**Supplementary Table 1** Baseline characteristics of the sample based on age group

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | | Total  (n = 1568) | Young-old  (65–74 years)  (n=1220) | Old-old  (≥75 years)  (n=348) | *t or X2* |
|  | | Mean ± SD or n (%) | Mean ± SD or n (%) | Mean ± SD or n (%) |  |
| **Socio-demographics** | |  |  |  |  |
| Age (years) | | 71.06 ± 0.12 | 68.97 ± 0.08 | 78.41 ± 0.16 | -54.892\*\*\* |
| Sex | |  |  |  | 1.461 |
| Male | | 852 (54.3) | 653(53.5) | 199(57.2) |  |
| Female | | 716 (45.7) | 567(46.5) | 149(42.8) |  |
| Marital status | |  |  |  | 13.381\*\*\* |
| Widowed | | 347(22.1) | 245(20.1) | 102(29.3) |  |
| Married | | 1221(77.9) | 975(79.9) | 246(70.1) |  |
| Education | |  |  |  | 8.240\* |
| ≤Elementary school | | 882(56.3) | 665(54.5) | 217(62.4) |  |
| Middle school | | 238(15.2) | 193(15.8) | 45(12.9) |  |
| High school | | 302(19.3) | 249(20.4) | 53(15.2) |  |
| College or above | | 146(9.3) | 113(9.3) | 33(9.5) |  |
| Household income | |  |  |  | 10.887\* |
| 1 quartile (lowest) | | 390(24.9) | 283(23.2) | 107(30.7) |  |
| 2 quartile | | 395(25.2) | 307(25.2) | 88(25.3) |  |
| 3 quartile | | 420(26.8) | 345(28.3) | 75(21.6) |  |
| 4 quartile | | 363(23.1) | 285(23.3) | 78(22.4) |  |
| Living arrangement | |  |  |  | 1.427 |
| With someone | | 1372(87.5) | 1074(88.0) | 298(85.6) |  |
| Alone | | 196(12.5) | 146(12.0) | 50(14.4) |  |
| Residential area | |  |  |  |  |
| Rural | | 462(29.5) | 350(28.7) | 112(32.2) | 1.592 |
| Urban | | 1106(70.5) | 870(71.3) | 236(67.8) |  |
| **Health-related variables** | |  |  |  |  |
| Comorbidities | |  |  |  |  |
| Hypertension | |  |  |  | 10.005\*\* |
| Yes | | 659(42.0) | 487(39.9) | 172(49.4) |  |
| No | | 909(58.0) | 733(60.1) | 176(50.6) |  |
| Diabetes mellitus | |  |  |  | 2.454 |
| Yes | | 263(16.8) | 195(16.0) | 68(19.5) |  |
| No | | 1305(83.2) | 1025(84.0) | 280(80.5) |  |
| Cancer | |  |  |  | 1.449 |
| Yes | | 40(2.6) | 28(2.3) | 12(3.5) |  |
| No | 1528(97.4) | | 1192(97.7) | 336(96.5) |  |
| Heart disease | |  |  |  | 2.325 |
| Yes | | 135(8.6) | 98(8.0) | 37(10.6) |  |
| No | | 1433(91.4) | 1122(92.0) | 311(89.4) |  |
| Stroke | |  |  |  | 0.301 |
| Yes | | 62(4.0) | 50(4.1) | 12(3.5) |  |
| No | | 1506(96.0) | 1170(95.9) | 336(96.5) |  |
| Hearing problems | |  |  |  | 11.804\*\*\* |
| Yes | | 66(4.2) | 40(3.3) | 26(7.5) |  |
| No | | 1502(95.8) | 1180(96.7) | 322(92.5) |  |
| ADL | |  |  |  | 1.197 |
| Independent | | 1546(98.6) | 1205(98.8) | 341(98.0) |  |
| Dependent | | 22(1.40) | 15(1.2) | 7(2.0) |  |
| IADL | |  |  |  | 10.796\*\*\* |
| Independent | | 1415(90.2) | 1117(91.6) | 298(85.6) |  |
| Dependent | | 153(9.8) | 103(8.4) | 50(14.4) |  |
| **Mental well-being** | |  |  |  |  |
| Depressive symptom at baseline | | 6.90 ± 5.07 | 6.81 ± 4.99 | 7.22 ± 5.37 | -1.321 |
| Ratio of change in depressive symptom 4 years later | | .37±1.63 | 0.34±1.62 | 0.47±1.68 | -1.21 |
| Quality of life | | 62.01±17.57 | 61.89±17.44 | 62.44±18.05 | -0.522 |
| **Social activities** | |  |  |  |  |
| Formal social activities | |  |  |  |  |
| Level of participation in church or other religious groups | | 1.88±3.36 | 1.84±3.33 | 2.00±3.45 | -0.770 |
| Level of participation in senior citizen clubs or senior centers | | 4.03±3.58 | 4.06±3.47 | 3.92±3.93 | 0.638 |
| Level of participation in alumni societies or family councils | | 0.67±1.79 | 0.70±1.81 | 0.57±1.72 | 1.163 |
| Informal social activities | |  |  |  |  |
| Level of face-to-face contact with close friends | | 8.03 ± 2.26 | 8.05±2.19 | 7.97±2.47 | 0.628 |
| Level of face-to-face contact with one’s children | | 5.09±1.52 | 5.17±1.56 | 4.80±1.33 | 4.083\*\*\* |
| Level of contact with one’s children by phone or letter | | 7.17±1.49 | 7.24±1.51 | 6.92±1.41 | 3.447\*\*\* |
| **Cognitive function** | |  |  |  |  |
| MMSE score (mean, SD) in 2008 | | 26.64 ± 1.69 | 26.73 ± 1.69 | 26.32 ± 1.68 | 4.085\*\*\* |
| MMSE score (mean, SD) in 2012 | | 23.92 ± 6.63 | 24.55 ± 6.06 | 21.73 ± 7.97 | 7.104\*\*\* |
| Decline in cognitive function 4 years later | | 2.72 ± 6.52 | 2.18 ± 5.96 | 4.59 ± 7.90 | -6.136\*\*\* |

Note: SD = standard deviation; ADL = activities of daily living; IADL = instrumental activities of daily living; MMSE = Mini-Mental State Examination, \* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001

**Supplementary Table 2** Cognitive decline 4 years later among study population

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Total  (n = 1568) | Young-old  (n=1220) | Old-old  (n=348) | *t* |
|  | Mean ± SD | Mean ± SD | Mean ± SD |  |
| Global cognition (MMSE score) | 2.72 ± 6.52 | 2.18 ± 5.96 | 4.59 ± 7.90 | -6.136\*\*\* |
| Orientation for time (5 points) | 0.39 ± 1.27 | 0.31 ± 1.17 | 0.67 ± 1.56 | -4.623\*\*\* |
| Orientation for place (5 points) | 0.39 ± 1.23 | 0.32 ± 1.13 | 0.61 ± 1.50 | -3.900\*\*\* |
| Registration (3 points) | 0.34 ± 0.93 | 0.27 ± 0.87 | 0.59 ± 1.08 | -5.776\*\*\* |
| Attention & calculation (5 points) | 0.71 ± 1.79 | 0.60 ± 1.70 | 1.13 ± 2.00 | -4.913\*\*\* |
| Recall (3 points) | 0.21 ± 1.15 | 0.16 ± 1.12 | 0.37 ± 1.24 | -3.076\*\* |
| Language (8 points) | 0.60 ± 2.02 | 0.46 ± 1.87 | 1.11 ± 2.40 | -5.373\*\*\* |
| Visual construction (1 points) | 0.13 ± 0.51 | 0.10 ± 0.50 | 0.23 ±0.51 | -4.376\*\*\* |

All positive values indicate a decline in the MMSE score. \* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001

**Supplementary Table 3** Percentage of cognitive decline 4 years later among study population

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Total  (n = 1568) | Young-old  (n=1220) | Old-old  (n=348) | *X2* |
|  | n (%) | n (%) | n (%) |  |
| Global cognition (MMSE score) | 867 (55.3) | 634 (52.0) | 233 (67.0) | 24.602\*\*\* |
| Orientation for time | 305 (19.5) | 201 (16.5) | 104 (29.9) | 31.075\*\*\* |
| Orientation for place | 287 (18.3) | 197 (16.2) | 90 (25.9) | 17.088\*\*\* |
| Registration | 398 (25.4) | 266 (21.8) | 132 (37.9) | 37.185\*\*\* |
| Attention & calculation | 621 (39.6) | 451 (37.0) | 170 (48.9) | 15.985\*\*\* |
| Recall | 566 (36.1) | 412 (33.8) | 154 (44.25) | 12.898\*\*\* |
| Language | 596 (38.0) | 430 (35.3) | 166 (47.7) | 17.827\*\*\* |
| Visual construction | 314 (20.0) | 219 (18.0) | 95 (27.3) | 14.774\*\*\* |

\* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001

**Supplementary Table 4** Participation in formal social activities according to subject’s characteristics at baseline

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variable | Participation in church or other religious groups | | *t or X2* | Participation in senior citizen clubs or senior centers | | *t or X2* | Participation in alumni societies or family councils | | *t or X2* |
| Mean ± SD or n (%) | | Mean ± SD or n (%) | | Mean ± SD or n (%) | |
| YES  (n=391) | No  (n=1177) | YES  (n=937) | No  (n=631) | YES  (n=215) | No  (n=1353) |
| Age (yr), mean±SD \* | 71.13 ± 4.89 | 71.04 ± 4.82 | 0.090 | 70.75 ± 4.76 | 71.53 ± 4.91 | 10.020\*\* | 70.60 ± 4.49 | 71.14 ± 4.89 | 2.230 |
| Gender |  |  | 48.544\*\*\* |  |  | 10.853\*\* |  |  | 119.530\*\*\* |
| Female | 238 (60.9) | 478 (40.6) |  | 396 (42.3) | 320 (50.7) |  | 24 (11.2) | 692 (51.2) |  |
| Male | 153 (39.1) | 699 (59.4) |  | 541 (57.7) | 311 (49.3) |  | 191 (88.8) | 661 (48.8) |  |
| Marital status |  |  | 7.496\*\* |  |  | 7.021\*\* |  |  | 23.8\*\*\* |
| Bereaved | 106 (27.1) | 241 (20.5) |  | 186 (19.9) | 161 (25.5) |  | 20 (9.3) | 327 (24.2) |  |
| Married | 285 (72.9) | 936 (79.5) |  | 751 (80.1) | 470 (74.5) |  | 195 (90.7) | 1026(75.8) |  |
| Education |  |  | 1.105 |  |  | 5.752 |  |  | 133.701\*\*\* |
| ≤Elementary school | 212 (54.2) | 670 (56.9) |  | 507 (54.1) | 375 (59.4) |  | 52 (24.2) | 830 (61.4) |  |
| Middle school | 60 (15.4) | 178 (15.1) |  | 150 (16.0) | 88 (13.9) |  | 38 (17.7) | 200 (14.8) |  |
| High school | 79 (20.2) | 223 (19.0) |  | 183 (19.5) | 119 (18.9) |  | 73 (33.9) | 229 (16.9) |  |
| College or above | 40 (10.2) | 106 (9.0) |  | 97 (10.4) | 49 (7.8) |  | 52 (24.1) | 94 (6.9) |  |
| Household income |  |  | 2.859 |  |  | 14.465\*\* |  |  | 34.227\*\*\* |
| 1 quartile (lowest) | 103 (26.3) | 287 (24.4) |  | 213 (22.7) | 177 (28.1) |  | 42 (19.5) | 348 (25.7) |  |
| 2 quartile | 102 (26.1) | 293 (24.9) |  | 224 (23.9) | 171 (27.1) |  | 36 (16.7) | 359 (26.5) |  |
| 3 quartile | 92 (23.5) | 328 (27.8) |  | 256 (27.3) | 164 (26.0) |  | 55 (25.6) | 365 (27.0) |  |
| 4 quartile | 94 (24.1) | 269 (22.9) |  | 244 (26.1) | 119 (18.8) |  | 82 (38.1) | 281 (20.8) |  |
| ADL |  |  | 1.557 |  |  | 7.243\*\* |  |  | 4.536 |
| Independent | 383 (98.0) | 1163 (98.8) |  | 930 (99.3) | 616 (97.6) |  | 215 (100.0) | 1331 (98.4) |  |
| Dependent | 8 (2.0) | 14 (1.2) |  | 7 (0.7) | 15 (2.4) |  | 0 (0.0) | 22 (1.6) |  |
| IADL |  |  | 3.241 |  |  | 0.062 |  |  | 6.096\* |
| Independent | 1053 (89.5) | 362 (92.6) |  | 837 (90.4) | 568 (90.0) |  | 204 (94.9) | 1211 (89.5) |  |
| Dependent | 124 (10.5) | 29 (7.4) |  | 90 (9.6) | 63 (10.0) |  | 11(5.1) | 142 (10.5) |  |

\* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001

**Supplementary Table 5** Correlations of the study variables for total sample

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| Cognitive decline | 1. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Age | 0.175\*\*\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sex | -0.020 | 0.075\*\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Marital status | 0.043 | 0.111\*\*\* | -0.401\*\*\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Education | -0.027 | -0.074\*\* | 0.359\*\*\* | -0.200\*\*\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Household income | 0.010 | -0.102\*\*\* | 0.068\*\* | -0.075\*\* | 0.112\*\*\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Living arrangement | 0.018 | 0.040 | -0.269\*\*\* | 0.687\*\*\* | -0.120\*\*\* | -0.184\*\*\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Residential area | -0.013 | -0.008 | -0.006 | 0.061\* | 0.187\*\*\* | -0.003 | 0.012 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hypertension | 0.046 | 0.093\*\*\* | -0.088\*\*\* | 0.054\* | 0.025 | -0.084\*\*\* | 0.073\*\* | 0.074\*\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Diabetes mellitus | -0.019 | 0.013 | -0.055\* | 0.068\*\* | -0.059\* | -0.026 | 0.068\*\* | 0.032 | 0.206\*\*\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Cancer | 0.028 | 0.024 | 0.018 | -0.017 | 0.004 | -0.066\*\* | -0.012 | 0.007 | -0.056\* | -0.019 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Heart disease | 0.004 | 0.037 | -0.043 | 0.037 | -0.000 | -0.029 | 0.008 | 0.034 | 0.107\*\*\* | 0.075\*\* | -0.035 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Stroke | 0.052\* | 0.003 | 0.055\* | -0.015 | -0.021 | -0.020 | -0.027 | -0.005 | 0.119\*\*\* | 0.040 | -0.012 | 0.019 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hearing problems | 0.040 | 0.128\*\*\* | 0.084\*\*\* | 0.013 | -0.044 | -0.041 | 0.007 | -0.011 | -0.018 | 0.042 | 0.006 | 0.038 | 0.039 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |
| ADL | 0.088\*\*\* | 0.033 | 0.011 | 0.038 | 0.026 | -0.007 | -0.012 | 0.018 | 0.030 | 0.005 | 0.015 | 0.060\* | 0.115\*\*\* | 0.002 | 1 |  |  |  |  |  |  |  |  |  |  |  |
| IADL | 0.029 | 0.109\*\*\* | 0.103\*\*\* | -0.052\* | 0.026 | -0.054\* | -0.066\*\* | 0.038 | 0.016 | 0.031 | -0.012 | 0.045 | 0.088\*\*\* | 0.027 | 0.290\*\*\* | 1 |  |  |  |  |  |  |  |  |  |  |
| Depressive symptom at baseline | 0.093\*\*\* | 0.058\* | -0.184\*\*\* | 0.137\*\*\* | -0.113\*\*\* | -0.112\*\*\* | 0.095\*\*\* | -0.025 | 0.042 | 0.078\*\* | 0.086\*\*\* | 0.030 | 0.034 | 0.031 | 0.154\*\*\* | 0.127\*\*\* | 1 |  |  |  |  |  |  |  |  |  |
| Ratio of change in depressive symptom 4 years later | 0.100\*\*\* | 0.055\* | 0.050 | -0.036 | 0.053 | 0.024 | -0.021 | -0.011 | 0.041 | -0.006 | -0.042 | -0.008 | 0.072 | -0.041 | -0.030 | -0.052\* | -0.388\*\*\* | 1.00 |  |  |  |  |  |  |  |  |
| Quality of life | -0.080\*\* | -0.017 | 0.074\*\* | -0.116\*\*\* | 0.190\*\*\* | 0.125\*\*\* | -0.054\* | -0.034 | -0.033 | -0.071\*\* | -0.042 | -0.021 | -0.021 | -0.055\* | -0.079\*\* | -0.052\* | -0.313\*\*\* | 0.059\* | 1 |  |  |  |  |  |  |  |
| Baseline MMSE | 0.059\* | -0.142\*\*\* | 0.104\*\*\* | -0.025 | 0.190\*\*\* | 0.093\*\*\* | -0.023 | 0.119\*\*\* | -0.021 | -0.044 | -0.047 | -0.029 | -0.027 | -0.070\*\* | -0.064\* | -0.043 | -0.161\*\*\* | 0.009 | 0.093\*\*\* | 1 |  |  |  |  |  |  |
| Participation in church or other religious groups | 0.009 | 0.008 | -0.176\*\*\* | 0.172\*\* | 0.024 | -0.020 | 0.063\* | 0.124\*\*\* | 0.074\*\* | 0.045 | -0.037 | 0.049 | 0.050 | -0.011 | 0.032 | -0.046 | 0.023 | 0.012 | 0.047 | -0.005 | 1 |  |  |  |  |  |
| Participation in senior citizen clubs or senior centers | -0.097\*\*\* | -0.080\*\* | 0.083\*\* | -0.066\*\* | 0.053\* | 0.060\* | -0.008 | -0.117\*\*\* | -0.034 | -0.032 | -0.032 | -0.026 | -0.020 | -0.087\*\*\* | -0.068\*\* | -0.006 | -0.036 | 0.071\*\* | 0.112\*\*\* | 0.049 | -0.200\*\*\* | 1 |  |  |  |  |
| Participation in alumni societies or family councils | -0.015 | -0.038 | 0.276\*\*\* | -0.123\*\*\* | 0.258\*\*\* | 0.049 | -0.089\*\*\* | 0.038 | -0.039 | -0.065\* | -0.006 | 0.043 | -0.024 | -0.047 | -0.048 | -0.062\* | -0.159\*\*\* | 0.037 | 0.171\*\*\* | 0.095\*\*\* | -0.003 | 0.085\*\*\* | 1 |  |  |  |
| Level of face-to-face contact with close friends | -0.052\* | -0.028 | -0.040 | 0.040 | -0.040 | -0.051\* | 0.095\*\*\* | -0.087\*\*\* | -0.032 | 0.020 | -0.017 | 0.042 | -0.064\* | 0.014 | -0.122\*\*\* | -0.042 | -0.146\*\*\* | -0.006 | 0.118\*\*\* | 0.023 | 0.095\*\*\* | 0.105\*\*\* | 0.056\* | 1 |  |  |
| Level of face-to-face contact with one’s children | -0.020 | -0.121\*\*\* | 0.067\*\* | -0.030 | 0.127\*\*\* | 0.036 | -0.008 | 0.127\*\*\* | -0.037 | -0.031 | -0.014 | 0.033 | -0.014 | -0.067\*\* | -0.042 | -0.060\* | -0.111\*\*\* | -0.034 | 0.123\*\*\* | 0.072\*\* | 0.025 | 0.002 | 0.067\*\* | 0.040 | 1 |  |
| Level of contact with one’s children by phone or letter | -0.073\*\* | -0.108\*\*\* | 0.002 | -0.018 | 0.097\*\*\* | 0.089\*\*\* | -0.016 | 0.028 | -0.057\* | -0.036 | -0.035 | -0.002 | -0.026 | -0.105\*\*\* | -0.063\* | -0.067\*\* | -0.133\*\*\* | -0.012 | 0.196\*\*\* | 0.071\*\* | 0.046 | 0.048 | 0.081\*\* | 0.067\*\* | 0.615\*\*\* | 1 |

\* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001

**Supplementary Table 5-1** Correlations of the study variables for Y-O adults

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| Cognitive decline | 1. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Age | 0.108\*\*\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sex | -0.040 | 0.083\*\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Marital status | 0.040 | 0.056 | -0.356\*\*\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Education | -.018 | -0.026 | 0.369\*\*\* | -0.203\*\*\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Household income | -0.010 | -0.083\*\* | 0.084\*\* | -0.081\*\* | 0.104\*\*\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Living arrangement | 0.020 | 0.050 | -0.254\*\*\* | 0.709\*\*\* | -0.129\*\*\* | -0.156\*\*\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Residential area | -0.007 | 0.031 | -0.010 | 0.068\* | 0.194\*\*\* | -0.027 | 0.005 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hypertension | 0.039 | 0.067\*\* | -0.086\*\* | 0.019 | 0.018 | -0.076\*\* | -0.050 | 0.070\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Diabetes mellitus | -0.001 | -0.005 | -0.060\* | 0.072\* | -0.066\* | -0.036 | 0.053 | 0.044 | 0.197\*\*\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Cancer | -0.021 | -0.010 | 0.000 | -0.007 | 0.014 | -0.071\* | -0.023 | 0.013 | -0.047 | -0.022 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Heart disease | 0.002 | 0.012 | -0.051 | 0.021 | -0.004 | -0.031 | -0.007 | 0.067\* | 0.110\*\*\* | 0.085\*\* | -0.025 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Stroke | 0.049 | 0.047 | 0.068\* | -0.002 | -0.023 | -0.014 | -0.025 | 0.003 | 0.144\*\*\* | 0.034 | -0.032 | 0.015 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hearing problems | 0.011 | 0.110\*\*\* | 0.061\*\* | 0.048 | -0.039 | -0.041 | 0.017 | 0.015 | 0.000 | 0.007 | 0.033 | 0.013 | 0.032 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |
| ADL | 0.122\*\*\* | 0.031 | -0.000 | 0.051 | 0.032 | -0.009 | 0.005 | 0.024 | 0.015 | 0.033 | -0.017 | 0.076\*\* | 0.165\*\*\* | 0.021 | 1 |  |  |  |  |  |  |  |  |  |  |  |
| IADL | 0.021 | 0.097\*\*\* | 0.123\*\*\* | -0.074\*\* | 0.072\* | -0.043 | -0.058\* | 0.043 | -0.000 | 0.029 | -0.027 | 0.062\* | 0.086\*\* | -0.006 | 0.260\*\*\* | 1 |  |  |  |  |  |  |  |  |  |  |
| Depressive symptom at baseline | 0.073\* | 0.062\* | -0.205\*\*\* | 0.140\*\*\* | -0.128\*\*\* | -0.138\*\*\* | 0.117\*\*\* | -0.032 | 0.036 | 0.085\*\* | 0.080\*\* | 0.041 | 0.032 | 0.036 | 0.131\*\*\* | 0.084\*\* | 1 |  |  |  |  |  |  |  |  |  |
| Ratio of change in depressive symptom 4 years later | 0.088\*\* | 0.049 | 0.030 | -0.032 | 0.056 | 0.044 | -0.035 | 0.022 | 0.048 | -0.020 | -0.047 | 0.017 | 0.068 | -0.041 | -0.029 | -0.053 | -0.387\*\*\* | 1.00 |  |  |  |  |  |  |  |  |
| Quality of life | -0.106\*\*\* | -0.074 | 0.066\* | -0.114\*\*\* | 0.186\*\*\* | 0.124\*\*\* | -0.053 | -0.034 | -0.004 | -0.086\*\* | -0.057\* | -0.046 | -0.046 | -0.086\*\* | -0.046 | -0.043 | -0.320\*\*\* | 0.042 | 1 |  |  |  |  |  |  |  |
| Baseline MMSE | 0.082\*\* | -0.102\*\*\* | 0.100\*\*\* | -0.027 | 0.191\*\*\* | 0.083\*\* | -0.041 | 0.103\*\*\* | -0.002 | -0.060\* | -0.060\* | -0.025 | -0.039 | -0.031 | -0.102\*\*\* | -0.040 | -0.150\*\*\* | -0.011 | 0.118\*\*\* | 1 |  |  |  |  |  |  |
| Participation in church or other religious groups | 0.034 | -0.004 | -0.180\*\*\* | 0.062\* | 0.012 | -0.023 | 0.047 | 0.123\*\*\* | -0.073\* | 0.062\* | -0.037\* | 0.069\* | 0.083\*\* | -0.009 | 0.040 | -0.030 | 0.027 | 0.014 | 0.021 | 0.009 | 1 |  |  |  |  |  |
| Participation in senior citizen clubs or senior centers | -0.076\* | \*-0.064\* | 0.083\*\* | -0.082\*\* | 0.054 | 0.076\*\* | -0.014 | -0.107\*\*\* | -0.025 | -0.050 | -0.070\* | -0.057\* | -0.006 | -0.062\* | -0.065\* | -0.014 | -0.048 | 0.023 | 0.127\*\*\* | 0.061\* | -0.199\*\*\* | 1 |  |  |  |  |
| Participation in alumni societies or family councils | -0.003 | -0.004 | 0.292\*\*\* | -0.111\*\*\* | 0.260\*\*\* | 0.053 | -0.086\*\* | 0.037 | -0.018 | -0.057\* | 0.015 | 0.034 | -0.014 | -0.049 | -0.046 | -0.040 | -0.169\*\*\* | 0.061\* | 0.172\*\*\* | 0.089\*\* | 0.010 | 0.079\*\* | 1 |  |  |  |
| Level of face-to-face contact with close friends | -0.017 | -0.025 | -0.038 | 0.043 | -0.040 | -0.031 | 0.077\*\* | -0.113\*\*\* | -0.009 | 0.011 | -0.021 | 0.034 | -0.045 | 0.008 | -0.064\* | -0.001 | -0.116\*\*\* | 0.022 | 0.103\*\*\* | 0.037 | 0.087\*\* | 0.073\* | 0.050 | 1 |  |  |
| Level of face-to-face contact with one’s children | -0.038 | -0.085\*\* | 0.058\* | -0.017 | 0.111\*\*\* | 0.044 | -0.021 | 0.127\*\*\* | -0.051 | -0.038 | 0.002 | 0.054\* | -0.003 | -0.054 | -0.011 | -0.031 | -0.112\*\*\* | 0.000 | 0.118\*\*\* | 0.075\*\* | 0.045 | -0.005 | 0.059\* | 0.034 | 1 |  |
| Level of contact with one’s children by phone or letter | -0.063\* | -0.063\* | -0.009 | -0.012 | 0.084\*\* | 0.100\*\*\* | -0.030 | 0.021 | -0.062\* | -0.040 | -0.038 | 0.017 | -0.013 | -0.103\*\*\* | -0.040 | -0.054 | -0.127\*\*\* | -0.012 | 0.192\*\*\* | 0.080\*\* | 0.068\* | 0.042 | 0.071\* | 0.072\* | 0.611\*\*\* | 1 |

\* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001

**Supplementary Table 5-2** Correlations of the study variables for O-O adults

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| Cognitive decline | 1. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Age | 0.040 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sex | 0.014 | 0.093 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Marital status | 0.002 | 0.061 | -0.564\*\*\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Education | -0.014 | -0.069 | 0.337\*\*\* | -0.172\*\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Household income | 0.097 | -0.048 | 0.028 | -0.035 | 0.119\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Living arrangement | -0.002 | -0.042 | -0.324\*\*\* | 0.629\*\*\* | -0.082 | -0.260\*\*\* | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Residential area | -0.010 | 0.026 | 0.013 | 0.054 | 0.154\*\* | 0.061 | 0.037 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hypertension | 0.023 | -0.012 | -0.109\* | 0.130\* | 0.074 | -0.089 | 0.136\*\* | 0.103 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Diabetes mellitus | -0.065 | -0.011 | -0.042 | 0.046 | -0.024 | 0.014 | 0.108\* | -0.002 | 0.223\*\*\* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Cancer | 0.128\* | 0.021 | 0.068 | -0.052 | -0.017 | -0.045 | 0.012 | -0.005 | -0.092 | -0.014 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Heart disease | -0.017 | -0.013 | -0.022 | 0.066 | 0.021 | -0.013 | 0.045 | -0.062 | 0.088 | 0.042 | -0.065 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Stroke | 0.074 | -0.057 | 0.004 | -0.052 | -0.017 | -0.045 | -0.033 | -0.038 | 0.034 | 0.066 | 0.051 | 0.037 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hearing problems | 0.058 | 0.077 | 0.135\* | -0.086 | -0.040 | -0.024 | -0.023 | -0.062 | -0.084 | -0.030 | -0.054 | 0.079 | 0.066 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |
| ADL | 0.008 | -0.013 | 0.041 | -0.002 | 0.015 | 0.007 | -0.059 | 0.011 | 0.063 | -0.071 | 0.085 | 0.017 | -0.027 | -0.041 | 1 |  |  |  |  |  |  |  |  |  |  |  |
| IADL | 0.007 | 0.004 | 0.040 | -0.028 | -0.082 | -0.064 | -0.098 | 0.037 | 0.038 | 0.025 | 0.012 | -0.008 | 0.102 | 0.071 | 0.350\*\*\* | 1 |  |  |  |  |  |  |  |  |  |  |
| Depressive symptom at baseline | 0127\* | 0.021 | -0.120\* | 0.118\* | -0.057 | -0.028 | 0.026 | 0.002 | 0.050 | 0.053 | 0.101 | -0.007 | 0.045 | 0.013 | 0.212\*\*\* | 0.230\*\*\* | 1 |  |  |  |  |  |  |  |  |  |
| Ratio of change in depressive symptom 4 years later | 0.122\* | 0.048 | 0.115\* | -0.061 | 0.052 | -0.029 | 0.019 | -0.115\* | 0.008 | 0.032 | -0.033 | -0.022 | 0.087 | -0.052 | -0.038 | -0.063 | -0.399\*\*\* | 1.00 |  |  |  |  |  |  |  |  |
| Quality of life | -0.029 | 0.033 | 0.098 | -0.131\* | 0.211\*\*\* | 0.135\*\*\* | -0.060 | -0.023 | -0.003 | -0.027 | 0.000 | 0.052 | 0.071 | 0.010 | -0.167\*\* | -0.083 | -292\*\*\* | 0.113 | 1 |  |  |  |  |  |  |  |
| Baseline MMSE | 0.065 | -0.100 | 0.135\* | 0.023 | 0.161\*\* | 0.100 | 0.050 | 0.163\*\* | -0.049 | -0.067 | 0.002 | -0.027 | 0.011 | -0.138\*\* | 0.046 | -0.024 | -0.185\*\*\* | 0.092 | 0.017 | 1 |  |  |  |  |  |  |
| Participation in church or other religious groups | -0.061 | 0.001 | -0.165\*\* | 0.098 | 0.069 | -0.005 | 0.114\* | 0.126\* | 0.072 | -0.010 | -0.040 | -0.012 | -0.076 | -0.018 | 0.009 | -0.092 | 0.006 | -0.053 | 0.131 | -0.049 | 1 |  |  |  |  |  |
| Participation in senior citizen clubs or senior centers | -0.122\* | 0.011 | 0.094 | 0.007 | 0.031 | -0.006 | 0.019 | -0.158\*\* | -0.040 | 0.036 | 0.081 | 0.077 | -0.077 | -0.131\* | -0.072 | 0.035 | 0.013 | -0.015 | 0.065 | -0.021 | -0.202\*\*\* | 1 |  |  |  |  |
| Participation in alumni societies or family councils | -0.029 | -0.060 | 0.221\*\*\* | -0.152\*\* | 0.241\*\*\* | 0.025 | -0.096 | 0.036 | -0.104 | -0.087 | -0.068 | 0.080 | -0.068 | -0.034 | -0.052 | -0.122\* | -0.122\* | 0.114\* | 0.171\*\* | 0.104 | -0.048 | 0.100\*\*\* | 1 |  |  |  |
| Level of face-to-face contact with close friends | -0.127\* | -0.026 | -0.043 | 0.038 | -0.045 | -0.113\* | 0.152\*\* | -0.012 | -0.098 | 0.048 | -0.004 | 0.065 | -0.132\* | 0.031 | -0.264\*\*\* | -0.117\* | -0.234\*\*\* | 0.086 | 0.164\*\* | -0.028 | 0.120\* | 0.200\*\*\* | 0.075 | 1 |  |  |
| Level of face-to-face contact with one’s children | 0.102 | 0.007 | 0.123\* | -0.034 | 0.165\*\* | -0.031 | 0.058 | 0.116 | 0.056 | 0.013 | -0.056 | -0.032 | -0.070 | -0.076 | -0.135\* | -0.122\* | -0.098 | -0.015 | 0.157\*\* | 0.012 | -0.048 | -0.003 | 0.089 | 0.059 | 1 |  |
| Level of contact with one’s children by phone or letter | -0.053 | -0.072 | 0.056 | -0.004 | 0.118\* | 0.026 | 0.043 | 0.041 | -0.006 | -0.011 | -0.018 | -0.050 | -0.083 | -0.092 | -0.123\* | -0.081 | -0.154\*\* | -0.103 | 0.222\*\*\* | -0.002 | -0.032 | 0.042 | 0.109\* | 0.047 | 0.062 | 1 |

\* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001

**Supplementary Table 6** Variance inflation factors (VIF) of the study variables for multicollinearity

|  |  |  |  |
| --- | --- | --- | --- |
| Variables | Total | Young-old | Old-old |
| Age | 1.14 | 1.08 | 1.13 |
| Sex | 1.54 | 1.51 | 1.87 |
| Marital status | 2.28 | 2.32 | 2.48 |
| Education | 1.33 | 1.34 | 1.35 |
| Household income | 1.11 | 1.10 | 1.23 |
| Living arrangement | 2.04 | 2.14 | 2.01 |
| Residential area | 1.13 | 1.14 | 1.18 |
| Hypertension | 1.11 | 1.11 | 1.18 |
| Diabetes mellitus | 1.06 | 1.07 | 1.12 |
| Cancer | 1.03 | 1.04 | 1.08 |
| Heart disease | 1.03 | 1.04 | 1.07 |
| Stroke | 1.06 | 1.10 | 1.12 |
| Hearing problems | 1.06 | 1.06 | 1.18 |
| ADL | 1.17 | 1.17 | 1.33 |
| IADL | 1.18 | 1.16 | 1.30 |
| Depressive symptom at baseline | 1.40 | 1.40 | 1.49 |
| Ratio of change in depressive symptom 4 years later | 1.22 | 1.22 | 1.31 |
| Quality of life | 1.21 | 1.21 | 1.35 |
| MMSE score at baseline | 1.09 | 1.10 | 1.19 |
| Participation in church or other religious groups | 1.14 | 1.15 | 1.20 |
| Participation in senior citizen clubs or senior centers | 1.12 | 1.12 | 1.23 |
| Participation in alumni societies or family councils | 1.14 | 1.15 | 1.15 |
| Level of face-to-face contact with close friends | 1.12 | 1.09 | 1.31 |
| Level of face-to-face contact with one’s children | 1.66 | 1.66 | 1.71 |
| Level of contact with one’s children by phone or letter | 1.68 | 1.68 | 1.75 |
| Mean VIF | 1.28 | 1.29 | 1.37 |

**Supplementary Table 7** Multivariate linear regression analysis of the associations between social activities and cognitive decline 4 years later

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Total | Young-old | Old-old |
|  | Coefficients (SE) | Coefficients (SE) | Coefficients (SE) |
| **Socio-demographics** |  |  |  |
| Age (years) | 0.24 (0.04) \*\*\* | 0.24 (0.07) \*\*\* | 0.06 (0.17) |
| Sex |  |  |  |
| Male (ref. female) | -0.50 (0.43) | -0.57 (0.46) | -0.30 (1.16) |
| Marital status |  |  |  |
| Married (ref. widowed) | -0.08 (0.21) | 0.04 (0.21) | -0.08 (0.54) |
| Education |  |  |  |
| ≥ Middle school (ref. ≤Elementary school) | -0.15(0.40) | -0.10 (0.42) | -0.49 (0.98) |
| Household income |  |  |  |
| > 1 quartile (ref. ≤1 quartile) | 0.64 (0.38) | 0.01 (0.42) | 2.64 (0.93) \*\* |
| Living arrangement |  |  |  |
| Alone (ref. with someone) | 0.23 (0.69) | 0.02 (0.72) | .43 (1.81) |
| Residential area |  |  |  |
| Urban (ref. rural) | -0.65 (0.39) | -0.61 (0.41) | -0.89 (1.00) |
| **Health-related variables** |  |  |  |
| Hypertension (yes *vs*. no) | 0.43 (0.38) | 0.12 (0.40) | 1.59 (0.94) |
| Diabetes mellitus (yes *vs*. no) | -0.63 (0.40) | -0.52 (0.44) | -1.72 (1.01) |
| Cancer (yes *vs*. no) | 1.45 (1.21) | -1.09 (0.76) | 6.66 (3.04) \* |
| Heart disease (yes *vs*. no) | -0.30 (0.60) | -0.35 (0.62) | -0.47 (1.69) |
| Stroke (yes *vs*. no) | 1.30 (0.97) | 0.64 (0.91) | 1.70 (2.38) |
| Hearing problems (yes *vs*. no) | 0.68 (0.97) | 0.02 (1.13) | 2.15 (2.06) |
| ADL |  |  |  |
| Dependent (ref. independent) | 4.28 (2.44) | 7.64 (2.97) \* | -2.88 (3.70) |
| IADL |  |  |  |
| Dependent (ref. independent) | -.63 (0.62) | -0.82 (0.66) | -0.16 (1.43) |
| **Mental well-being** |  |  |  |
| Depressive symptom score at baseline | 0.13(.05)\*\* | 0.08(.05) | 0.29(0.11)\*\* |
| Ratio of change in depressive symptom 4 years later | 0.52(.12)\*\*\* | 0.41(.12)\*\* | 0.84(.32)\*\* |
| Quality of life | -0.02 (0.01) | -0.03 (0.01) \*\* | 0.01 (0.02) |
| MMSE score at baseline | 0.46 (0.11) \*\*\* | 0.44 (0.11) \*\*\* | 0.58 (0.27)\* |
| **Formal social activities** |  |  |  |
| Participation in church or other religious groups (yes *vs*. no) | -0.09 (0.45) | 0.12 (0.50) | -0.39 (1.06) |
| Participation in senior citizen clubs or senior centers (yes *vs*. no) | -0.95 (0.37) \* | -0.80 (0.40) \* | -1.02 (0.97) |
| Participation in alumni societies or family councils (yes *vs*. no) | 0.46 (0.60) | 0.64 (0.64) | -0.04 (1.46) |
| **Informal social activity** |  |  |  |
| Level of face-to-face contact with close friends | 0.05 (0.09) | -0.01 (0.09) | -0.21 (0.23) |
| Level of face-to-face contact with one’s children | 0.34 (0.15)\* | 0.08 (0.15) | 1.54 (0.45) \*\* |
| Level of contact with one’s children by phone or letter | -0.30 (0.15) | -0.14 (0.15) | -0.95 (0.45) \* |
| Adjusted R-square | 0.08 | 0.07 | 0.16 |
| F-value | 4.36\*\*\* | 3.24\*\*\* | 2.45\*\* |

Note: SE = standard error \* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001