et al. Neuroreport | 3 | DTI, VBM | FA, volume |
| **11** | 2009, Wang et al. Chin J Med Img Tech | 3 | DTI | FA |
| **13** | 2010, Leporé et al. Hum Brain Mapp | 1.5 | VBM | VBM |
| **14** | 2010, Li, et al. J Clin Rad | 1.5 | VBM | volume |
| **15** | 2010, Liu et al. Chin J Med Img Tech | 3 | CT | FA |
| **16** | 2011, Smith et al. Cereb Cortex | 3 | VBM | asymmetry, ratio GM/WM, volume |
| **17** | 2012, Li et al. Brain Res | 3 | CT | Thickness |
| **18** | 2012, Li et al. Hum Brain Mapp | 3 | DTI | AD, FA, RD |
| **19** | 2013, Allen et al. Front Neuroanat | 1.5 | VBM | asymmetry, volume |
| **20** | 2013, Boyen et al. Hear Res | 3 | VBM | volume |
| **21** | 2013, Miao et al. Am J Neuroradiol | 3 | DTI | FA, RD |
| **22** | 2013, Pénicaud et al. Neuroimage | 1.5 | VBM | volume |
| **23** | 2014, Hribar et al. Hear Res | 3 | DTI, VBM | AD, FA, Thickness |
| **24** | 2014, Kim et al. Hear Res | 3 | VBM | volume |
| **25** | 2014, Lin et al. Neuroimage | 1.5 | VBM | volume |
| **27** | 2014, Olulade et al. J Neurosci | 3 | VBM | volume |
| **28** | 2014, Profant et al. Neuroscience | 3 | DTI, VBM | AD, CT, FA, MD, RD, Surface, volume |
| **29** | 2014, Profant et al. Neuroscience | 3 | DTI, VBM | AD, CT, FA, MD, RD, Surface, volume |
| **30** | 2015, Huang et al. PLoS One | 1.5 | DTI | FA, MD |
| **31** | 2015, Tae Investig Magn Reson Imaging | 1.5 | VBM | VBM |
| **32** | 2016, Amaral et al. Eur J Neurosci | 3 | VBM | asymmetry, Thickness |
| **33** | 2016, Chinnadurai et al. Magn Reson Imaging | 1.5 | DTI | AD, Axial Kurtosis, FA, Mean Kurtosis, Radial Kurtosis, RD |
| **34** | 2016, Ma et al. AJNR Am J Neuroradiol | 3 | DTI | AD, FA, MD, RD |
| **35** | 2016, Shi et al. Neuroreport | 3 | VBM | volume |
| **36** | 2016, Shiell et al. Neural Plasticity | 3 | CT | Thickness |
| **37** | 2016, Smittenaar et al. Open Neuroimag J | 1.5 | CT | CT |

| | Source | MRI Tesla | all.techniques | all.measures |
|---|---|---|---|---|
| **38** | 2016, Wu et al. Brain Res | 1.5 | VBM | ADC, FA |
| **39** | 2016, Wu et al. Brain Res | 1.5 | VBM | ADC, FA |
| **40** | 2016, Wu et al. Brain Res | 1.5 | VBM | ADC, FA |
| **42** | 2017, Kim et al. Neuroreport | 3 | DTI | FA |
| **43** | 2017, Shiell & Zatorre. Hear Res | 3 | DTI | AD, MD, RD, volume |
| **44** | 2017, Zheng et al. Sci Rep | 3 | DTI | FA, Mean Kurtosis |
| **45** | 2018, Benetti et al. Neuroimage | 4 | DTI | AD, FA, RD |
| **46** | 2018, Chen et al. Behav Neurosci | 3 | VBM | volume |
| **47** | 2018, Feng et al. PNAS | 3 | VBM | VBM |
| **49** | 2018, Park et al. Biomed Res Int | 3 | DTI | FA |
| **50** | 2018, Pereira-Jorge et al. Neural Plast | 1.5 | VBM | volume |
| **51** | 2018, Ren et al. Front Neurosci | 3 | CT, VBM | Thickness, volume |
| **52** | 2018, Uchida et al. Front Aging Neurosci | 3 | VBM | volume |
| **53** | 2018, Uchida et al. Front Aging Neurosci | 3 | VBM | volume |
| **54** | 2018, Zou et al. Otol Neurotol | 3 | DTI | AK, FA, MK, RK |
| **55** | 2019, Belkhiria et al. Front. Aging Neurosci | 3 | VBM | CT, volume |
| **56** | 2019, Belkhiria et al. Front. Aging Neurosci | 3 | VBM | CT, volume |
| **57** | 2019, Luan et al. Front Neurosci | 3 | DTI, VBM | FA, MD, volume |
| **58** | 2019, Ponticorvo et al. Hum Brain Mapp | 3 | VBM | volume |
| **59** | 2019, Xu et al. J Magn Reson Imaging | 3 | VBM | volume |

# Relation between hearing loss (dB) and age (Figure 2.D)



## Studies characteristics (Figure 2.E, 2.F)

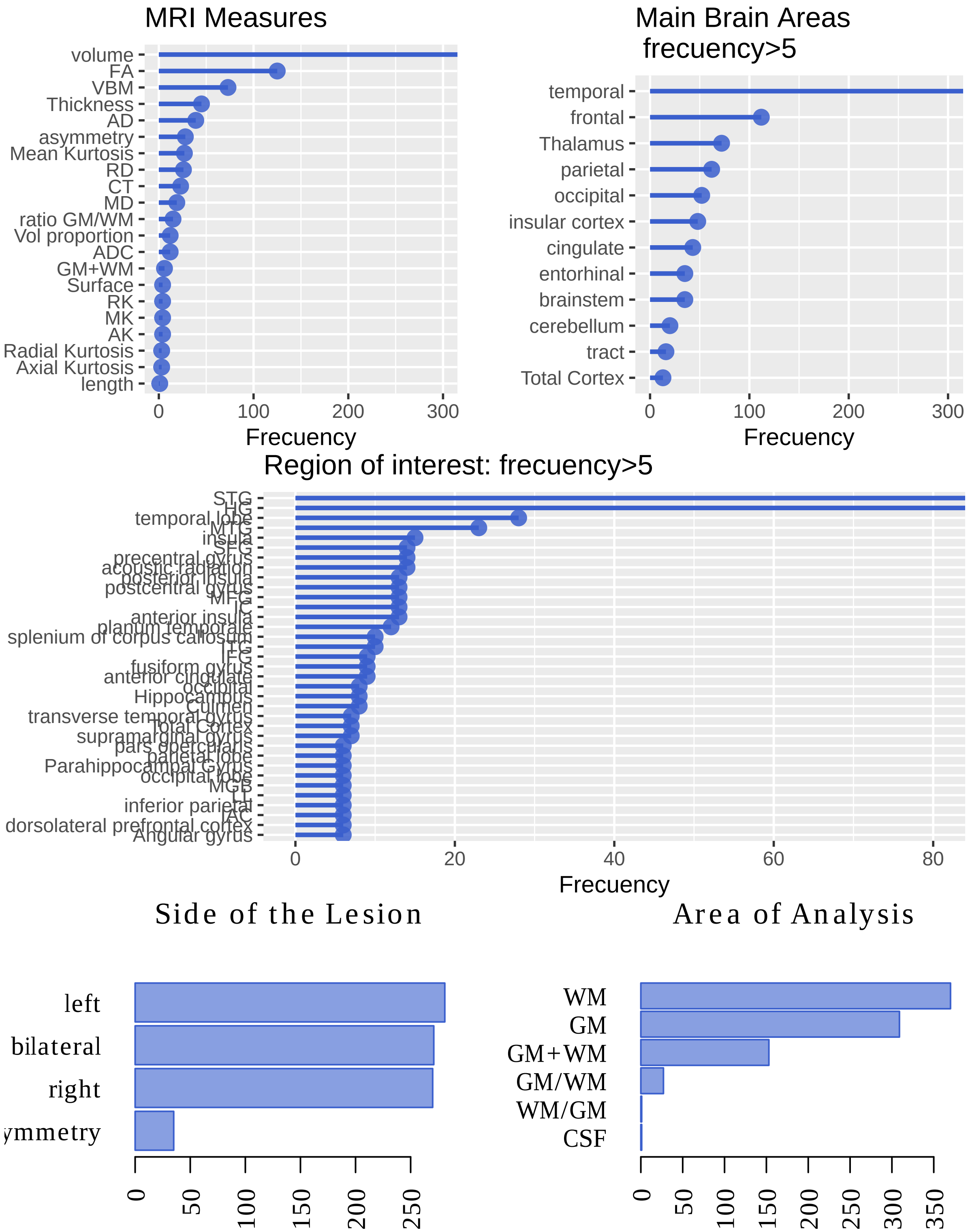


Fig.2.E − Severity

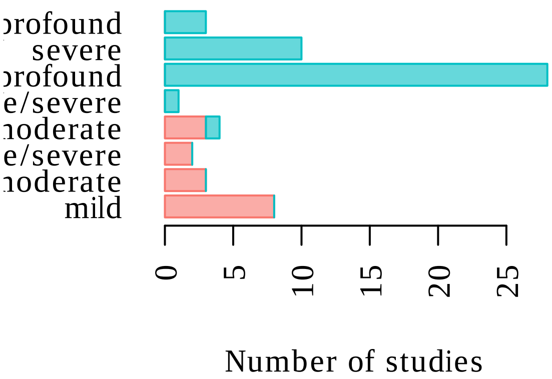
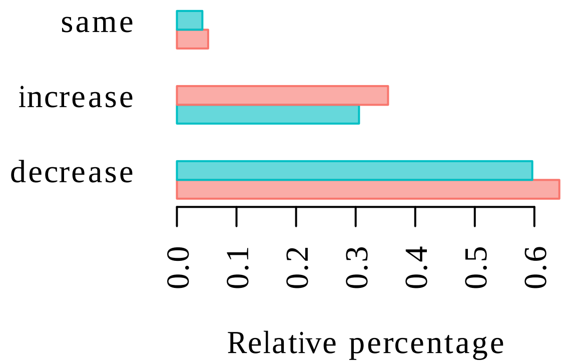



Fig.2.F − Effect direction



## Brain structure (GM, WM) and MRI measures

**Highlights** a. Most of the studies that measured Gray matter focus on cortical changes (volume, thicknes and VBM).
b. White matter studies are more heterogeneous in their measurements.
c. Diffusion tensor (DT) derived mesurements are the most frequent in white matter, followed by volume.
c.1 It is harder to interpret a meta-analysis of multiple white matter measurements because its effect varies widely in different directions. The measurements derived from DT have the most differences.

We conduct our meta-analysis using the **TWO** most frequent measurements for gray and white matter. We use *volume* for GM and *fractional anysotropy* for WM.

Further meta regressions can be found in the supplementary material.
**Gray Matter**
- thickness
- VBM

**White Matter integrity**
- mean diffusivity MD
- radial diffusivity RD
- axial diffusivity AD
- mean kurtosis

**White Matter volume**
- thickness (I am unsure how they did this)
- VBM
- volume

**Biletareal** - GM volume
- WM volume
- WM fractional anisotropy

## Frequency table: Brain structure (GM, WM) and MRI measures

Table 6: Matter vs measure (continued below)

| | AD | ADC | AK | asymmetry | Axial Kurtosis | CT | FA | GM+WM |
|---|---|---|---|---|---|---|---|---|
| **GM** | 0 | 0 | 2 | 9 | 0 | 23 | 8 | 0 |
| **WM** | 39 | 12 | 2 | 8 | 3 | 0 | 117 | 0 |

Table 7: Table continues below

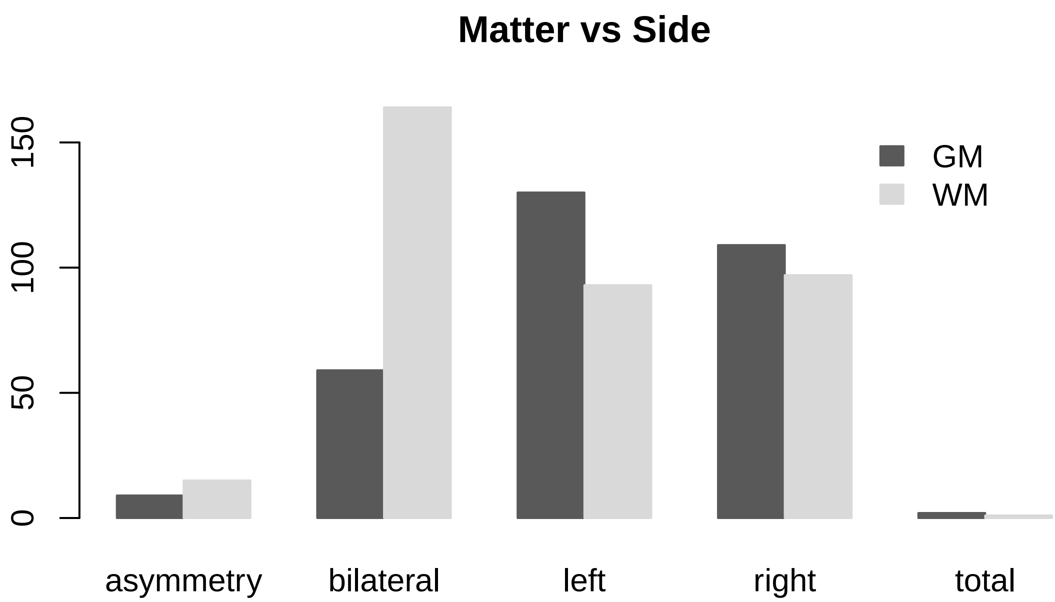
| | length | MD | Mean Kurtosis | MK | Radial Kurtosis | ratio GM/WM | RD |
|---|---|---|---|---|---|---|---|
| **GM** | 0 | 2 | 0 | 2 | 0 | 0 | 0 |
| **WM** | 1 | 17 | 27 | 2 | 3 | 0 | 26 |

| | RK | Surface | Thickness | VBM | Vol proportion | volume |
|---|---|---|---|---|---|---|
| **GM** | 2 | 4 | 14 | 43 | 6 | 194 |
| **WM** | 2 | 0 | 10 | 16 | 6 | 79 |

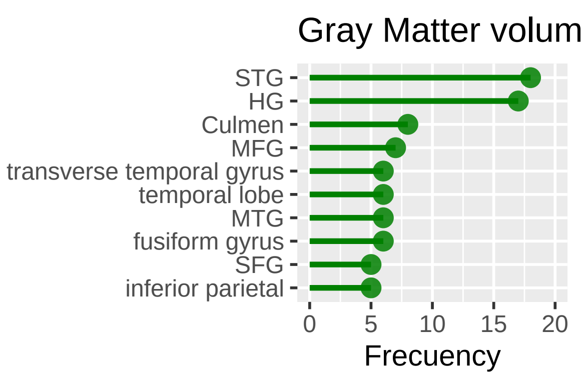
Table 9: Matter vs Side

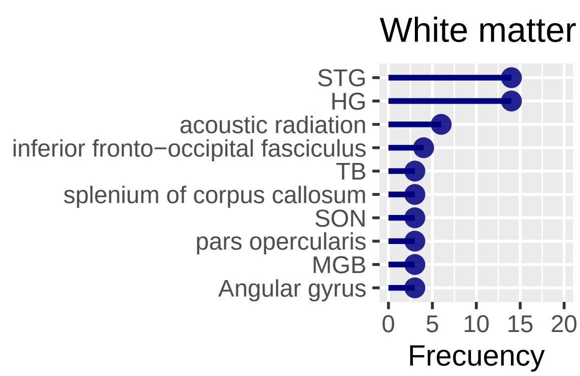
| | asymmetry | bilateral | left | right | total |
|---|---|---|---|---|---|
| **GM** | 9 | 59 | 130 | 109 | 2 |
| **WM** | 15 | 164 | 93 | 97 | 1 |

### Brain structure (GM, WM) and side

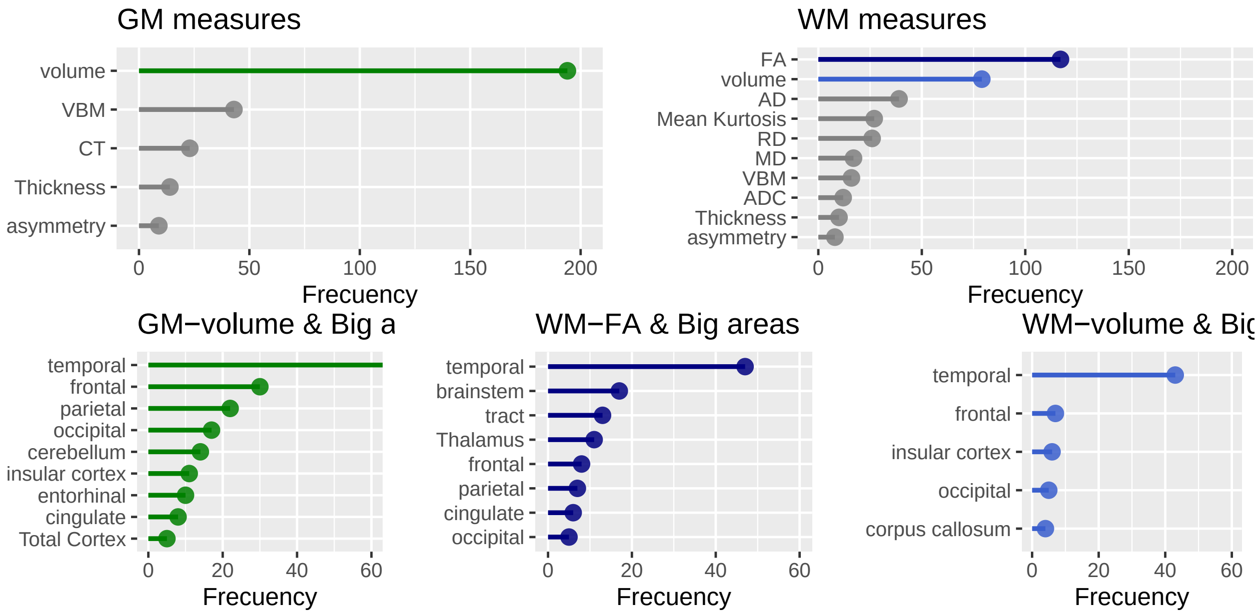



### Brain structure (GM, WM) by MRI measure (volume) and ROI



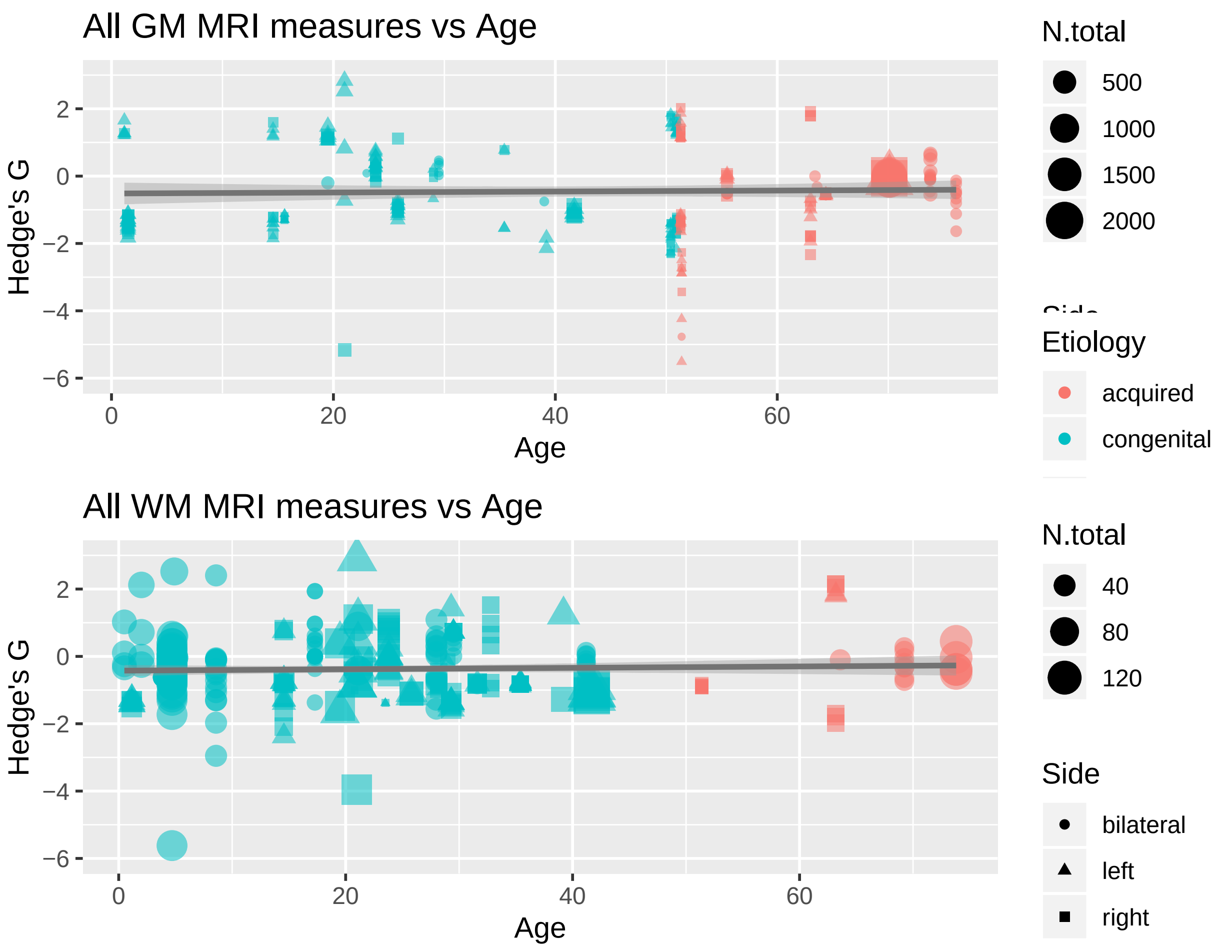



## Studies characteristics (Figure 2.A, 2.B): Brain structure (GM, WM) by MRI measure (volume and FA)

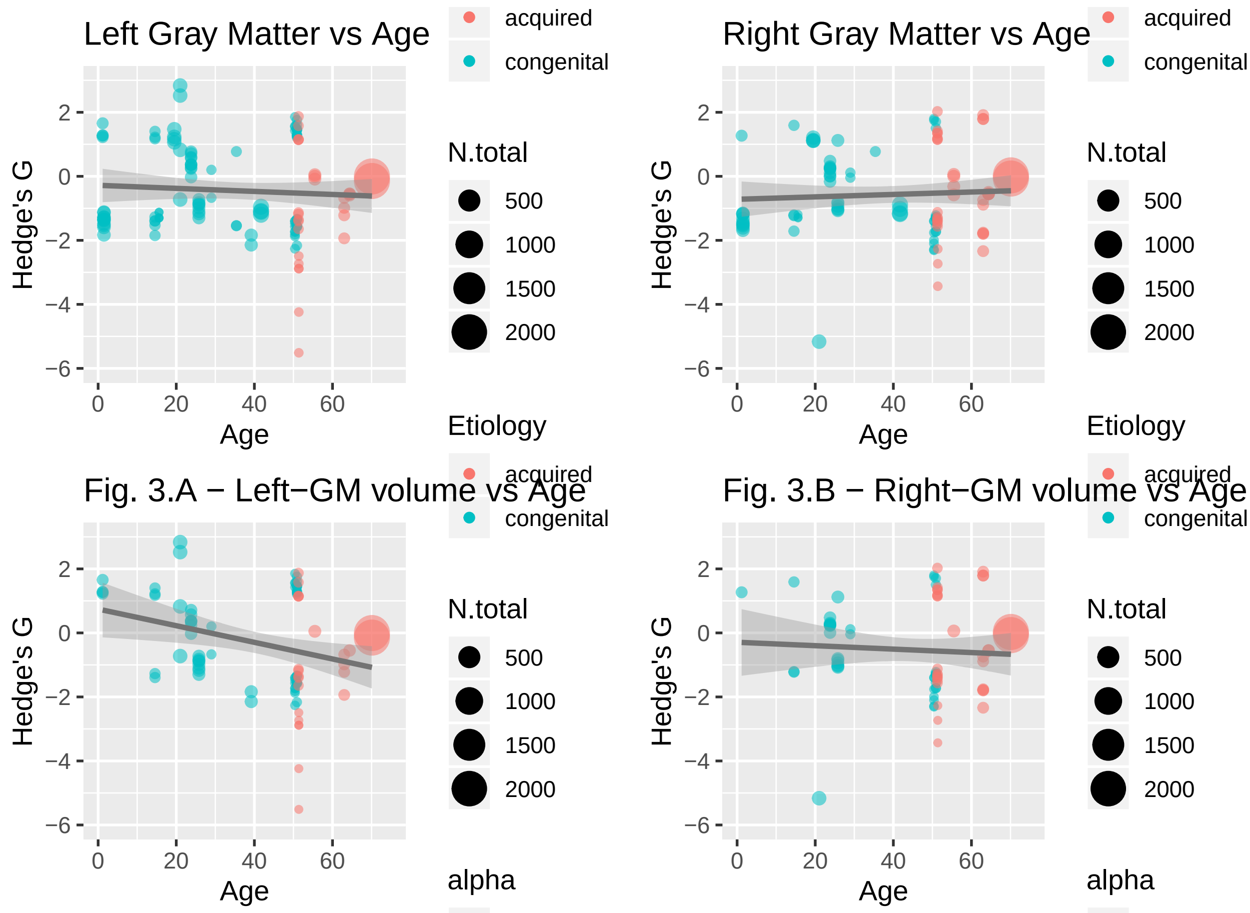



## MRI measures by ROI (Figure 2.C)

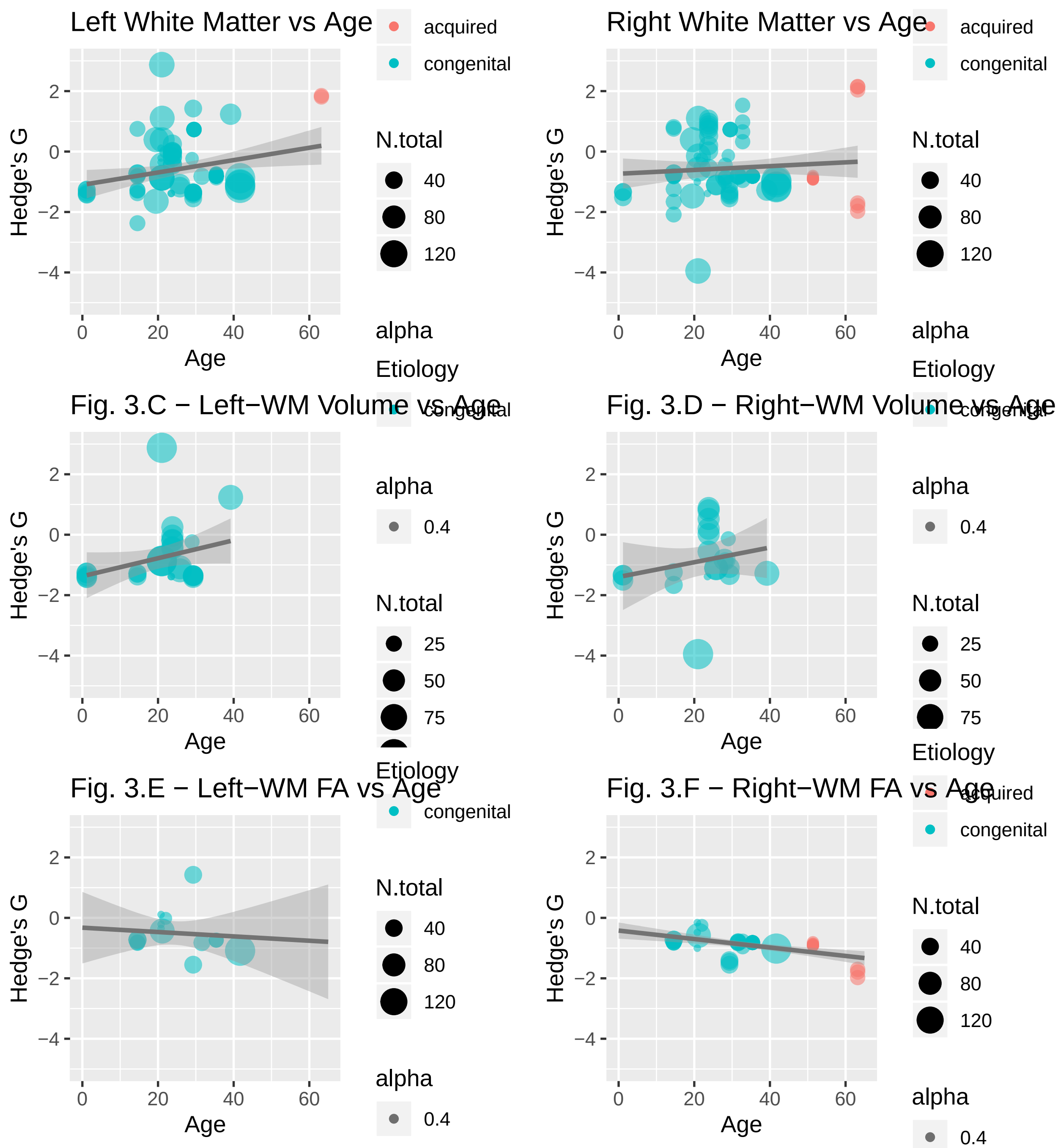
### Relations of all MRI measurements of GM and WM with age



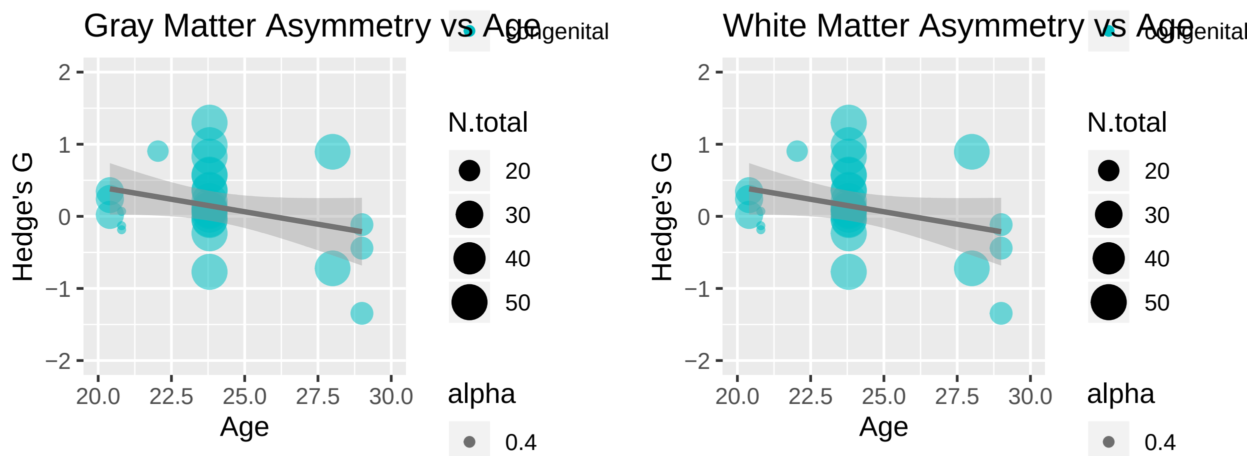
## Gray matter relation with Age by volume (Figures 3.A and 3.B)



## White matter relation with Age by volume and FA (Figures 3.C, 3.D and 3.F)

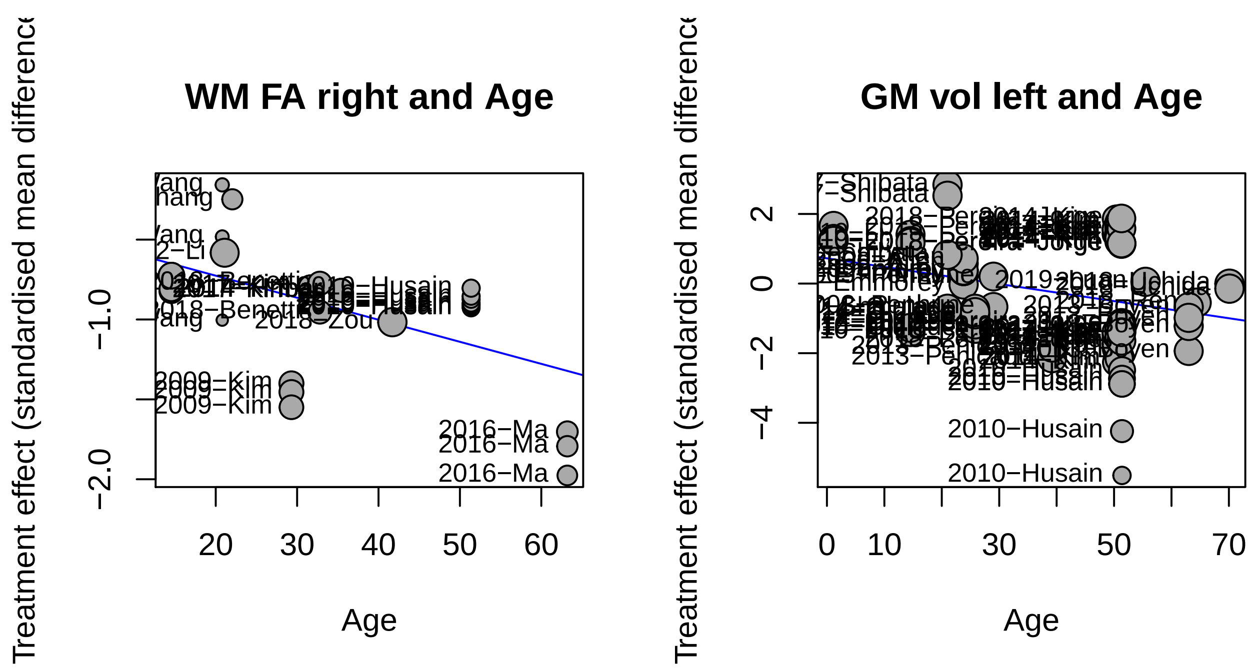


### Gray and White matter relation with Age by asymmetry

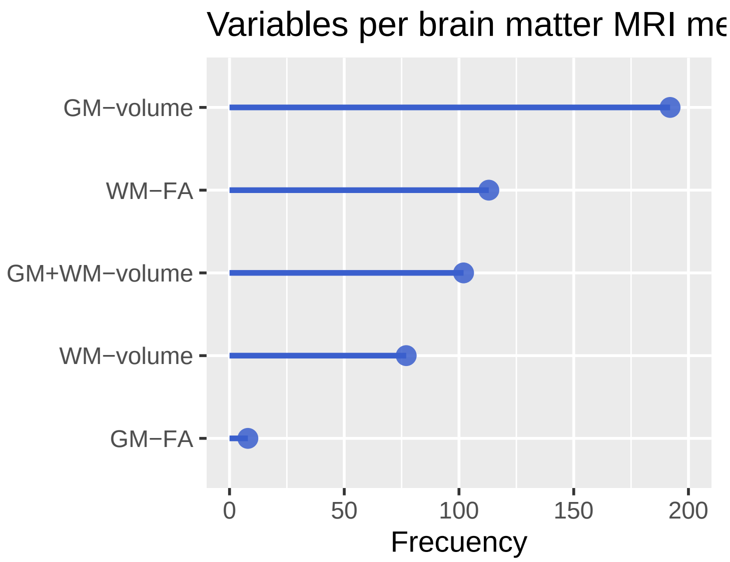


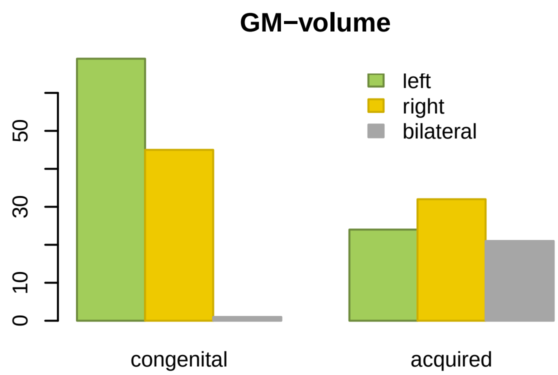

### Table of estimates and meta-regression: WM and GM relation with age by MRI measures (volume and FA)

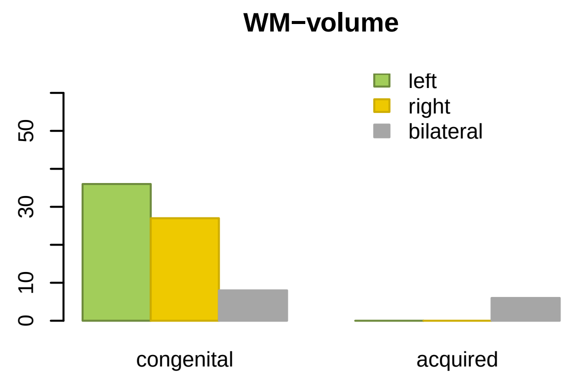
| Model | r | p-value | t.stat | df |
|---|---|---|---|---|
| GM.vol.L | -0.27 | 0.0103 | -2.62 | 85 |
| WM.vol.L | 0.26 | 0.1687 | 1.41 | 28 |
| WM.fa.L | -0.09 | 0.7393 | -0.34 | 13 |
| GM.vol.R | -0.07 | 0.5343 | -0.62 | 69 |
| WM.vol.R | 0.23 | 0.316 | 1.03 | 19 |
| WM.fa.R | -0.55 | 2e-04 | -4.04 | 38 |

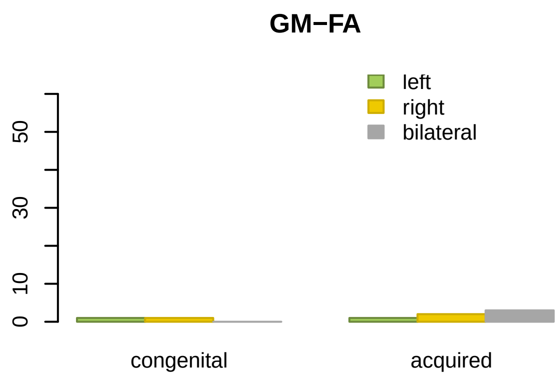


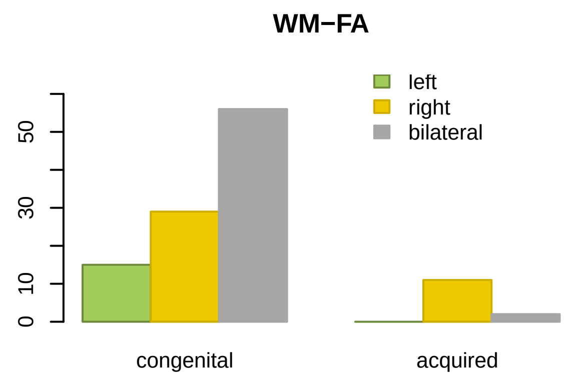
## Meta-regression: Variables by Etiology, Brain matter and MRI measure

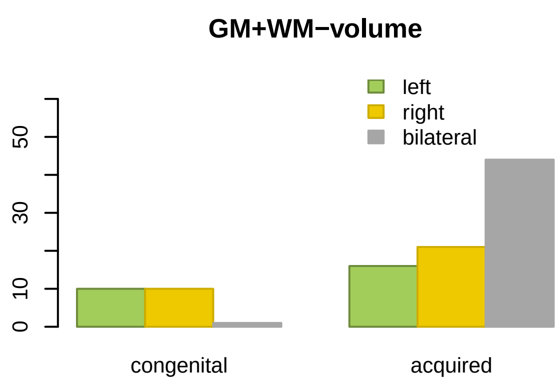




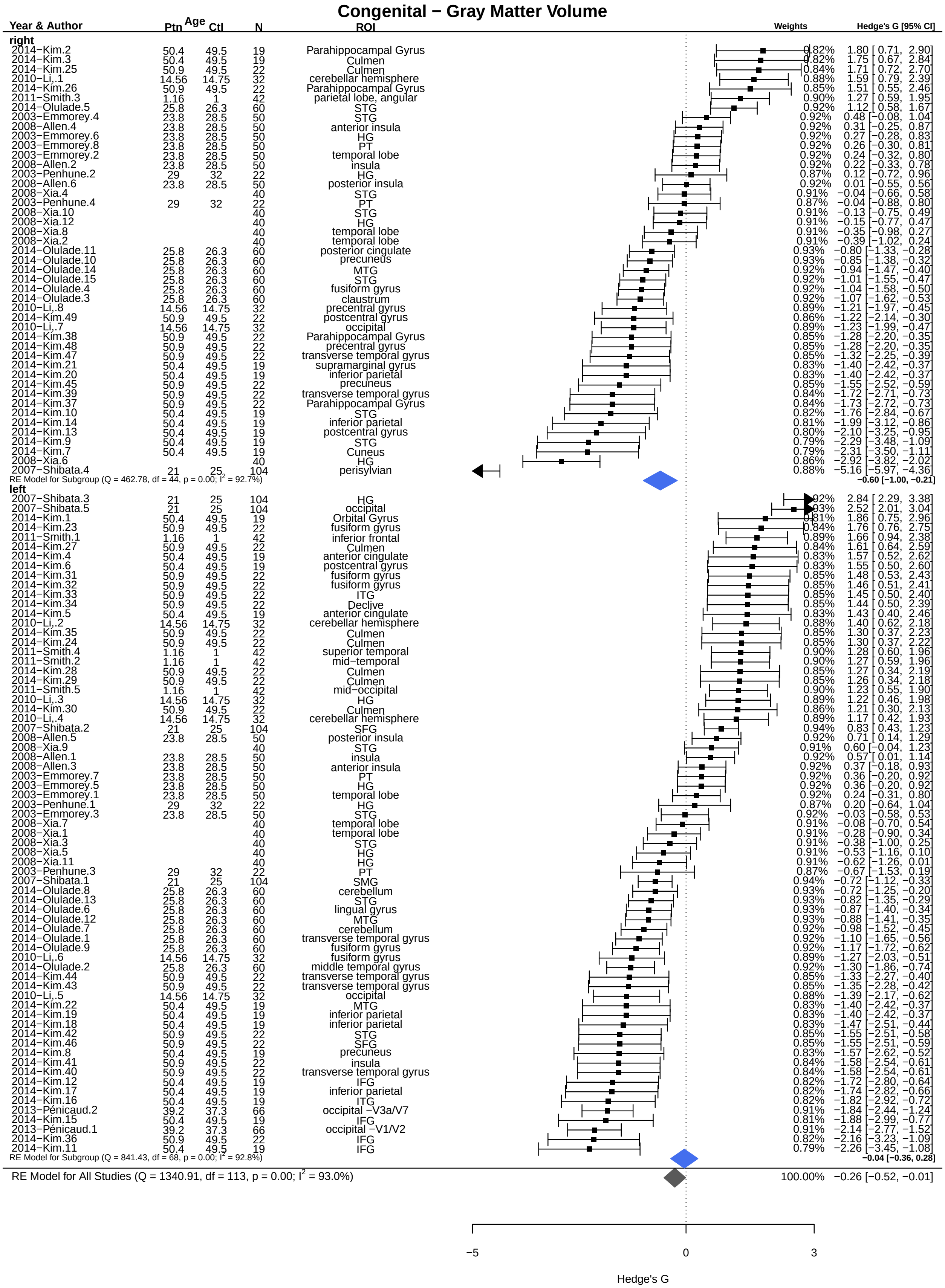

## Gray Matter Volume: Random effects model no intercept covariated by Big area

Table 11: Table continues below

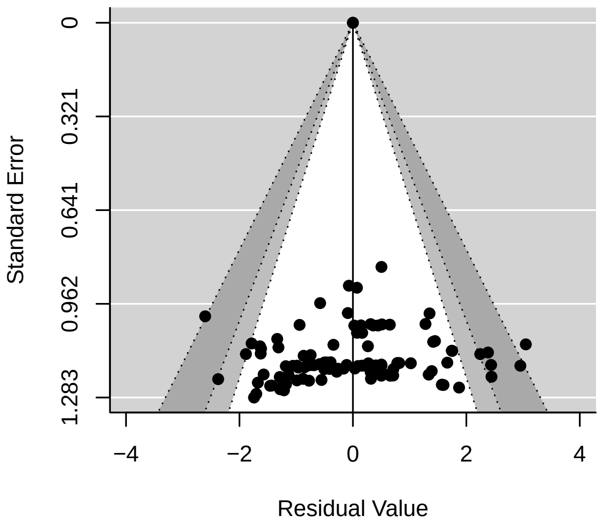
| | HedgeG | se | zval | ci.lo | ci.up |
|---|---|---|---|---|---|
| **left cerebellum** | 0.9013 | 0.3735 | 2.413 | 0.1693 | 1.633 |
| **left cingulate** | 1.5 | 0.9037 | 1.66 | -0.2712 | 3.271 |
| **left frontal** | -0.588 | 0.4468 | -1.316 | -1.464 | 0.2877 |
| **left insular cortex** | 0.0628 | 0.6065 | 0.1035 | -1.126 | 1.252 |
| **left occipital** | -0.5252 | 0.4567 | -1.15 | -1.42 | 0.3699 |

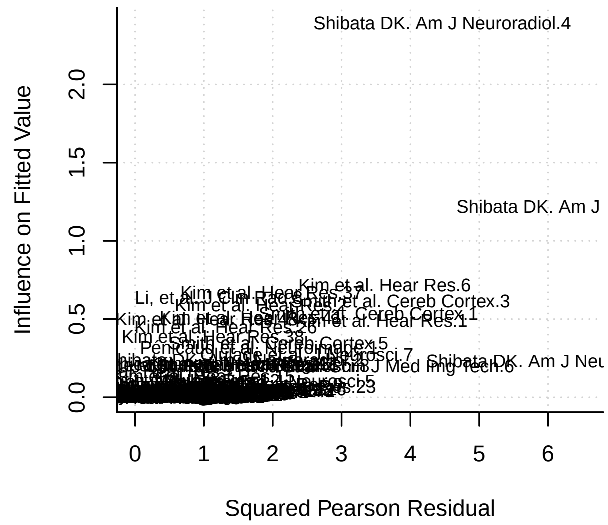
| | HedgeG | se | zval | ci.lo | ci.up |
|---|---|---|---|---|---|
| **left parietal** | -0.8875 | 0.5149 | -1.724 | -1.897 | 0.1217 |
| **left temporal** | -0.116 | 0.2235 | -0.5189 | -0.554 | 0.3221 |
| **left Thalamus** | 1.282 | 1.213 | 1.056 | -1.097 | 3.66 |
| **right cerebellum** | 1.682 | 0.7284 | 2.309 | 0.254 | 3.109 |
| **right cingulate** | -0.8018 | 1.193 | -0.6721 | -3.14 | 1.536 |
| **right entorhinal** | 0.05865 | 0.6339 | 0.09251 | -1.184 | 1.301 |
| **right frontal** | -2.559 | 0.7143 | -3.583 | -3.959 | -1.159 |
| **right insular cortex** | -0.1339 | 0.598 | -0.2239 | -1.306 | 1.038 |
| **right occipital** | -1.73 | 0.8957 | -1.932 | -3.486 | 0.02545 |
| **right parietal** | -1.113 | 0.4445 | -2.503 | -1.984 | -0.2413 |
| **right temporal** | -0.5427 | 0.2729 | -1.989 | -1.078 | -0.007815 |

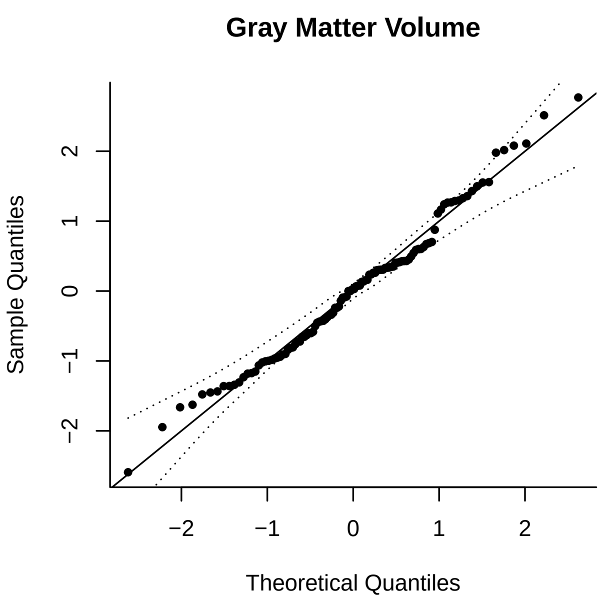
| | pval |
|---|---|
| **left cerebellum** | 0.01581 |
| **left cingulate** | 0.09694 |
| **left frontal** | 0.1882 |
| **left insular cortex** | 0.9175 |
| **left occipital** | 0.2502 |
| **left parietal** | 0.08478 |
| **left temporal** | 0.6039 |
| **left Thalamus** | 0.2909 |
| **right cerebellum** | 0.02096 |
| **right cingulate** | 0.5015 |
| **right entorhinal** | 0.9263 |
| **right frontal** | 0.0003399 |
| **right insular cortex** | 0.8228 |
| **right occipital** | 0.05341 |
| **right parietal** | 0.01233 |
| **right temporal** | 0.04675 |



Congenital − Gray Matter Volume
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
right
2014−Kim.2 50.4 49.5 19 Parahippocampal Gyrus 0.82% 1.80 [ 0.71, 2.90]
2014−Kim.3 50.4 49.5 19 Culmen 0.82% 1.75 [ 0.67, 2.84]
2014−Kim.25 50.9 49.5 22 Culmen 0.84% 1.71 [ 0.72, 2.70]
2010−Li,.1 14.56 14.75 32 cerebellar hemisphere 0.88% 1.59 [ 0.79, 2.39]
2014−Kim.26 50.9 49.5 22 Parahippocampal Gyrus 0.85% 1.51 [ 0.55, 2.46]
2011−Smith.3 1.16 1 42 parietal lobe, angular 0.90% 1.27 [ 0.59, 1.95]
2014−Olulade.5 25.8 26.3 60 STG 0.92% 1.12 [ 0.58, 1.67]
2003−Emmorey.4 23.8 28.5 50 STG 0.92% 0.48 [−0.08, 1.04]
2008−Allen.4 23.8 28.5 50 anterior insula 0.92% 0.31 [−0.25, 0.87]
2003−Emmorey.6 23.8 28.5 50 HG 0.92% 0.27 [−0.28, 0.83]
2003−Emmorey.8 23.8 28.5 50 PT 0.92% 0.26 [−0.30, 0.81]
2003−Emmorey.2 23.8 28.5 50 temporal lobe 0.92% 0.24 [−0.32, 0.80]
2008−Allen.2 23.8 28.5 50 insula 0.92% 0.22 [−0.33, 0.78]
2003−Penhune.2 29 32 22 HG 0.87% 0.12 [−0.72, 0.96]
2008−Allen.6 23.8 28.5 50 posterior insula 0.92% 0.01 [−0.55, 0.56]
2008−Xia.4 40 STG 0.91% −0.04 [−0.66, 0.58]
2003−Penhune.4 29 32 22 PT 0.87% −0.04 [−0.88, 0.80]
2008−Xia.10 40 STG 0.91% −0.13 [−0.75, 0.49]
2008−Xia.12 40 HG 0.91% −0.15 [−0.77, 0.47]
2008−Xia.8 40 temporal lobe 0.91% −0.35 [−0.98, 0.27]
2008−Xia.2 40 temporal lobe 0.91% −0.39 [−1.02, 0.24]
2014−Olulade.11 25.8 26.3 60 posterior cingulate 0.93% −0.80 [−1.33, −0.28]
2014−Olulade.10 25.8 26.3 60 precuneus 0.93% −0.85 [−1.38, −0.32]
2014−Olulade.14 25.8 26.3 60 MTG 0.92% −0.94 [−1.47, −0.40]
2014−Olulade.15 25.8 26.3 60 STG 0.92% −1.01 [−1.55, −0.47]
2014−Olulade.4 25.8 26.3 60 fusiform gyrus 0.92% −1.04 [−1.58, −0.50]
2014−Olulade.3 25.8 26.3 60 claustrum 0.92% −1.07 [−1.62, −0.53]
2010−Li,.8 14.56 14.75 32 precentral gyrus 0.89% −1.21 [−1.97, −0.45]
2014−Kim.49 50.9 49.5 22 postcentral gyrus 0.86% −1.22 [−2.14, −0.30]
2010−Li,.7 14.56 14.75 32 occipital 0.89% −1.23 [−1.99, −0.47]
2014−Kim.38 50.9 49.5 22 Parahippocampal Gyrus 0.85% −1.28 [−2.20, −0.35]
2014−Kim.48 50.9 49.5 22 precentral gyrus 0.85% −1.28 [−2.20, −0.35]
2014−Kim.47 50.9 49.5 22 transverse temporal gyrus 0.85% −1.32 [−2.25, −0.39]
2014−Kim.21 50.4 49.5 19 supramarginal gyrus 0.83% −1.40 [−2.42, −0.37]
2014−Kim.20 50.4 49.5 19 inferior parietal 0.83% −1.40 [−2.42, −0.37]
2014−Kim.45 50.9 49.5 22 precuneus 0.85% −1.55 [−2.52, −0.59]
2014−Kim.39 50.9 49.5 22 transverse temporal gyrus 0.84% −1.72 [−2.71, −0.73]
2014−Kim.37 50.9 49.5 22 Parahippocampal Gyrus 0.84% −1.73 [−2.72, −0.73]
2014−Kim.10 50.4 49.5 19 STG 0.82% −1.76 [−2.84, −0.67]
2014−Kim.14 50.4 49.5 19 inferior parietal 0.81% −1.99 [−3.12, −0.86]
2014−Kim.13 50.4 49.5 19 postcentral gyrus 0.80% −2.10 [−3.25, −0.95]
2014−Kim.9 50.4 49.5 19 STG 0.79% −2.29 [−3.48, −1.09]
2014−Kim.7 50.4 49.5 19 Cuneus 0.79% −2.31 [−3.50, −1.11]
2008−Xia.6 40 HG 0.86% −2.92 [−3.82, −2.02]
2007−Shibata.4 21 25 104 perisylvian 0.88% −5.16 [−5.97, −4.36]
RE Model for Subgroup (Q = 462.78, df = 44, p = 0.00; I² = 92.7%) −0.60 [−1.00, −0.21]
left
2007−Shibata.3 21 25 104 HG 0.92% 2.84 [ 2.29, 3.38]
2007−Shibata.5 21 25 104 occipital 0.93% 2.52 [ 2.01, 3.04]
2014−Kim.1 50.4 49.5 19 Orbital Gyrus 0.81% 1.86 [ 0.75, 2.96]
2014−Kim.23 50.9 49.5 22 fusiform gyrus 0.84% 1.76 [ 0.76, 2.75]
2011−Smith.1 1.16 1 42 inferior frontal 0.89% 1.66 [ 0.94, 2.38]
2014−Kim.27 50.9 49.5 22 Culmen 0.84% 1.61 [ 0.64, 2.59]
2014−Kim.4 50.4 49.5 19 anterior cingulate 0.83% 1.57 [ 0.52, 2.62]
2014−Kim.6 50.4 49.5 19 postcentral gyrus 0.83% 1.55 [ 0.50, 2.60]
2014−Kim.31 50.9 49.5 22 fusiform gyrus 0.85% 1.48 [ 0.53, 2.43]
2014−Kim.32 50.9 49.5 22 fusiform gyrus 0.85% 1.46 [ 0.51, 2.41]
2014−Kim.33 50.9 49.5 22 ITG 0.85% 1.45 [ 0.50, 2.40]
2014−Kim.34 50.9 49.5 22 Declive 0.85% 1.44 [ 0.50, 2.39]
2014−Kim.5 50.4 49.5 19 anterior cingulate 0.83% 1.43 [ 0.40, 2.46]
2010−Li,.2 14.56 14.75 32 cerebellar hemisphere 0.88% 1.40 [ 0.62, 2.18]
2014−Kim.35 50.9 49.5 22 Culmen 0.85% 1.30 [ 0.37, 2.23]
2014−Kim.24 50.9 49.5 22 Culmen 0.85% 1.30 [ 0.37, 2.22]
2011−Smith.4 1.16 1 42 superior temporal 0.90% 1.28 [ 0.60, 1.96]
2011−Smith.2 1.16 1 42 mid−temporal 0.90% 1.27 [ 0.59, 1.96]
2014−Kim.28 50.9 49.5 22 Culmen 0.85% 1.27 [ 0.34, 2.19]
2014−Kim.29 50.9 49.5 22 Culmen 0.85% 1.26 [ 0.34, 2.18]
2011−Smith.5 1.16 1 42 mid−occipital 0.90% 1.23 [ 0.55, 1.90]
2010−Li,.3 14.56 14.75 32 HG 0.89% 1.22 [ 0.46, 1.98]
2014−Kim.30 50.9 49.5 22 Culmen 0.86% 1.21 [ 0.30, 2.13]
2010−Li,.4 14.56 14.75 32 cerebellar hemisphere 0.89% 1.17 [ 0.42, 1.93]
2007−Shibata.2 21 25 104 SFG 0.94% 0.83 [ 0.43, 1.23]
2008−Allen.5 23.8 28.5 50 posterior insula 0.92% 0.71 [ 0.14, 1.29]
2008−Xia.9 40 STG 0.91% 0.60 [−0.04, 1.23]
2008−Allen.1 23.8 28.5 50 insula 0.92% 0.57 [ 0.01, 1.14]
2008−Allen.3 23.8 28.5 50 anterior insula 0.92% 0.37 [−0.18, 0.93]
2003−Emmorey.7 23.8 28.5 50 PT 0.92% 0.36 [−0.20, 0.92]
2003−Emmorey.5 23.8 28.5 50 HG 0.92% 0.36 [−0.20, 0.92]
2003−Emmorey.1 23.8 28.5 50 temporal lobe 0.92% 0.24 [−0.31, 0.80]
2003−Penhune.1 29 32 22 HG 0.87% 0.20 [−0.64, 1.04]
2003−Emmorey.3 23.8 28.5 50 STG 0.92% −0.03 [−0.58, 0.53]
2008−Xia.7 40 temporal lobe 0.91% −0.08 [−0.70, 0.54]
2008−Xia.1 40 temporal lobe 0.91% −0.28 [−0.90, 0.34]
2008−Xia.3 40 STG 0.91% −0.38 [−1.00, 0.25]
2008−Xia.5 40 HG 0.91% −0.53 [−1.16, 0.10]
2008−Xia.11 40 HG 0.91% −0.62 [−1.26, 0.01]
2003−Penhune.3 29 32 22 PT 0.87% −0.67 [−1.53, 0.19]
2007−Shibata.1 21 25 104 SMG 0.94% −0.72 [−1.12, −0.33]
2014−Olulade.8 25.8 26.3 60 cerebellum 0.93% −0.72 [−1.25, −0.20]
2014−Olulade.13 25.8 26.3 60 STG 0.93% −0.82 [−1.35, −0.29]
2014−Olulade.6 25.8 26.3 60 lingual gyrus 0.93% −0.87 [−1.40, −0.34]
2014−Olulade.12 25.8 26.3 60 MTG 0.93% −0.88 [−1.41, −0.35]
2014−Olulade.7 25.8 26.3 60 cerebellum 0.92% −0.98 [−1.52, −0.45]
2014−Olulade.1 25.8 26.3 60 transverse temporal gyrus 0.92% −1.10 [−1.65, −0.56]
2014−Olulade.9 25.8 26.3 60 fusiform gyrus 0.92% −1.17 [−1.72, −0.62]
2010−Li,.6 14.56 14.75 32 fusiform gyrus 0.89% −1.27 [−2.03, −0.51]
2014−Olulade.2 25.8 26.3 60 middle temporal gyrus 0.92% −1.30 [−1.86, −0.74]
2014−Kim.44 50.9 49.5 22 transverse temporal gyrus 0.85% −1.33 [−2.27, −0.40]
2014−Kim.43 50.9 49.5 22 transverse temporal gyrus 0.85% −1.35 [−2.28, −0.42]
2010−Li,.5 14.56 14.75 32 occipital 0.88% −1.39 [−2.17, −0.62]
2014−Kim.22 50.4 49.5 19 MTG 0.83% −1.40 [−2.42, −0.37]
2014−Kim.19 50.4 49.5 19 inferior parietal 0.83% −1.40 [−2.42, −0.37]
2014−Kim.18 50.4 49.5 19 inferior parietal 0.83% −1.47 [−2.51, −0.44]
2014−Kim.42 50.9 49.5 22 STG 0.85% −1.55 [−2.51, −0.58]
2014−Kim.46 50.9 49.5 22 SFG 0.85% −1.55 [−2.51, −0.59]
2014−Kim.8 50.4 49.5 19 precuneus 0.83% −1.57 [−2.62, −0.52]
2014−Kim.41 50.9 49.5 22 insula 0.84% −1.58 [−2.54, −0.61]
2014−Kim.40 50.9 49.5 22 transverse temporal gyrus 0.84% −1.58 [−2.54, −0.61]
2014−Kim.12 50.4 49.5 19 IFG 0.82% −1.72 [−2.80, −0.64]
2014−Kim.17 50.4 49.5 19 inferior parietal 0.82% −1.74 [−2.82, −0.66]
2014−Kim.16 50.4 49.5 19 ITG 0.82% −1.82 [−2.92, −0.72]
2013−Pénicaud.2 39.2 37.3 66 occipital −V3a/V7 0.91% −1.84 [−2.44, −1.24]
2014−Kim.15 50.4 49.5 19 IFG 0.81% −1.88 [−2.99, −0.77]
2013−Pénicaud.1 39.2 37.3 66 occipital −V1/V2 0.91% −2.14 [−2.77, −1.52]
2014−Kim.36 50.9 49.5 22 IFG 0.82% −2.16 [−3.23, −1.09]
2014−Kim.11 50.4 49.5 19 IFG 0.79% −2.26 [−3.45, −1.08]
RE Model for Subgroup (Q = 841.43, df = 68, p = 0.00; I² = 92.8%) −0.04 [−0.36, 0.28]
RE Model for All Studies (Q = 1340.91, df = 113, p = 0.00; I² = 93.0%) 100.00% −0.26 [−0.52, −0.01]
−5
0
3
Hedge's G




## ACQUIRED - Meta-regressions of Gray Matter by Volume

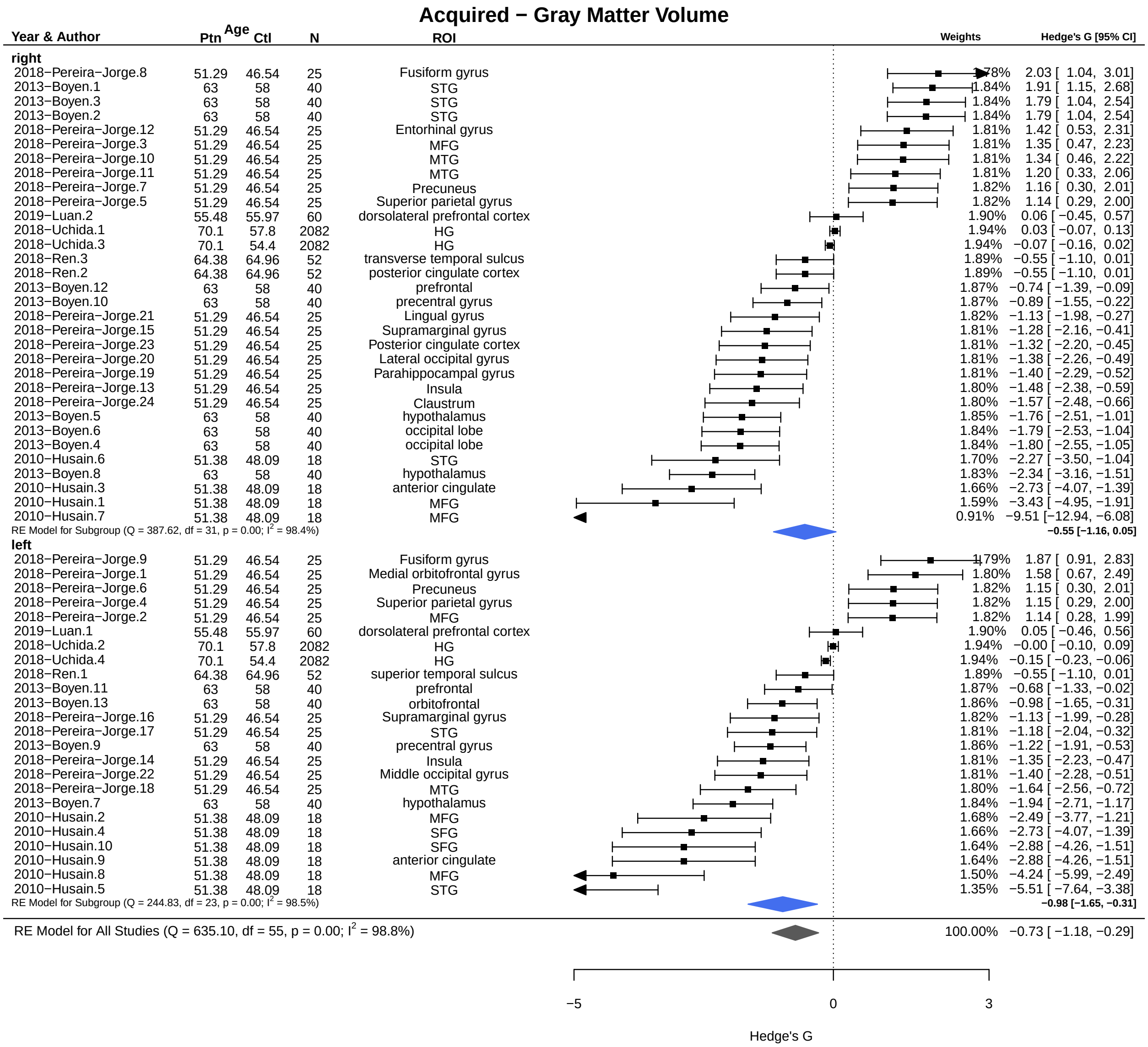
Random effects model no intercept covariated by Big area

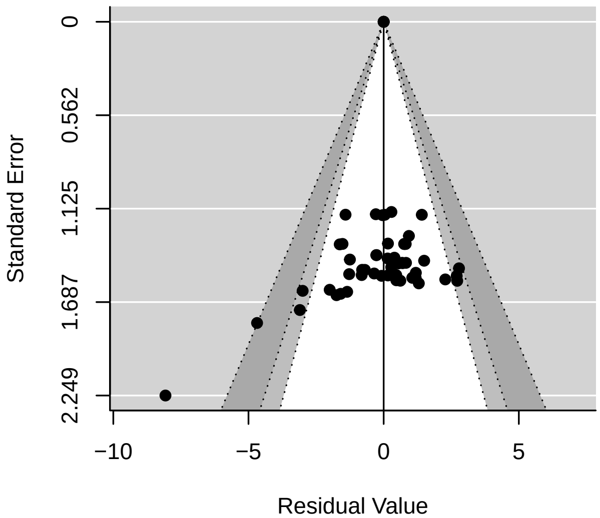
Table 13: Table continues below

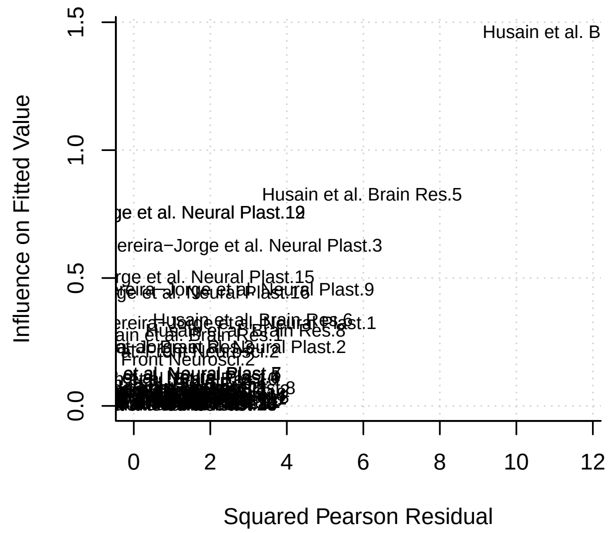
| | HedgeG | se | zval | ci.lo | ci.up |
|---|---|---|---|---|---|
| **left cingulate** | -2.883 | 1.728 | -1.669 | -6.269 | 0.5024 |
| **left frontal** | -1.14 | 0.5268 | -2.164 | -2.173 | -0.1076 |
| **left hypothalamus** | -1.937 | 1.626 | -1.191 | -5.124 | 1.25 |
| **left insular cortex** | -1.353 | 1.641 | -0.8248 | -4.57 | 1.863 |
| **left occipital** | -1.398 | 1.642 | -0.8514 | -4.616 | 1.82 |
| **left parietal** | 0.3896 | 0.9454 | 0.4121 | -1.463 | 2.243 |
| **left temporal** | -0.8302 | 0.6236 | -1.331 | -2.052 | 0.3921 |
| **right cingulate** | -1.483 | 0.954 | -1.554 | -3.352 | 0.3872 |

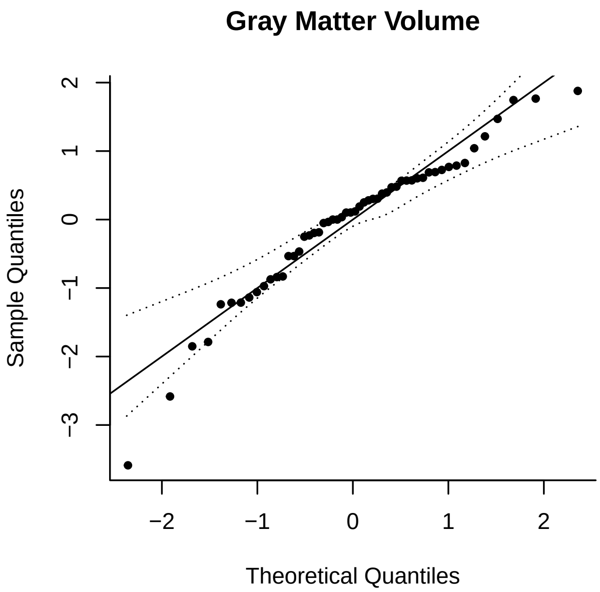
| | HedgeG | se | zval | ci.lo | ci.up |
|---|---|---|---|---|---|
| **right entorhinal** | 0.007072 | 1.161 | 0.006091 | -2.269 | 2.283 |
| **right frontal** | -1.438 | 0.7012 | -2.05 | -2.812 | -0.06331 |
| **right hypothalamus** | -2.047 | 1.151 | -1.778 | -4.304 | 0.2095 |
| **right insular cortex** | -1.525 | 1.163 | -1.311 | -3.803 | 0.7542 |
| **right occipital** | -1.524 | 0.8158 | -1.868 | -3.123 | 0.07522 |
| **right parietal** | 0.3405 | 0.9459 | 0.36 | -1.513 | 2.194 |
| **right temporal** | 0.727 | 0.5141 | 1.414 | -0.2806 | 1.735 |

| | pval |
|---|---|
| **left cingulate** | 0.09509 |
| **left frontal** | 0.03045 |
| **left hypothalamus** | 0.2335 |
| **left insular cortex** | 0.4095 |
| **left occipital** | 0.3945 |
| **left parietal** | 0.6803 |
| **left temporal** | 0.1831 |
| **right cingulate** | 0.1202 |
| **right entorhinal** | 0.9951 |
| **right frontal** | 0.04034 |
| **right hypothalamus** | 0.0754 |
| **right insular cortex** | 0.1898 |
| **right occipital** | 0.0618 |
| **right parietal** | 0.7189 |
| **right temporal** | 0.1573 |


Acquired − Gray Matter Volume
Year & Author | Age Ptn | Age Ctl | N | ROI | Weights | Hedge's G [95% CI]
right
2018−Pereira−Jorge.8 51.29 46.54 25 Fusiform gyrus 1.78% 2.03 [ 1.04, 3.01]
2013−Boyen.1 63 58 40 STG 1.84% 1.91 [ 1.15, 2.68]
2013−Boyen.3 63 58 40 STG 1.84% 1.79 [ 1.04, 2.54]
2013−Boyen.2 63 58 40 STG 1.84% 1.79 [ 1.04, 2.54]
2018−Pereira−Jorge.12 51.29 46.54 25 Entorhinal gyrus 1.81% 1.42 [ 0.53, 2.31]
2018−Pereira−Jorge.3 51.29 46.54 25 MFG 1.81% 1.35 [ 0.47, 2.23]
2018−Pereira−Jorge.10 51.29 46.54 25 MTG 1.81% 1.34 [ 0.46, 2.22]
2018−Pereira−Jorge.11 51.29 46.54 25 MTG 1.81% 1.20 [ 0.33, 2.06]
2018−Pereira−Jorge.7 51.29 46.54 25 Precuneus 1.82% 1.16 [ 0.30, 2.01]
2018−Pereira−Jorge.5 51.29 46.54 25 Superior parietal gyrus 1.82% 1.14 [ 0.29, 2.00]
2019−Luan.2 55.48 55.97 60 dorsolateral prefrontal cortex 1.90% 0.06 [ −0.45, 0.57]
2018−Uchida.1 70.1 57.8 2082 HG 1.94% 0.03 [ −0.07, 0.13]
2018−Uchida.3 70.1 54.4 2082 HG 1.94% −0.07 [ −0.16, 0.02]
2018−Ren.3 64.38 64.96 52 transverse temporal sulcus 1.89% −0.55 [ −1.10, 0.01]
2018−Ren.2 64.38 64.96 52 posterior cingulate cortex 1.89% −0.55 [ −1.10, 0.01]
2013−Boyen.12 63 58 40 prefrontal 1.87% −0.74 [ −1.39, −0.09]
2013−Boyen.10 63 58 40 precentral gyrus 1.87% −0.89 [ −1.55, −0.22]
2018−Pereira−Jorge.21 51.29 46.54 25 Lingual gyrus 1.82% −1.13 [ −1.98, −0.27]
2018−Pereira−Jorge.15 51.29 46.54 25 Supramarginal gyrus 1.81% −1.28 [ −2.16, −0.41]
2018−Pereira−Jorge.23 51.29 46.54 25 Posterior cingulate cortex 1.81% −1.32 [ −2.20, −0.45]
2018−Pereira−Jorge.20 51.29 46.54 25 Lateral occipital gyrus 1.81% −1.38 [ −2.26, −0.49]
2018−Pereira−Jorge.19 51.29 46.54 25 Parahippocampal gyrus 1.81% −1.40 [ −2.29, −0.52]
2018−Pereira−Jorge.13 51.29 46.54 25 Insula 1.80% −1.48 [ −2.38, −0.59]
2018−Pereira−Jorge.24 51.29 46.54 25 Claustrum 1.80% −1.57 [ −2.48, −0.66]
2013−Boyen.5 63 58 40 hypothalamus 1.85% −1.76 [ −2.51, −1.01]
2013−Boyen.6 63 58 40 occipital lobe 1.84% −1.79 [ −2.53, −1.04]
2013−Boyen.4 63 58 40 occipital lobe 1.84% −1.80 [ −2.55, −1.05]
2010−Husain.6 51.38 48.09 18 STG 1.70% −2.27 [ −3.50, −1.04]
2013−Boyen.8 63 58 40 hypothalamus 1.83% −2.34 [ −3.16, −1.51]
2010−Husain.3 51.38 48.09 18 anterior cingulate 1.66% −2.73 [ −4.07, −1.39]
2010−Husain.1 51.38 48.09 18 MFG 1.59% −3.43 [ −4.95, −1.91]
2010−Husain.7 51.38 48.09 18 MFG 0.91% −9.51 [ −12.94, −6.08]
RE Model for Subgroup (Q = 387.62, df = 31, p = 0.00; I² = 98.4%) −0.55 [−1.16, 0.05]
left
2018−Pereira−Jorge.9 51.29 46.54 25 Fusiform gyrus 1.79% 1.87 [ 0.91, 2.83]
2018−Pereira−Jorge.1 51.29 46.54 25 Medial orbitofrontal gyrus 1.80% 1.58 [ 0.67, 2.49]
2018−Pereira−Jorge.6 51.29 46.54 25 Precuneus 1.82% 1.15 [ 0.30, 2.01]
2018−Pereira−Jorge.4 51.29 46.54 25 Superior parietal gyrus 1.82% 1.15 [ 0.29, 2.00]
2018−Pereira−Jorge.2 51.29 46.54 25 MFG 1.82% 1.14 [ 0.28, 1.99]
2019−Luan.1 55.48 55.97 60 dorsolateral prefrontal cortex 1.90% 0.05 [ −0.46, 0.56]
2018−Uchida.2 70.1 57.8 2082 HG 1.94% −0.00 [ −0.10, 0.09]
2018−Uchida.4 70.1 54.4 2082 HG 1.94% −0.15 [ −0.23, −0.06]
2018−Ren.1 64.38 64.96 52 superior temporal sulcus 1.89% −0.55 [ −1.10, 0.01]
2013−Boyen.11 63 58 40 prefrontal 1.87% −0.68 [ −1.33, −0.02]
2013−Boyen.13 63 58 40 orbitofrontal 1.86% −0.98 [ −1.65, −0.31]
2018−Pereira−Jorge.16 51.29 46.54 25 Supramarginal gyrus 1.82% −1.13 [ −1.99, −0.28]
2018−Pereira−Jorge.17 51.29 46.54 25 STG 1.81% −1.18 [ −2.04, −0.32]
2013−Boyen.9 63 58 40 precentral gyrus 1.86% −1.22 [ −1.91, −0.53]
2018−Pereira−Jorge.14 51.29 46.54 25 Insula 1.81% −1.35 [ −2.23, −0.47]
2018−Pereira−Jorge.22 51.29 46.54 25 Middle occipital gyrus 1.81% −1.40 [ −2.28, −0.51]
2018−Pereira−Jorge.18 51.29 46.54 25 MTG 1.80% −1.64 [ −2.56, −0.72]
2013−Boyen.7 63 58 40 hypothalamus 1.84% −1.94 [ −2.71, −1.17]
2010−Husain.2 51.38 48.09 18 MFG 1.68% −2.49 [ −3.77, −1.21]
2010−Husain.4 51.38 48.09 18 SFG 1.66% −2.73 [ −4.07, −1.39]
2010−Husain.10 51.38 48.09 18 SFG 1.64% −2.88 [ −4.26, −1.51]
2010−Husain.9 51.38 48.09 18 anterior cingulate 1.64% −2.88 [ −4.26, −1.51]
2010−Husain.8 51.38 48.09 18 MFG 1.50% −4.24 [ −5.99, −2.49]
2010−Husain.5 51.38 48.09 18 STG 1.35% −5.51 [ −7.64, −3.38]
RE Model for Subgroup (Q = 244.83, df = 23, p = 0.00; I² = 98.5%) −0.98 [−1.65, −0.31]
RE Model for All Studies (Q = 635.10, df = 55, p = 0.00; I² = 98.8%) 100.00% −0.73 [ −1.18, −0.29]
−5
0
3
Hedge's G



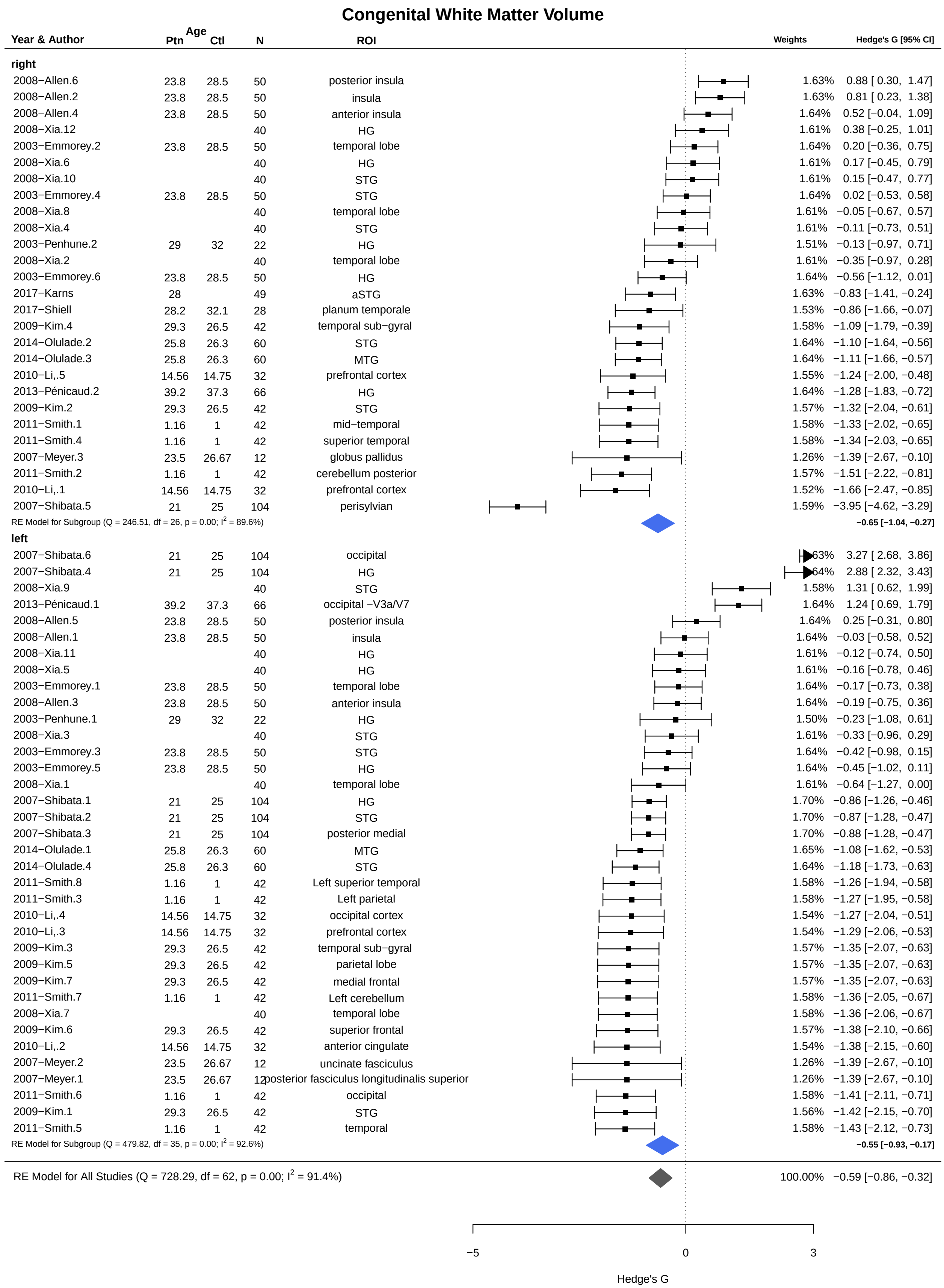



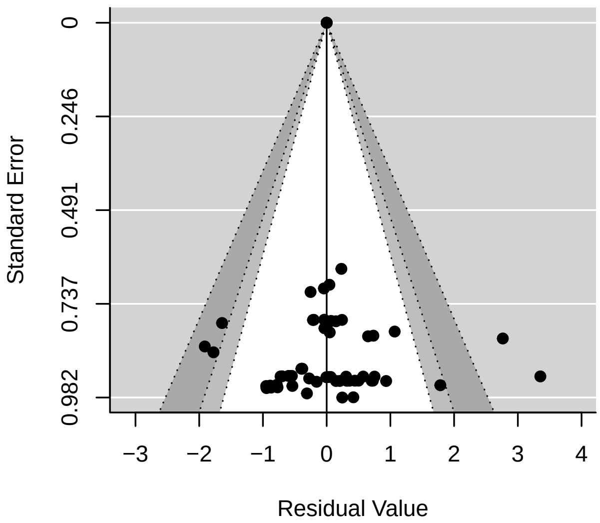

## CONGENITAL - White Matter by VOLUME

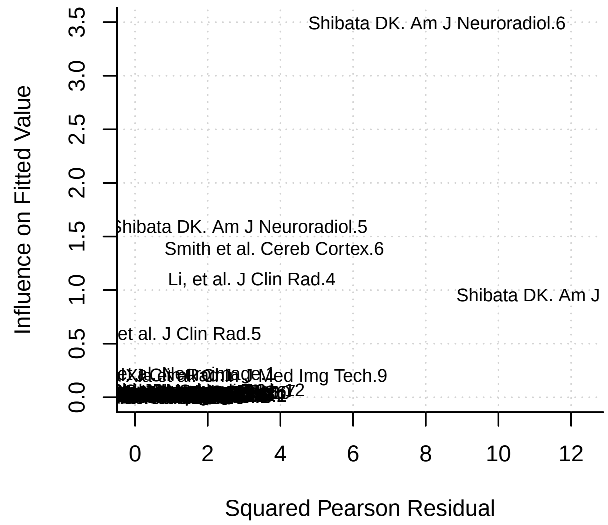
Random effects model no intercept covariated by Big area

| | HedgeG | se | zval | ci.lo | ci.up | N |
|---|---|---|---|---|---|---|
| **left cerebellum** | -1.107 | 0.6745 | -1.641 | -2.429 | 0.2149 | 2 |
| **left cingulate** | -1.379 | 0.9926 | -1.389 | -3.324 | 0.5668 | 1 |
| **left frontal** | -1.34 | 0.5684 | -2.358 | -2.454 | -0.2262 | 3 |
| **left insular cortex** | 0.007913 | 0.5504 | 0.01438 | -1.071 | 1.087 | 3 |
| **left occipital** | 0.5024 | 0.4846 | 1.037 | -0.4475 | 1.452 | 4 |
| **left parietal** | -1.308 | 0.6914 | -1.892 | -2.663 | 0.04705 | 2 |
| **left temporal** | -0.478 | 0.2211 | -2.163 | -0.9113 | -0.04478 | 19 |
| **left tract** | -1.386 | 0.7931 | -1.747 | -2.94 | 0.1688 | 2 |
| **right cerebellum** | -1.513 | 0.9789 | -1.546 | -3.432 | 0.4051 | 1 |
| **right forebrain** | -1.386 | 1.122 | -1.235 | -3.584 | 0.8126 | 1 |

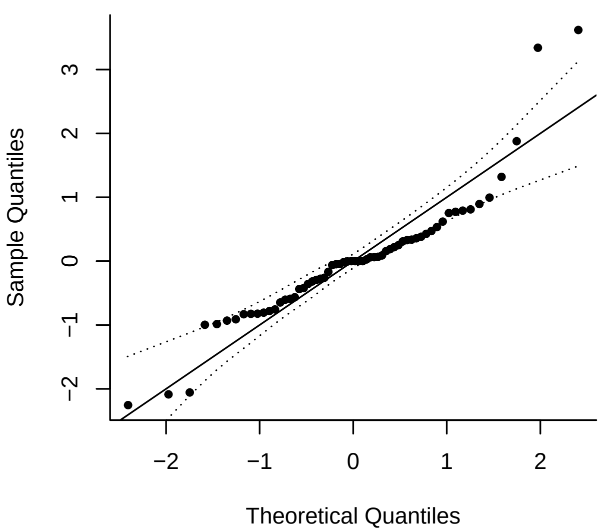
| | HedgeG | se | zval | ci.lo | ci.up | N |
|---|---|---|---|---|---|---|
| **right frontal** | -2.31 | 0.5697 | -4.055 | -3.426 | -1.193 | 3 |
| **right insular cortex** | 0.737 | 0.5521 | 1.335 | -0.3451 | 1.819 | 3 |
| **right temporal** | -0.5529 | 0.2218 | -2.493 | -0.9875 | -0.1183 | 19 |


Congenital White Matter Volume
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
right
2008−Allen.6 23.8 28.5 50 posterior insula 1.63% 0.88 [ 0.30, 1.47]
2008−Allen.2 23.8 28.5 50 insula 1.63% 0.81 [ 0.23, 1.38]
2008−Allen.4 23.8 28.5 50 anterior insula 1.64% 0.52 [−0.04, 1.09]
2008−Xia.12 40 HG 1.61% 0.38 [−0.25, 1.01]
2003−Emmorey.2 23.8 28.5 50 temporal lobe 1.64% 0.20 [−0.36, 0.75]
2008−Xia.6 40 HG 1.61% 0.17 [−0.45, 0.79]
2008−Xia.10 40 STG 1.61% 0.15 [−0.47, 0.77]
2003−Emmorey.4 23.8 28.5 50 STG 1.64% 0.02 [−0.53, 0.58]
2008−Xia.8 40 temporal lobe 1.61% −0.05 [−0.67, 0.57]
2008−Xia.4 40 STG 1.61% −0.11 [−0.73, 0.51]
2003−Penhune.2 29 32 22 HG 1.51% −0.13 [−0.97, 0.71]
2008−Xia.2 40 temporal lobe 1.61% −0.35 [−0.97, 0.28]
2003−Emmorey.6 23.8 28.5 50 HG 1.64% −0.56 [−1.12, 0.01]
2017−Karns 28 49 aSTG 1.63% −0.83 [−1.41, −0.24]
2017−Shiell 28.2 32.1 28 planum temporale 1.53% −0.86 [−1.66, −0.07]
2009−Kim.4 29.3 26.5 42 temporal sub−gyral 1.58% −1.09 [−1.79, −0.39]
2014−Olulade.2 25.8 26.3 60 STG 1.64% −1.10 [−1.64, −0.56]
2014−Olulade.3 25.8 26.3 60 MTG 1.64% −1.11 [−1.66, −0.57]
2010−Li,.5 14.56 14.75 32 prefrontal cortex 1.55% −1.24 [−2.00, −0.48]
2013−Pénicaud.2 39.2 37.3 66 HG 1.64% −1.28 [−1.83, −0.72]
2009−Kim.2 29.3 26.5 42 STG 1.57% −1.32 [−2.04, −0.61]
2011−Smith.1 1.16 1 42 mid−temporal 1.58% −1.33 [−2.02, −0.65]
2011−Smith.4 1.16 1 42 superior temporal 1.58% −1.34 [−2.03, −0.65]
2007−Meyer.3 23.5 26.67 12 globus pallidus 1.26% −1.39 [−2.67, −0.10]
2011−Smith.2 1.16 1 42 cerebellum posterior 1.57% −1.51 [−2.22, −0.81]
2010−Li,.1 14.56 14.75 32 prefrontal cortex 1.52% −1.66 [−2.47, −0.85]
2007−Shibata.5 21 25 104 perisylvian 1.59% −3.95 [−4.62, −3.29]
RE Model for Subgroup (Q = 246.51, df = 26, p = 0.00; $I^2$ = 89.6%) −0.65 [−1.04, −0.27]
left
2007−Shibata.6 21 25 104 occipital 63% 3.27 [ 2.68, 3.86]
2007−Shibata.4 21 25 104 HG 64% 2.88 [ 2.32, 3.43]
2008−Xia.9 40 STG 1.58% 1.31 [ 0.62, 1.99]
2013−Pénicaud.1 39.2 37.3 66 occipital −V3a/V7 1.64% 1.24 [ 0.69, 1.79]
2008−Allen.5 23.8 28.5 50 posterior insula 1.64% 0.25 [−0.31, 0.80]
2008−Allen.1 23.8 28.5 50 insula 1.64% −0.03 [−0.58, 0.52]
2008−Xia.11 40 HG 1.61% −0.12 [−0.74, 0.50]
2008−Xia.5 40 HG 1.61% −0.16 [−0.78, 0.46]
2003−Emmorey.1 23.8 28.5 50 temporal lobe 1.64% −0.17 [−0.73, 0.38]
2008−Allen.3 23.8 28.5 50 anterior insula 1.64% −0.19 [−0.75, 0.36]
2003−Penhune.1 29 32 22 HG 1.50% −0.23 [−1.08, 0.61]
2008−Xia.3 40 STG 1.61% −0.33 [−0.96, 0.29]
2003−Emmorey.3 23.8 28.5 50 STG 1.64% −0.42 [−0.98, 0.15]
2003−Emmorey.5 23.8 28.5 50 HG 1.64% −0.45 [−1.02, 0.11]
2008−Xia.1 40 temporal lobe 1.61% −0.64 [−1.27, 0.00]
2007−Shibata.1 21 25 104 HG 1.70% −0.86 [−1.26, −0.46]
2007−Shibata.2 21 25 104 STG 1.70% −0.87 [−1.28, −0.47]
2007−Shibata.3 21 25 104 posterior medial 1.70% −0.88 [−1.28, −0.47]
2014−Olulade.1 25.8 26.3 60 MTG 1.65% −1.08 [−1.62, −0.53]
2014−Olulade.4 25.8 26.3 60 STG 1.64% −1.18 [−1.73, −0.63]
2011−Smith.8 1.16 1 42 Left superior temporal 1.58% −1.26 [−1.94, −0.58]
2011−Smith.3 1.16 1 42 Left parietal 1.58% −1.27 [−1.95, −0.58]
2010−Li,.4 14.56 14.75 32 occipital cortex 1.54% −1.27 [−2.04, −0.51]
2010−Li,.3 14.56 14.75 32 prefrontal cortex 1.54% −1.29 [−2.06, −0.53]
2009−Kim.3 29.3 26.5 42 temporal sub−gyral 1.57% −1.35 [−2.07, −0.63]
2009−Kim.5 29.3 26.5 42 parietal lobe 1.57% −1.35 [−2.07, −0.63]
2009−Kim.7 29.3 26.5 42 medial frontal 1.57% −1.35 [−2.07, −0.63]
2011−Smith.7 1.16 1 42 Left cerebellum 1.58% −1.36 [−2.05, −0.67]
2008−Xia.7 40 temporal lobe 1.58% −1.36 [−2.06, −0.67]
2009−Kim.6 29.3 26.5 42 superior frontal 1.57% −1.38 [−2.10, −0.66]
2010−Li,.2 14.56 14.75 32 anterior cingulate 1.54% −1.38 [−2.15, −0.60]
2007−Meyer.2 23.5 26.67 12 uncinate fasciculus 1.26% −1.39 [−2.67, −0.10]
2007−Meyer.1 23.5 26.67 12 posterior fasciculus longitudinalis superior 1.26% −1.39 [−2.67, −0.10]
2011−Smith.6 1.16 1 42 occipital 1.58% −1.41 [−2.11, −0.71]
2009−Kim.1 29.3 26.5 42 STG 1.56% −1.42 [−2.15, −0.70]
2011−Smith.5 1.16 1 42 temporal 1.58% −1.43 [−2.12, −0.73]
RE Model for Subgroup (Q = 479.82, df = 35, p = 0.00; $I^2$ = 92.6%) −0.55 [−0.93, −0.17]
RE Model for All Studies (Q = 728.29, df = 62, p = 0.00; $I^2$ = 91.4%) 100.00% −0.59 [−0.86, −0.32]
−5
0
3
Hedge's G



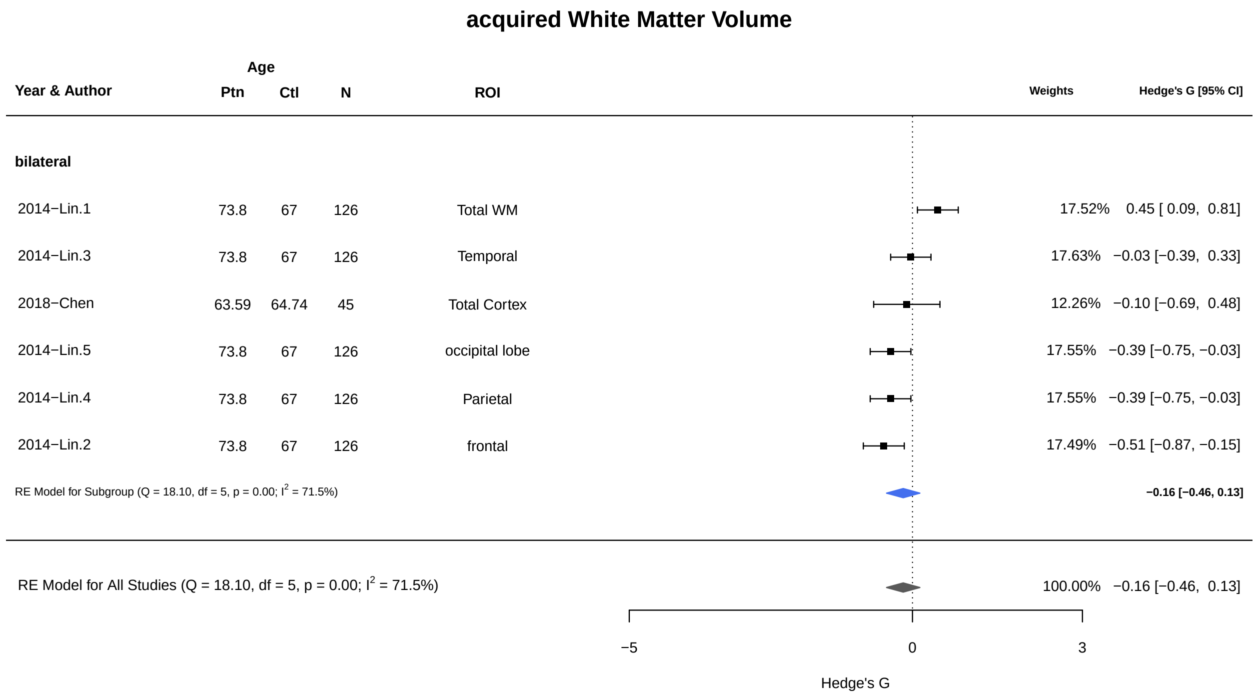



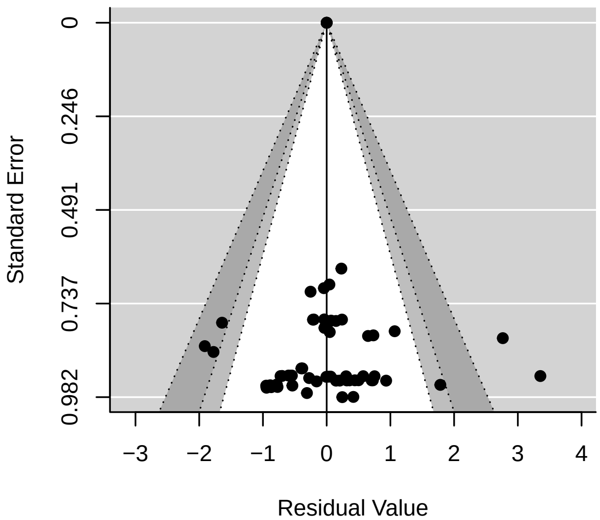

Congenital White Matter Volume

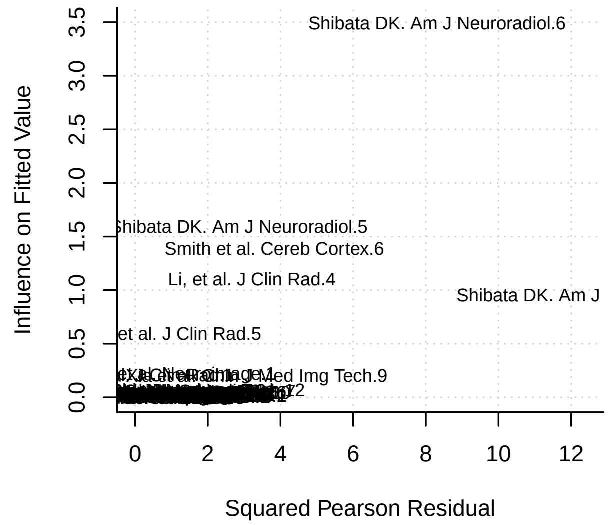


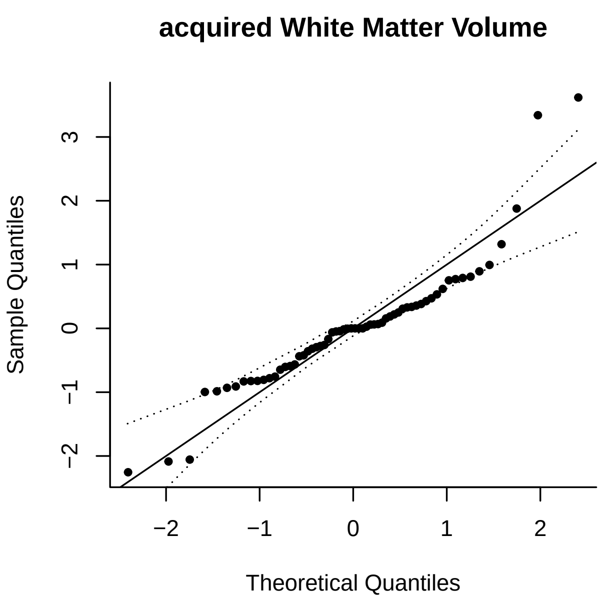

## ACQUIRED - White Matter by VOLUME

Not enough values for the Random effects model no intercept covariated by Big area and Side (left or right)


acquired White Matter Volume
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
bilateral
2014−Lin.1 73.8 67 126 Total WM 17.52% 0.45 [ 0.09, 0.81]
2014−Lin.3 73.8 67 126 Temporal 17.63% −0.03 [−0.39, 0.33]
2018−Chen 63.59 64.74 45 Total Cortex 12.26% −0.10 [−0.69, 0.48]
2014−Lin.5 73.8 67 126 occipital lobe 17.55% −0.39 [−0.75, −0.03]
2014−Lin.4 73.8 67 126 Parietal 17.55% −0.39 [−0.75, −0.03]
2014−Lin.2 73.8 67 126 frontal 17.49% −0.51 [−0.87, −0.15]
RE Model for Subgroup (Q = 18.10, df = 5, p = 0.00; I2 = 71.5%) −0.16 [−0.46, 0.13]
RE Model for All Studies (Q = 18.10, df = 5, p = 0.00; I2 = 71.5%) 100.00% −0.16 [−0.46, 0.13]
−5
0
3
Hedge's G




## CONGENITAL - White Matter by FA fractional anisotropy

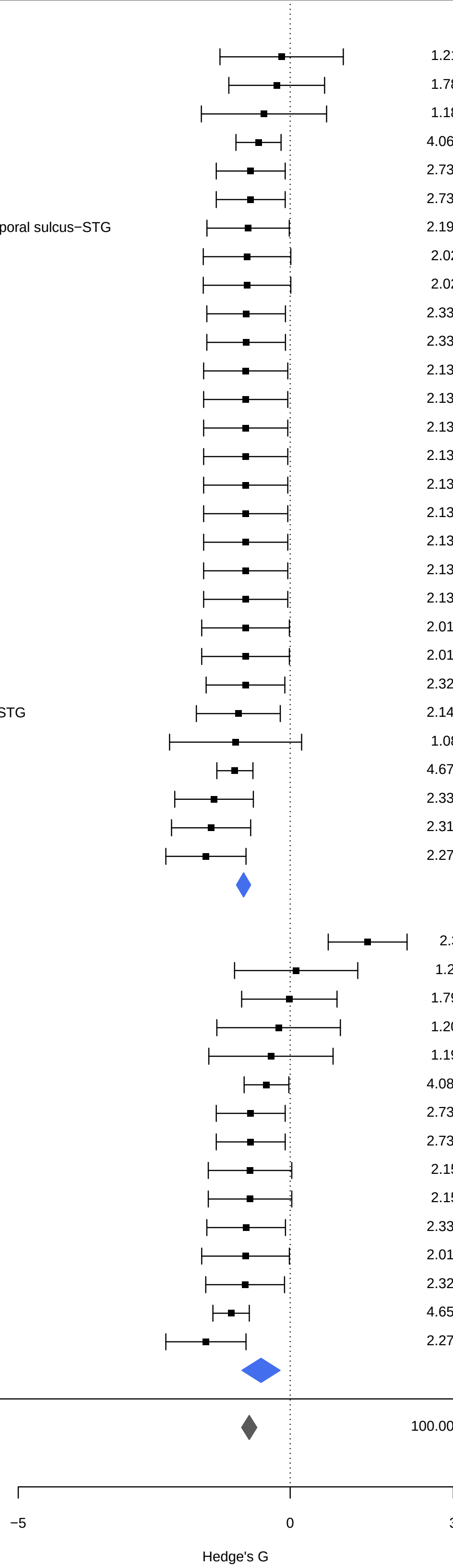
Random effects model no intercept covariated by Big area

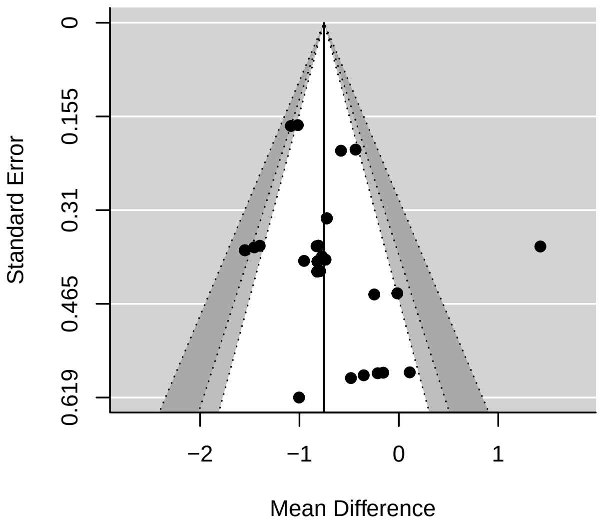
| | HedgeG | se | zval | ci.lo | ci.up | N |
|---|---|---|---|---|---|---|
| **left brainstem** | -0.01557 | 0.4891 | -0.03183 | -0.9742 | 0.9431 | 1 |
| **left cingulate** | 0.297 | 0.2965 | 1.002 | -0.2841 | 0.8781 | 2 |
| **left occipital** | -0.7254 | 0.3791 | -1.914 | -1.468 | 0.01755 | 1 |
| **left temporal** | -0.698 | 0.1265 | -5.518 | -0.946 | -0.4501 | 10 |
| **left tract** | -1.549 | 0.425 | -3.645 | -2.382 | -0.7163 | 1 |
| **right brainstem** | -0.2476 | 0.4908 | -0.5044 | -1.21 | 0.7145 | 1 |
| **right insular cortex** | -0.8178 | 0.4415 | -1.852 | -1.683 | 0.04759 | 1 |
| **right occipital** | -0.7254 | 0.3791 | -1.914 | -1.468 | 0.01755 | 1 |
| **right temporal** | -0.8298 | 0.1036 | -8.013 | -1.033 | -0.6269 | 16 |
| **right Thalamus** | -0.9238 | 0.1789 | -5.164 | -1.274 | -0.5732 | 6 |

| | HedgeG | se | zval | ci.lo | ci.up | N |
|---|---|---|---|---|---|---|
| **right tract** | -1.004 | 0.2156 | -4.656 | -1.427 | -0.5813 | 4 |

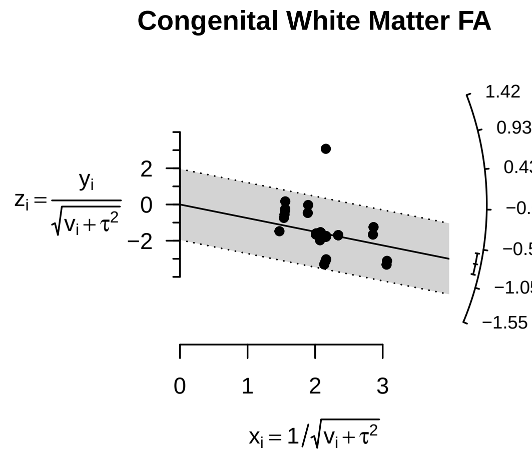
## Congenital White Matter FA

| Year & Author | Age Ptn | Age Ctl | N | ROI | Weights | Hedge's G [95% CI] |
|---|---|---|---|---|---|---|
| **right** | | | | | | |
| 2009−Wang.6 | 20.8 | 23.5 | 12 | pars opercularis | 1.21% | −0.16 [−1.29, 0.98] |
| 2004−Chang.2 | 22.04 | 26.5 | 20 | Superior olivary nucleus | 1.78% | −0.25 [−1.13, 0.63] |
| 2009−Wang.2 | 20.8 | 23.5 | 12 | HG | 1.18% | −0.48 [−1.63, 0.67] |
| 2012−Li.1 | 21.1 | 21.8 | 98 | STG | 4.06% | −0.58 [−1.00, −0.17] |
| 2010−Liu.4 | 14.56 | 14.75 | 44 | optic radiation | 2.73% | −0.73 [−1.36, −0.09] |
| 2010−Liu.2 | 14.56 | 14.75 | 44 | HG | 2.73% | −0.73 [−1.36, −0.09] |
| 2018−Benetti.2 | 32.79 | 34.07 | 29 | middle lateral fusiform gyrusright posterior superior temporal sulcus−STG | 2.19% | −0.77 [−1.53, −0.02] |
| 2017−Kim.5 | 31.6 | 26.5 | 37 | thalmus | 2.02% | −0.79 [−1.60, 0.01] |
| 2017−Kim.4 | 31.6 | 26.5 | 37 | internal capsule | 2.02% | −0.79 [−1.60, 0.01] |
| 2013−Miao.5 | 14.56 | 14.75 | 32 | thalmus | 2.33% | −0.81 [−1.53, −0.09] |
| 2013−Miao.4 | 14.56 | 14.75 | 32 | external capsule | 2.33% | −0.81 [−1.53, −0.09] |
| 2014−Hribar.9 | 35.4 | 30.5 | 28 | external capsule | 2.13% | −0.82 [−1.59, −0.04] |
| 2014−Hribar.8 | 35.4 | 30.5 | 28 | sagittal stratum | 2.13% | −0.82 [−1.59, −0.04] |
| 2014−Hribar.7 | 35.4 | 30.5 | 28 | posterior thalamic radiation | 2.13% | −0.82 [−1.59, −0.04] |
| 2014−Hribar.6 | 35.4 | 30.5 | 28 | retrolenticular part of internal capsule | 2.13% | −0.82 [−1.59, −0.04] |
| 2014−Hribar.5 | 35.4 | 30.5 | 28 | insular cortex | 2.13% | −0.82 [−1.59, −0.04] |
| 2014−Hribar.4 | 35.4 | 30.5 | 28 | STG | 2.13% | −0.82 [−1.59, −0.04] |
| 2014−Hribar.3 | 35.4 | 30.5 | 28 | planum temporale | 2.13% | −0.82 [−1.59, −0.04] |
| 2014−Hribar.2 | 35.4 | 30.5 | 28 | planum polare | 2.13% | −0.82 [−1.59, −0.04] |
| 2014−Hribar.1 | 35.4 | 30.5 | 28 | HG | 2.13% | −0.82 [−1.59, −0.04] |
| 2017−Kim.3 | 31.6 | 26.5 | 37 | temporal lobe WM | 2.01% | −0.82 [−1.63, −0.01] |
| 2017−Kim.1 | 31.6 | 26.5 | 37 | STG | 2.01% | −0.82 [−1.63, −0.01] |
| 2013−Miao.2 | 14.56 | 14.75 | 32 | STG/HG | 2.32% | −0.82 [−1.55, −0.10] |
| 2018−Benetti.1 | 32.79 | 34.07 | 29 | V2/3−posterior superior temporal sulcus−STG | 2.14% | −0.95 [−1.73, −0.18] |
| 2009−Wang.4 | 20.8 | 23.5 | 12 | STG | 1.08% | −1.00 [−2.22, 0.21] |
| 2018−Zou.2 | 41.7 | 44 | 158 | STG | 4.67% | −1.02 [−1.35, −0.69] |
| 2009−Kim.2 | 29.3 | 26.5 | 42 | superior temporal | 2.33% | −1.40 [−2.12, −0.68] |
| 2009−Kim.3 | 29.3 | 26.5 | 42 | internal capsule | 2.31% | −1.45 [−2.18, −0.73] |
| 2009−Kim.4 | 29.3 | 26.5 | 42 | superior longitudinal fasciculus | 2.27% | −1.55 [−2.29, −0.81] |
| RE Model for Subgroup (Q = 15.12, df = 28, p = 0.98; $I^2$ = 0.0%) | | | | | | **−0.86 [−0.99, −0.73]** |
| **left** | | | | | | |
| 2009−Kim.1 | 29.3 | 26.5 | 42 | Bilateral forceps major | 2.32% | 1.42 [ 0.70, 2.15] |
| 2009−Wang.1 | 20.8 | 23.5 | 12 | HG | 1.21% | 0.11 [−1.02, 1.24] |
| 2004−Chang.1 | 22.04 | 26.5 | 20 | Superior olivary nucleus | 1.79% | −0.02 [−0.89, 0.86] |
| 2009−Wang.3 | 20.8 | 23.5 | 12 | STG | 1.20% | −0.21 [−1.35, 0.92] |
| 2009−Wang.5 | 20.8 | 23.5 | 12 | pars opercularis | 1.19% | −0.35 [−1.50, 0.79] |
| 2012−Li.2 | 21.1 | 21.8 | 98 | HG | 4.08% | −0.44 [−0.85, −0.02] |
| 2010−Liu.3 | 14.56 | 14.75 | 44 | optic radiation | 2.73% | −0.73 [−1.36, −0.09] |
| 2010−Liu.1 | 14.56 | 14.75 | 44 | HG | 2.73% | −0.73 [−1.36, −0.09] |
| 2014−Hribar.11 | 35.4 | 30.5 | 28 | planum temporale | 2.15% | −0.74 [−1.51, 0.03] |
| 2014−Hribar.10 | 35.4 | 30.5 | 28 | HG | 2.15% | −0.74 [−1.51, 0.03] |
| 2013−Miao.3 | 14.56 | 14.75 | 32 | STG/HG | 2.33% | −0.81 [−1.53, −0.09] |
| 2017−Kim.2 | 31.6 | 26.5 | 37 | STG | 2.01% | −0.82 [−1.63, −0.01] |
| 2013−Miao.1 | 14.56 | 14.75 | 32 | corpus callosum | 2.32% | −0.83 [−1.55, −0.10] |
| 2018−Zou.1 | 41.7 | 44 | 158 | STG | 4.65% | −1.09 [−1.42, −0.75] |
| 2009−Kim.5 | 29.3 | 26.5 | 42 | inferior fronto−occipital fasciculus | 2.27% | −1.55 [−2.29, −0.81] |
| RE Model for Subgroup (Q = 50.14, df = 14, p = 0.00; $I^2$ = 73.9%) | | | | | | **−0.54 [−0.89, −0.19]** |
| RE Model for All Studies (Q = 69.00, df = 43, p = 0.01; $I^2$ = 39.0%) | | | | | 100.00% | −0.75 [−0.89, −0.61] |

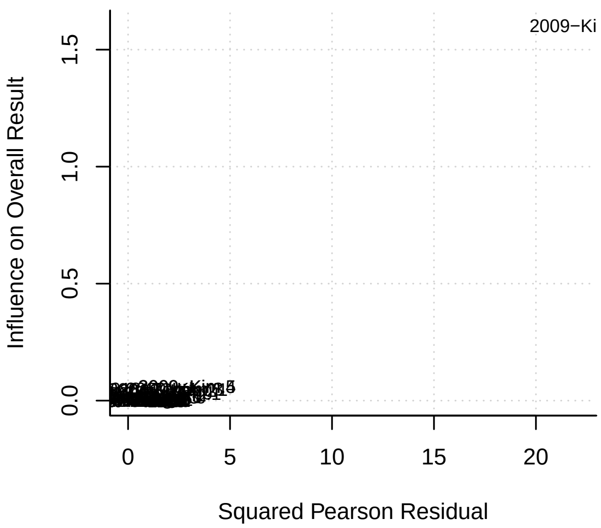




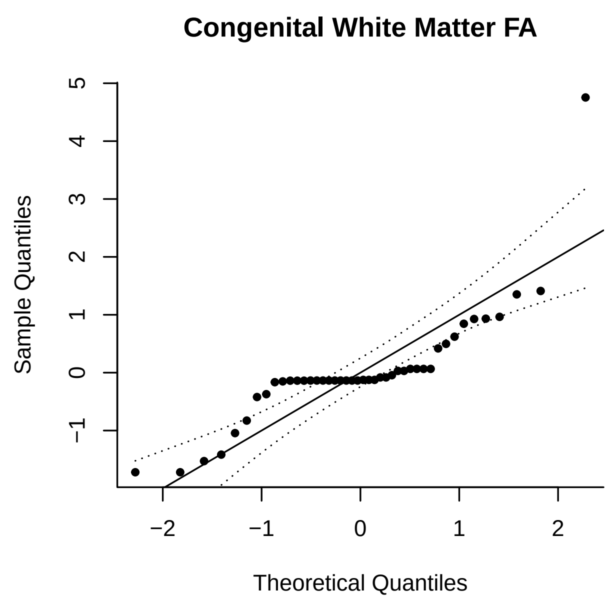
Standard Error
0
0.155
0.31
0.465
0.619
−2
−1
0
1
Mean Difference

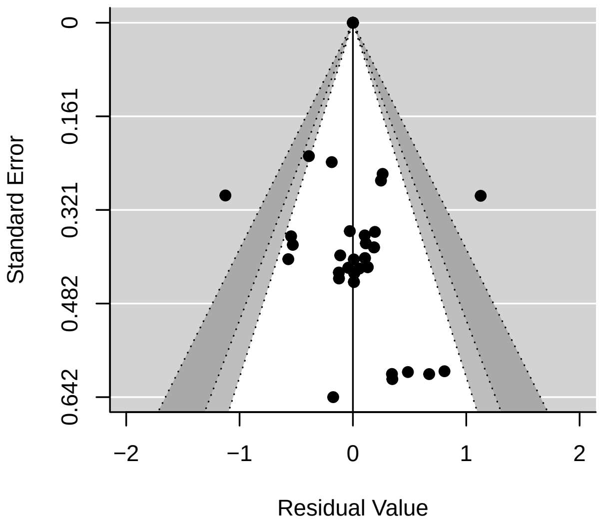
Congenital White Matter FA
$z_i = \frac{y_i}{\sqrt{v_i + \tau^2}}$
2
0
−2
0
1
2
3
$x_i = 1/\sqrt{v_i + \tau^2}$
1.42
0.93
0.43
−0.06
−0.56
−1.05
−1.55

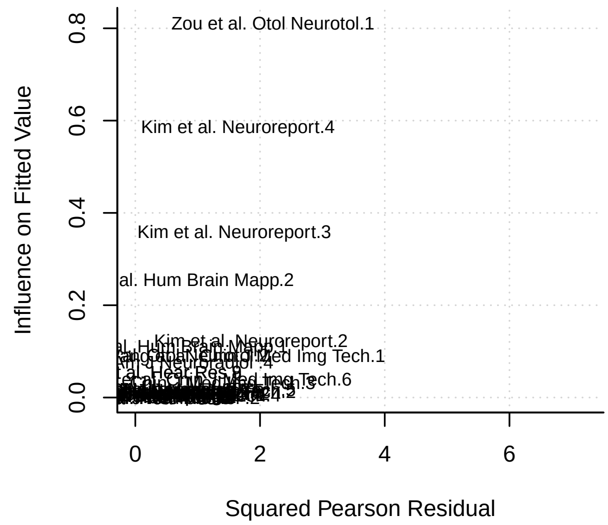



Influence on Overall Result
0.0
0.5
1.0
1.5
2009−Ki
0
5
10
15
20
Squared Pearson Residual

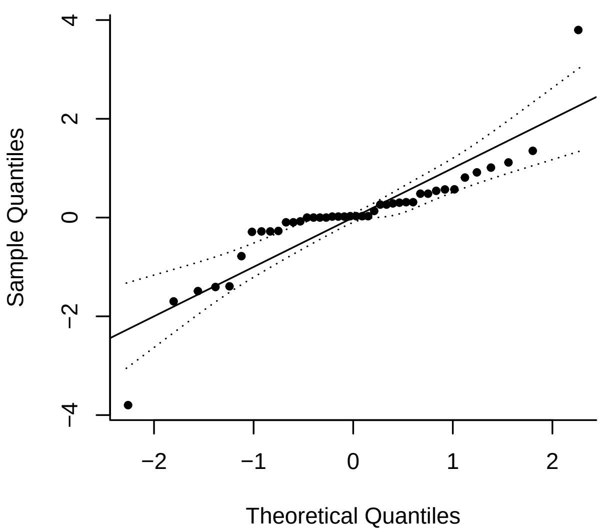



Congenital White Matter FA
Sample Quantiles
−1
0
1
2
3
4
5
−2
−1
0
1
2
Theoretical Quantiles



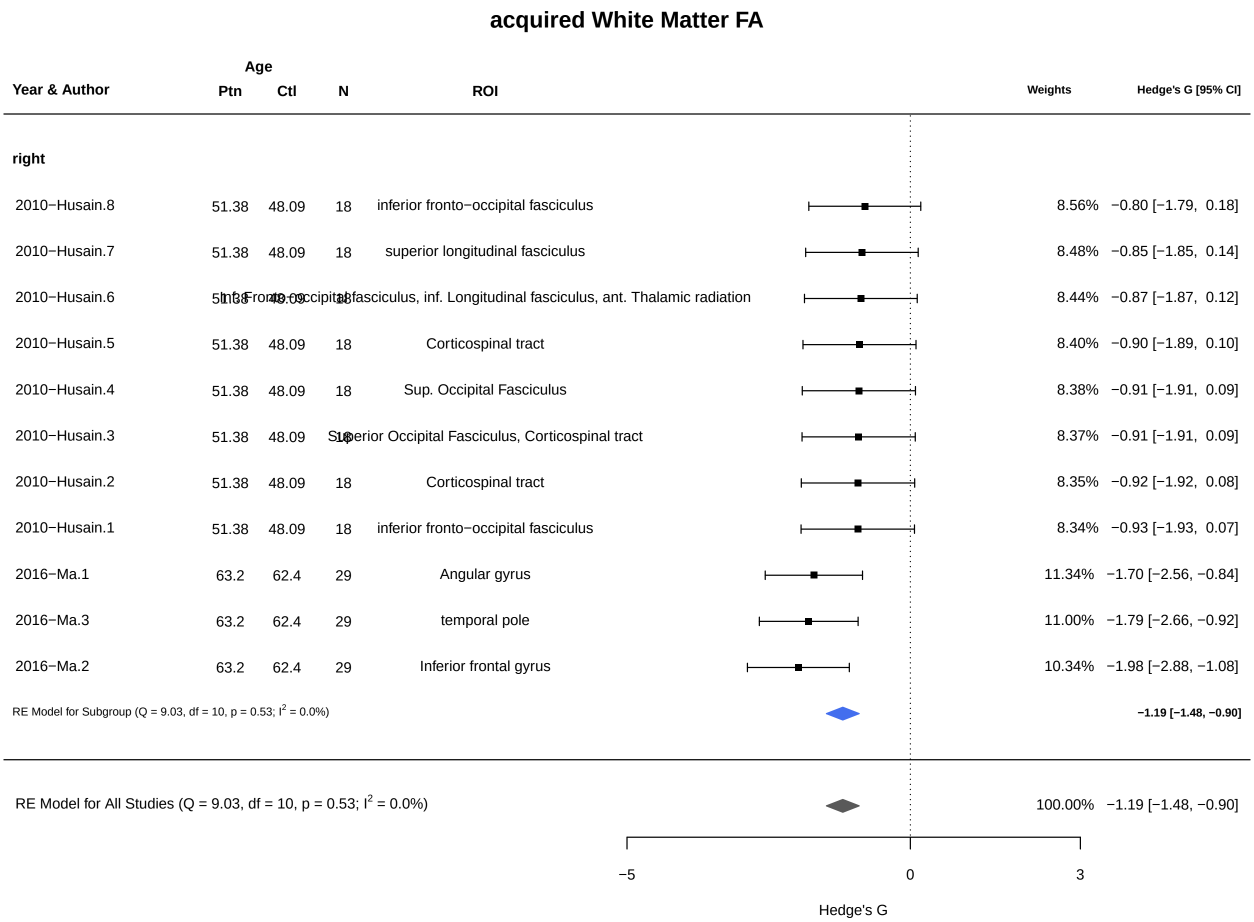

**Congenital White Matter FA**

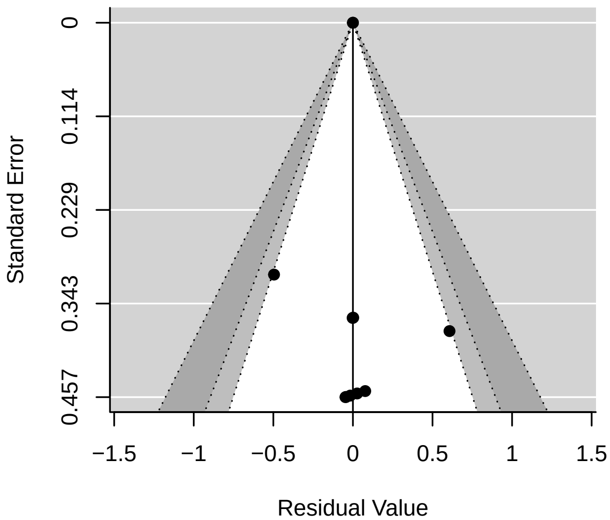


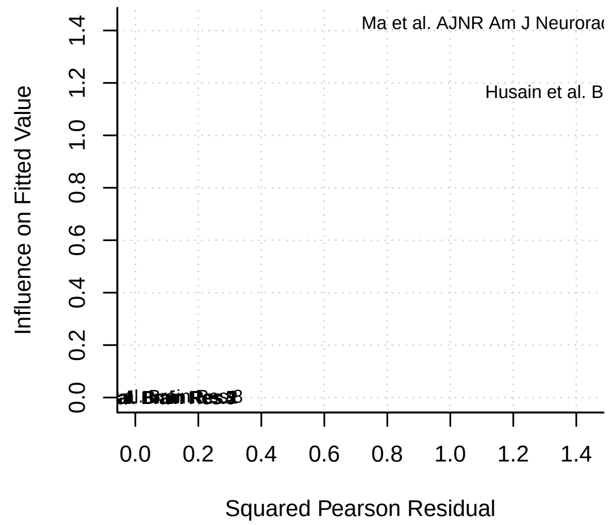

## ACQUIRED - White Matter by FA fractional anisotropy

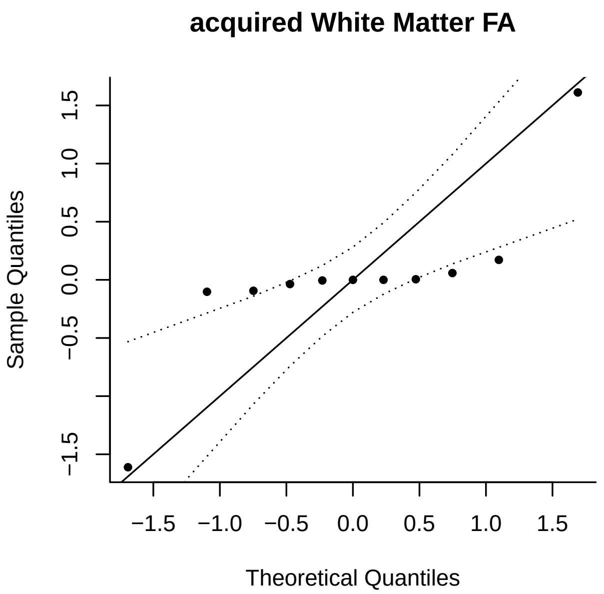
Random effects model no intercept covariated by Big area

| | HedgeG | se | zval | ci.lo | ci.up | N |
|---|---|---|---|---|---|---|
| **right frontal** | -1.48 | 0.3403 | -4.35 | -2.147 | -0.8134 | 2 |
| **right occipital** | -0.9105 | 0.3603 | -2.527 | -1.617 | -0.2042 | 2 |
| **right parietal** | -1.703 | 0.4379 | -3.888 | -2.561 | -0.8443 | 1 |
| **right temporal** | -1.793 | 0.4446 | -4.034 | -2.665 | -0.922 | 1 |
| **right tract** | -0.8812 | 0.2272 | -3.878 | -1.326 | -0.4359 | 5 |


acquired White Matter FA
Age
Year & Author
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
right
2010−Husain.8 51.38 48.09 18 inferior fronto−occipital fasciculus 8.56% −0.80 [−1.79, 0.18]
2010−Husain.7 51.38 48.09 18 superior longitudinal fasciculus 8.48% −0.85 [−1.85, 0.14]
2010−Husain.6 51.38 48.09 18 Inf. Fronto-occipital fasciculus, inf. Longitudinal fasciculus, ant. Thalamic radiation 8.44% −0.87 [−1.87, 0.12]
2010−Husain.5 51.38 48.09 18 Corticospinal tract 8.40% −0.90 [−1.89, 0.10]
2010−Husain.4 51.38 48.09 18 Sup. Occipital Fasciculus 8.38% −0.91 [−1.91, 0.09]
2010−Husain.3 51.38 48.09 18 Superior Occipital Fasciculus, Corticospinal tract 8.37% −0.91 [−1.91, 0.09]
2010−Husain.2 51.38 48.09 18 Corticospinal tract 8.35% −0.92 [−1.92, 0.08]
2010−Husain.1 51.38 48.09 18 inferior fronto−occipital fasciculus 8.34% −0.93 [−1.93, 0.07]
2016−Ma.1 63.2 62.4 29 Angular gyrus 11.34% −1.70 [−2.56, −0.84]
2016−Ma.3 63.2 62.4 29 temporal pole 11.00% −1.79 [−2.66, −0.92]
2016−Ma.2 63.2 62.4 29 Inferior frontal gyrus 10.34% −1.98 [−2.88, −1.08]
RE Model for Subgroup (Q = 9.03, df = 10, p = 0.53; I2 = 0.0%) −1.19 [−1.48, −0.90]
RE Model for All Studies (Q = 9.03, df = 10, p = 0.53; I2 = 0.0%) 100.00% −1.19 [−1.48, −0.90]
−5
0
3
Hedge's G

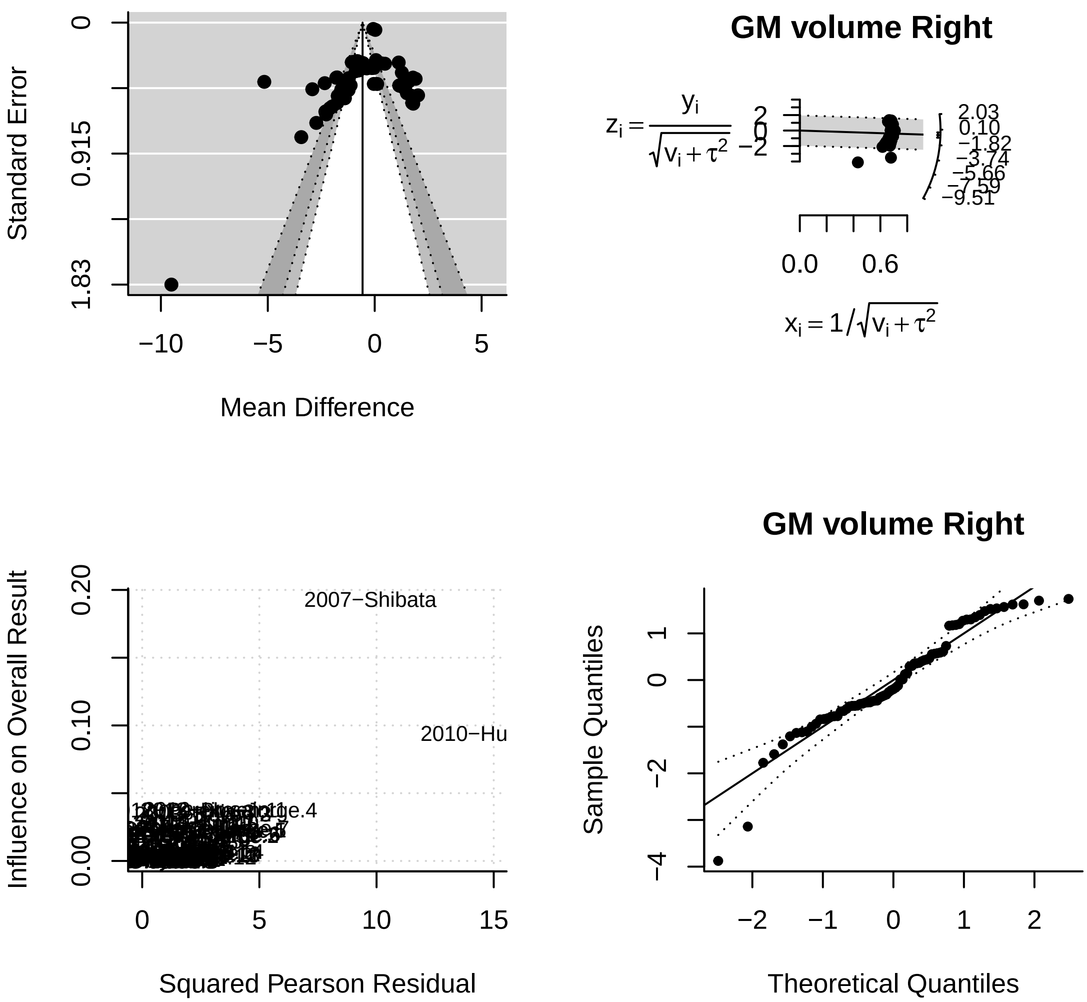

Standard Error
0
0.114
0.229
0.343
0.457
−1.5
−1
−0.5
0
0.5
1
1.5
Residual Value


Influence on Fitted Value
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Ma et al. AJNR Am J Neurora
Husain et al. B
Squared Pearson Residual

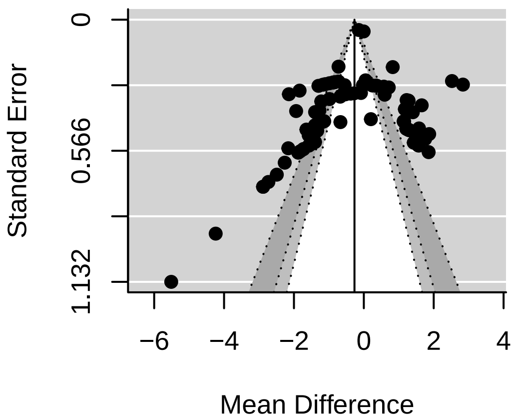

acquired White Matter FA
Sample Quantiles
−1.5
−0.5
0.0
0.5
1.0
1.5
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles

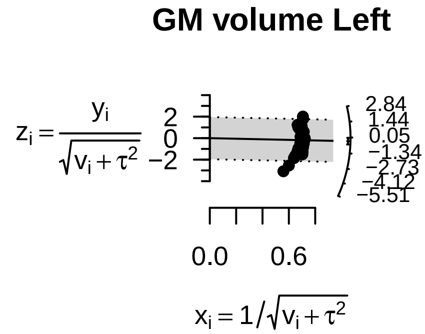
# Supplementary material: heterogeneity per model

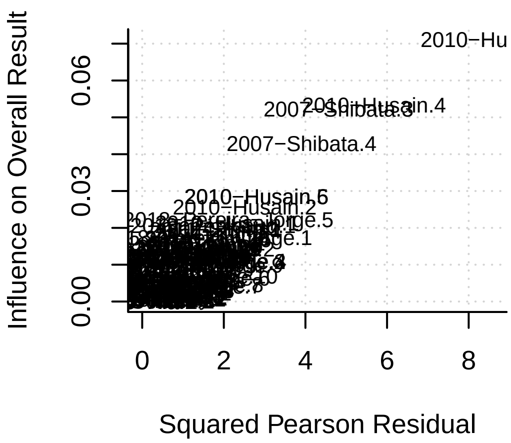
## Heterogeney: GM volume Right

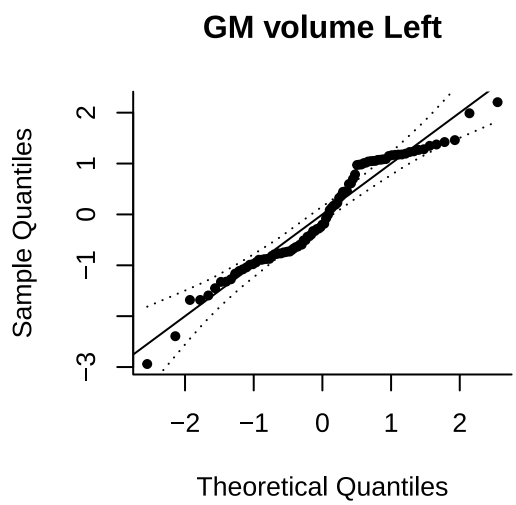


**Heterogeney: GM volume Left**

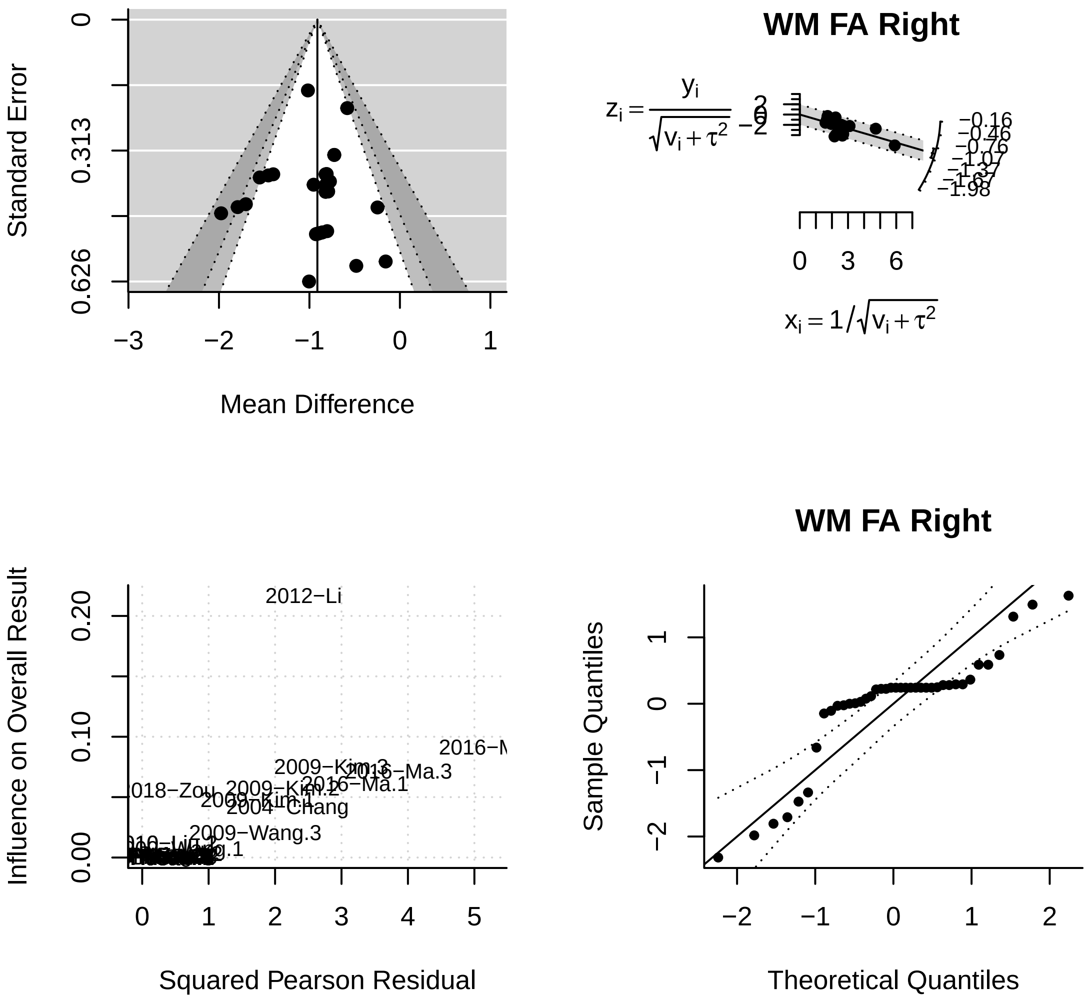


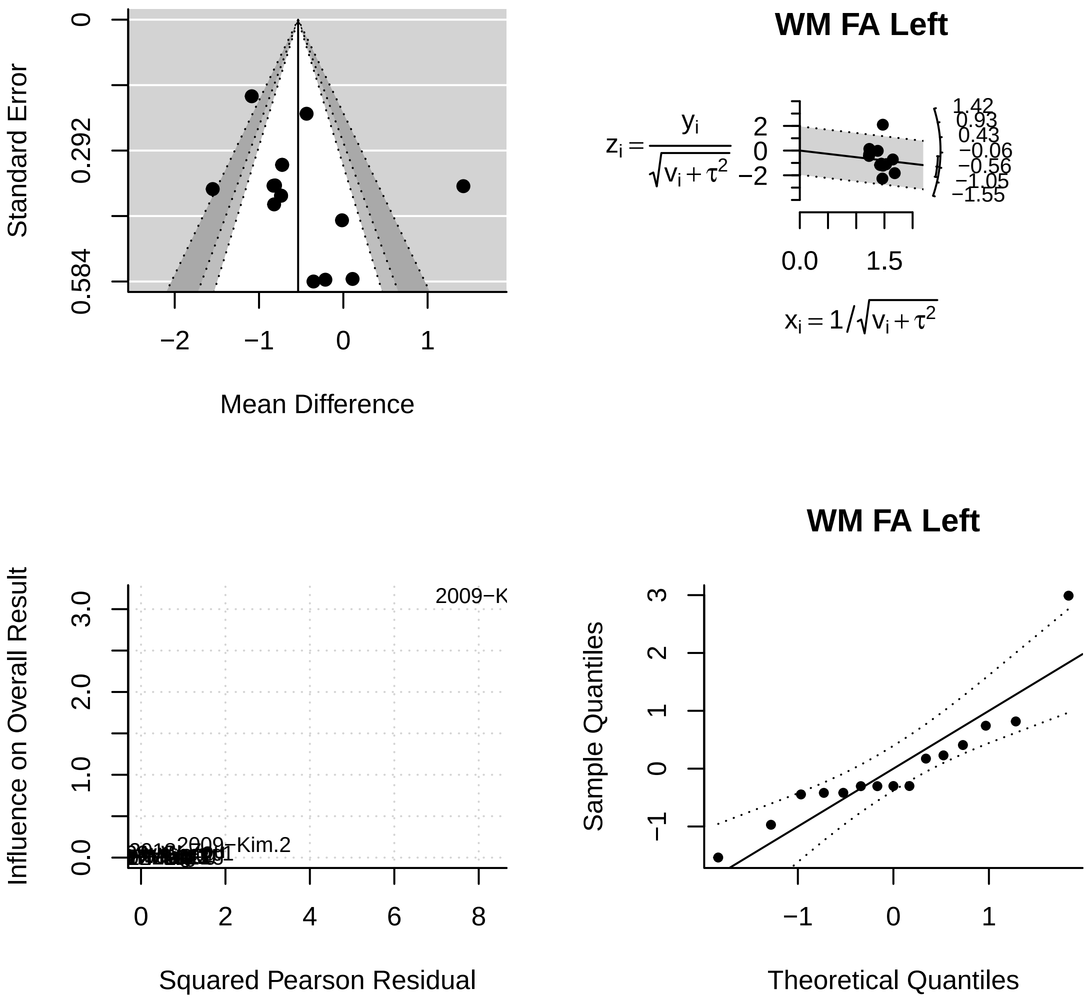



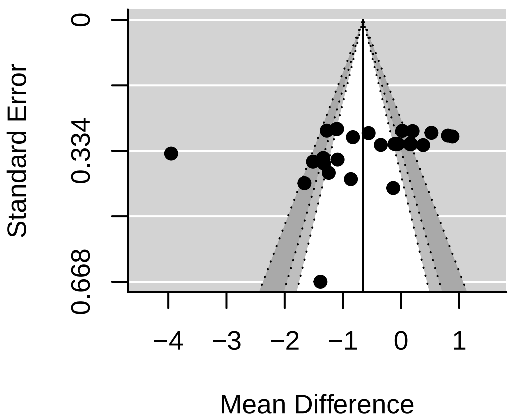
## Heterogeney: WM FA Right

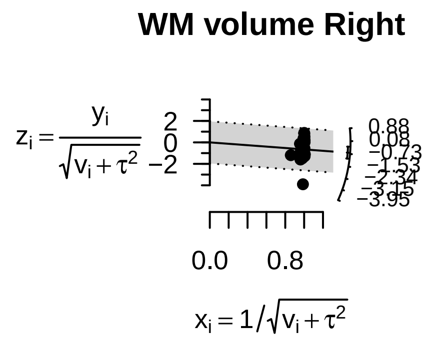


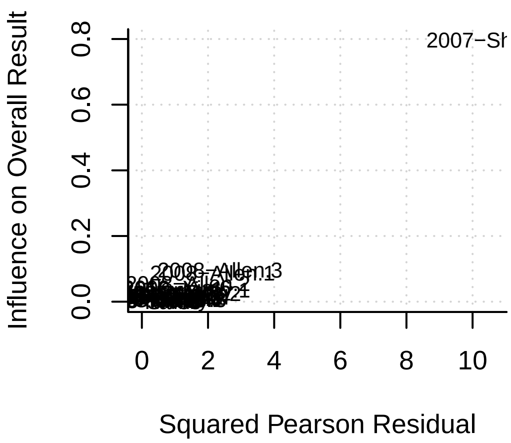
**Heterogeney: WM FA Left**

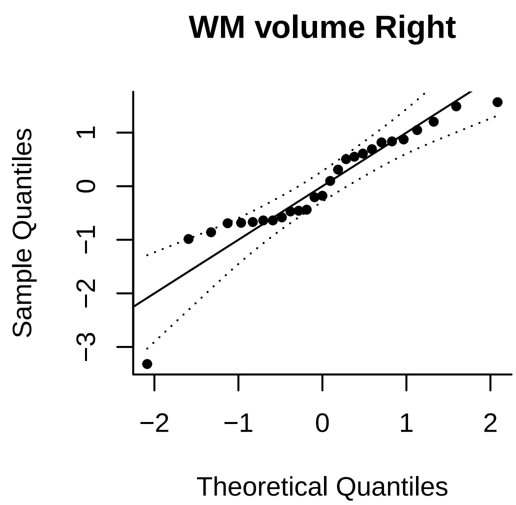


## Heterogeney: WM volume Right

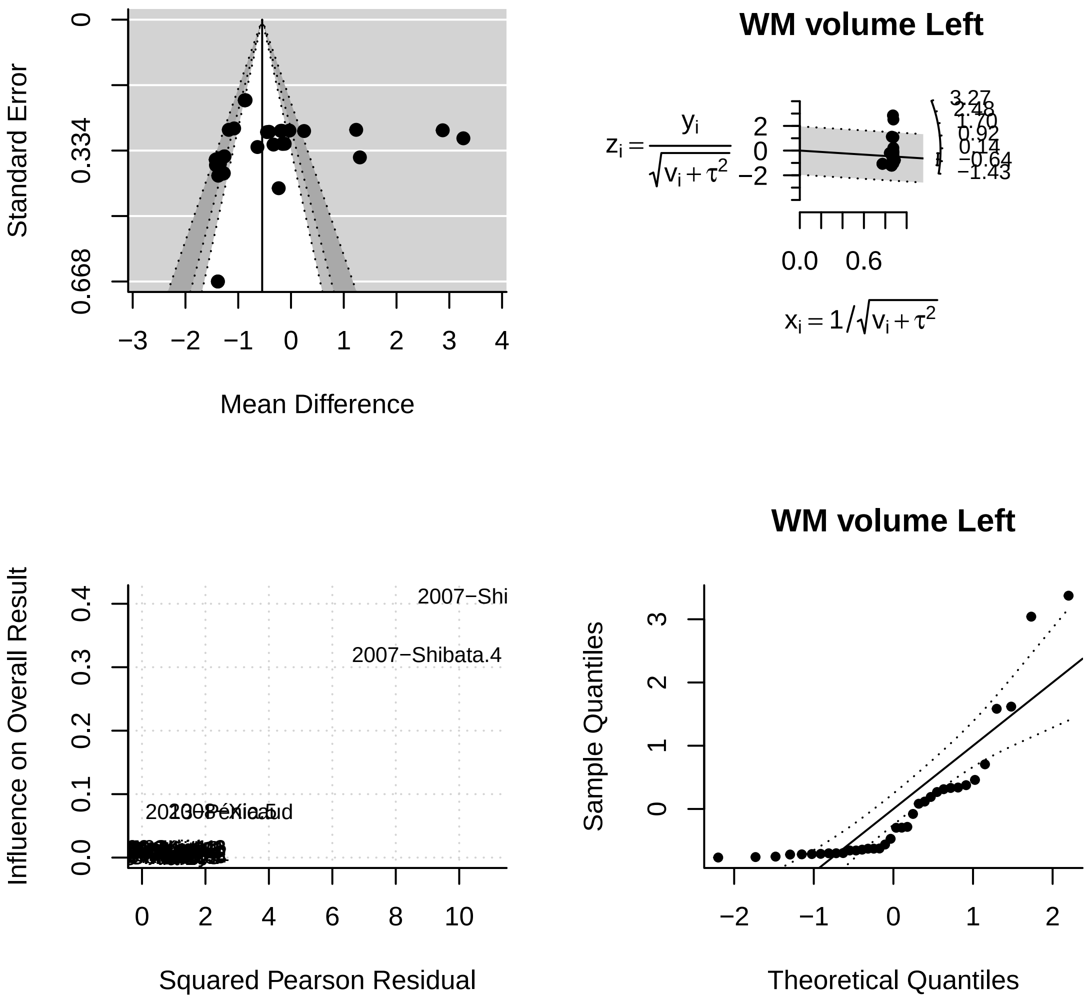


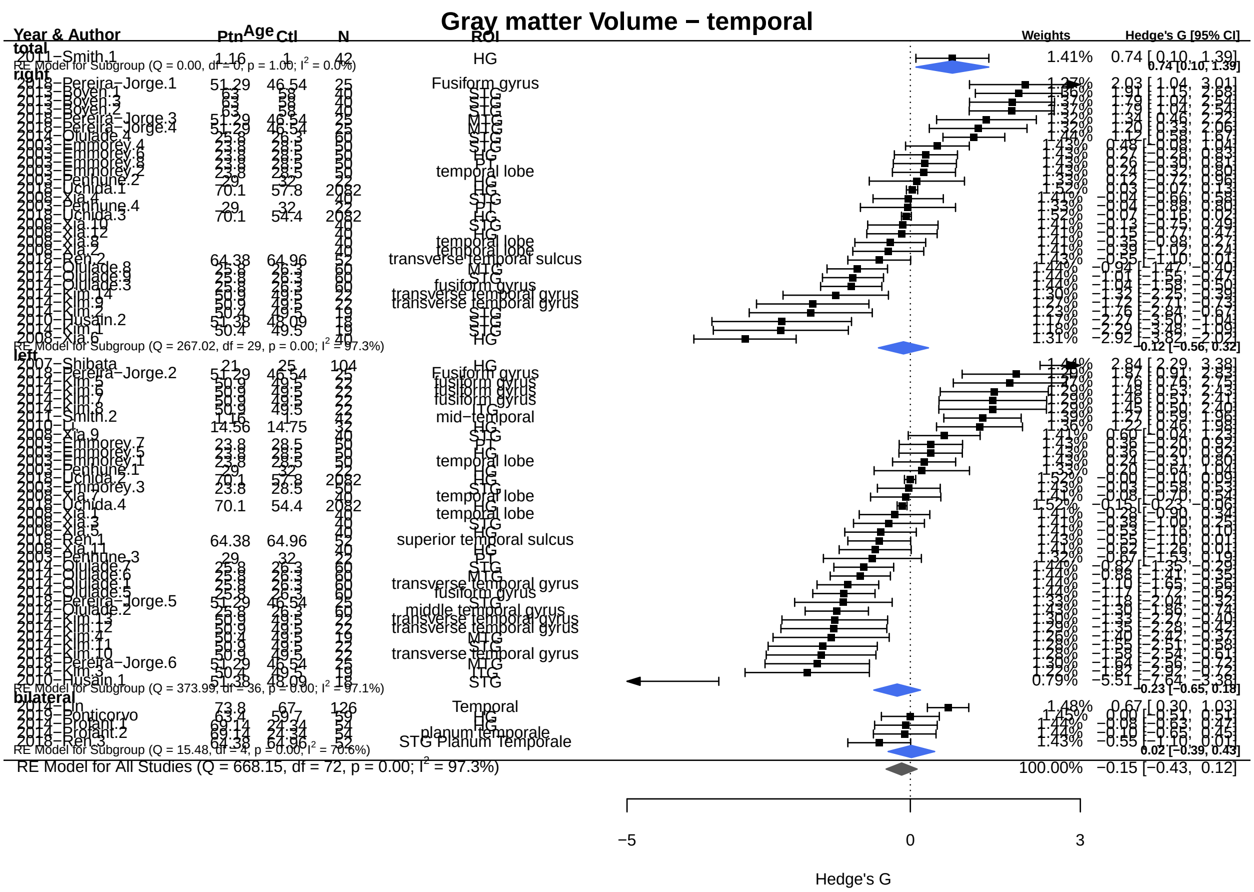



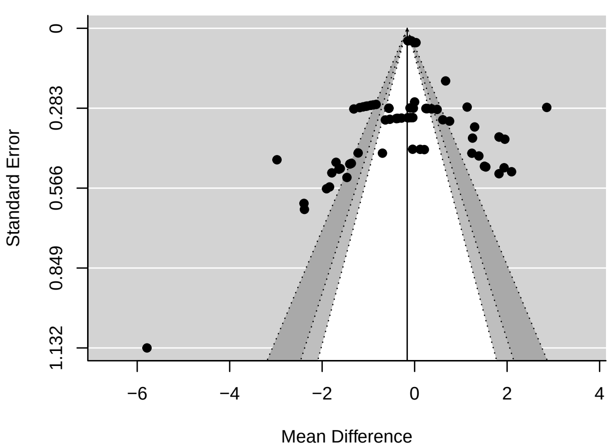



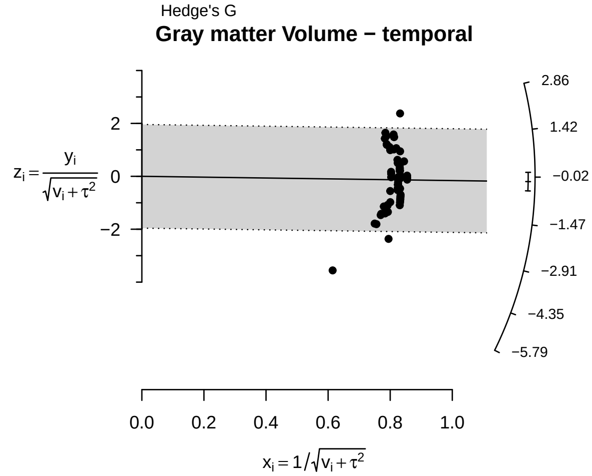
**Heterogeney: WM volume Left**

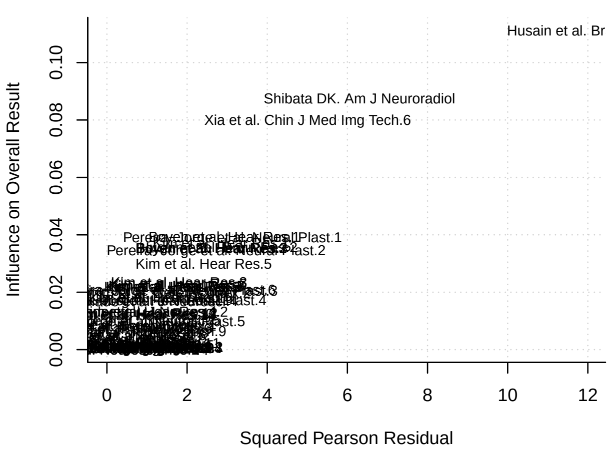


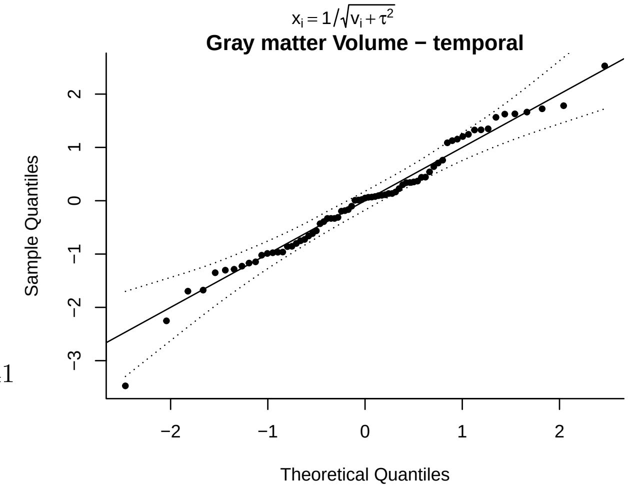
## Meta-regressions of Gray Matter Volume & Brain Areas: Random effects model no intercept covariated by Side

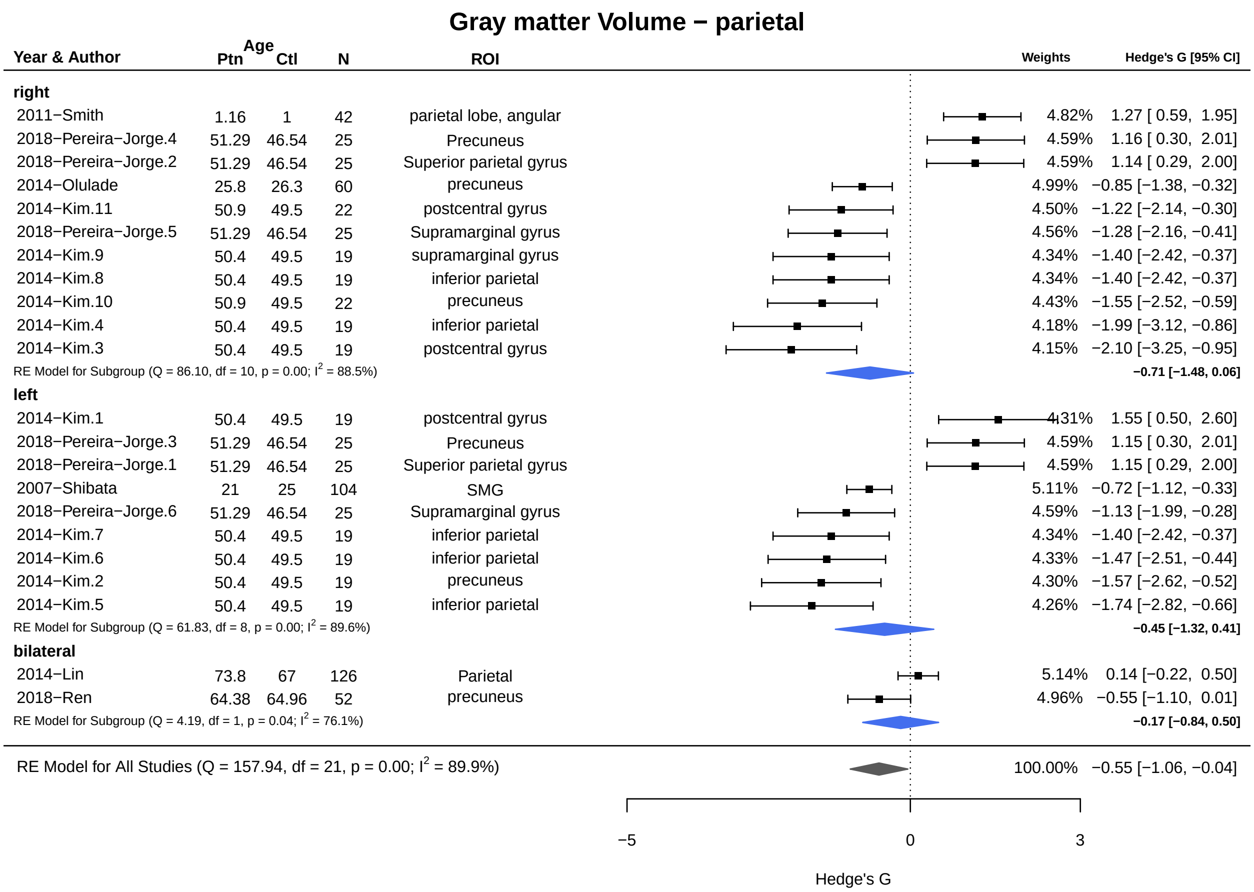


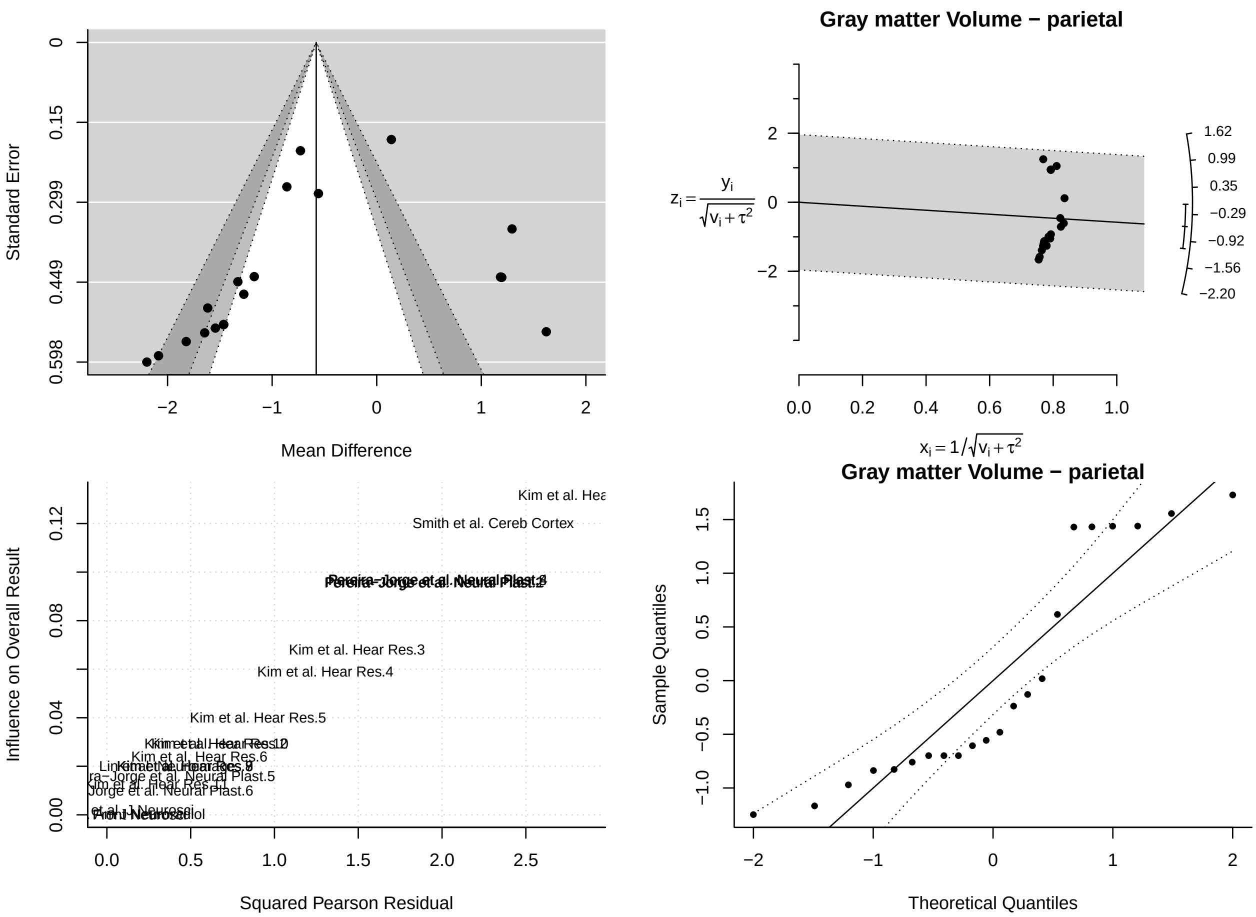



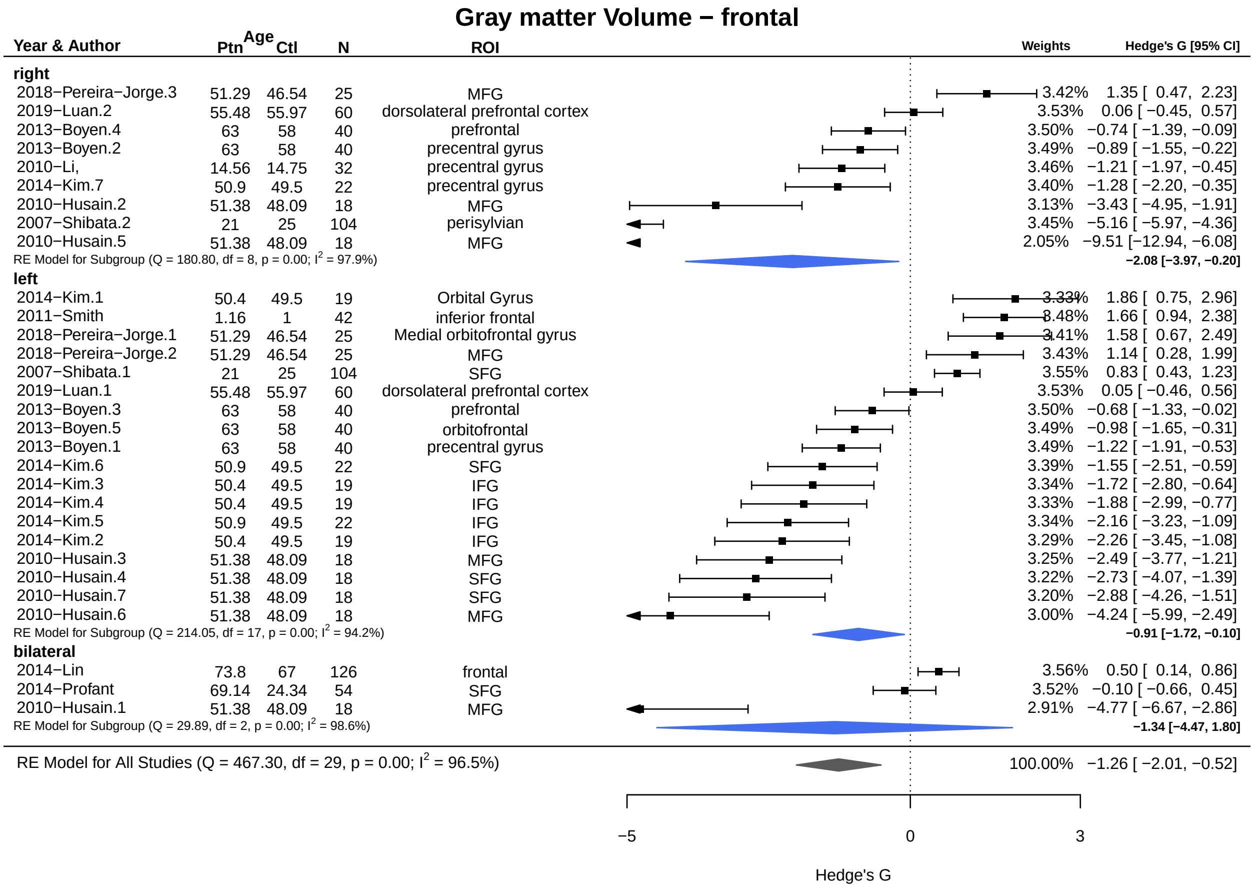



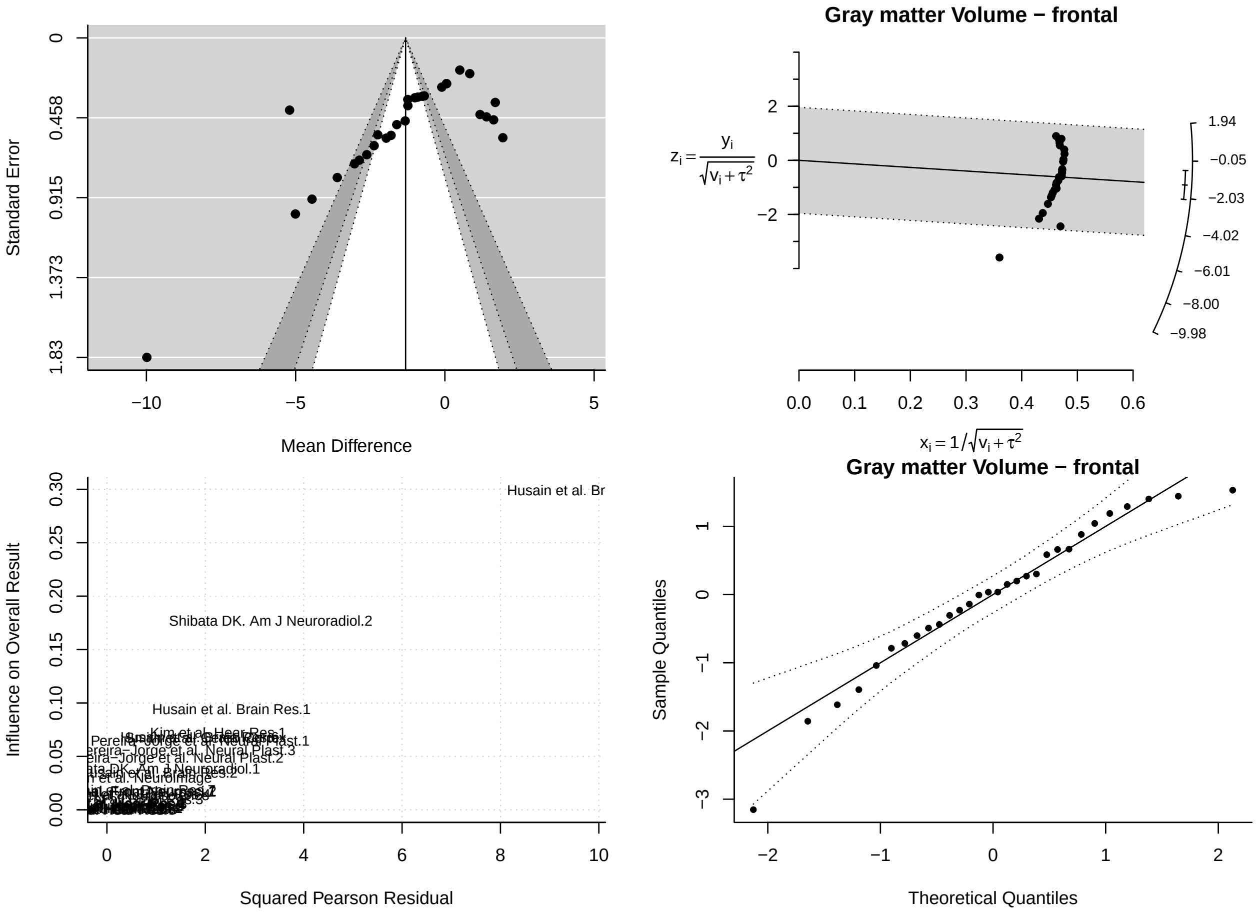



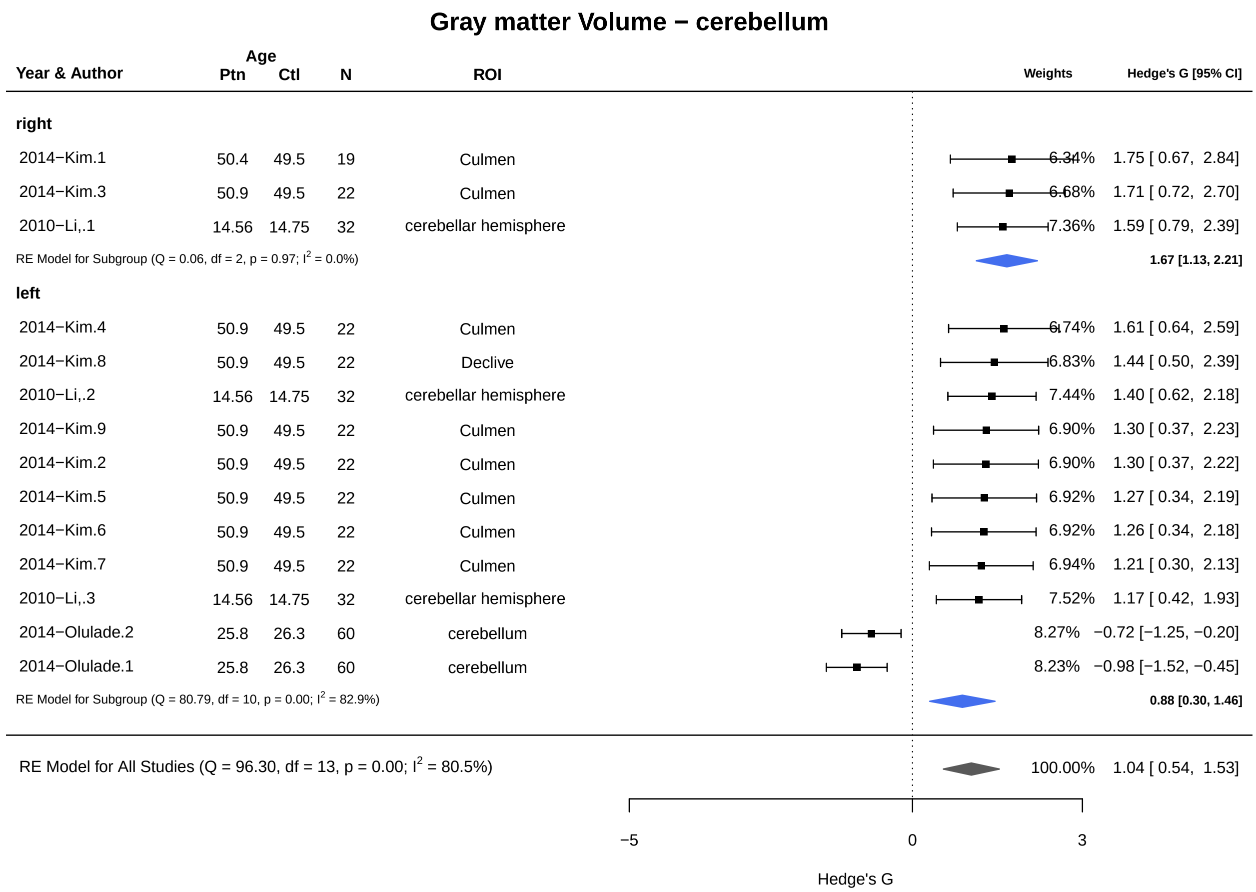



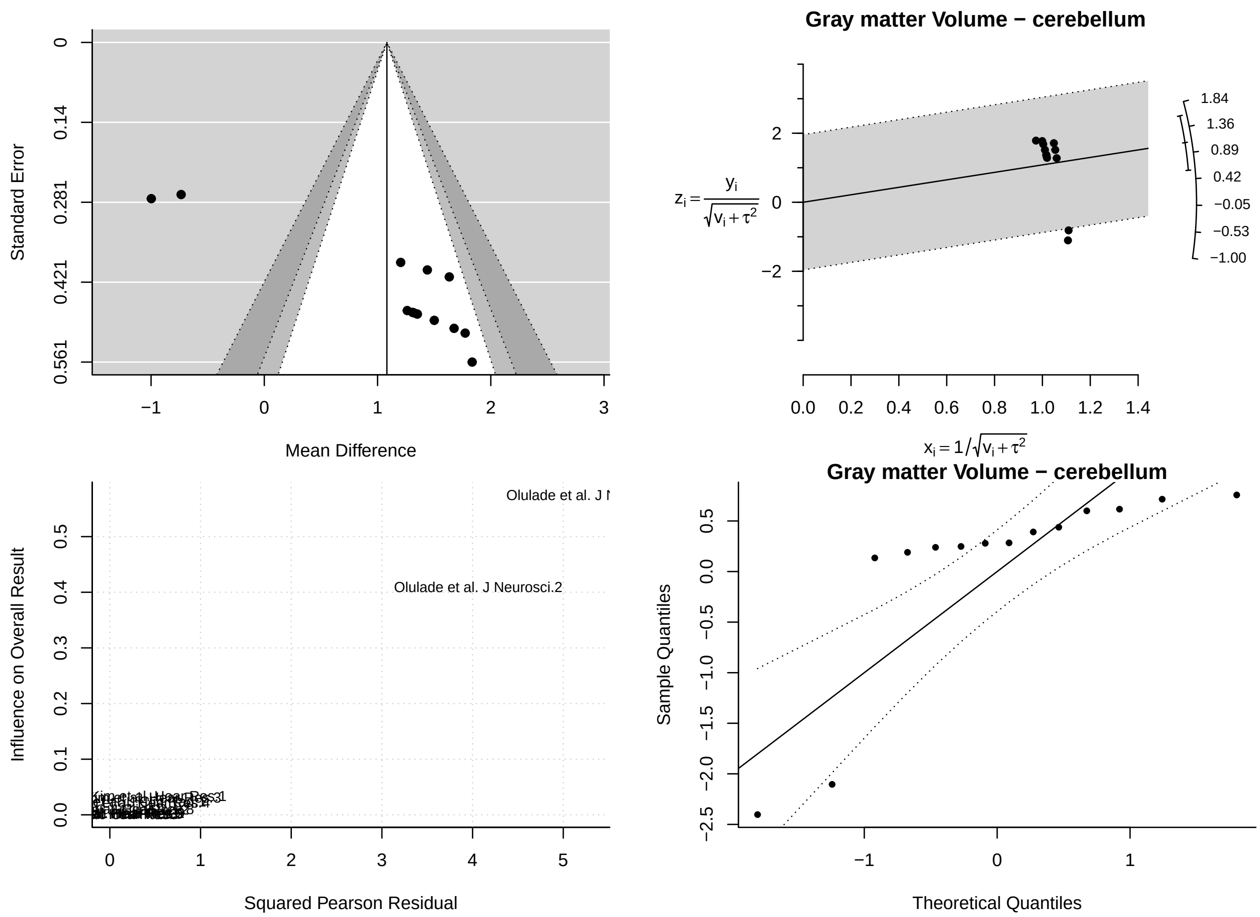

Gray matter Volume − parietal
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
right
2011−Smith 1.16 1 42 parietal lobe, angular 4.82% 1.27 [ 0.59, 1.95]
2018−Pereira−Jorge.4 51.29 46.54 25 Precuneus 4.59% 1.16 [ 0.30, 2.01]
2018−Pereira−Jorge.2 51.29 46.54 25 Superior parietal gyrus 4.59% 1.14 [ 0.29, 2.00]
2014−Olulade 25.8 26.3 60 precuneus 4.99% −0.85 [−1.38, −0.32]
2014−Kim.11 50.9 49.5 22 postcentral gyrus 4.50% −1.22 [−2.14, −0.30]
2018−Pereira−Jorge.5 51.29 46.54 25 Supramarginal gyrus 4.56% −1.28 [−2.16, −0.41]
2014−Kim.9 50.4 49.5 19 supramarginal gyrus 4.34% −1.40 [−2.42, −0.37]
2014−Kim.8 50.4 49.5 19 inferior parietal 4.34% −1.40 [−2.42, −0.37]
2014−Kim.10 50.9 49.5 22 precuneus 4.43% −1.55 [−2.52, −0.59]
2014−Kim.4 50.4 49.5 19 inferior parietal 4.18% −1.99 [−3.12, −0.86]
2014−Kim.3 50.4 49.5 19 postcentral gyrus 4.15% −2.10 [−3.25, −0.95]
RE Model for Subgroup (Q = 86.10, df = 10, p = 0.00; I2 = 88.5%) −0.71 [−1.48, 0.06]
left
2014−Kim.1 50.4 49.5 19 postcentral gyrus 4.31% 1.55 [ 0.50, 2.60]
2018−Pereira−Jorge.3 51.29 46.54 25 Precuneus 4.59% 1.15 [ 0.30, 2.01]
2018−Pereira−Jorge.1 51.29 46.54 25 Superior parietal gyrus 4.59% 1.15 [ 0.29, 2.00]
2007−Shibata 21 25 104 SMG 5.11% −0.72 [−1.12, −0.33]
2018−Pereira−Jorge.6 51.29 46.54 25 Supramarginal gyrus 4.59% −1.13 [−1.99, −0.28]
2014−Kim.7 50.4 49.5 19 inferior parietal 4.34% −1.40 [−2.42, −0.37]
2014−Kim.6 50.4 49.5 19 inferior parietal 4.33% −1.47 [−2.51, −0.44]
2014−Kim.2 50.4 49.5 19 precuneus 4.30% −1.57 [−2.62, −0.52]
2014−Kim.5 50.4 49.5 19 inferior parietal 4.26% −1.74 [−2.82, −0.66]
RE Model for Subgroup (Q = 61.83, df = 8, p = 0.00; I2 = 89.6%) −0.45 [−1.32, 0.41]
bilateral
2014−Lin 73.8 67 126 Parietal 5.14% 0.14 [−0.22, 0.50]
2018−Ren 64.38 64.96 52 precuneus 4.96% −0.55 [−1.10, 0.01]
RE Model for Subgroup (Q = 4.19, df = 1, p = 0.04; I2 = 76.1%) −0.17 [−0.84, 0.50]
RE Model for All Studies (Q = 157.94, df = 21, p = 0.00; I2 = 89.9%) 100.00% −0.55 [−1.06, −0.04]
−5
0
3
Hedge's G

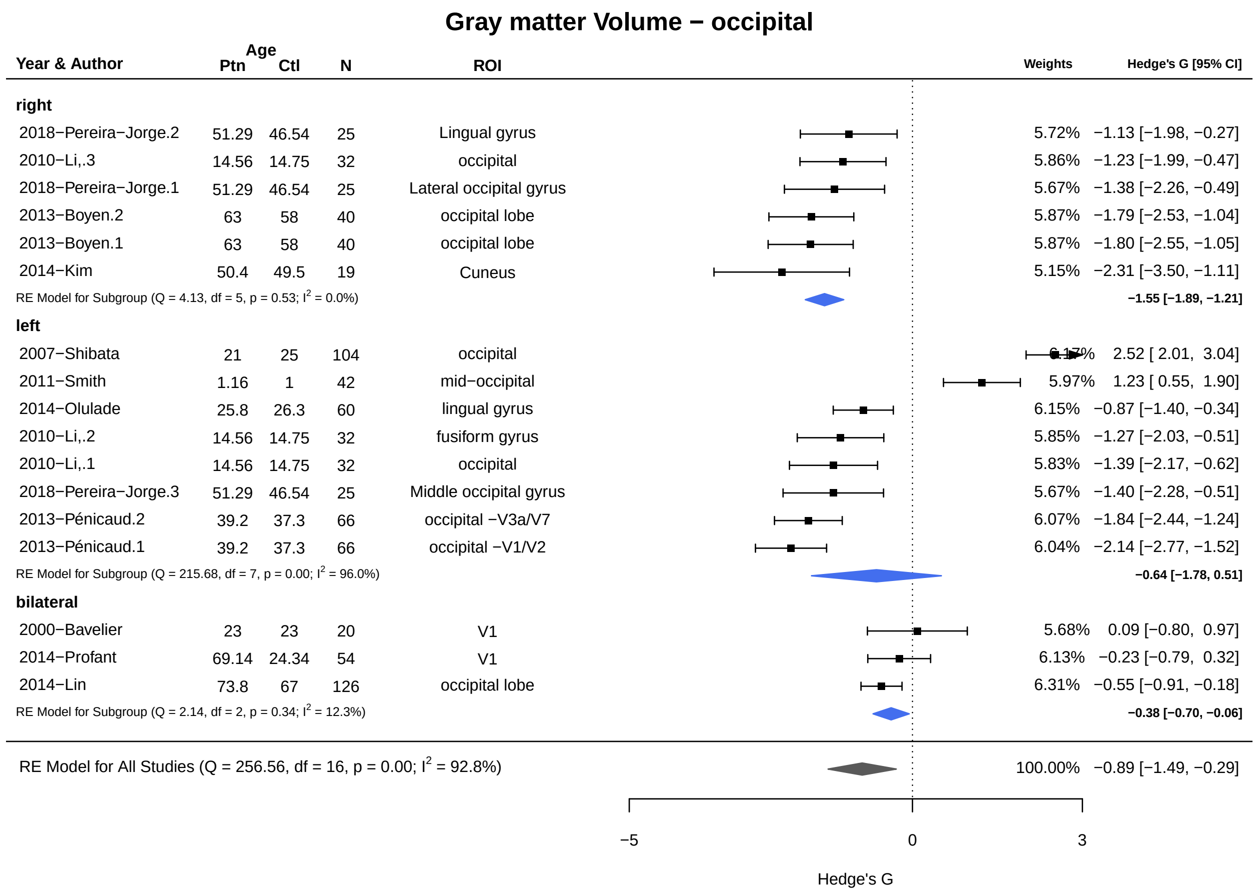

Standard Error
0
0.15
0.299
0.449
0.598
−2
−1
0
1
2
Mean Difference
Gray matter Volume − parietal
$z_i = \frac{y_i}{\sqrt{v_i + \tau^2}}$
2
0
−2
1.62
0.99
0.35
−0.29
−0.92
−1.56
−2.20
0.0
0.2
0.4
0.6
0.8
1.0
$x_i = 1/\sqrt{v_i + \tau^2}$
Influence on Overall Result
0.12
0.08
0.04
0.00
Smith et al. Cereb Cortex
Kim et al. Hear Res.3
Kim et al. Hear Res.4
Kim et al. Hear Res.5
Kim et al. Hear Res.6
0.0
0.5
1.0
1.5
2.0
2.5
Squared Pearson Residual
Gray matter Volume − parietal
Sample Quantiles
1.5
1.0
0.5
0.0
−0.5
−1.0
−2
−1
0
1
2
Theoretical Quantiles

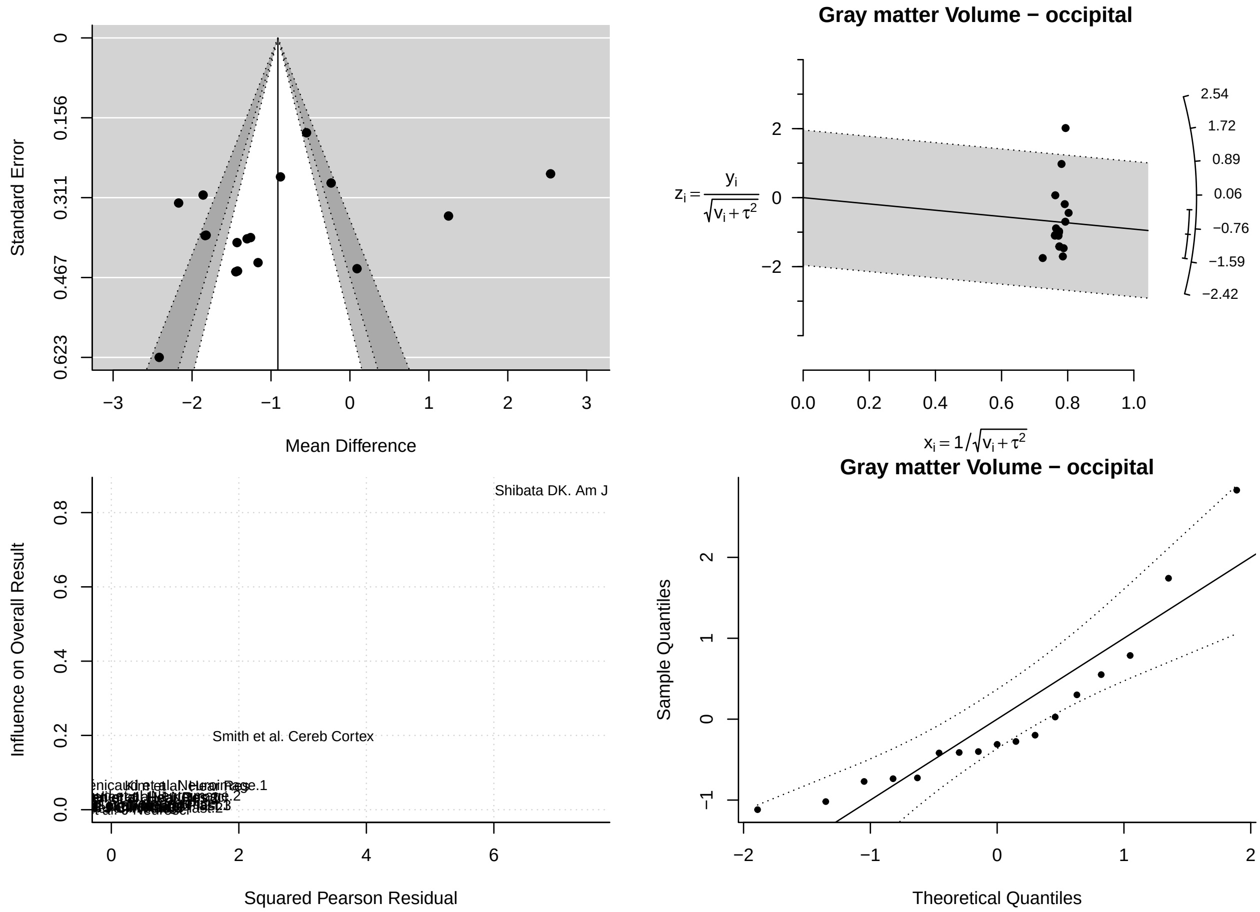

Gray matter Volume − frontal
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
right
2018−Pereira−Jorge.3 51.29 46.54 25 MFG 3.42% 1.35 [ 0.47, 2.23]
2019−Luan.2 55.48 55.97 60 dorsolateral prefrontal cortex 3.53% 0.06 [ −0.45, 0.57]
2013−Boyen.4 63 58 40 prefrontal 3.50% −0.74 [ −1.39, −0.09]
2013−Boyen.2 63 58 40 precentral gyrus 3.49% −0.89 [ −1.55, −0.22]
2010−Li, 14.56 14.75 32 precentral gyrus 3.46% −1.21 [ −1.97, −0.45]
2014−Kim.7 50.9 49.5 22 precentral gyrus 3.40% −1.28 [ −2.20, −0.35]
2010−Husain.2 51.38 48.09 18 MFG 3.13% −3.43 [ −4.95, −1.91]
2007−Shibata.2 21 25 104 perisylvian 3.45% −5.16 [ −5.97, −4.36]
2010−Husain.5 51.38 48.09 18 MFG 2.05% −9.51 [−12.94, −6.08]
RE Model for Subgroup (Q = 180.80, df = 8, p = 0.00; I2 = 97.9%) −2.08 [−3.97, −0.20]
left
2014−Kim.1 50.4 49.5 19 Orbital Gyrus 3.33% 1.86 [ 0.75, 2.96]
2011−Smith 1.16 1 42 inferior frontal 3.48% 1.66 [ 0.94, 2.38]
2018−Pereira−Jorge.1 51.29 46.54 25 Medial orbitofrontal gyrus 3.41% 1.58 [ 0.67, 2.49]
2018−Pereira−Jorge.2 51.29 46.54 25 MFG 3.43% 1.14 [ 0.28, 1.99]
2007−Shibata.1 21 25 104 SFG 3.55% 0.83 [ 0.43, 1.23]
2019−Luan.1 55.48 55.97 60 dorsolateral prefrontal cortex 3.53% 0.05 [ −0.46, 0.56]
2013−Boyen.3 63 58 40 prefrontal 3.50% −0.68 [ −1.33, −0.02]
2013−Boyen.5 63 58 40 orbitofrontal 3.49% −0.98 [ −1.65, −0.31]
2013−Boyen.1 63 58 40 precentral gyrus 3.49% −1.22 [ −1.91, −0.53]
2014−Kim.6 50.9 49.5 22 SFG 3.39% −1.55 [ −2.51, −0.59]
2014−Kim.3 50.4 49.5 19 IFG 3.34% −1.72 [ −2.80, −0.64]
2014−Kim.4 50.4 49.5 19 IFG 3.33% −1.88 [ −2.99, −0.77]
2014−Kim.5 50.9 49.5 22 IFG 3.34% −2.16 [ −3.23, −1.09]
2014−Kim.2 50.4 49.5 19 IFG 3.29% −2.26 [ −3.45, −1.08]
2010−Husain.3 51.38 48.09 18 MFG 3.25% −2.49 [ −3.77, −1.21]
2010−Husain.4 51.38 48.09 18 SFG 3.22% −2.73 [ −4.07, −1.39]
2010−Husain.7 51.38 48.09 18 SFG 3.20% −2.88 [ −4.26, −1.51]
2010−Husain.6 51.38 48.09 18 MFG 3.00% −4.24 [ −5.99, −2.49]
RE Model for Subgroup (Q = 214.05, df = 17, p = 0.00; I2 = 94.2%) −0.91 [−1.72, −0.10]
bilateral
2014−Lin 73.8 67 126 frontal 3.56% 0.50 [ 0.14, 0.86]
2014−Profant 69.14 24.34 54 SFG 3.52% −0.10 [ −0.66, 0.45]
2010−Husain.1 51.38 48.09 18 MFG 2.91% −4.77 [ −6.67, −2.86]
RE Model for Subgroup (Q = 29.89, df = 2, p = 0.00; I2 = 98.6%) −1.34 [−4.47, 1.80]
RE Model for All Studies (Q = 467.30, df = 29, p = 0.00; I2 = 96.5%) 100.00% −1.26 [ −2.01, −0.52]
−5
0
3
Hedge's G

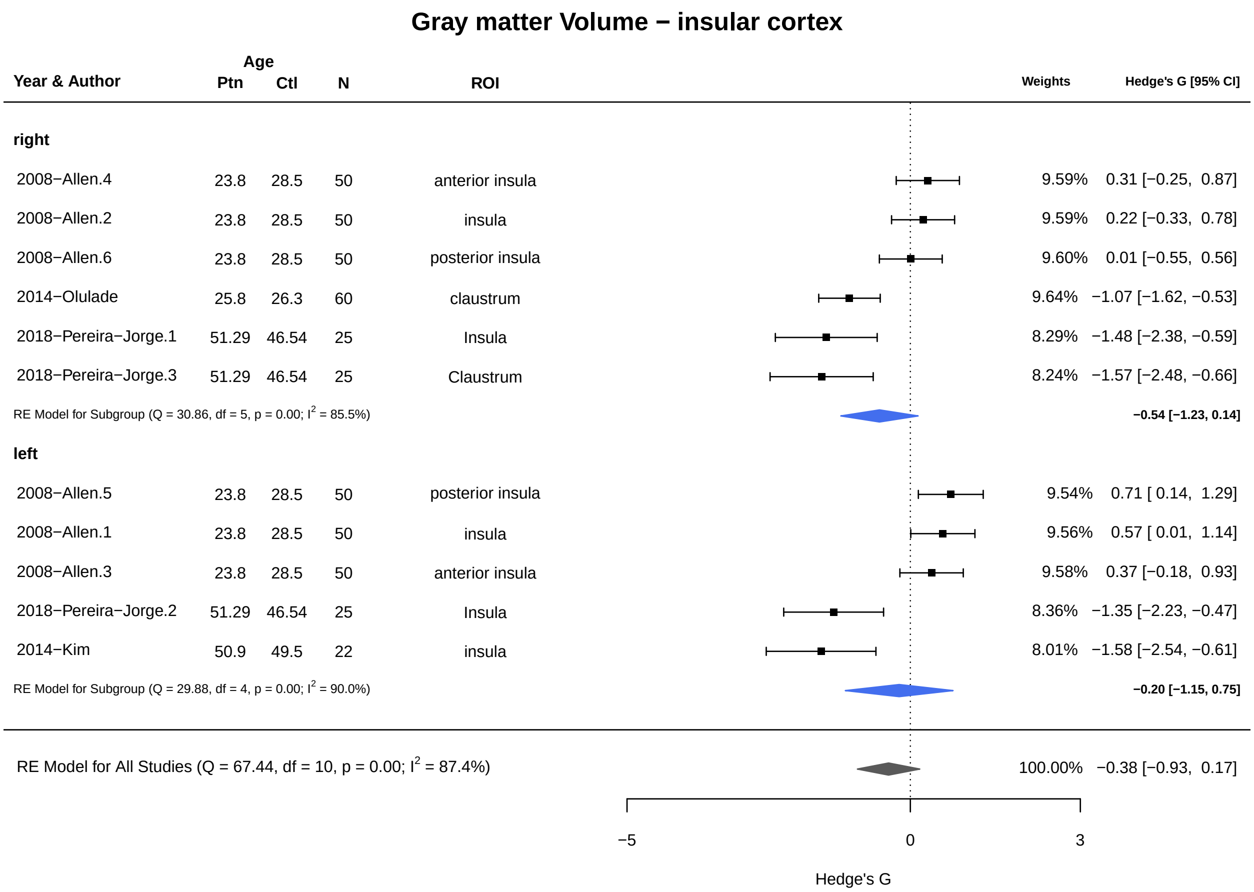

Gray matter Volume − frontal
Standard Error
Mean Difference
Influence on Overall Result
Squared Pearson Residual
Husain et al. Br
Shibata DK. Am J Neuroradiol.2
Husain et al. Brain Res.1
Gray matter Volume − frontal
Sample Quantiles
Theoretical Quantiles

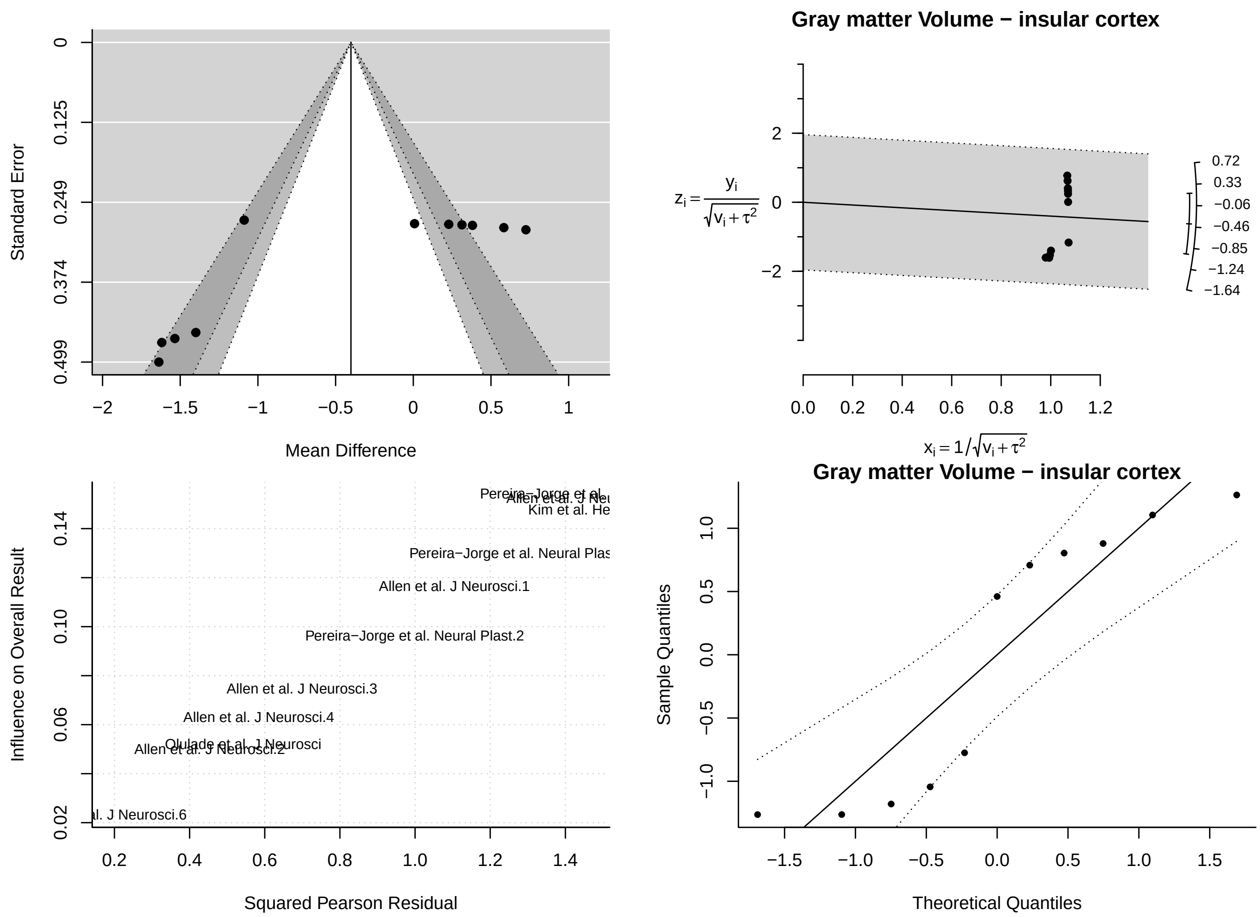

Gray matter Volume − cerebellum
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
right
2014−Kim.1 50.4 49.5 19 Culmen 6.34% 1.75 [ 0.67, 2.84]
2014−Kim.3 50.9 49.5 22 Culmen 6.68% 1.71 [ 0.72, 2.70]
2010−Li,.1 14.56 14.75 32 cerebellar hemisphere 7.36% 1.59 [ 0.79, 2.39]
RE Model for Subgroup (Q = 0.06, df = 2, p = 0.97; I2 = 0.0%)
1.67 [1.13, 2.21]
left
2014−Kim.4 50.9 49.5 22 Culmen 6.74% 1.61 [ 0.64, 2.59]
2014−Kim.8 50.9 49.5 22 Declive 6.83% 1.44 [ 0.50, 2.39]
2010−Li,.2 14.56 14.75 32 cerebellar hemisphere 7.44% 1.40 [ 0.62, 2.18]
2014−Kim.9 50.9 49.5 22 Culmen 6.90% 1.30 [ 0.37, 2.23]
2014−Kim.2 50.9 49.5 22 Culmen 6.90% 1.30 [ 0.37, 2.22]
2014−Kim.5 50.9 49.5 22 Culmen 6.92% 1.27 [ 0.34, 2.19]
2014−Kim.6 50.9 49.5 22 Culmen 6.92% 1.26 [ 0.34, 2.18]
2014−Kim.7 50.9 49.5 22 Culmen 6.94% 1.21 [ 0.30, 2.13]
2010−Li,.3 14.56 14.75 32 cerebellar hemisphere 7.52% 1.17 [ 0.42, 1.93]
2014−Olulade.2 25.8 26.3 60 cerebellum 8.27% −0.72 [−1.25, −0.20]
2014−Olulade.1 25.8 26.3 60 cerebellum 8.23% −0.98 [−1.52, −0.45]
RE Model for Subgroup (Q = 80.79, df = 10, p = 0.00; I2 = 82.9%)
0.88 [0.30, 1.46]
RE Model for All Studies (Q = 96.30, df = 13, p = 0.00; I2 = 80.5%)
100.00% 1.04 [ 0.54, 1.53]
−5
0
3
Hedge's G


Standard Error
Mean Difference
Gray matter Volume − cerebellum
Olulade et al. J N
Olulade et al. J Neurosci.2
Influence on Overall Result
Squared Pearson Residual
Gray matter Volume − cerebellum
Sample Quantiles
Theoretical Quantiles

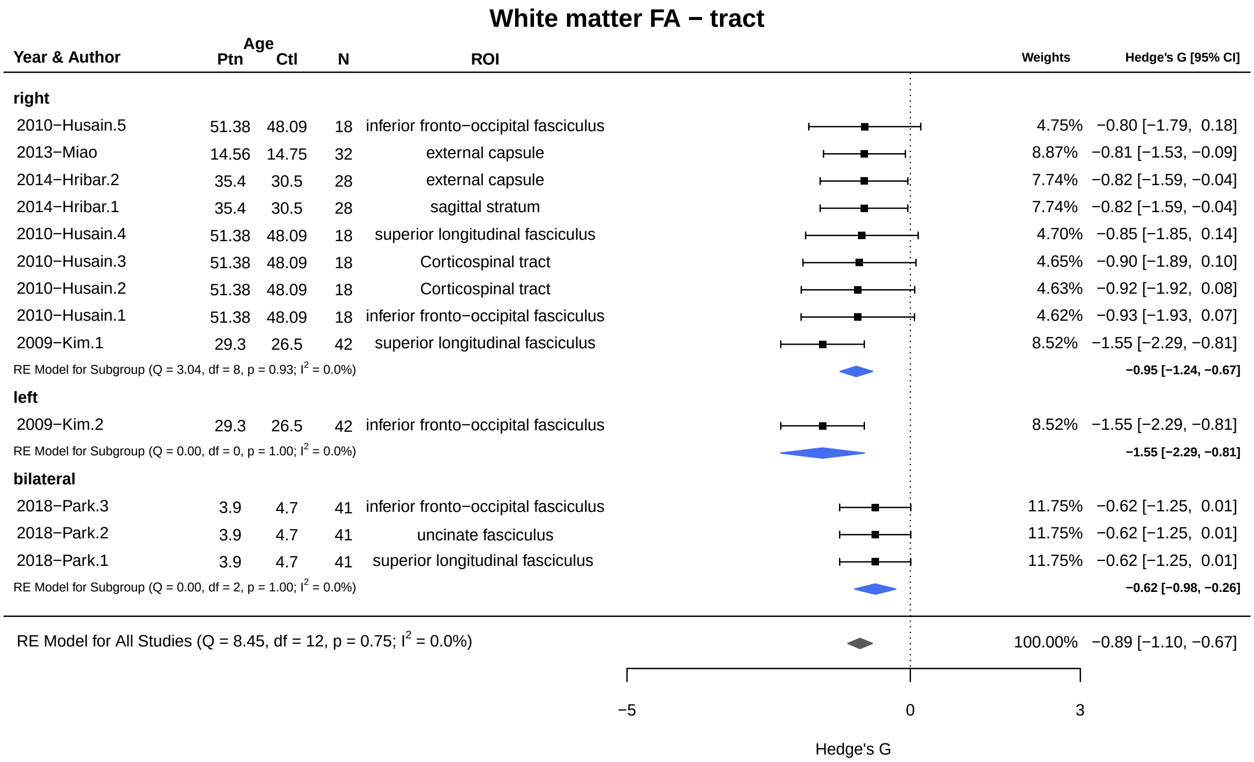

Gray matter Volume − occipital
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
right
2018−Pereira−Jorge.2 51.29 46.54 25 Lingual gyrus 5.72% −1.13 [−1.98, −0.27]
2010−Li,.3 14.56 14.75 32 occipital 5.86% −1.23 [−1.99, −0.47]
2018−Pereira−Jorge.1 51.29 46.54 25 Lateral occipital gyrus 5.67% −1.38 [−2.26, −0.49]
2013−Boyen.2 63 58 40 occipital lobe 5.87% −1.79 [−2.53, −1.04]
2013−Boyen.1 63 58 40 occipital lobe 5.87% −1.80 [−2.55, −1.05]
2014−Kim 50.4 49.5 19 Cuneus 5.15% −2.31 [−3.50, −1.11]
RE Model for Subgroup (Q = 4.13, df = 5, p = 0.53; I2 = 0.0%) −1.55 [−1.89, −1.21]
left
2007−Shibata 21 25 104 occipital 6.17% 2.52 [ 2.01, 3.04]
2011−Smith 1.16 1 42 mid−occipital 5.97% 1.23 [ 0.55, 1.90]
2014−Olulade 25.8 26.3 60 lingual gyrus 6.15% −0.87 [−1.40, −0.34]
2010−Li,.2 14.56 14.75 32 fusiform gyrus 5.85% −1.27 [−2.03, −0.51]
2010−Li,.1 14.56 14.75 32 occipital 5.83% −1.39 [−2.17, −0.62]
2018−Pereira−Jorge.3 51.29 46.54 25 Middle occipital gyrus 5.67% −1.40 [−2.28, −0.51]
2013−Pénicaud.2 39.2 37.3 66 occipital −V3a/V7 6.07% −1.84 [−2.44, −1.24]
2013−Pénicaud.1 39.2 37.3 66 occipital −V1/V2 6.04% −2.14 [−2.77, −1.52]
RE Model for Subgroup (Q = 215.68, df = 7, p = 0.00; I2 = 96.0%) −0.64 [−1.78, 0.51]
bilateral
2000−Bavelier 23 23 20 V1 5.68% 0.09 [−0.80, 0.97]
2014−Profant 69.14 24.34 54 V1 6.13% −0.23 [−0.79, 0.32]
2014−Lin 73.8 67 126 occipital lobe 6.31% −0.55 [−0.91, −0.18]
RE Model for Subgroup (Q = 2.14, df = 2, p = 0.34; I2 = 12.3%) −0.38 [−0.70, −0.06]
RE Model for All Studies (Q = 256.56, df = 16, p = 0.00; I2 = 92.8%) 100.00% −0.89 [−1.49, −0.29]
−5
0
3
Hedge's G

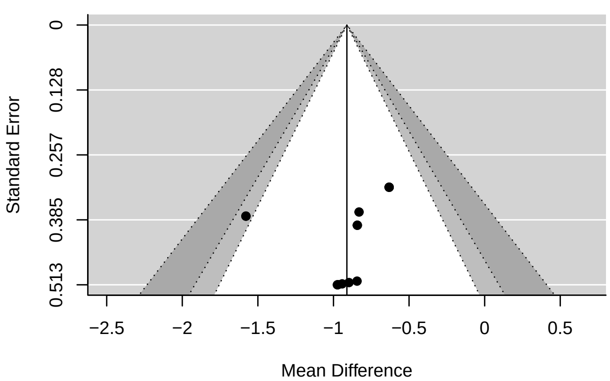

Gray matter Volume − occipital
Standard Error
Mean Difference
Influence on Overall Result
Squared Pearson Residual
Shibata DK. Am J
Smith et al. Cereb Cortex
Gray matter Volume − occipital
Sample Quantiles
Theoretical Quantiles

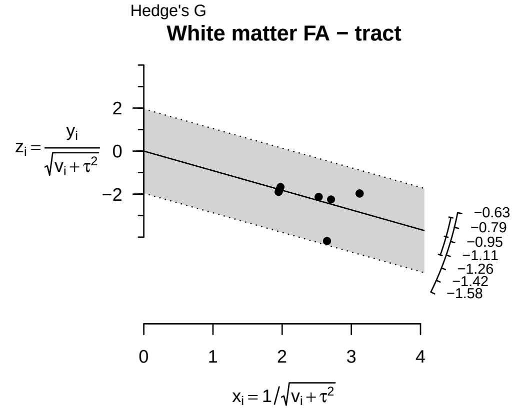

Gray matter Volume − insular cortex
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
right
2008−Allen.4 23.8 28.5 50 anterior insula 9.59% 0.31 [−0.25, 0.87]
2008−Allen.2 23.8 28.5 50 insula 9.59% 0.22 [−0.33, 0.78]
2008−Allen.6 23.8 28.5 50 posterior insula 9.60% 0.01 [−0.55, 0.56]
2014−Olulade 25.8 26.3 60 claustrum 9.64% −1.07 [−1.62, −0.53]
2018−Pereira−Jorge.1 51.29 46.54 25 Insula 8.29% −1.48 [−2.38, −0.59]
2018−Pereira−Jorge.3 51.29 46.54 25 Claustrum 8.24% −1.57 [−2.48, −0.66]
RE Model for Subgroup (Q = 30.86, df = 5, p = 0.00; I2 = 85.5%) −0.54 [−1.23, 0.14]
left
2008−Allen.5 23.8 28.5 50 posterior insula 9.54% 0.71 [ 0.14, 1.29]
2008−Allen.1 23.8 28.5 50 insula 9.56% 0.57 [ 0.01, 1.14]
2008−Allen.3 23.8 28.5 50 anterior insula 9.58% 0.37 [−0.18, 0.93]
2018−Pereira−Jorge.2 51.29 46.54 25 Insula 8.36% −1.35 [−2.23, −0.47]
2014−Kim 50.9 49.5 22 insula 8.01% −1.58 [−2.54, −0.61]
RE Model for Subgroup (Q = 29.88, df = 4, p = 0.00; I2 = 90.0%) −0.20 [−1.15, 0.75]
RE Model for All Studies (Q = 67.44, df = 10, p = 0.00; I2 = 87.4%) 100.00% −0.38 [−0.93, 0.17]
−5
0
3
Hedge's G

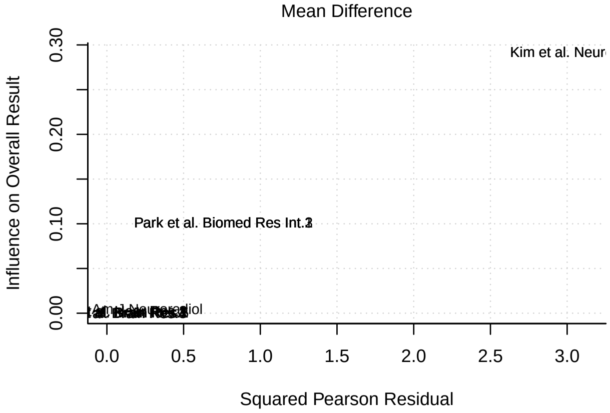

Standard Error
Mean Difference
Gray matter Volume − insular cortex
$z_i = \frac{y_i}{\sqrt{v_i + \tau^2}}$
$x_i = 1/\sqrt{v_i + \tau^2}$
0.72
0.33
−0.06
−0.46
−0.85
−1.24
−1.64
Influence on Overall Result
Squared Pearson Residual
Pereira−Jorge et al.
Allen et al. J Neu
Kim et al. He
Pereira−Jorge et al. Neural Plas
Allen et al. J Neurosci.1
Pereira−Jorge et al. Neural Plast.2
Allen et al. J Neurosci.3
Allen et al. J Neurosci.4
Olulade et al. J Neurosci
Allen et al. J Neurosci.2
al. J Neurosci.6
Gray matter Volume − insular cortex
Sample Quantiles
Theoretical Quantiles

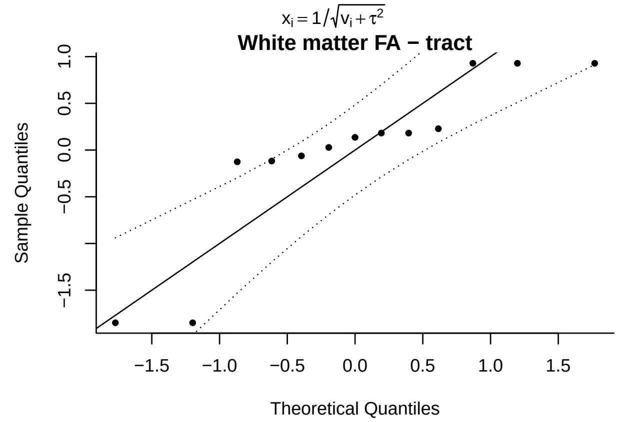
# Meta-regressions of White Matter FA & Brain Areas: Random effects model no intercept covariated by Side

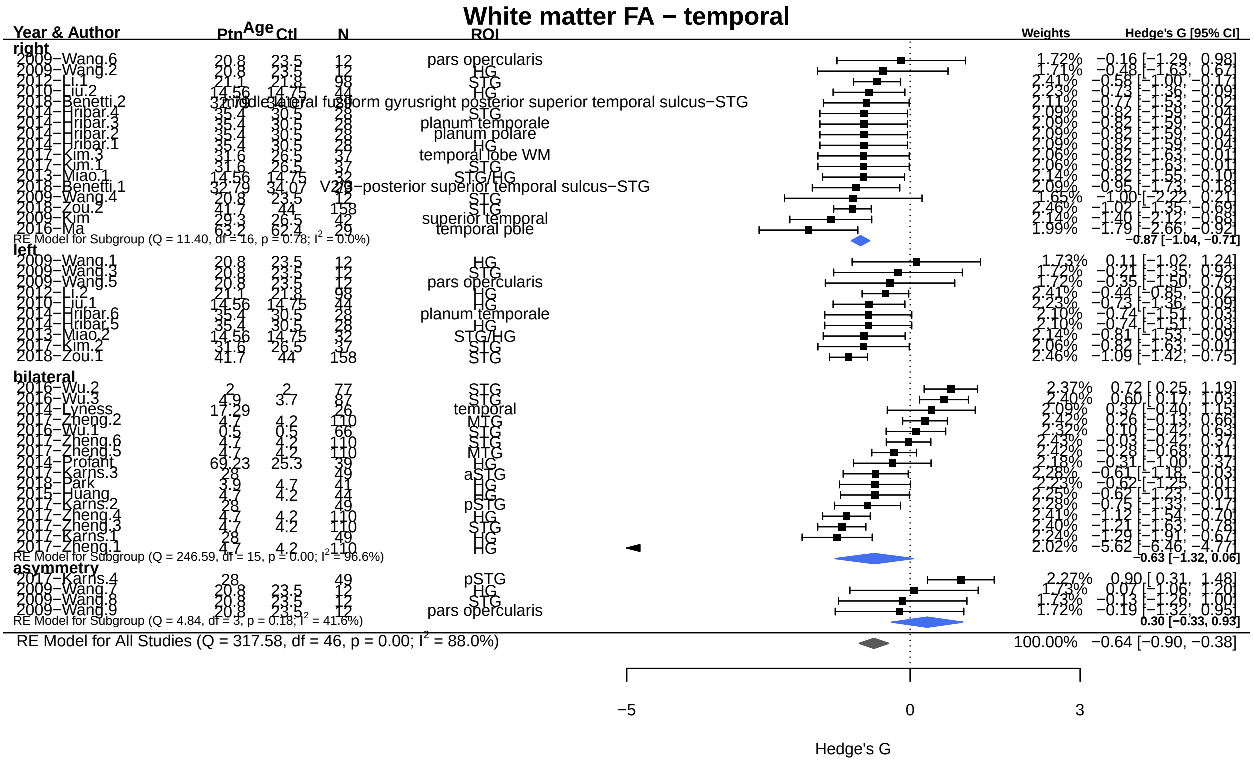


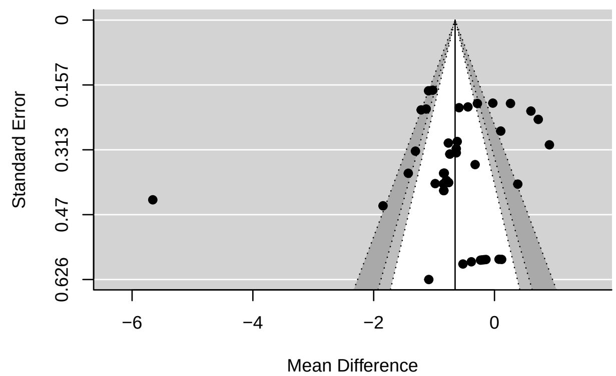



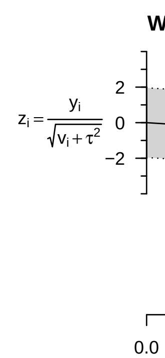



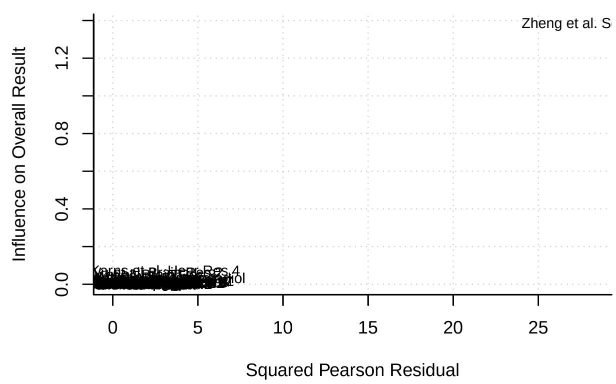



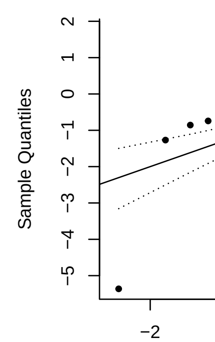



Error in rma(yi = hedgesG, vi = varG, data = meta.mod, measure = “MD”, : Fisher scoring algorithm did

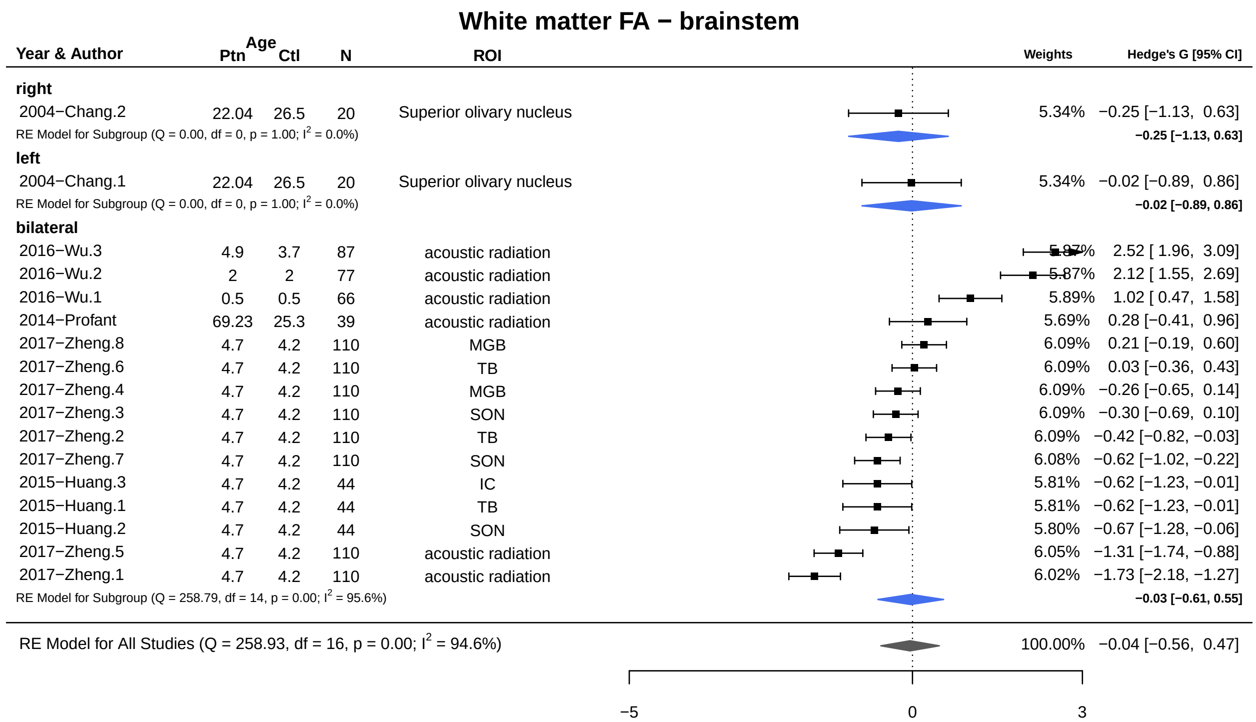


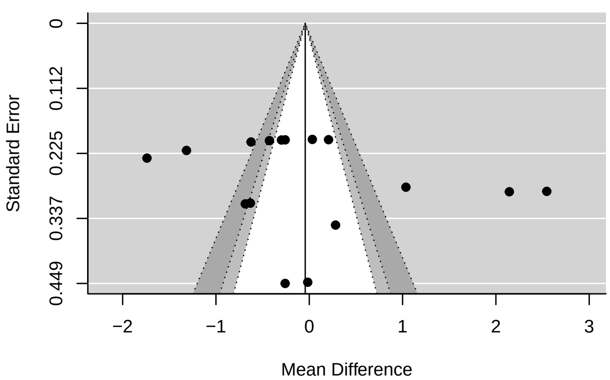



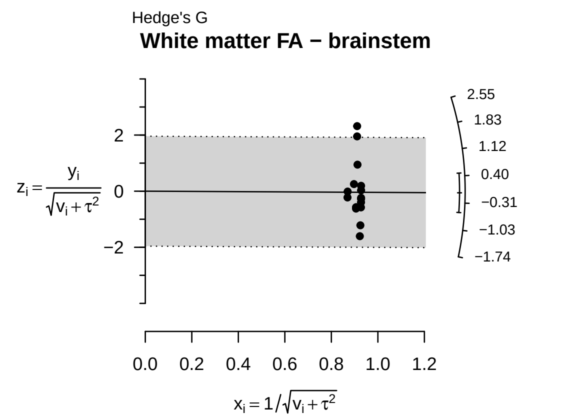


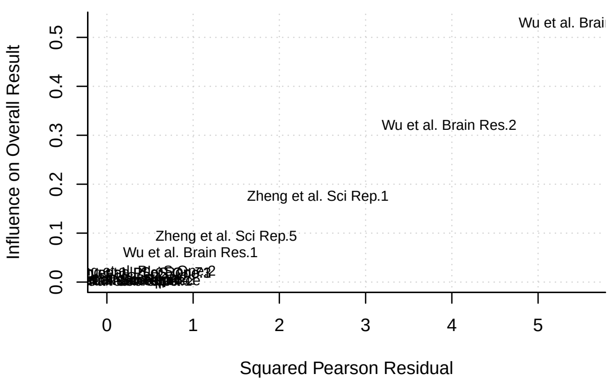



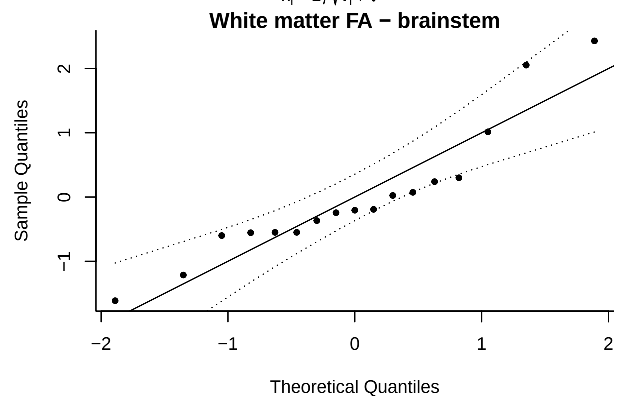

not converge. See ‘help(rma)’ for possible remedies.

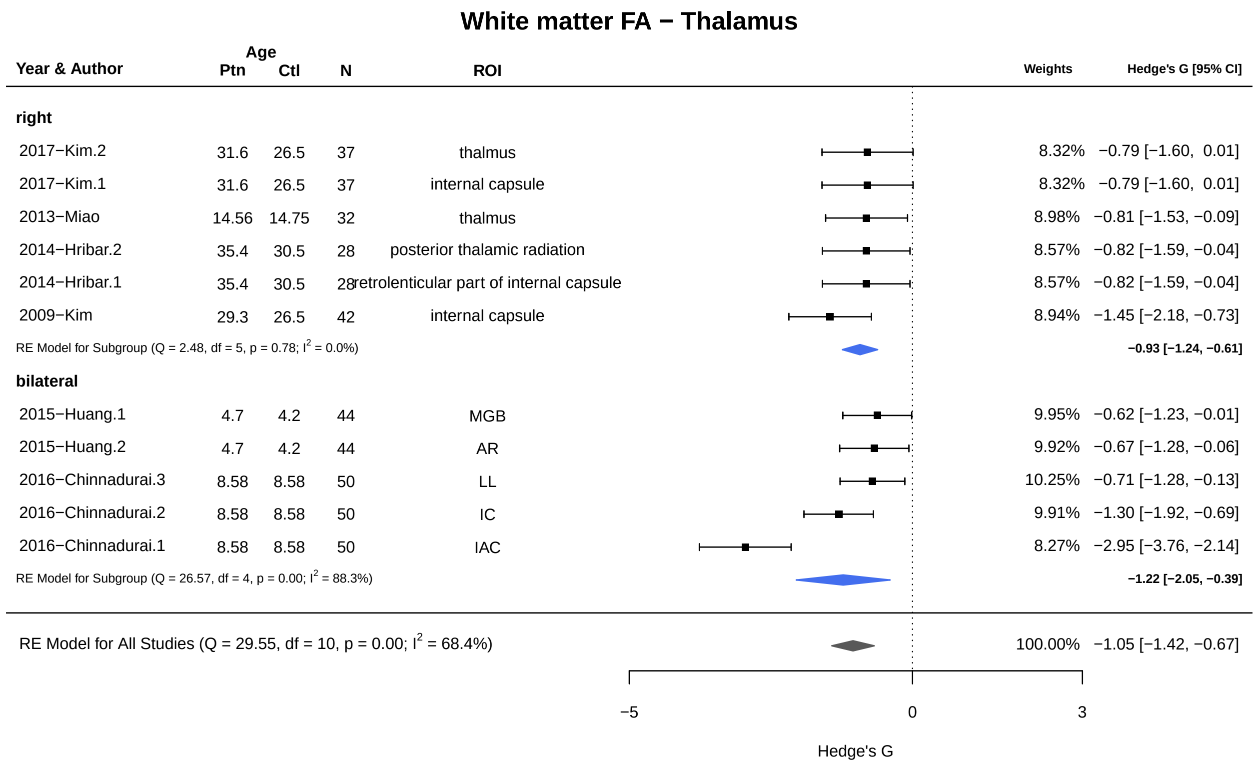

White matter FA − brainstem
Year & Author | Age Ptn | Ctl | N | ROI | Weights | Hedge's G [95% CI]
right
2004−Chang.2 22.04 26.5 20 Superior olivary nucleus 5.34% −0.25 [−1.13, 0.63]
RE Model for Subgroup (Q = 0.00, df = 0, p = 1.00; I2 = 0.0%) −0.25 [−1.13, 0.63]
left
2004−Chang.1 22.04 26.5 20 Superior olivary nucleus 5.34% −0.02 [−0.89, 0.86]
RE Model for Subgroup (Q = 0.00, df = 0, p = 1.00; I2 = 0.0%) −0.02 [−0.89, 0.86]
bilateral
2016−Wu.3 4.9 3.7 87 acoustic radiation 5.97% 2.52 [ 1.96, 3.09]
2016−Wu.2 2 2 77 acoustic radiation 5.87% 2.12 [ 1.55, 2.69]
2016−Wu.1 0.5 0.5 66 acoustic radiation 5.89% 1.02 [ 0.47, 1.58]
2014−Profant 69.23 25.3 39 acoustic radiation 5.69% 0.28 [−0.41, 0.96]
2017−Zheng.8 4.7 4.2 110 MGB 6.09% 0.21 [−0.19, 0.60]
2017−Zheng.6 4.7 4.2 110 TB 6.09% 0.03 [−0.36, 0.43]
2017−Zheng.4 4.7 4.2 110 MGB 6.09% −0.26 [−0.65, 0.14]
2017−Zheng.3 4.7 4.2 110 SON 6.09% −0.30 [−0.69, 0.10]
2017−Zheng.2 4.7 4.2 110 TB 6.09% −0.42 [−0.82, −0.03]
2017−Zheng.7 4.7 4.2 110 SON 6.08% −0.62 [−1.02, −0.22]
2015−Huang.3 4.7 4.2 44 IC 5.81% −0.62 [−1.23, −0.01]
2015−Huang.1 4.7 4.2 44 TB 5.81% −0.62 [−1.23, −0.01]
2015−Huang.2 4.7 4.2 44 SON 5.80% −0.67 [−1.28, −0.06]
2017−Zheng.5 4.7 4.2 110 acoustic radiation 6.05% −1.31 [−1.74, −0.88]
2017−Zheng.1 4.7 4.2 110 acoustic radiation 6.02% −1.73 [−2.18, −1.27]
RE Model for Subgroup (Q = 258.79, df = 14, p = 0.00; I2 = 95.6%) −0.03 [−0.61, 0.55]
RE Model for All Studies (Q = 258.93, df = 16, p = 0.00; I2 = 94.6%) 100.00% −0.04 [−0.56, 0.47]
−5
0
3
Hedge's G

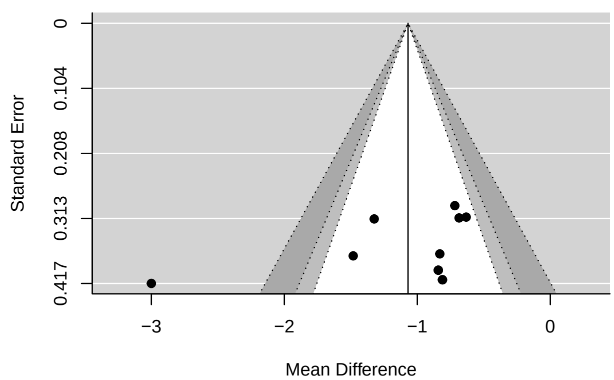

Standard Error
0
0.112
0.225
0.337
0.449
−2
−1
0
1
2
3
Mean Difference

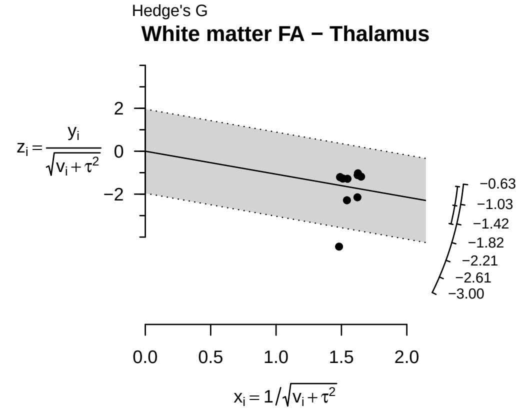

White matter FA − brainstem
$z_i = \frac{y_i}{\sqrt{v_i + \tau^2}}$
2
0
−2
2.55
1.83
1.12
0.40
−0.31
−1.03
−1.74
0.0
0.2
0.4
0.6
0.8
1.0
1.2
$x_i = 1/\sqrt{v_i + \tau^2}$

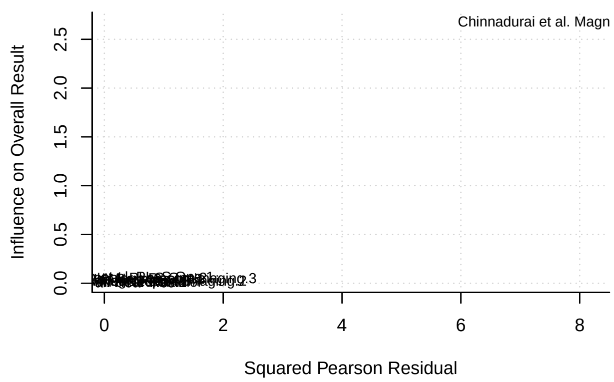

Influence on Overall Result
0.0
0.1
0.2
0.3
0.4
0.5
Wu et al. Brai
Wu et al. Brain Res.2
Zheng et al. Sci Rep.1
Zheng et al. Sci Rep.5
Wu et al. Brain Res.1
0
1
2
3
4
5
Squared Pearson Residual

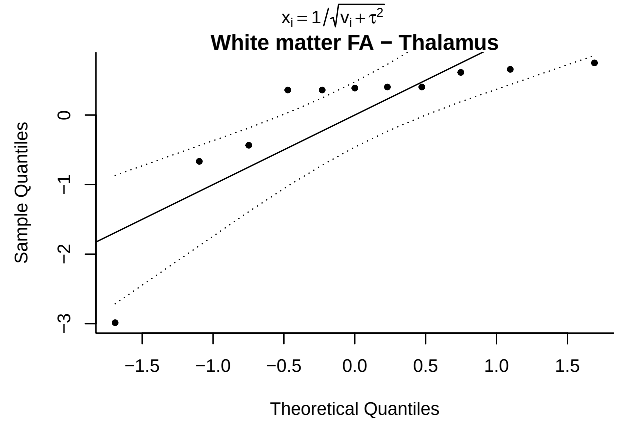

White matter FA − brainstem
Sample Quantiles
−1
0
1
2
−2
−1
0
1
2
Theoretical Quantiles

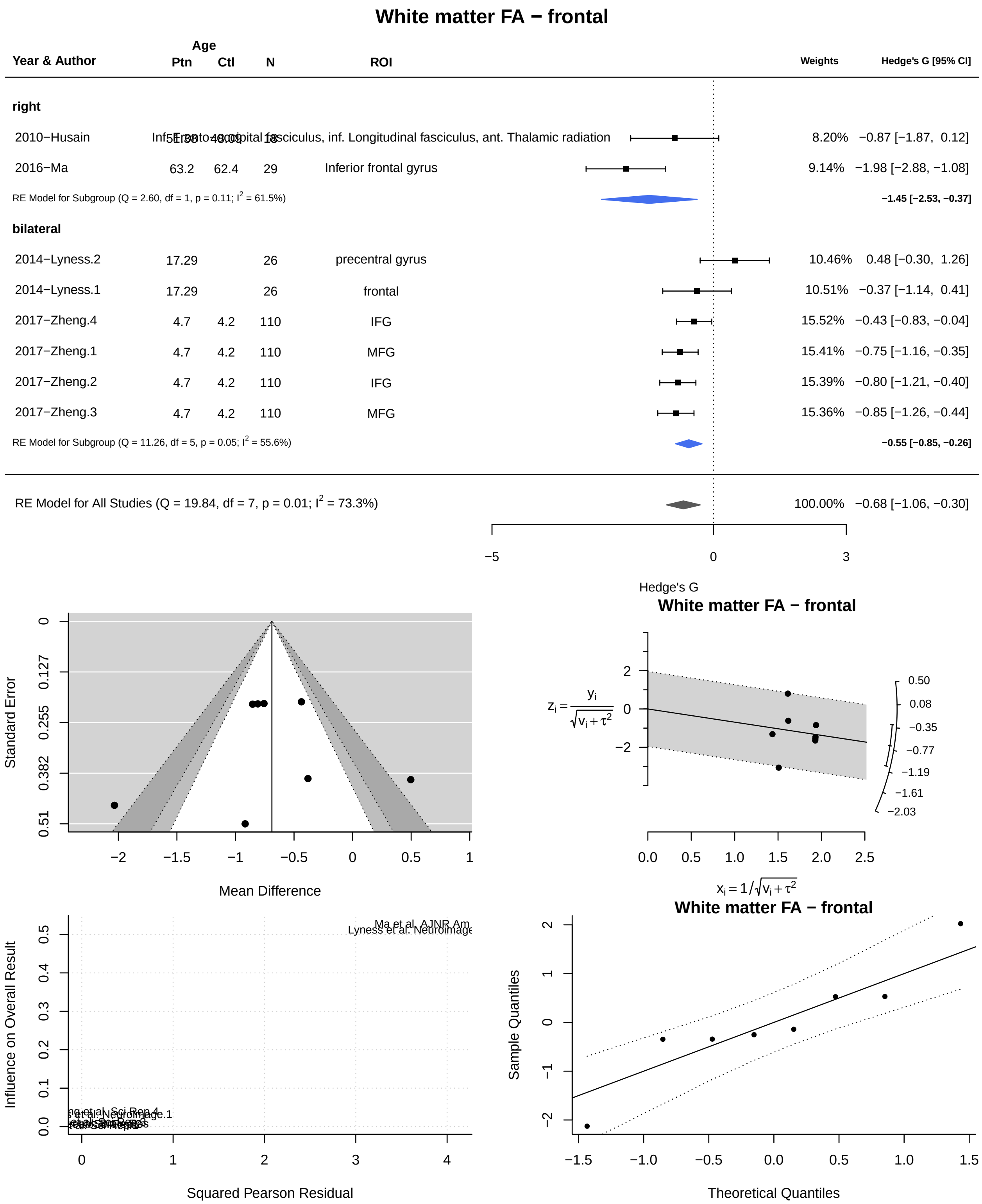

White matter FA − Thalamus
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
right
2017−Kim.2 31.6 26.5 37 thalmus 8.32% −0.79 [−1.60, 0.01]
2017−Kim.1 31.6 26.5 37 internal capsule 8.32% −0.79 [−1.60, 0.01]
2013−Miao 14.56 14.75 32 thalmus 8.98% −0.81 [−1.53, −0.09]
2014−Hribar.2 35.4 30.5 28 posterior thalamic radiation 8.57% −0.82 [−1.59, −0.04]
2014−Hribar.1 35.4 30.5 28 retrolenticular part of internal capsule 8.57% −0.82 [−1.59, −0.04]
2009−Kim 29.3 26.5 42 internal capsule 8.94% −1.45 [−2.18, −0.73]
RE Model for Subgroup (Q = 2.48, df = 5, p = 0.78; I2 = 0.0%) −0.93 [−1.24, −0.61]
bilateral
2015−Huang.1 4.7 4.2 44 MGB 9.95% −0.62 [−1.23, −0.01]
2015−Huang.2 4.7 4.2 44 AR 9.92% −0.67 [−1.28, −0.06]
2016−Chinnadurai.3 8.58 8.58 50 LL 10.25% −0.71 [−1.28, −0.13]
2016−Chinnadurai.2 8.58 8.58 50 IC 9.91% −1.30 [−1.92, −0.69]
2016−Chinnadurai.1 8.58 8.58 50 IAC 8.27% −2.95 [−3.76, −2.14]
RE Model for Subgroup (Q = 26.57, df = 4, p = 0.00; I2 = 88.3%) −1.22 [−2.05, −0.39]
RE Model for All Studies (Q = 29.55, df = 10, p = 0.00; I2 = 68.4%) 100.00% −1.05 [−1.42, −0.67]
−5
0
3
Hedge's G

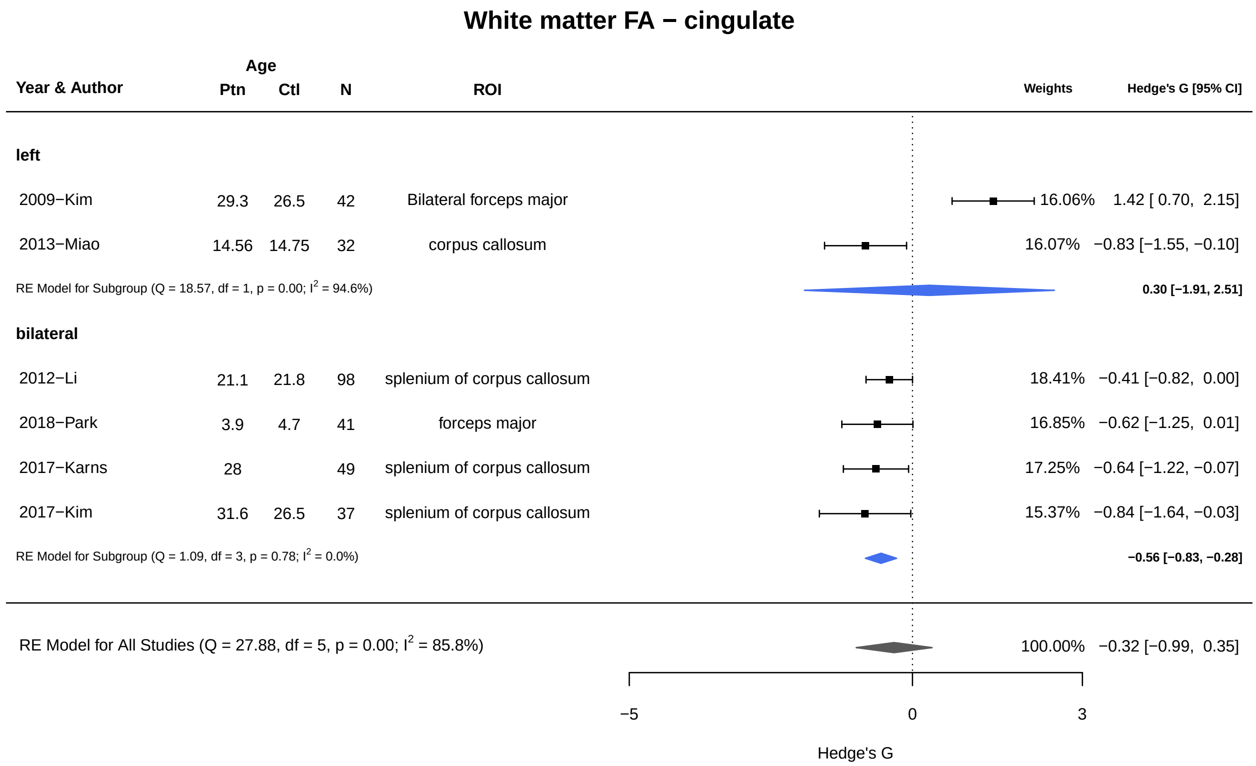

Standard Error
0
0.104
0.208
0.313
0.417
−3
−2
−1
0
Mean Difference

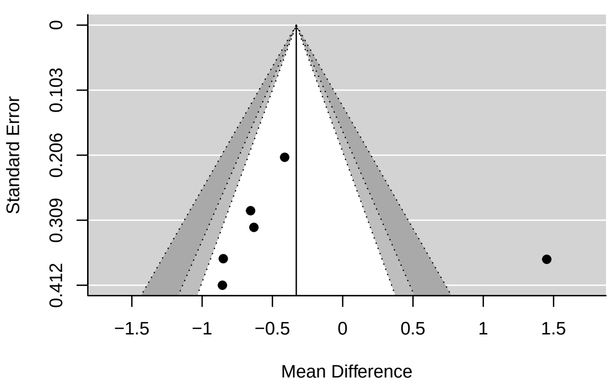

White matter FA − Thalamus
$z_i = \frac{y_i}{\sqrt{v_i + \tau^2}}$
2
0
−2
−0.63
−1.03
−1.42
−1.82
−2.21
−2.61
−3.00
0.0
0.5
1.0
1.5
2.0
$x_i = 1/\sqrt{v_i + \tau^2}$

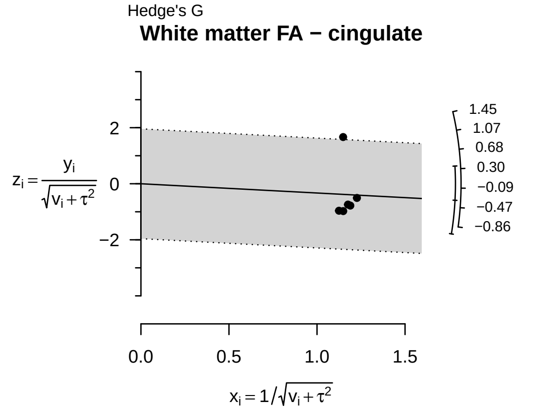

Influence on Overall Result
Chinnadurai et al. Magn
0.0
0.5
1.0
1.5
2.0
2.5
0
2
4
6
8
Squared Pearson Residual

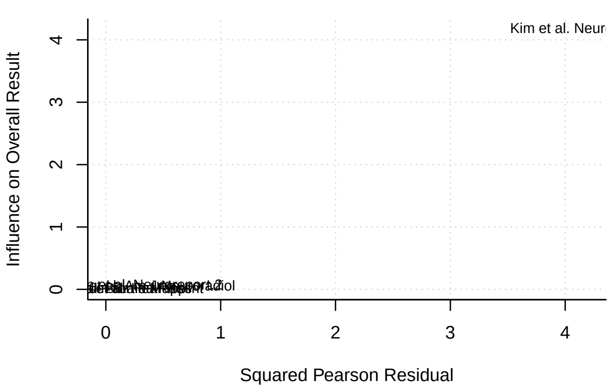

White matter FA − Thalamus
Sample Quantiles
0
−1
−2
−3
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles

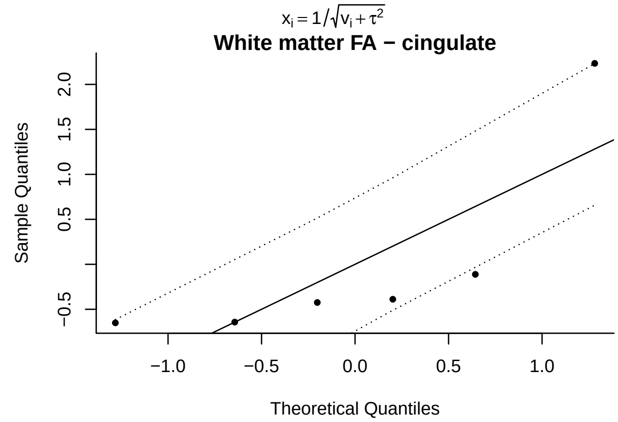

White matter FA − frontal
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
right
2010−Husain
Inf. Fronto-occipital fasciculus, inf. Longitudinal fasciculus, ant. Thalamic radiation
8.20% −0.87 [−1.87, 0.12]
2016−Ma 63.2 62.4 29 Inferior frontal gyrus
9.14% −1.98 [−2.88, −1.08]
RE Model for Subgroup (Q = 2.60, df = 1, p = 0.11; I² = 61.5%)
−1.45 [−2.53, −0.37]
bilateral
2014−Lyness.2 17.29 26 precentral gyrus
10.46% 0.48 [−0.30, 1.26]
2014−Lyness.1 17.29 26 frontal
10.51% −0.37 [−1.14, 0.41]
2017−Zheng.4 4.7 4.2 110 IFG
15.52% −0.43 [−0.83, −0.04]
2017−Zheng.1 4.7 4.2 110 MFG
15.41% −0.75 [−1.16, −0.35]
2017−Zheng.2 4.7 4.2 110 IFG
15.39% −0.80 [−1.21, −0.40]
2017−Zheng.3 4.7 4.2 110 MFG
15.36% −0.85 [−1.26, −0.44]
RE Model for Subgroup (Q = 11.26, df = 5, p = 0.05; I² = 55.6%)
−0.55 [−0.85, −0.26]
RE Model for All Studies (Q = 19.84, df = 7, p = 0.01; I² = 73.3%)
100.00% −0.68 [−1.06, −0.30]
−5
0
3
Hedge's G
Standard Error
0
0.127
0.255
0.382
0.51
−2
−1.5
−1
−0.5
0
0.5
1
Mean Difference
White matter FA − frontal
$z_i = \frac{y_i}{\sqrt{v_i + \tau^2}}$
2
0
−2
0.50
0.08
−0.35
−0.77
−1.19
−1.61
−2.03
0.0
0.5
1.0
1.5
2.0
2.5
$x_i = 1/\sqrt{v_i + \tau^2}$
Influence on Overall Result
0.0
0.1
0.2
0.3
0.4
0.5
Ma et al. AJNR Am
Lyness et al. Neuroimage
0
1
2
3
4
Squared Pearson Residual
White matter FA − frontal
Sample Quantiles
2
1
0
−1
−2
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles


White matter FA − cingulate
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
left
2009−Kim 29.3 26.5 42 Bilateral forceps major 16.06% 1.42 [ 0.70, 2.15]
2013−Miao 14.56 14.75 32 corpus callosum 16.07% −0.83 [−1.55, −0.10]
RE Model for Subgroup (Q = 18.57, df = 1, p = 0.00; I$^2$ = 94.6%) 0.30 [−1.91, 2.51]
bilateral
2012−Li 21.1 21.8 98 splenium of corpus callosum 18.41% −0.41 [−0.82, 0.00]
2018−Park 3.9 4.7 41 forceps major 16.85% −0.62 [−1.25, 0.01]
2017−Karns 28 49 splenium of corpus callosum 17.25% −0.64 [−1.22, −0.07]
2017−Kim 31.6 26.5 37 splenium of corpus callosum 15.37% −0.84 [−1.64, −0.03]
RE Model for Subgroup (Q = 1.09, df = 3, p = 0.78; I$^2$ = 0.0%) −0.56 [−0.83, −0.28]
RE Model for All Studies (Q = 27.88, df = 5, p = 0.00; I$^2$ = 85.8%) 100.00% −0.32 [−0.99, 0.35]
−5
0
3
Hedge's G

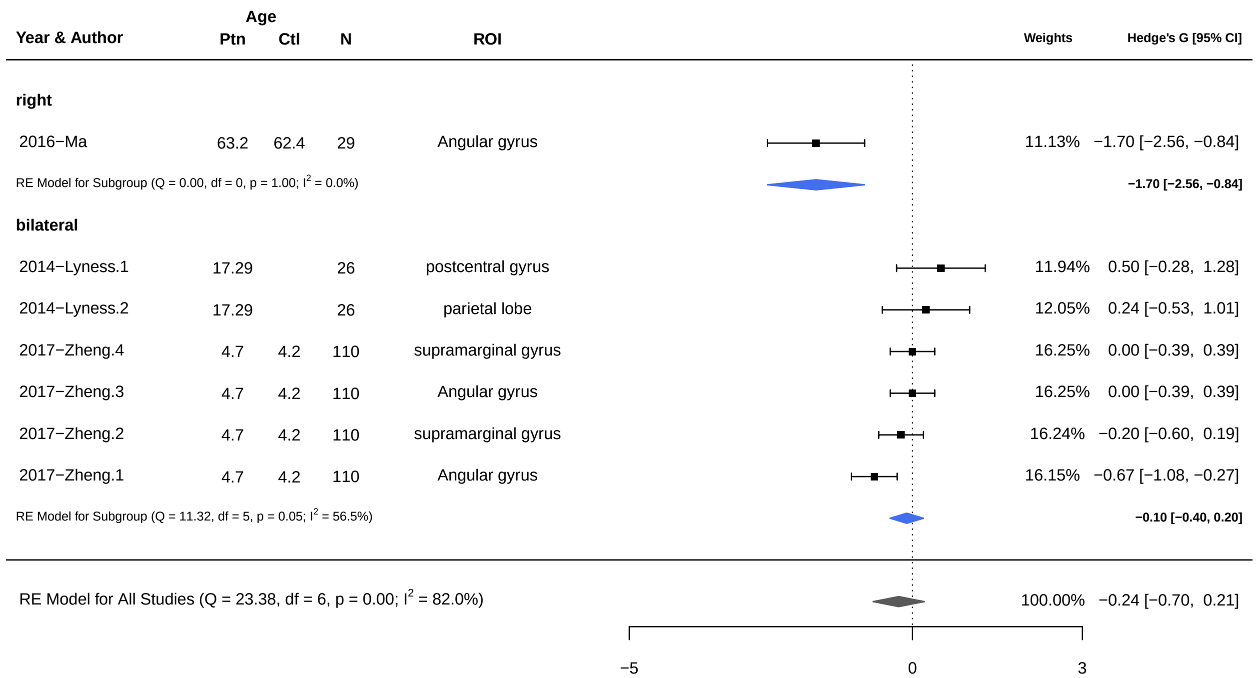

Standard Error
0
0.103
0.206
0.309
0.412
−1.5
−1
−0.5
0
0.5
1
1.5
Mean Difference

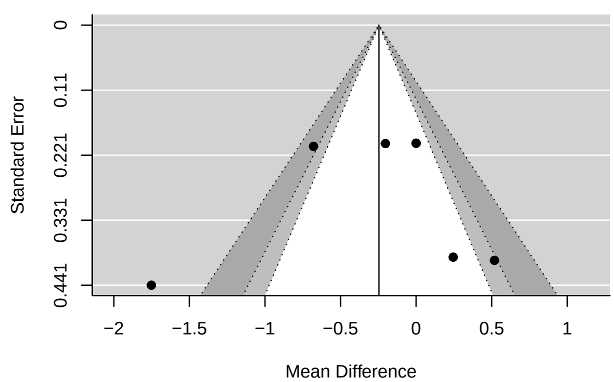

White matter FA − cingulate
2
0
−2
$z_i = \frac{y_i}{\sqrt{v_i + \tau^2}}$
1.45
1.07
0.68
0.30
−0.09
−0.47
−0.86
0.0
0.5
1.0
1.5
$x_i = 1/\sqrt{v_i + \tau^2}$

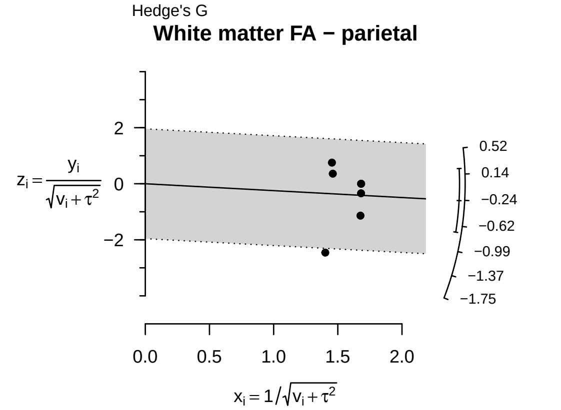

Influence on Overall Result
Kim et al. Neur
0
1
2
3
4
Squared Pearson Residual

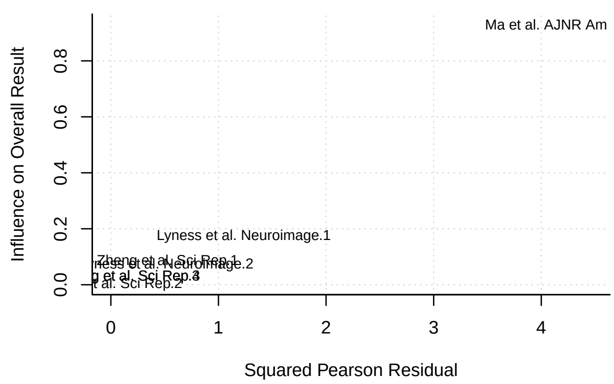

White matter FA − cingulate
Sample Quantiles
−0.5
0.5
1.0
1.5
2.0
−1.0
−0.5
0.0
0.5
1.0
Theoretical Quantiles

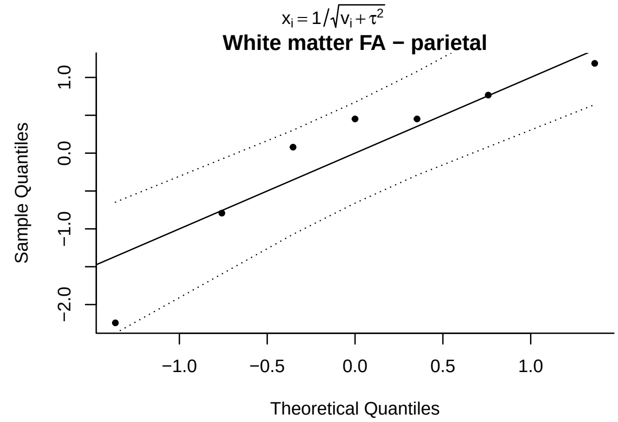
## White matter FA − parietal

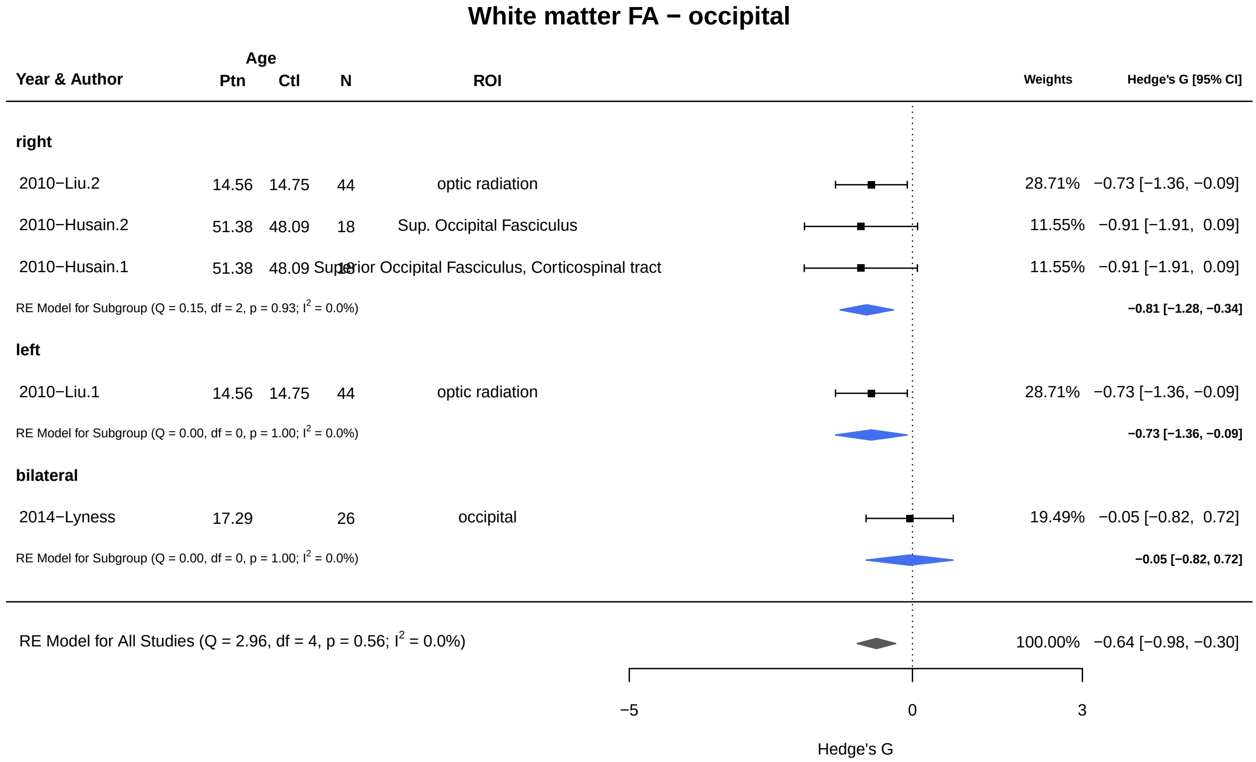


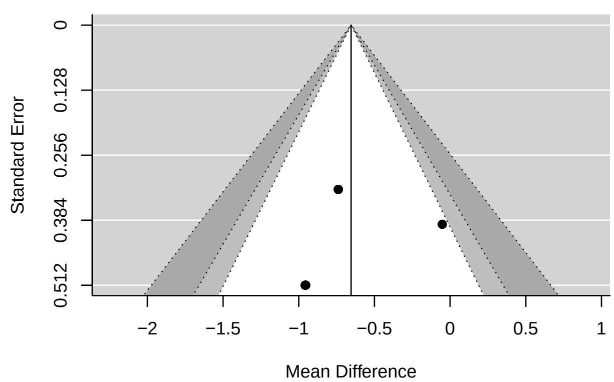



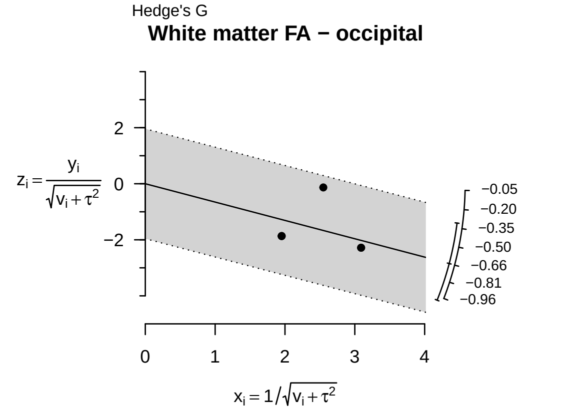



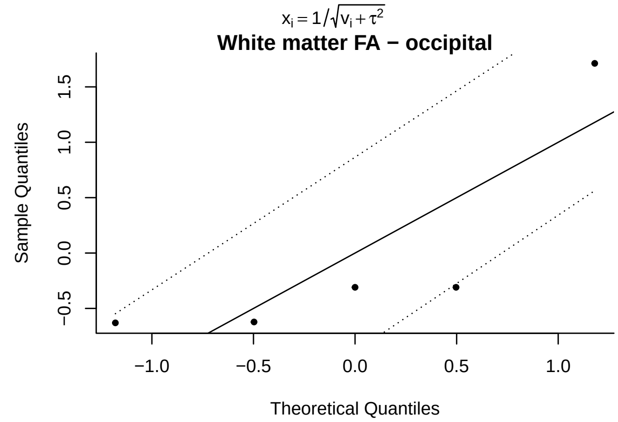




White matter FA − occipital
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
right
2010−Liu.2
14.56
14.75
44
optic radiation
28.71%
−0.73 [−1.36, −0.09]
2010−Husain.2
51.38
48.09
18
Sup. Occipital Fasciculus
11.55%
−0.91 [−1.91, 0.09]
2010−Husain.1
51.38
48.09
18
Superior Occipital Fasciculus, Corticospinal tract
11.55%
−0.91 [−1.91, 0.09]
RE Model for Subgroup (Q = 0.15, df = 2, p = 0.93; I² = 0.0%)
−0.81 [−1.28, −0.34]
left
2010−Liu.1
14.56
14.75
44
optic radiation
28.71%
−0.73 [−1.36, −0.09]
RE Model for Subgroup (Q = 0.00, df = 0, p = 1.00; I² = 0.0%)
−0.73 [−1.36, −0.09]
bilateral
2014−Lyness
17.29
26
occipital
19.49%
−0.05 [−0.82, 0.72]
RE Model for Subgroup (Q = 0.00, df = 0, p = 1.00; I² = 0.0%)
−0.05 [−0.82, 0.72]
RE Model for All Studies (Q = 2.96, df = 4, p = 0.56; I² = 0.0%)
100.00%
−0.64 [−0.98, −0.30]
−5
0
3
Hedge's G

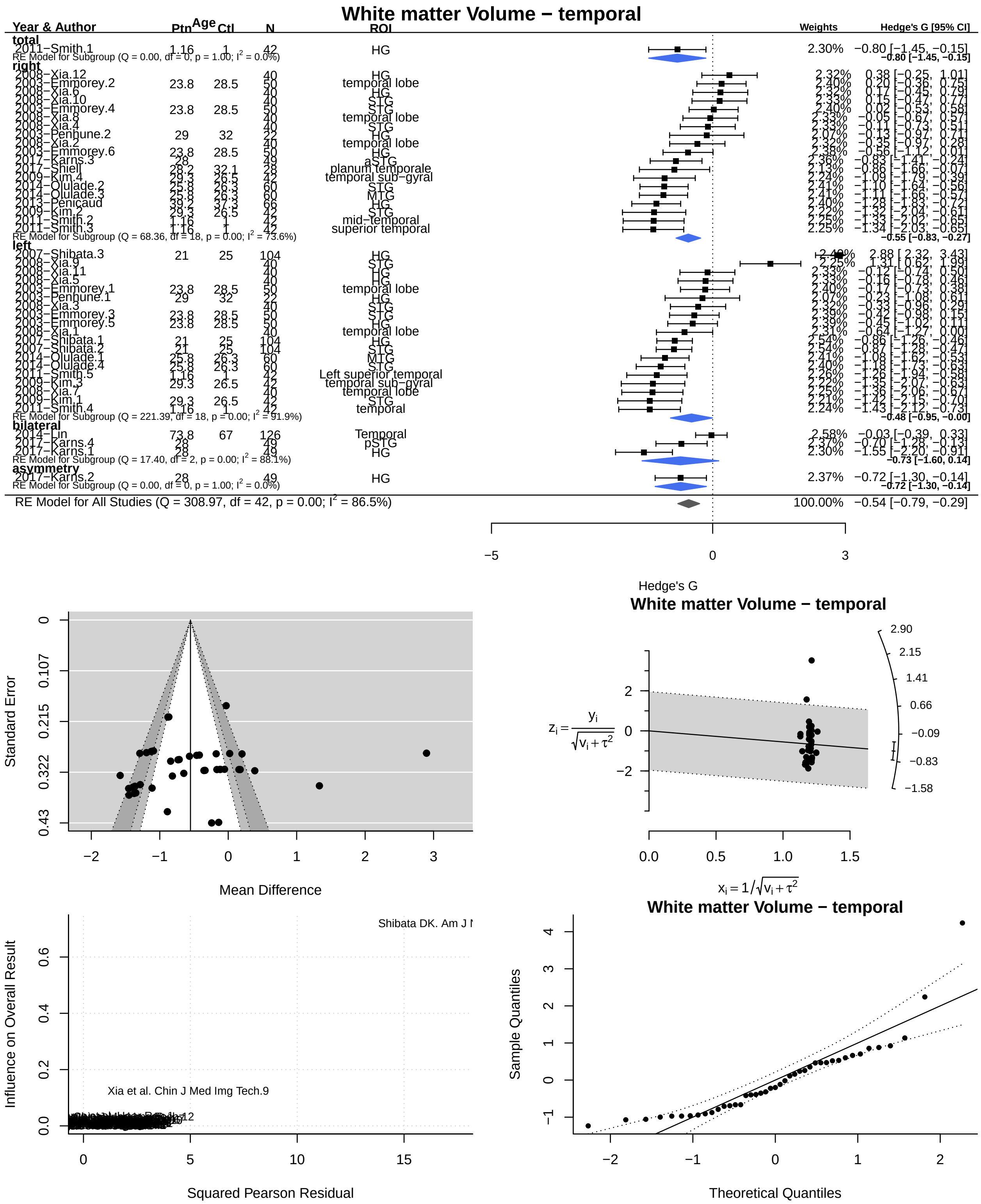

Standard Error
0
0.128
0.256
0.384
0.512
−2
−1.5
−1
−0.5
0
0.5
1
Mean Difference

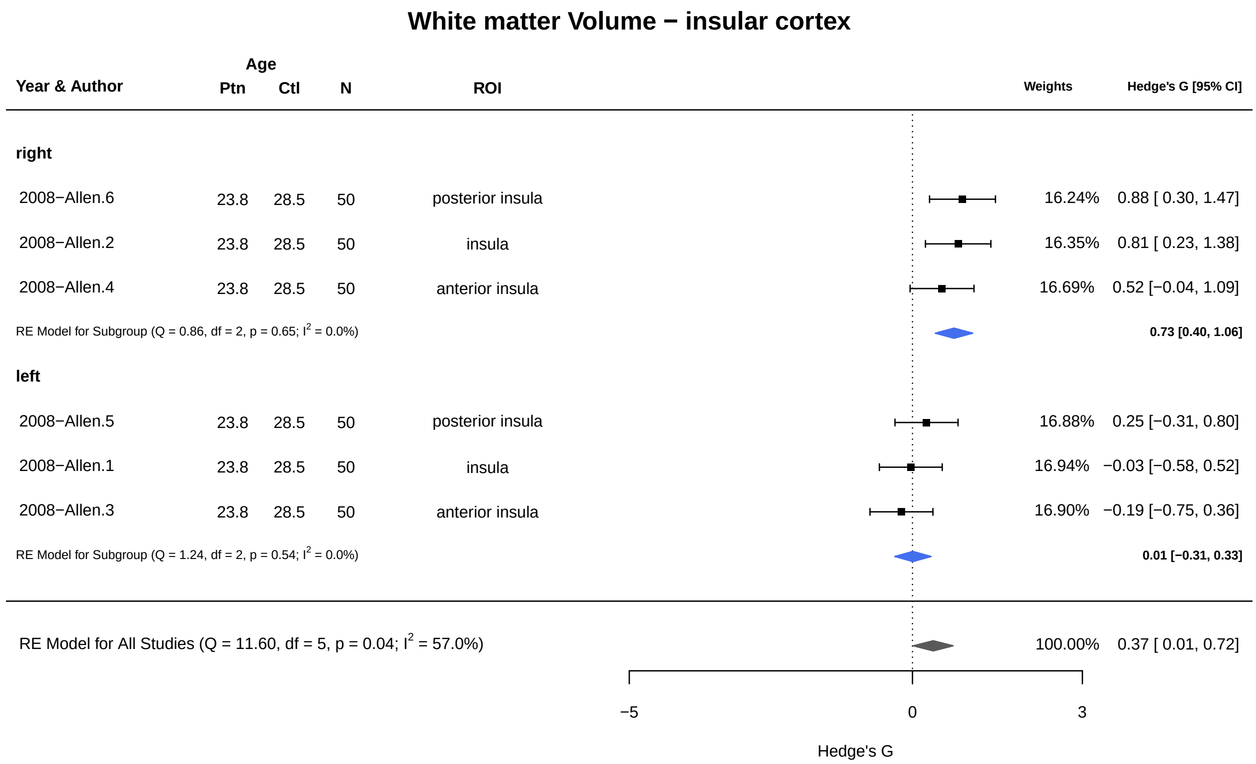

White matter FA − occipital
2
0
−2
−0.05
−0.20
−0.35
−0.50
−0.66
−0.81
−0.96
0
1
2
3
4

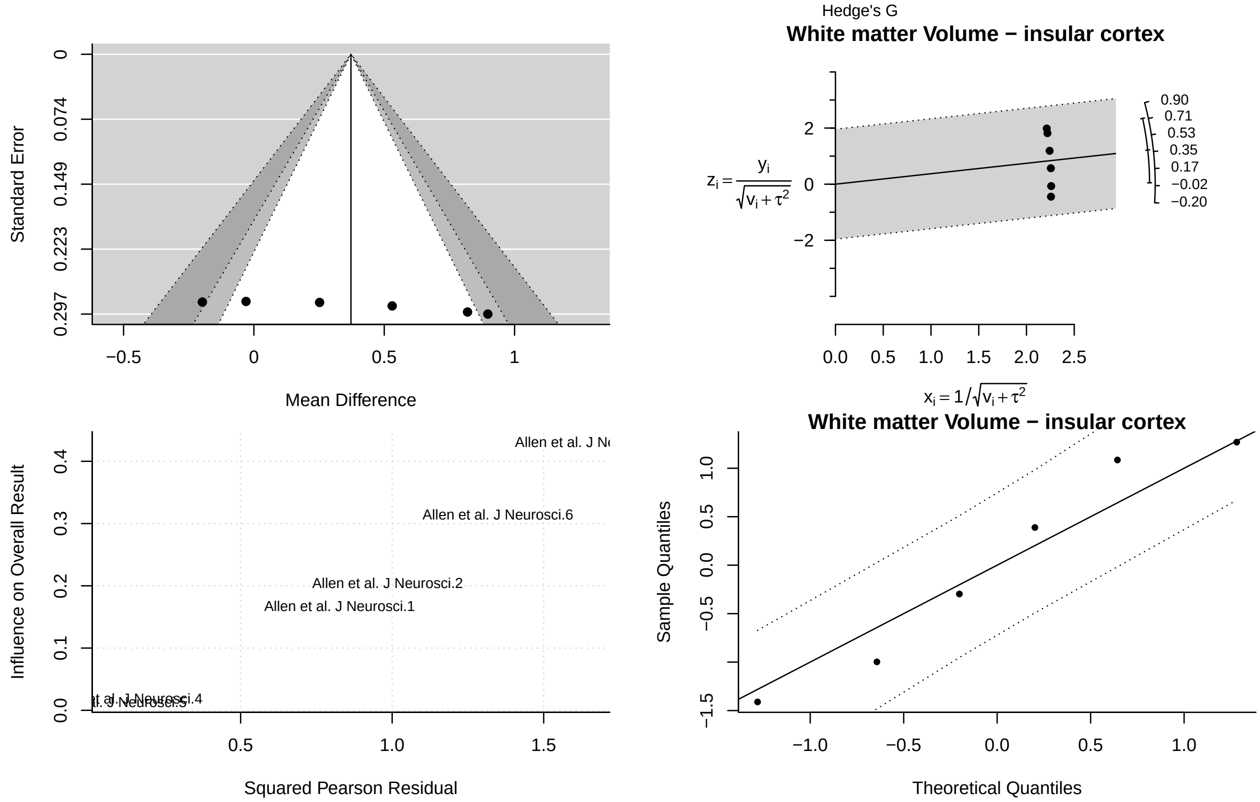

Influence on Overall Result
0.1
0.2
0.3
0.4
0.5
Lyness et al. Ne
0.0
0.5
1.0
1.5
2.0
Squared Pearson Residual

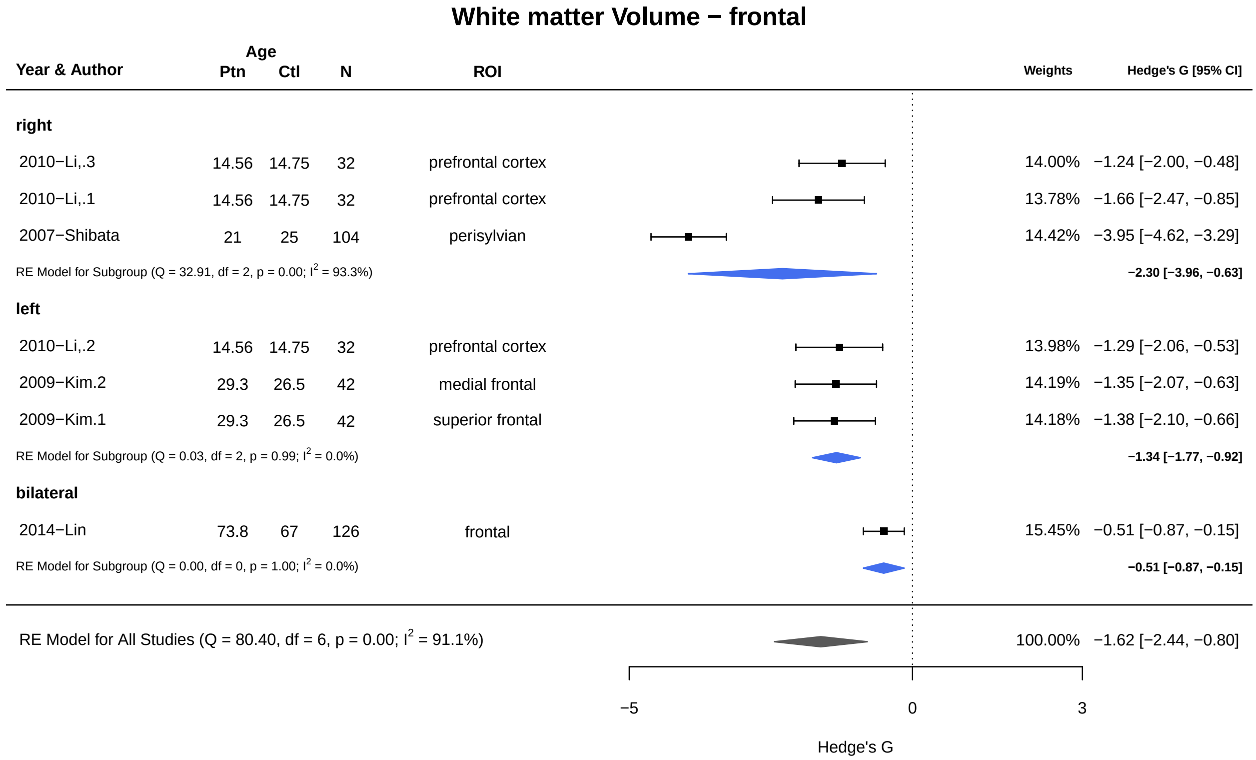

White matter FA − occipital
Sample Quantiles
−0.5
0.0
0.5
1.0
1.5
−1.0
−0.5
0.0
0.5
1.0
Theoretical Quantiles

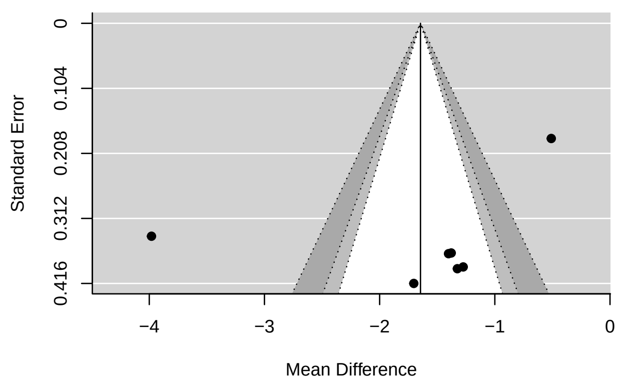
# Meta-regressions of White Matter Volume & Brain Areas: Random effects model no intercept covariated by Side

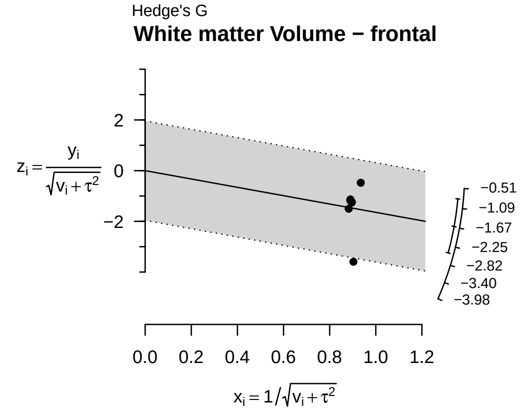



White matter Volume − insular cortex
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
right
2008−Allen.6 23.8 28.5 50 posterior insula 16.24% 0.88 [ 0.30, 1.47]
2008−Allen.2 23.8 28.5 50 insula 16.35% 0.81 [ 0.23, 1.38]
2008−Allen.4 23.8 28.5 50 anterior insula 16.69% 0.52 [−0.04, 1.09]
RE Model for Subgroup (Q = 0.86, df = 2, p = 0.65; I2 = 0.0%) 0.73 [0.40, 1.06]
left
2008−Allen.5 23.8 28.5 50 posterior insula 16.88% 0.25 [−0.31, 0.80]
2008−Allen.1 23.8 28.5 50 insula 16.94% −0.03 [−0.58, 0.52]
2008−Allen.3 23.8 28.5 50 anterior insula 16.90% −0.19 [−0.75, 0.36]
RE Model for Subgroup (Q = 1.24, df = 2, p = 0.54; I2 = 0.0%) 0.01 [−0.31, 0.33]
RE Model for All Studies (Q = 11.60, df = 5, p = 0.04; I2 = 57.0%) 100.00% 0.37 [ 0.01, 0.72]
−5
0
3
Hedge's G

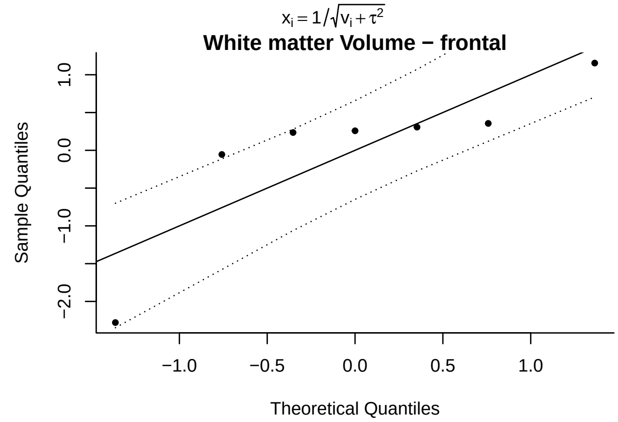

Standard Error
0
0.074
0.149
0.223
0.297
−0.5
0
0.5
1
Mean Difference
White matter Volume − insular cortex
zi = yi / √(vi + τ2)
2
0
−2
0.0
0.5
1.0
1.5
2.0
2.5
xi = 1/√(vi + τ2)
0.90
0.71
0.53
0.35
0.17
−0.02
−0.20
Influence on Overall Result
0.0
0.1
0.2
0.3
0.4
Allen et al. J Neurosci.6
Allen et al. J Neurosci.2
Allen et al. J Neurosci.1
0.5
1.0
1.5
Squared Pearson Residual
White matter Volume − insular cortex
Sample Quantiles
−1.5
−0.5
0.0
0.5
1.0
−1.0
−0.5
0.0
0.5
1.0
Theoretical Quantiles

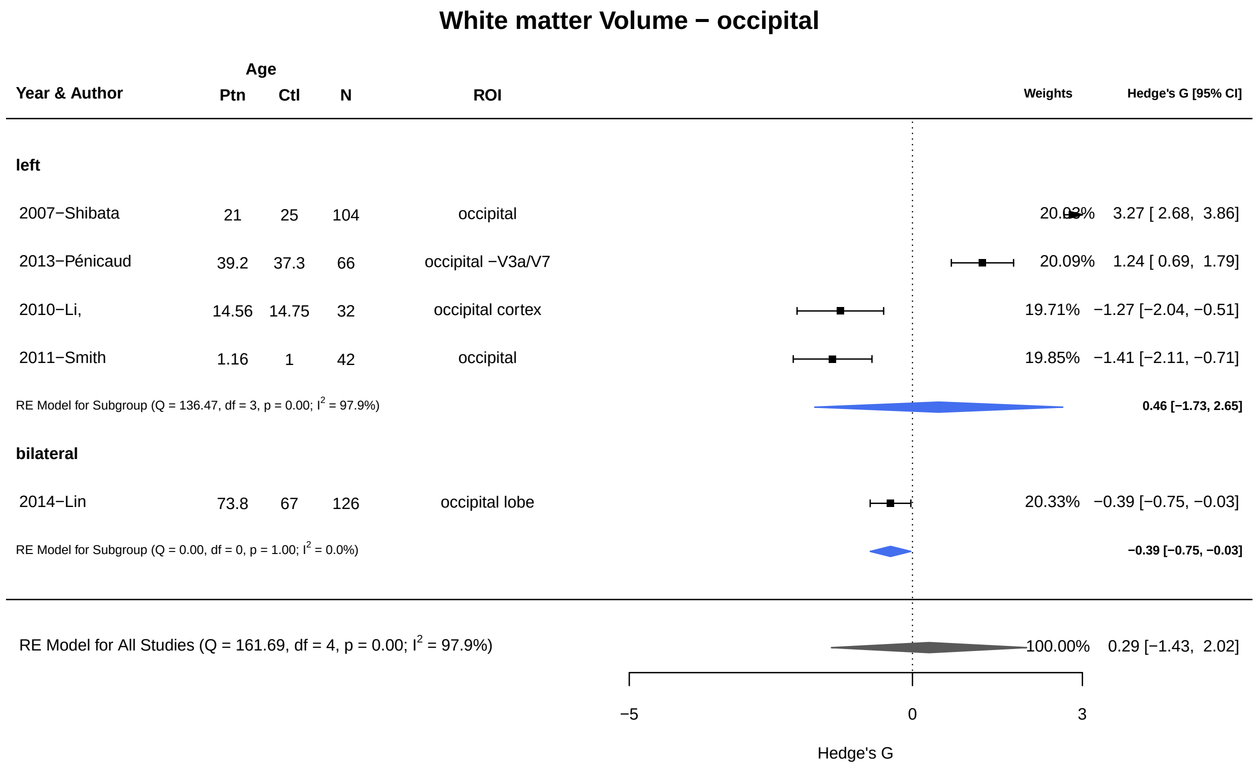

White matter Volume − frontal
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
right
2010−Li,.3 14.56 14.75 32 prefrontal cortex 14.00% −1.24 [−2.00, −0.48]
2010−Li,.1 14.56 14.75 32 prefrontal cortex 13.78% −1.66 [−2.47, −0.85]
2007−Shibata 21 25 104 perisylvian 14.42% −3.95 [−4.62, −3.29]
RE Model for Subgroup (Q = 32.91, df = 2, p = 0.00; I² = 93.3%) −2.30 [−3.96, −0.63]
left
2010−Li,.2 14.56 14.75 32 prefrontal cortex 13.98% −1.29 [−2.06, −0.53]
2009−Kim.2 29.3 26.5 42 medial frontal 14.19% −1.35 [−2.07, −0.63]
2009−Kim.1 29.3 26.5 42 superior frontal 14.18% −1.38 [−2.10, −0.66]
RE Model for Subgroup (Q = 0.03, df = 2, p = 0.99; I² = 0.0%) −1.34 [−1.77, −0.92]
bilateral
2014−Lin 73.8 67 126 frontal 15.45% −0.51 [−0.87, −0.15]
RE Model for Subgroup (Q = 0.00, df = 0, p = 1.00; I² = 0.0%) −0.51 [−0.87, −0.15]
RE Model for All Studies (Q = 80.40, df = 6, p = 0.00; I² = 91.1%) 100.00% −1.62 [−2.44, −0.80]
−5
0
3
Hedge's G

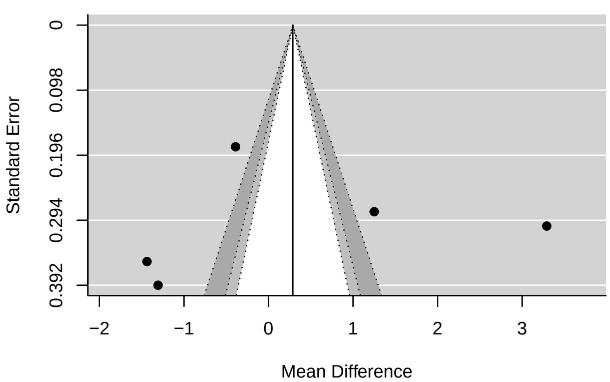

Standard Error
0
0.104
0.208
0.312
0.416
−4
−3
−2
−1
0
Mean Difference

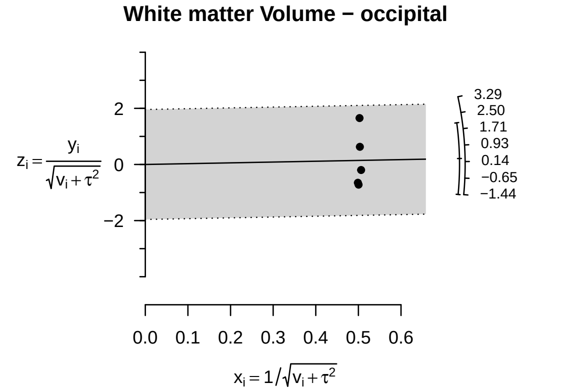

White matter Volume − frontal
$z_i = \frac{y_i}{\sqrt{v_i + \tau^2}}$
2
0
−2
−0.51
−1.09
−1.67
−2.25
−2.82
−3.40
−3.98
0.0
0.2
0.4
0.6
0.8
1.0
1.2
$x_i = 1/\sqrt{v_i + \tau^2}$

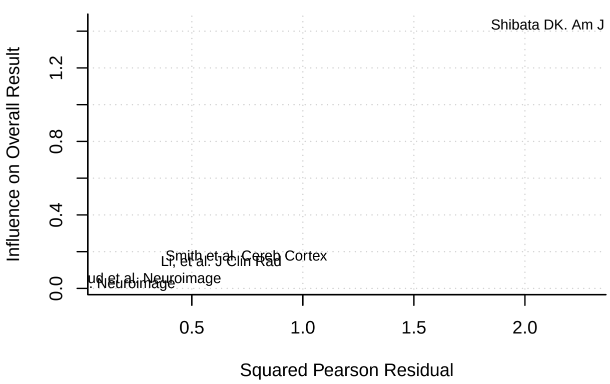

Shibata DK. Am J
Lin et al. Neuroimage
Influence on Overall Result
0
1
2
3
4
Squared Pearson Residual

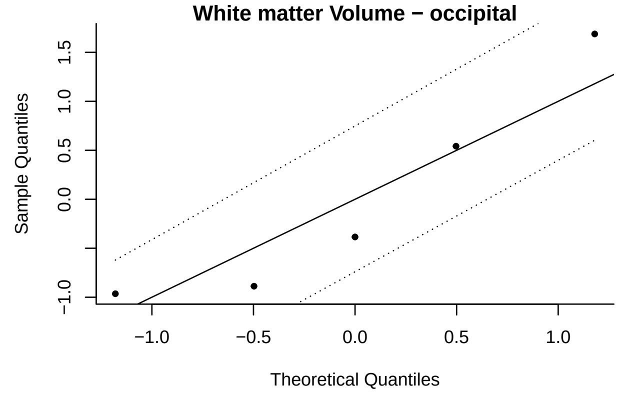

White matter Volume − frontal
Sample Quantiles
1.0
0.0
−1.0
−2.0
−1.0
−0.5
0.0
0.5
1.0
Theoretical Quantiles

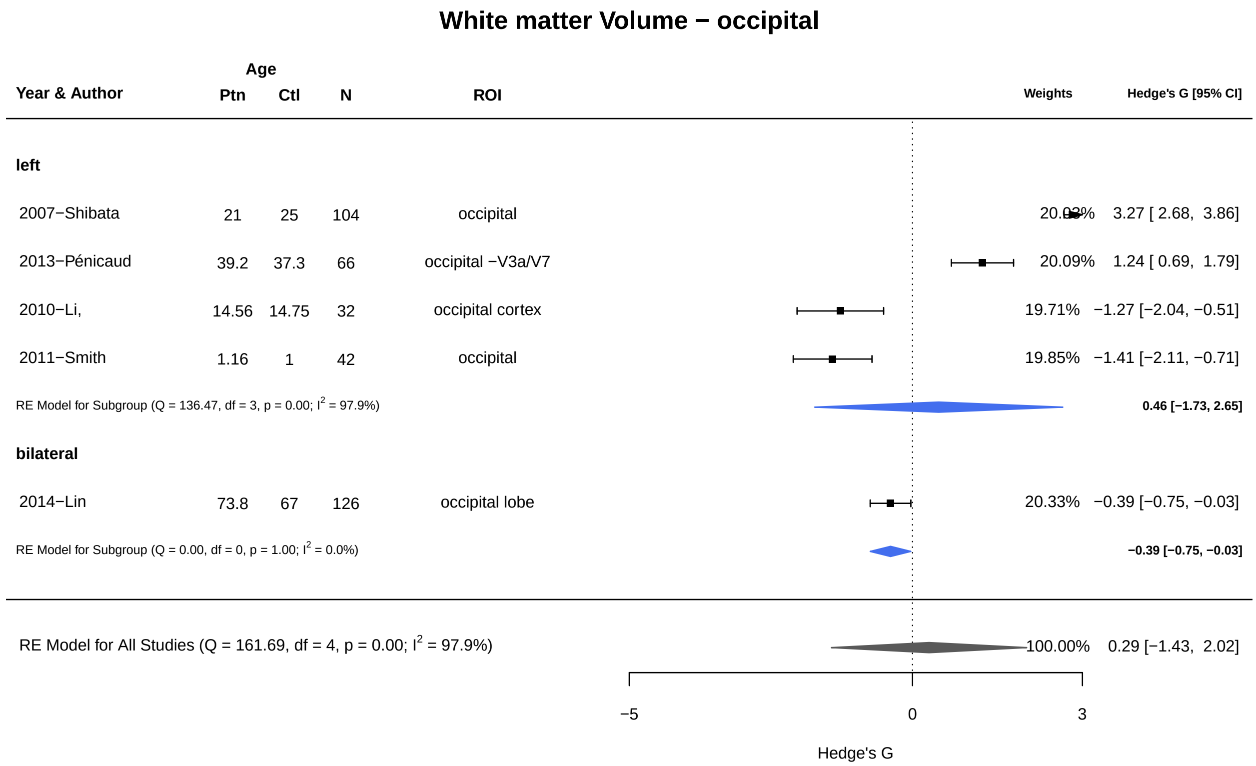

White matter Volume − occipital
Age
Year & Author
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
left
2007−Shibata 21 25 104 occipital 20.02% 3.27 [ 2.68, 3.86]
2013−Pénicaud 39.2 37.3 66 occipital −V3a/V7 20.09% 1.24 [ 0.69, 1.79]
2010−Li, 14.56 14.75 32 occipital cortex 19.71% −1.27 [−2.04, −0.51]
2011−Smith 1.16 1 42 occipital 19.85% −1.41 [−2.11, −0.71]
RE Model for Subgroup (Q = 136.47, df = 3, p = 0.00; I² = 97.9%) 0.46 [−1.73, 2.65]
bilateral
2014−Lin 73.8 67 126 occipital lobe 20.33% −0.39 [−0.75, −0.03]
RE Model for Subgroup (Q = 0.00, df = 0, p = 1.00; I² = 0.0%) −0.39 [−0.75, −0.03]
RE Model for All Studies (Q = 161.69, df = 4, p = 0.00; I² = 97.9%) 100.00% 0.29 [−1.43, 2.02]
−5
0
3
Hedge's G

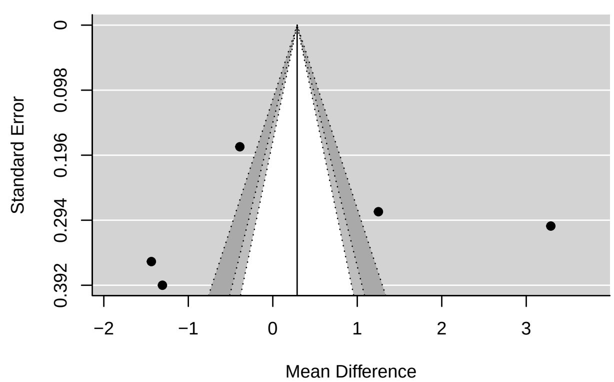

Standard Error
0
0.098
0.196
0.294
0.392
−2
−1
0
1
2
3
Mean Difference

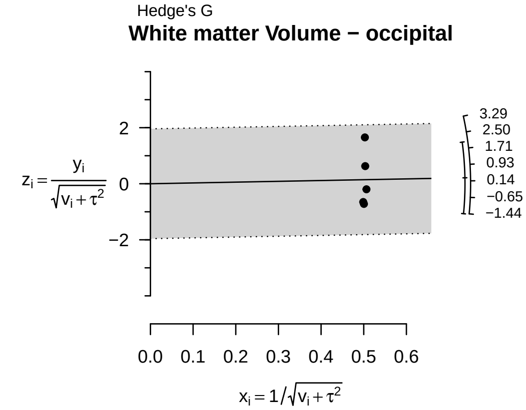

White matter Volume − occipital
2
0
−2
3.29
2.50
1.71
0.93
0.14
−0.65
−1.44
0.0
0.1
0.2
0.3
0.4
0.5
0.6

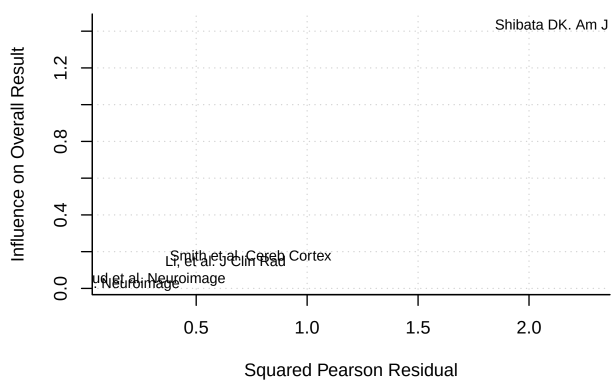

Influence on Overall Result
Shibata DK. Am J
Smith et al. Cereb Cortex
Li, et al. J Clin Rad
ud et al. Neuroimage
: Neuroimage
0.0
0.4
0.8
1.2
0.5
1.0
1.5
2.0
Squared Pearson Residual

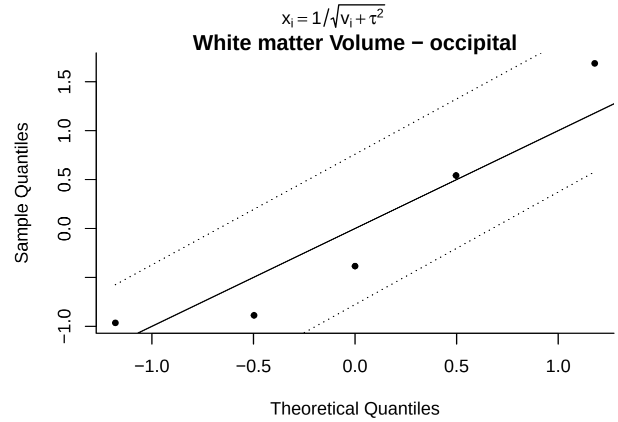

White matter Volume − occipital
Sample Quantiles
−1.0
0.0
0.5
1.0
1.5
−1.0
−0.5
0.0
0.5
1.0
Theoretical Quantiles

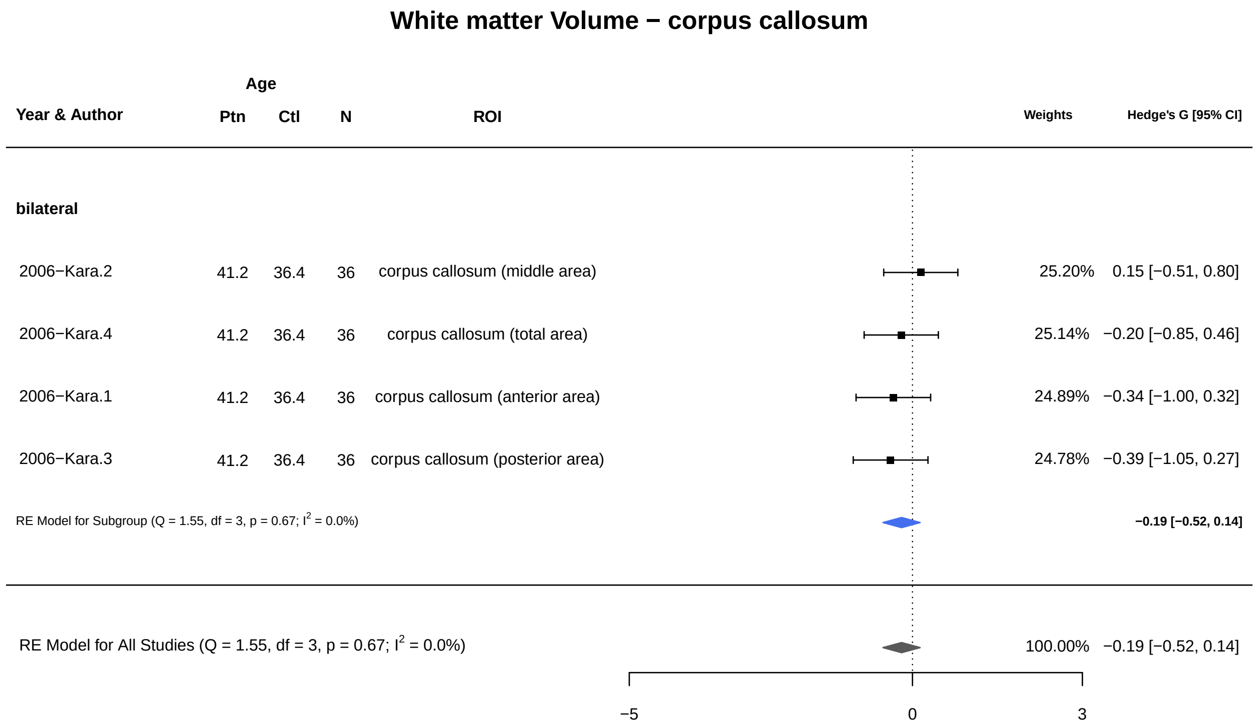

White matter Volume − occipital
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
left
2007−Shibata 21 25 104 occipital 20.02% 3.27 [ 2.68, 3.86]
2013−Pénicaud 39.2 37.3 66 occipital −V3a/V7 20.09% 1.24 [ 0.69, 1.79]
2010−Li, 14.56 14.75 32 occipital cortex 19.71% −1.27 [−2.04, −0.51]
2011−Smith 1.16 1 42 occipital 19.85% −1.41 [−2.11, −0.71]
RE Model for Subgroup (Q = 136.47, df = 3, p = 0.00; I² = 97.9%) 0.46 [−1.73, 2.65]
bilateral
2014−Lin 73.8 67 126 occipital lobe 20.33% −0.39 [−0.75, −0.03]
RE Model for Subgroup (Q = 0.00, df = 0, p = 1.00; I² = 0.0%) −0.39 [−0.75, −0.03]
RE Model for All Studies (Q = 161.69, df = 4, p = 0.00; I² = 97.9%) 100.00% 0.29 [−1.43, 2.02]
−5
0
3
Hedge's G

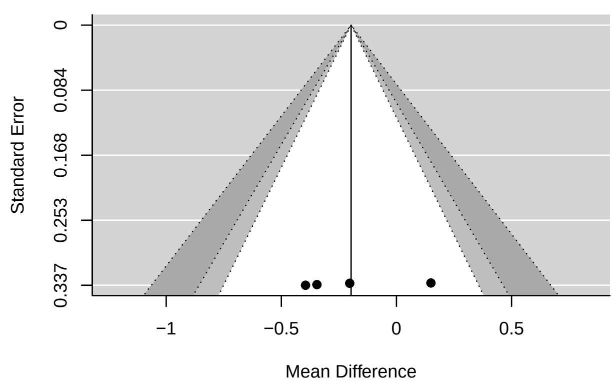

Standard Error
0
0.098
0.196
0.294
0.392
−2
−1
0
1
2
3
Mean Difference

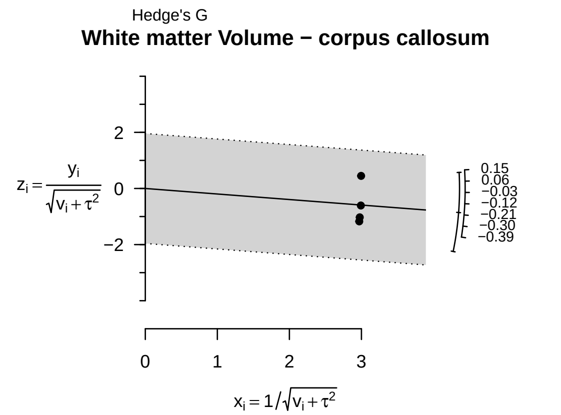

White matter Volume − occipital
$z_i = \frac{y_i}{\sqrt{v_i + \tau^2}}$
2
0
−2
3.29
2.50
1.71
0.93
0.14
−0.65
−1.44
0.0
0.1
0.2
0.3
0.4
0.5
0.6
$x_i = 1/\sqrt{v_i + \tau^2}$

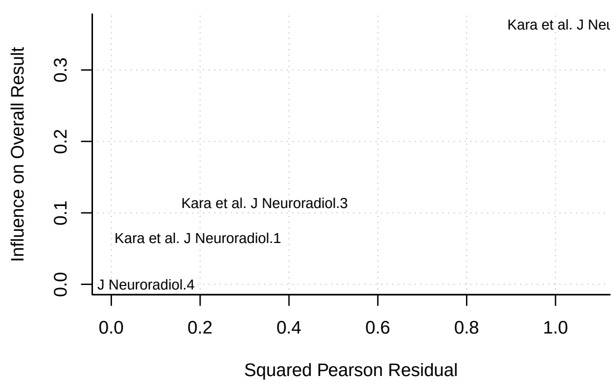

Influence on Overall Result
0.0
0.4
0.8
1.2
Shibata DK. Am J
Smith et al. Cereb Cortex
Li, et al. J Clin Rad
ud et al. Neuroimage
: Neuroimage
0.5
1.0
1.5
2.0
Squared Pearson Residual

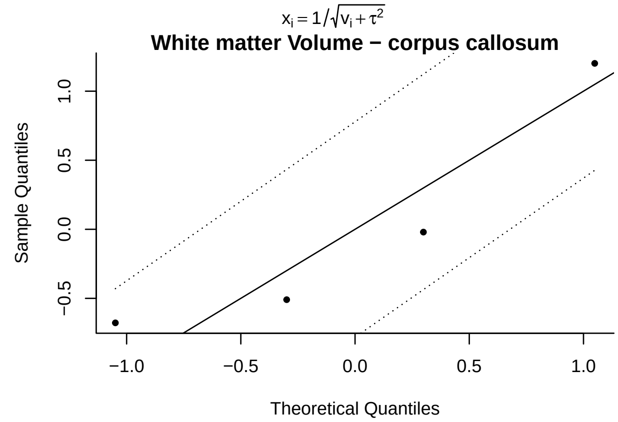

White matter Volume − occipital
Sample Quantiles
−1.0
0.0
0.5
1.0
1.5
−1.0
−0.5
0.0
0.5
1.0
Theoretical Quantiles


White matter Volume − corpus callosum
Age
Year & Author
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
bilateral
2006−Kara.2 41.2 36.4 36 corpus callosum (middle area) 25.20% 0.15 [−0.51, 0.80]
2006−Kara.4 41.2 36.4 36 corpus callosum (total area) 25.14% −0.20 [−0.85, 0.46]
2006−Kara.1 41.2 36.4 36 corpus callosum (anterior area) 24.89% −0.34 [−1.00, 0.32]
2006−Kara.3 41.2 36.4 36 corpus callosum (posterior area) 24.78% −0.39 [−1.05, 0.27]
RE Model for Subgroup (Q = 1.55, df = 3, p = 0.67; I² = 0.0%) −0.19 [−0.52, 0.14]
RE Model for All Studies (Q = 1.55, df = 3, p = 0.67; I² = 0.0%) 100.00% −0.19 [−0.52, 0.14]
−5
0
3
Hedge's G


Standard Error
0
0.084
0.168
0.253
0.337
−1
−0.5
0
0.5
Mean Difference

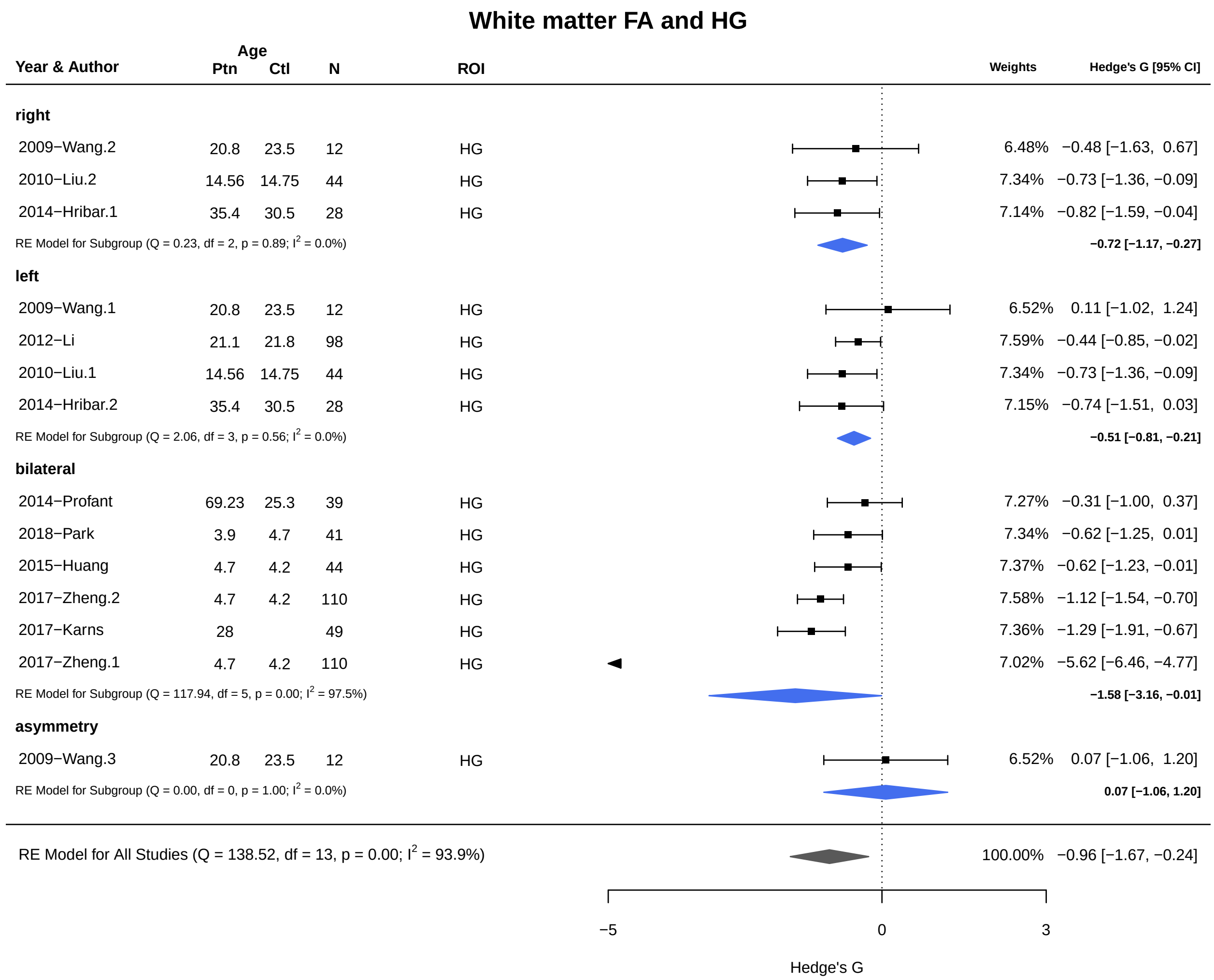

White matter Volume − corpus callosum
2
0
−2
0.15
0.06
−0.03
−0.12
−0.21
−0.30
−0.39
0
1
2
3


Influence on Overall Result
Kara et al. J Neu
Kara et al. J Neuroradiol.3
Kara et al. J Neuroradiol.1
J Neuroradiol.4
0.0
0.1
0.2
0.3
0.0
0.2
0.4
0.6
0.8
1.0
Squared Pearson Residual

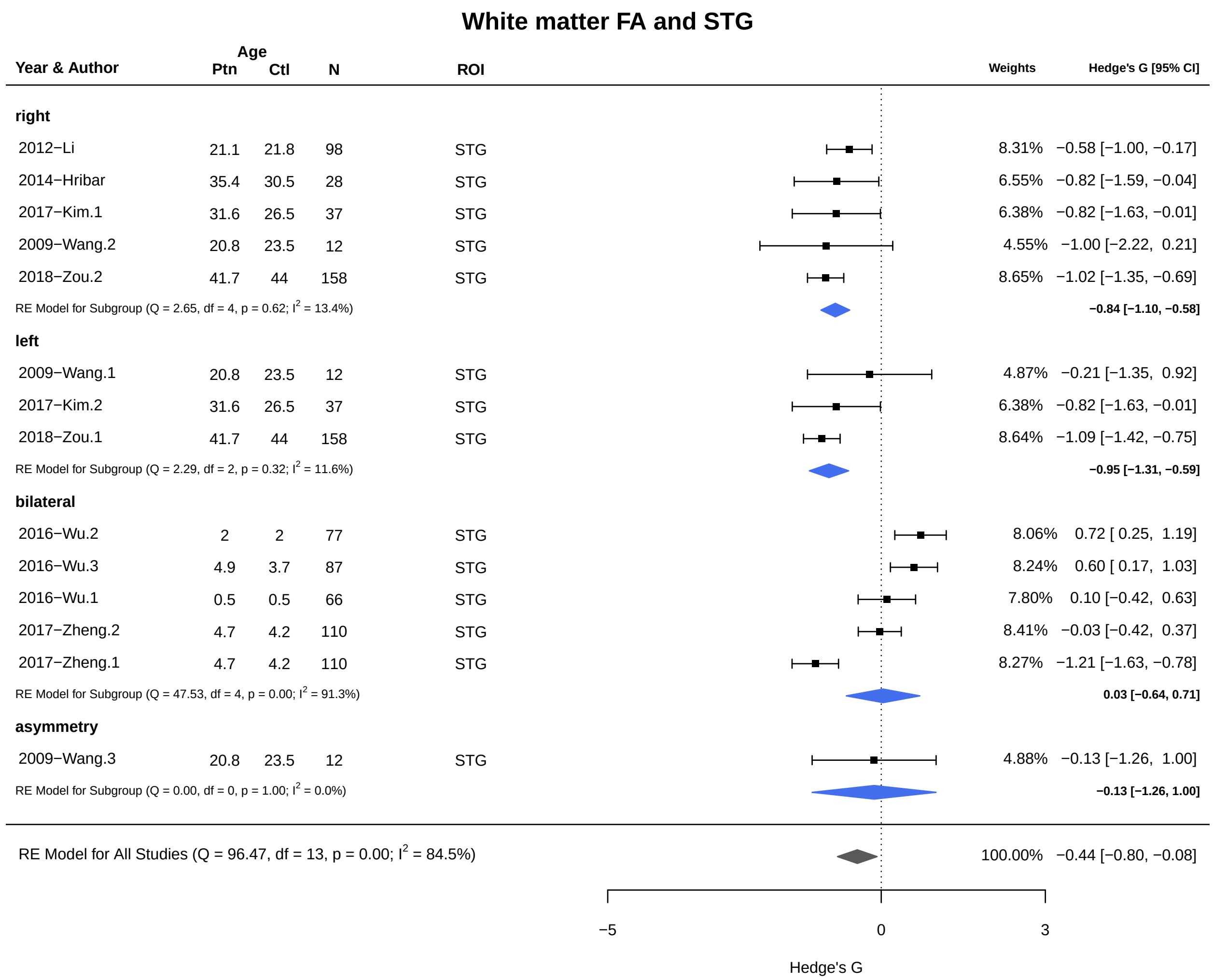

White matter Volume − corpus callosum
Sample Quantiles
1.0
0.5
0.0
−0.5
−1.0
−0.5
0.0
0.5
1.0
Theoretical Quantiles

# Supplementary material: Forest-plots of other Measures

## Hesch gyrus FA white matter

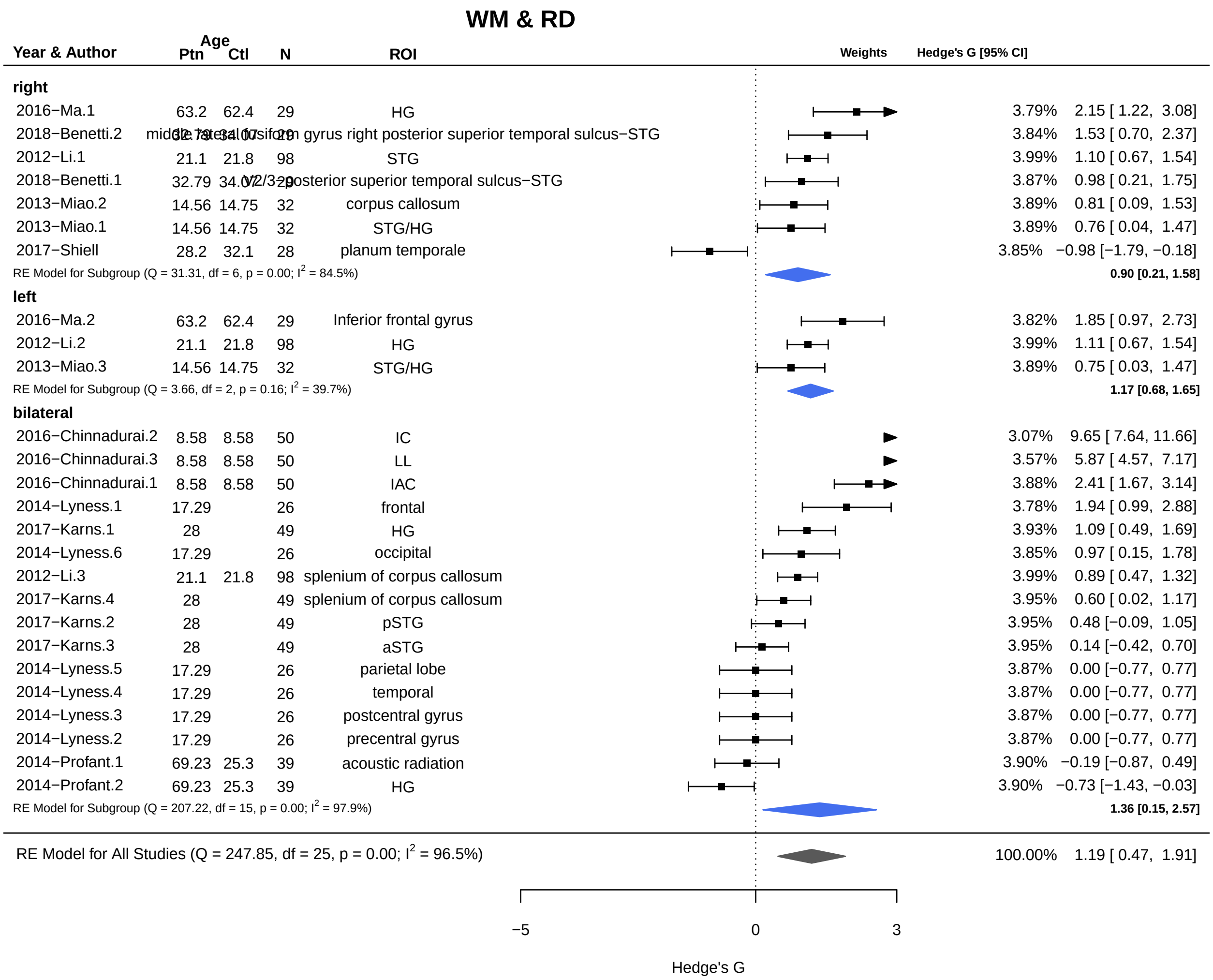


## STG Volume White matter

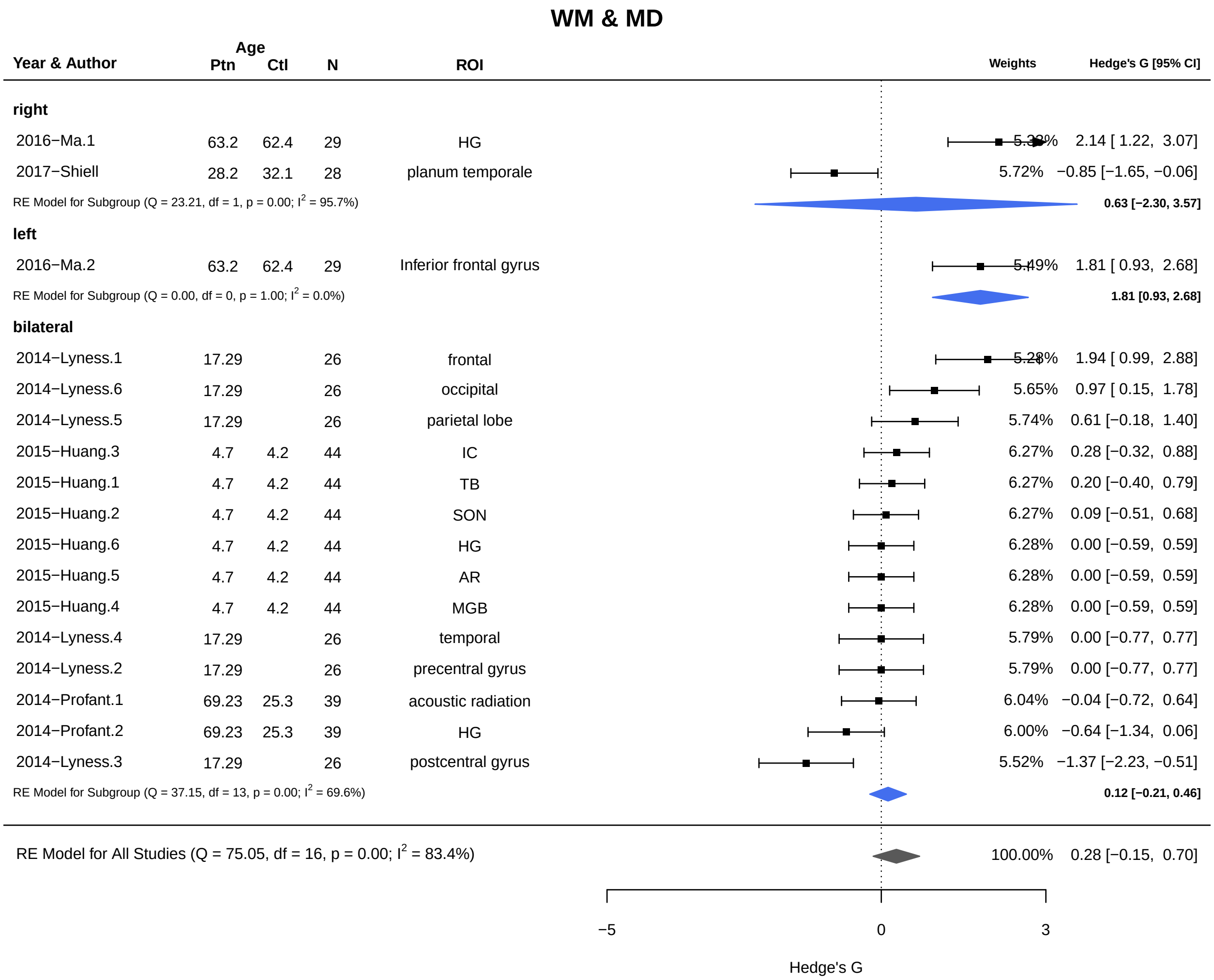


# Measures of White matter Integrity

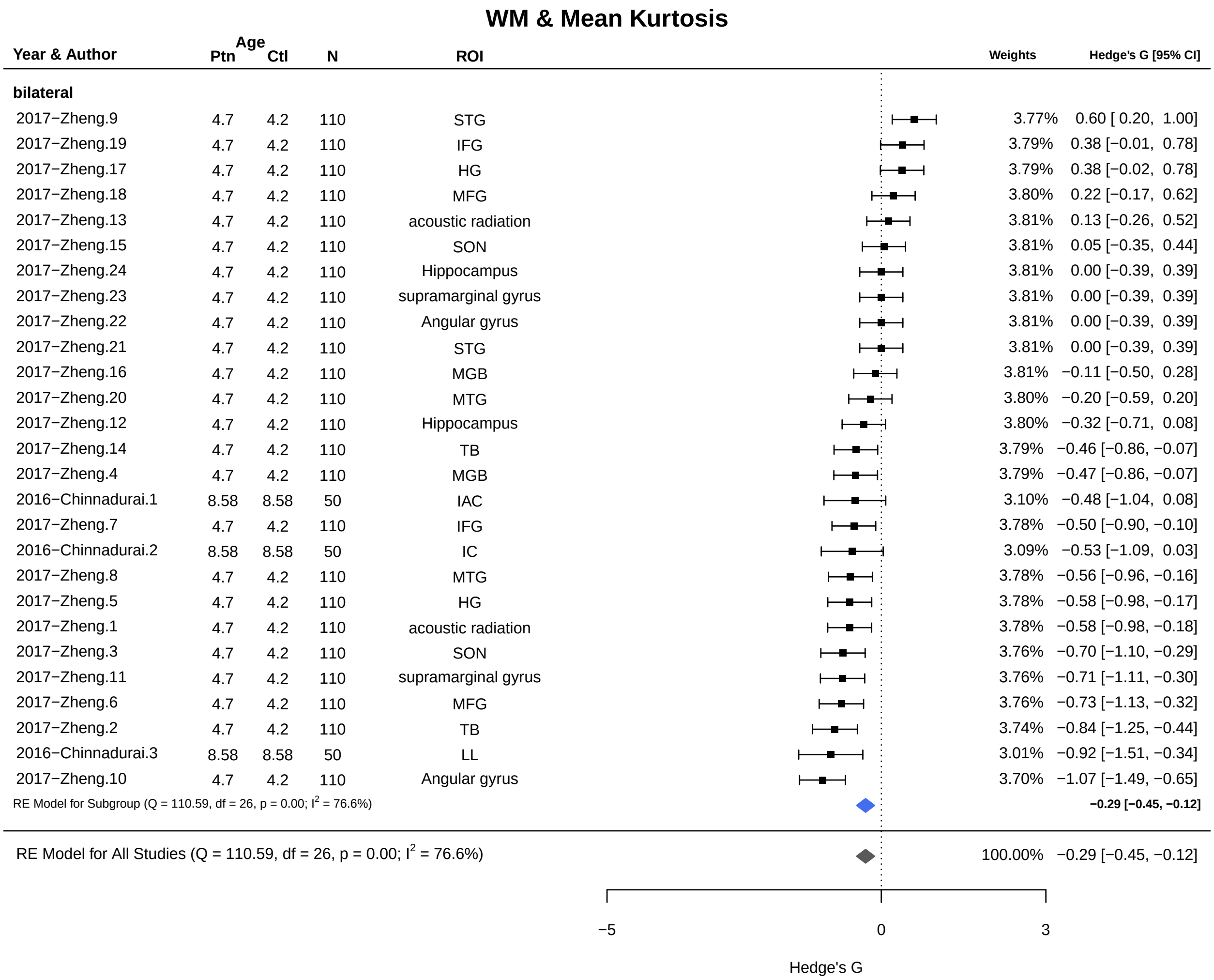
## White matter: RD



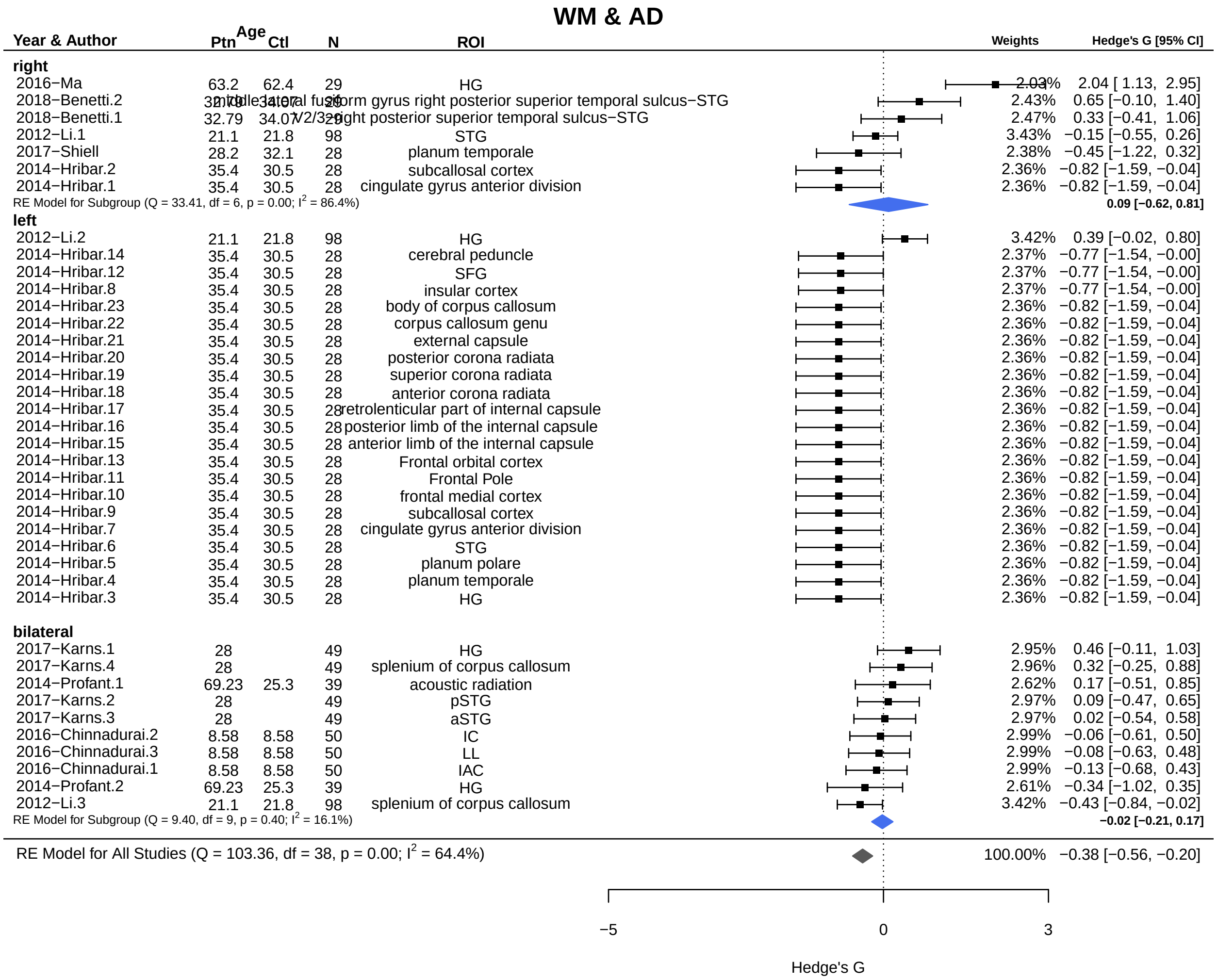
## White matter: MD



## White matter: Mean Kurtosis



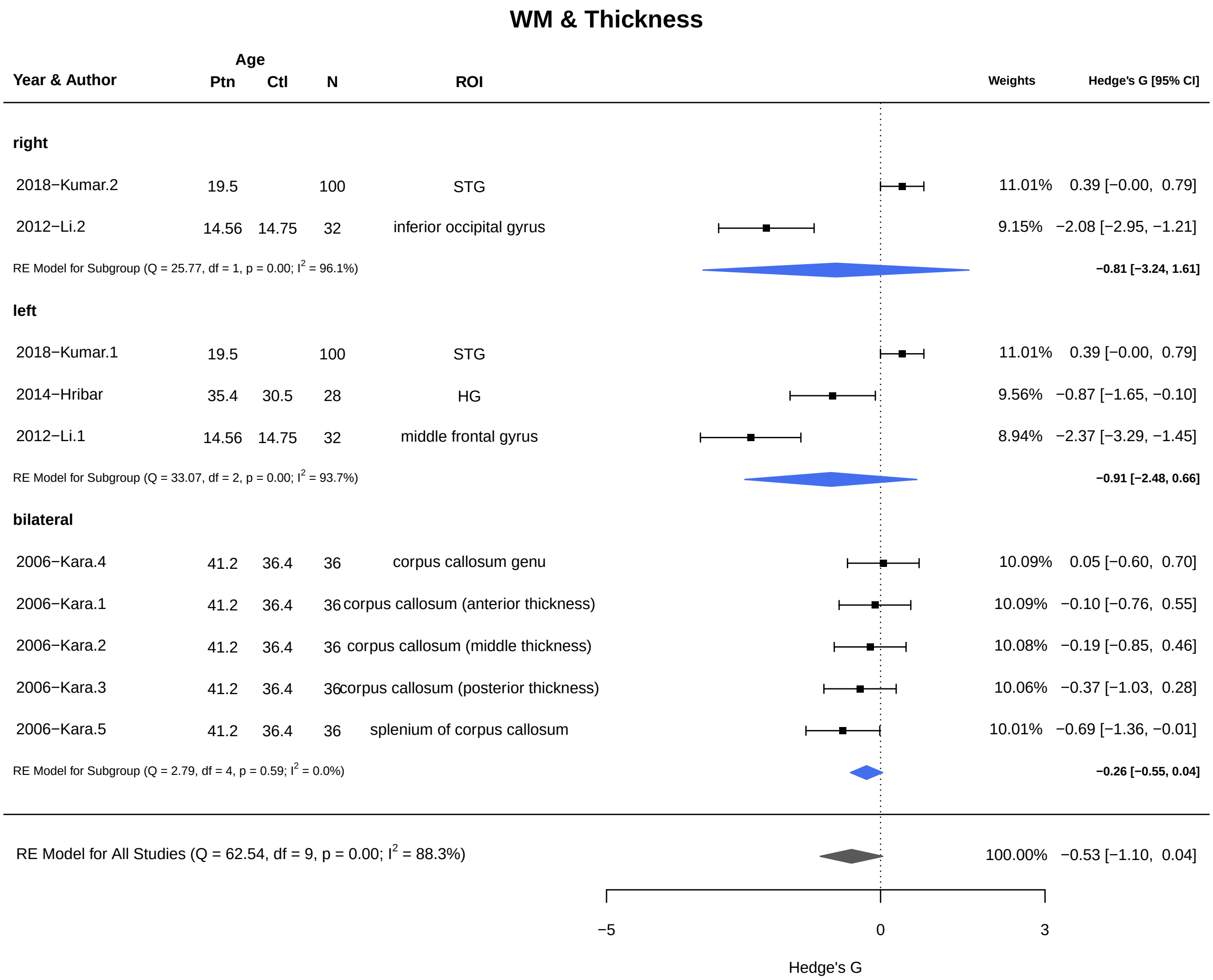
## White matter: AD



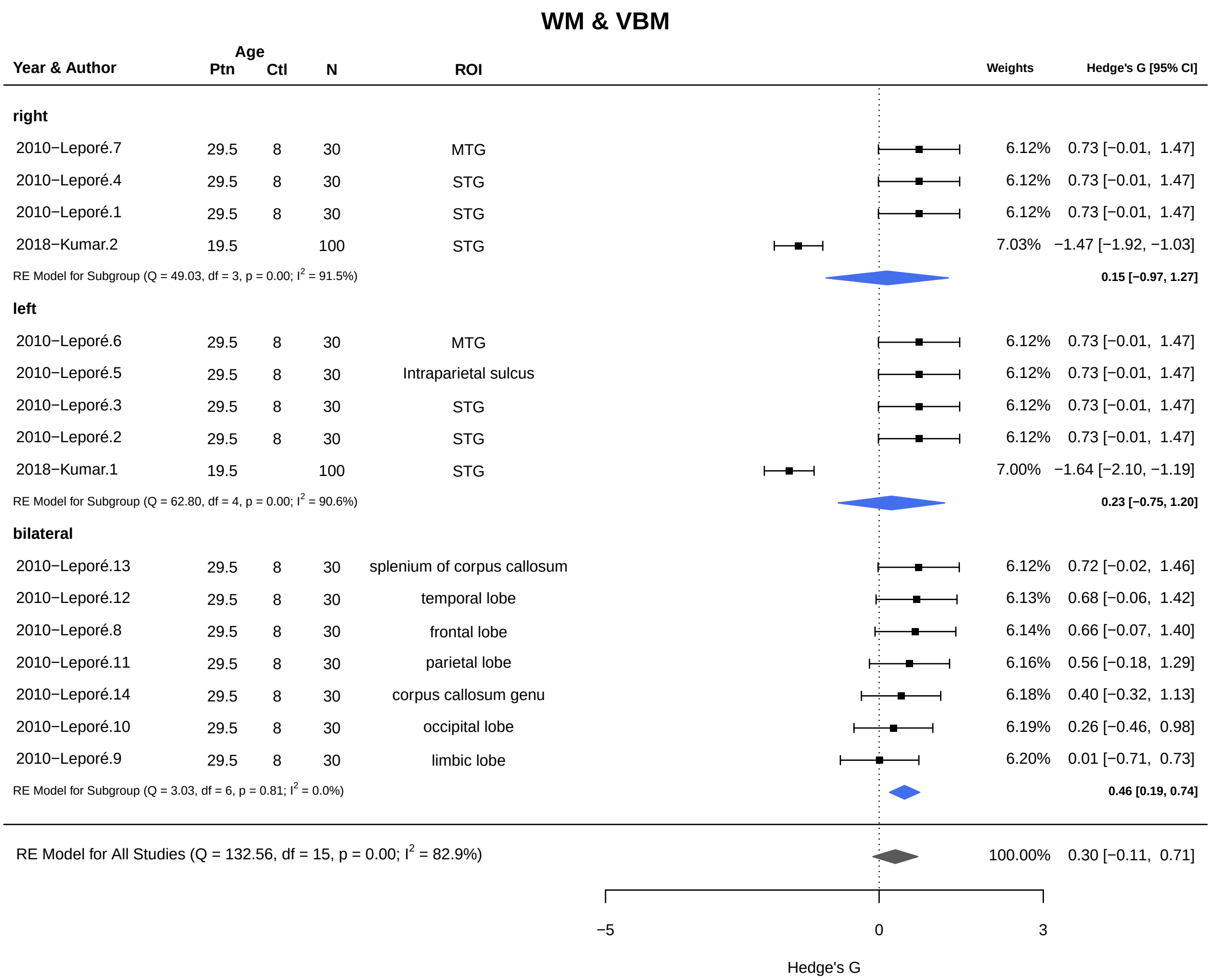

Error in rma(yi = hedgesG, vi = varG, data = meta.mod, measure = "MD", : Fisher scoring algorithm did not converge. See 'help(rma)' for possible remedies.

# Other Measures of White Matter

## White matter: Thickness



## White matter: VBM




# Meta Plots

## The L'Abbé plot

In a L'Abbé plot (based on L'Abbé, Detsky, & O'Rourke, 1987), the arm-level outcomes for two experimental groups (e.g., treatment and control group) are plotted against each other. is treatment versus effect, since you have the cohen's d this should be relatively simple.
> WE DON'T HAVE TWO EXPERIMENTAL GROUPS

## Baujat plot to identify studies contributing to heterogeneity

The plot shows the contribution of each study to the overall Q-test statistic for heterogeneity on the horizontal axis versus the influence of each study (defined as the standardized squared difference between the overall estimate based on a fixed-effects model with and without the ith study included in the model) on the vertical axis 2.17. Funnel plot to illustrate publication bias

### Galbraith plot

Radial plot (radial) of variables and cohen's d - Galbraith, Rex (1988). "Graphical display of estimates having differing standard errors". Technometrics. Technometrics, Vol. 30, No. 3. 30 (3): 271–281.
2.18.2. We want to see this type of error plot over time for our patient cohorts by age. we want this for each measure WM and GM versus age on the x-axis so we can see GM and WM over time! Do a monte carlo simulation to connect different age population and create the error.
For a fixed-effects model, the plot shows the inverse of the standard errors on the horizontal axis against the individual observed effect sizes or outcomes standardized by their corresponding standard errors on the vertical axis. On the right hand side of the plot, an arc is drawn corresponding to the individual observed effect sizes or outcomes. A line projected from (0,0) through a particular point within the plot onto this arc indicates the value of the individual observed effect size or outcome for that point.

## Resources

We are following Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines: Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., and Prisma Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med. 6:e1000097. doi: 10.1371/journal.pmed.1000097 AND https://www.bmj.com/content/339/bmj.b2535

- https://stackoverflow.com/questions/14426637/how-to-do-bubble-plot
- https://www.researchgate.net/publication/296680807_Menstrual_hygiene_management_among_adolescent_girls_in_India_A_Systematic_review_and_meta-analysis/figures?lo=1

#### Good explanation of some of the plots:

- https://ora.ox.ac.uk/objects/uuid:ff78831d-6f82-4187-97cc-349058e9abde/download_file?file_format=pdf&safe_filename=Rahimi%2Bet%2Bal%252C%2BData%2Bvisualisation%2Bfor%2Bmeta-analysis.pdf&type_of_work=Journal+article