1. **Four cognitive tests**

word recall tests of ten unrelated and random words were conducted verbally by the interviewer to estimate immediate and delayed recall function. The score of each test ranged from 0 to 10, with higher score indicating better memory function. Word recall tests have shown good construct consistency and validity in previous study. Executive function was assessed using animal-naming test with well-documented reliability and validity. Within the process of the verbal fluency task, the participants were asked to list as many names of animals as they could within one minute. The total score was the total number of words produced eligibly, excluding repetitive words and inanimate category words. Additionally, the letter cancellation test evaluated precision, mental processing speed, and visual search capabilities, which presented the participant with a randomized alphabet page and instructed them to mark as many occurrences of the letters “P” and “W” as they can within one minute.

1. **Composite global cognitive z score**

A composite global cognitive z-score for each participant was generated by averaging the z-scores from the four tests and re-standardizing based on the mean and standard deviation of the cognitive z-scores from wave 1. Z scores standardized to wave 1 from the four tests were calculated by subtracting the mean score at wave 1 from the participant’s score on each test in each wave and dividing by the standard deviation of the wave 1 score. Thus, a z score of one indicated that cognitive performance was one standard deviation above the mean score at wave 1.

1. **Covariates (More details)**

Education attainment level was coded into three categories: no qualification/other, less than A-level/equivalent, and higher than A-level. Life style variable included smoking status (never smoke; former or current smokers) and alcohol intake (frequency of alcohol consumption: not at all; occasions/weekly/monthly; daily or more in the last 12 months), which were based on three questions: “In the past 12 months have you taken an alcoholic drink ...? ”, “Have you ever smoked cigarettes?” and “Do you smoke cigarettes at all nowadays?”. Besides, depressive symptom was classified as two categories based on the score of the 8-item Center for Epidemiologic Studies Depression Scale (CES-D). According to the guidelines, a score of 3 or above on the eight-item CES-D is deemed to be indicative of depressive symptoms. Finally, we included the scores of each cognitive function test at baseline to avoid confounding of baseline cognition status.

**Table S1.** Sample characteristics by physical multimorbidity status at baseline.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Overall (n=9,035)  Mean±SD or N(%) | No multimorbidity (n=5,273, 58.36%)  Mean±SD or N(%) | Two LTCs (n=1,960, 21.69%)  Mean±SD or N(%) | ≥Three LTCs (n=1,802, 19.94%)  Mean±SD or N(%) | P-value |
| Age group b |  |  |  |  | <0.001 |
| 50-59 years | 3,492 (38.65) | 2,607(49.44) | 593（30.26） | 292（16.20） |  |
| 60-69 years | 2,817(31.18) | 1,640(31.10) | 638(32.55) | 539(29.91) |  |
| ≥70 years | 2,726(30.17) | 1,026(19.46) | 729(37.19) | 971(53.88) |  |
| Male b | 4,056(44.89) | 2,518(47.75) | 838(42.76) | 700(38.85) | <0.001 |
| Educational attainment b |  |  |  |  | <0.001 |
| No qualification/other | 3,586(39.69) | 1,809(34.31) | 838(42.76) | 939(52.11) |  |
| Less than A-level/equivalent | 3,304(36.57) | 2,028(38.46) | 712(36.33) | 564(31.30) |  |
| Higher than A-level | 2,145(23.74) | 1,436(27.23) | 410(20.92) | 299(16.59) |  |
| Cohabitation status b |  |  |  |  | <0.001 |
| Not cohabiting | 2,730(30.22) | 1,330(25.22) | 688(35.10) | 712(39.51) |  |
| Married/Cohabiting | 6,305(69.78) | 3,943(74.78) | 1,272(64.90) | 1,090(60.49) |  |
| Net non-pension wealth b |  |  |  |  | <0.001 |
| Quintile 1 | 1,680(18.59) | 809(15.34) | 390(19.90) | 481(26.69) |  |
| Quintile 2 | 1,772(19.61) | 944(17.90) | 398(20.31) | 430(23.86) |  |
| Quintile 3 | 1,865(20.64) | 1,082(20.52) | 432(22.04) | 351(19.48) |  |
| Quintile 4 | 1,923(21.28) | 1,191(22.59) | 415(21.17) | 317(17.59) |  |
| Quintile 5 (richest) | 1,795(19.87) | 1,247 (23.65) | 325(16.58) | 223(12.38) |  |
| Smoking status b |  |  |  |  | <0.001 |
| Never smoke | 3,249(35.96) | 2,004(38.00) | 673(34.34) | 572(31.74) |  |
| Former or current smokers | 5,786(64.04) | 3,269(62.00) | 1,287(65.66) | 1,230(68.26) |  |
| Alcohol intake b |  |  |  |  | <0.001 |
| Not at all | 962(10.65) | 401(7.60) | 244(12.45) | 317(17.59) |  |
| Occasions/weekly/monthly | 5,456(60.39) | 3,227(61.20) | 1,169(59.64) | 1,060 (58.82) |  |
| Daily or more | 2,617(28.97) | 1,645(31.20) | 547(27.91) | 425(23.58) |  |
| Depressive symptoms b |  |  |  |  | <0.001 |
| No | 6,012(66.54) | 3,915(74.25) | 1,213(61.89) | 884(49.06) |  |
| Yes | 3,023(33.46) | 1,358 (25.75) | 747(38.11) | 918(50.94) |  |
| Baseline cognitive function a |  |  |  |  |  |
| Immediate recall | 5.5±0.02 | 5.79±1.65 | 5.37±1.70 | 5.11±1.70 | <0.001 |
| Delayed recall | 4.12±0.02 | 4.41±2.04 | 3.86±2,04 | 3.54±2.04 | <0.001 |
| Executive function | 19.75±0.07 | 20.48±6.27 | 19.34±6.03 | 18.08±5.99 | <0.001 |
| Letter cancellation | 18.92±0.06 | 19.54±5.85 | 18.70±5.99 | 17.35±5.41 | <0.001 |

a p value was tested by one-way analysis of variance; b p value was tested by Pearson chi-squared test or Fisher’s exact.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table S2.** Akaike Information Criteria (AIC), Bayesian Information Criteria (BIC), Bootstrapped likelihood ratio test (BLRT) and Vuong-lo-mendell-rubin likelihood ratio test (VLMR-LMR) for each potential model. | | | | |
|  | AIC | BIC | BLRT（P） | VLMR-LMR（P） |
| 8-class model | 69853.667 | 70699.622 | 0.6667 | 0.7354 |
| 7-class model | 69845.014 | 70584.336 | 0.0200 | 0.3255 |
| 6-class model | 69855.399 | 70488.087 | <0.001 | 0.1214 |
| 5-class model | 69889.212 | 70415.268 | <0.001 | 0.1384 |
| 4-class model | 69964.477 | 70383.899 | <0.001 | 0.0421 |
| 3-class model | 70048.194 | 70360.984 | <0.001 | 0.002 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table S3.** Predicted probabilities of latent multimorbidity class membership | | | | |
| **Class** | | | | |
|  | One | Two | Three | Four |
|  | Relatively healthy | Complex/multisystem | Respiratory/osteoporosis | Hypertension/diabetes |
| Probability (class) | 0.574 | 0.069 | 0.183 | 0.174 |
| Probability of |  |  |  |  |
| Hypertension | **0.224** | **0.683** | **0.372** | **0.760** |
| Coronary heart disease | **0.039** | **0.589** | **0.107** | **0.189** |
| Other cardiac illnesses | **0.055** | **0.414** | **0.100** | **0.108** |
| Stroke | **0.005** | **0.215** | 0.011 | **0.096** |
| Diabetes | **0.013** | **0.177** | **0.051** | **0.222** |
| Lung disease | **0.025** | **0.230** | **0.168** | 0 |
| Asthma | **0.084** | **0.236** | **0.218** | **0.060** |
| Arthritis | **0.210** | **0.609** | **0.538** | **0.356** |
| Osteoporosis | **0.017** | **0.112** | **0.160** | 0.012 |
| Cancer | **0.047** | **0.099** | **0.068** | **0.071** |
| Parkinson's disease | **0.003** | 0.005 | 0.005 | 0.005 |
| Dementia | 0.001 | 0.007 | 0.001 | 0.005 |
| Glaucoma | **0.017** | **0.057** | **0.077** | **0.075** |
| Cataracts | **0.030** | **0.280** | **0.292** | **0.204** |
|  |  |  |  |  |
| Proportion of participants in each class | 6400 (70.83%) | 428 (4.73%) | 1005(11.12%) | 1202(13.30%) |

\*Bold font indicates that the result is statistically significant (<0.05).

**Table S4.** Prospective associations between physical multimorbidity and individual cognitive domains z score at follow-up.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Individual cognitive domains z score | | | | | | | | | | | |
|  | Immediate recall  (N=8,948) | |  | Delayed recall  (N=8,948) | |  | Executive function  (N=8,948) | |  | Letter cancellation  (N=8,571) | |
| Fully-adjusted model  β (95%CI) | Fully-adjusted plus interaction term  β\*time2(95%CI) |  | Fully-adjusted model  β (95%CI) | Fully-adjusted plus interaction term  β\*time2(95%CI) |  | Fully-adjusted model  β (95%CI) | Fully-adjusted plus interaction term  β\*time2(95%CI) |  | Fully-adjusted model  β (95%CI) | Fully-adjusted plus interaction term  β\*time2(95%CI) |
| Physical multimorbidity status | |  |  |  |  |  |  |  |  |  |  |
| No multimorbidity | Reference | Reference |  | Reference |  |  | Reference |  |  | Reference |  |
| Two conditions | -0.023  (-0.057, 0.011) | 0.0003  (-0.0008, 0.0013) |  | -0.011  (-0.045, 0.022) | -0.0005  (-0.0014, 0.0004) |  | **-0.047**  **(-0.082, -0.012)** | 0.0003  (-0.0001, 0.0013) |  | -0.021  (-0.054, 0.012) | -0.0010  (-0.0056, 0.0036) |
| ≥Three conditions | **-0.062**  **(-0.100, -0.025)** | 0.0002  (-0.0010, 0.0014) |  | **-0.055**  **(-0.091, -0.018)** | -0.0007  (-0.0004, 0.0017) |  | -0.029  (-0.068, 0.010) | -0.00001  (-0.0012, 0.0011) |  | **-0.068**  **(-0.105, -0.031)** | -0.0030  (-0.0078, 0.0021) |
| Multimorbidity patterns |  |  |  |  |  |  |  |  |  |  |  |
| Relatively healthy | Reference | Reference |  | Reference | Reference |  | Reference | Reference |  | Reference | Reference |
| Complex/multisystem | **-0.090**  **(-0.157 -0.022)** | -0.0001  (-0.0024, 0.0023) |  | -0.062  (-0.127, 0.004) | -0.0001  (-0.0022, 0.0020) |  | -0.064  (-0.133, 0.005) | 0.0005  (-0.0018, 0.0029) |  | **-0.072**  **(-0.138, -0.006)** | -0.0046  (-0.0142, 0.0051) |
| Respiratory/osteoporosis | -0.013  (-0.058, 0.032) | -0.0001  (-0.0015, 0.0013) |  | -0.042  (-0.086, 0.002) | 0.0001  (-0.0011, 0.0014) |  | -0.034  (-0.081, 0.012) | -0.0005  (-0.0018, 0.0009) |  | -0.038  (-0.082, 0.002) | -0.0032  (-0.0093, 0.0029) |
| Hypertension/diabetes | **-0.076**  **(-0.117, -0.034)** | 0.0010  (-0.0003, 0.0024) |  | **-0.064**  **(-0.105, -0.024)** | 0.0007  (-0.0005, 0.0019) |  | -0.030  (-0.073, 0.013) | -0.0000  (-0.0014, 0.0012) |  | **-0.077**  **(-0.073, -0.036)** | -0.0020  (-0.0077, 0.0037) |

\*Full-adjusted model: adjusted for age, gender, cohabitation status, quintiles of net non-pension wealth, education attainment level, smoking status, alcohol intake, four cognitive tests score at baseline, and depressive symptom; β\*time2 reported in full-adjusted plus interaction term model were the coefficients of the interaction terms between multimorbidity (status or patterns) and quadratic time (to test whether the association between multimorbidity and cognitive function differed across time-points).

**Table S5.** Prospective associations between physical multimorbidity/wealth status combinations and individual cognitive domains z score at follow-up in the full-adjusted model.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Individual cognitive domains z score | | | | | | | | | | | |
|  | Immediate recall  (N=8,948) | |  | Delayed recall  (N=8,948) | |  | Executive function  (N=8,948) | |  | Letter cancellation  (N=8,571) | |
| Fully-adjusted model  β (95%CI) | Fully-adjusted plus interaction term  β\*time2(95%CI) |  | Fully-adjusted model  β (95%CI) | Fully-adjusted plus interaction term  β\*time2(95%CI) |  | Fully-adjusted model  β (95%CI) | Fully-adjusted plus interaction term  β\*time2(95%CI) |  | Fully-adjusted model  β (95%CI) | Fully-adjusted plus interaction term  β\*time2(95%CI) |
| Physical multimorbidity status | |  |  |  |  |  |  |  |  |  |  |
| No multimorbidity /↑wealth status | Reference | Reference |  | Reference |  |  | Reference |  |  | Reference |  |
| No multimorbidity /↓wealth status | -0.185  (-0.236, -0.135) | 0.0004  (-0.0011 0.0018) |  | -0.159  (-0.208, -0.110) | -0.0005  (-0.0018 0.0008 ) |  | -0.088  (-0.141, -0.036) | -0.0008  (-0.0023 0.0007 ) |  | -0.024(-0.074, 0.025) | 0.0015  (-0.0055 0.0085 ) |
| Two conditions /↓wealth status | -0.137  (-0.208, -0.067) | 0.0002  (-0.0020 0.0025 ) |  | -0.122  (-0.055, -0.054) | -0.0010  (-0.0029 0.0010 ) |  | -0.162  (-0.235, -0.090) | 0.0010  (-0.0012 0.0032 ) |  | -0.057(-0.126, 0.012) | -0.0044  (-0.0143 0.0056 ) |
| Two conditions /↑wealth status | -0.035  (-0.072,0.003) | 0.0003  (-0.0008 0.0014) |  | -0.018  (-0.055,0.018) | -0.0005  (-0.0015 0.0004 ) |  | -0.039  (-0.077,-0.000) | 0.0001  (-0.0010 0.0012 ) |  | -0.018(-0.054,0.018) | -0.0001  (-0.0051 0.0049 ) |
| ≥Three conditions /↓wealth status | -0.145  (-0.211, -0.079) | 0.0031  (0.0009 0.0053 ) |  | -0.114  (-0.177,-0.050) | -0.0001  (-0.0021 0.0019 ) |  | -0.074  (-0.142,-0.007) | 0.0014  (-0.0008 0.0036 ) |  | -0.078(-0.142,-0.013) | -0.0052  (-0.0144 0.0039 ) |
| ≥Three conditions /↑wealth status | -0.079  (-0.121, -0.037) | -0.0006  (-0.0019 0.0007) |  | -0.074  (-0.115, -0.032) | 0.0008  (-0.0004 0.0020) |  | -0.036  (-0.080, 0.007) | -0.0005  (-0.0018 0.0008 ) |  | -0.071(-0.112, -0.030) | -0.0019  (-0.0075 0.0037 ) |
| Multimorbidity patterns |  |  |  |  |  |  |  |  |  |  |  |
| Relatively healthy /↑wealth status | Reference | Reference |  | Reference | Reference |  | Reference | Reference |  | Reference | Reference |
| Relatively healthy /↓wealth status | -0.151  (-0.197, -0.106) | 0.0002(-0.0012 0.0015) |  | -0.129  (-0.174 -0.085) | -0.0004(-0.0016 0.0008) |  | -0.100  (-0.148 -0.053 ) | -0.0003(-0.0016 0.0010) |  | -0.027  (-0.072 0.017 ) | 0.0006(-0.0057 0.0068) |
| Complex/multisystem /↓wealth status | -0.240  (-0.356, -0.124 ) | 0.0019(-0.0028 0.0065) |  | -0.199  (-0.310 -0.087) | 0(-0.0041 0.0042) |  | -0.149  (-0.267 -0.031 ) | 0.0015(-0.0030 0.0060) |  | -0.063  (-0.176 0.051 ) | -0.0019(-0.0201 0.0163) |
| Complex/multisystem /↑wealth status | -0.067  (-0.147, 0.014 ) | -0.0006(-0.0033 0.0022) |  | -0.038  (-0.116 0.040) | -0.0002(-0.0027 0.0022) |  | -0.055  (-0.138 0.028 ) | 0.0003(-0.0024 0.0030) |  | -0.085  (-0.164 -0.005) | -0.0059(-0.0173 0.0054) |
| Respiratory/osteoporosis /↓wealth status | -0.068  (-0.154, 0.018 ) | 0.0027(-0.0002 0.0056) |  | -0.094  (-0.177 -0.010) | -0.0004(-0.0030 0.0022) |  | -0.050  (-0.139 0.038 ) | 0.0001(-0.0028 0.0029) |  | -0.054  (-0.138 0.031 ) | -0.01(-0.0221 0.0022) |
| Respiratory/osteoporosis /↑wealth status | -0.033  (-0.084, 0.018 ) | -0.0009(-0.0025 0.0007) |  | -0.058  (-0.108 -0.008) | 0.0002(-0.0012 0.0016) |  | -0.055  (-0.107 -0.002 ) | -0.0007(-0.0023 0.0008) |  | -0.040  (-0.090 0.009 ) | -0.0011(-0.0080 0.0058) |
| Hypertension/diabetes /↓wealth status | -0.217  (-0.302, -0.133 ) | 0.0031(0.0001 0.0060) |  | -0.174  (-0.256 -0.092) | -0.0012(-0.0038 0.0015) |  | -0.109  (-0.196 -0.023 ) | 0.0012(-0.0017 0.0042) |  | -0.110  (-0.193 -0.028 ) | -0.0039(-0.0160 0.0082) |
| Hypertension/diabetes /↑wealth status | -0.072  (-0.118, -0.026) | 0.0006(-0.0009 0.0021) |  | -0.064  (-0.109 -0.019) | 0.0011(-0.0002 0.0024) |  | -0.032  (-0.079 0.016 ) | -0.0004(-0.0019 0.0011) |  | -0.074  (-0.119 -0.029 ) | -0.0014(-0.0077 0.0048) |

\*Full-adjusted model: adjusted for age, gender, cohabitation status, quintiles of net non-pension wealth, education attainment level, smoking status, alcohol intake, four cognitive tests score at baseline, and depressive symptom; β\*time2 reported in full-adjusted plus interaction term model were the coefficients of the interaction terms between multimorbidity (status or patterns) and quadratic time (to test whether the association between multimorbidity and cognitive function differed across time-points).

**Table S6.** The association between physical multimorbidity and low cognitive performance, using a repeated measures cognitive function outcome from eight waves of follow-up.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Added quadratic time variables  (N=9,035) | |  | Age and sex adjusted  (N=9,035) | |  | Fully-adjusted model (N=8,793) | |
| Odds ratio  (95% CI) | P-value |  | Odds ratio  (95% CI) | P-value |  | Odds ratio  (95%CI) | P-value |
| Physical multimorbidity status | |  |  |  |  |  |  |  |
| No multimorbidity | Reference |  |  | Reference |  |  | Reference |  |
| Two conditions | 1.64(1,29, 2.08) | <0.001 |  | 1.25(1.19,1.32) | <0.001 |  | 1.07( 1.01,1.14) | <0.001 |
| ≥Three conditions | 2.67(1.67, 4.26) | <0.001 |  | 1.53(1.44,1.62) | <0.001 |  | 1.43(1.07,1.22) | <0.001 |
| Multimorbidity patterns |  |  |  |  |  |  |  |  |
| Relatively healthy | Reference |  |  | Reference |  |  | Reference |  |
| Complex/multisystem | 2.35(1.97,5.68) | <0.001 |  | 1.84(1.65,2.05) | <0.001 |  | 1.22(1.08,1.38) | 0.001 |
| Respiratory/osteoporosis | 2.14(1.53, 2.98) | <0.001 |  | 1.38(1.29,1.48) | <0.001 |  | 1.11(1.02,1.19) | 0.011 |
| Hypertension/diabetes | 2.41(1.65, 3.53) | <0.001 |  | 1.41(1.33,1.51) | <0.001 |  | 1.16(1.08,1.25) | <0.001 |

\*Full-adjusted model: adjusted for age, gender, cohabitation status, quintiles of net non-pension wealth, education attainment level, smoking status, alcohol intake, four cognitive tests score at baseline, and depressive symptom.

**Table S7.** Prospective associations between physical multimorbidity/wealth status combinations and composite global cognitive z score at follow-up in the full-adjusted model.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Full-adjusted | |  | Full-adjusted plus interaction term | |
|  | β (95% CI) | P-value |  | β\*time2 (95% CI) | P-value |
| Physical multimorbidity patterns | | | | | |
| Relatively healthy /↑wealth status | reference | - |  |  |  |
| Relatively healthy /↓wealth status | -0.073(-0.111, -0.035) | <0.001 |  | -0.000(-0.002,0.001) | 0.532 |
| Complex/multisystem /↓wealth status | -0.123(-0.221, -0.026) | 0.013 |  | -0.001(-0.006,0.003) | 0.521 |
| Complex/multisystem /↑wealth status | -0.026(-0.093,0.042) | 0.460 |  | -0.004(-0.006, -0.001) | 0.004 |
| Respiratory/osteoporosis /↓wealth status | -0.031(-0.103,0.040) | 0.390 |  | -0.001(-0.004,0.001) | 0.316 |
| Respiratory/osteoporosis /↑wealth status | -0.034(-0.076,0.008) | 0.112 |  | -0.003(-0.004, -0.001) | <0.001 |
| Hypertension/diabetes /↓wealth status | -0.106(-0.176, -0.035) | 0.003 |  | -0.001(-0.004,0.002) | 0.544 |
| Hypertension/diabetes /↑wealth status | -0.052(-0.089, -0.014) | 0.008 |  | -0.002(-0.003, -0.000) | 0.009 |
| Physical multimorbidity status |  |  |  |  |  |
| No multimorbidity /↑wealth status | reference | - |  |  |  |
| No multimorbidity /↓wealth status | -0.085(-0.127, -0.043) | <0.001 |  | -0.000(-0.002,0.001) | 0.626 |
| Two conditions /↓wealth status | -0.087(-0.146, -0.029) | 0.004 |  | -0.002(-0.004,0.000) | 0.078 |
| Two conditions /↑wealth status | -0.016(-0.047,0.014) | 0.293 |  | -0.001(-0.002, -0.000) | 0.040 |
| ≥Three conditions /↓wealth status | -0.057(-0.112, -0.002) | 0.041 |  | -0.000(-0.003,0.002) | 0.653 |
| ≥Three conditions /↑wealth status | -0.052(-0.087, -0.017) | 0.004 |  | -0.004(-0.397, -0.002) | <0.001 |

\*Full-adjusted model: adjusted for age, gender, cohabitation status, quintiles of net non-pension wealth, education attainment level, smoking status, alcohol intake, four cognitive tests score at baseline, and depressive symptom; the coefficients reported in full-adjusted plus interaction term model were the coefficients of the interaction terms between multimorbidity (status or patterns) and quadratic time (to test whether the association between multimorbidity and cognitive function differed across time-points).

**Table S8** Prospective associations between physical multimorbidity and composite global cognitive z score at follow-up by age-groups in the full-adjusted model .

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Full-adjusted | | | | | | | |  | Full-adjusted plus interaction term | | | | | | | |
|  | 50-59 years | |  | 60-69 years | |  | ≥70 years | |  | 50-59 years | |  | 60-69 years | |  | ≥70 years | |
| β (95% CI) | P-value |  | β (95% CI) | P-value |  | β (95%CI) | P-value |  | β\*time2 (95% CI) | P-value |  | β\*time2 (95% CI) | P-value |  | β\*time2 (95%CI) | P-value |
| Physical multimorbidity status | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| No multimorbidity | Reference |  |  | Reference |  |  | Reference |  |  |  |  |  |  |  |  |  |  |
| Two conditions | -0.034(-0.078, 0.010) | 0.125 |  | -0.004(-0.051,0.044) | 0.874 |  | 0.012( -0.045,0.068) | 0.683 |  | -0.002(-0.003, -0.001) | 0.005 |  | 0.000( -0.001,0.001) | 0.665 |  | 0.000( -0.002,0.003) | 0.837 |
| ≥Three conditions | -0.038(-0.099, 0.023) | 0.225 |  | -0.038(-0.090,0.015) | 0.162 |  | -0.008(-0.061, 0.046) | 0.778 |  | -0.001(-0.003,0.001) | 0.466 |  | -0.002(-0.003, 0.000) | 0.084 |  | -0.001(-0.004, 0.001) | 0.255 |
| Multimorbidity patterns |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Relatively healthy | Reference |  |  | Reference |  |  | Reference |  |  | Reference |  |  | Reference |  |  | Reference |  |
| Complex/multisystem | -0.076(-0.198,0.047) | 0.225 |  | -0.060(-0.160,0.040) | 0.240 |  | 0.018(-0.069, 0.105) | 0.680 |  | -0.002(-0.006,0.002) | 0.353 |  | -0.003(-0.007, 0.001) | 0.099 |  | -0.002(-0.006, 0.002) | 0.377 |
| Respiratory/osteoporosis | -0.050( -0.124, 0.023) | 0.180 |  | 0.012(-0.051,0.074) | 0.715 |  | 0.000(-0.061,0.061) | 0.994 |  | -0.001(-0.003,0.001) | 0.529 |  | -0.001(-0.002,0.003) | 0.653 |  | -0.003(-0.006, -0.001) | 0.015 |
| Hypertension/diabetes | -0.064(-0.131, 0.003) | 0.061 |  | -0.076(-0.133, -0.018) | 0.010 |  | -0.001(-0.058,0.056) | 0.960 |  | -0.001(-0.003,0.001) | 0.491 |  | -0.001(-0.003,0.001) | 0.472 |  | -0.000(-0.003,0.002) | 0.171 |

\*Full-adjusted model: adjusted for age, gender, cohabitation status, quintiles of net non-pension wealth, education attainment level, smoking status, alcohol intake, four cognitive tests score at baseline, and depressive symptom; the coefficients reported in full-adjusted plus interaction term model were the coefficients of the interaction terms between multimorbidity (status or patterns) and quadratic time (to test whether the association between multimorbidity and cognitive function differed across time-points).

**Table S9.** Prospective associations between physical multimorbidity and composite global cognitive z score at follow-up by gender in the full-adjusted model.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Full-adjusted | | | | |  | Full-adjusted plus interaction term | | | | |
|  | Female | |  | Male | |  | Female | |  | Male | |
| β (95% CI) | P-value |  | β (95% CI) | P-value |  | β\*time2 (95% CI) | P-value |  | β\*time2 (95% CI) | P-value |
| Physical multimorbidity status | |  |  |  |  |  |  |  |  |  |  |
| No multimorbidity | Reference |  |  | Reference |  |  | Reference |  |  | Reference |  |
| Two conditions | -0.005(-0.043, 0.033) | 0.798 |  | -0.029(-0.071,0.013) | 0.175 |  | -0.001(-0.002, 0.000) | 0.052 |  | -0.001(-0.002,0.001) | 0.227 |
| ≥Three conditions | -0.037(-0.046, -0.029) | 0.025 |  | -0.006(-0.055,0.043) | 0.807 |  | -0.002(-0.004, -0.001) | 0.001 |  | -0.003(-0.004, -0.001) | 0.003 |
| Multimorbidity patterns |  |  |  |  |  |  |  |  |  |  |  |
| Relatively healthy | Reference |  |  | Reference |  |  | Reference |  |  | Reference |  |
| Complex/multisystem | -0.027(-0.105, 0.050) | 0.489 |  | -0.033(-0.116,0.050) | 0.435 |  | -0.003(-0.006, -0.000) | 0.048 |  | -0.003(-0.007,0.000) | 0.059 |
| Respiratory/osteoporosis | -0.031( -0.076, 0.014) | 0.179 |  | 0.006(-0.059,0.071) | 0.856 |  | -0.002( -0.003, -0.000) | 0.016 |  | -0.003(-0.006, -0.001) | 0.007 |
| Hypertension/diabetes | -0.062(-0.110, -0.013) | 0.013 |  | -0.030(-0.078, 0.018) | 0.225 |  | -0.002(-0.004, -0.000) | 0.023 |  | -0.001(-0.003,0.000) | 0.140 |

\*Full-adjusted model: adjusted for age, gender, cohabitation status, quintiles of net non-pension wealth, education attainment level, smoking status, alcohol intake, four cognitive tests score at baseline, and depressive symptom; the coefficients reported in full-adjusted plus interaction term model were the coefficients of the interaction terms between multimorbidity (status or patterns) and quadratic time (to test whether the association between multimorbidity and cognitive function differed across time-points).