**Appendix S1.** Correlation matrix between variables for girls

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variables | Mean (SD) | BMI-K | BMI-G1 | BMI-G2 | BMI-G3 | BMI-G4 | BMI-G5 | Read-K | Read-G1 | Read-G2 | Read-G3 | Read-G4 | Read-G5 |
| BMI-K | 16.56 (.06) | 1.00 |  |  |  |  |  |  |  |  |  |  |  |
| BMI-G1 | 17.06 (.07) | 0.90 | 1.00 |  |  |  |  |  |  |  |  |  |  |
| BMI-G2 | 17.74 (.09) | 0.86 | 0.92 | 1.00 |  |  |  |  |  |  |  |  |  |
| BMI-G3 | 18.57 (.09) | 0.83 | 0.89 | 0.91 | 1.00 |  |  |  |  |  |  |  |  |
| BMI-G4 | 19.42 (.09) | 0.80 | 0.87 | 0.89 | 0.92 | 1.00 |  |  |  |  |  |  |  |
| BMI-G5 | 20.46 (.12) | 0.78 | 0.84 | 0.86 | 0.90 | 0.92 | 1.00 |  |  |  |  |  |  |
| Read-K | 70.86 (.40) | **-0.08** | -0.09 | -0.09 | -0.11 | -0.10 | -0.10 | 1.00 |  |  |  |  |  |
| Read-G1 | 97.55 (.51) | -0.09 | **-0.10** | -0.10 | -0.12 | -0.12 | -0.12 | 0.76 | 1 |  |  |  |  |
| Read-G2 | 114.70 (.45) | -0.09 | -0.10 | **-0.10** | -0.11 | -0.12 | -0.12 | 0.67 | 0.85 | 1.00 |  |  |  |
| Read-G3 | 123.13 (.39) | -0.09 | -0.09 | -0.10 | **-0.11** | -0.12 | -0.13 | 0.61 | 0.77 | 0.83 | 1.00 |  |  |
| Read-G4 | 130.87 (.38) | -0.08 | -0.09 | -0.09 | -0.11 | **-0.12** | -0.13 | 0.62 | 0.78 | 0.84 | 0.84 | 1.00 |  |
| Read-G5 | 137.63 (.44) | -0.07 | -0.07 | -0.08 | -0.09 | -0.10 | **-0.12** | 0.58 | 0.74 | 0.80 | 0.82 | 0.85 | 1 |
| Variables | Mean (SD) | BMI-K | BMI-G1 | BMI-G2 | BMI-G3 | BMI-G4 | BMI-G5 | Math-K | Math-G1 | Math-G2 | Math-G3 | Math-G4 | Math-G5 |
| Math-K | 50.93 (.38) | **-0.09** | -0.10 | -0.09 | -0.11 | -0.12 | -0.12 | 1.00 |  |  |  |  |  |
| Math-G1 | 72.62 (.40) | -0.09 | **-0.09** | -0.09 | -0.11 | -0.11 | -0.12 | 0.80 | 1 |  |  |  |  |
| Math-G2 | 89.30 (.54) | -0.10 | -0.11 | **-0.11** | -0.13 | -0.13 | -0.14 | 0.77 | 0.84 | 1.00 |  |  |  |
| Math-G3 | 102.96 (.54) | -0.11 | -0.11 | -0.12 | **-0.13** | -0.14 | -0.15 | 0.74 | 0.80 | 0.86 | 1.00 |  |  |
| Math-G4 | 111.25 (.60) | -0.08 | -0.09 | -0.09 | -0.11 | **-0.12** | -0.13 | 0.72 | 0.79 | 0.84 | 0.88 | 1.00 |  |
| Math-G5 | 119.11 (.57) | -0.08 | -0.08 | -0.08 | -0.09 | -0.11 | **-0.13** | 0.72 | 0.78 | 0.83 | 0.86 | 0.90 | 1 |
| Variables | Mean (SD) | BMI-K | BMI-G1 | BMI-G2 | BMI-G3 | BMI-G4 | BMI-G5 | Sci-K | Sci-G1 | Sci-G2 | Sci-G3 | Sci-G4 | Sci-G5 |
| Sci-K | 34.23 (.22) | **-0.07** | -0.07 | -0.06 | -0.07 | -0.08 | -0.08 | 1.00 |  |  |  |  |  |
| Sci-G1 | 43.28 (.31) | -0.07 | **-0.07** | -0.07 | -0.08 | -0.09 | -0.09 | 0.76 | 1 |  |  |  |  |
| Sci-G2 | 52.68 (.32) | -0.08 | -0.09 | **-0.09** | -0.10 | -0.10 | -0.11 | 0.71 | 0.82 | 1.00 |  |  |  |
| Sci-G3 | 60.22 (.35) | -0.10 | -0.10 | -0.11 | **-0.11** | -0.12 | -0.12 | 0.69 | 0.79 | 0.83 | 1.00 |  |  |
| Sci-G4 | 67.15 (.36) | -0.09 | -0.09 | -0.10 | -0.11 | **-0.12** | -0.12 | 0.65 | 0.75 | 0.79 | 0.84 | 1.00 |  |
| Sci-G5 | 73.71 (.37) | -0.08 | -0.08 | -0.08 | -0.09 | -0.11 | **-0.12** | 0.63 | 0.72 | 0.77 | 0.82 | 0.84 | 1 |

*Note:* unweighted correlations reported. K and G stand for kindergarten and grade respectively.

**Appendix S2.** Correlation matrix between variables for boys

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variables | Mean (SD) | BMI-K | BMI-G1 | BMI-G2 | BMI-G3 | BMI-G4 | BMI-G5 | Read-K | Read-G1 | Read-G2 | Read-G3 | Read-G4 | Read-G5 |
| BMI-K | 16.70 (.05) | 1.00 |  |  |  |  |  |  |  |  |  |  |  |
| BMI-G1 | 17.06 (.06) | 0.88 | 1.00 |  |  |  |  |  |  |  |  |  |  |
| BMI-G2 | 17.82 (.07) | 0.85 | 0.90 | 1.00 |  |  |  |  |  |  |  |  |  |
| BMI-G3 | 18.66 (.09) | 0.81 | 0.87 | 0.91 | 1.00 |  |  |  |  |  |  |  |  |
| BMI-G4 | 19.50 (.09) | 0.78 | 0.84 | 0.88 | 0.92 | 1.00 |  |  |  |  |  |  |  |
| BMI-G5 | 20.41 (.11) | 0.75 | 0.81 | 0.86 | 0.90 | 0.93 | 1.00 |  |  |  |  |  |  |
| Read-K | 69.18 (.40) | **-0.07** | -0.08 | -0.07 | -0.09 | -0.09 | -0.09 | 1.00 |  |  |  |  |  |
| Read-G1 | 94.12 (.48) | -0.07 | **-0.08** | -0.08 | -0.10 | -0.10 | -0.09 | 0.77 | 1.00 |  |  |  |  |
| Read-G2 | 111.41 (.43) | -0.08 | -0.09 | **-0.08** | -0.10 | -0.11 | -0.09 | 0.69 | 0.87 | 1.00 |  |  |  |
| Read-G3 | 120.19 (.39) | -0.07 | -0.08 | -0.07 | **-0.09** | -0.10 | -0.08 | 0.63 | 0.78 | 0.86 | 1.00 |  |  |
| Read-G4 | 128.97 (.37) | -0.09 | -0.10 | -0.09 | -0.10 | **-0.11** | -0.10 | 0.63 | 0.79 | 0.85 | 0.85 | 1.00 |  |
| Read-G5 | 136.35 (.40) | -0.06 | -0.07 | -0.06 | -0.07 | -0.08 | **-0.07** | 0.59 | 0.75 | 0.81 | 0.83 | 0.87 | 1.00 |
| Variables | Mean (SD) | BMI-K | BMI-G1 | BMI-G2 | BMI-G3 | BMI-G4 | BMI-G5 | Math-K | Math-G1 | Math-G2 | Math-G3 | Math-G4 | Math-G5 |
| Math-K | 51.10 (.43) | **-0.08** | -0.09 | -0.08 | -0.10 | -0.10 | -0.10 | 1.00 |  |  |  |  |  |
| Math-G1 | 74.14 (.44) | -0.08 | **-0.10** | -0.10 | -0.11 | -0.12 | -0.11 | 0.84 | 1 |  |  |  |  |
| Math-G2 | 92.33 (.50) | -0.10 | -0.12 | **-0.12** | -0.13 | -0.14 | -0.13 | 0.79 | 0.87 | 1.00 |  |  |  |
| Math-G3 | 106.52 (.48) | -0.08 | -0.10 | -0.09 | **-0.11** | -0.12 | -0.11 | 0.75 | 0.82 | 0.89 | 1.00 |  |  |
| Math-G4 | 115.08 (.48) | -0.08 | -0.09 | -0.09 | -0.10 | **-0.12** | -0.11 | 0.72 | 0.81 | 0.87 | 0.90 | 1.00 |  |
| Math-G5 | 121.33 (.46) | -0.07 | -0.08 | -0.08 | -0.10 | -0.11 | **-0.11** | 0.72 | 0.79 | 0.85 | 0.88 | 0.91 | 1 |
| Variables | Mean (SD) | BMI-K | BMI-G1 | BMI-G2 | BMI-G3 | BMI-G4 | BMI-G5 | Sci-K | Sci-G1 | Sci-G2 | Sci-G3 | Sci-G4 | Sci-G5 |
| Sci-K | 34.58 (.21) | **-0.06** | -0.07 | -0.05 | -0.07 | -0.08 | -0.07 | 1.00 |  |  |  |  |  |
| Sci-G1 | 44.06 (.30) | -0.06 | **-0.07** | -0.06 | -0.07 | -0.07 | -0.06 | 0.77 | 1 |  |  |  |  |
| Sci-G2 | 53.89 (.32) | -0.06 | -0.08 | **-0.07** | -0.08 | -0.09 | -0.08 | 0.72 | 0.83 | 1.00 |  |  |  |
| Sci-G3 | 61.45 (.31) | -0.07 | -0.08 | -0.07 | **-0.09** | -0.09 | -0.08 | 0.69 | 0.79 | 0.85 | 1.00 |  |  |
| Sci-G4 | 68.02 (.35) | -0.08 | -0.09 | -0.08 | -0.09 | **-0.09** | -0.08 | 0.65 | 0.75 | 0.81 | 0.85 | 1.00 |  |
| Sci-G5 | 74.85 (.34) | -0.07 | -0.07 | -0.06 | -0.07 | -0.08 | **-0.07** | 0.62 | 0.72 | 0.78 | 0.82 | 0.85 | 1 |

*Note:* unweighted correlations reported. K and G stand for kindergarten and grade respectively.

**Appendix S3:** Descriptive statistics from Spring of Kindergarten (K) to Grade 5 (G5): ECLS-

K variable labels.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variables | N | Mean | SD | Min | Max |
| Male (pr) | 18,140 | .51 | .50 | .00 | 1.00 |
| BMI\_K | 17,160 | 16.60 | 2.51 | 7.60 | 49.14 |
| BMI\_G1 | 15,060 | 17.05 | 2.97 | 7.22 | 51.75 |
| BMI\_G2 | 13,710 | 17.76 | 3.50 | 6.87 | 56.12 |
| BMI\_G3 | 12,640 | 18.59 | 3.99 | 5.96 | 53.28 |
| BMI\_G4 | 11,660 | 19.45 | 4.43 | 6.07 | 50.02 |
| BMI\_G5 | 10,980 | 20.38 | 4.87 | 6.05 | 78.49 |
| Reading\_K | 17,190 | 68.89 | 14.73 | 32.39 | 133.54 |
| Reading\_G1 | 15,120 | 94.40 | 17.93 | 32.74 | 139.21 |
| Reading\_G2 | 13,840 | 111.89 | 17.22 | 45.91 | 146.42 |
| Reading\_G3 | 12,870 | 120.54 | 15.60 | 65.54 | 156.47 |
| Reading\_G4 | 12,070 | 129.00 | 14.92 | 73.40 | 155.49 |
| Reading\_G5 | 11,430 | 136.08 | 15.72 | 72.27 | 159.01 |
| Math\_K | 17,140 | 49.86 | 13.34 | 11.75 | 112.54 |
| Math\_G1 | 15,100 | 72.25 | 15.73 | 12.27 | 138.92 |
| Math\_G2 | 13,830 | 89.86 | 18.24 | 18.24 | 139.10 |
| Math\_G3 | 12,870 | 103.69 | 18.04 | 43.41 | 147.89 |
| Math\_G4 | 12,080 | 112.29 | 17.97 | 25.73 | 147.90 |
| Math\_G5 | 11,430 | 119.66 | 17.79 | 26.76 | 148.04 |
| Science\_K | 16,940 | 33.48 | 7.38 | 19.19 | 55.28 |
| Science\_G1 | 15,070 | 42.36 | 10.36 | 18.42 | 74.94 |
| Science\_G2 | 13,820 | 52.04 | 11.84 | 17.83 | 86.87 |
| Science\_G3 | 12,860 | 59.63 | 12.14 | 23.38 | 88.67 |
| Science\_G4 | 12,070 | 66.38 | 12.17 | 21.35 | 89.36 |
| Science\_G5 | 11,420 | 73.17 | 13.04 | 25.19 | 90.15 |
| Confounders |  |  |  |  |  |
| Income\_K | 13,530 | 10.48 | 5.60 | 1.00 | 18.00 |
| Income\_G1 | 12,950 | 10.53 | 5.60 | 1.00 | 18.00 |
| Income\_G2 | 12,100 | 10.67 | 5.61 | 1.00 | 18.00 |
| Income\_G3 | 11,080 | 11.18 | 5.50 | 1.00 | 18.00 |
| Income\_G4 | 10,680 | 11.30 | 5.53 | 1.00 | 18.00 |
| Income\_G5 | 10,220 | 11.63 | 5.49 | 1.00 | 18.00 |
| Disability\_K (pr) | 12,750 | .20 | .40 | .00 | 1.00 |
| Disability\_G1 (pr) | 11,870 | .16 | .36 | .00 | 1.00 |
| Disability\_G2 (pr) | 11,200 | .17 | .37 | .00 | 1.00 |
| Disability\_G3 (pr) | 10,090 | .16 | .37 | .00 | 1.00 |
| Disability\_G4 (pr) | 9,700 | .16 | .37 | .00 | 1.00 |
| Disability\_G5 (pr) | 9,040 | .15 | .36 | .00 | 1.00 |
| Health\_K | 13,020 | 3.45 | .78 | 1.00 | 4.00 |
| Health\_G1 | 12,350 | 3.41 | .78 | 1.00 | 4.00 |
| Health\_G2 | 11,590 | 3.37 | .80 | 1.00 | 4.00 |
| Health\_G3 | 10,500 | 3.39 | .79 | 1.00 | 4.00 |
| Health\_G4 | 10,120 | 3.32 | .82 | 1.00 | 4.00 |
| Health\_G5 | 9,380 | 3.35 | .80 | 1.00 | 4.00 |

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLS-K:2011).

*Note:* K and G stand for kindergarten and grade respectively. pr refers to a proportion of individuals who responded “yes” to the question We used composite household income and disability status provided in the ECLS-K. Income was imputed and categorized from $5000 less to above $200,001. Disability status was coded 1 (yes), if the parent answered “yes” to at least one of the questions about diagnosis e.g., child’s ability to be independent and take care of himself or ability to pay attention and learn. Child health condition was measured by parents (1=fair/poor to 4=excellent). Sample sizes were rounded to be nearest 10 in accordance with NCES secure data.

**Appendix S4:** Results from RI-CLPM for reading

|  |  |  |
| --- | --- | --- |
| Models | Girls  | Boys |
| Paths | Standardized coefficients[confidence interval] | Standardized coefficients[confidence interval] |
| $Reading\_{K}$->$Reading\_{G1}$ | .31\*\*\* [.29 to .33] | .33\*\*\* [.31 to .35] |
| $Reading\_{G1}$->$Reading\_{G2}$ | .29\*\*\* [.25 to .32] | .32\*\*\* [.29 to .35] |
| $Reading\_{G2}$->$Reading\_{G3}$ | .09\*\* [.03 to .15] | .18\*\*\* [.11 to .24] |
| $Reading\_{G3}$->$Reading\_{G4}$ | .10\*\* [.03 to .17] | .13\*\*\* [.06 to .21] |
| $Reading\_{G4}$->$Reading\_{G5}$ | .27\*\*\* [.21 to .33] | .30\*\*\* [.24 to .36] |
| $Reading\_{T-1}$->$Reading\_{T}$ | .28\*\*\* [.26 to .29] | .31\*\*\* [.29 to .33] |
| $BMI\_{K}$->$BMI\_{G1}$ | .36\*\*\* [.30 to .42] | .41\*\*\* [.36 to .46] |
| $BMI\_{G1}$->$BMI\_{G2}$ | .25\*\*\* [.15 to .34] | .25\*\*\* [.18 to .33] |
| $BMI\_{G2}$->$BMI\_{G3}$ | .16\* [.04 to .29] | .19\*\* [.05 to .33] |
| $BMI\_{G3}$->$BMI\_{G4}$ | .42\*\*\* [.29 to .56] | .47\*\*\* [.34 to .60] |
| $BMI\_{G4}$->$BMI\_{G5}$ | .58\*\*\* [.45 to .70] | .63\*\*\* [.50 to .76] |
| $BMI\_{T-1}$->$BMI\_{T}$ | .42\*\*\* [.38 to .46] | .47\*\*\* [.42 to .51] |
| $Reading\_{K}$->$BMI\_{G1}$ | -.01 [-.02 to .01] | .00 [-.02 to .02] |
| $Reading\_{G1}$->$BMI\_{G2}$ | -.00 [-.03 to .02] | -.00 [-.03 to .03] |
| $Reading\_{G2}$->$BMI\_{G3}$ | -.01 [-.07 to .06] | -.04 [-.10 to .03] |
| $Reading\_{G3}$->$BMI\_{G4}$ | -.03 [-.08 to .02] | .00 [-.05 to .05] |
| $Reading\_{G4}$->$BMI\_{G5}$ | -.06\* [-.11 to -.01] | -.00 [-.04 to .03] |
| $Reading\_{T-1}$->$BMI\_{T}$ | -.02\*\* [-.03 to -.01] | -.00 [-.01 to .01] |
| $BMI\_{K}$->$Reading\_{G1}$ | .02 [-.02 to .06] | .03 [-.01 to .06] |
| $BMI\_{G1}$->$Reading\_{G2}$ | .03 [-.03 to .09] | -.01 [-.06 to .03] |
| $BMI\_{G2}$->$Reading\_{G3}$ | .01 [-.07 to .10] | .01 [-.06 to .08] |
| $BMI\_{G3}$->$Reading\_{G4}$ | -.08 [-.17 to .02] | -.07 [-.16 to .02] |
| $BMI\_{G4}$->$Reading\_{G5}$ | -.04 [-.11 to .03] | .00 [-.06 to .06] |
| $BMI\_{T-1}$->$Reading\_{T}$ | -.00 [-.02 to .02] | .01 [-.01 to .03] |
| $Cov(U\_{BMI}$ , $U\_{Reading})$ for equality constrained model | -.10\*\*\* [-.12 to -.08] | -.08\*\*\* [-.10 to -.06] |
| $Cov(U\_{BMI}$ , $U\_{Reading})$ for equality unconstrained model | -.10\*\*\* [-.12 to -.07] | -.08\*\*\*[-.10 to -.06] |
| Model fit indices for equality constrained model | $χ^{2}$: 930.85 (57)RMSEA: .04; CFI: .97; TLI: .97 | $χ^{2}$: 981.37 (57)RMSEA: .04; CFI: .97; TLI: .97 |
| Model fit indices for equality unconstrained model | $χ^{2}$: 954.91 (37)RMSEA: .05; CFI: .97; TLI: .95 | $χ^{2}$: 1130.24 (37)RMSEA: .06; CFI: .97; TLI: .94 |

*Note:* *\*\*\*p<.001 \*\*p<.01 \*p<.05*. 95% confidence intervals reported in brackets.

**Appendix S5:** Results from RI-CLPM for math

|  |  |  |
| --- | --- | --- |
| Models | Girls  | Boys  |
| Paths | Standardized coefficients[confidence interval] | Standardized coefficients[confidence interval] |
| $Math\_{K}$->$Math\_{G1}$ | .26\*\*\* [.23 to .30] | .37\*\*\* [.34 to .41] |
| $Math\_{G1}$->$Math\_{G2}$ | .16\*\*\* [.12 to .19] | .23\*\*\* [.19 to .27] |
| $Math\_{G2}$->$Math\_{G3}$ | .18\*\*\* [.12 to .24] | .18\*\*\* [.10 to .26] |
| $Math\_{G3}$->$Math\_{G4}$ | .38\*\*\* [.32 to .43] | .37\*\*\* [.28 to .45] |
| $Math\_{G4}$->$Math\_{G5}$ | .47\*\*\* [.43 to .52] | .47\*\*\* [.42 to .53] |
| $Math\_{T-1}$->$Math\_{T}$ | .30\*\*\* [.28 to .32] | .37\*\*\* [.35 to .39] |
| $BMI\_{K}$->$BMI\_{G1}$ | .36\*\*\* [.30 to .41] | .41\*\*\* [.36 to .46] |
| $BMI\_{G1}$->$BMI\_{G2}$ | .24\*\*\* [.15 to .33] | .25\*\*\* [.18 to .32] |
| $BMI\_{G2}$->$BMI\_{G3}$ | .17\*\* [.04 to .30] | .19\*\* [.06 to .32] |
| $BMI\_{G3}$->$BMI\_{G4}$ | .43\*\*\* [.30 to .56] | .48\*\*\* [.35 to .61] |
| $BMI\_{G4}$->$BMI\_{G5}$ | .58\*\*\* [.47 to .70] | .63\*\*\* [.50 to .76] |
| $BMI\_{T-1}$->$BMI\_{T}$ | .42\*\*\* [.38 to .46] | .47\*\*\* [.42 to .51] |
| $Math\_{K}$->$BMI\_{G1}$ | .01 [-.02 to .03] | -.00 [-.02 to .02] |
| $Math\_{G1}$->$BMI\_{G2}$ | .02 [-.01 to .04] | -.02 [-.05 to .01] |
| $Math\_{G2}$->$BMI\_{G3}$ | -.04 [-.10 to .01] | -.07 [-.14 to .003] |
| $Math\_{G3}$->$BMI\_{G4}$ | -.06\* [-.11 to -.01] | -.02 [-.08 to .04] |
| $Math\_{G4}$->$BMI\_{G5}$ | -.08\*\*\* [-.11 to -.04] | .01 [-.03 to .05] |
| $Math\_{T-1}$->$BMI\_{T}$ | -.02\*\* [-.03 to -.01] | -.01 [-.02 to .001] |
| $BMI\_{K}$->$Math\_{G1}$ | .03 [-.00 to .07] | -.01 [-.04 to .02] |
| $BMI\_{G1}$->$Math\_{G2}$ | .03 [-.03 to .09] | -.04 [-.09 to .02] |
| $BMI\_{G2}$->$Math\_{G3}$ | -.07 [-.16 to .02] | -.02 [-.09 to .06] |
| $BMI\_{G3}$->$Math\_{G4}$ | -.11\*\*\* [-.17 to -.05] | -.03 [-.10 to .04] |
| $BMI\_{G4}$->$Math\_{G5}$ | -.05 [-.10 to .00] | -.01 [-.06 to .04] |
| $BMI\_{T-1}$->$Math\_{T}$ | -.02\* [-.04 to -.002] | -.01 [-.03 to .002] |
| $Cov(U\_{BMI}$ , $U\_{math})$ for equality constrained model | -.10\*\*\* [-.12 to -.08] | -.09\*\*\* [-.11 to -.07] |
| $Cov(U\_{BMI}$ , $U\_{math})$ for equality unconstrained model | -.10\*\*\* [-.12 to -.08] | -.09\*\*\* [-.11 to -.07] |
| Model fit indices for equality constrained model | $χ^{2}$: 646.70 (57)RMSEA: .04; CFI: .98; TLI: .98 | $χ^{2}$: 771.12 (57)RMSEA: .04; CFI: .98; TLI: .97 |
| Model fit indices for equality unconstrained model | $χ^{2}$: 522.84 (37)RMSEA: .04; CFI: .99; TLI: .97 | $χ^{2}$: 762.87 (37)RMSEA: .05; CFI: .98; TLI: .97 |

*Note:* *\*\*\*p<.001 \*\*p<.01 \*p<.05.* 95% confidence intervals reported in brackets.

**Appendix S6:** Results from RI-CLPM for science

|  |  |  |
| --- | --- | --- |
| Models | Girls | Boys |
| Paths  | Standardized coefficients[confidence interval] | Standardized coefficients[confidence interval] |
| $Sci\_{K}$->$Sci\_{G1}$ | .26\*\*\* [.23 to .29] | .29\*\*\* [.27 to .32] |
| $Sci\_{G1}$->$Sci\_{G2}$ | .21\*\*\* [.17 to .25] | .22\*\*\* [.19 to .26] |
| $Sci\_{G2}$->$Sci\_{G3}$ | .13\*\*\* [.09 to .18] | .14\*\*\* [.09 to .20] |
| $Sci\_{G3}$->$Sci\_{G4}$ | .25\*\*\* [.18 to .31] | .26\*\*\* [.20 to .33] |
| $Sci\_{G4}$->$Sci\_{G5}$ | .37\*\*\* [.32 to .41] | .38\*\*\* [.34 to .43] |
| $Sci\_{T-1}$->$Sci\_{T}$ | .27\*\*\* [.26 to .29] | .30\*\*\* [.28 to .31] |
| $BMI\_{K}$->$BMI\_{G1}$ | .36\*\*\* [.30 to .42] | .41\*\*\* [.36 to .46] |
| $BMI\_{G1}$->$BMI\_{G2}$ | .25\*\*\* [.16 to .34] | .25\*\*\* [.17 to .33] |
| $BMI\_{G2}$->$BMI\_{G3}$ | .18\*\* [.05 to .31] | .19\*\* [.05 to .33] |
| $BMI\_{G3}$->$BMI\_{G4}$ | .43\*\*\* [.31 to .56] | .47\*\*\* [.34 to .60] |
| $BMI\_{G4}$->$BMI\_{G5}$ | .59\*\*\* [.47 to .71] | .63\*\*\* [.50 to .76] |
| $BMI\_{T-1}$->$BMI\_{T}$ | .42\*\*\* [.38 to .46] | .47\*\*\* [.42 to .51] |
| $Sci\_{K}$->$BMI\_{G1}$ | -.00 [-.02 to .02] | .01 [-.01 to .03] |
| $Sci\_{G1}$->$BMI\_{G2}$ | .03 [-.001 to .05] | .01 [-.02 to .04] |
| $Sci\_{G2}$->$BMI\_{G3}$ | -.03 [-.07 to .01] | -.03 [-.07 to .02] |
| $Sci\_{G3}$->$BMI\_{G4}$ | -.04 [-.09 to .02] | -.01 [-.06 to .04] |
| $Sci\_{G4}$->$BMI\_{G5}$ | -.04\*\* [-.07 to -.02] | .01 [-.02 to .04] |
| $Sci\_{T-1}$->$BMI\_{T}$ | -.02\*\* [-.03 to -.004] | .01 [-.01 to .02] |
| $BMI\_{K}$->$Sci\_{G1}$ | .03 [-.01 to .07] | -.01 [-.04 to .03] |
| $BMI\_{G1}$->$Sci\_{G2}$ | .00 [-.07 to .07] | -.03 [-.07 to .02] |
| $BMI\_{G2}$->$Sci\_{G3}$ | -.07 [-.16 to .02] | -.03 [-.10 to .05] |
| $BMI\_{G3}$->$Sci\_{G4}$ | -.14\*\*\* [-.22 to -.06] | -.02 [-.10 to .06] |
| $BMI\_{G4}$->$Sci\_{G5}$ | -.10\*\* [-.17 to -.03] | .02 [-.03 to .08] |
| $BMI\_{T-1}$->$Sci\_{T}$ | -.04\*\*\* [-.06 to -.02] | -.00 [-.02 to .02] |
| $Cov(U\_{BMI}$ , $U\_{sci})$ for equality constrained model | -.08\*\*\* [-.10 to -.06] | -.07\*\*\* [-.09 to -.05] |
| $Cov(U\_{BMI}$ , $U\_{sci})$ for equality unconstrained model | -.08\*\*\* [-.10 to -.06] | -.07\*\*\* [-.09 to -.05] |
| Model fit indices for equality constrained model | $χ^{2}$: 659.15 (57)RMSEA: .04; CFI: .98; TLI: .98 | $χ^{2}$: 755.07 (57)RMSEA: .04; CFI: .98; TLI: .98 |
| Model fit indices for equality unconstrained model | $χ^{2}$: 607.90 (37)RMSEA: .04; CFI: .98; TLI: .97 | $χ^{2}$: 799.65 (37)RMSEA: .05; CFI: .98; TLI: .96 |

*Note:* *\*\*\*p<.001 \*\*p<.01 \*p<.05*. 95% confidence intervals reported in brackets.

**Appendix S7:** Results from FE-CLPM with time-varying unit effects and controls

|  |  |  |
| --- | --- | --- |
| Models | Girls  | Boys |
| Paths | Standardized coefficients[confidence interval] | Standardized coefficients[confidence interval] |
| $Reading\_{T-1}$->$Reading\_{T}$ | .28\*\*\* [.27 to .30] | .32\*\*\* [.30 to .33] |
| $BMI\_{T-1}$->$BMI\_{T}$ | .41\*\*\* [.38 to .45] | .46\*\*\* [.41 to .50] |
| $Reading\_{T-1}$->$BMI\_{T}$ | -.02\*\* [-.03 to -.01] | .00 [-.01 to .01] |
| $BMI\_{T-1}$->$Reading\_{T}$ | -.01 [-.03 to .01] | .01[-.01 to .03] |
| Model fir indices for BMI and reading  | $χ^{2}$: 645.38 (135)RMSEA: .02; CFI: .99; TLI:.99 | $χ^{2}$: 753.71 (135)RMSEA: .02; CFI: .99; TLI: .98 |
| $Math\_{T-1}$->$Math\_{T}$ | .29\*\*\* [.27 to .31] | .37\*\*\* [.35 to .38] |
| $BMI\_{T-1}$->$BMI\_{T}$ | .41\*\*\* [.38 to .45] | .46\*\*\* [.41 to .50] |
| $Math\_{T-1}$->$BMI\_{T}$ | -.02\*\* [-.03 to -.01] | -.01 [-.02 to .004] |
| $BMI\_{T-1}$->$Math\_{T}$ | -.02\* [-.04 to -.003] | -.01 [-.03 to .002] |
| Model fir indices for BMI and math | $χ^{2}$: 619.63 (135)RMSEA: .02; CFI: .99; TLI: .99 | $χ^{2}$: 757.18 (135)RMSEA: .02; CFI: .99; TLI: .99 |
| $Science\_{T-1}$->$Science\_{T}$ | .27\*\*\* [.25 to .28] | .29\*\*\* [.27 to .30] |
| $BMI\_{T-1}$->$BMI\_{T}$ | .41\*\*\* [.38 to .45] | .46\*\*\* [.42 to .50] |
| $Science\_{T-1}$->$BMI\_{T}$ | -.02\*\* [-.03 to -.01] | .01 [-.01 to .02] |
| $BMI\_{T-1}$->$Science\_{T}$ | -.05\*\*\* [-.07 to -.03] | -.00 [-.02 to .02] |
| Model fit indices for BMI and science | $χ^{2}$: 627.73 (135)RMSEA: .02; CFI: .99; TLI: .99 | $χ^{2}$: 775.97 (135)RMSEA: .02; CFI: .99; TLI: .98  |

*Note*: *\*\*\*p<.001 \*\*p<.01 \*p<.05*. 95% confidence intervals reported in brackets.

**Appendix S8** Applied Mplus syntax for FE- and RI-CLPM

**FE-CLPM**

! IRTMW\* refers to math IRT scores at each wave

! BMIW\* refers to BMI at each wave

! Create latent unobserved heterogeneity correlated variables at each time point

U\_X by BMIW4@1 BMIW6@1 BMIW7@1 BMIW8@1 BMIW9@1;

U\_Y by IRTMW4@1 IRTMW6@1 IRTMW7@1 IRTMW8@1 IRTMW9@1;

U\_X U\_Y with BMIW2 IRTMW2;

! Autoregressive parameters

BMIW4 BMIW6 BMIW7 BMIW8 BMIW9 pon BMIW2 BMIW4 BMIW6 BMIW7 BMIW8;

IRTMW4 IRTMW6 IRTMW7 IRTMW8 IRTMW9 pon IRTMW2 IRTMW4 IRTMW6 IRTMW7 IRTMW8;

! Cross-lagged effects

BMIW9 on IRTMW8;

BMIW8 on IRTMW7;

BMIW7 on IRTMW6;

BMIW6 on IRTMW4;

BMIW4 on IRTMW2;

IRTMW9 on BMIW8;

IRTMW8 on BMIW7;

IRTMW7 on BMIW6;

IRTMW6 on BMIW4;

IRTMW4 on BMIW2;

! Allow the residuals at subsequent waves to be correlated

BMIW4 BMIW6 BMIW7 BMIW8 BMIW9 pwith IRTMW4 IRTMW6 IRTMW7 IRTMW8 IRTMW9;

**RI-CLPM**

! Create two random intercepts

 U\_X by BMIW2@1 BMIW4@1 BMIW6@1 BMIW7@1 BMIW8@1 BMIW9@1;

 U\_Y by IRTMW2@1 IRTMW4@1 IRTMW6@1 IRTMW7@1 IRTMW8@1 IRTMW9@1;

! Create person mean centered variables

Cbmi0 by BMIW2@1;

Cbmi1 by BMIW4@1;

Cbmi2 by BMIW6@1;

Cbmi3 by BMIW7@1;

 Cbmi4 by BMIW8@1;

 Cbmi5 by BMIW9@1;

 Cmath0 by IRTMW2@1;

 Cmath1 by IRTMW4@1;

 Cmath2 by IRTMW6@1;

 Cmath3 by IRTMW7@1;

 Cmath4 by IRTMW8@1;

 Cmath5 by IRTMW9@1;

 ! Constrain the measurement error variance to zero

 BMIW2-BMIW9@0;

 IRTMW2-IRTMW9@0;

 ! Specify the autoregressive effects between the person mean centered variables

 Cbmi1-Cbmi5 pon Cbmi0-Cbmi4;

 Cmath1-Cmath5 pon Cmath0-Cmath4;

 ! Specify the cross-lagged effects between the person mean centered variables

 Cbmi1 on Cmath0;

 Cbmi2 on Cmath1;

 Cbmi3 on Cmath2;

 Cbmi4 on Cmath3;

 Cbmi5 on Cmath4;

 Cmath1 on Cbmi0;

 Cmath2 on Cbmi1;

 Cmath3 on Cbmi2;

 Cmath4 on Cbmi3;

 Cmath5 on Cbmi4;

 ! Allow the person mean centered variable at the first wave to be correlated

 Cbmi0 with Cmath0;

 ! Allow the residuals (dynamic errors) at subsequent waves to be correlated

 Cbmi1-Cbmi5 pwith Cmath1-Cmath5;

 ! Fix the correlation between the random intercepts and the other exogenous variables to zero

 U\_X with Cbmi0@0 Cmath0@0;

 U\_Y with Cbmi0@0 Cmath0@0;