

## Supplemental Material – Document 2

**Generalized Linear Models:  
Dependent Variable: Cortical Lesion Counts**

**Predictor variable: White Matter Lesion Volume (T2 lesion volume)**

### Model Information

Dependent Variable	Total_CLCount
Probability Distribution	Negative binomial (1)
Link Function	Log

### Case Processing Summary

	N	Percent
Included	24	100.0%
Excluded	0	0.0%
Total	24	100.0%

### Continuous Variable Information

		N	Minimum	Maximum	Mean	Std. Deviation
Dependent Variable	Total_CLCount	24	0	115	16.29	27.181
Covariate	Total_T2_Vol	24	.000	103.473	12.01942	24.134384

### Goodness of Fit<sup>a</sup>

	Value	df	Value/df
Deviance	34.481	22	1.567
Scaled Deviance	34.481	22	
Pearson Chi-Square	25.722	22	1.169
Scaled Pearson Chi-Square	25.722	22	
Log Likelihood <sup>b</sup>	-82.111		
Akaike's Information Criterion (AIC)	168.222		
Finite Sample Corrected AIC (AICC)	168.793		
Bayesian Information Criterion (BIC)	170.578		
Consistent AIC (CAIC)	172.578		

Dependent Variable: Total\_CLCount

Model: (Intercept), Total\_T2\_Vol

- a. Information criteria are in smaller-is-better form.
- b. The full log likelihood function is displayed and used in computing information criteria.

**Omnibus Test<sup>a</sup>**

Likelihood Ratio		
Chi-Square	df	Sig.
19.174	1	.000

Dependent Variable: Total\_CLCount

Model: (Intercept), Total\_T2\_Vol

- a. Compares the fitted model against the intercept-only model.

**Tests of Model Effects**

Source	Wald Chi-Square	Type III	
		df	Sig.
(Intercept)	62.697	1	.000
Total_T2_Vol	10.252	1	.001

Dependent Variable: Total\_CLCount

Model: (Intercept), Total\_T2\_Vol

**Parameter Estimates**

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			Exp(B)	95% Wald Confidence Interval for Exp(B)	
			Lower	Upper	Wald Chi-Square	df	Sig.		Lower	Upper
(Intercept)	1.979	.2500	1.489	2.469	62.697	1	.000	7.238	4.434	11.814
Total_T2_Vol	.033	.0102	.013	.052	10.252	1	.001	1.033	1.013	1.054
(Scale)	1 <sup>a</sup>									
(Negative binomial)	1 <sup>a</sup>									

Dependent Variable: Total\_CLCount

Model: (Intercept), Total\_T2\_Vol

- a. Fixed at the displayed value.

**Generalized Linear Models:**  
**Dependent Variable: Cortical Lesion Counts**

**Predictor variable: Normalized Thalamic Volume**

**Model Information**

Dependent Variable	Total_CLCount
Probability Distribution	Negative binomial (1)
Link Function	Log

**Case Processing Summary**

	N	Percent
Included	24	100.0%
Excluded	0	0.0%
Total	24	100.0%

**Continuous Variable Information**

		N	Minimum	Maximum	Mean	Std. Deviation
Dependent Variable	Total_CLCount	24	0	115	16.29	27.181
Covariate	NormThalVol	24	.005839	.009756	.00885717	.000912117

**Goodness of Fit<sup>a</sup>**

	Value	df	Value/df
Deviance	40.408	22	1.837
Scaled Deviance	40.408	22	
Pearson Chi-Square	26.357	22	1.198
Scaled Pearson Chi-Square	26.357	22	
Log Likelihood <sup>b</sup>	-85.075		
Akaike's Information Criterion (AIC)	174.149		
Finite Sample Corrected AIC (AICC)	174.721		
Bayesian Information Criterion (BIC)	176.505		
Consistent AIC (CAIC)	178.505		

Dependent Variable: Total\_CLCount

Model: (Intercept), NormThalVol

- a. Information criteria are in smaller-is-better form.
- b. The full log likelihood function is displayed and used in computing information criteria.

**Omnibus Test<sup>a</sup>**

Likelihood Ratio	df	Sig.
Chi-Square		
13.246	1	.000

Dependent Variable: Total\_CLCount

Model: (Intercept), NormThalVol

- a. Compares the fitted model against the intercept-only model.

**Tests of Model Effects**

Source	Wald Chi-Square	Type III	
		df	Sig.
(Intercept)	20.696	1	.000
NormThalVol	9.792	1	.002

Dependent Variable: Total\_CLCount

Model: (Intercept), NormThalVol

**Parameter Estimates**

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			95% Wald Confidence Interval for Exp(B)		
			Lower	Upper	Wald Chi-Square	df	Sig.	Exp(B)	Lower	Upper
(Intercept)	7.949	1.7473	4.524	11.374	20.696	1	.000	2832.703	92.234	86997.957
NormThalVol	-196.6571 615.374		-1000.815	-229.934	9.792	1	.002	5.575E-268	.000	1.384E-100
(Scale)	1 <sup>a</sup>									
(Negative binomial)	1 <sup>a</sup>									

Dependent Variable: Total\_CLCount

Model: (Intercept), NormThalVol

- a. Fixed at the displayed value.

**Generalized Linear Models:  
Dependent Variable: Cortical Lesion Counts**

**Predictor variable: Age at the time of scan**

**Model Information**

Dependent Variable	Total_CLCount
Probability Distribution	Negative binomial (1)
Link Function	Log

**Case Processing Summary**

	N	Percent
Included	24	100.0%
Excluded	0	0.0%
Total	24	100.0%

**Continuous Variable Information**

		N	Minimum	Maximum	Mean	Std. Deviation
Dependent Variable	Total_CLCount	24	0	115	16.29	27.181
Covariate	Age_at_scan	24	13.17	24.33	18.8121	3.00389

**Goodness of Fit<sup>a</sup>**

	Value	df	Value/df
Deviance	44.538	22	2.024
Scaled Deviance	44.538	22	
Pearson Chi-Square	31.368	22	1.426
Scaled Pearson Chi-Square	31.368	22	
Log Likelihood <sup>b</sup>	-87.139		
Akaike's Information Criterion (AIC)	178.279		
Finite Sample Corrected AIC (AICC)	178.850		
Bayesian Information Criterion (BIC)	180.635		
Consistent AIC (CAIC)	182.635		

Dependent Variable: Total\_CLCount

Model: (Intercept), Age\_at\_scan

- a. Information criteria are in smaller-is-better form.
- b. The full log likelihood function is displayed and used in computing information criteria.

**Omnibus Test<sup>a</sup>**

Likelihood Ratio		
Chi-Square	df	Sig.
9.116	1	.003

Dependent Variable: Total\_CLCount

Model: (Intercept), Age\_at\_scan

- a. Compares the fitted model against the intercept-only model.

**Tests of Model Effects**

Source	Wald Chi-Square	Type III	
		df	Sig.
(Intercept)	.653	1	.419
Age_at_scan	9.287	1	.002

Dependent Variable: Total\_CLCount

Model: (Intercept), Age\_at\_scan

**Parameter Estimates**

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			Exp(B)	95% Wald Confidence Interval for Exp(B)	
			Lower	Upper	Wald Chi-Square	df	Sig.		Lower	Upper
(Intercept)	-.966	1.1951	-3.308	1.376	.653	1	.419	.381	.037	3.960
Age_at_scan	.189	.0620	.067	.310	9.287	1	.002	1.208	1.070	1.364
(Scale)	1 <sup>a</sup>									
(Negative binomial)	1 <sup>a</sup>									

Dependent Variable: Total\_CLCount

Model: (Intercept), Age\_at\_scan

- a. Fixed at the displayed value.

**Generalized Linear Models:  
Dependent Variable: Cortical Lesion Counts**

**Predictor variables: 1) Age at disease onset, 2) Disease Duration, 3) White Matter Lesion Volume (T2 lesion volume), and 4) Normalized Thalamic Volume**

**Model Information**

Dependent Variable	Total_CLCount
Probability Distribution	Negative binomial (1)
Link Function	Log

**Continuous Variable Information**

		N	Minimum	Maximum	Mean	Std. Deviation
Dependent Variable	Total_CLCount	24	0	115	16.29	27.181
Covariate	Total_T2_Vol	24	.000	103.473	12.01942	24.134384
	NormThalVol	24	.005839	.009756	.00885717	.000912117
	Disease_Duration_Months	24	13	131	59.63	37.972
	Age_disease_Onset	24	7	19	13.29	2.742

**Goodness of Fit<sup>a</sup>**

	Value	df	Value/df
Deviance	29.135	19	1.533
Scaled Deviance	29.135	19	
Pearson Chi-Square	15.748	19	.829
Scaled Pearson Chi-Square	15.748	19	
Log Likelihood <sup>b</sup>	-79.438		
Akaike's Information Criterion (AIC)	168.876		

Finite Sample Corrected AIC (AICC)	172.209		
Bayesian Information Criterion (BIC)	174.766		
Consistent AIC (CAIC)	179.766		

Dependent Variable: Total\_CLCount

Model: (Intercept), Total\_T2\_Vol, NormThalVol, Disease\_Duration\_Months, Age\_disease\_Onset

- a. Information criteria are in smaller-is-better form.
- b. The full log likelihood function is displayed and used in computing information criteria.

### Omnibus Test<sup>a</sup>

Likelihood Ratio Chi-Square	df	Sig.
24.519	4	.000

Dependent Variable: Total\_CLCount

Model: (Intercept), Total\_T2\_Vol, NormThalVol, Disease\_Duration\_Months, Age\_disease\_Onset

- a. Compares the fitted model against the intercept-only model.

### Tests of Model Effects

Source	Type III		
	Wald Chi-Square	df	Sig.
(Intercept)	.004	1	.950
Total_T2_Vol	4.324	1	.038
NormThalVol	.004	1	.948
Disease_Duration_Months	.413	1	.521
Age_disease_Onset	2.834	1	.092

Dependent Variable: Total\_CLCount

Model: (Intercept), Total\_T2\_Vol, NormThalVol, Disease\_Duration\_Months, Age\_disease\_Onset



**Parameter Estimates**

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			Exp(B)	95% Wald Confidence Interval for Exp(B)	
			Lower	Upper	Wald Chi-Square	df	Sig.		Lower	Upper
(Intercept)	-.244	3.9053	-7.899	7.410	.004	1	.950	.783	.000	1652.075
Total_T2_Vol	.043	.0209	.002	.084	4.324	1	.038	1.044	1.002	1.088
NormThalVol	26.790	408.4079	-773.675	827.255	.004	1	.948	431207566400.000	.000	. <sup>a</sup>
Disease_Duration_Months	-.005	.0075	-.019	.010	.413	1	.521	.995	.981	1.010
Age_disease_Onset	.151	.0900	-.025	.328	2.834	1	.092	1.164	.975	1.388
(Scale)	1 <sup>b</sup>									
(Negative binomial)	1 <sup>b</sup>									

Dependent Variable: Total\_CLCount

Model: (Intercept), Total\_T2\_Vol, NormThalVol, Disease\_Duration\_Months, Age\_disease\_Onset

a. Set to system missing due to overflow

b. Fixed at the displayed value.

**Generalized Linear Models:  
Dependent Variable: Cortical Lesion Counts**

**Predictor variables: 1) Age at the time of the scan, 2) White Matter Lesion Volume (T2 lesion volume), and 3) Normalized Thalamic Volume**

**Continuous Variable Information**

		N	Minimum	Maximum	Mean	Std. Deviation
Dependent Variable	Total_CLCount	24	0	115	16.29	27.181
Covariate	Total_T2_Vol	24	.000	103.473	12.01942	24.134384
	NormThalVol	24	.005839	.009756	.00885717	.000912117
	Age_at_scan	24	13.17	24.33	18.8121	3.00389

**Goodness of Fit**

	Value	df	Value/df
Deviance	33.606	20	1.680
Scaled Deviance	33.606	20	
Pearson Chi-Square	22.006	20	1.100

Scaled Pearson Chi-Square 22.006 20

Log Likelihood<sup>b</sup> -81.674

Akaike's Information Criterion (AIC) 171.347

Finite Sample Corrected AIC (AICC) 173.452

Bayesian Information Criterion (BIC) 176.059

Consistent AIC (CAIC) 180.059

Dependent Variable: Total\_CLCount

Model: (Intercept), NormThalVol, Total\_T2\_Vol, Age\_at\_scan

a Information criteria are in smaller-is-better form.

b The full log likelihood function is displayed and used in computing information criteria.

### Omnibus Test<sup>a</sup>

Likelihood Ratio Chi-Square	df	Sig.
20.048	3	.000

Dependent Variable: Total\_CLCount

Model: (Intercept), NormThalVol, Total\_T2\_Vol,  
Age\_at\_scan

a. Compares the fitted model against the  
intercept-only model.

### Tests of Model Effects

Source	Type III		
	Wald Chi-Square	df	Sig.
(Intercept)	.075	1	.784
NormThalVol	.300	1	.584
Total_T2_Vol	3.557	1	.059
Age_at_scan	.541	1	.462

Dependent Variable: Total\_CLCount

Model: (Intercept), NormThalVol, Total\_T2\_Vol, Age\_at\_scan

### Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			95% Wald Confidence Interval for Exp(B)		
			Lower	Upper	Wald Chi-Square	df	Sig.	Exp(B)	Lower	Upper
(Intercept)	-1.095	3.9960	-8.927	6.737	.075	1	.784	.335	.000	843.407
NormThalVol	220.994	403.6224	-570.091	1012.079	.300	1	.584	9.473E+95	2.585E-248	. <sup>a</sup>
Total_T2_Vol	.039	.0208	-.002	.080	3.557	1	.059	1.040	.998	1.083
Age_at_scan	.054	.0734	-.090	.198	.541	1	.462	1.055	.914	1.219
(Scale)	1 <sup>b</sup>									
(Negative binomial)	1 <sup>b</sup>									

Dependent Variable: Total\_CLCount

Model: (Intercept), NormThalVol, Total\_T2\_Vol, Age\_at\_scan

a. Set to system missing due to overflow

b. Fixed at the displayed value.

## Generalized Linear Models

**Dependent Variable: 9 Hole Peg Tests Results of Dominant hand**

**Predictor Variables: 1) CL Counts Frontal Lobe, 2) CLs Counts other lobes, 3) White Matter lesion volume Frontal Lobes, 4) Thalamic Volumes**

### Model Information

Dependent Variable	Nine_HPT_Dominant
Probability Distribution	Normal
Link Function	Identity

### Case Processing Summary

	N	Percent
Included	23	95.8%
Excluded	1	4.2%
Total	24	100.0%

### Continuous Variable Information

		N	Minimum	Maximum	Mean	Std. Deviation
Dependent Variable	Nine_HPT_Dominant	23	-7.300	1.865	-1.58048	2.005451
Covariate	Frontal_T2_Vol	23	.000	58.567	5.73600	13.042172
	CLCount_FrontalLobe	23	0	45	7.00	11.237
	NormThalVol	23	.005839	.009756	.00881983	.000913668
	CLs_Rest_Lobes	23	0	52	7.17	11.396

### Goodness of Fit<sup>a</sup>

	Value	df	Value/df
Deviance	57.416	18	3.190
Scaled Deviance	23.000	18	
Pearson Chi-Square	57.416	18	3.190
Scaled Pearson Chi-Square	23.000	18	
Log Likelihood <sup>b</sup>	-43.156		
Akaike's Information Criterion (AIC)	98.312		
Finite Sample Corrected AIC (AICC)	103.562		
Bayesian Information Criterion (BIC)	105.125		
Consistent AIC (CAIC)	111.125		

Dependent Variable: Nine\_HPT\_Dominant

Model: (Intercept), Frontal\_T2\_Vol, CLCount\_FrontalLobe, NormThalVol, CLs\_Rest\_Lobes

- a. Information criteria are in smaller-is-better form.
- b. The full log likelihood function is displayed and used in computing information criteria.

### Omnibus Test<sup>a</sup>

Likelihood Ratio Chi-Square	df	Sig.
9.946	4	.041

Dependent Variable: Nine\_HPT\_Dominant

Model: (Intercept), Frontal\_T2\_Vol,  
CLCount\_FrontalLobe, NormThalVol,  
CLs\_Rest\_Lobes

a. Compares the fitted model against the  
intercept-only model.

**Tests of Model Effects**

Source	Type III		
	Wald Chi-Square	df	Sig.
(Intercept)	.003	1	.956
Frontal_T2_Vol	.121	1	.728
CLCount_FrontalLobe	3.906	1	.048
NormThalVol	.005	1	.942
CLs_Rest_Lobes	.109	1	.742

Dependent Variable: Nine\_HPT\_Dominant

Model: (Intercept), Frontal\_T2\_Vol, CLCount\_FrontalLobe, NormThalVol,  
CLs\_Rest\_Lobes

**Parameter Estimates**

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			95% Wald Confidence Interval for Exp(B)		
			Lower	Upper	Wald Chi-Square	df	Sig.	Exp(B)	Lower	Upper
(Intercept)	-.343	6.2196	-12.534	11.847	.003	1	.956	.709	3.604E-6	139639.495
Frontal_T2_Vol	.030	.0875	-.141	.202	.121	1	.728	1.031	.868	1.224
CLCount_FrontalLobe	-.106	.0538	-.212	-.001	3.906	1	.048	.899	.809	.999
NormThalVol	-49.564	684.2048	-1390.581	1291.453	.005	1	.942	2.982E-22	.000	. <sup>a</sup>
CLs_Rest_Lobes	-.032	.0973	-.223	.159	.109	1	.742	.968	.800	1.172
(Scale)	2.496 <sup>b</sup>	.7361	1.401	4.450						

Dependent Variable: Nine\_HPT\_Dominant

Model: (Intercept), Frontal\_T2\_Vol, CLCount\_FrontalLobe, NormThalVol, CLs\_Rest\_Lobes

a. Set to system missing due to overflow

b. Maximum likelihood estimate.

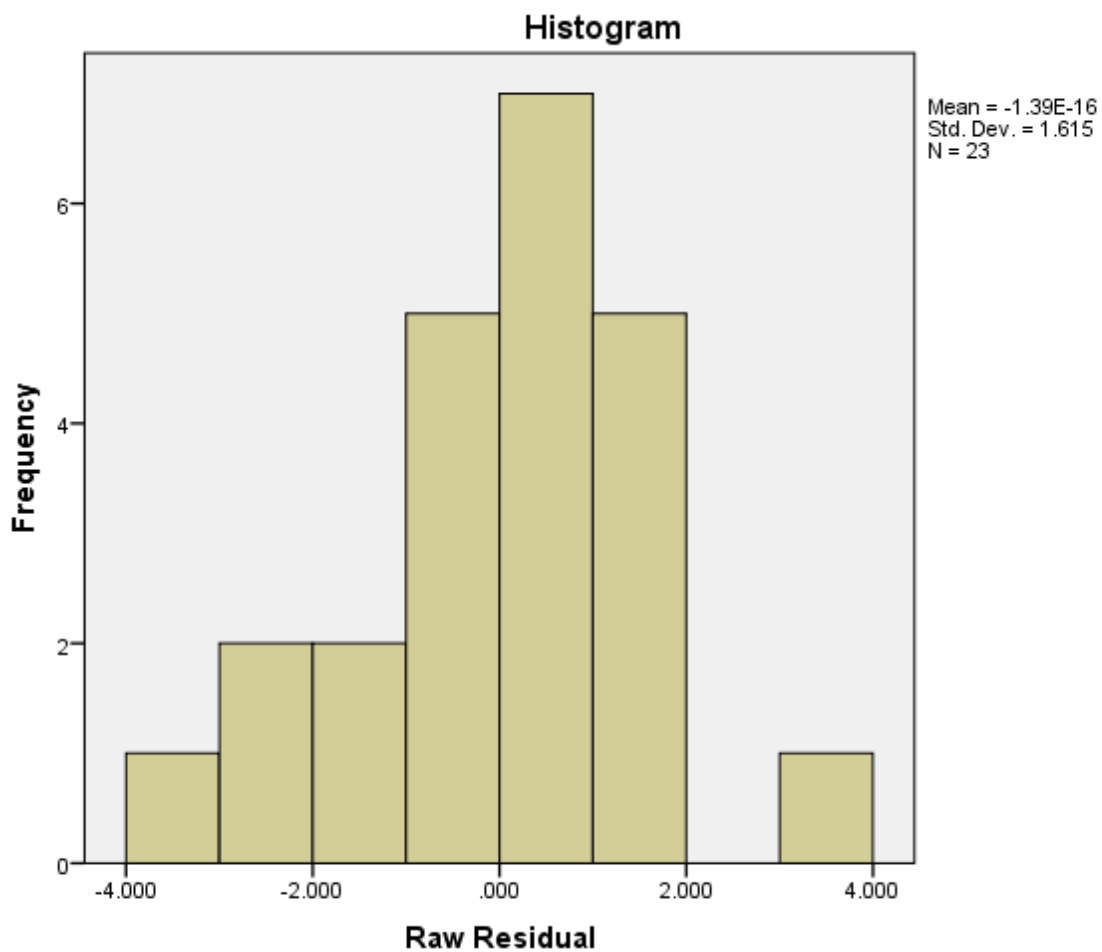
## **ANALYSIS OF THE RESIDUALS OF GLM Linear identity link function: 9HPT as dependent variable**

### Tests of Normality

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Raw Residual	.137	23	.200*	.965	23	.564

\*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction



Normal Q-Q Plot of Raw Residual

