**Supplementary Materials**

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**Supplementary Tables**

**Table S1. Intergroup differences in demographics, health conditions, and living habits.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variables (M±SD) | SCA (n=154) | CNC (n=173) | MCI (n=256) | *F*/$χ^{2}$/*H* | *p*-value |
| **Demographic Information** |
| Marriage (Y/N) | 126/25 | 143/28 | 188/54 | 3.08 | 0.214 |
| Income | 8.92±3.03 | 8.87±2.81 | 8.53±2.92 | 1.25 | 0.535 |
| **Mental Health** |
| Life self-satisfaction | 5.60±1.08 | 5.35±1.11 | 5.33±1.18 | 5.60 | 0.061 |
| Loneliness | 32.75±7.69 | 32.51±8.44 | 34.56±9.33 | 2.08 | 0.127 |
| Depression | 6.38±5.28 | 6.96±5.75 | 7.82±6.13 | 2.47 | 0.086 |
| **Physical Health** |
| Self-evaluation | 3.28±0.65 | 3.17±0.64 | 3.08±0.72 | 7.10 | 0.029b |
| Diabetes | 22.7% | 26.2% | 31.1% | 3.53 | 0.171 |
| Hypertension | 54.6% | 65.7% | 62.5% | 4.51 | 0.105 |
| Hyperlipidemia | 47.9% | 43.3% | 40.3% | 2.12 | 0.347 |
| CVD | 24.0% | 22.8% | 27.5% | 1.33 | 0.514 |
| CHD | 22.8% | 27.1% | 30.3% | 2.47 | 0.290 |
| **Living habit** |
| Eating regularity | 4.90±2.44 | 4.72±3.12 | 5.29±2.51 | 3.90 | 0.142 |
| Sleep regularity | 4.64±2.39 | 4.30±2.74 | 4.89±2.43 | 2.95 | 0.228 |
| Smoking | 16.9% | 23.4% | 17.3% | 2.68 | 0.262 |
| Drinking | 18.5% | 19.7% | 22.2% | 0.66 | 0.720 |
| PSQI Score | 6.57±3.26 | 6.69±3.93 | 6.99±4.18 | 0.21 | 0.815 |

*Note.* Abbreviation: marriage (Y: yes, married; N: no, single for various reasons including unmarried, widowed, and divorced); CVD, cerebrovascular disease; CHD, coronary heart disease; PSQI, Pittsburgh Sleep Quality Index; *H*, Kruskal-Wallis’ *H* value. Significance: a significant difference between the SCA and CNC groups; b significant difference between the SCA and MCI groups; c significant difference between the CNC and MCI groups.

**Table S2. Intergroup differences in detailed items of leisure activities.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Factors | SCA (n=154) | CNC (n=173) | MCI (n=256) | *H* value | *p-*value |
| Reading | 3.37±1.21 | 3.06±1.52 | 2.87±1.65 | 6.29 | 0.043b |
| Writing | 0.75±1.29 | 0.49±1.07 | 0.49±1.20 | 8.73 | 0.013b |
| Course learning | 0.68±1.10 | 0.35±0.88 | 0.33±0.90 | 16.59 | <0.001a,b |
| Table games | 0.88±1.36 | 0.86±1.35 | 0.63±1.26 | 5.50 | 0.064 |
| Handwork | 0.67±1.30 | 0.31±0.84 | 0.10±0.43 | 24.85 | <0.001a,b,c |
| Calligraphy | 0.92±1.32 | 0.82±1.34 | 0.57±1.20 | 9.35 | 0.009b |
| Arts | 0.99±1.45 | 0.78±1.34 | 0.62±1.27 | 5.31 | 0.070 |
| Watching TV | 3.88±0.67 | 3.90±0.52 | 3.92±0.45 | 0.25 | 0.883 |
| Playing computers | 2.00±1.87 | 1.67±1.92 | 1.10±1.75 | 19.88 | <0.001b,c |
| Playing puzzles | 0.94±1.51 | 0.31±0.95 | 0.27±0.91 | 33.16 | <0.001a,b |
| Exercise | 3.58±1.07 | 3.58±1.11 | 3.36±1.36 | 3.06 | 0.216 |
| Fitness | 0.26±0.83 | 0.43±1.10 | 0.23±0.86 | 4.10 | 0.129 |
| Agility | 1.17±1.70 | 1.16±1.73 | 0.92±1.61 | 2.84 | 0.242 |
| Taiji | 0.59±1.32 | 0.52±1.24 | 0.39±1.11 | 2.93 | 0.231 |
| Outdoor activities | 0.67±1.02 | 0.51±1.05 | 0.47±0.98 | 7.44 | 0.024a,b |
| Travel  | 0.71±0.59 | 0.64±0.59 | 0.53±0.57 | 8.27 | 0.016b |
| Team games | 0.16±0.58 | 0.19±0.70 | 0.10±0.50 | 3.04 | 0.218 |
| Planting | 2.50±1.83 | 2.58±1.83 | 2.51±1.88 | 0.22 | 0.896 |
| Pet | 0.84±1.62 | 0.93±1.69 | 0.92±1.68 | 0.23 | 0.890 |
| Visiting relatives  | 1.73±0.98 | 1.44±0.91 | 1.40±0.93 | 11.22 | 0.004a,b |
| Party  | 0.89±0.99 | 0.78±0.90 | 0.80±0.93 | 0.73 | 0.694 |
| Doing housework | 3.96±0.24 | 3.84±0.74 | 3.61±1.09 | 14.44 | 0.001b,c |
| Babysitting | 1.39±1.79 | 1.07±1.69 | 0.84±1.57 | 9.11 | 0.011b |

*Note.* Significance: a significant difference between the SCA and CNC groups; b significant difference between the SCA and MCI groups; c significant difference between the CNC and MCI groups. *H*, Kruskal-Wallis’ *H* value.

**Table S3. Results of the relative importance of influencing factors to each cognitive domain in the full sample (N=1347).**

|  |  |  |  |
| --- | --- | --- | --- |
| Cognitive domain | Factors | Multiple linear regression | Regression relative importance (lmg) |
| Standardized *β* | *p*-value |
| Cognitive Z-score($R^{2}$=0.326) | Education | 0.38 | <0.001 | 43.3% |
| Age | -0.27 | <0.001 | 19.5% |
| Mental activity | 0.25 | <0.001 | 12.9% |
| Occupation | 0.08 | 0.065 | 12.8% |
| Social activity | -0.12 | 0.140 | 6.2% |
| Physical activity | -0.01 | 0.917 | 3.7% |
| MS | 0.03 | 0.392 | 0.9% |
| BMI | -0.02 | 0.594 | 0.4% |
| Gender | 0.01 | 0.750 | 0.4% |
| Memory Z-score($R^{2}$=0.195) | Education | 0.28 | <0.001 | 37.1% |
| Age | -0.18 | <0.001 | 15.3% |
| MS | 0.15 | <0.001 | 13.0% |
| Mental activity | 0.17 | 0.020 | 12.5% |
| Occupation | 0.02 | 0.588 | 7.9% |
| Social activity | -0.13 | 0.130 | 6.3% |
| Physical activity | 0.06 | 0.403 | 5.1% |
| Gender | 0.08 | 0.025 | 2.5% |
| BMI | -0.02 | 0.626 | 0.4% |
| Visuospatial Z-score($R^{2}$=0.152) | Education | 0.31 | <0.001 | 57.7% |
| Occupation | 0.05 | 0.303 | 15.5% |
| Age | -0.13 | 0.001 | 8.8% |
| Mental activity | 0.14 | 0.061 | 7.2% |
| Gender | -0.07 | 0.063 | 4.7% |
| Social activity | -0.18 | 0.035 | 3.1% |
| Physical activity | 0.05 | 0.462 | 1.4% |
| BMI | -0.03 | 0.476 | 1.3% |
| MS | -0.03 | 0.492 | 0.3% |
| Attention Z-score ($R^{2}$=0.270) | Education | 0.32 | <0.001 | 41.5% |
| Age | -0.25 | <0.001 | 20.3% |
| Occupation | 0.10 | 0.020 | 15.2% |
| Mental activity | 0.20 | 0.005 | 12.1% |
| Social activity | -0.03 | 0.670 | 6.6% |
| Physical activity | -0.05 | 0.454 | 3.5% |
| Gender | 0.01 | 0.866 | 0.4% |
| MS | -0.01 | 0.829 | 0.3% |
| BMI | <0.01 | 0.926 | 0.1% |
| Executive Z-score ($R^{2}$=0.155) | Age | -0.20 | 0.001 | 23.6% |
| Education | 0.15 | 0.001 | 22.7% |
| Mental activity | 0.22 | 0.003 | 20.2% |
| Occupation | 0.09 | 0.058 | 12.0% |
| Social activity | 0.02 | 0.847 | 10.9% |
| Physical activity | -0.08 | 0.262 | 6.0% |
| BMI | -0.06 | 0.127 | 2.6% |
| Gender | 0.05 | 0.158 | 1.5% |
| MS | -0.02 | 0.520 | 0.5% |

*Note.* Abbreviation: MS: memory self-satisfaction; BMI: body mass index.

**Table S4. Estimated direct and indirect effects of the grouped sample (N=583) SEM with ECR, LLA, and four cognitive domains as latent factors.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model paths | Estimate | S.E. | Est./S.E. | *p*-value | 95%CI |
| **Measurement model** |
| ECR$\rightarrow $EDU | 0.905 | 0.047 | 19.386 | <0.001 | (0.813, 0.996) |
| ECR$\rightarrow $OCC | 0.630 | 0.040 | 15.719 | <0.001 | (0.551, 0.708) |
| LLA$\rightarrow $MA | 0.886 | 0.015 | 59.079 | <0.001 | (0.856, 0.915) |
| LLA$\rightarrow $PA | 0.862 | 0.016 | 52.390 | <0.001 | (0.830, 0.894) |
| LLA$\rightarrow $SA | 0.957 | 0.012 | 82.245 | <0.001 | (0.934, 0.979) |
| MEM$\rightarrow $N5 | 0.961 | 0.008 | 115.292 | <0.001 | (0.944, 0.977) |
| MEM$\rightarrow $N1N5 | 0.979 | 0.009 | 111.542 | <0.001 | (0.962, 0.996) |
| MEM$\rightarrow $CFT delay | 0.480 | 0.035 | 13.911 | <0.001 | (0.413, 0.548) |
| VSA$\rightarrow $CFT copy | 0.590 | 0.056 | 10.472 | <0.001 | (0.479, 0.700) |
| VSA$\rightarrow $CDT | 0.562 | 0.051 | 11.023 | <0.001 | (0.462, 0.662) |
| ATT$\rightarrow $SDMT | 0.823 | 0.026 | 31.206 | <0.001 | (0.771, 0.874) |
| ATT$\rightarrow $TMTA | 0.645 | 0.030 | 21.709 | <0.001 | (0.586, 0.703) |
| EF$\rightarrow $SCWT | 0.319 | 0.046 | 6.922 | <0.001 | (0.229, 0.410) |
| EF$\rightarrow $TMTB | 0.819 | 0.057 | 14.475 | <0.001 | (0.708, 0.930) |
| **Structural model: direct effects**  |
| ECR$\rightarrow $LLA | 0.282 | 0.055 | 5.134 | <0.001 | (0.174, 0.390) |
| LLA$\rightarrow $MEM | 0.196 | 0.052 | 3.739 | <0.001 | (0.093, 0.299) |
| LLA$\rightarrow $VSA | 0.054 | 0.073 | 0.745 | 0.456 | (-0.089, 0.198) |
| LLA$\rightarrow $ATT | 0.224 | 0.060 | 3.716 | <0.001 | (0.106, 0.343) |
| LLA$\rightarrow $EF | 0.209 | 0.058 | 3.577 | <0.001 | (0.094, 0.323) |
| ECR$\rightarrow $MEM | 0.311 | 0.043 | 7.159 | <0.001 | (0.226, 0.396) |
| ECR$\rightarrow $VSA | 0.557 | 0.068 | 8.163 | <0.001 | (0.423, 0.691) |
| ECR$\rightarrow $ATT | 0.480 | 0.055 | 8.749 | <0.001 | (0.372, 0.587) |
| ECR$\rightarrow $EF | 0.499 | 0.069 | 7.225 | <0.001 | (0.364, 0.634) |
| **Structural model: indirect effects** |
| ECR$\rightarrow $LLA$\rightarrow $MEM | 0.055 | 0.018 | 3.102 | 0.002 | (0.020, 0.090) |
| ECR$\rightarrow $LLA$\rightarrow $VSA | 0.015 | 0.021 | 0.735 | 0.463 | (-0.026, 0.056) |
| ECR$\rightarrow $LLA$\rightarrow $ATT | 0.063 | 0.020 | 3.217 | 0.001 | (0.025, 0.102) |
| ECR$\rightarrow $LLA$\rightarrow $EF | 0.059 | 0.018 | 3.201 | 0.001 | (0.023, 0.095) |
| **Structural model: total effect** |
| ECR$\rightarrow $MEM | 0.366 | 0.040 | 9.050 | <0.001 | (0.287, 0.445) |
| ECR$\rightarrow $VSA | 0.572 | 0.063 | 9.113 | <0.001 | (0.449, 0.696) |
| ECR$\rightarrow $ATT | 0.543 | 0.050 | 10.840 | <0.001 | (0.445, 0.641) |
| ECR$\rightarrow $EF | 0.558 | 0.067 | 8.318 | <0.001 | (0.426, 0.689) |

*Note.* Abbreviation: S.E. standard error; Est.: estimate; CI: confidence interval; ECR, early-life cognitive reserve; LLA, late-life leisure activity; EDU, level of education; OCC, occupational attainment; MA, mental activity; PA, physical activity; SA, social activity; MEM, memory; VSA, visuospatial ability; ATT, attention; EF, executive function; N5, auditory verbal learning test long-time delayed recall; N1N5, auditory verbal learning test total recall; CFT delay, Rey-Osterrieth complex figure test recall; CFT copy, Rey-Osterrieth complex figure test copy; CDT, clock-drawing test; SDMT, symbol digit modalities test; TMTA, trail-making test part A; SCWT, symbol digit modalities test; TMTB, trail-making test part B.

**Table S5. Estimated direct and indirect effects of the grouped sample (N=583) SEM with ECR, LLA, and general cognitive function as latent factors.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model paths | Estimate | S.E. | Est./S.E. | *p*-value | 95%CI |
| **Measurement model** |
| ECR$\rightarrow $EDU | 0.902 | 0.054 | 16.669 | <0.001 | (0.796, 1.008) |
| ECR$\rightarrow $OCC | 0.632 | 0.044 | 14.519 | <0.001 | (0.546, 0.717) |
| LLA$\rightarrow $MA | 0.887 | 0.015 | 59.498 | <0.001 | (0.857, 0.916) |
| LLA$\rightarrow $PA | 0.862 | 0.016 | 52.690 | <0.001 | (0.830, 0.894) |
| LLA$\rightarrow $SA | 0.956 | 0.012 | 83.066 | <0.001 | (0.934, 0.979) |
| COG$\rightarrow $Z-MEM | 0.636 | 0.034 | 18.672 | <0.001 | (0.569, 0.703) |
| COG$\rightarrow $Z-VSA | 0.552 | 0.037 | 14.831 | <0.001 | (0.479, 0.625) |
| COG$\rightarrow $Z-ATT | 0.753 | 0.029 | 26.272 | <0.001 | (0.697, 0.809) |
| COG$\rightarrow $Z-EF | 0.634 | 0.037 | 17.022 | <0.001 | (0.561, 0.707) |
| **Structural model: direct effects**  |
| ECR$\rightarrow $LLA | 0.287 | 0.056 | 5.139 | <0.001 | (0.178, 0.397) |
| LLA$\rightarrow $COG | 0.273 | 0.057 | 4.768 | <0.001 | (0.161, 0.385) |
| ECR$\rightarrow $COG | 0.493 | 0.057 | 8.628 | <0.001 | (0.381, 0.604) |
| **Structural model: indirect effects** |
| ECR$\rightarrow $LLA$\rightarrow $COG | 0.078 | 0.021 | 3.774 | <0.001 | (0.038, 0.119) |
| **Structural model: total effect** |
| ECR$\rightarrow $COG | 0.571 | 0.053 | 10.860 | <0.001 | (0.468, 0.674) |

*Note.* Abbreviation: S.E. standard error; Est.: estimate; CI: confidence interval; ECR, early-life cognitive reserve; LLA, late-life leisure activity; EDU, level of education; OCC, occupational attainment; MA, mental activity; PA, physical activity; SA, social activity; Z-MEM, mean Z-score of tests in memory domain; Z-VSA, mean Z-score of tests in visuospatial ability domain; Z-ATT, mean Z-score of tests in attention domain; Z-EF, mean Z-score of tests in executive function domain; COG, general cognitive function.

**Table S6. Estimated direct and indirect effects of the full sample (N=1347) SEM with ECR, LLA, and four cognitive domains as latent factors.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model paths | Estimate | S.E. | Est./S.E. | *p*-value | 95%CI |
| **Measurement model** |
| ECR$\rightarrow $EDU | 0.916 | 0.030 | 30.556 | <0.001 | (0.857, 0.974) |
| ECR$\rightarrow $OCC | 0.607 | 0.027 | 22.561 | <0.001 | (0.555, 0.660) |
| LLA$\rightarrow $MA | 0.884 | 0.009 | 96.346 | <0.001 | (0.866, 0.902) |
| LLA$\rightarrow $PA | 0.855 | 0.011 | 80.922 | <0.001 | (0.835, 0.876) |
| LLA$\rightarrow $SA | 0.964 | 0.007 | 140.786 | <0.001 | (0.950, 0.977) |
| MEM$\rightarrow $N5 | 0.928 | 0.010 | 90.548 | <0.001 | (0.908, 0.948) |
| MEM$\rightarrow $N1N5 | 0.971 | 0.010 | 98.168 | <0.001 | (0.952, 0.991) |
| MEM$\rightarrow $CFT delay | 0.325 | 0.026 | 12.425 | <0.001 | (0.274, 0.377) |
| VSA$\rightarrow $CFT copy | 0.480 | 0.040 | 12.104 | <0.001 | (0.402, 0.557) |
| VSA$\rightarrow $CDT | 0.450 | 0.039 | 11.540 | <0.001 | (0.374, 0.526) |
| ATT$\rightarrow $SDMT | 0.778 | 0.019 | 40.826 | <0.001 | (0.740, 0.815) |
| ATT$\rightarrow $TMTA | 0.659 | 0.020 | 32.389 | <0.001 | (0.619, 0.698) |
| EF$\rightarrow $SCWT | 0.296 | 0.030 | 9.910 | <0.001 | (0.238, 0.355) |
| EF$\rightarrow $TMTB | 0.792 | 0.042 | 19.070 | <0.001 | (0.711, 0.874) |
| **Structural model: direct effects**  |
| ECR$\rightarrow $LLA | 0.291 | 0.037 | 7.928 | <0.001 | (0.219, 0.363) |
| LLA$\rightarrow $MEM | 0.137 | 0.036 | 3.855 | <0.001 | (0.068, 0.207) |
| LLA$\rightarrow $VSA | 0.056 | 0.061 | 0.916 | 0.360 | (-0.063, 0.175) |
| LLA$\rightarrow $ATT | 0.198 | 0.042 | 4.730 | <0.001 | (0.116, 0.281) |
| LLA$\rightarrow $EF | 0.175 | 0.042 | 4.170 | <0.001 | (0.092, 0.257) |
| ECR$\rightarrow $MEM | 0.233 | 0.030 | 7.740 | <0.001 | (0.174, 0.292) |
| ECR$\rightarrow $VSA | 0.623 | 0.058 | 10.773 | <0.001 | (0.510, 0.737) |
| ECR$\rightarrow $ATT | 0.524 | 0.038 | 13.767 | <0.001 | (0.449, 0.599) |
| ECR$\rightarrow $EF | 0.520 | 0.046 | 11.375 | <0.001 | (0.430, 0.609) |
| **Structural model: indirect effects** |
| ECR$\rightarrow $LLA$\rightarrow $MEM | 0.040 | 0.012 | 3.423 | 0.001 | (0.017, 0.063) |
| ECR$\rightarrow $LLA$\rightarrow $VSA | 0.016 | 0.018 | 0.915 | 0.360 | (-0.018, 0.051) |
| ECR$\rightarrow $LLA$\rightarrow $ATT | 0.058 | 0.013 | 4.372 | <0.001 | (0.032, 0.083) |
| ECR$\rightarrow $LLA$\rightarrow $EF | 0.051 | 0.012 | 4.069 | <0.001 | (0.026, 0.075) |
| **Structural model: total effect** |
| ECR$\rightarrow $MEM | 0.273 | 0.027 | 9.956 | <0.001 | (0.220, 0.327) |
| ECR$\rightarrow $VSA | 0.640 | 0.054 | 11.929 | <0.001 | (0.534, 0.745) |
| ECR$\rightarrow $ATT | 0.582 | 0.034 | 17.075 | <0.001 | (0.515, 0.649) |
| ECR$\rightarrow $EF | 0.570 | 0.043 | 13.183 | <0.001 | (0.485, 0.655) |

*Note.* Abbreviation: S.E. standard error; Est.: estimate; CI: confidence interval; ECR, early-life cognitive reserve; LLA, late-life leisure activity; EDU, level of education; OCC, occupational attainment; MA, mental activity; PA, physical activity; SA, social activity; MEM, memory; VSA, visuospatial ability; ATT, attention; EF, executive function; N5, auditory verbal learning test long-time delayed recall; N1N5, auditory verbal learning test total recall; CFT delay, Rey-Osterrieth complex figure test recall; CFT copy, Rey-Osterrieth complex figure test copy; CDT, clock-drawing test; SDMT, symbol digit modalities test; TMTA, trail-making test part A; SCWT, symbol digit modalities test; TMTB, trail-making test part B.

**Table S7. Estimated direct and indirect effects of the full sample (N=1347) SEM with ECR, LLA, and general cognitive function as latent factors.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model paths | Estimate | S.E. | Est./S.E. | *p*-value | 95%CI |
| **Measurement model** |
| ECR$\rightarrow $EDU | 0.913 | 0.035 | 26.455 | <0.001 | (0.845, 0.981) |
| ECR$\rightarrow $OCC | 0.609 | 0.029 | 20.981 | <0.001 | (0.552, 0.666) |
| LLA$\rightarrow $MA | 0.885 | 0.009 | 96.683 | <0.001 | (0.867, 0.903) |
| LLA$\rightarrow $PA | 0.856 | 0.011 | 81.258 | <0.001 | (0.835, 0.877) |
| LLA$\rightarrow $SA | 0.963 | 0.007 | 141.604 | <0.001 | (0.950, 0.976) |
| COG$\rightarrow $Z-MEM | 0.539 | 0.027 | 19.697 | <0.001 | (0.486, 0.593) |
| COG$\rightarrow $Z-VSA | 0.504 | 0.029 | 17.587 | <0.001 | (0.448, 0.561) |
| COG$\rightarrow $Z-ATT | 0.790 | 0.022 | 36.072 | <0.001 | (0.747, 0.832) |
| COG$\rightarrow $Z-EF | 0.622 | 0.026 | 23.936 | <0.001 | (0.571, 0.672) |
| **Structural model: direct effects**  |
| ECR$\rightarrow $LLA | 0.294 | 0.037 | 7.975 | <0.001 | (0.221, 0.366) |
| LLA$\rightarrow $COG | 0.244 | 0.039 | 6.213 | <0.001 | (0.167, 0.321) |
| ECR$\rightarrow $COG | 0.506 | 0.039 | 13.068 | <0.001 | (0.430, 0.582) |
| **Structural model: indirect effects** |
| ECR$\rightarrow $LLA$\rightarrow $COG | 0.072 | 0.013 | 5.311 | <0.001 | (0.045, 0.098) |
| **Structural model: total effect** |
| ECR$\rightarrow $COG | 0.578 | 0.035 | 16.628 | <0.001 | (0.510, 0.646) |

*Note.* Abbreviation: S.E. standard error; Est.: estimate; CI: confidence interval; ECR, early-life cognitive reserve; LLA, late-life leisure activity; EDU, level of education; OCC, occupational attainment; MA, mental activity; PA, physical activity; SA, social activity; Z-MEM, mean Z-score of tests in memory domain; Z-VSA, mean Z-score of tests in visuospatial ability domain; Z-ATT, mean Z-score of tests in attention domain; Z-EF, mean Z-score of tests in executive function domain; COG, general cognitive function.

**Table S8. Estimated direct and indirect effects of the multi-group SEM with ECR, LLA, and general cognitive function as latent factors.**

|  |  |  |  |
| --- | --- | --- | --- |
|  | SCA group (N=154) | CNC group (N=173) | MCI group (N=256) |
| Model paths | Estimate (95%CI) | S.E. | *p*-value | Estimate (95%CI) | S.E. | *p*-value | Estimate (95%CI) | S.E. | *p*-value |
| **Measurement model** |
| ECR$\rightarrow $EDU | 1.015 (0.080, 1.950) | 0.477 | 0.033 | 0.847 (0.639, 1.055) | 0.106 | <0.001 | 0.813 (0.408, 1.218) | 0.207 | <0.001 |
| ECR$\rightarrow $OCC | 0.465 (0.201, 0.728) | 0.134 | 0.001 | 0.705 (0.540, 0.870) | 0.084 | <0.001 | 0.658 (0.375, 0.940) | 0.144 | <0.001 |
| LLA$\rightarrow $MA | 0.843 (0.776, 0.909) | 0.034 | <0.001 | 0.929 (0.886, 0.971) | 0.022 | <0.001 | 0.849 (0.789, 0.909) | 0.030 | <0.001 |
| LLA$\rightarrow $PA | 0.850 (0.779, 0.922) | 0.036 | <0.001 | 0.878 (0.830, 0.926) | 0.024 | <0.001 | 0.843 (0.787, 0.900) | 0.029 | <0.001 |
| LLA$\rightarrow $SA | 0.967 (0.918, 1.017) | 0.025 | <0.001 | 0.954 (0.912, 0.997) | 0.022 | <0.001 | 0.950 (0.913, 0.988) | 0.019 | <0.001 |
| COG$\rightarrow $Z-MEM | n.s. | n.s. | n.s. | 0.378 (0.167, 0.589) | 0.108 | <0.001 | n.s. | n.s. | n.s. |
| COG$\rightarrow $Z-VSA | 0.283 (0.083, 0.483) | 0.102 | 0.006 | 0.439 (0.172, 0.706) | 0.136 | 0.001 | 0.402 (0.168, 0.636) | 0.119 | 0.001 |
| COG$\rightarrow $Z-ATT | 0.659 (0.438, 0.881) | 0.113 | <0.001 | 0.524 (0.273, 0.775) | 0.128 | <0.001 | 0.666 (0.392, 0.940) | 0.140 | <0.001 |
| COG$\rightarrow $Z-EF | 0.533 (0.294, 0.772) | 0.122 | <0.001 | n.s. | n.s. | n.s. | 0.468 (0.254, 0.682) | 0.109 | <0.001 |
| **Structural model: direct effects**  |
| ECR$\rightarrow $LLA | 0.093 (-0.093, 0.280) | 0.095 | 0.327 | 0.387 (0.155, 0.620) | 0.118 | 0.001 | 0.229 (0.015, 0.444) | 0.109 | 0.036 |
| LLA$\rightarrow $COG | 0.236 (-0.021, 0.494) | 0.131 | 0.071 | -0.148 (-0.577, 0.280) | 0.218 | 0.497 | 0.320 (0.072, 0.569) | 0.127 | 0.012 |
| ECR$\rightarrow $COG | 0.473 (0.192, 0.753) | 0.143 | 0.001 | 0.684 (0.348, 1.019) | 0.171 | <0.001 | 0.416 (0.105, 0.726) | 0.158 | 0.009 |
| **Structural model: indirect effects** |
| ECR$\rightarrow $LLA$\rightarrow $COG | 0.022 (-0.034, 0.078) | 0.029 | 0.440 | -0.057 (-0.253, 0.138) | 0.100 | 0.564 | 0.073 (-0.013, 0.160) | 0.044 | 0.096 |
| **Structural model: total effect** |
| ECR$\rightarrow $COG | 0.495 (0.217, 0.772) | 0.142 | <0.001 | 0.626 (0.365, 0.887) | 0.133 | <0.001 | 0.489 (0.188, 0.790) | 0.154 | 0.001 |

*Note*. Abbreviation: S.E. standard error; n.s.: not significant; ECR, early-life cognitive reserve; LLA, late-life leisure activity; EDU, level of education; OCC, occupational attainment; MA, mental activity; PA, physical activity; SA, social activity; Z-MEM, mean Z-score of tests in memory domain; Z-VSA, mean Z-score of tests in visuospatial ability domain; Z-ATT, mean Z-score of tests in attention domain; Z-EF, mean Z-score of tests in executive function domain; COG, general cognitive function.

**Supplementary Figures**



**Figure S1. Structural equation models that reveal relationships among ECR, LLA, and cognitive performance in the full sample (N=1347).** Full lines with arrows indicate significant paths and dotted lines indicate insignificant paths. Bold numbers without asterisks are significant path coefficients (*β*, all *p*<0.001), bold numbers with asterisks (\**p*<0.05, \*\**p*<0.01, and \*\*\**p*<0.001) indicate indirect effects, and narrow numbers are residual variances. Metrics that represent the goodness of model fit are listed separately. **(A)** Full sample (N=1347) SEM model built with ECR, LLA, and four cognitive domains. **(B)** Full sample (N=1347) SEM model built with ECR, LLA, and general cognitive function. Abbreviation: ECR, early-life cognitive reserve; LLA, late-life leisure activity; MEM, memory; VSA, visuospatial ability; ATT, attention; EF, executive function; EDU, level of education; OCC, occupational attainment; MA, mental activity; PA, physical activity; SA, social activity; N5, auditory verbal learning test long-time delayed recall; N1N5, auditory verbal learning test total recall; CFT, Rey-Osterrieth complex figure test; CDT, clock-drawing test; SDMT, symbol digit modalities test; TMTA, trail-making test part A; SCWT, Stroop color-word test; TMTB, trail-making test part B; COG, general cognitive function; Z-MEM, mean Z-score of tests in memory domain; Z-VSA, mean Z-score of tests in visuospatial ability domain; Z-ATT, mean Z-score of tests in attention domain; Z-EF, mean Z-score of tests in executive function domain.