Hearing loss meta-analysis

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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.
Study design was using cross-sectional including control groups, ivestigating the structural relation between MRI changes and the Hearing loss. ROI were selected among the included studies Analysis method, the most common outcome measures were **volume, FA, VBM and thickness.** A total of 41 studies were included, with a total of 851 patients and 964 patients.
Notes:

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 calculated the meta-regression for left and right. We measure a global meta regression for white and gray mater by side (Left and rigth). We include those ROI with most frequency of apearing.

Effects were summarized across studies using the generic inverse-variance weighting method with DerSimonian and Laird random effects, meaning studies were weighted by $1/SE$š (where SE is the standard error)

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

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 in the between studies variance and eterogeneity calculations. We should have done the mean and standart deviation from each study. Variance was estimated using the following formula:

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

Estimate of heterogeneity per model

"We estimated heterogeneity in results using the τ statistic, which represents the standard deviation" such as overall.hetstat or a heterogeneity test $x2$ and $I2$ index
We performed a multi-level meta-analytic model, over our multiple effect size estimates nested withing variables: Big brain area, ROI, etc. We expect that the underlying true effects are more similar for the same level of the grouping variable 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 N studies, each comparing different measurements between patients and controls. The diference of between groups was quantified in terms of Cohen's D.

Notes from Francis

Remember I created the effect size because are the variables and metric were different. This take mean and SD out of the equation. But you can represent the mean and SD as another variable if you want to calculate what effect sizes would create a cohen's d and cc r for specific variables. That way we would standardize it across our different means and SD. 2.1.16. CC which is the correlation coefficient
2.3. Calculate Hedges' g which takes into consideration sample size
> I used Cohen's D instead of these last two because ai calculated the variace from the cohen's D, but I can do it for the Hedges'G as well

Table 1: Total included studies: 41

	Hearing Loss	Healthy
Total number of patients	964	851
Number mean	23.51	21.82
Number sd	18.21	11.25
Age mean	21.27	22.12
Age SD	12.07	12.2
%Female mean	52.32	55.46
%Female sd	10.8	13.21

Table of included studies

Table 2: Studies with incomplete information (NA)

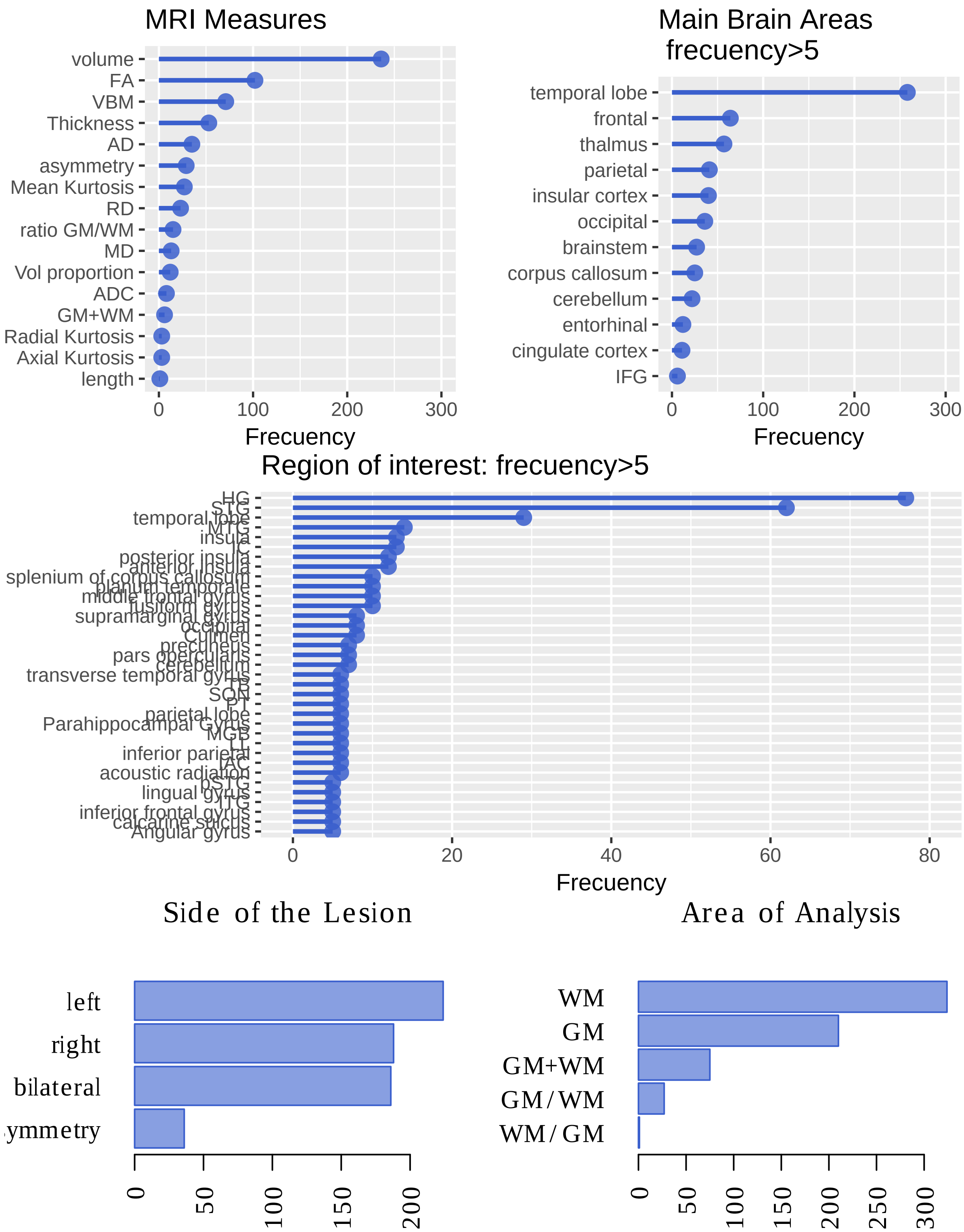
	Source	MRI Tesla	all.techniques	all.measures
4	2006, Kara et al. J Neuroradiol	1.5	VBM	length, Thickness, volume
8	2008, Xia et al. Chin J Med Img Tech	1.5	VBM	volume
15	2012, Chang et al., Clin Exp Otorhinolaryngo	3	DTI	FA
24	2014, Lyness et al. Neuroimage	1.5	DTI	FA, MD, RD
32	2016, Wu et al. Brain Res	1.5	VBM	ADC, FA
33	2017, Karns et al. Hear Res	3	DTI	AD, FA, RD, volume
40	2018, Kumar U, Mishra M. Brain Res	3	VBM	Thickness, VBM

Table 3: Included studies

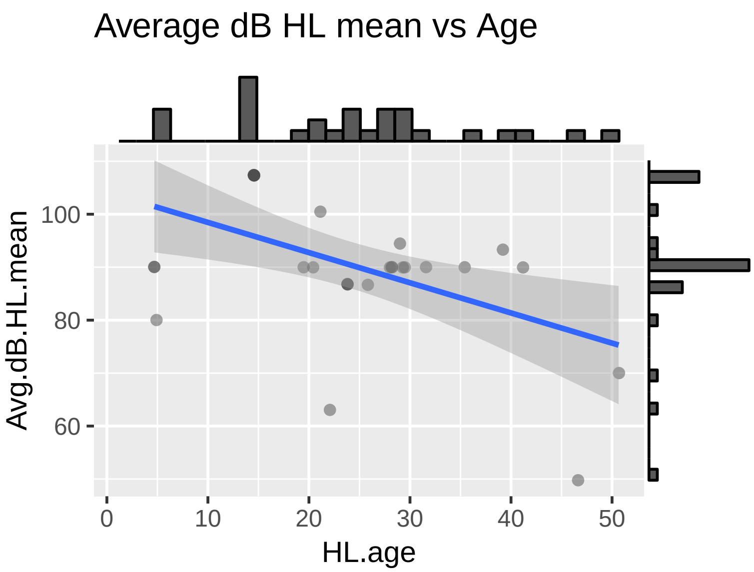
	Source	MRI Tesla	all.techniques	all.measures
1	2003, Emmorey et al. PNAS	1.5	VBM	asymmetry, GM+WM, ratio GM/WM, volume
2	2003, Penhune et al. Neuroimage	1.5	VBM	asymmetry, ratio GM/WM, volume
3	2004, Chang et al. Neuroreport	3	DTI	asymmetry, FA

	Source	MRI Tesla	all.techniques	all.measures
5	2007, Meyer et al. Restor Neurol Neurosci	3	VBM	volume
6	2007, Shibata DK. AJNR Am J Neuroradiol	1.5	VBM	volume
7	2008, Allen et al. J Neurosci	1.5	VBM	asymmetry, ratio GM/WM, Vol proportion, volume
9	2009, Kim et al. Neuroreport	3	DTI, VBM	FA, volume
10	2009, Wang et al. Chin J Med Img Tech	3	DTI	FA
11	2010, Leporé et al. Hum Brain Mapp	1.5	VBM	VBM
12	2010, Li, et al. J Clin Rad	1.5	VBM	volume
13	2010, Liu et al. Chin J Med Img Tech	3	CT	FA
14	2011, Smith et al. Cereb Cortex	3	VBM	asymmetry, ratio GM/WM, volume
16	2012, Li et al. Brain Res	3	CT	Thickness
17	2012, Li et al. Hum Brain Mapp	3	DTI	AD, FA, RD
18	2013, Allen et al. Front Neuroanat	1.5	VBM	asymmetry, volume
19	2013, Li et al. Restor Neurol Neurosci	3	VBM	asymmetry, Thickness
20	2013, Miao et al. AJNR Am J Neuroradiol	3	CT	FA, RD
21	2013, Pénicaud et al. Neuroimage	1.5	VBM	volume
22	2014, Hribar et al. Hear Res	3	DTI, VBM	AD, FA, Thickness
23	2014, Kim et al. Hear Res	3	VBM	volume
25	2014, Olulade et al. J Neurosci	3	VBM	volume
26	2015, Huang et al. PLoS One	1.5	DTI	FA, MD
27	2015, Li et al. Restor Neurol Neurosci	3	CT	volume
28	2015, Tae Investig Magn Reson Imaging	1.5	VBM	VBM
29	2016, Amaral et al. Eur J Neurosci	3	VBM	asymmetry, Thickness
30	2016, Chinnadurai et al. Magn Reson Imaging	1.5	DTI	AD, Axial Kurtosis, FA, Mean Kurtosis, Radial Kurtosis, RD
31	2016, Shiell et al. Neural Plasticity	3	CT	Thickness
34	2017, Kim et al. Neuroreport	3	DTI	FA
35	2017, Shiell & Zatorre. Hear Res	3	DTI	AD, MD, RD, volume
36	2017, Zheng et al. Sci Rep	3	DTI	FA, Mean Kurtosis
37	2018, Alfandari et al. Trends Hear	3	VBM	volume
38	2018, Benetti et al. Neuroimage	4	DTI	AD, FA, RD
39	2018, Feng et al. PNAS	3	VBM	VBM
41	2018, Park et al. Biomed Res Int	3	DTI	FA

Overal view of the studies



Relation of Average dB and Age



Frequency and contingensy tables

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 their effect varies widely and 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

Frequency tables: measures of WM & GM

Table 4: Matter vs Side

	asymmetry	bilateral	left	right	total
GM	10	19	105	75	1
WM	15	148	83	77	1

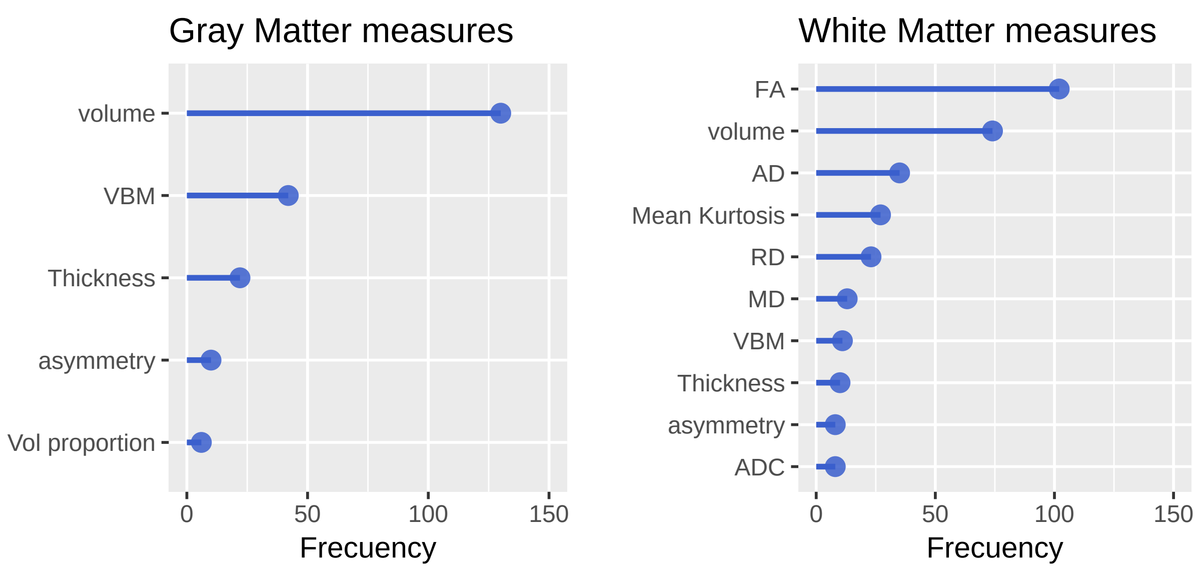
Table 5: Matter vs measure (continued below)

	AD	ADC	asymmetry	Axial Kurtosis	FA	GM+WM	length	MD
GM	0	0	10	0	0	0	0	0
WM	35	8	8	3	102	0	1	13

Table 6: Table continues below

	Mean Kurtosis	Radial Kurtosis	ratio GM/WM	RD	Thickness	VBM
GM	0	0	0	0	22	42
WM	27	3	0	23	10	11

	Vol proportion	volume
GM	6	130
WM	6	74



Contingensy tables: Main areas and sub-areas

Sub-analys were carried out in those areas that had measures from at least five studies. Those areas were selected from the contingensy tables.

Table 8: Table: Measure vs Big area (continued below)

	AD	ADC	asymmetry	Axial Kurtosis	FA	GM+WM
temporal lobe	12	7	11	0	41	6
frontal	4	0	1	0	5	0

	AD	ADC	asymmetry	Axial Kurtosis	FA	GM+WM
thalmus	10	0	6	3	11	0
parietal	0	0	0	0	5	0
insular cortex	1	0	6	0	1	0
occipital	0	0	1	0	1	0
brainstem	0	1	1	0	14	0
corpus callosum	4	0	0	0	5	0
cerebellum	0	0	0	0	0	0

Table 9: Table continues below

	length	MD	Mean Kurtosis	Radial Kurtosis
temporal lobe	0	3	6	0
frontal	0	1	4	0
thalmus	0	2	3	3
parietal	0	1	4	0
insular cortex	0	0	0	0
occipital	0	1	0	0
brainstem	0	3	8	0
corpus callosum	1	0	0	0
cerebellum	0	0	0	0

	ratio GM/WM	RD	Thickness	VBM	Vol proportion	volume
temporal lobe	7	12	9	22	0	122
frontal	1	1	8	19	0	20
thalmus	0	3	12	3	0	1
parietal	1	1	3	8	0	18
insular cortex	6	0	0	0	12	14
occipital	0	1	6	6	0	20
brainstem	0	0	0	0	0	0
corpus callosum	0	3	5	2	0	5
cerebellum	0	0	4	1	0	17

Table 11: Table: Measure vs ROI (continued below)

	AD	ADC	asymmetry	Axial Kurtosis	FA	GM+WM
HG	3	6	5	0	13	2
STG	2	1	2	0	10	2
temporal lobe	0	0	2	0	0	2
MTG	0	0	0	0	2	0
IC	1	0	1	1	2	0
insula	0	0	2	0	0	0
anterior insula	0	0	2	0	0	0
posterior insula	0	0	2	0	0	0
fusiform gyrus	0	0	0	0	0	0
middle frontal gyrus	0	0	0	0	2	0
planum temporale	2	0	0	0	2	0
splenium of corpus callosum	2	0	0	0	3	0
Culmen	0	0	0	0	0	0
occipital	0	0	0	0	1	0
supramarginal gyrus	0	0	0	0	2	0
cerebellum	0	0	0	0	0	0

Table 12: Table continues below

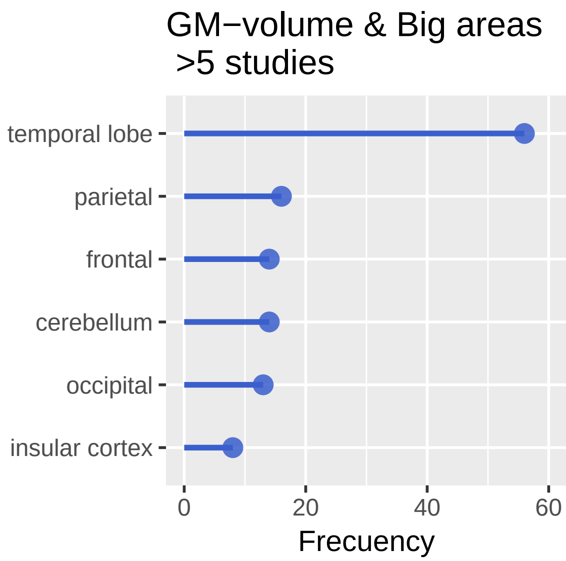
	length	MD	Mean Kurtosis	Radial Kurtosis
HG	0	1	2	0
STG	0	0	2	0

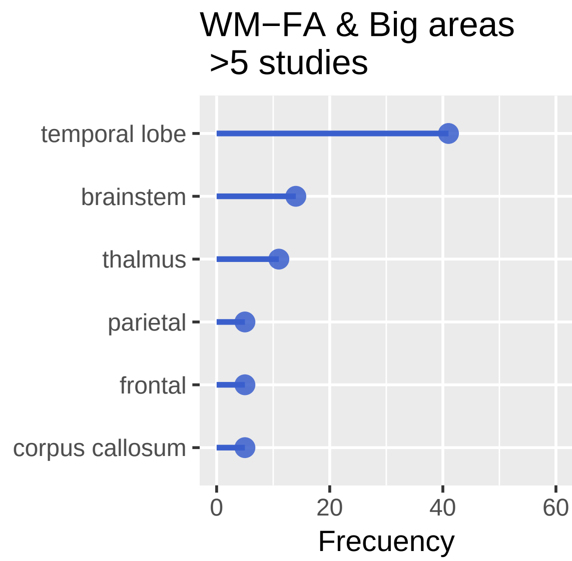
	length	MD	Mean Kurtosis	Radial Kurtosis
temporal lobe	0	0	0	0
MTG	0	0	2	0
IC	0	1	1	1
insula	0	0	0	0
anterior insula	0	0	0	0
posterior insula	0	0	0	0
fusiform gyrus	0	0	0	0
middle frontal gyrus	0	0	2	0
planum temporale	0	1	0	0
splenium of corpus callosum	0	0	0	0
Culmen	0	0	0	0
occipital	0	1	0	0
supramarginal gyrus	0	0	2	0
cerebellum	0	0	0	0

Table 13: Table continues below

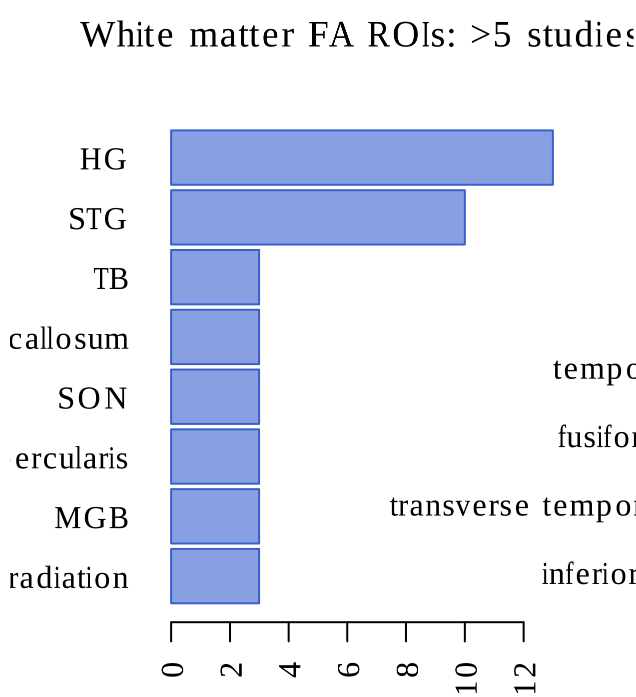
	ratio GM/WM	RD	Thickness	VBM	Vol proportion
HG	3	2	3	3	0
STG	2	1	2	6	0
temporal lobe	2	0	0	2	0
MTG	0	0	2	2	0
IC	0	1	2	2	0
insula	2	0	0	0	4
anterior insula	2	0	0	0	4
posterior insula	2	0	0	0	4
fusiform gyrus	0	0	1	2	0
middle frontal gyrus	0	0	3	3	0
planum temporale	0	2	2	0	0
splenium of corpus callosum	0	2	1	1	0
Culmen	0	0	0	0	0
occipital	0	1	0	0	0
supramarginal gyrus	0	0	1	1	0
cerebellum	0	0	4	1	0

	volume
HG	34
STG	32
temporal lobe	21
MTG	6
IC	0
insula	5
anterior insula	4
posterior insula	4
fusiform gyrus	7
middle frontal gyrus	0
planum temporale	1
splenium of corpus callosum	1
Culmen	8
occipital	5
supramarginal gyrus	2
cerebellum	2





Most common ROI for WM-FA and GM-volume



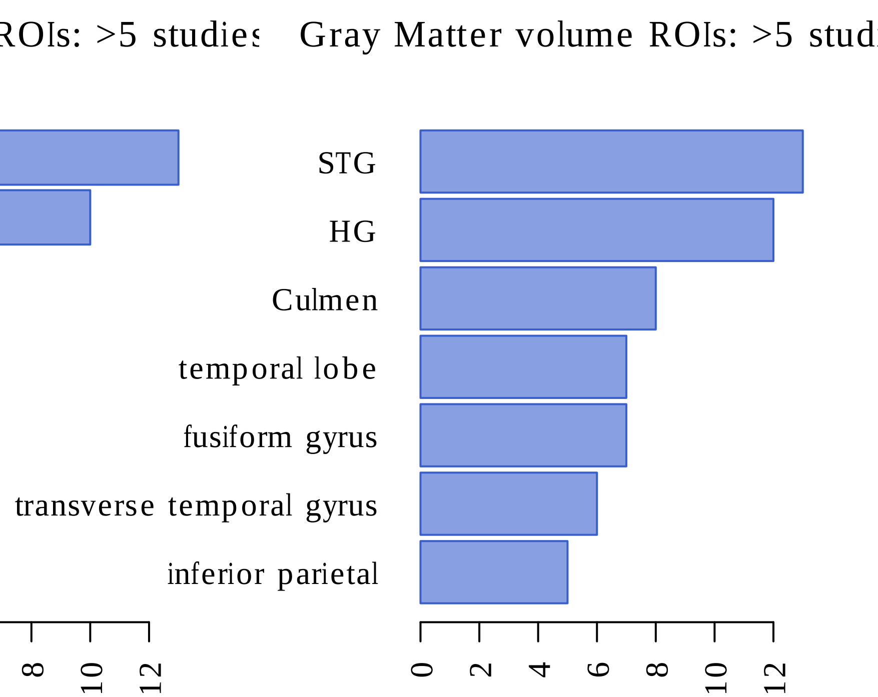


Figure 1 - Methods

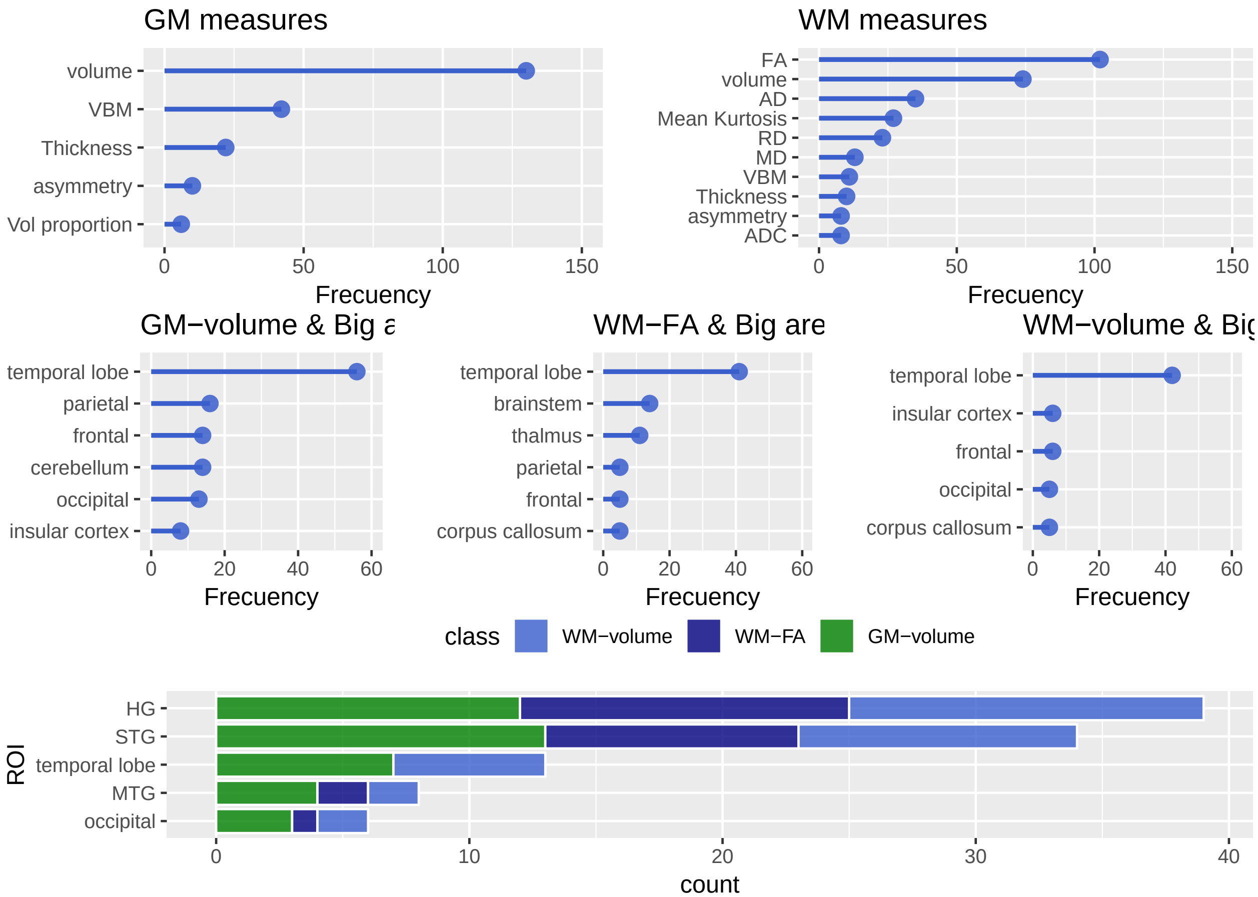
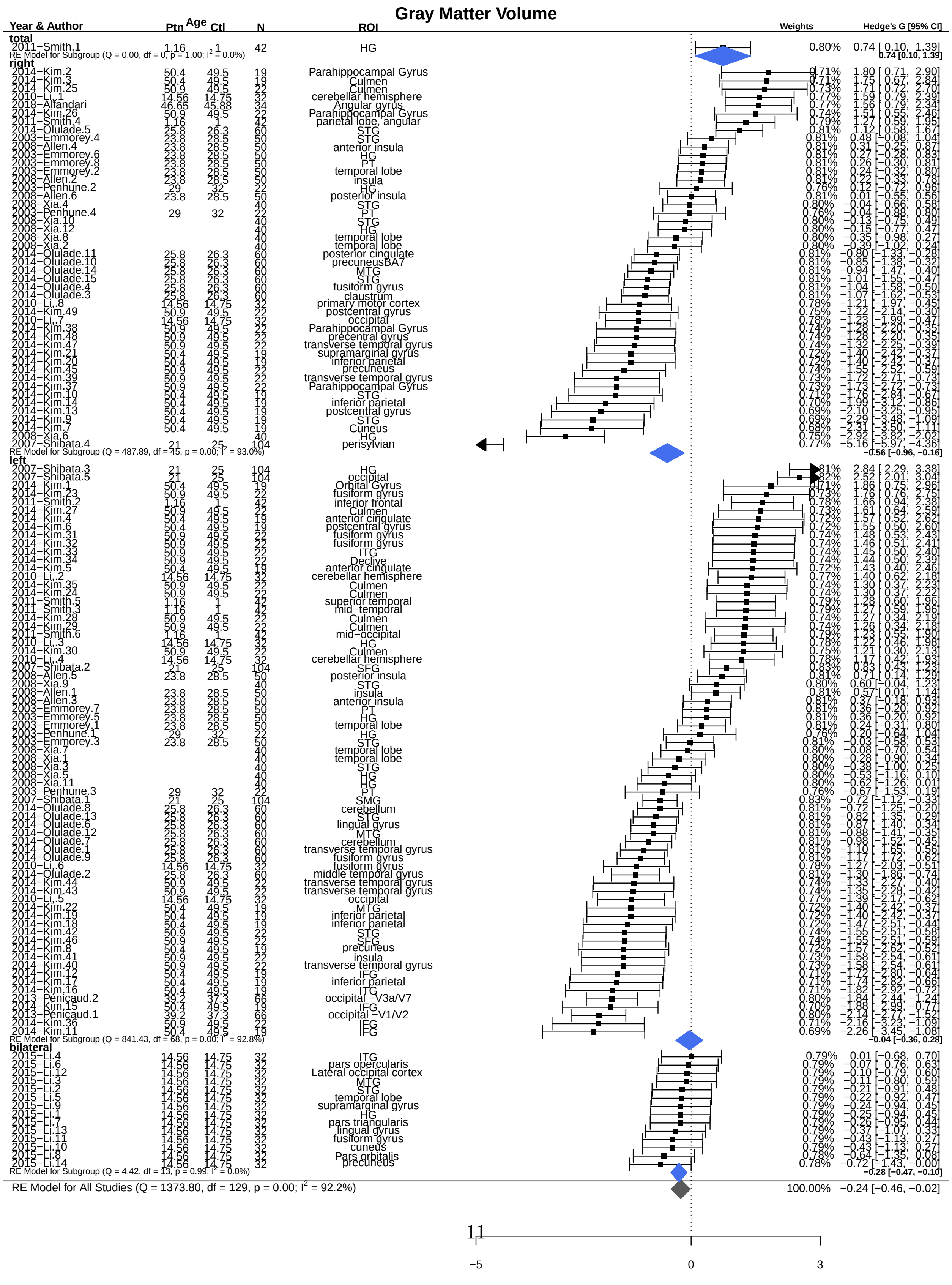


Figure 3 - Meta-regressions of GM & WM by measure

Figure 3 - Gray Matter Volume: Random effects model no intercept covariated by Big area



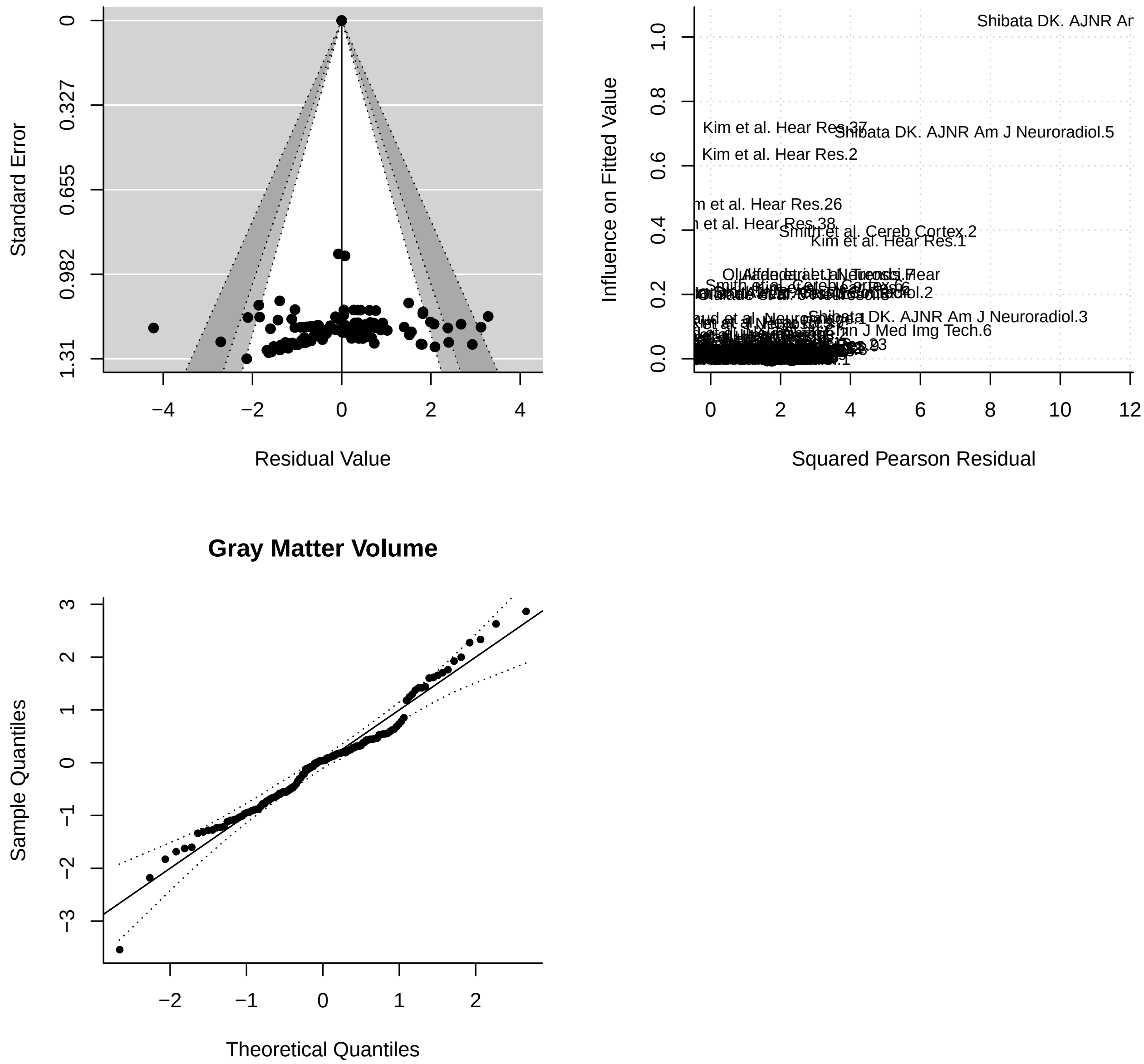
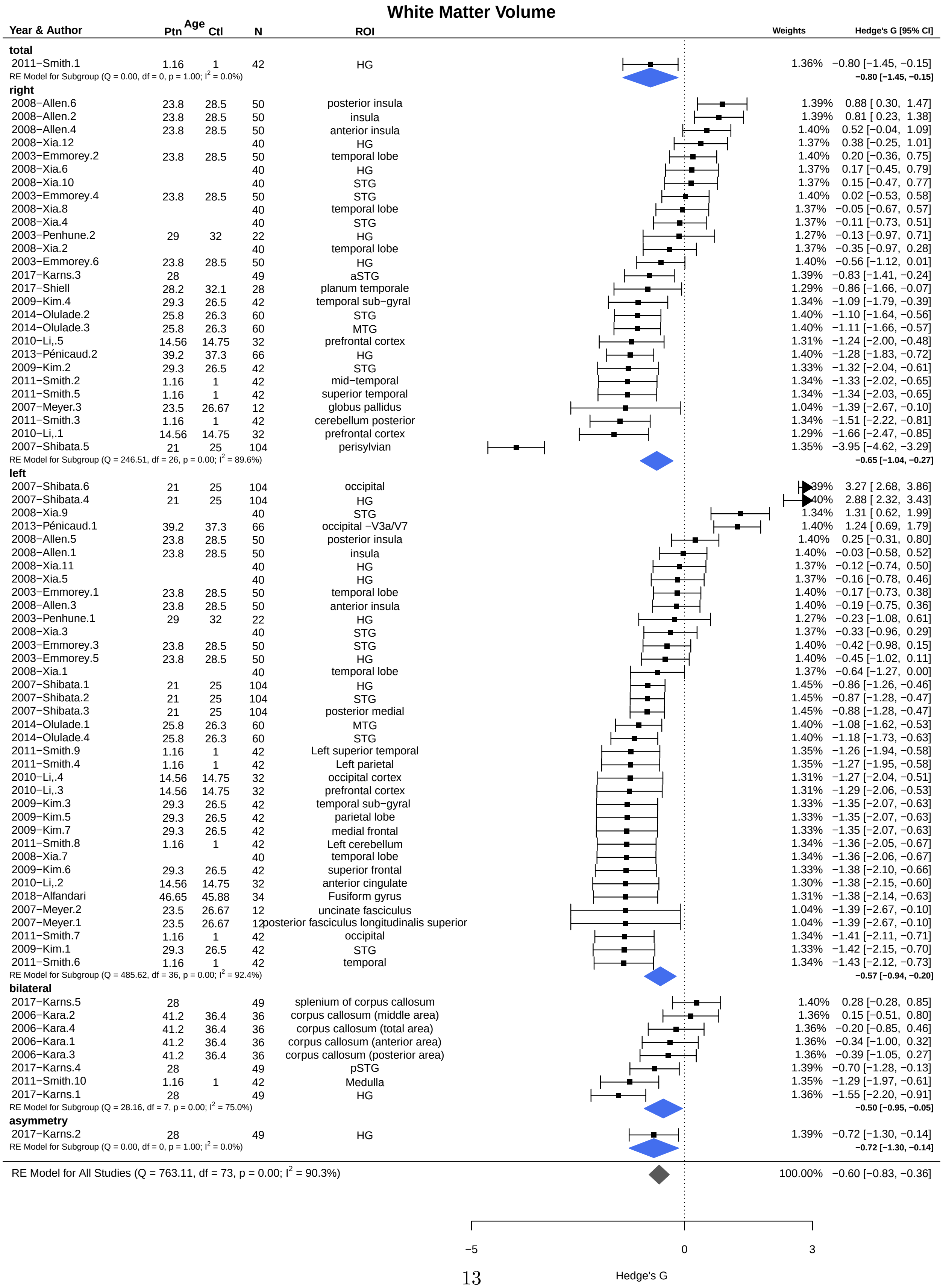

Standard Error
Residual Value
Influence on Fitted Value
Squared Pearson Residual
Shibata DK. AJNR Am J Neuroradiol.5
Kim et al. Hear Res.2
Kim et al. Hear Res.1
Gray Matter Volume
Sample Quantiles
Theoretical Quantiles

Figure 3 - White Matter Volume: Random effects model no intercept covariated by Big area



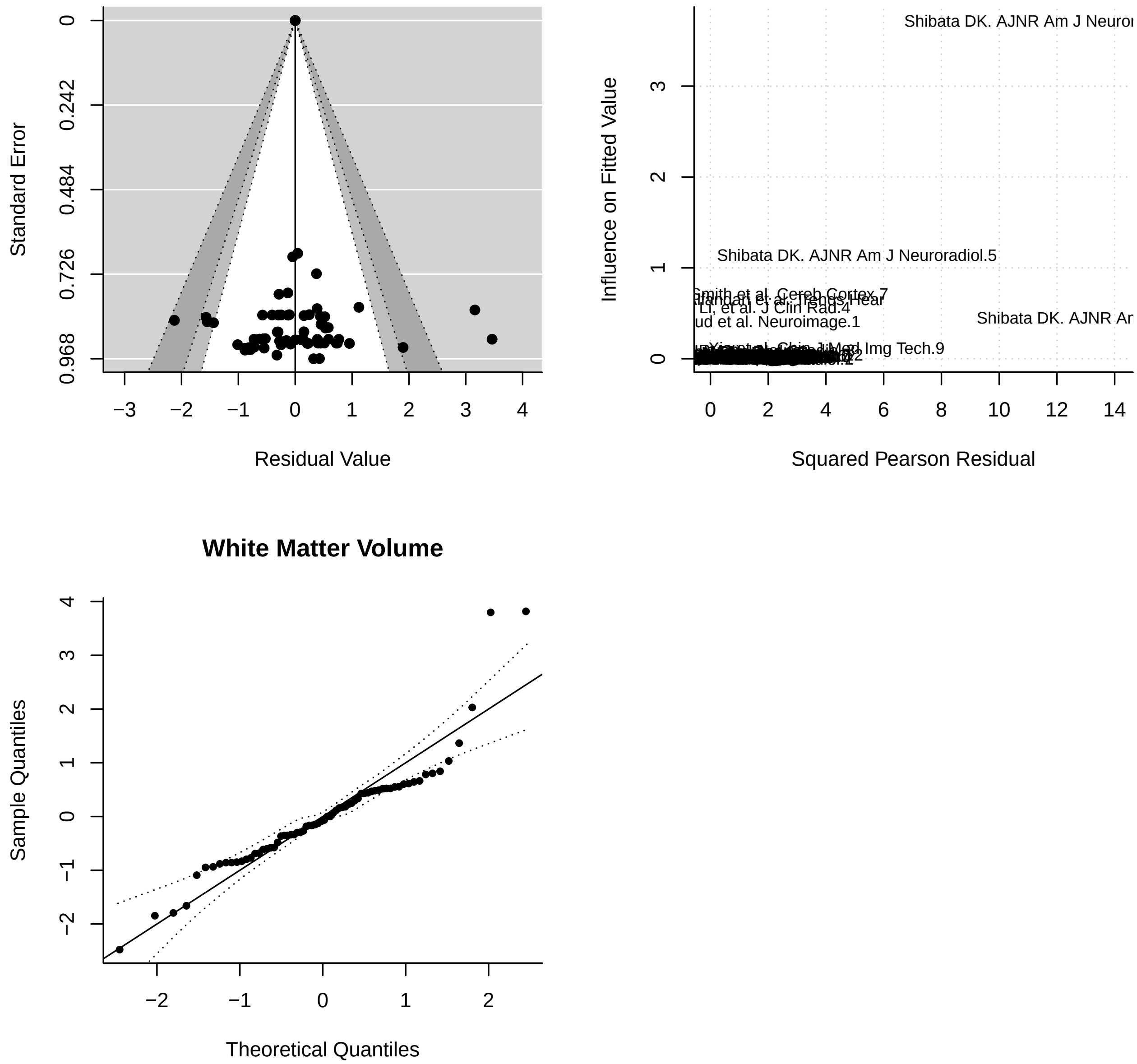
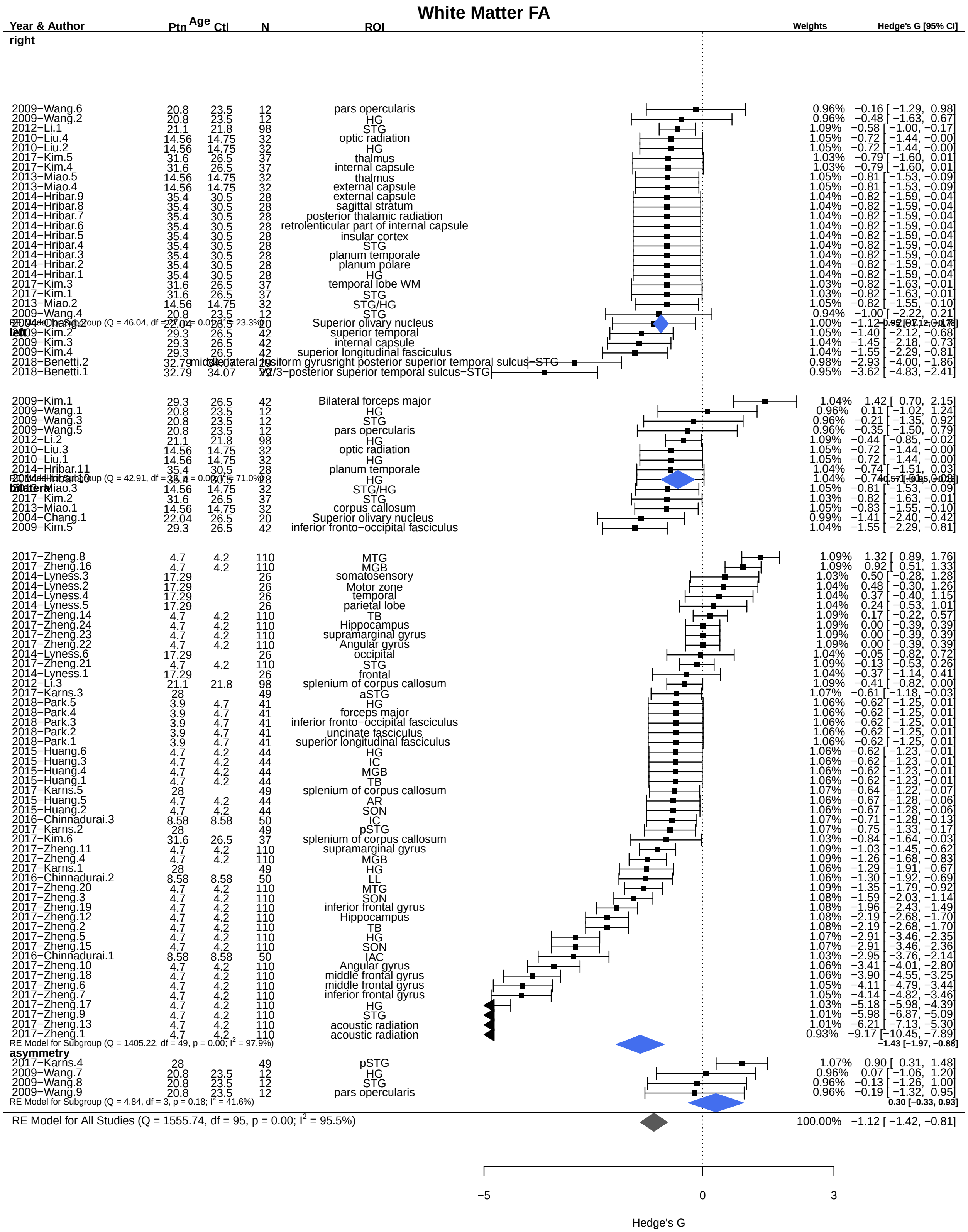
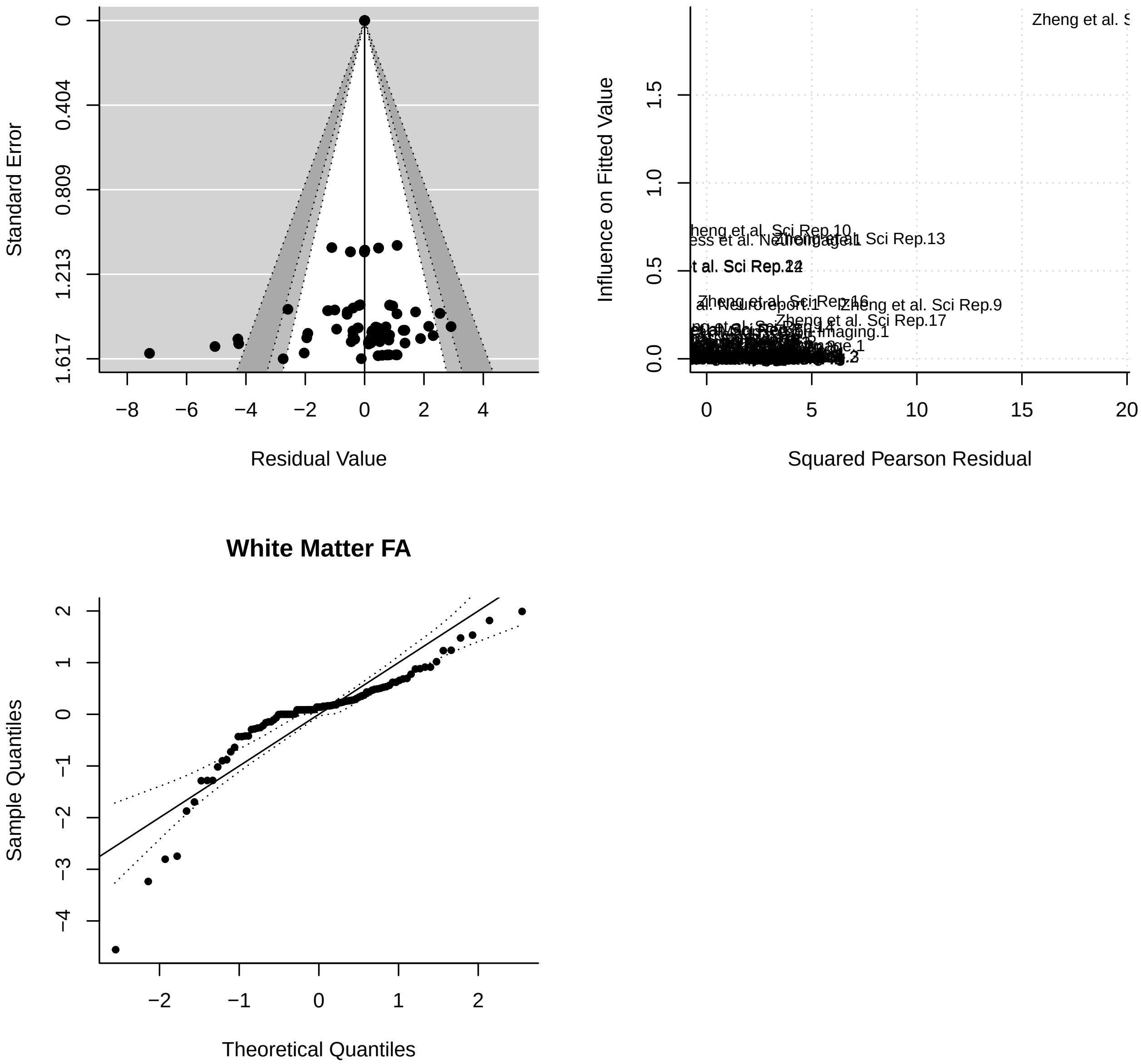

Standard Error
Residual Value
Influence on Fitted Value
Squared Pearson Residual
Shibata DK. AJNR Am J Neuroradiol.5
Smith et al. Cereb Cortex.7
Li, et al. J Clin Rad.4
ud et al. Neuroimage.1
Shibata DK. AJNR Am J Neuroi
Shibata DK. AJNR Ar
White Matter Volume
Sample Quantiles
Theoretical Quantiles

Figure 3 - White Matter Fractional Anisotropy (FA): Random effects model no intercept covariated by Big area




Standard Error
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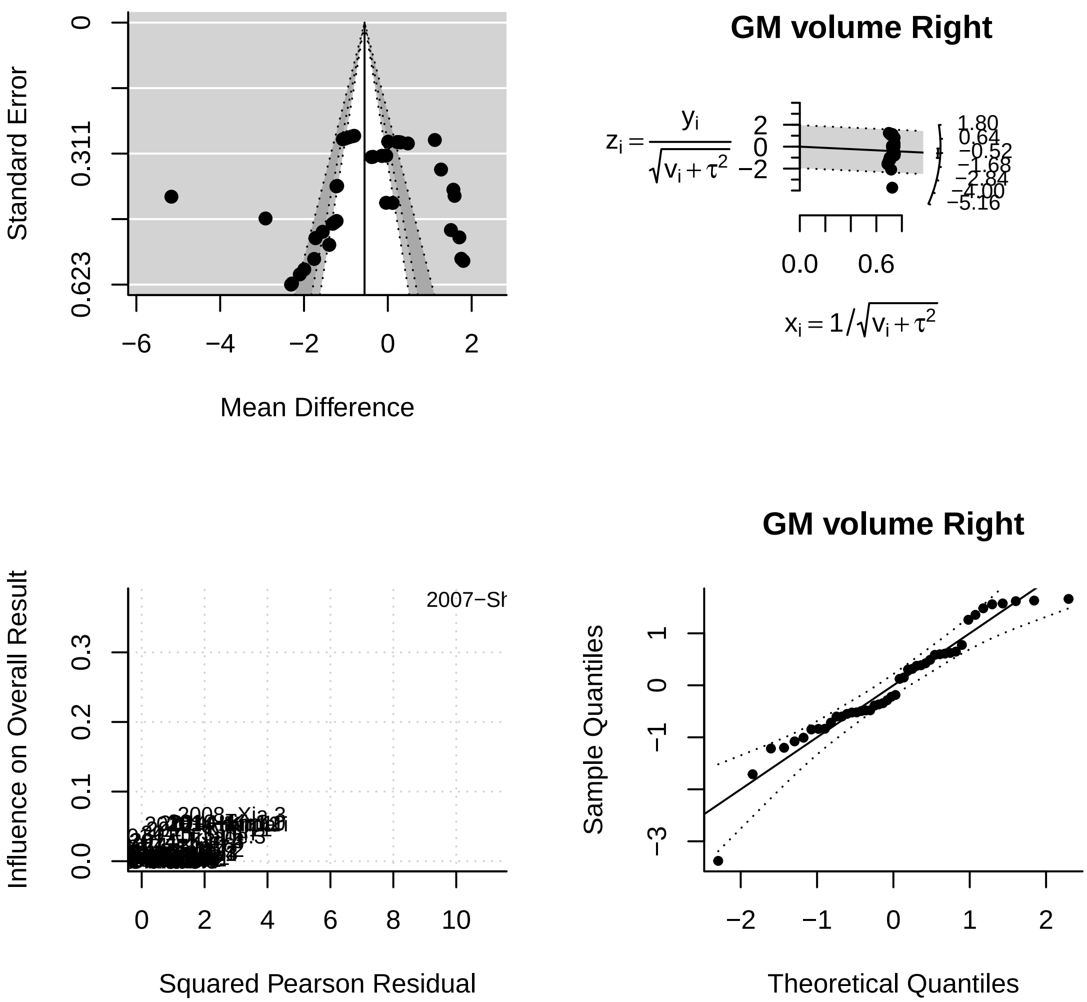
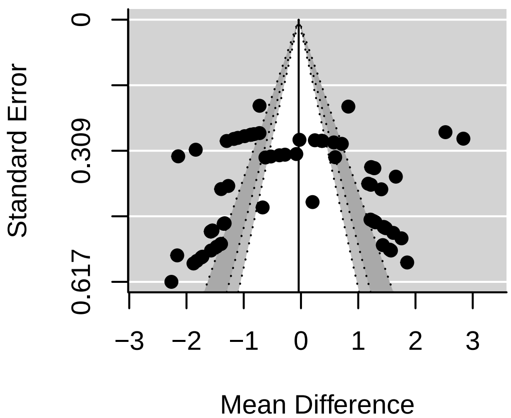
0.404
0.809
1.213
1.617
−8 −6 −4 −2 0 2 4
Residual Value
Influence on Fitted Value
0.0
0.5
1.0
1.5
0 5 10 15 20
Squared Pearson Residual
Zheng et al. Sci Rep.13
Zheng et al. Sci Rep.16
Zheng et al. Sci Rep.9
Zheng et al. Sci Rep.17
White Matter FA
Sample Quantiles
2
1
0
−1
−2
−3
−4
−2 −1 0 1 2
Theoretical Quantiles

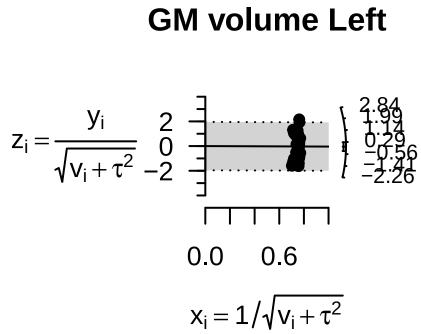
Figure 3 - Supplementary material: heterogeneity per model

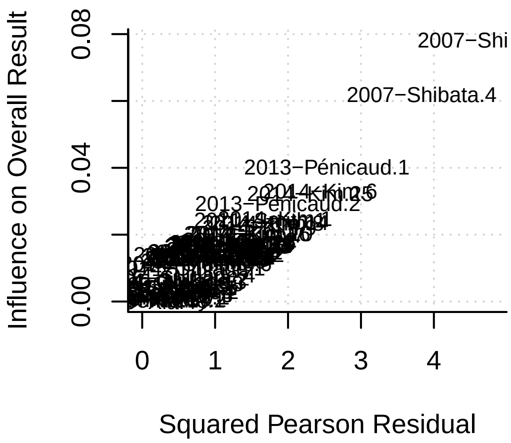
Heterogeney: GM volume Right

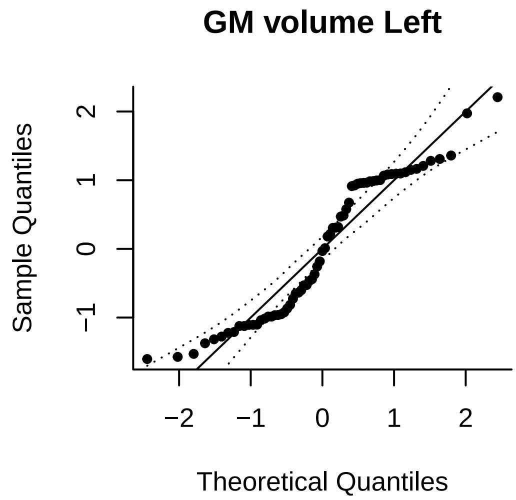


Heterogeney: GM volume Left

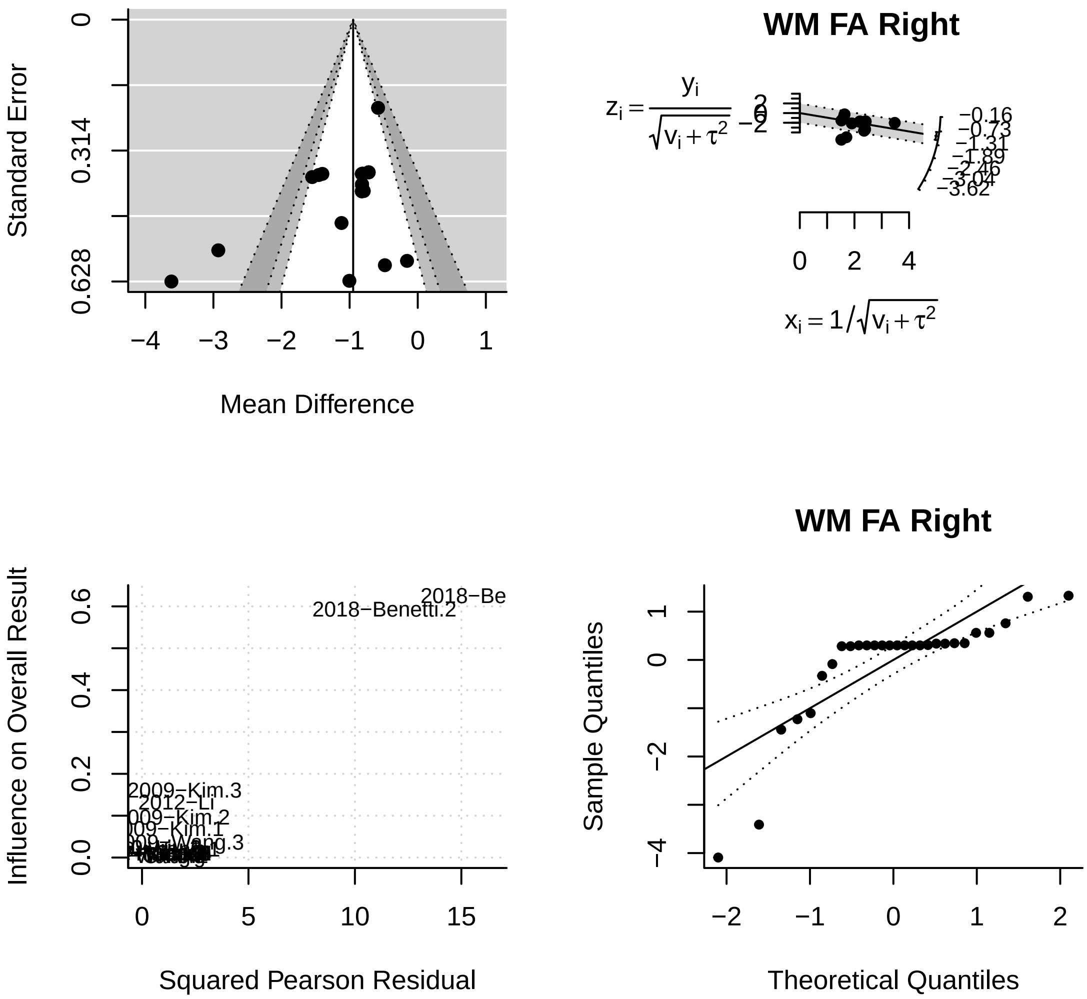




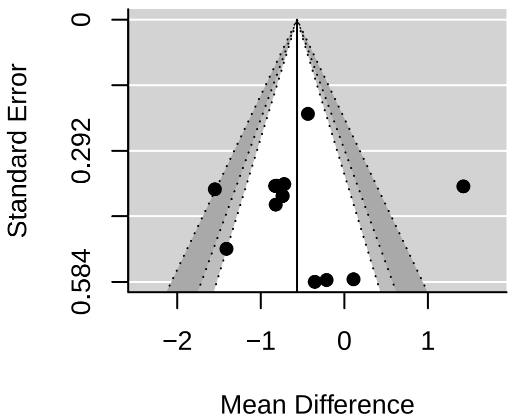


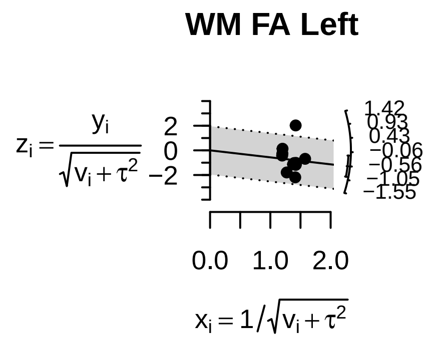


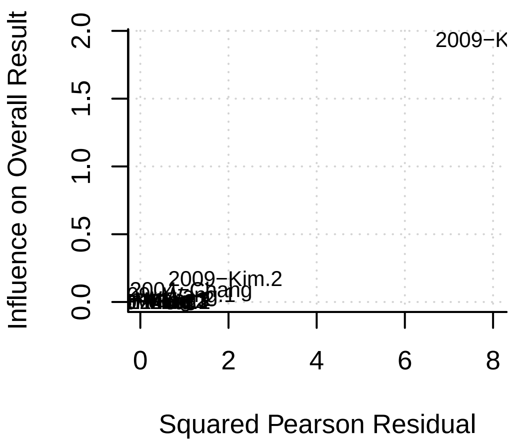
Heterogeney: WM FA Right

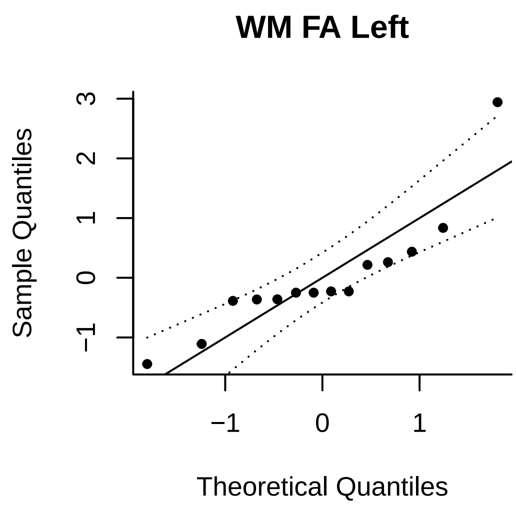


Heterogeney: WM FA Left

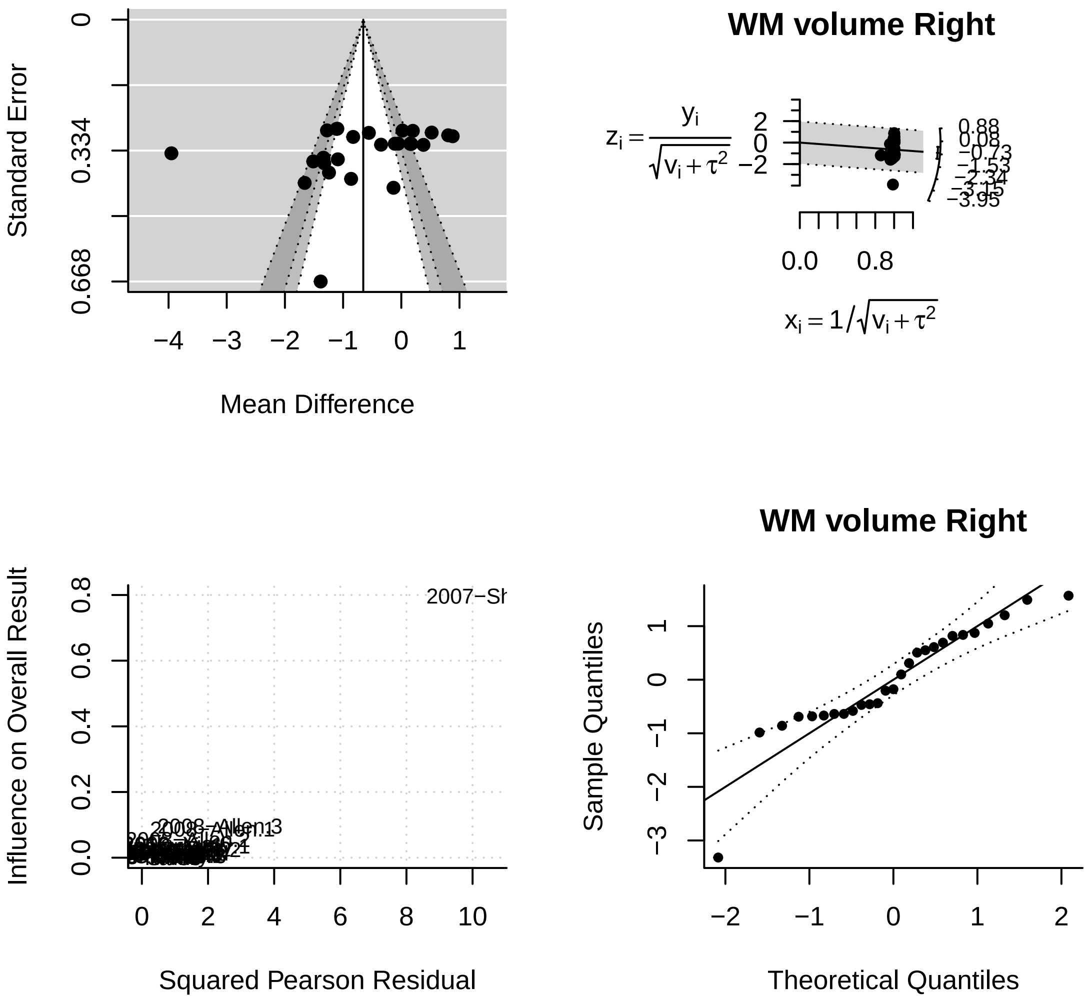








Heterogeney: WM volume Right



Heterogeney: WM volume Left

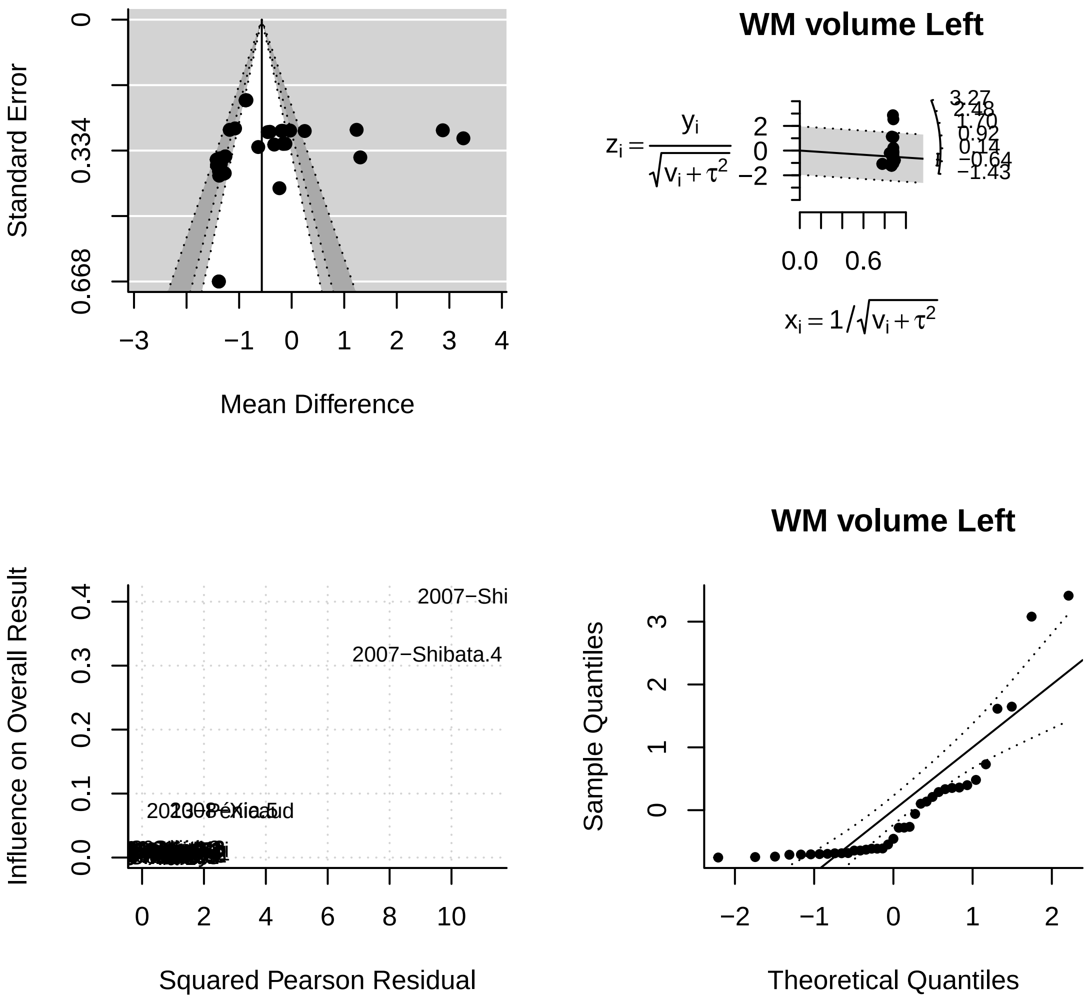
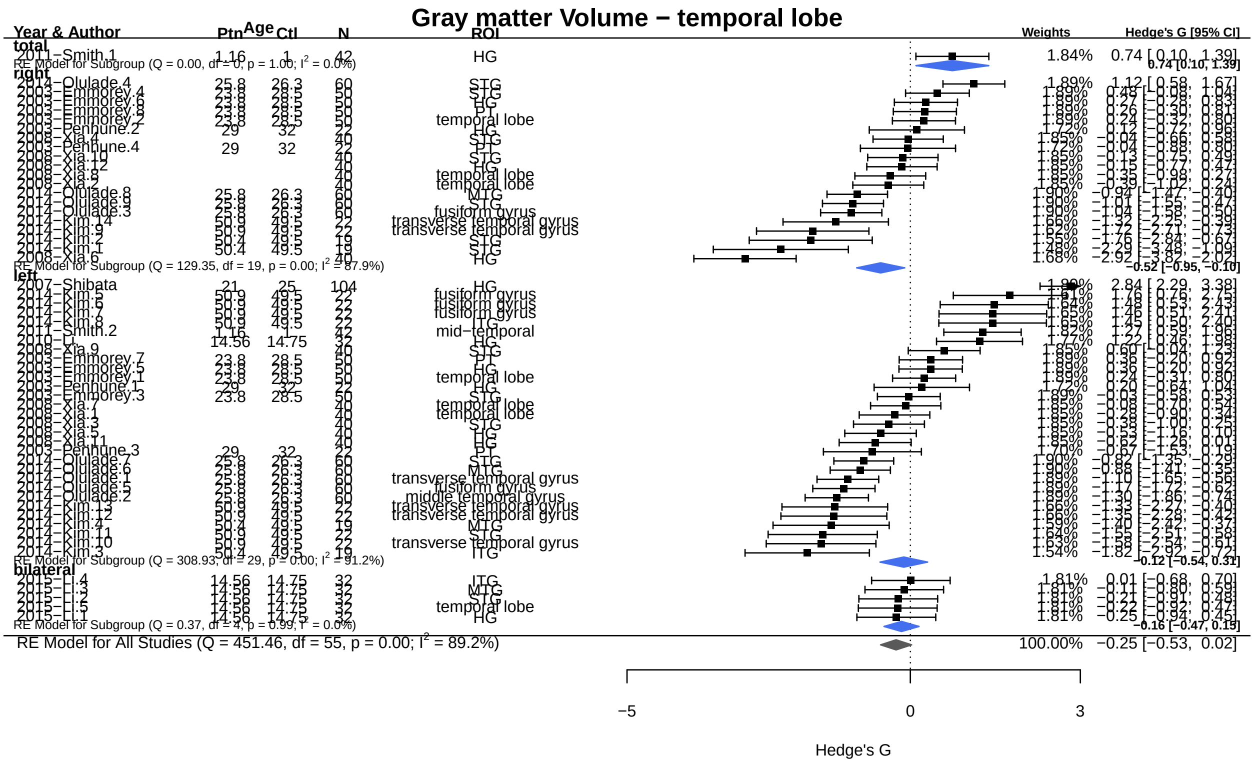
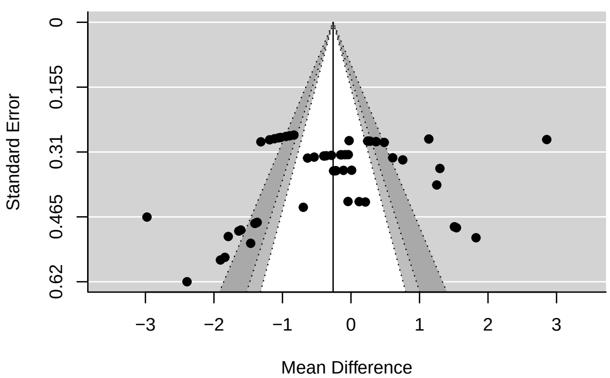
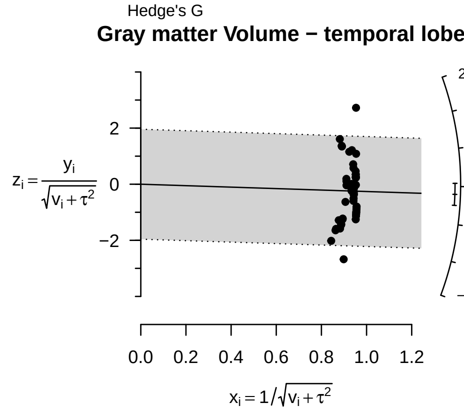
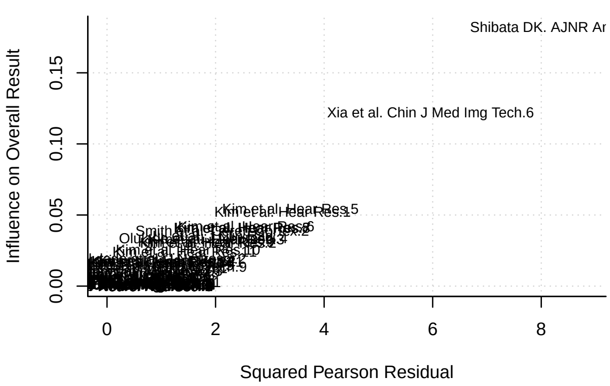


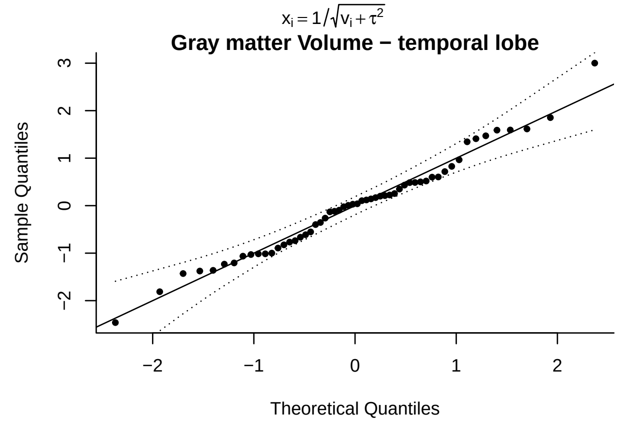
Figure 4 - Meta-regressions of Gray Matter Volume & Brain Areas: Random effects model no intercept covariated by Side

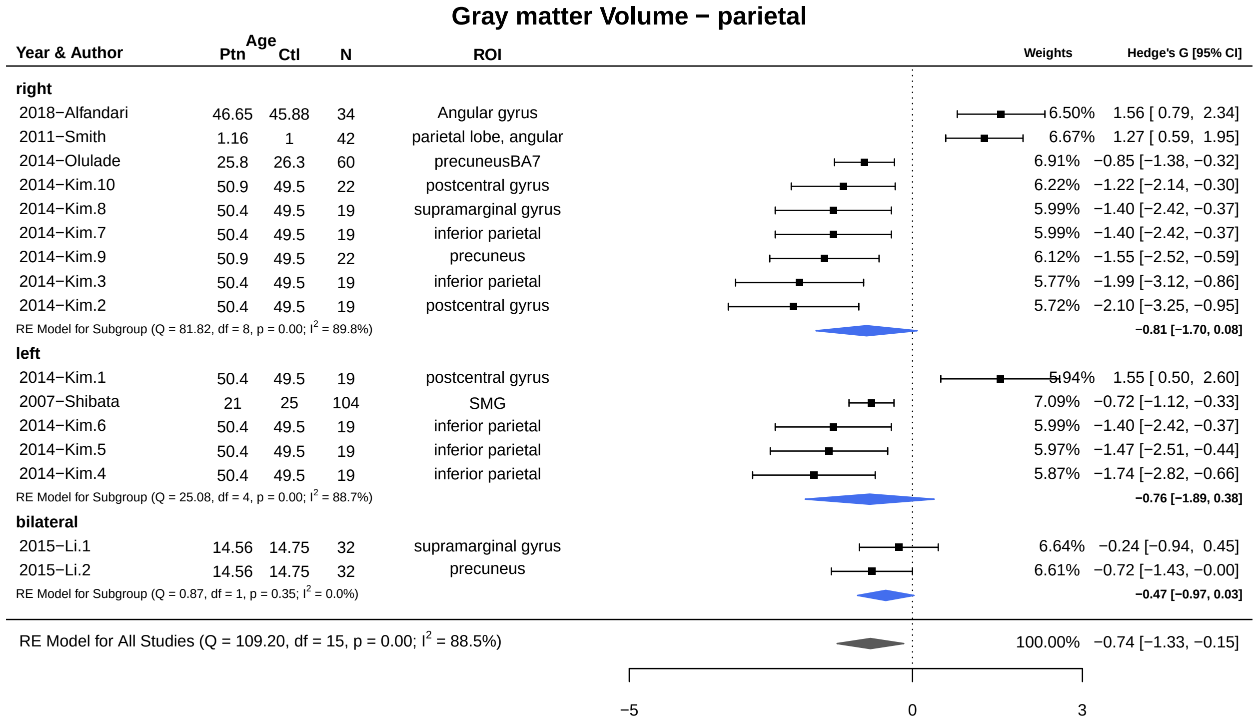


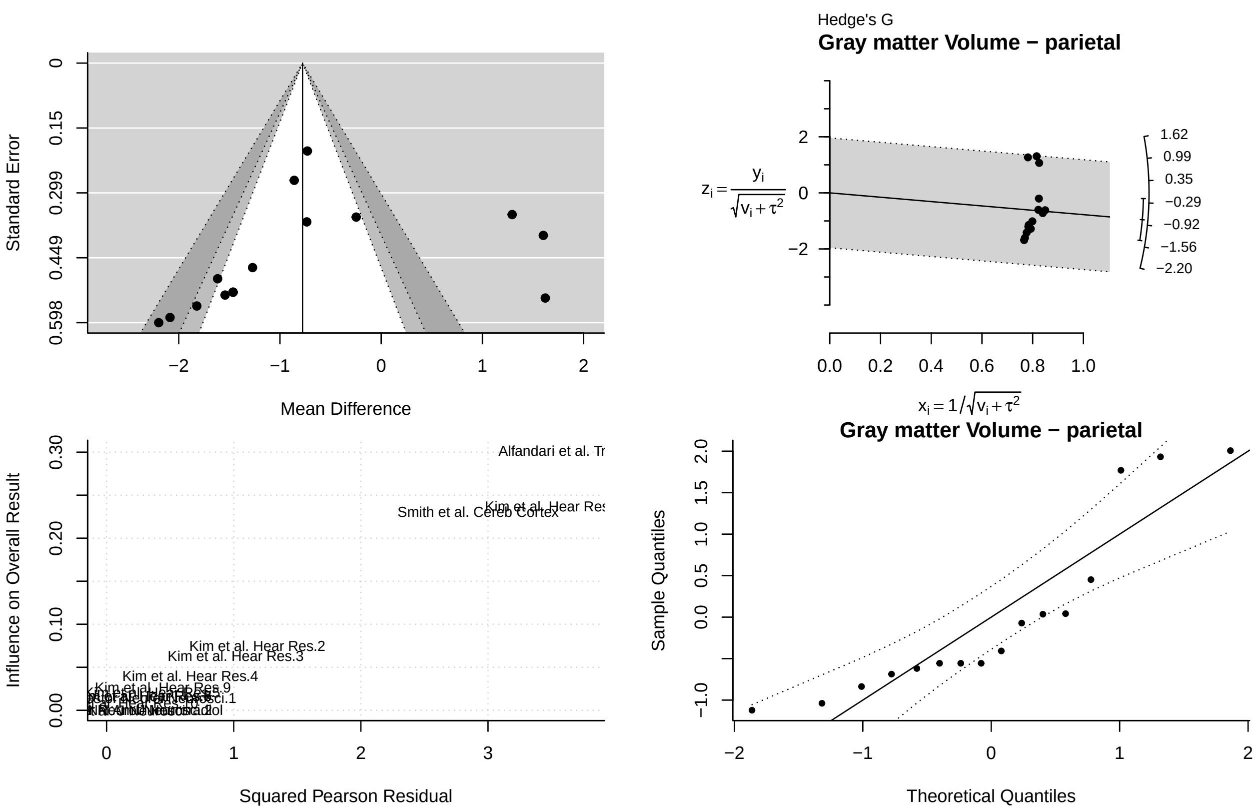


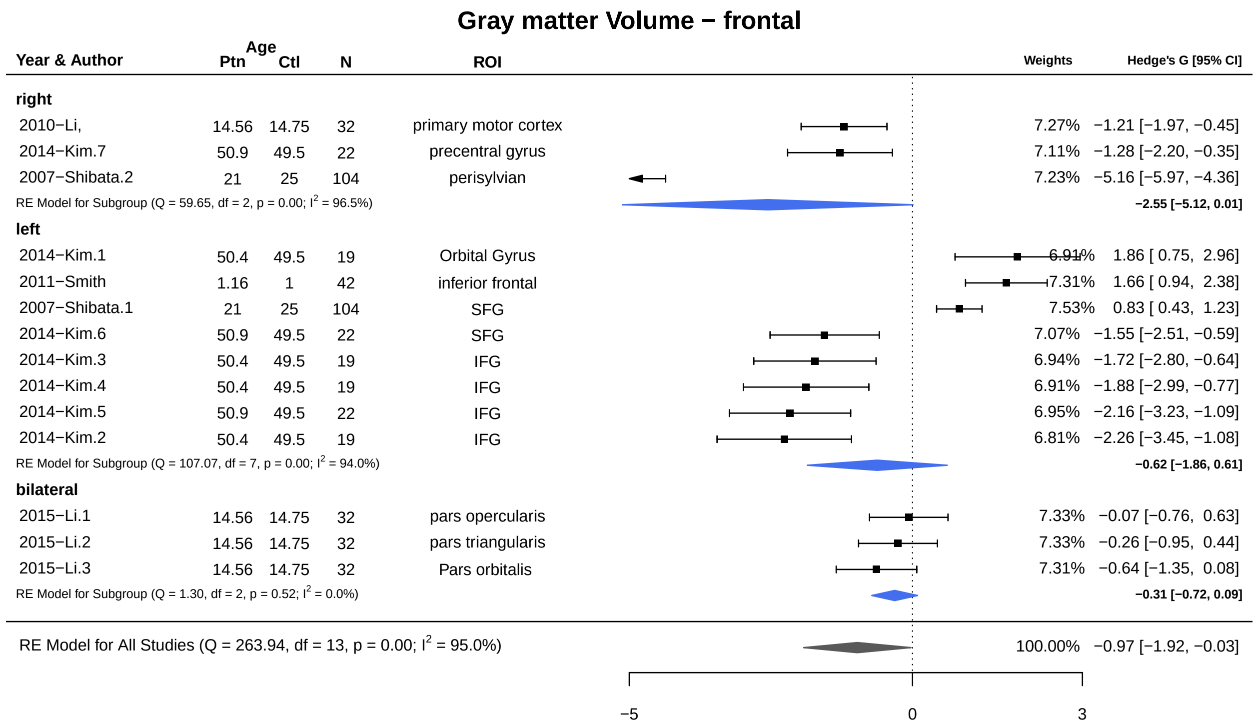


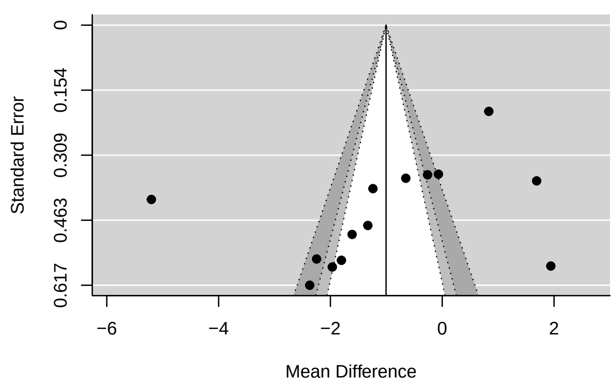


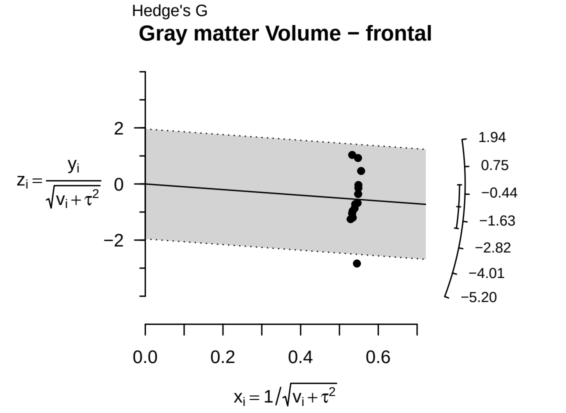


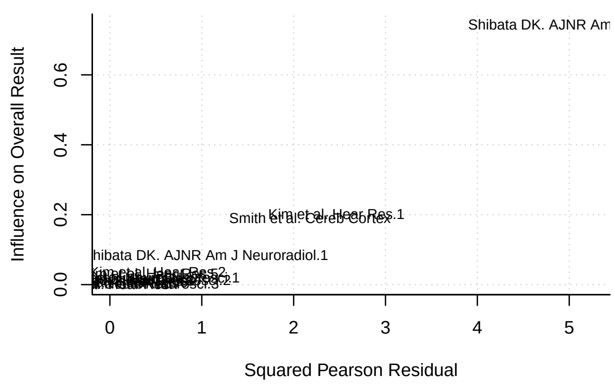

Gray matter Volume − parietal
Year & Author | Age Ptn | Ctl | N | ROI | Weights | Hedge's G [95% CI]
right
2018−Alfandari 46.65 45.88 34 Angular gyrus 6.50% 1.56 [0.79, 2.34]
2011−Smith 1.16 1 42 parietal lobe, angular 6.67% 1.27 [0.59, 1.95]
2014−Olulade 25.8 26.3 60 precuneusBA7 6.91% −0.85 [−1.38, −0.32]
2014−Kim.10 50.9 49.5 22 postcentral gyrus 6.22% −1.22 [−2.14, −0.30]
2014−Kim.8 50.4 49.5 19 supramarginal gyrus 5.99% −1.40 [−2.42, −0.37]
2014−Kim.7 50.4 49.5 19 inferior parietal 5.99% −1.40 [−2.42, −0.37]
2014−Kim.9 50.9 49.5 22 precuneus 6.12% −1.55 [−2.52, −0.59]
2014−Kim.3 50.4 49.5 19 inferior parietal 5.77% −1.99 [−3.12, −0.86]
2014−Kim.2 50.4 49.5 19 postcentral gyrus 5.72% −2.10 [−3.25, −0.95]
RE Model for Subgroup (Q = 81.82, df = 8, p = 0.00; I² = 89.8%) −0.81 [−1.70, 0.08]
left
2014−Kim.1 50.4 49.5 19 postcentral gyrus 5.94% 1.55 [0.50, 2.60]
2007−Shibata 21 25 104 SMG 7.09% −0.72 [−1.12, −0.33]
2014−Kim.6 50.4 49.5 19 inferior parietal 5.99% −1.40 [−2.42, −0.37]
2014−Kim.5 50.4 49.5 19 inferior parietal 5.97% −1.47 [−2.51, −0.44]
2014−Kim.4 50.4 49.5 19 inferior parietal 5.87% −1.74 [−2.82, −0.66]
RE Model for Subgroup (Q = 25.08, df = 4, p = 0.00; I² = 88.7%) −0.76 [−1.89, 0.38]
bilateral
2015−Li.1 14.56 14.75 32 supramarginal gyrus 6.64% −0.24 [−0.94, 0.45]
2015−Li.2 14.56 14.75 32 precuneus 6.61% −0.72 [−1.43, −0.00]
RE Model for Subgroup (Q = 0.87, df = 1, p = 0.35; I² = 0.0%) −0.47 [−0.97, 0.03]
RE Model for All Studies (Q = 109.20, df = 15, p = 0.00; I² = 88.5%) 100.00% −0.74 [−1.33, −0.15]
−5
0
3
Hedge's G

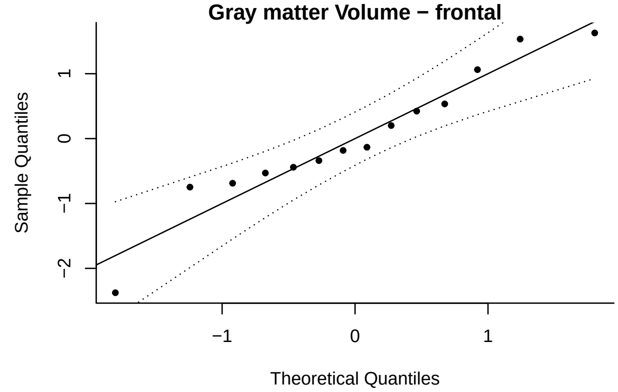

Standard Error
Mean Difference
Gray matter Volume − parietal
$z_i = \frac{y_i}{\sqrt{v_i + \tau^2}}$
$x_i = 1/\sqrt{v_i + \tau^2}$
Influence on Overall Result
Squared Pearson Residual
Alfandari et al. Tr
Smith et al. Cereb Cortex
Kim et al. Hear Res
Kim et al. Hear Res.2
Kim et al. Hear Res.3
Kim et al. Hear Res.4
Gray matter Volume − parietal
Sample Quantiles
Theoretical Quantiles

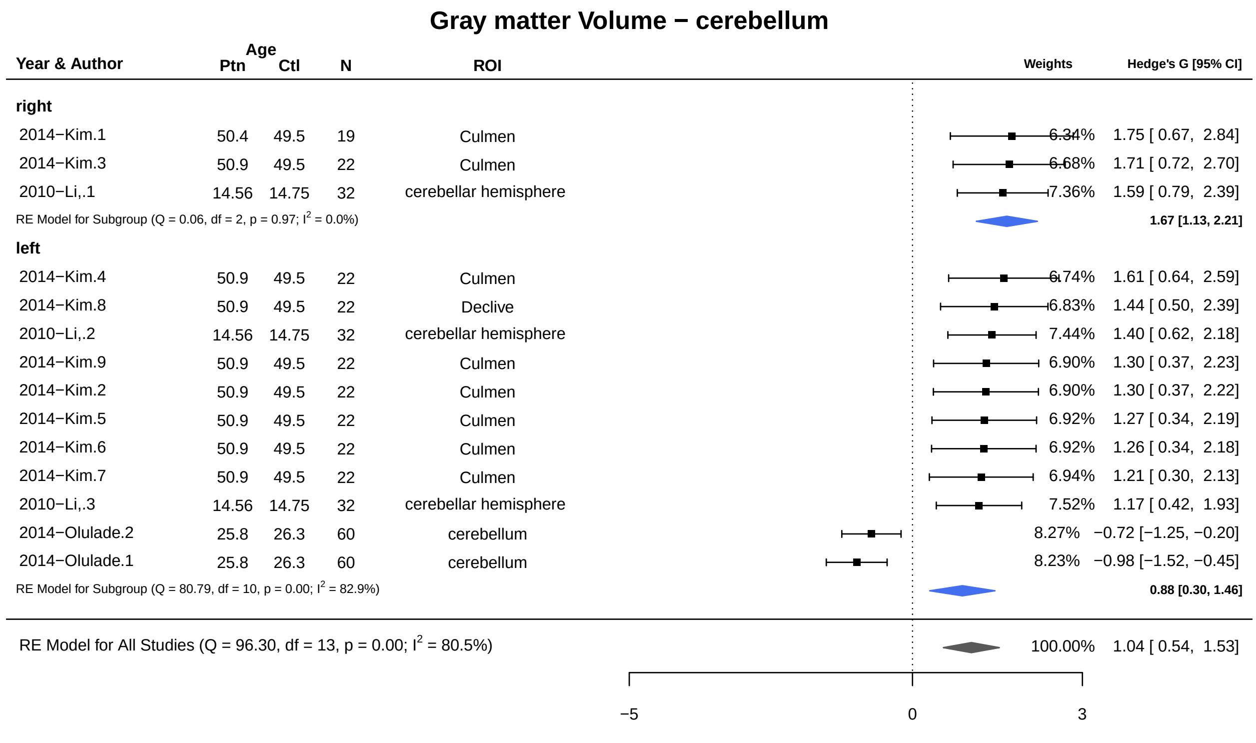

Gray matter Volume − frontal
Year & Author | Age Ptn | Ctl | N | ROI | Weights | Hedge's G [95% CI]
right
2010−Li, 14.56 14.75 32 primary motor cortex 7.27% −1.21 [−1.97, −0.45]
2014−Kim.7 50.9 49.5 22 precentral gyrus 7.11% −1.28 [−2.20, −0.35]
2007−Shibata.2 21 25 104 perisylvian 7.23% −5.16 [−5.97, −4.36]
RE Model for Subgroup (Q = 59.65, df = 2, p = 0.00; I2 = 96.5%) −2.55 [−5.12, 0.01]
left
2014−Kim.1 50.4 49.5 19 Orbital Gyrus 6.91% 1.86 [0.75, 2.96]
2011−Smith 1.16 1 42 inferior frontal 7.31% 1.66 [0.94, 2.38]
2007−Shibata.1 21 25 104 SFG 7.53% 0.83 [0.43, 1.23]
2014−Kim.6 50.9 49.5 22 SFG 7.07% −1.55 [−2.51, −0.59]
2014−Kim.3 50.4 49.5 19 IFG 6.94% −1.72 [−2.80, −0.64]
2014−Kim.4 50.4 49.5 19 IFG 6.91% −1.88 [−2.99, −0.77]
2014−Kim.5 50.9 49.5 22 IFG 6.95% −2.16 [−3.23, −1.09]
2014−Kim.2 50.4 49.5 19 IFG 6.81% −2.26 [−3.45, −1.08]
RE Model for Subgroup (Q = 107.07, df = 7, p = 0.00; I2 = 94.0%) −0.62 [−1.86, 0.61]
bilateral
2015−Li.1 14.56 14.75 32 pars opercularis 7.33% −0.07 [−0.76, 0.63]
2015−Li.2 14.56 14.75 32 pars triangularis 7.33% −0.26 [−0.95, 0.44]
2015−Li.3 14.56 14.75 32 Pars orbitalis 7.31% −0.64 [−1.35, 0.08]
RE Model for Subgroup (Q = 1.30, df = 2, p = 0.52; I2 = 0.0%) −0.31 [−0.72, 0.09]
RE Model for All Studies (Q = 263.94, df = 13, p = 0.00; I2 = 95.0%) 100.00% −0.97 [−1.92, −0.03]
−5
0
3
Hedge's G

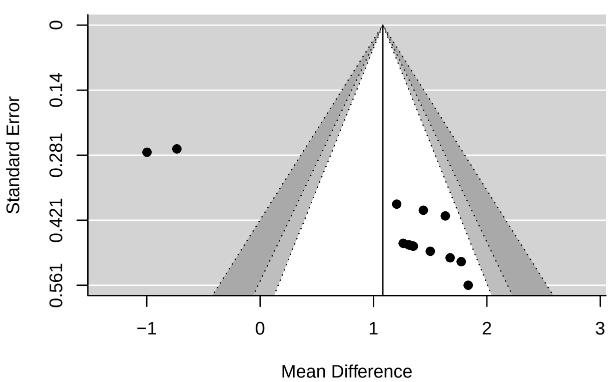

Standard Error
0
0.154
0.309
0.463
0.617
−6
−4
−2
0
2
Mean Difference

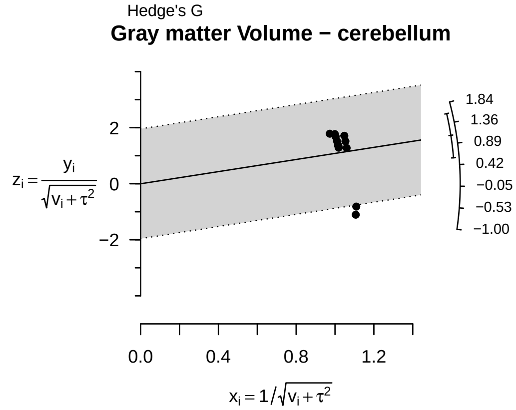

Gray matter Volume − frontal
2
0
−2
0.0
0.2
0.4
0.6
1.94
0.75
−0.44
−1.63
−2.82
−4.01
−5.20

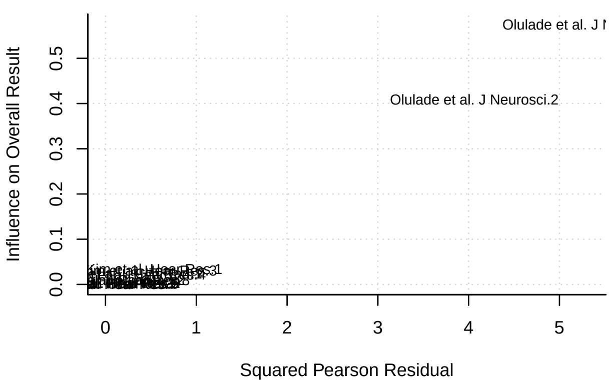

Influence on Overall Result
0.0
0.2
0.4
0.6
Shibata DK. AJNR Am
Smith et al. Cereb Cortex
Kim et al. Hear Res.1
hibata DK. AJNR Am J Neuroradiol.1
0
1
2
3
4
5
Squared Pearson Residual

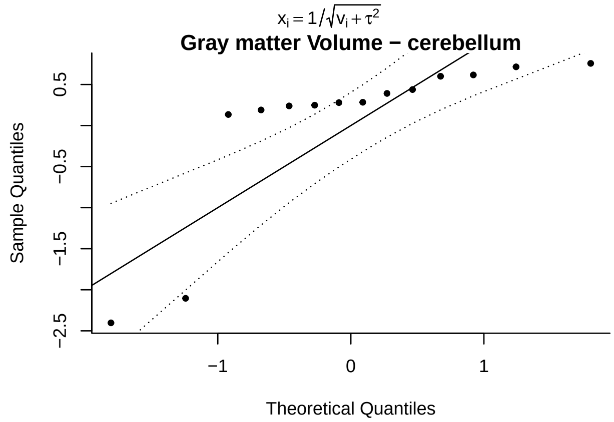

Gray matter Volume − frontal
Sample Quantiles
1
0
−1
−2
−1
0
1
Theoretical Quantiles

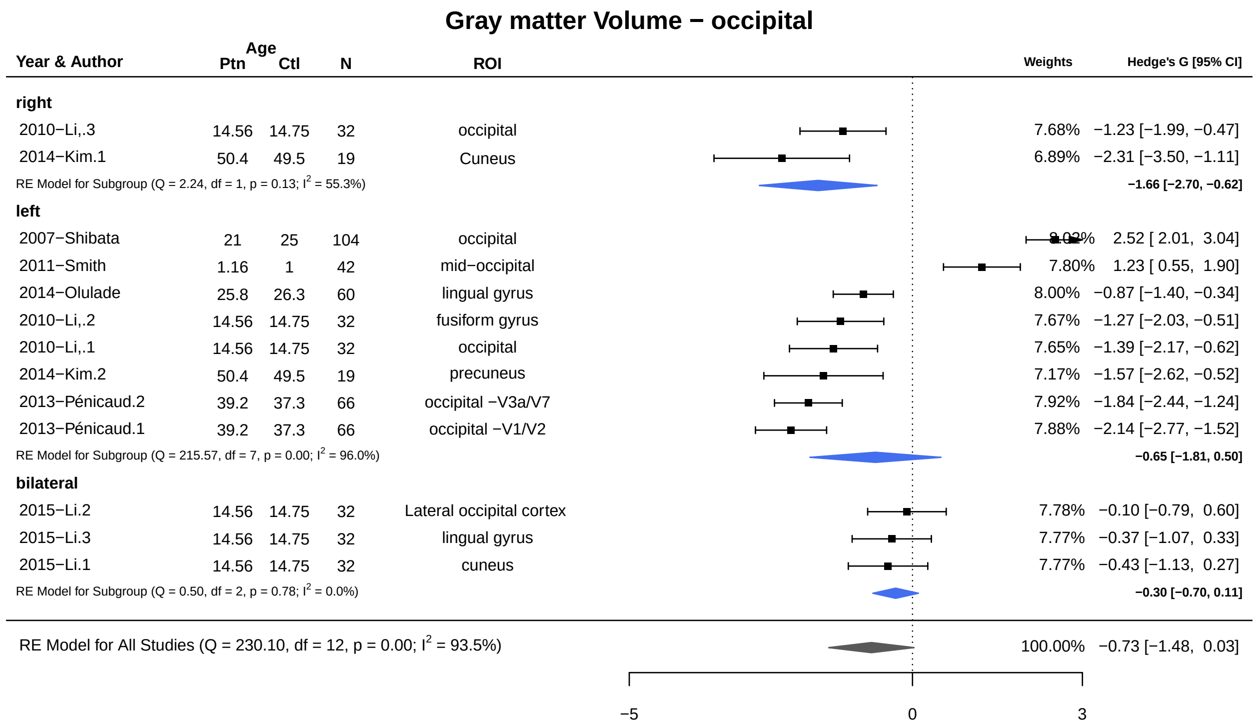

Gray matter Volume − cerebellum
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
right
2014−Kim.1 50.4 49.5 19 Culmen 6.34% 1.75 [0.67, 2.84]
2014−Kim.3 50.9 49.5 22 Culmen 6.68% 1.71 [0.72, 2.70]
2010−Li,.1 14.56 14.75 32 cerebellar hemisphere 7.36% 1.59 [0.79, 2.39]
RE Model for Subgroup (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

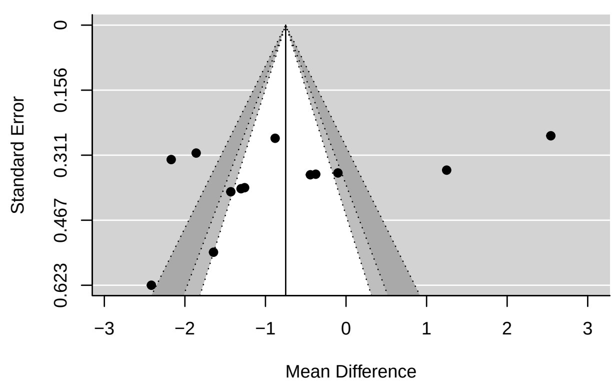

Standard Error
0
0.14
0.281
0.421
0.561
−1
0
1
2
3
Mean Difference

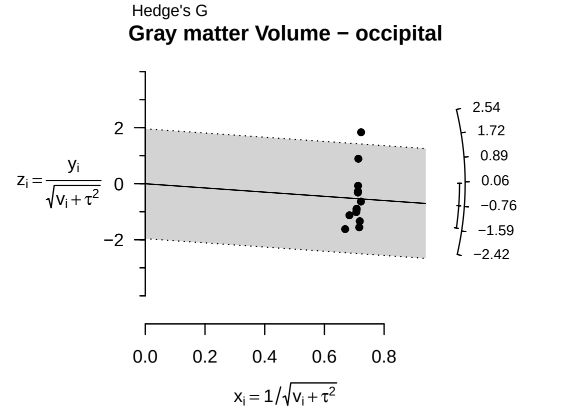

Gray matter Volume − cerebellum
$z_i = \frac{y_i}{\sqrt{v_i + \tau^2}}$
2
0
−2
1.84
1.36
0.89
0.42
−0.05
−0.53
−1.00
0.0
0.4
0.8
1.2
$x_i = 1/\sqrt{v_i + \tau^2}$

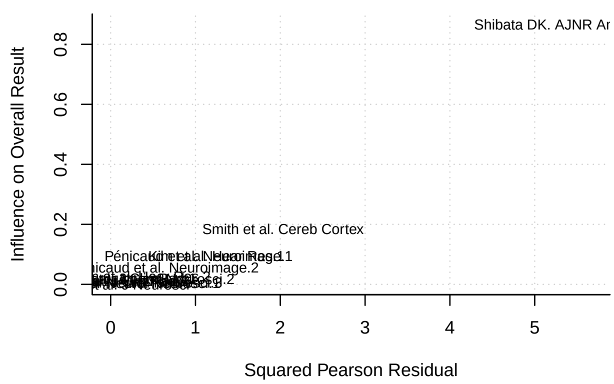

Influence on Overall Result
0.0
0.1
0.2
0.3
0.4
0.5
Olulade et al. J N
Olulade et al. J Neurosci.2
0
1
2
3
4
5
Squared Pearson Residual

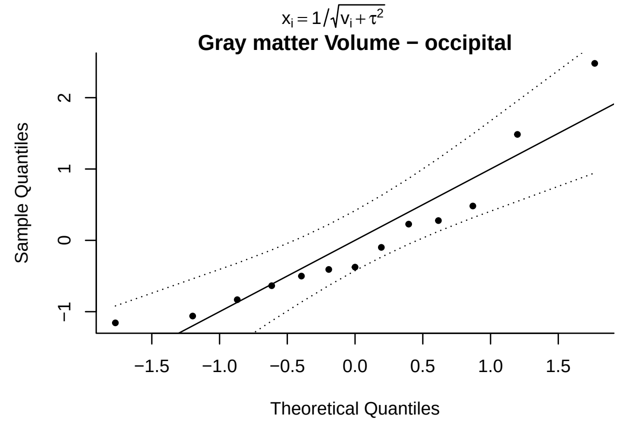

Gray matter Volume − cerebellum
Sample Quantiles
0.5
−0.5
−1.5
−2.5
−1
0
1
Theoretical Quantiles

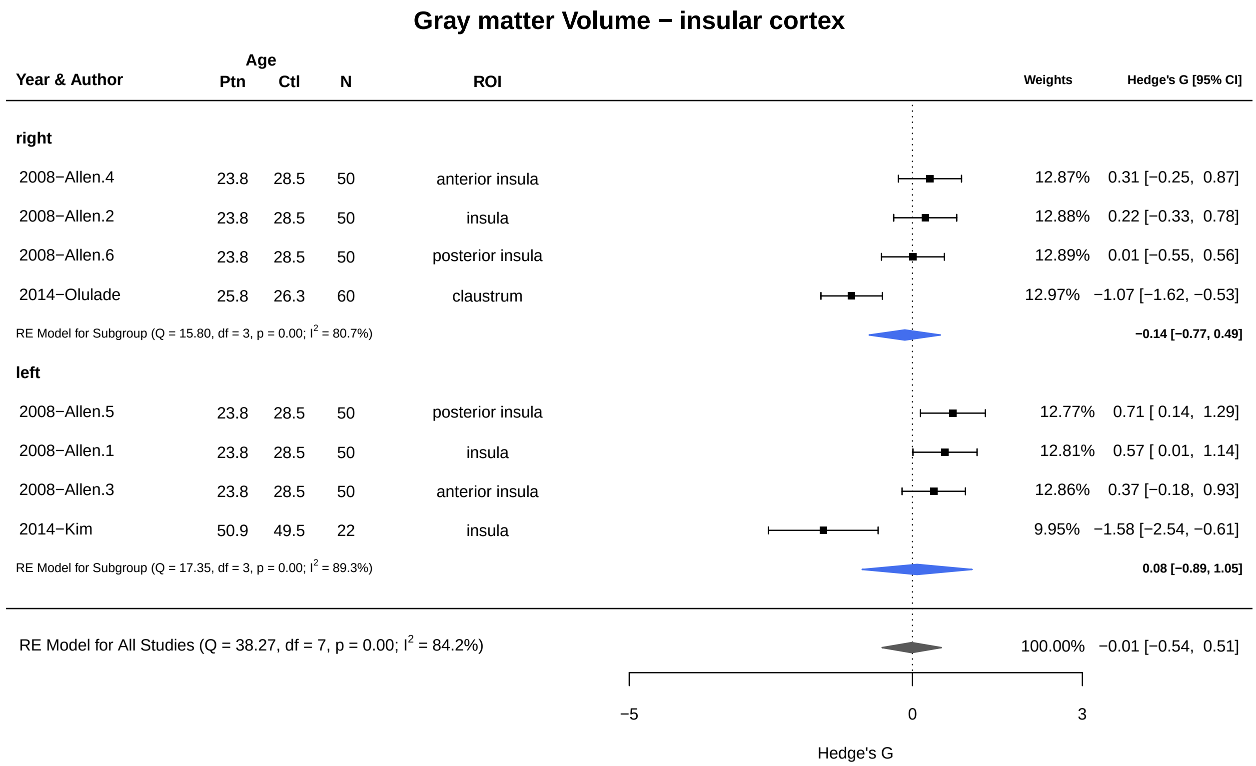

Gray matter Volume − occipital
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
right
2010−Li,.3 14.56 14.75 32 occipital 7.68% −1.23 [−1.99, −0.47]
2014−Kim.1 50.4 49.5 19 Cuneus 6.89% −2.31 [−3.50, −1.11]
RE Model for Subgroup (Q = 2.24, df = 1, p = 0.13; I² = 55.3%) −1.66 [−2.70, −0.62]
left
2007−Shibata 21 25 104 occipital 8.02% 2.52 [2.01, 3.04]
2011−Smith 1.16 1 42 mid−occipital 7.80% 1.23 [0.55, 1.90]
2014−Olulade 25.8 26.3 60 lingual gyrus 8.00% −0.87 [−1.40, −0.34]
2010−Li,.2 14.56 14.75 32 fusiform gyrus 7.67% −1.27 [−2.03, −0.51]
2010−Li,.1 14.56 14.75 32 occipital 7.65% −1.39 [−2.17, −0.62]
2014−Kim.2 50.4 49.5 19 precuneus 7.17% −1.57 [−2.62, −0.52]
2013−Pénicaud.2 39.2 37.3 66 occipital −V3a/V7 7.92% −1.84 [−2.44, −1.24]
2013−Pénicaud.1 39.2 37.3 66 occipital −V1/V2 7.88% −2.14 [−2.77, −1.52]
RE Model for Subgroup (Q = 215.57, df = 7, p = 0.00; I² = 96.0%) −0.65 [−1.81, 0.50]
bilateral
2015−Li.2 14.56 14.75 32 Lateral occipital cortex 7.78% −0.10 [−0.79, 0.60]
2015−Li.3 14.56 14.75 32 lingual gyrus 7.77% −0.37 [−1.07, 0.33]
2015−Li.1 14.56 14.75 32 cuneus 7.77% −0.43 [−1.13, 0.27]
RE Model for Subgroup (Q = 0.50, df = 2, p = 0.78; I² = 0.0%) −0.30 [−0.70, 0.11]
RE Model for All Studies (Q = 230.10, df = 12, p = 0.00; I² = 93.5%) 100.00% −0.73 [−1.48, 0.03]
−5
0
3
Hedge's G

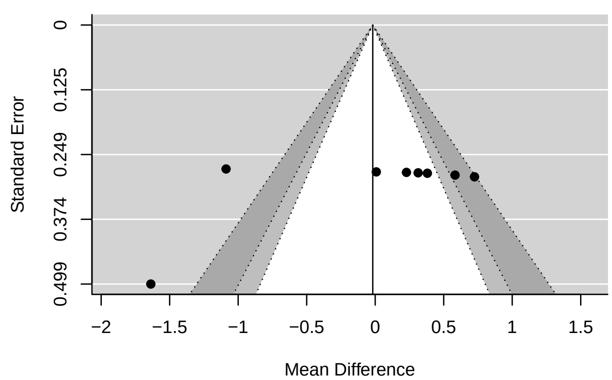

Standard Error
0
0.156
0.311
0.467
0.623
−3
−2
−1
0
1
2
3
Mean Difference

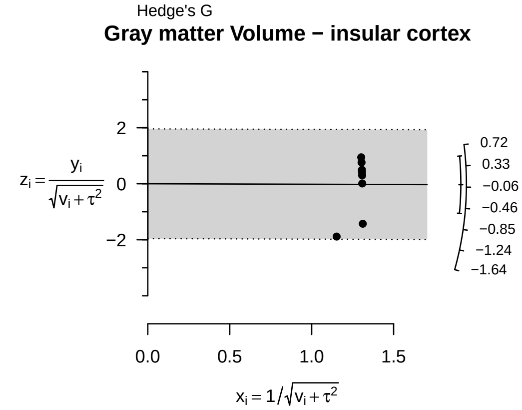

Gray matter Volume − occipital
2
0
−2
$z_i = \frac{y_i}{\sqrt{v_i + \tau^2}}$
2.54
1.72
0.89
0.06
−0.76
−1.59
−2.42
0.0
0.2
0.4
0.6
0.8
$x_i = 1/\sqrt{v_i + \tau^2}$

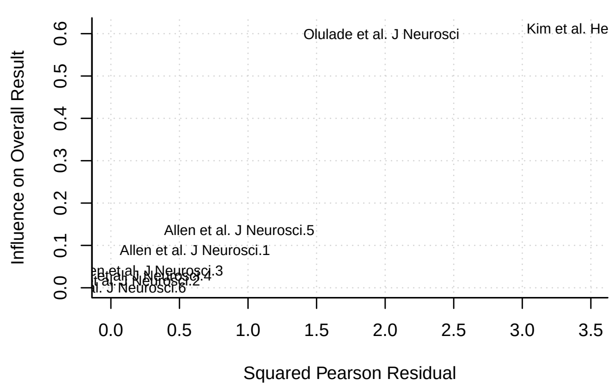

Influence on Overall Result
0.0
0.2
0.4
0.6
0.8
Shibata DK. AJNR Ar
Smith et al. Cereb Cortex
0
1
2
3
4
5
Squared Pearson Residual


Gray matter Volume − occipital
Sample Quantiles
−1
0
1
2
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
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 12.87% 0.31 [−0.25, 0.87]
2008−Allen.2 23.8 28.5 50 insula 12.88% 0.22 [−0.33, 0.78]
2008−Allen.6 23.8 28.5 50 posterior insula 12.89% 0.01 [−0.55, 0.56]
2014−Olulade 25.8 26.3 60 claustrum 12.97% −1.07 [−1.62, −0.53]
RE Model for Subgroup (Q = 15.80, df = 3, p = 0.00; I² = 80.7%) −0.14 [−0.77, 0.49]
left
2008−Allen.5 23.8 28.5 50 posterior insula 12.77% 0.71 [0.14, 1.29]
2008−Allen.1 23.8 28.5 50 insula 12.81% 0.57 [0.01, 1.14]
2008−Allen.3 23.8 28.5 50 anterior insula 12.86% 0.37 [−0.18, 0.93]
2014−Kim 50.9 49.5 22 insula 9.95% −1.58 [−2.54, −0.61]
RE Model for Subgroup (Q = 17.35, df = 3, p = 0.00; I² = 89.3%) 0.08 [−0.89, 1.05]
RE Model for All Studies (Q = 38.27, df = 7, p = 0.00; I² = 84.2%) 100.00% −0.01 [−0.54, 0.51]
−5
0
3
Hedge's G


Standard Error
0
0.125
0.249
0.374
0.499
−2
−1.5
−1
−0.5
0
0.5
1
1.5
Mean Difference


Gray matter Volume − insular cortex
$z_i = \frac{y_i}{\sqrt{v_i + \tau^2}}$
2
0
−2
0.72
0.33
−0.06
−0.46
−0.85
−1.24
−1.64
0.0
0.5
1.0
1.5
$x_i = 1/\sqrt{v_i + \tau^2}$


Influence on Overall Result
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Olulade et al. J Neurosci
Kim et al. He
Allen et al. J Neurosci.5
Allen et al. J Neurosci.1
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Squared Pearson Residual

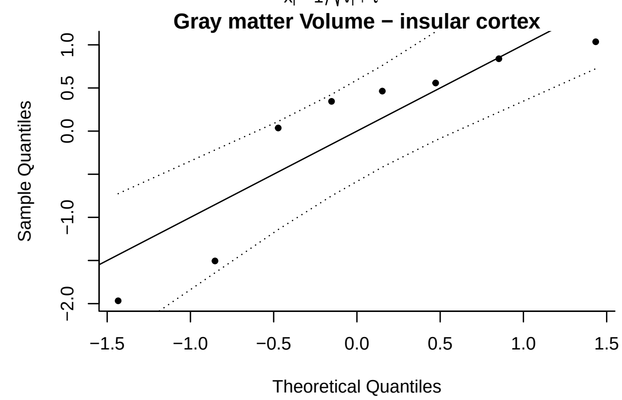
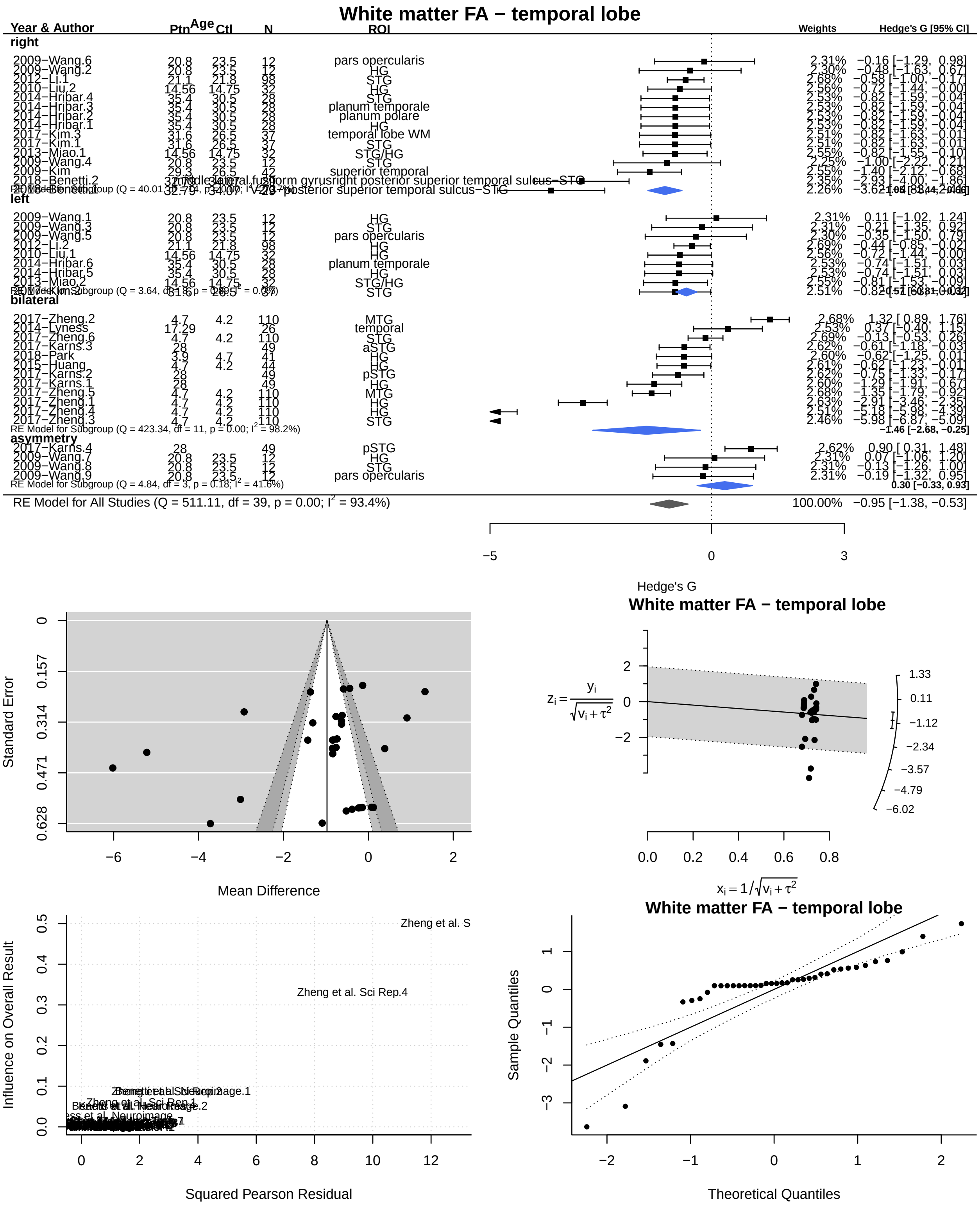
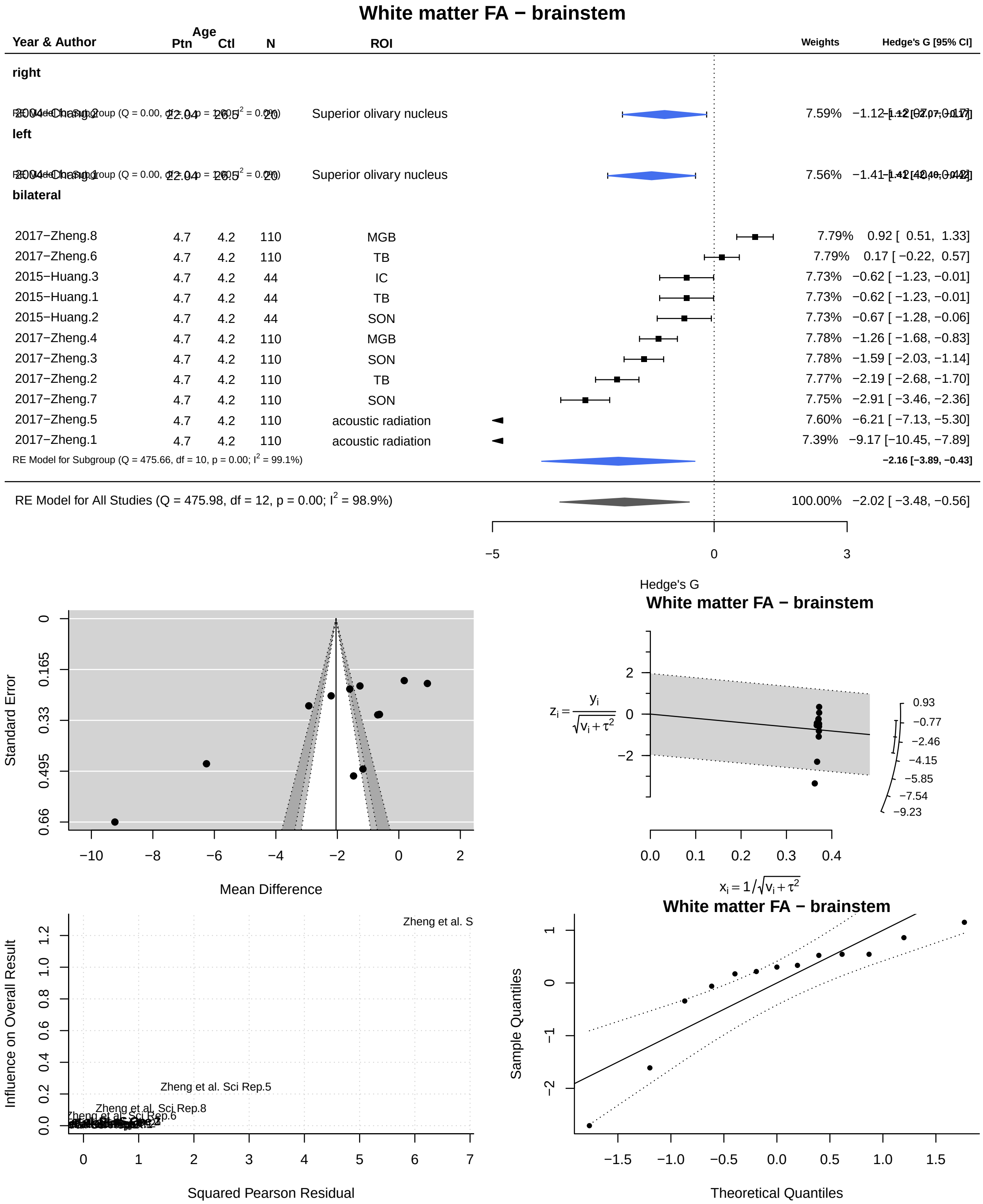
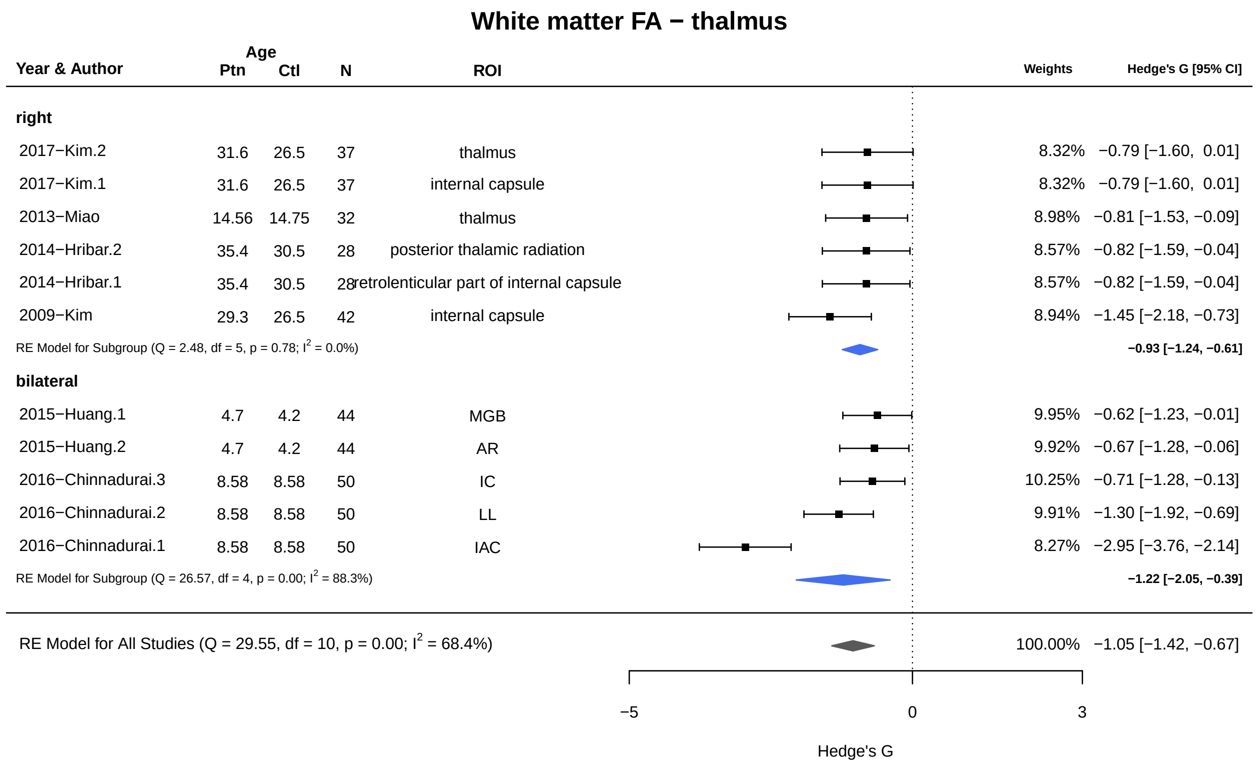

Gray matter Volume − insular cortex
Sample Quantiles
−2.0
−1.0
0.0
0.5
1.0
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles

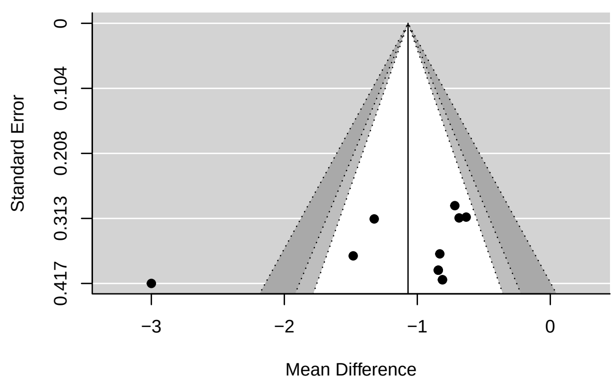
Figure 5 - Meta-regressions of White Matter FA & Brain Areas: Random effects model no intercept covariated by Side

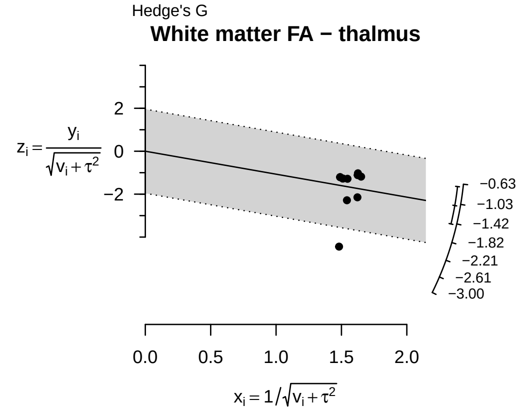


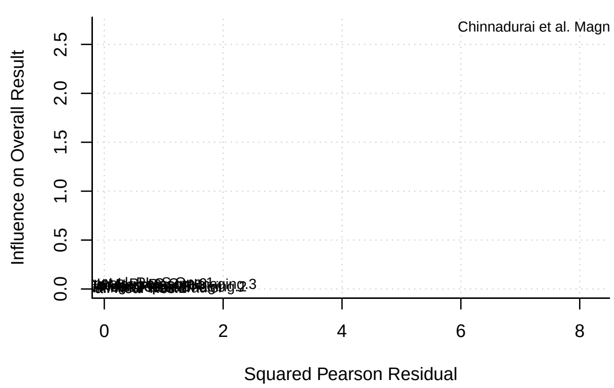


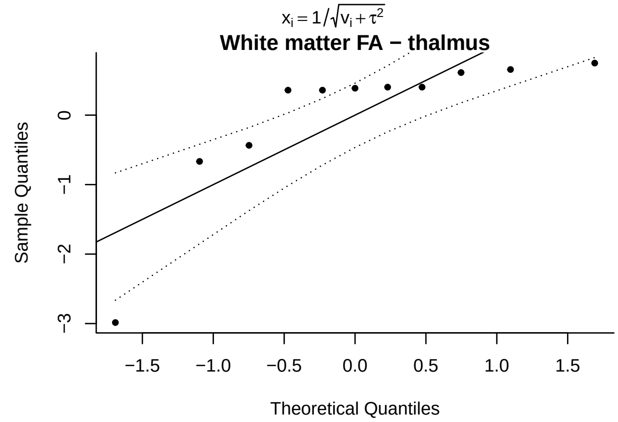
White matter FA − brainstem
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
right
Superior olivary nucleus
7.59%
left
Superior olivary nucleus
7.56%
bilateral
2017−Zheng.8 4.7 4.2 110 MGB 7.79% 0.92 [0.51, 1.33]
2017−Zheng.6 4.7 4.2 110 TB 7.79% 0.17 [−0.22, 0.57]
2015−Huang.3 4.7 4.2 44 IC 7.73% −0.62 [−1.23, −0.01]
2015−Huang.1 4.7 4.2 44 TB 7.73% −0.62 [−1.23, −0.01]
2015−Huang.2 4.7 4.2 44 SON 7.73% −0.67 [−1.28, −0.06]
2017−Zheng.4 4.7 4.2 110 MGB 7.78% −1.26 [−1.68, −0.83]
2017−Zheng.3 4.7 4.2 110 SON 7.78% −1.59 [−2.03, −1.14]
2017−Zheng.2 4.7 4.2 110 TB 7.77% −2.19 [−2.68, −1.70]
2017−Zheng.7 4.7 4.2 110 SON 7.75% −2.91 [−3.46, −2.36]
2017−Zheng.5 4.7 4.2 110 acoustic radiation 7.60% −6.21 [−7.13, −5.30]
2017−Zheng.1 4.7 4.2 110 acoustic radiation 7.39% −9.17 [−10.45, −7.89]
RE Model for Subgroup (Q = 475.66, df = 10, p = 0.00; I² = 99.1%)
−2.16 [−3.89, −0.43]
RE Model for All Studies (Q = 475.98, df = 12, p = 0.00; I² = 98.9%)
100.00% −2.02 [−3.48, −0.56]
−5
0
3
Hedge's G
Standard Error
Mean Difference
White matter FA − brainstem
Influence on Overall Result
Squared Pearson Residual
Zheng et al. Sci Rep.5
Zheng et al. Sci Rep.8
White matter FA − brainstem
Sample Quantiles
Theoretical Quantiles

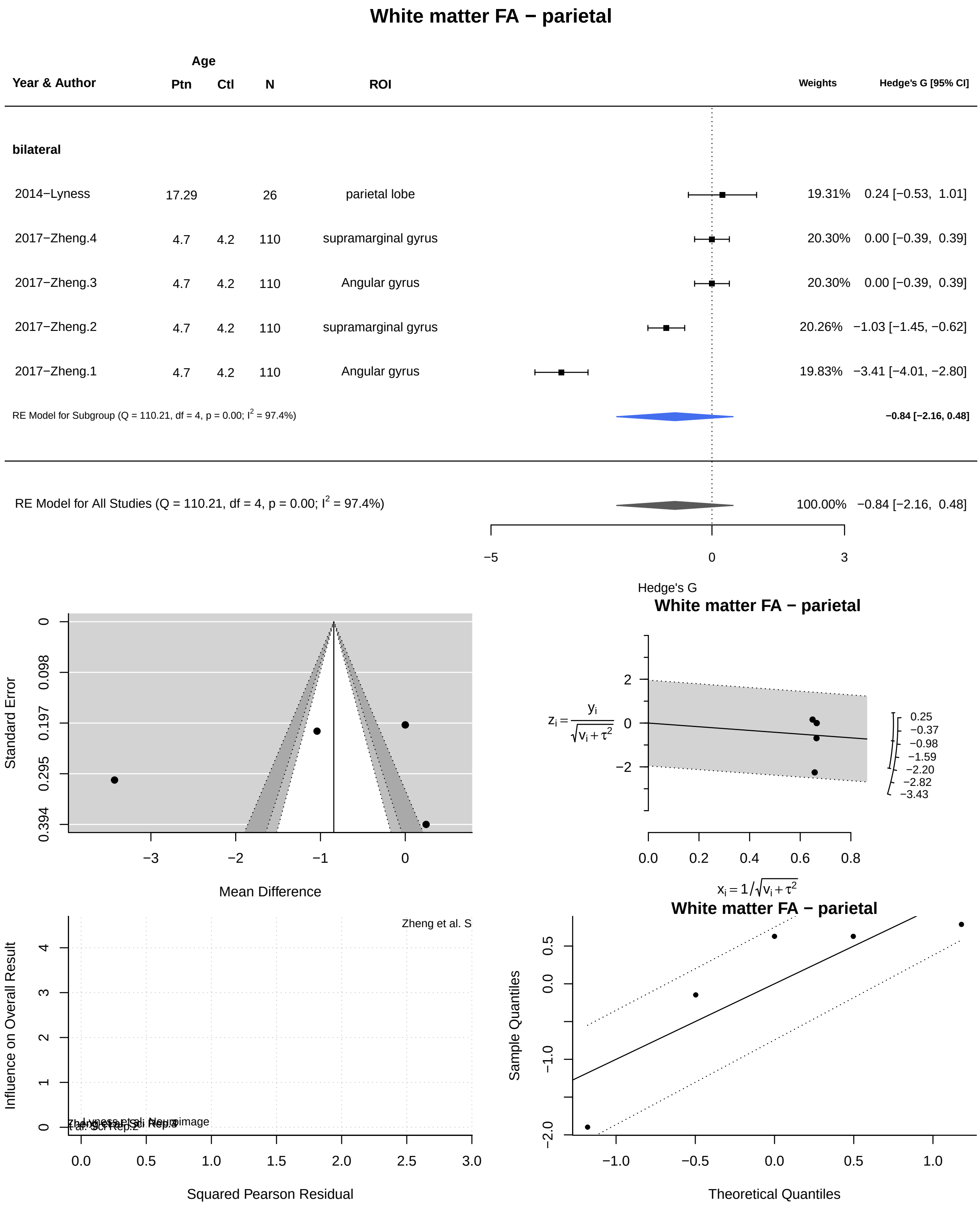

White matter FA − thalmus
Year & Author | Age Ptn | Age Ctl | N | ROI | Weights | Hedge's G [95% CI]
right
2017−Kim.2 31.6 26.5 37 thalmus 8.32% −0.79 [−1.60, 0.01]
2017−Kim.1 31.6 26.5 37 internal capsule 8.32% −0.79 [−1.60, 0.01]
2013−Miao 14.56 14.75 32 thalmus 8.98% −0.81 [−1.53, −0.09]
2014−Hribar.2 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; I^2 = 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 IC 10.25% −0.71 [−1.28, −0.13]
2016−Chinnadurai.2 8.58 8.58 50 LL 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; I^2 = 88.3%) −1.22 [−2.05, −0.39]
RE Model for All Studies (Q = 29.55, df = 10, p = 0.00; I^2 = 68.4%) 100.00% −1.05 [−1.42, −0.67]
−5
0
3
Hedge's G

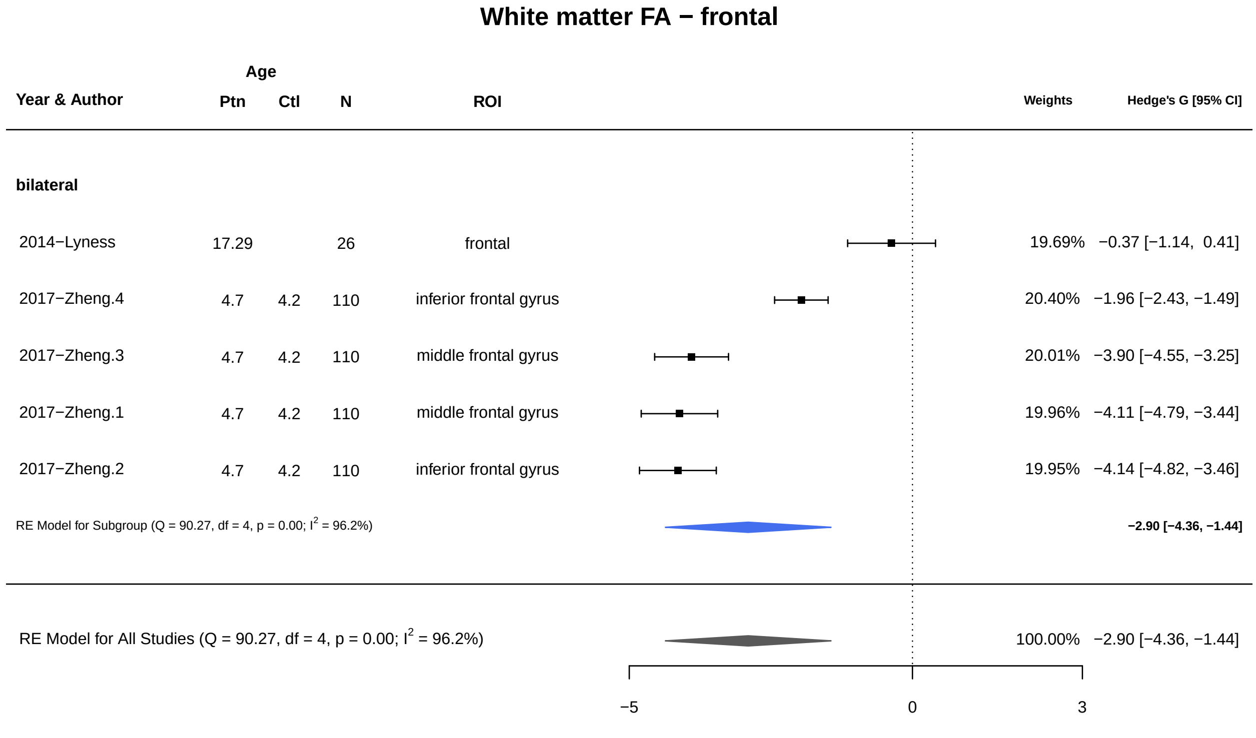

Standard Error
0
0.104
0.208
0.313
0.417
−3
−2
−1
0
Mean Difference

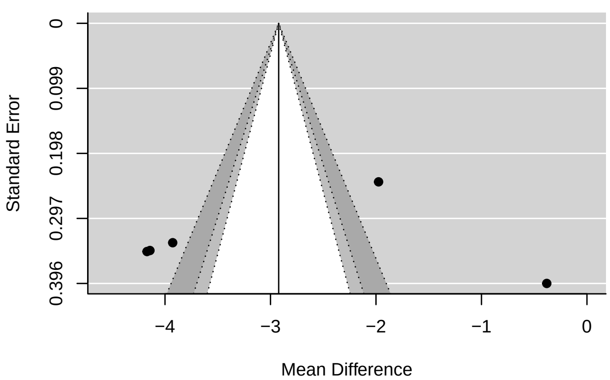

White matter FA − thalmus
$z_i = \frac{y_i}{\sqrt{v_i + \tau^2}}$
2
0
−2
−0.63
−1.03
−1.42
−1.82
−2.21
−2.61
−3.00
0.0
0.5
1.0
1.5
2.0
$x_i = 1/\sqrt{v_i + \tau^2}$

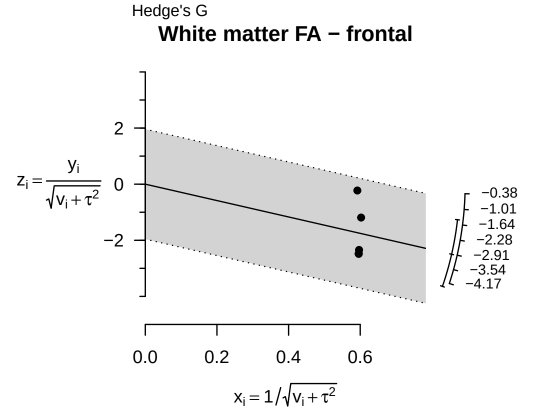

Influence on Overall Result
Chinnadurai et al. Magn
0.0
0.5
1.0
1.5
2.0
2.5
0
2
4
6
8
Squared Pearson Residual

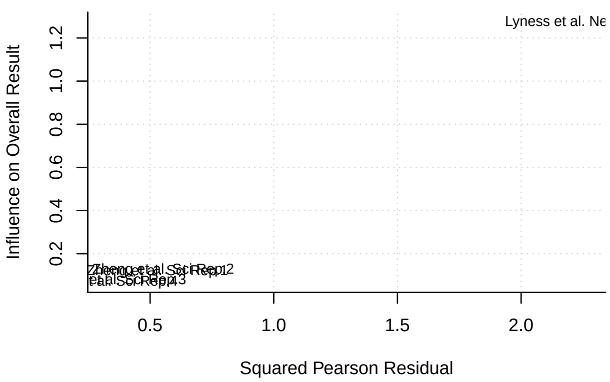

White matter FA − thalmus
Sample Quantiles
0
−1
−2
−3
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles

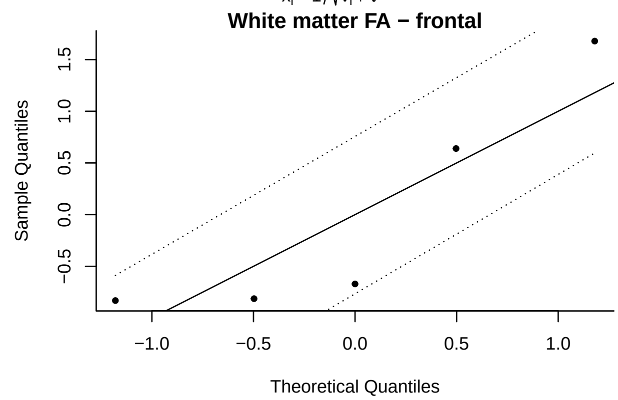

White matter FA − parietal
Age
Year & Author
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
bilateral
2014−Lyness 17.29 26 parietal lobe 19.31% 0.24 [−0.53, 1.01]
2017−Zheng.4 4.7 4.2 110 supramarginal gyrus 20.30% 0.00 [−0.39, 0.39]
2017−Zheng.3 4.7 4.2 110 Angular gyrus 20.30% 0.00 [−0.39, 0.39]
2017−Zheng.2 4.7 4.2 110 supramarginal gyrus 20.26% −1.03 [−1.45, −0.62]
2017−Zheng.1 4.7 4.2 110 Angular gyrus 19.83% −3.41 [−4.01, −2.80]
RE Model for Subgroup (Q = 110.21, df = 4, p = 0.00; I^2 = 97.4%) −0.84 [−2.16, 0.48]
RE Model for All Studies (Q = 110.21, df = 4, p = 0.00; I^2 = 97.4%) 100.00% −0.84 [−2.16, 0.48]
−5
0
3
Hedge's G
Standard Error
Mean Difference
White matter FA − parietal
$z_i = \frac{y_i}{\sqrt{v_i + \tau^2}}$
$x_i = 1/\sqrt{v_i + \tau^2}$
0.25
−0.37
−0.98
−1.59
−2.20
−2.82
−3.43
Influence on Overall Result
Squared Pearson Residual
Zheng et al. S
Lyness et al. Neuroimage
White matter FA − parietal
Sample Quantiles
Theoretical Quantiles

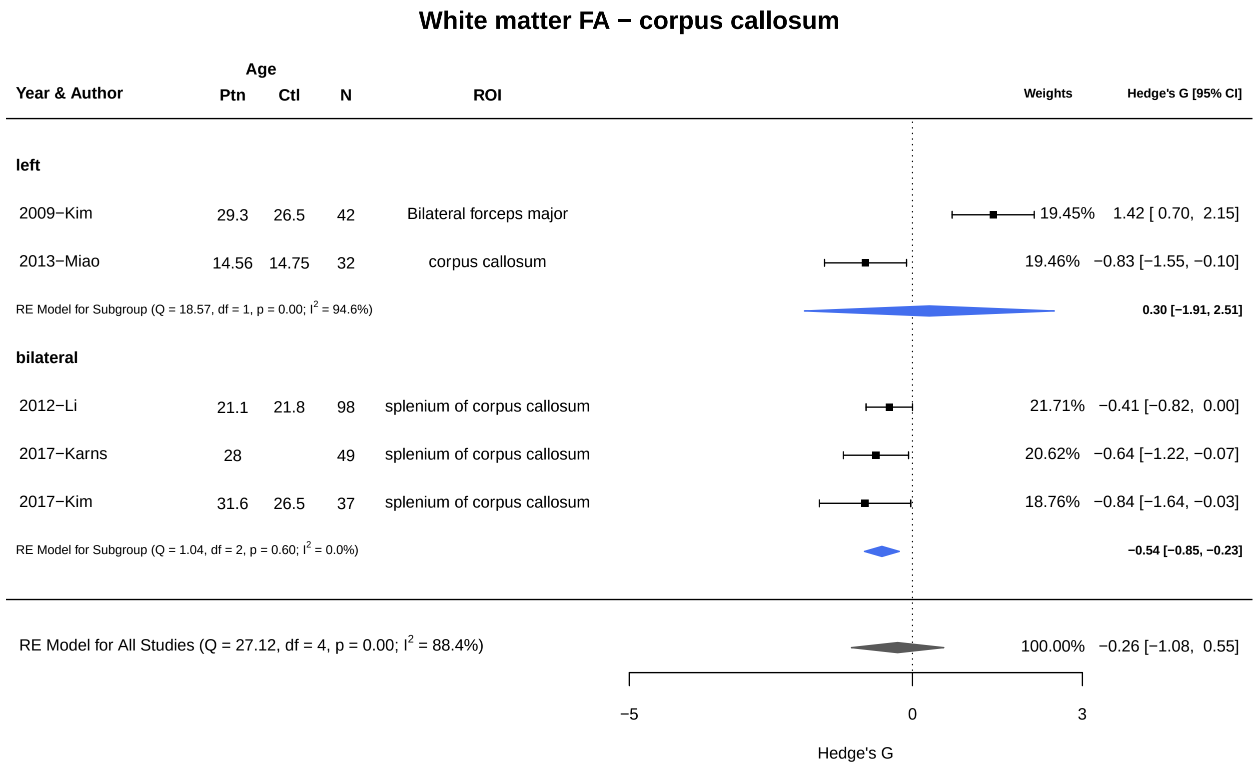

White matter FA − frontal
Age
Year & Author
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
bilateral
2014−Lyness 17.29 26 frontal 19.69% −0.37 [−1.14, 0.41]
2017−Zheng.4 4.7 4.2 110 inferior frontal gyrus 20.40% −1.96 [−2.43, −1.49]
2017−Zheng.3 4.7 4.2 110 middle frontal gyrus 20.01% −3.90 [−4.55, −3.25]
2017−Zheng.1 4.7 4.2 110 middle frontal gyrus 19.96% −4.11 [−4.79, −3.44]
2017−Zheng.2 4.7 4.2 110 inferior frontal gyrus 19.95% −4.14 [−4.82, −3.46]
RE Model for Subgroup (Q = 90.27, df = 4, p = 0.00; I2 = 96.2%) −2.90 [−4.36, −1.44]
RE Model for All Studies (Q = 90.27, df = 4, p = 0.00; I2 = 96.2%) 100.00% −2.90 [−4.36, −1.44]
−5
0
3
Hedge's G

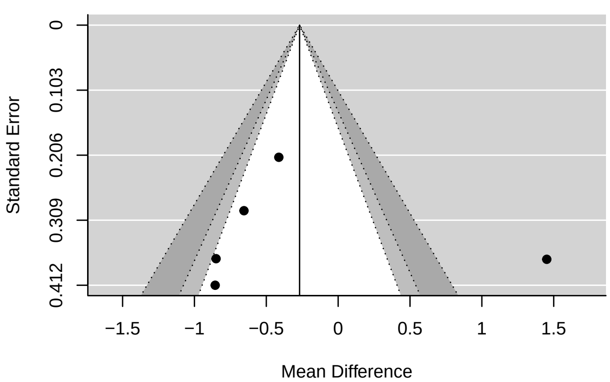

Standard Error
0
0.099
0.198
0.297
0.396
−4
−3
−2
−1
0
Mean Difference

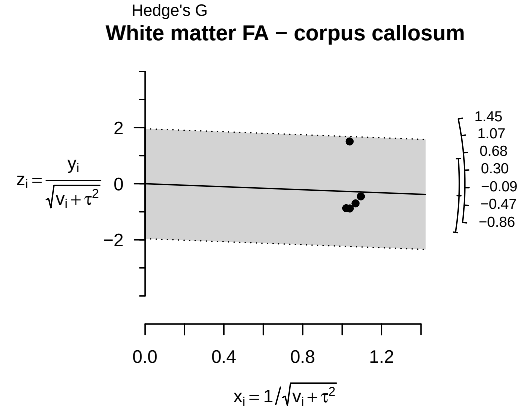

White matter FA − frontal
2
0
−2
−0.38
−1.01
−1.64
−2.28
−2.91
−3.54
−4.17
0.0
0.2
0.4
0.6

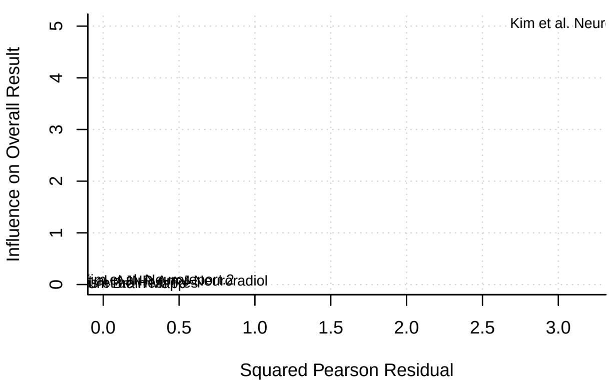

Influence on Overall Result
Lyness et al. Ne
0.2
0.4
0.6
0.8
1.0
1.2
0.5
1.0
1.5
2.0
Squared Pearson Residual


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


White matter FA − corpus callosum
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
left
2009−Kim 29.3 26.5 42 Bilateral forceps major 19.45% 1.42 [0.70, 2.15]
2013−Miao 14.56 14.75 32 corpus callosum 19.46% −0.83 [−1.55, −0.10]
RE Model for Subgroup (Q = 18.57, df = 1, p = 0.00; I² = 94.6%) 0.30 [−1.91, 2.51]
bilateral
2012−Li 21.1 21.8 98 splenium of corpus callosum 21.71% −0.41 [−0.82, 0.00]
2017−Karns 28 49 splenium of corpus callosum 20.62% −0.64 [−1.22, −0.07]
2017−Kim 31.6 26.5 37 splenium of corpus callosum 18.76% −0.84 [−1.64, −0.03]
RE Model for Subgroup (Q = 1.04, df = 2, p = 0.60; I² = 0.0%) −0.54 [−0.85, −0.23]
RE Model for All Studies (Q = 27.12, df = 4, p = 0.00; I² = 88.4%) 100.00% −0.26 [−1.08, 0.55]
−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 − corpus callosum
$z_i = \frac{y_i}{\sqrt{v_i + \tau^2}}$
2
0
−2
1.45
1.07
0.68
0.30
−0.09
−0.47
−0.86
0.0
0.4
0.8
1.2
$x_i = 1/\sqrt{v_i + \tau^2}$


Influence on Overall Result
Kim et al. Neur
0
1
2
3
4
5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Squared Pearson Residual

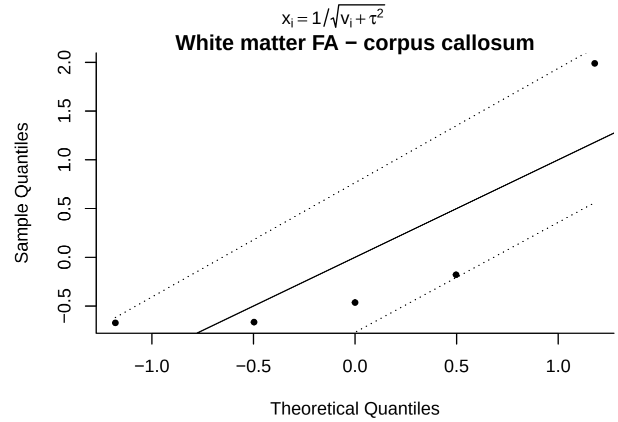
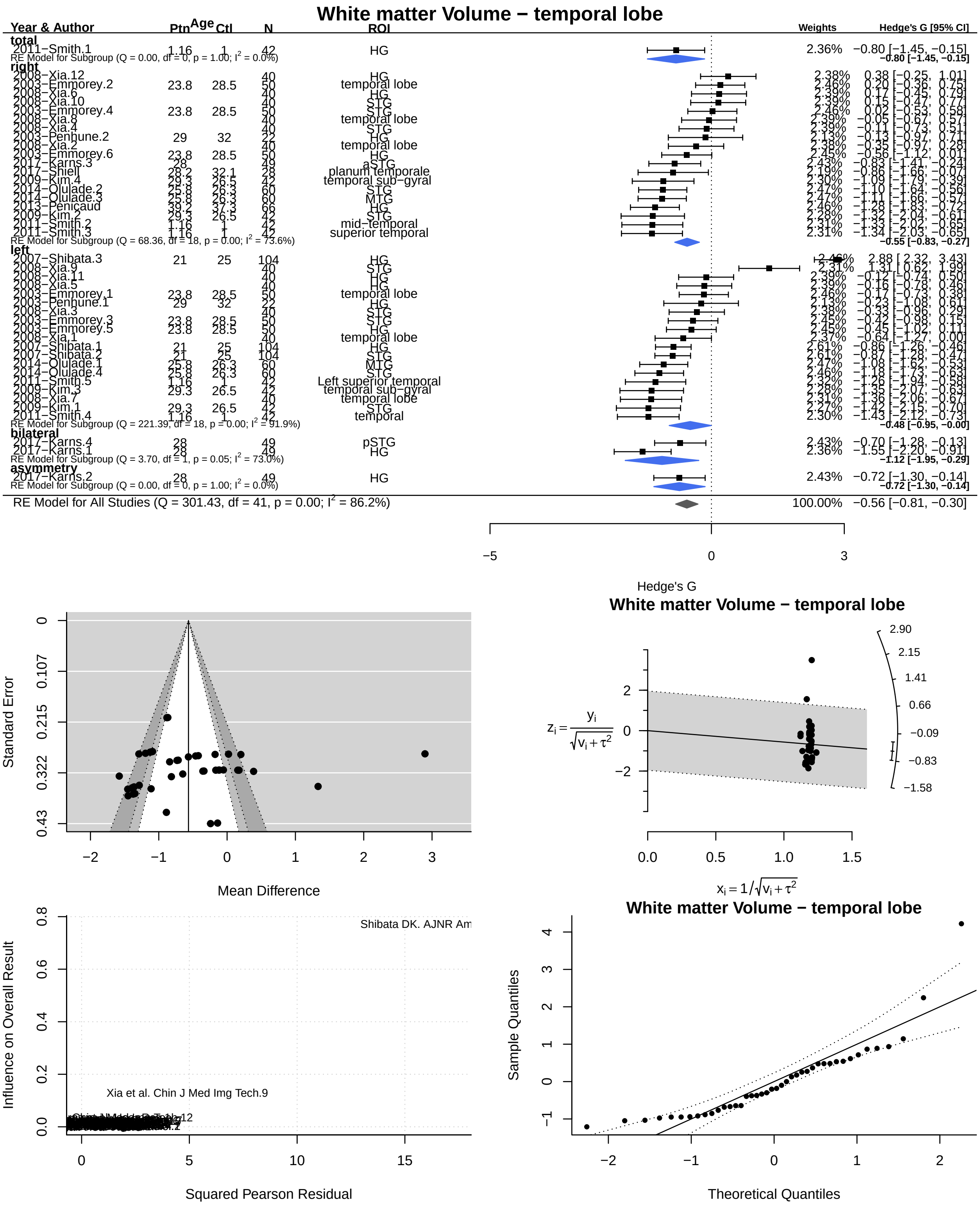
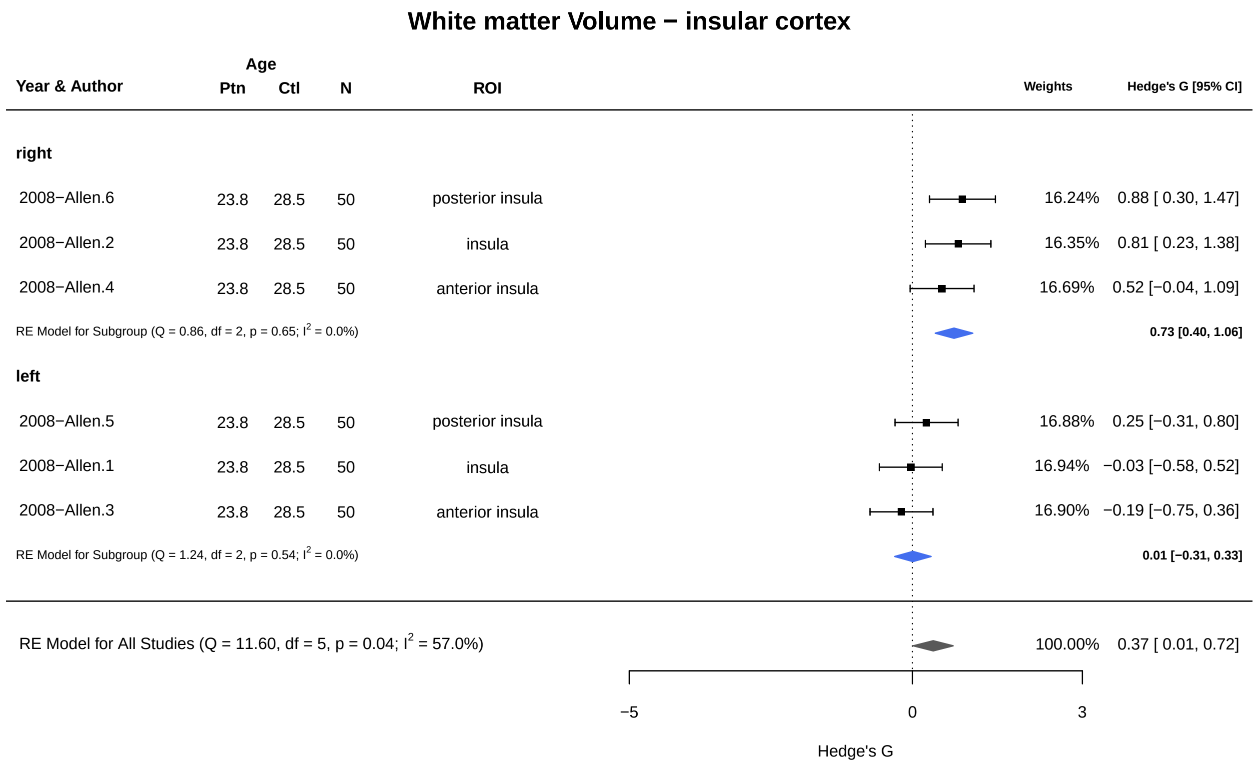
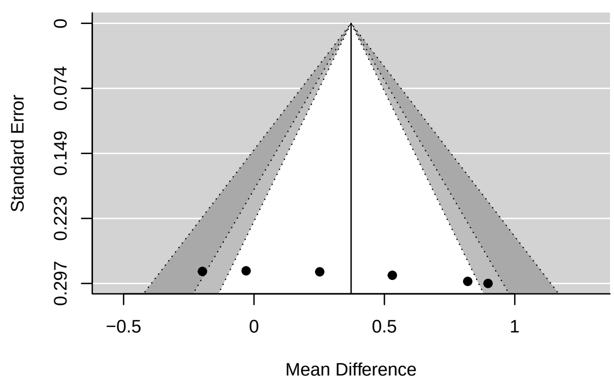
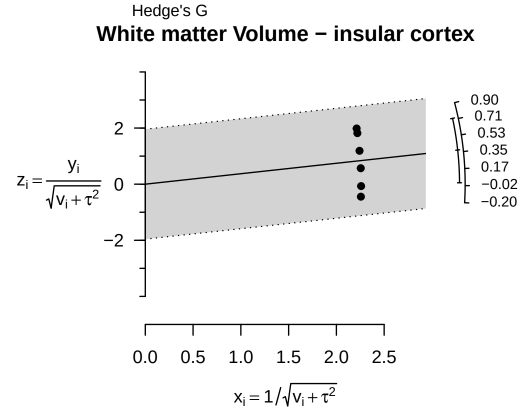

White matter FA − corpus callosum
Sample Quantiles
−0.5
0.0
0.5
1.0
1.5
2.0
−1.0
−0.5
0.0
0.5
1.0
Theoretical Quantiles

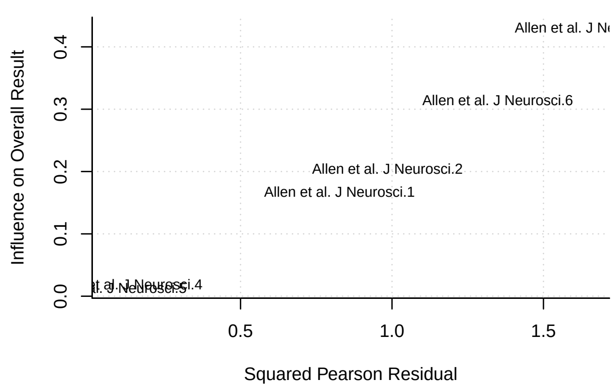
Figure 6 - Meta-regressions of White Matter Volume & Brain Areas: Random effects model no intercept covariated by Side

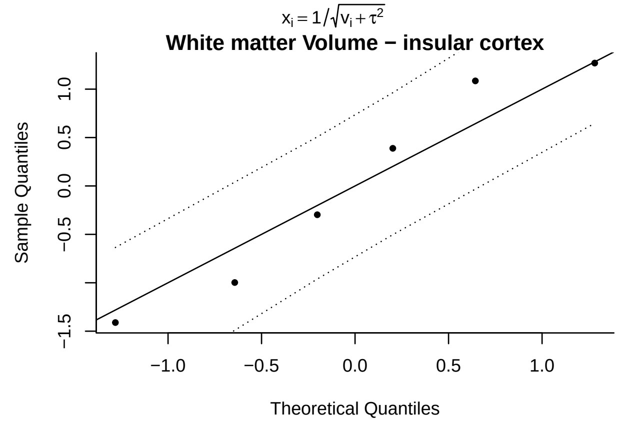


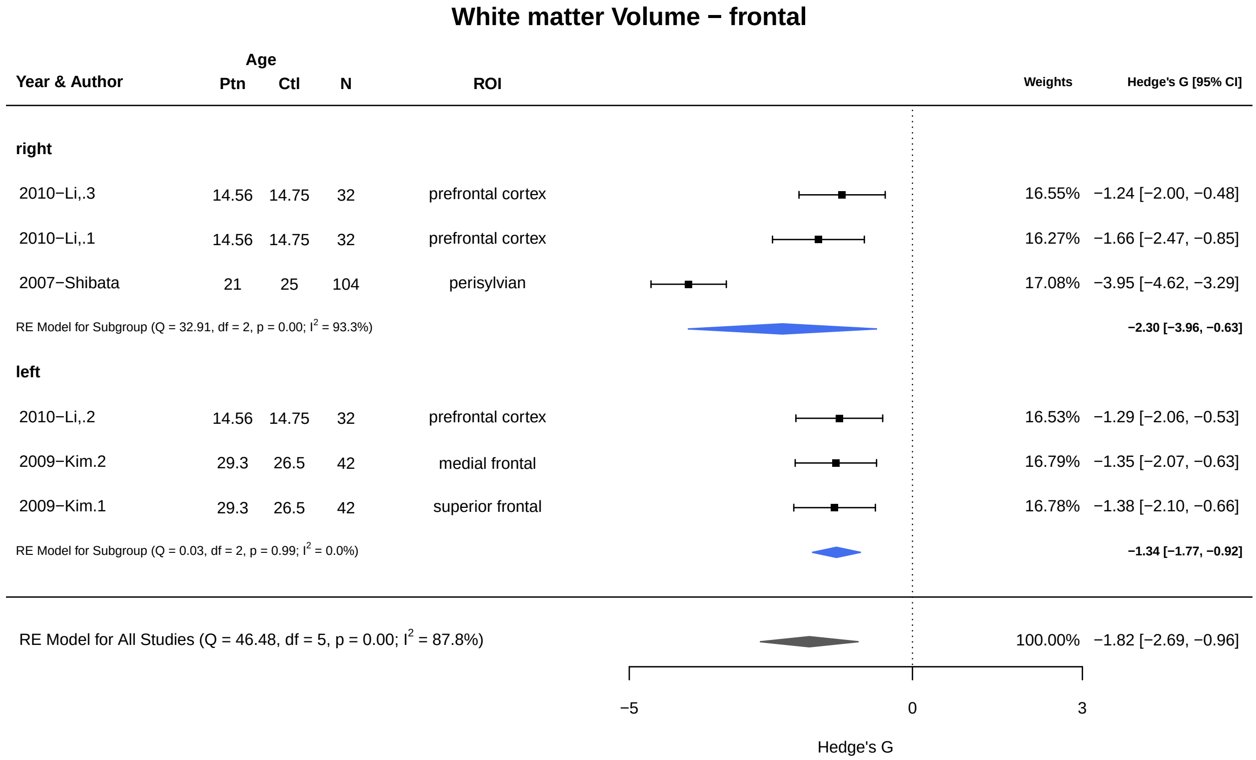

White matter Volume − insular cortex
Year & Author | Age Ptn | Age Ctl | N | ROI | Weights | Hedge's G [95% CI]
right
2008−Allen.6 23.8 28.5 50 posterior insula 16.24% 0.88 [0.30, 1.47]
2008−Allen.2 23.8 28.5 50 insula 16.35% 0.81 [0.23, 1.38]
2008−Allen.4 23.8 28.5 50 anterior insula 16.69% 0.52 [−0.04, 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

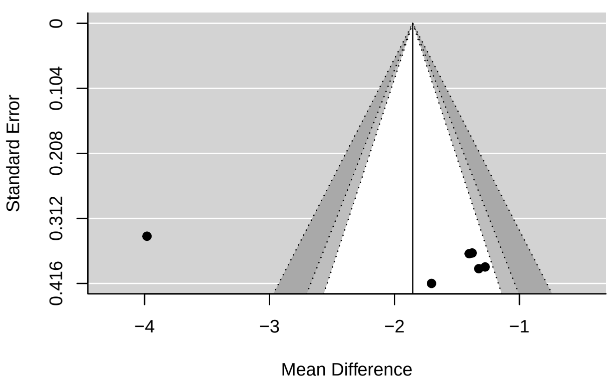

Standard Error
0
0.074
0.149
0.223
0.297
−0.5
0
0.5
1
Mean Difference

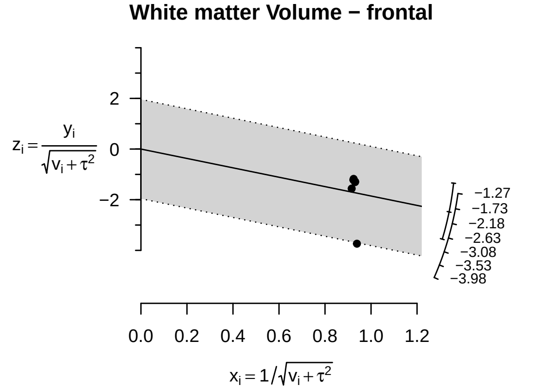

White matter Volume − insular cortex
$z_i = \frac{y_i}{\sqrt{v_i + \tau^2}}$
2
0
−2
0.90
0.71
0.53
0.35
0.17
−0.02
−0.20
0.0 0.5 1.0 1.5 2.0 2.5
$x_i = 1/\sqrt{v_i + \tau^2}$

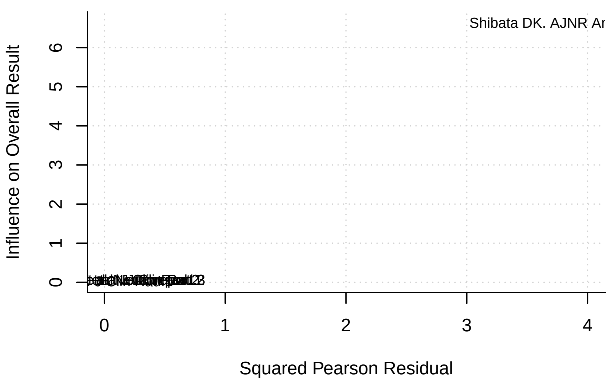

Influence on Overall Result
0.0 0.1 0.2 0.3 0.4
Allen et al. J Neurosci.6
Allen et al. J Neurosci.2
Allen et al. J Neurosci.1
0.5 1.0 1.5
Squared Pearson Residual

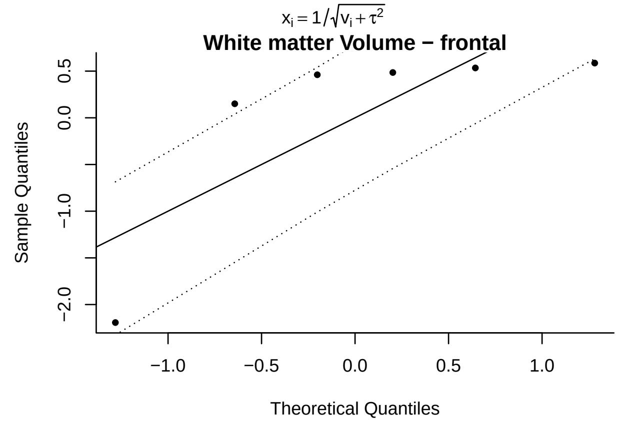

White matter Volume − insular cortex
Sample Quantiles
−1.5 −0.5 0.0 0.5 1.0
−1.0 −0.5 0.0 0.5 1.0
Theoretical Quantiles

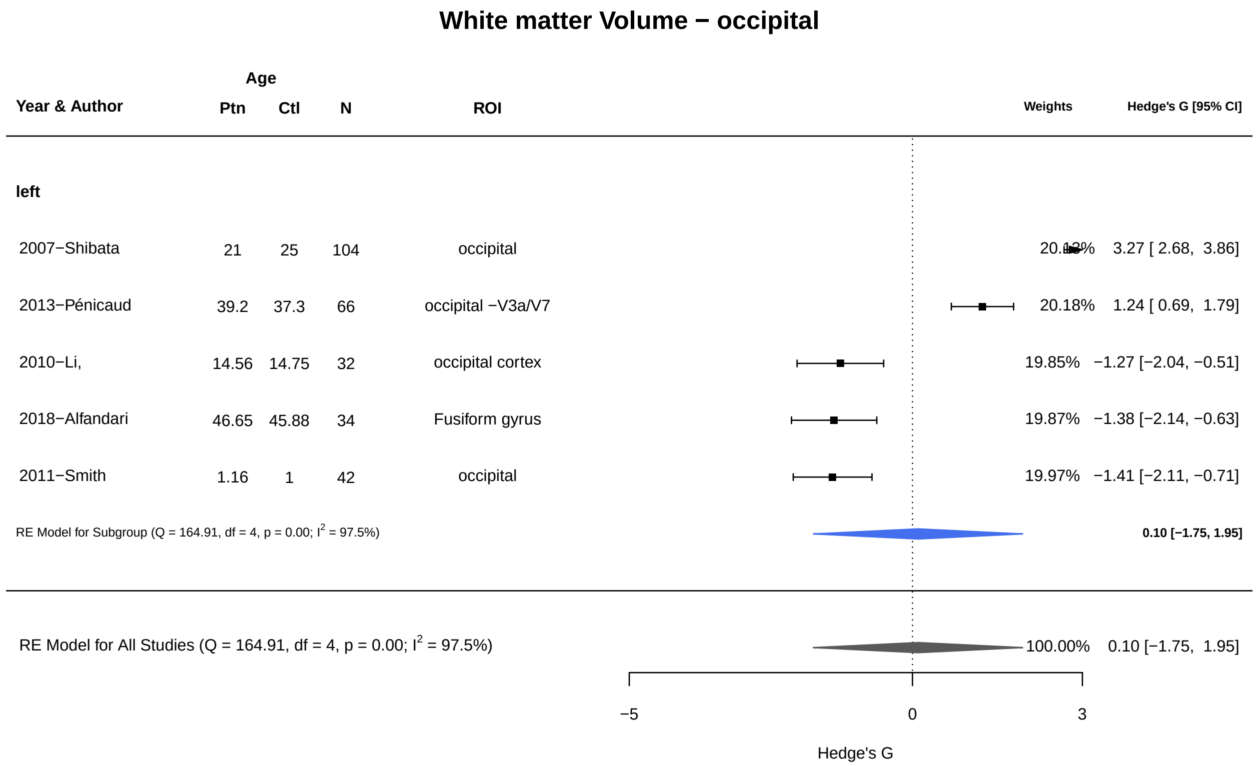

White matter Volume − frontal
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
right
2010−Li,.3 14.56 14.75 32 prefrontal cortex 16.55% −1.24 [−2.00, −0.48]
2010−Li,.1 14.56 14.75 32 prefrontal cortex 16.27% −1.66 [−2.47, −0.85]
2007−Shibata 21 25 104 perisylvian 17.08% −3.95 [−4.62, −3.29]
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 16.53% −1.29 [−2.06, −0.53]
2009−Kim.2 29.3 26.5 42 medial frontal 16.79% −1.35 [−2.07, −0.63]
2009−Kim.1 29.3 26.5 42 superior frontal 16.78% −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]
RE Model for All Studies (Q = 46.48, df = 5, p = 0.00; I2 = 87.8%) 100.00% −1.82 [−2.69, −0.96]
−5
0
3
Hedge's G

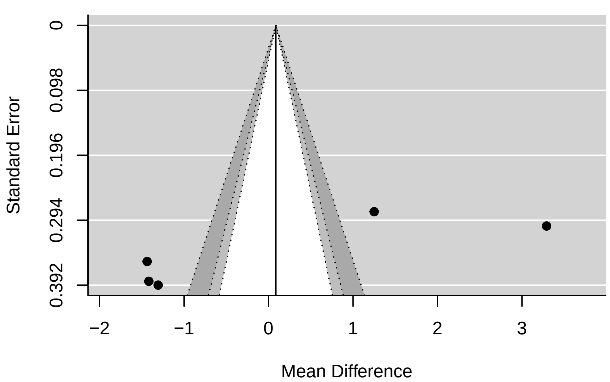

Standard Error
0
0.104
0.208
0.312
0.416
−4
−3
−2
−1
Mean Difference

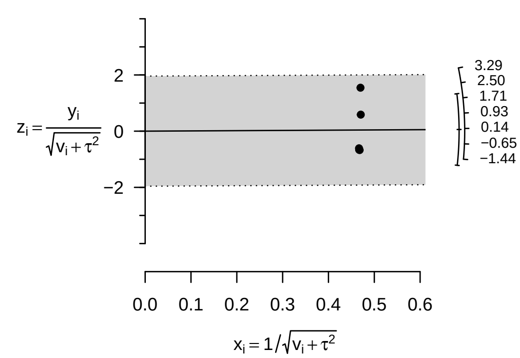

White matter Volume − frontal
2
0
−2
0.0
0.2
0.4
0.6
0.8
1.0
1.2
−1.27
−1.73
−2.18
−2.63
−3.08
−3.53
−3.98

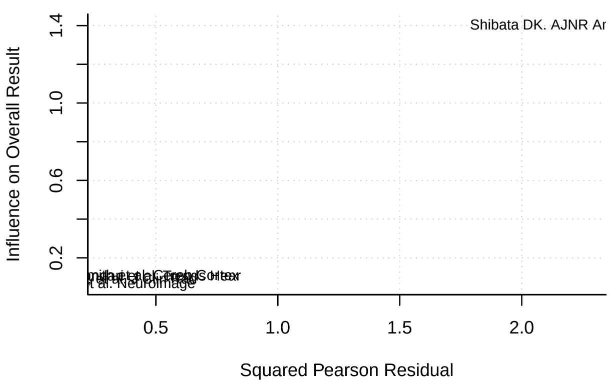

Influence on Overall Result
Shibata DK. AJNR Ar
0
1
2
3
4
5
6
0
1
2
3
4
Squared Pearson Residual

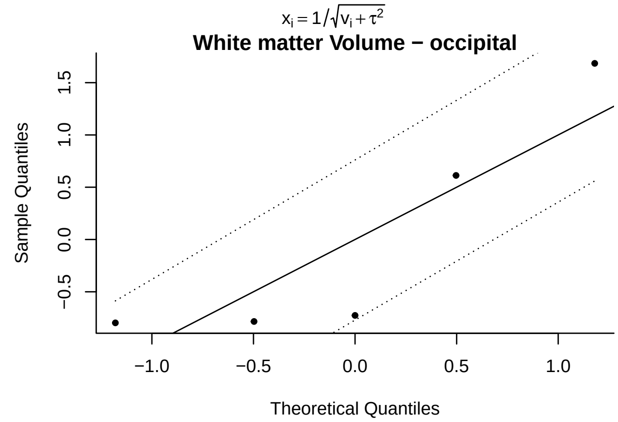

White matter Volume − frontal
Sample Quantiles
0.5
0.0
−1.0
−2.0
−1.0
−0.5
0.0
0.5
1.0
Theoretical Quantiles

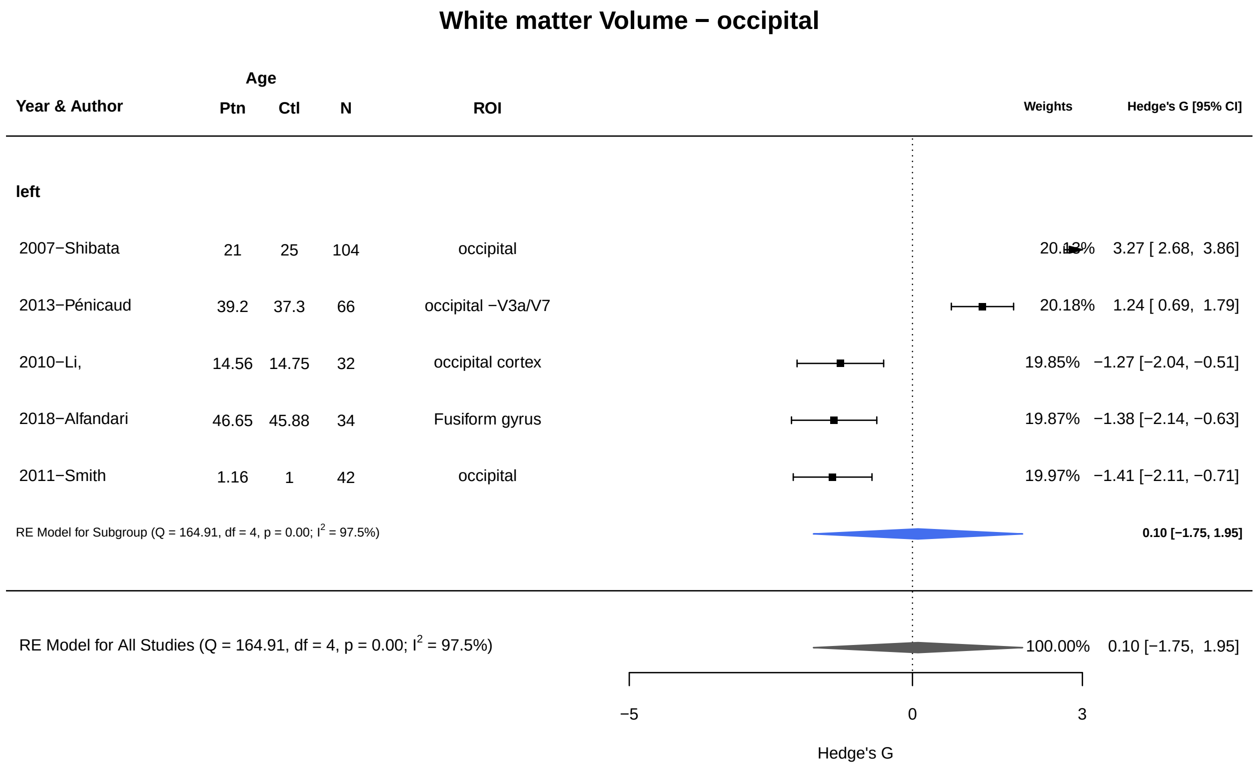

White matter Volume − occipital
Year & Author | Age Ptn | Ctl | N | ROI | Weights | Hedge's G [95% CI]
left
2007−Shibata 21 25 104 occipital 20.13% 3.27 [2.68, 3.86]
2013−Pénicaud 39.2 37.3 66 occipital −V3a/V7 20.18% 1.24 [0.69, 1.79]
2010−Li, 14.56 14.75 32 occipital cortex 19.85% −1.27 [−2.04, −0.51]
2018−Alfandari 46.65 45.88 34 Fusiform gyrus 19.87% −1.38 [−2.14, −0.63]
2011−Smith 1.16 1 42 occipital 19.97% −1.41 [−2.11, −0.71]
RE Model for Subgroup (Q = 164.91, df = 4, p = 0.00; I2 = 97.5%) 0.10 [−1.75, 1.95]
RE Model for All Studies (Q = 164.91, df = 4, p = 0.00; I2 = 97.5%) 100.00% 0.10 [−1.75, 1.95]
−5
0
3
Hedge's G

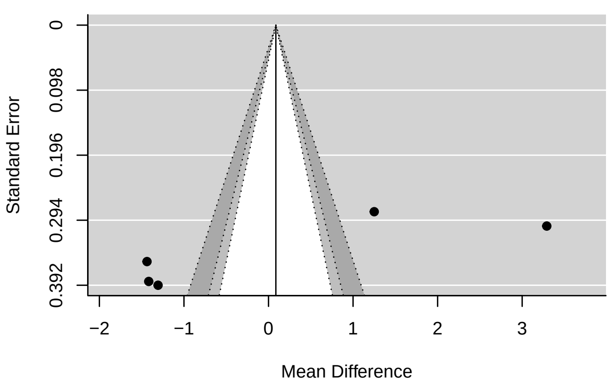

Standard Error
0
0.098
0.196
0.294
0.392
−2
−1
0
1
2
3
Mean Difference

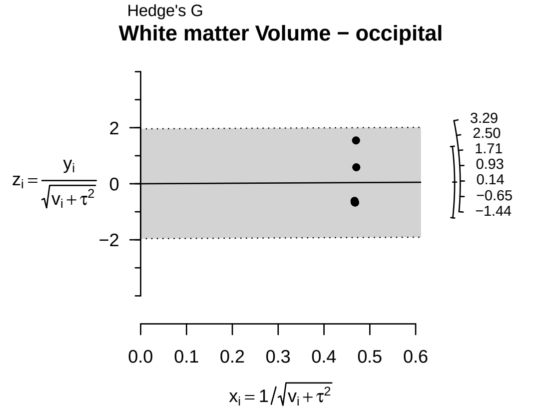

White matter Volume − occipital
2
0
−2
3.29
2.50
1.71
0.93
0.14
−0.65
−1.44
0.0
0.1
0.2
0.3
0.4
0.5
0.6

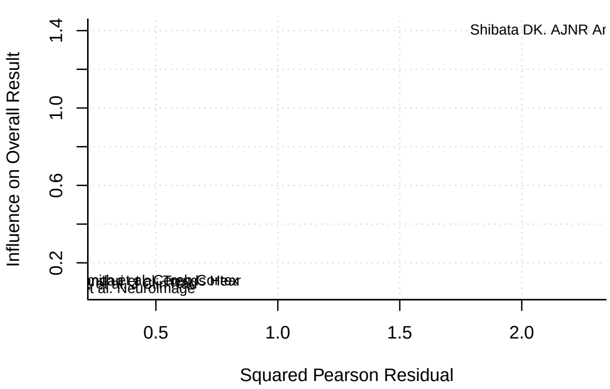

Influence on Overall Result
0.2
0.6
1.0
1.4
Shibata DK. AJNR Ar
0.5
1.0
1.5
2.0
Squared Pearson Residual

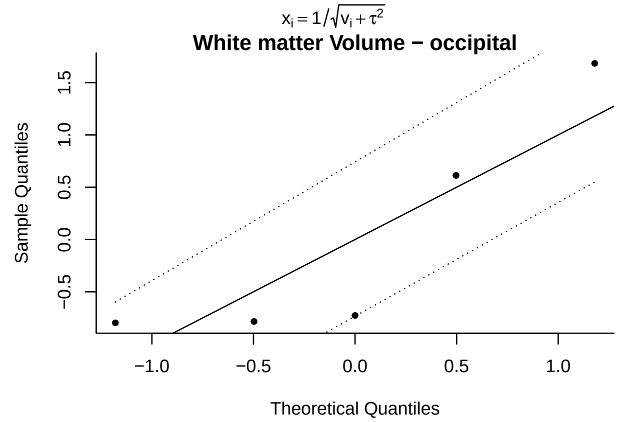

White matter Volume − occipital
Sample Quantiles
−0.5
0.0
0.5
1.0
1.5
−1.0
−0.5
0.0
0.5
1.0
Theoretical Quantiles

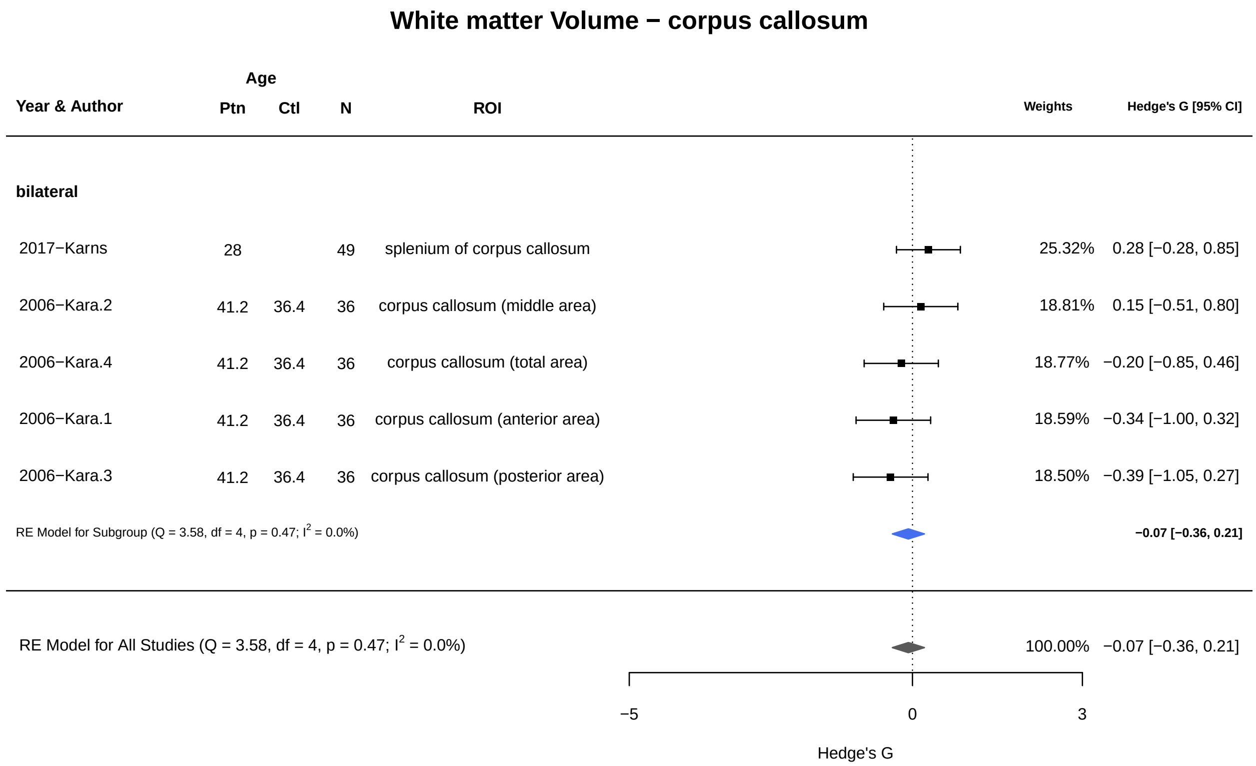

White matter Volume − occipital
Age
Year & Author
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
left
2007−Shibata 21 25 104 occipital 20.13% 3.27 [2.68, 3.86]
2013−Pénicaud 39.2 37.3 66 occipital −V3a/V7 20.18% 1.24 [0.69, 1.79]
2010−Li, 14.56 14.75 32 occipital cortex 19.85% −1.27 [−2.04, −0.51]
2018−Alfandari 46.65 45.88 34 Fusiform gyrus 19.87% −1.38 [−2.14, −0.63]
2011−Smith 1.16 1 42 occipital 19.97% −1.41 [−2.11, −0.71]
RE Model for Subgroup (Q = 164.91, df = 4, p = 0.00; I2 = 97.5%) 0.10 [−1.75, 1.95]
RE Model for All Studies (Q = 164.91, df = 4, p = 0.00; I2 = 97.5%) 100.00% 0.10 [−1.75, 1.95]
−5
0
3
Hedge's G

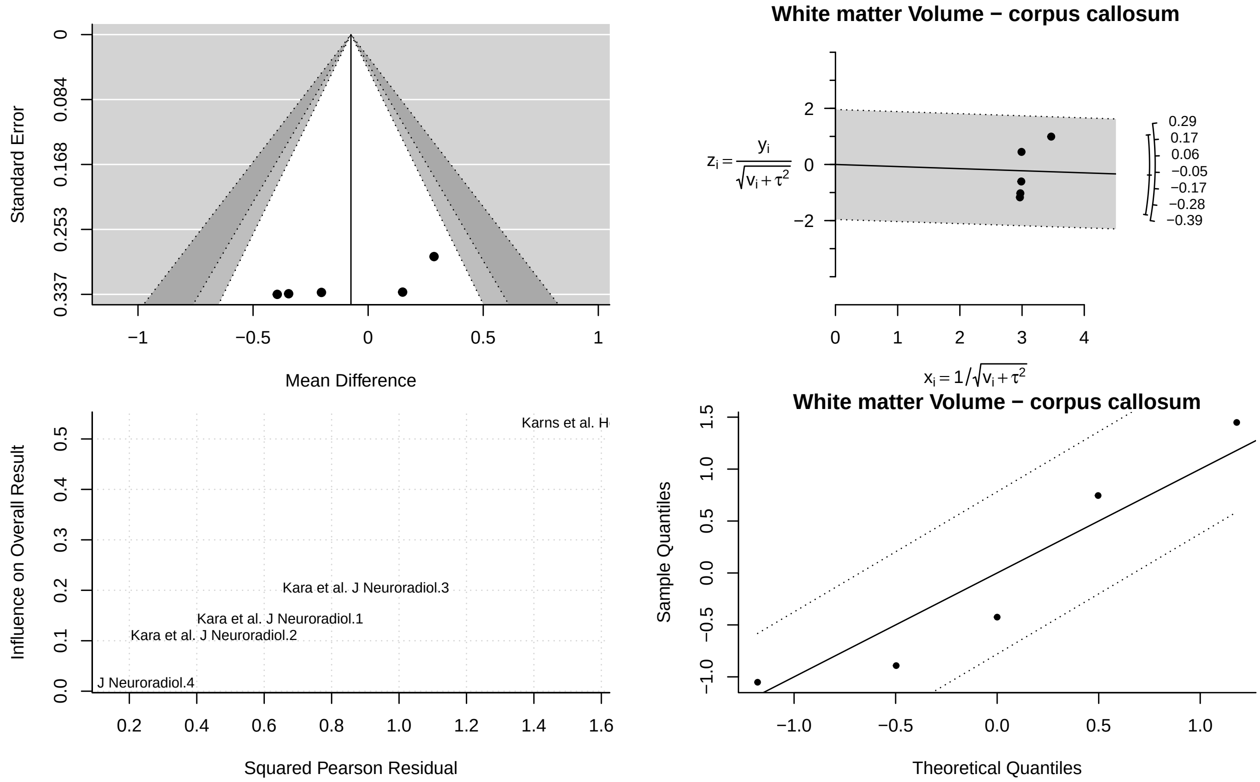

Standard Error
0
0.098
0.196
0.294
0.392
−2
−1
0
1
2
3
Mean Difference


White matter Volume − occipital
2
0
−2
zi = yi / √(vi + τ2)
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
xi = 1/√(vi + τ2)


Influence on Overall Result
1.4
1.0
0.6
0.2
Shibata DK. AJNR Ar
0.5
1.0
1.5
2.0
Squared Pearson Residual

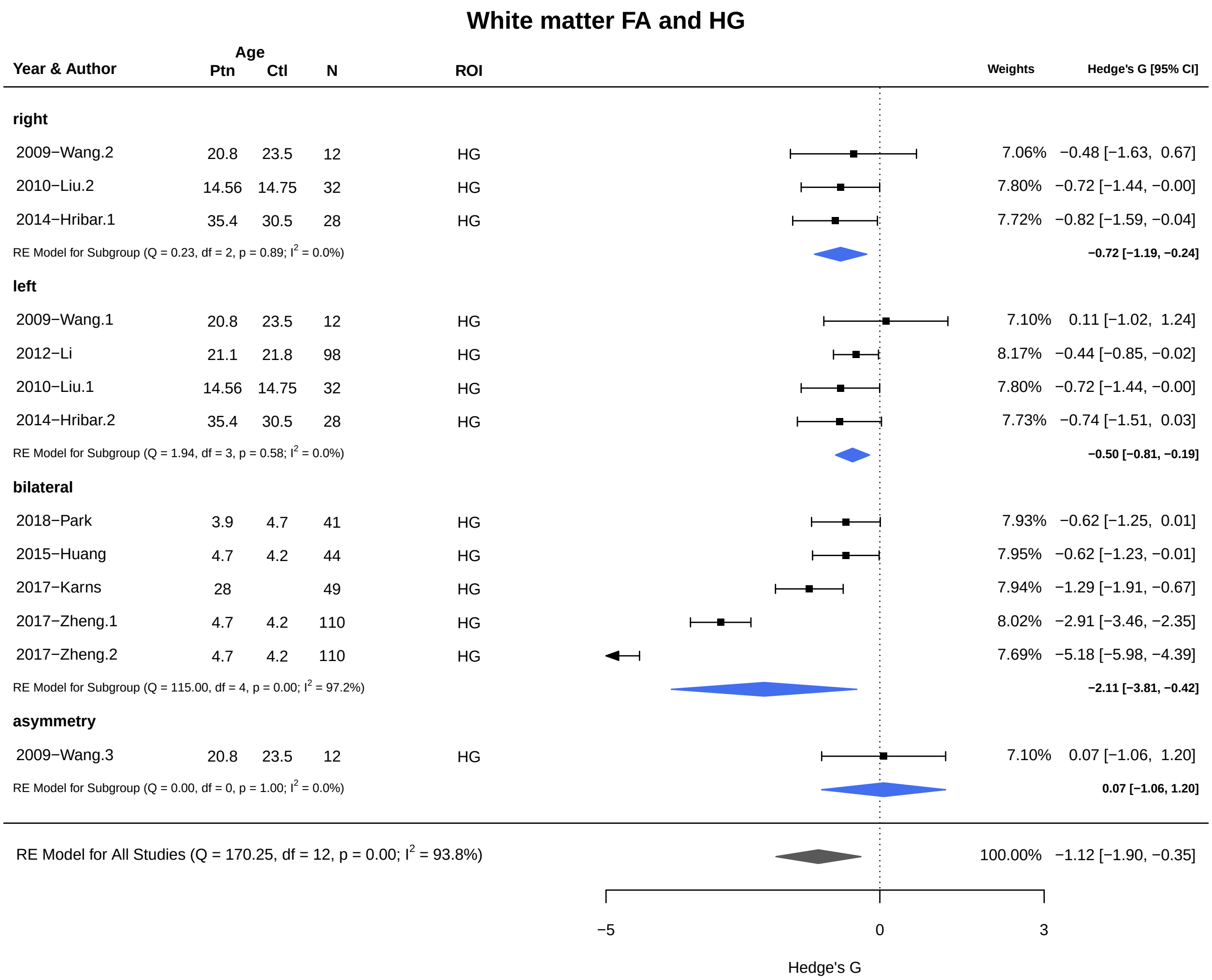

White matter Volume − occipital
Sample Quantiles
1.5
1.0
0.5
0.0
−0.5
−1.0
−0.5
0.0
0.5
1.0
Theoretical Quantiles


White matter Volume − corpus callosum
Year & Author
Age
Ptn
Ctl
N
ROI
Weights
Hedge's G [95% CI]
bilateral
2017−Karns 28 49 splenium of corpus callosum 25.32% 0.28 [−0.28, 0.85]
2006−Kara.2 41.2 36.4 36 corpus callosum (middle area) 18.81% 0.15 [−0.51, 0.80]
2006−Kara.4 41.2 36.4 36 corpus callosum (total area) 18.77% −0.20 [−0.85, 0.46]
2006−Kara.1 41.2 36.4 36 corpus callosum (anterior area) 18.59% −0.34 [−1.00, 0.32]
2006−Kara.3 41.2 36.4 36 corpus callosum (posterior area) 18.50% −0.39 [−1.05, 0.27]
RE Model for Subgroup (Q = 3.58, df = 4, p = 0.47; I2 = 0.0%) −0.07 [−0.36, 0.21]
RE Model for All Studies (Q = 3.58, df = 4, p = 0.47; I2 = 0.0%) 100.00% −0.07 [−0.36, 0.21]
−5
0
3
Hedge's G

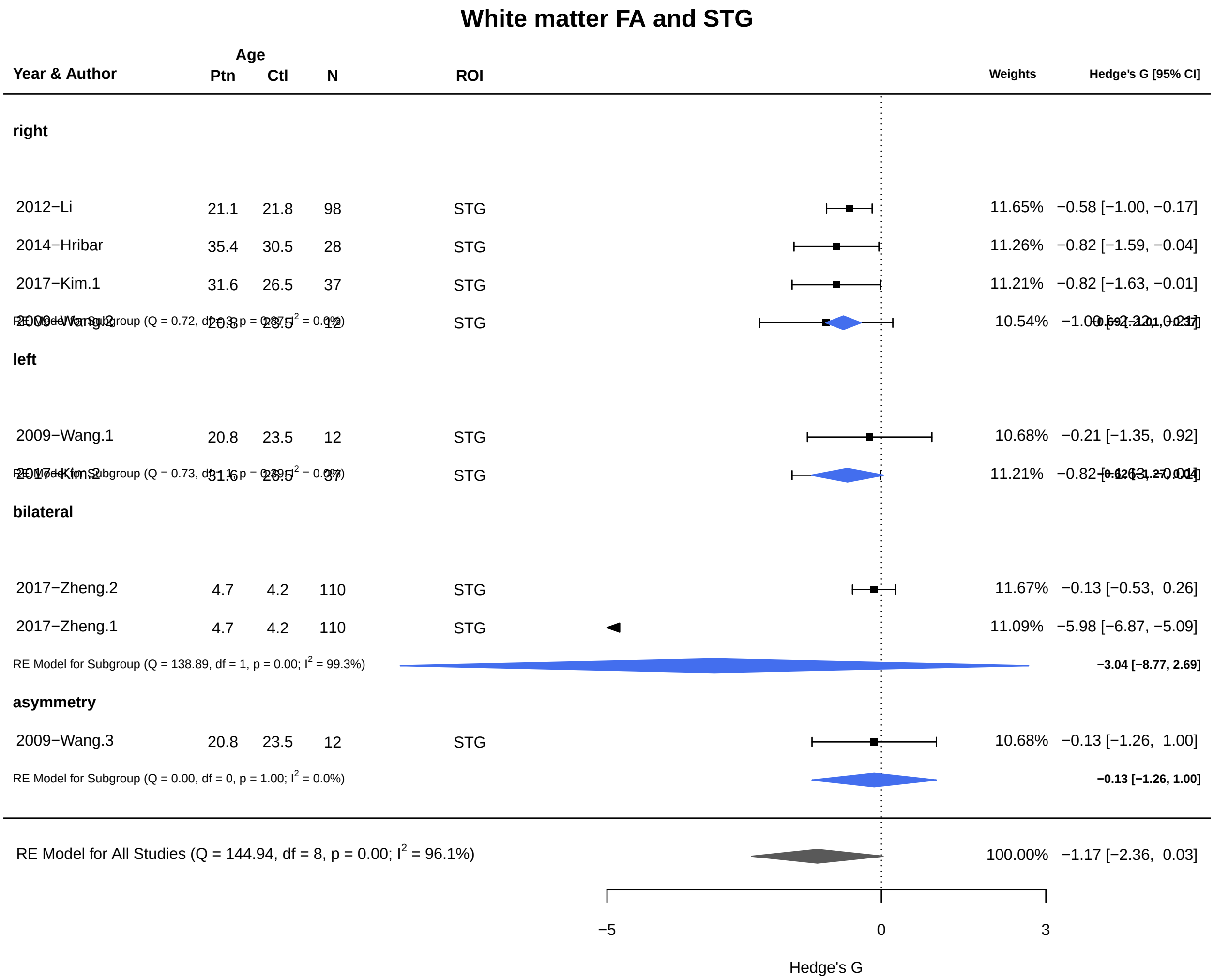

Standard Error
0
0.084
0.168
0.253
0.337
−1
−0.5
0
0.5
1
Mean Difference
White matter Volume − corpus callosum
$z_i = \frac{y_i}{\sqrt{v_i + \tau^2}}$
2
0
−2
0
1
2
3
4
$x_i = 1/\sqrt{v_i + \tau^2}$
0.29
0.17
0.06
−0.05
−0.17
−0.28
−0.39
Influence on Overall Result
0.0
0.1
0.2
0.3
0.4
0.5
Karns et al. H
Kara et al. J Neuroradiol.3
Kara et al. J Neuroradiol.1
Kara et al. J Neuroradiol.2
J Neuroradiol.4
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
Squared Pearson Residual
White matter Volume − corpus callosum
Sample Quantiles
−1.0
−0.5
0.0
0.5
1.0
1.5
−1.0
−0.5
0.0
0.5
1.0
Theoretical Quantiles

Supplementary material: Forest-plots of other Measures

Hesch gyrus FA white matter

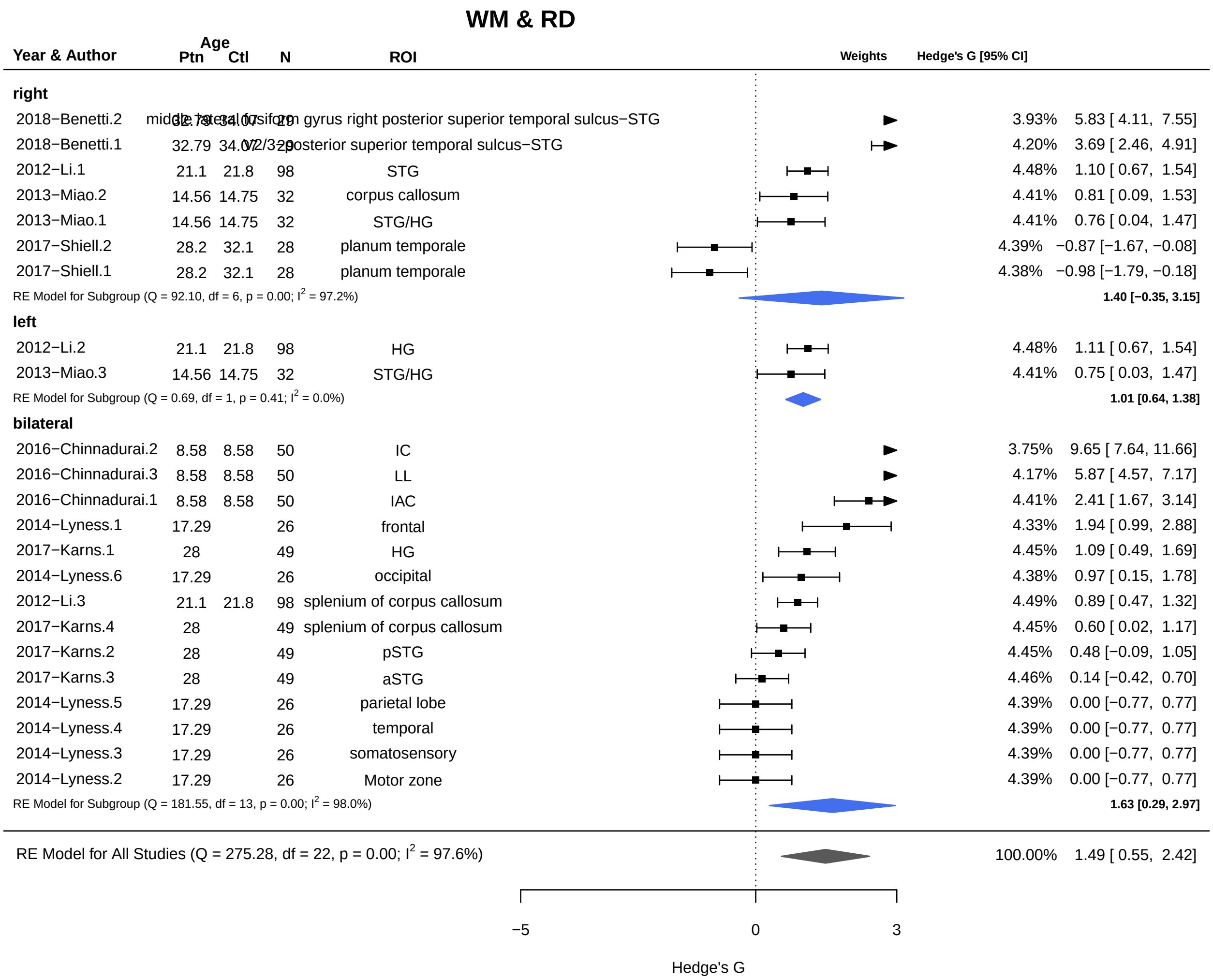


STG Volume White matter

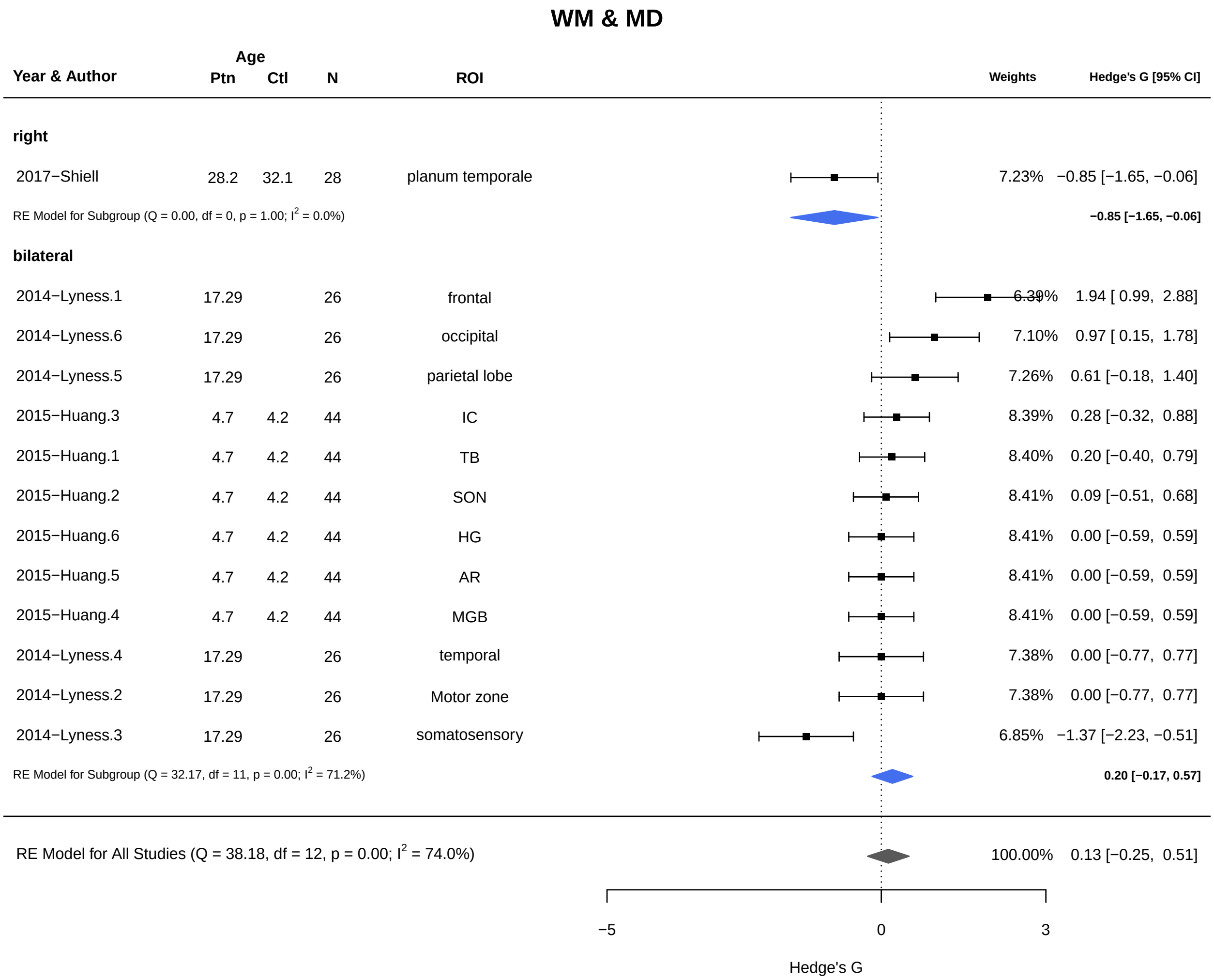


Measures of White matter Integrity

White matter: RD



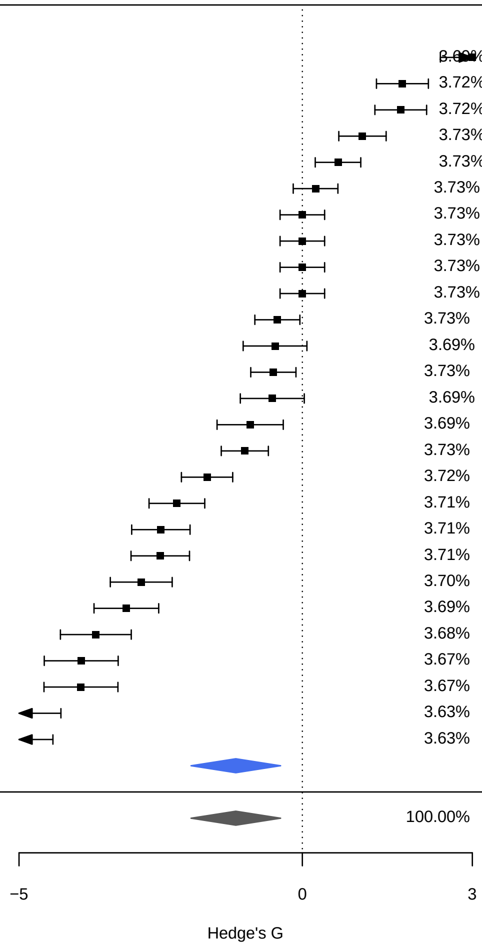
White matter: MD



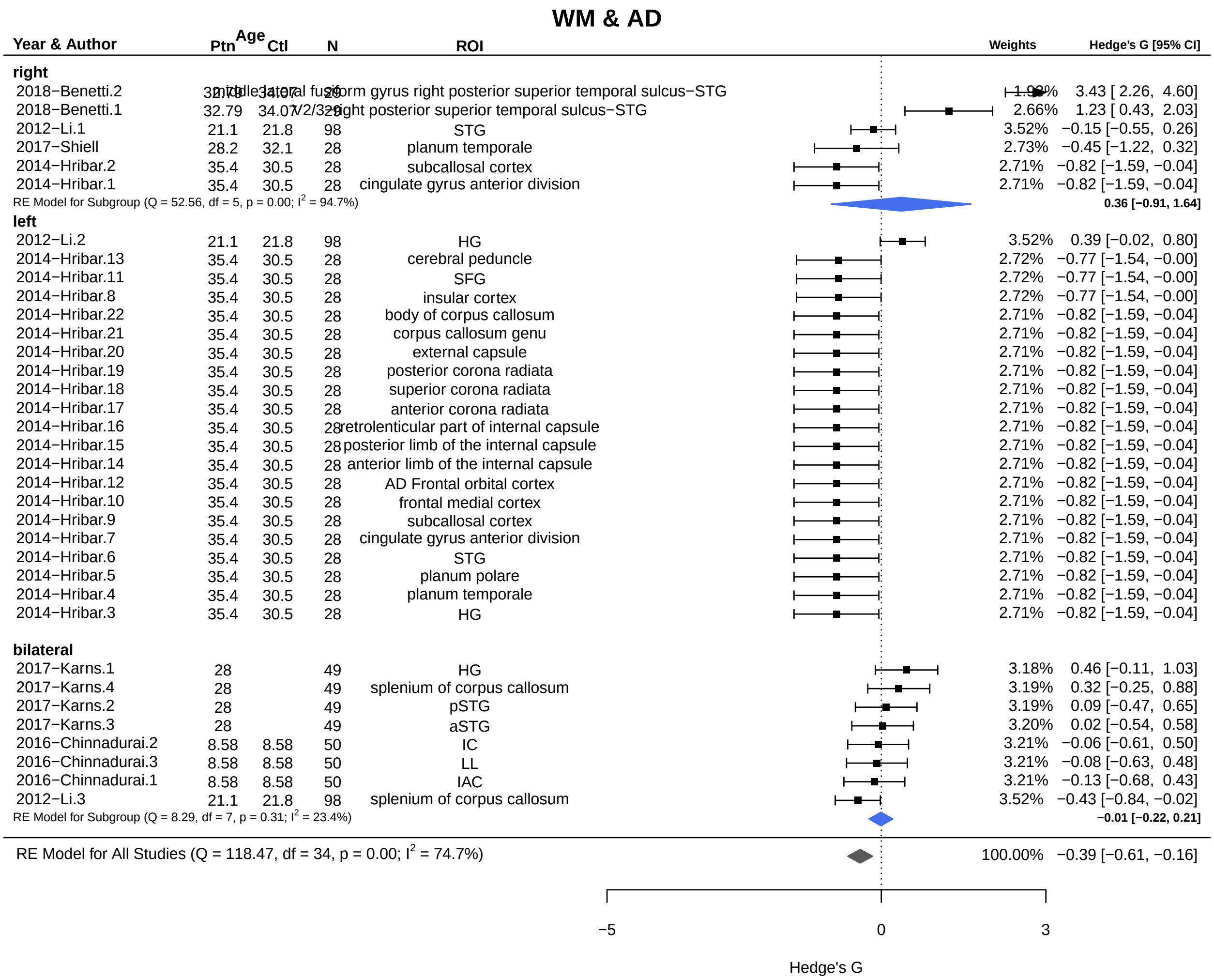
White matter: Mean Kurtosis

WM & Mean Kurtosis

Year & Author	Age Ptn	Age Ctl	N	ROI	Weights	Hedge's G [95% CI]
bilateral						
2017−Zheng.9	4.7	4.2	110	STG	[illegible]	3.00 [2.44, 3.56]
2017−Zheng.17	4.7	4.2	110	HG	3.72%	1.77 [1.31, 2.22]
2017−Zheng.19	4.7	4.2	110	inferior frontal gyrus	3.72%	1.74 [1.28, 2.19]
2017−Zheng.18	4.7	4.2	110	middle frontal gyrus	3.73%	1.06 [0.64, 1.48]
2017−Zheng.13	4.7	4.2	110	acoustic radiation	3.73%	0.63 [0.23, 1.03]
2017−Zheng.15	4.7	4.2	110	SON	3.73%	0.23 [−0.16, 0.63]
2017−Zheng.24	4.7	4.2	110	Hippocampus	3.73%	0.00 [−0.39, 0.39]
2017−Zheng.23	4.7	4.2	110	supramarginal gyrus	3.73%	0.00 [−0.39, 0.39]
2017−Zheng.22	4.7	4.2	110	Angular gyrus	3.73%	0.00 [−0.39, 0.39]
2017−Zheng.21	4.7	4.2	110	STG	3.73%	0.00 [−0.39, 0.39]
2017−Zheng.1	4.7	4.2	110	acoustic radiation	3.73%	−0.44 [−0.84, −0.04]
2016−Chinnadurai.1	8.58	8.58	50	IAC	3.69%	−0.48 [−1.04, 0.08]
2017−Zheng.16	4.7	4.2	110	MGB	3.73%	−0.51 [−0.91, −0.11]
2016−Chinnadurai.2	8.58	8.58	50	IC	3.69%	−0.53 [−1.09, 0.03]
2016−Chinnadurai.3	8.58	8.58	50	LL	3.69%	−0.92 [−1.51, −0.34]
2017−Zheng.20	4.7	4.2	110	MTG	3.73%	−1.02 [−1.43, −0.60]
2017−Zheng.12	4.7	4.2	110	Hippocampus	3.72%	−1.68 [−2.13, −1.23]
2017−Zheng.14	4.7	4.2	110	TB	3.71%	−2.21 [−2.71, −1.72]
2017−Zheng.7	4.7	4.2	110	inferior frontal gyrus	3.71%	−2.50 [−3.01, −1.98]
2017−Zheng.4	4.7	4.2	110	MGB	3.71%	−2.51 [−3.02, −1.99]
2017−Zheng.8	4.7	4.2	110	MTG	3.70%	−2.84 [−3.39, −2.30]
2017−Zheng.5	4.7	4.2	110	HG	3.69%	−3.11 [−3.68, −2.53]
2017−Zheng.11	4.7	4.2	110	supramarginal gyrus	3.68%	−3.64 [−4.27, −3.02]
2017−Zheng.3	4.7	4.2	110	SON	3.67%	−3.90 [−4.55, −3.25]
2017−Zheng.6	4.7	4.2	110	middle frontal gyrus	3.67%	−3.91 [−4.56, −3.25]
2017−Zheng.2	4.7	4.2	110	TB	3.63%	−5.04 [−5.82, −4.26]
2017−Zheng.10	4.7	4.2	110	Angular gyrus	3.63%	−5.20 [−6.00, −4.40]
RE Model for Subgroup (Q = 1362.61, df = 26, p = 0.00; I^2 = 98.6%)						**−1.17 [−1.97, −0.38]**
RE Model for All Studies (Q = 1362.61, df = 26, p = 0.00; I^2 = 98.6%)					100.00%	−1.17 [−1.97, −0.38]



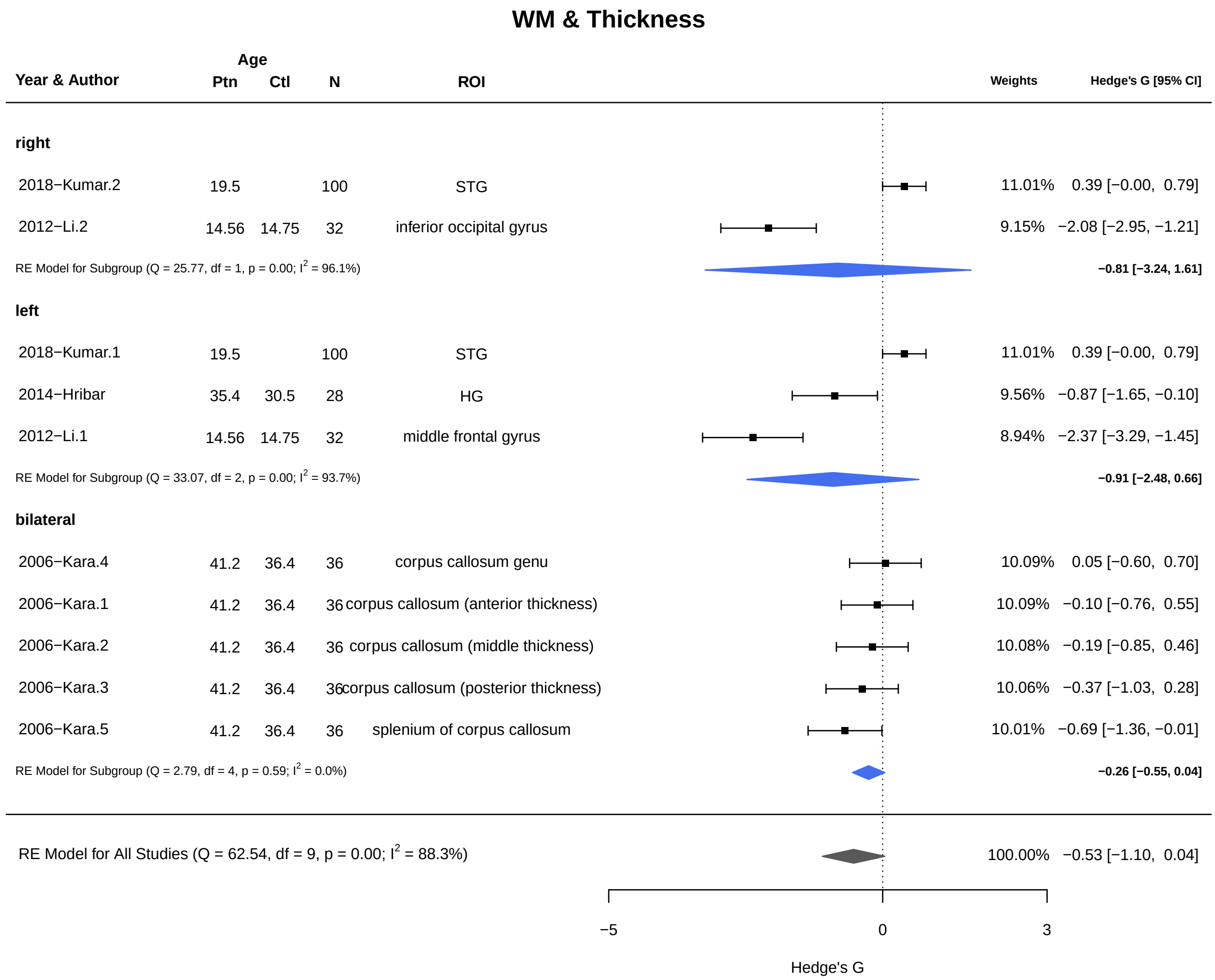
White matter: AD



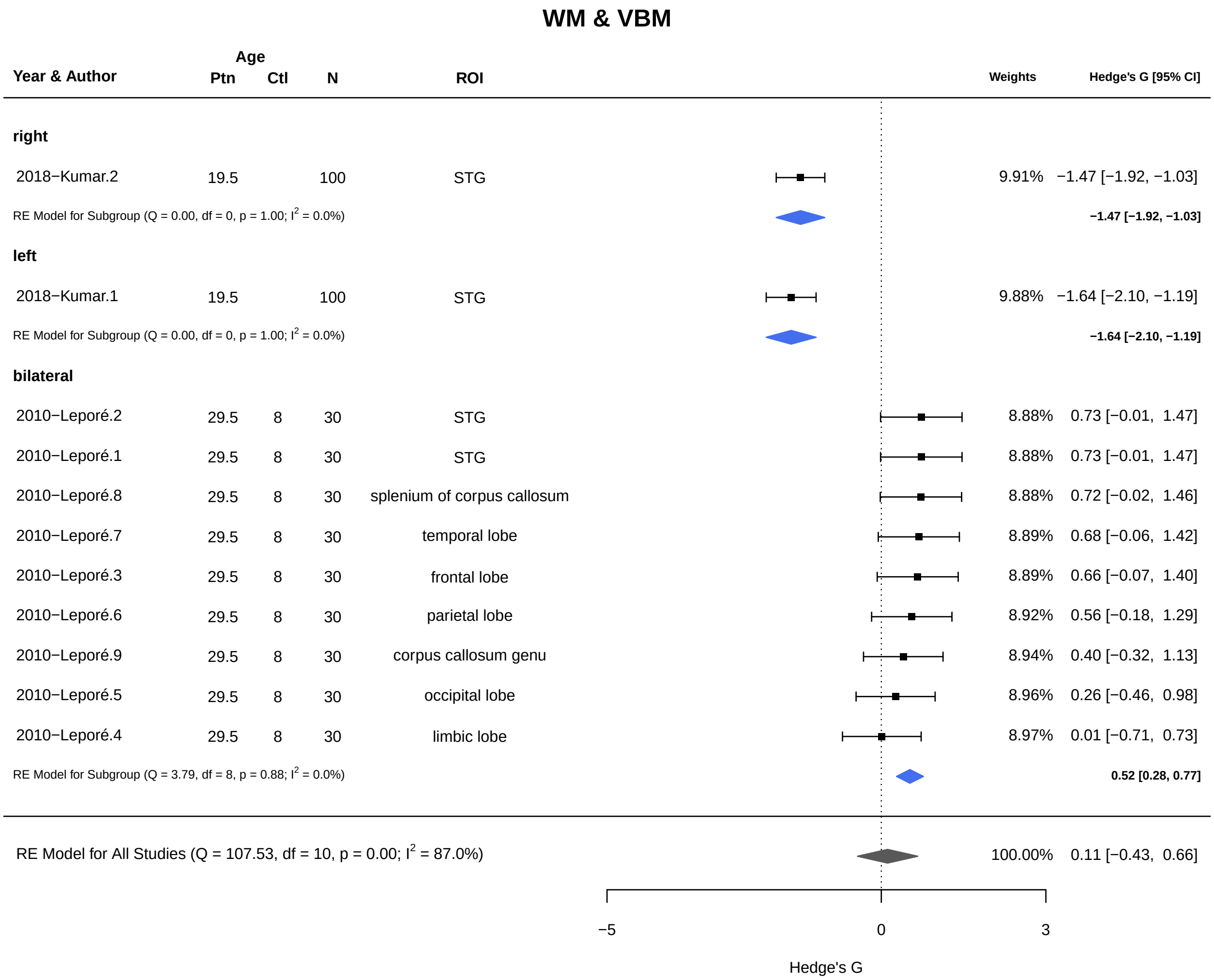
Error in rma(yi = hedgesG, vi = varG, data = meta.mod, measure = “MD”, : Fisher scoring algorithm did not converge. See ‘help(rma)’ for possible remedies.

Other Measures of White Matter

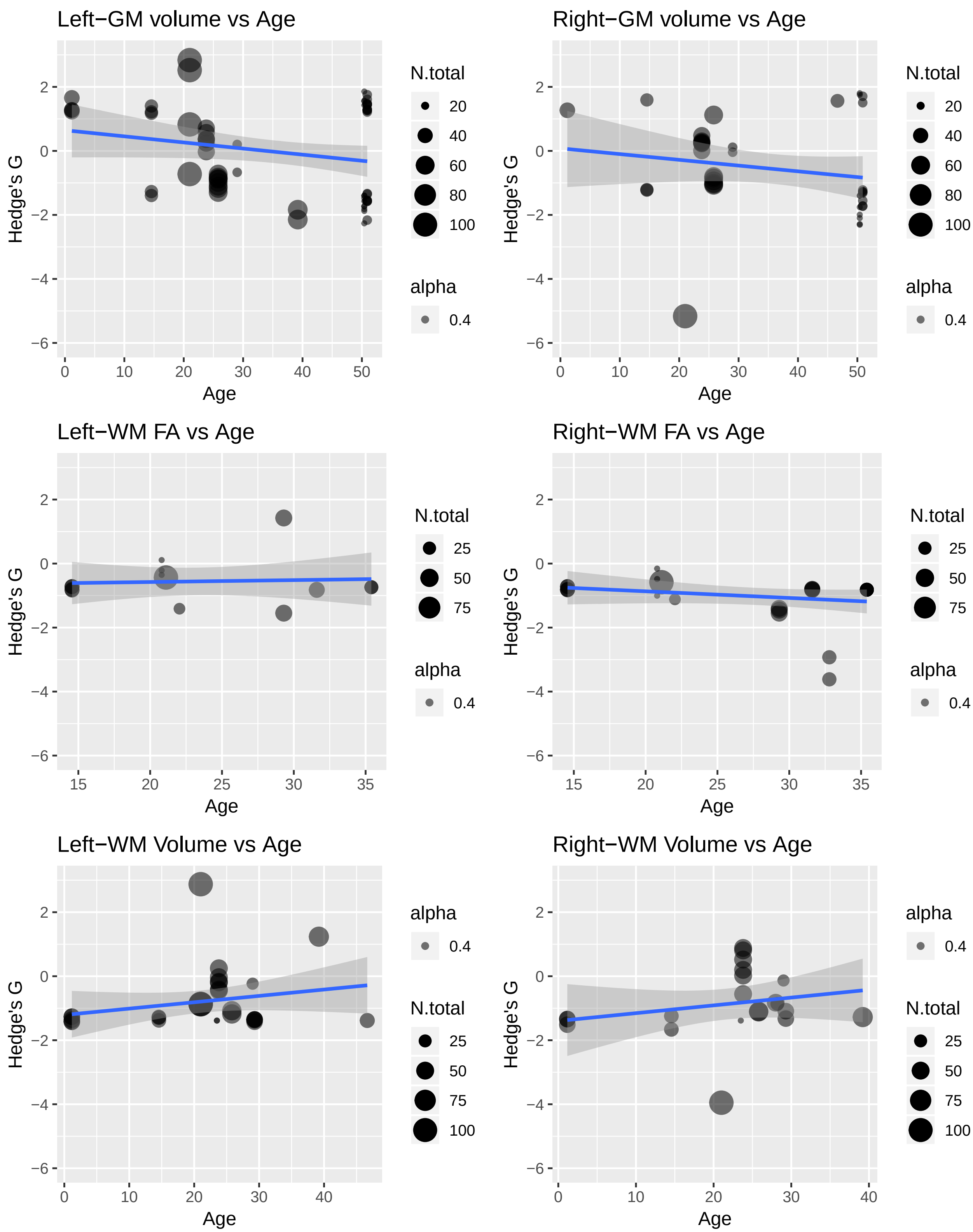
White matter: Thickness



White matter: VBM



Supplementary material: Gray and White matter relation with Age



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