List of Supporting Information for *Cross-sectional and longitudinal associations between gut microbiota composition and cognition in the second year of life: Findings from the Child Health & Resident Microbes (CHaRM) study*

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Supporting Information 1. Flow diagram of included samples

Children enrolled in the longitudinal CHaRM study n=51

Samples with both BSID III and gut microbiota data at age 12m n=45

Withdrawn before 12 months follow up n=3

Missing cognitive data at 24m n=1

Final dataset for age 12m n=41

Children completed 12 months follow up in the CHaRM study n=48

Samples with both BSID III and gut microbiota data at age 24m n=46

Low sequencing reads n=3

Final dataset for age 24m n=43
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Supplementary Information 4b. Statistical outputs for Alpha diversity

| Cross sectional Alpha diversity – Cognitive/Language/Motor | term       | estimate | std.error | statistic | p.value |
|-----------------------------------------------------------|------------|----------|-----------|-----------|---------|
| (Intercept)                                               | -2.786     | 1.595    | -1.747    | 0.08      |
| Chao1                                                     | 0.009      | 0.014    | 0.649     | 0.516     |
| (Intercept)                                               | -3.731     | 1.507    | -2.476    | 0.013     |
| InvSimpson                                                | 0.077      | 0.054    | 1.426     | 0.154     |
| (Intercept)                                               | -2.758     | 1.593    | -1.731    | 0.083     |
| Observed                                                  | 0.009      | 0.014    | 0.630     | 0.528     |
| (Intercept)                                               | -6.645     | 5.311    | -1.251    | 0.211     |
| Shannon                                                   | 1.306      | 1.412    | 0.924     | 0.355     |
| (Intercept)                                               | -27.283    | 26.966   | -1.012    | 0.312     |
| Simpson                                                   | 26.718     | 28.182   | 0.948     | 0.343     |

| Cross sectional Alpha diversity – Social-Emotional/General Adaptive | term       | estimate | std.error | statistic | p.value |
|---------------------------------------------------------------------|------------|----------|-----------|-----------|---------|
| (Intercept)                                                         | -0.779     | 1.289    | -0.604    | 0.546     |
| Chao1                                                               | -0.004     | 0.012    | -0.333    | 0.739     |
| (Intercept)                                                         | -0.389     | 1.034    | -0.376    | 0.707     |
| InvSimpson                                                          | -0.036     | 0.045    | -0.807    | 0.420     |
| (Intercept)                                                         | -0.782     | 1.288    | -0.608    | 0.543     |
| Observed                                                            | -0.004     | 0.012    | -0.330    | 0.741     |
| (Intercept)                                                         | -0.927     | 3.797    | -0.244    | 0.807     |
| Shannon                                                             | -0.073     | 1.039    | -0.071    | 0.944     |
| (Intercept)                                                         | -4.856     | 14.186   | -0.342    | 0.732     |
| Simpson                                                             | 3.860      | 14.936   | 0.258     | 0.796     |
### Longitudinal Alpha diversity – Cognitive/Language/Motor

| term          | estimate | std.error | statistic | p.value |
|---------------|----------|-----------|-----------|---------|
| (Intercept)   | 0.691    | 2.067     | 0.334     | 0.738   |
| Chao1         | -0.037   | 0.027     | -1.347    | 0.178   |
| (Intercept)   | -1.278   | 1.336     | -0.957    | 0.339   |
| InvSimpson    | -0.060   | 0.083     | -0.719    | 0.472   |
| (Intercept)   | 0.734    | 2.075     | 0.354     | 0.723   |
| Observed      | -0.037   | 0.027     | -1.360    | 0.174   |
| (Intercept)   | 2.434    | 4.143     | 0.588     | 0.557   |
| Shannon       | -1.441   | 1.307     | -0.102    | 0.270   |
| (Intercept)   | 10.654   | 11.032    | 0.966     | 0.334   |
| Simpson       | -14.005  | 12.095    | -1.158    | 0.247   |

### Longitudinal Alpha diversity – Social-Emotional/General Adaptive

| term          | estimate | std.error | statistic | p.value |
|---------------|----------|-----------|-----------|---------|
| (Intercept)   | 0.238    | 1.443     | 0.165     | 0.869   |
| Chao1         | -0.016   | 0.017     | -0.959    | 0.338   |
| (Intercept)   | -0.337   | 0.937     | -0.360    | 0.719   |
| InvSimpson    | -0.048   | 0.055     | -0.885    | 0.376   |
| (Intercept)   | 0.216    | 1.443     | 0.150     | 0.881   |
| Observed      | -0.016   | 0.017     | -0.943    | 0.346   |
| (Intercept)   | 0.932    | 3.001     | 0.310     | 0.757   |
| Shannon       | -0.625   | 0.911     | -0.686    | 0.493   |
| (Intercept)   | 5.889    | 8.689     | 0.678     | 0.498   |
| Simpson       | -7.587   | 9.405     | -0.807    | 0.420   |
Supporting Information 5a. Aitchison distance – cross-sectional (outputs and plots)
Cognitive/Language/Motor Combined Composite

Permutation: free
Number of permutations: 999
Terms added sequentially (first to last)

|                          | Df | SumsOfSqs | MeanSqs | F.Model | R²   | Pr(>F) |
|--------------------------|----|-----------|---------|---------|------|--------|
| Cognitive/Language/Motor Composite | 1  | 1361      | 1360.5  | 0.84334 | 0.02015 | 0.931  |
| Residuals                | 41 | 66143     | 1613.3  |         |      | 0.97985|
| Total                    | 42 | 67504     |         |         |      | 1.00000|

Ordination Centroids and Dispersion Labeled:
Aitchison Distance - Cross-sectional
Cognitive/Language/Motor Combined Composite
Supporting Information 5b. Aitchison distance – cross-sectional (outputs and plots)
Social-Emotional /General Adaptive Combined Composite

| Terms added sequentially (first to last) | Df | SumsOfSqs | MeanSqs | F.Model | $R^2$ | Pr(>F) |
|-----------------------------------------|----|-----------|---------|---------|-------|--------|
| Social-Emotional/General Adaptive       | 1  | 1479      | 1478.8  | 0.91832 | 0.02191| 0.747  |
| Combined Composite                      |    |           |         |         |       |        |
| Residuals                               | 41 | 66025     | 1610.4  |         | 0.97809|        |
| Total                                   | 42 | 67504     |         |         | 1.0000 |        |

Ordination Centroids and Dispersion labelled:
Aitchison Distance - Cross-sectional Social-emotional/General Adaptation Combined Composite

PCoA1 Eigenvalue: 5379
PCoA2 Eigenvalue: 3100
Supporting Information 6a. Aitchison distance – longitudinal (outputs and plots)
Cognitive/Language/Motor Combined Composite

Permutation: free
Number of permutations: 999
Terms added sequentially (first to last)

|                          | Df | SumsOfSqs | MeanSqs | F.Model | R^2  | Pr(>F) |
|--------------------------|----|-----------|---------|---------|------|--------|
| Cognitive/Language/Motor Combined Composite | 1  | 1550      | 1549.9  | 0.88175 | 0.819|        |
| Residuals                | 39 | 68553     | 1757.8  | 0.97789 |      |        |
| Total                    | 40 | 70103     | 1.00000 |         |      |        |

 Ordination Centroids and Dispersion labeled:
 Aitchison Distance - Longitudinal
 Cognitive/Language/Motor Combined Composite
Supporting Information 6b. Aitchison distance – longitudinal (outputs and plots) Social-Emotional /General Adaptive Combined Composite

| Permutation: free | Number of permutations: 999 |
|-------------------|-----------------------------|
| Terms added sequentially (first to last) | Df | SumsOfSqs | MeanSqs | F.Model | R² | Pr(>F) |
| Social-Emotional / General Adaptive Combined Composite | 1 | 1576 | 1575.7 | 0.89677 | 0.02248 | 0.825 |
| Residuals | 39 | 68527 | 1757.1 | 0.97752 |
| Total | 40 | 70103 | 1.00000 |

Ordination Centroids and Dispersion labeled: Aitchison Distance - Longitudinal Social-emotional/General Adaptation Combined Composite