

SUPPLEMENTAL MATERIAL

Table S1. Participant characteristics of those included and excluded from analyses, the CARDIA Study, (2005-16)*

| Year 20 Participant Characteristics | Overall | Included | | Excluded | | P-value |
|---|-------------------|----------|--------------------------|----------|--------------------------|---------|
| | | N | Mean \pm SD or n(%) | N | Mean \pm SD or n(%) | |
| Age, years \pm SD | 45.21 \pm 3.63 | 1970 | 45.27 \pm 3.56 | 1579 | 45.14 \pm 3.71 | 0.293 |
| Female, n(%) | 2787 (54.50) | 1970 | 1148 (58.27) | 1579 | 866 (54.84) | 0.040 |
| White, n(%) | 2477 (48.44) | 1970 | 1179 (59.85) | 1579 | 719 (45.54) | <0.001 |
| Education, years \pm SD | 15.00 \pm 2.58 | 1970 | 15.32 \pm 2.53 | 1559 | 14.60 \pm 2.58 | <0.001 |
| Unemployment, n(%) | 434 (12.29) | 1970 | 198 (10.05) | 1561 | 236 (15.12) | <0.001 |
| Health insurance, n(%) | 3085 (87.22) | 1970 | 1766 (89.64) | 1567 | 1319 (84.19) | <0.001 |
| CES-D score \pm SD | 9.33 \pm 7.87 | 1970 | 8.48 \pm 7.21 | 1478 | 10.46 \pm 8.55 | <0.001 |
| BMI, kg/m ² \pm SD | 29.46 \pm 7.24 | 1970 | 28.95 \pm 6.96 | 1559 | 30.11 \pm 7.54 | <0.001 |
| Diabetes, n(%) | 332 (6.49) | 1970 | 154 (7.82) | 1552 | 178 (11.47) | <0.001 |
| Hypertension, n(%) | 1209 (34.09) | 1970 | 579 (29.39) | 1576 | 630 (39.97) | <0.001 |
| Cardiovascular/renal disease, n(%) | 210 (4.34) | 1970 | 75 (3.86) | 1604 | 89 (5.77) | 0.008 |
| ApoE E4 allele, n(%) | 1183 (30.26) | 1794 | 508 (28.32) | 1299 | 413 (31.79) | 0.037 |
| Smoking status, n(%) | | 1970 | | 1545 | | <0.001 |
| Current | 683 (19.43) | | 293 (14.87) | | 390 (25.24) | |
| Former | 682 (19.40) | | 414 (21.02) | | 268 (17.35) | |
| Never | 2150 (61.17) | | 1263 (64.11) | | 887 (57.41) | |
| Alcohol, ml/day \pm SD | 10.83 \pm 22.24 | 1970 | 11.01 \pm 22.85 | 1497 | 10.61 \pm 21.42 | 0.599 |
| Diet quality score \pm SD | 62.34 \pm 13.03 | 1753 | 63.52 \pm 12.76 | 1336 | 60.78 \pm 13.21 | <0.001 |
| Sleep quality, n(%) | | 1970 | | 1525 | | 0.001 |
| Very good | 625 (17.88) | | 353 (17.92) | | 272 (17.84) | |
| Fairly good | 1226 (35.08) | | 720 (36.55) | | 506 (33.18) | |
| Good | 1032 (29.53) | | 581 (29.49) | | 451 (29.57) | |
| Fairly bad | 542 (15.51) | | 292 (14.82) | | 250 (16.39) | |
| Very bad | 70 (2.00) | | 24 (1.22) | | 46 (3.02) | |
| Self-reported snoring, n(%) | 1888 (53.93) | 1970 | 1105 (56.09) | 1531 | 783 (51.14) | 0.004 |
| Self-reported sleep hours \pm SD | 6.69 \pm 1.50 | 1970 | 6.70 \pm 1.30 | 1441 | 6.66 \pm 1.74 | 0.473 |
| Accelerometer measured activity, min/day \pm SD | | | | | | |

| | | | | | | |
|-------------------------------|-----------------|------|-----------------|------|-----------------|--------|
| Sedentary | 486.96 ± 104.50 | 1970 | 490.57 ± 101.48 | 362 | 467.30 ± 117.84 | <0.001 |
| LPA | 360.81 ± 86.83 | 1970 | 360.61 ± 85.44 | 362 | 361.86 ± 94.15 | 0.815 |
| MVPA | 35.57 ± 25.94 | 1970 | 35.81 ± 26.04 | 358 | 34.27 ± 25.41 | 0.301 |
| Sleep† | 509.16 ± 72.27 | 1970 | 506.32 ± 67.90 | 362 | 524.60 ± 91.10 | <0.001 |
| Year 5 cognition scores ± SD | | | | | | |
| DSST‡ | 70.08 ± 16.07 | 1870 | 72.98 ± 15.20 | 1477 | 66.41 ± 16.39 | <0.001 |
| RAVLT§ | 8.35 ± 3.25 | 1865 | 8.83 ± 3.18 | 1470 | 7.75 ± 3.23 | <0.001 |
| Stroop | 22.76 ± 10.97 | 1868 | 21.40 ± 9.82 | 1478 | 24.47 ± 12.05 | <0.001 |
| Year 10 cognition scores ± SD | | | | | | |
| DSST‡ | 67.45 ± 16.96 | 1758 | 70.60 ± 15.98 | 1366 | 63.39 ± 17.32 | <0.001 |
| RAVLT§ | 8.43 ± 3.46 | 1765 | 8.99 ± 3.32 | 1375 | 7.72 ± 3.52 | <0.001 |
| Stroop | 23.02 ± 11.69 | 1735 | 21.23 ± 9.94 | 1329 | 25.36 ± 13.29 | <0.001 |

SED = sedentary behavior, LPA = light-intensity physical activity; MVPA = moderate-to-vigorous intensity physical activity; CES-D = Center for Epidemiologic Studies Depression Scale; BMI = body mass index; DSST = Digital Symbol Substitution Test; RAVLT = Rey Auditory Verbal Learning Test

*Data presented from the CARDIA year 20 exam (2005-06; baseline for these analyses) unless otherwise specified

†Non-wear time from the accelerometer was used to approximate sleep minutes if accelerometer non-wear time was within one hour of self-reported sleep time. If non-wear time and self-reported sleep time differed by more than one hour, the average of non-wear time and self-reported sleep were used to estimate sleep minutes.

‡DSST score range from 0 to 133, higher score indicates better performance

§RAVLT score range from 0 to 15, higher score indicates better performance

||Stroop score range from -160 to 160, higher score indicates worse performance

Table S2. Participant characteristics of those with and without cognitive function measures, the CARDIA Study, (2005-06).

| Year 20 Participant Characteristics | With Cognitive Function Measures | | Without Cognitive Function Measures | | P-value |
|---|----------------------------------|-----------------------|-------------------------------------|-----------------------|---------|
| | N | Mean \pm SD or n(%) | N | Mean \pm SD or n(%) | |
| Age, years \pm SD | 1970 | 45.27 \pm 3.56 | 325 | 44.97 \pm 3.84 | 0.167 |
| Female, n(%) | 1970 | 1148 (58.27) | 325 | 170 (52.31) | 0.044 |
| White, n(%) | 1970 | 1179 (59.85) | 325 | 142 (43.69) | <0.001 |
| Education, years \pm SD | 1970 | 15.32 \pm 2.53 | 321 | 14.38 \pm 2.57 | <0.001 |
| Unemployment, n(%) | 1970 | 198 (10.05) | 321 | 59 (18.38) | <0.001 |
| Health insurance, n(%) | 1970 | 1766 (89.64) | 321 | 260 (81.00) | <0.001 |
| CES-D score \pm SD | 1970 | 8.48 \pm 7.21 | 312 | 11.18 \pm 8.82 | <0.001 |
| BMI, kg/m ² \pm SD | 1970 | 28.95 \pm 6.96 | 318 | 29.80 \pm 8.07 | 0.076 |
| Diabetes, n(%) | 1970 | 154 (7.82) | 325 | 39 (12.00) | 0.012 |
| Hypertension, n(%) | 1970 | 579 (29.39) | 324 | 140 (43.21) | <0.001 |
| Cardiovascular/renal disease, n(%) | 1970 | 75 (3.86) | 313 | 14 (4.47) | 0.603 |
| ApoE E4 allele, n(%) | 1794 | 508 (28.32) | 232 | 64 (27.59) | 0.816 |
| Smoking status, n(%) | 1970 | | 320 | | <0.001 |
| Current | | 293 (14.87) | | 84 (26.25) | |
| Former | | 414 (21.02) | | 51 (15.94) | |
| Never | | 1263 (64.11) | | 185 (57.81) | |
| Alcohol, ml/day \pm SD | 1970 | 11.01 \pm 22.85 | 318 | 9.98 \pm 22.26 | 0.456 |
| Diet quality score \pm SD | 1753 | 63.52 \pm 12.76 | 269 | 60.76 \pm 13.06 | 0.001 |
| Sleep quality, n(%) | 1970 | | 316 | | 0.015 |
| Very good | | 353 (17.92) | | 54 (17.09) | |
| Fairly good | | 720 (36.55) | | 99 (31.33) | |
| Good | | 581 (29.49) | | 104 (32.91) | |
| Fairly bad | | 292 (14.82) | | 48 (15.19) | |
| Very bad | | 24 (1.22) | | 11 (3.48) | |
| Self-reported snoring, n(%) | 1970 | 1105 (56.09) | 316 | 138 (43.67) | <0.001 |
| Self-reported sleep hours \pm SD | 1970 | 6.70 \pm 1.30 | 300 | 6.59 \pm 1.74 | 0.286 |
| Accelerometer measured activity, min/day \pm SD | | | | | |
| Sedentary | 1970 | 490.57 \pm 101.48 | 156 | 470.44 \pm 100.43 | 0.017 |
| LPA | 1970 | 360.61 \pm 85.44 | 156 | 357.16 \pm 95.54 | 0.662 |
| MVPA | 1970 | 35.81 \pm 26.04 | 155 | 32.41 \pm 26.52 | 0.118 |
| Sleep† | 1970 | 506.32 \pm 67.90 | 156 | 525.49 \pm 81.09 | 0.005 |

SED = sedentary behavior, LPA = light-intensity physical activity; MVPA = moderate-to-vigorous intensity physical activity; CES-D = Center for Epidemiologic Studies Depression Scale; BMI = body mass index; DSST = Digital Symbol Substitution Test; RAVLT = Rey Auditory Verbal Learning Test
†Non-wear time from the accelerometer was used to approximate sleep minutes if accelerometer non-wear time was within one hour of self-reported sleep time. If non-wear time and self-reported sleep time differed by more than one hour, the average of non-wear time and self-reported sleep were used to estimate sleep minutes.

Table S3. Participant Characteristics by Sex, the CARDIA Study (2005-16),* N=1,970.

| Year 20 Participant Characteristics | Male N=822 | Female N=1148 | P-value |
|---|-----------------------|--------------------------|----------------|
| Age, years \pm SD | 45.31 \pm 3.47 | 45.24 \pm 3.63 | 0.640 |
| White, n(%) | 531 (64.60) | 648 (56.45) | <0.001 |
| Education, years \pm SD | 15.32 \pm 2.68 | 15.31 \pm 2.42 | 0.963 |
| Unemployment, n(%) | 74 (9.00) | 124 (10.80) | 0.190 |
| Health insurance, n(%) | 721 (87.71) | 1045 (91.03) | 0.017 |
| CES-D score \pm SD | 8.05 \pm 6.46 | 8.79 \pm 7.69 | 0.021 |
| BMI, kg/m ² \pm SD | 28.82 \pm 6.41 | 29.04 \pm 7.33 | 0.470 |
| Diabetes, n(%) | 71 (8.65) | 83 (7.31) | 0.279 |
| Hypertension, n(%) | 246 (29.93) | 333 (29.01) | 0.659 |
| Cardiovascular/renal disease, n(%) | 45 (5.56) | 30 (2.64) | 0.001 |
| ApoE E4 allele, n(%), n=1794 | 211 (28.25) | 297 (28.37) | 0.956 |
| Smoking status, n(%) | | | 0.003 |
| Current | 128 (15.57) | 165 (14.37) | |
| Former | 142 (17.27) | 272 (23.69) | |
| Never | 552 (67.15) | 711 (61.93) | |
| Alcohol, ml/day \pm SD | 15.73 \pm 30.71 | 7.62 \pm 13.91 | <0.001 |
| Diet quality score \pm SD, n=1753 | 61.01 \pm 12.58 | 65.35 \pm 12.59 | <0.001 |
| Sleep quality, n(%) | | | 0.054 |
| Very good | 145 (17.64) | 208 (18.12) | |
| Fairly good | 321 (39.05) | 399 (34.76) | |
| Good | 245 (29.81) | 336 (29.27) | |
| Fairly bad | 105 (12.77) | 187 (16.29) | |
| Very bad | 6 (0.73) | 18 (1.57) | |
| Self-reported snoring, n(%) | 524 (63.8) | 581 (50.61) | <0.001 |
| Self-reported sleep hours \pm SD | 6.64 \pm 1.19 | 6.74 \pm 1.36 | 0.073 |
| Accelerometer measured activity, min/day \pm SD | | | |
| SED | 502.78 \pm 104.47 | 481.83 \pm 98.39 | <0.001 |
| LPA | 352.18 \pm 92.09 | 366.65 \pm 79.84 | <0.001 |
| MVPA | 43.13 \pm 30.23 | 30.57 \pm 21.07 | <0.001 |
| Sleep Time† | 497.50 \pm 69.19 | 512.64 \pm 66.27 | <0.001 |
| Year 5 cognition scores \pm SD | | | |
| DSST‡ | 68.55 \pm 14.62 | 76.18 \pm 14.80 | <0.001 |
| RAVLT§ | 7.86 \pm 3.15 | 9.52 \pm 3.02 | <0.001 |
| Stroop | 21.60 \pm 9.59 | 21.26 \pm 9.99 | 0.464 |
| Year 10 cognition scores \pm SD | | | |
| DSST‡ | 66.20 \pm 14.83 | 73.70 \pm 16.03 | <0.001 |
| RAVLT§ | 8.08 \pm 3.32 | 9.64 \pm 3.16 | <0.001 |
| Stroop | 21.30 \pm 10.62 | 21.18 \pm 9.44 | 0.803 |

SED = sedentary behavior, LPA = light-intensity physical activity; MVPA = moderate-to-vigorous intensity physical activity; CES-D = Center for Epidemiologic Studies Depression Scale; BMI = body mass index; DSST = Digital Symbol Substitution Test; RAVLT = Rey Auditory Verbal Learning Test

*Data presented from the CARDIA year 20 exam (2005-06; baseline for these analyses) unless otherwise specified

†Non-wear time from the accelerometer was used to approximate sleep minutes if accelerometer non-wear time was within one hour of self-reported sleep time. If non-wear time and self-reported sleep time differed by more than one hour, the average of non-wear time and self-reported sleep were used to estimate sleep minutes.

‡DSST score range from 0 to 133, higher score indicates better performance

§RAVLT score range from 0 to 15, higher score indicates better performance

||Stroop score range from -160 to 160, higher score indicates worse performance

Table S4. Compositional isotemporal substitution, estimated changes in mean cognitive function variables between Year 25 and Year 30 following 30-minute time reallocation of sedentary behavior and physical activity (2005-16), N=1,970.

| Cognitive Test | Change Made | Estimated Score | Estimated Difference to Mean Values | 95% CI |
|-----------------|-------------|-----------------|-------------------------------------|---------------|
| ΔDSST* | | | | |
| | Reference | -0.032 | - | - |
| | SED to LPA | -0.039 | -0.007 | -0.016, 0.003 |
| | SED to MVPA | -0.007 | 0.026 | -0.003, 0.054 |
| | LPA to MVPA | 0.001 | 0.033 | -0.001, 0.065 |
| ΔRAVLT* | | | | |
| | Reference | -0.081 | - | - |
| | SED to LPA | -0.086 | 0.005 | -0.017, 0.007 |
| | SED to MVPA | -0.073 | 0.008 | -0.028, 0.044 |
| | LPA to MVPA | -0.068 | 0.013 | -0.027, 0.054 |
| ΔStroop† | | | | |
| | Reference | 0.096 | - | - |
| | SED to LPA | 0.107 | 0.011 | -0.002, 0.024 |
| | SED to MVPA | 0.117 | 0.022 | -0.017, 0.060 |
| | LPA to MVPA | 0.105 | 0.009 | -0.034, 0.053 |

DSST = Digit Symbol Substitution Test, SED = sedentary behavior, LPA = light-intensity physical activity; MVPA = moderate-to-vigorous intensity physical activity; RAVLT = Rey Auditory Verbal Learning Test

*Standardized scores, higher score indicates improved performance

†Standardized scores, higher score indicates worse performance

Models adjusted for year 20 demographics (race, age, sex, center, education, employment status), chronic health conditions (depressive symptoms, diabetes, hypertension), lifestyle factors (BMI, smoking, alcohol consumption, sleep quality, snoring), and year 25 cognitive function measures.