

## **Supplementary Materials**

**Fig. S1.** Actograms of the two motor activity recordings shown in Fig. 1.

**Fig. S2.** A demonstration of the temporal self-similarity in motor activity.

**Fig. S3.** A demonstration of the procedure of DFA.

**Table S1.** Fractal regulation metric  $\alpha_1$ , potential confounders, and risk of frailty.

**Table S2.** Fractal regulation metric  $\alpha_1$ , potential confounders, and risk of ADL disability.

**Table S3.** Fractal regulation metric  $\alpha_2$ , potential confounders, and risk of ADL disability.

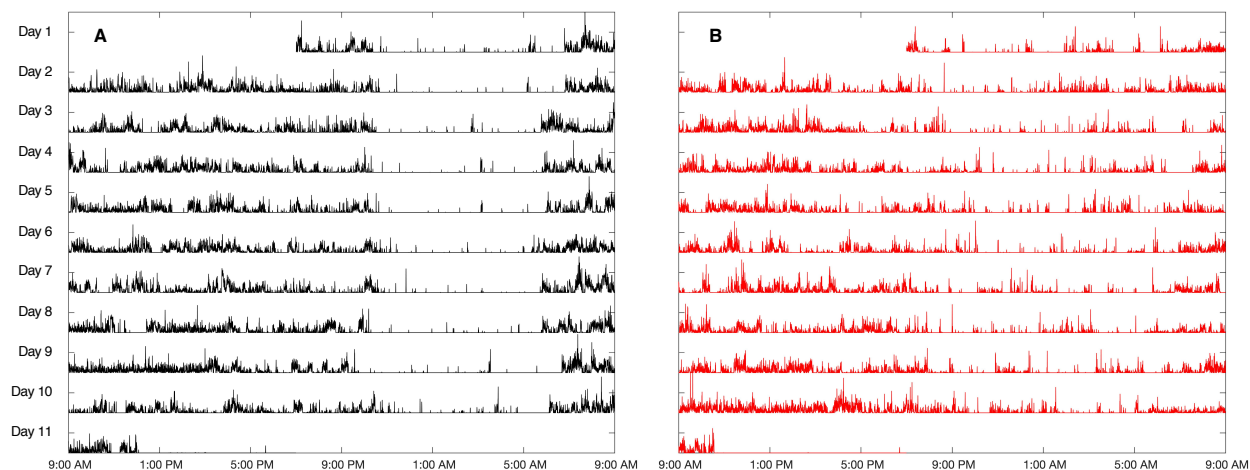
**Table S4.** Fractal regulation metric  $\alpha_1$ , potential confounders, and risk of IADL disability.

**Table S5.** Fractal regulation metric  $\alpha_1$ , potential confounders, and risk of mobility disability.

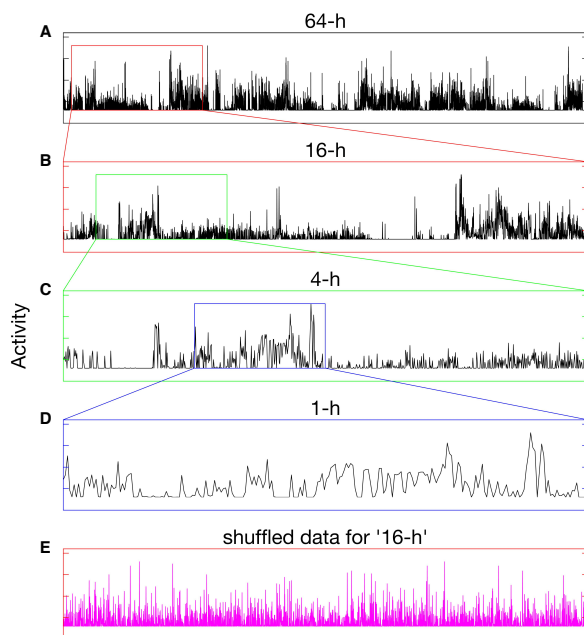
**Table S6.** Fractal regulation metric  $\alpha_1$ , potential confounders, and risk of death.

**Table S7.** Fractal regulation metric  $\alpha_2$ , potential confounders, and risk of death.

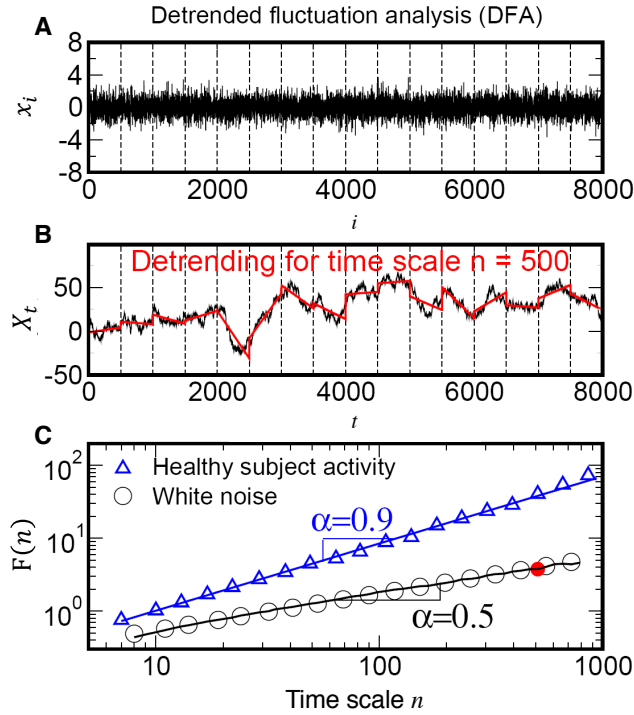
## Supplementary Figures



**Fig. S1.** Actograms of the two motor activity recordings shown in Fig. 1. Signal in panel (A) corresponds to data shown in Fig. 1A and signal in panel (B) corresponds to data shown in Fig. 1B. To have better time resolution, the abscissas are shown on a 24-hour scale and the signals of different days are plotted in different panels.



**Fig. S2.** A demonstration of the temporal self-similarity in motor activity. Shown are four segments of 64 hours (A), 16 hours (B), 4 hours (C), and 1 hour (D), respectively, from one activity recording. The fluctuation patterns (irregularity) seen on different scales are not readily distinguishable, suggesting statistical self-similarity, scale invariance, or fractal. Panel (E) shows a signal generated by randomly shuffling the signal segment on the panel shown in the second row. The shuffling disturbed the temporal structure by removing the temporal correlations.



**Fig. S3. A demonstration of the procedure of DFA.** (A) A random time series  $x_i$ . (B) The solid black curve is the integrated time series  $X_t$  of  $x_i$  after subtraction of its global mean. The vertical dotted lines indicate boxes of size  $n = 500$  points. The red line segments represent the “trend” estimated in each box by a linear least-squares fit. (C) The root-mean-square deviations,  $F(n)$ , in (B) are plotted against the box size (time scale),  $n$ , in a double logarithmic plot. The red circle is the data point for  $F(500)$ . A straight-line graph indicates power-law scaling. The slope of the line,  $\alpha$ , relates to the presence and type of correlations. The blue line is demonstrating the  $F(n)$  for a real activity recording of a healthy young subject.

## Supplementary Tables

**Table S1. Fractal regulation metric  $\alpha_1$ , potential confounders, and risk of frailty.** <sup>a</sup>Results for 1-SD decrease in  $\alpha_1$ ; <sup>b</sup>Results for 1-year older; <sup>c</sup>Results for 1-year less education; <sup>d</sup>Results for 1-unit increase in the item for vascular risk factors; <sup>e</sup>Results for 1-unit increase in the item for vascular diseases; <sup>f</sup>Results for 1 more depressive symptom; <sup>g</sup>Results for 1-SD decrease in global cognition; <sup>h</sup>Results for 1-SD decrease in the composite score of motor function; <sup>i</sup>Results for 1-SD decrease in total daily activity. Abbreviations: CI = confidential interval; HR = hazard ratio; SD = standard deviation.

Variable	Models					
	A HR (95% CI), <i>p</i> value	B HR (95% CI), <i>p</i> value	C HR (95% CI), <i>p</i> value	D HR (95% CI), <i>p</i> value	E HR (95% CI), <i>p</i> value	F HR (95% CI), <i>p</i> value
$\alpha_1^a$	1.31 (1.16, 1.48), <0.0001	1.29 (1.14, 1.46), <0.0001	1.29 (1.15, 1.45), <0.0001	1.29 (1.14, 1.46), <0.0001	1.20 (1.05, 1.37), 0.007	1.21 (1.05, 1.39), 0.008
Age <sup>b</sup>	1.09 (1.06, 1.11), <0.0001	1.08 (1.06, 1.10), <0.0001	1.08 (1.06, 1.10), <0.0001	1.07 (1.05, 1.09), <0.0001	1.05 (1.03, 1.07), <0.0001	1.08 (1.06, 1.10), <0.0001
Sex (Male)	0.32 (0.21, 0.46), <0.0001	0.31 (0.21, 0.46), <0.0001	0.32 (0.22, 0.48), <0.0001	0.28 (0.19, 0.41), <0.0001	0.32 (0.21, 0.50), <0.0001	0.31 (0.20, 0.45), <0.0001
Education <sup>c</sup>	1.05 (1.00, 1.09), 0.03	1.05 (1.00, 1.09), 0.04	1.04 (1.00, 1.09), 0.05	1.02 (0.97, 1.06), 0.4	1.03 (0.98, 1.08), 0.2	1.05 (1.01, 1.10), 0.03
Vascular risk factors <sup>d</sup>		1.12 (0.96, 1.30), 0.2				
Vascular diseases <sup>e</sup>		1.15 (0.98, 1.34), 0.1				
Depression <sup>f</sup>			1.18 (1.10, 1.26), <0.0001			
Cognition <sup>g</sup>				1.40 (1.23, 1.58), <0.0001		
Motor function <sup>h</sup>					1.61 (1.40, 1.86), <0.0001	
Total daily activity <sup>i</sup>						1.24 (1.05, 1.50), 0.01

**Table S2. Fractal regulation metric  $\alpha_1$ , potential confounders, and risk of ADL disability.** <sup>a</sup>Results for 1-SD decrease in  $\alpha_1$ ; <sup>b</sup>Results for 1-year older; <sup>c</sup>Results for 1-year less education; <sup>d</sup>Results for 1-unit increase in the item for vascular risk factors; <sup>e</sup>Results for 1-unit increase in the item for vascular diseases; <sup>f</sup>Results for 1 more depressive symptom; <sup>g</sup>Results for 1-SD decrease in global cognition; <sup>h</sup>Results for 1-SD decrease in the composite score of motor function; <sup>i</sup>Results for 1-SD decrease in total daily activity. Abbreviations: CI = confidential interval; HR = hazard ratio; SD = standard deviation.

Variable	Models					
	A HR (95% CI), <i>p</i> value	B HR (95% CI), <i>p</i> value	C HR (95% CI), <i>p</i> value	D HR (95% CI), <i>p</i> value	E HR (95% CI), <i>p</i> value	F HR (95% CI), <i>p</i> value
$\alpha_1^a$	1.25 (1.14, 1.36), <0.0001	1.25 (1.14, 1.36), <0.0001	1.23 (1.13, 1.33), <0.0001	1.23 (1.13, 1.34), <0.0001	1.15 (1.05, 1.26), 0.004	1.19 (1.08, 1.31), 0.0003
Age <sup>b</sup>	1.10 (1.09, 1.12), <0.0001	1.10 (1.08, 1.12), <0.0001	1.10 (1.09, 1.12), <0.0001	1.09(1.08, 1.11), <0.0001	1.05 (1.03, 1.07), <0.0001	1.10 (1.08, 1.12), <0.0001
Sex (Male)	0.72 (0.58, 0.89), 0.002	0.71 (0.57, 0.88), 0.001	0.74 (0.59, 0.91), 0.004	0.66 (0.53, 0.82), <0.0001	0.93 (0.74, 1.16), 0.5	0.71 (0.57, 0.88), 0.002
Education <sup>c</sup>	1.03 (1.00, 1.06), 0.04	1.03 (1.00, 1.06), 0.08	1.03 (1.00, 1.06), 0.06	1.00 (0.97, 1.03), 0.9	1.01 (0.98, 1.04), 0.5	1.03 (1.00, 1.06), 0.03
Vascular risk factors <sup>d</sup>	-	1.06 (0.94, 1.19), 0.3	-	-	-	-
Vascular diseases <sup>e</sup>	-	1.11 (0.98, 1.26), 0.1	-	-	-	-
Depression <sup>f</sup>	-	-	1.10 (1.04, 1.15), 0.0008	-	-	-
Cognition <sup>g</sup>	-	-	-	1.33 (1.21, 1.45), <0.0001	-	-
Motor function <sup>h</sup>	-	-	-	-	1.97 (1.76, 2.21), <0.0001	-
Total daily activity <sup>i</sup>	-	-	-	-	-	1.20 (1.02, 1.42), 0.03

**Table S3. Fractal regulation metric  $\alpha_2$ , potential confounders, and risk of ADL disability.** <sup>a</sup>Results for 1-SD decrease in  $\alpha_1$ ; <sup>b</sup>Results for 1-year older; <sup>c</sup>Results for 1-year less education; <sup>d</sup>Results for 1-unit increase in the item for vascular risk factors; <sup>e</sup>Results for 1-unit increase in the item for vascular diseases; <sup>f</sup>Results for 1 more depressive symptom; <sup>g</sup>Results for 1-SD decrease in global cognition; <sup>h</sup>Results for 1-SD decrease in the composite score of motor function; <sup>i</sup>Results for 1-SD decrease in total daily activity. Abbreviations: CI = confidential interval; HR = hazard ratio; SD = standard deviation.

Variable	Models					
	A HR (95% CI), <i>p</i> value	B HR (95% CI), <i>p</i> value	C HR (95% CI), <i>p</i> value	D HR (95% CI), <i>p</i> value	E HR (95% CI), <i>p</i> value	F HR (95% CI), <i>p</i> value
$\alpha_2^a$	1.11 (1.01, 1.22), 0.02	1.10 (1.01, 1.21), 0.03	1.11 (1.02, 1.22), 0.02	1.15 (1.05, 1.26), 0.004	1.16 (1.05, 1.28), 0.004	1.06 (0.97, 1.17), 0.2
Age <sup>b</sup>	1.10 (1.08, 1.11), <0.0001	1.10 (1.08, 1.11), <0.0001	1.10 (1.08, 1.11), <0.0001	1.09 (1.07, 1.10), <0.0001	1.05 (1.03, 1.06), <0.0001	1.10 (1.08, 1.11), <0.0001
Sex (Male)	0.73 (0.58, 0.90) 0.003	0.72 (0.58, 0.89), 0.002	0.75 (0.60, 0.92), 0.007	0.67 (0.54, 0.83), 0.0002	0.93 (0.74, 1.17), 0.6	0.71 (0.57, 0.89), 0.002
Education <sup>c</sup>	1.03 (1.00, 1.07), 0.03	1.03 (1.00, 1.06), 0.07	1.03 (1.00, 1.06), 0.05	1.00 (0.97, 1.03), 0.9	1.01 (0.98, 1.05), 0.4	1.03 (1.00, 1.07), 0.03
Vascular risk factors <sup>d</sup>	-	1.07 (0.96, 1.20), 0.2	-	-	-	-
Vascular diseases <sup>e</sup>	-	1.10 (0.98, 1.25), 0.1	-	-	-	-
Depression <sup>f</sup>	-	-	1.11 (1.06, 1.17), 0.0001	-	-	-
Cognition <sup>g</sup>	-	-	-	1.37 (1.24, 1.49), <0.0001	-	-
Motor function <sup>h</sup>	-	-	-	-	2.03 (1.81, 2.27), <0.0001	-
Total daily activity <sup>i</sup>	-	-	-	-	-	1.32 (1.11, 1.57), 0.001

**Table S4. Fractal regulation metric  $\alpha_1$ , potential confounders, and risk of IADL disability.** <sup>a</sup>Results for 1-SD decrease in  $\alpha_1$ ; <sup>b</sup>Results for 1-year older; <sup>c</sup>Results for 1-year less education; <sup>d</sup>Results for 1-unit increase in the item for vascular risk factors; <sup>e</sup>Results for 1-unit increase in the item for vascular diseases; <sup>f</sup>Results for 1 more depressive symptom; <sup>g</sup>Results for 1-SD decrease in global cognition; <sup>h</sup>Results for 1-SD decrease in the composite score of motor function; <sup>i</sup>Results for 1-SD decrease in total daily activity. Abbreviations: CI = confidential interval; HR = hazard ratio; SD = standard deviation.

Variable	Models					
	A HR (95% CI), <i>p</i> value	B HR (95% CI), <i>p</i> value	C HR (95% CI), <i>p</i> value	D HR (95% CI), <i>p</i> value	E HR (95% CI), <i>p</i> value	F HR (95% CI), <i>p</i> value
$\alpha_1^a$	1.15 (1.04, 1.26), 0.01	1.14 (1.03, 1.26), 0.007	1.13 (1.03, 1.23), 0.01	1.15 (1.04, 1.27), 0.005	1.11 (1.01, 1.22), 0.04	1.14 (1.03, 1.26), 0.01
Age <sup>b</sup>	1.08 (1.06, 1.09), <0.0001	1.08 (1.06, 1.09), <0.0001	1.08 (1.06, 1.09), <0.0001	1.07 (1.05, 1.09), <0.0001	1.05 (1.03, 1.06), <0.0001	1.08 (1.06, 1.09), <0.0001
Sex (Male)	0.68 (0.55, 0.85), 0.0006	0.67 (0.54, 0.84), 0.0003	0.71 (0.57, 0.88), 0.002	0.66 (0.53, 0.82), 0.0002	0.73 (0.58, 0.92), 0.0008	0.68 (0.55, 0.85), 0.0004
Education <sup>c</sup>	1.03 (1.00, 1.06), 0.09	1.03 (0.99, 1.06), 0.1	1.03 (1.00, 1.07), 0.07	1.01 (0.98, 1.05), 0.5	1.01 (0.98, 1.05), 0.5	1.03 (1.00, 1.06), 0.09
Vascular risk factors <sup>d</sup>	-	1.08 (0.95, 1.22), 0.3	-	-	-	-
Vascular diseases <sup>e</sup>	-	1.00 (0.84, 1.19), 0.9	-	-	-	-
Depression <sup>f</sup>	-	-	1.16 (1.09, 1.23), <0.0001	-	-	-
Cognition <sup>g</sup>	-	-	-	1.16 (1.05, 1.29), 0.006	-	-
Motor function <sup>h</sup>	-	-	-	-	1.64 (1.545, 1.86), <0.0001	-
Total daily activity <sup>i</sup>	-	-	-	-	-	1.02 (0.92, 1.20), 0.7



**Table S5. Fractal regulation metric  $\alpha_1$ , potential confounders, and risk of mobility disability.** <sup>a</sup>Results for 1-SD decrease in  $\alpha_1$ ; <sup>b</sup>Results for 1-year older; <sup>c</sup>Results for 1-year less education; <sup>d</sup>Results for 1-unit increase in the item for vascular risk factors; <sup>e</sup>Results for 1-unit increase in the item for vascular diseases; <sup>f</sup>Results for 1 more depressive symptom; <sup>g</sup>Results for 1-SD decrease in global cognition; <sup>h</sup>Results for 1-SD decrease in the composite score of motor function; <sup>i</sup>Results for 1-SD decrease in total daily activity. Abbreviations: CI = confidential interval; HR = hazard ratio; SD = standard deviation.

Variable	Models					
	A HR (95% CI), <i>p</i> value	B HR (95% CI), <i>p</i> value	C HR (95% CI), <i>p</i> value	D HR (95% CI), <i>p</i> value	E HR (95% CI), <i>p</i> value	F HR (95% CI), <i>p</i> value
$\alpha_1^a$	1.19 (1.08, 1.32), 0.0004	1.19 (1.08, 1.32), 0.0006	1.19 (1.08, 1.32), 0.0005	1.19 (1.07, 1.31), 0.0008	1.14 (1.03, 1.26), 0.01	1.15 (1.04, 1.28), 0.008
Age <sup>b</sup>	1.07 (1.05, 1.09), <0.0001	1.07 (1.05, 1.08), <0.0001	1.07 (1.05, 1.09), <0.0001	1.06 (1.05, 1.08), <0.0001	1.04 (1.02, 1.06), <0.0001	1.07 (1.05, 1.08), <0.0001
Sex (Male)	0.70 (0.56, 0.87), 0.001	0.68 (0.54, 0.84), 0.005	0.71 (0.57, 0.89), 0.002	0.68 (0.55, 0.85), 0.0005	0.81 (0.64, 1.03), <0.0001	0.69 (0.55, 0.86), 0.0007
Education <sup>c</sup>	1.05 (1.02, 1.08), 0.004	1.04 (1.01, 1.08), 0.009	1.05 (1.02, 1.08), 0.003	1.03 (1.00, 1.07), 0.06	1.04 (1.01, 1.07), 0.02	1.05 (1.02, 1.08), 0.003
Vascular risk factors <sup>d</sup>	-	1.07 (0.95, 1.21), 0.3	-	-	-	-
Vascular diseases <sup>e</sup>	-	1.17 (1.00, 1.36), 0.05	-	-	-	-
Depression <sup>f</sup>	-	-	1.14 (1.07, 1.22), 0.0001	-	-	-
Cognition <sup>g</sup>	-	-	-	1.15 (1.04, 1.26), 0.006	-	-
Motor function <sup>h</sup>	-	-	-	-	1.64 (1.45, 1.84), <0.0001	-
Total daily activity <sup>i</sup>	-	-	-	-	-	1.10 (0.99, 1.24), 0.09

**Table S6. Fractal regulation metric  $\alpha_1$ , potential confounders, and risk of death.** <sup>a</sup>Results for 1-SD decrease in  $\alpha_1$ ; <sup>b</sup>Results for 1-year older; <sup>c</sup>Results for 1-year less education; <sup>d</sup>Results for 1-unit increase in the item for vascular risk factors; <sup>e</sup>Results for 1-unit increase in the item for vascular diseases; <sup>f</sup>Results for 1 more depressive symptom; <sup>g</sup>Results for 1-SD decrease in global cognition; <sup>h</sup>Results for 1-SD decrease in the composite score of motor function; <sup>i</sup>Results for 1-SD decrease in total daily activity. Abbreviations: CI = confidential interval; HR = hazard ratio; SD = standard deviation.

Variable	Models									
	A	B	C	D	E	F	G	H	I	J
	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value
$\alpha_1^a$	1.26 (1.17, 1.37), <0.0001	1.23 (1.13, 1.33), <0.0001	1.22 (1.13, 1.32), <0.0001	1.19 (1.10, 1.30), <0.0001	1.10 (1.01, 1.21), 0.04	1.24 (1.14, 1.35), <0.0001	1.20 (1.10, 1.32), <0.0001	1.15 (1.06, 1.26), 0.001	1.18 (1.08, 1.28), 0.0002	1.16 (1.06, 1.26), 0.0008
Age <sup>b</sup>	1.12 (1.10, 1.14), <0.0001	1.12 (1.10, 1.13), <0.0001	1.12 (1.10, 1.13), <0.0001	1.10 (1.09, 1.12), <0.0001	1.09 (1.07, 1.10), <0.0001	1.12 (1.10, 1.13), <0.0001	1.10 (1.08, 1.11), <0.0001	1.09 (1.08, 1.11), <0.0001	1.09 (1.07, 1.10), <0.0001	1.09 (1.07, 1.10), <0.0001
Sex (Male)	1.50 (1.23, 1.82), <0.0001	1.45 (1.19, 1.76), 0.0002	1.55 (1.27, 1.88), <0.0001	1.38 (1.13, 1.67), 0.0013	1.89 (1.53, 2.34), <0.0001	1.50 (1.24, 1.82), <0.0001	1.52 (1.24, 1.87), <0.0001	1.49 (1.23, 1.81), <0.0001	1.60 (1.31, 1.94), <0.0001	1.62 (1.33, 1.97), <0.0001
Education <sup>c</sup>	1.06 (1.03, 1.11), <0.0001	1.05 (1.02, 1.08), 0.0011	1.06 (1.02, 1.09), 0.0005	1.03 (0.99, 1.06), 0.1	1.04 (1.01, 1.08), 0.007	1.06 (1.03, 1.09), <0.0001	1.04 (1.00, 1.07), 0.02	1.04 (1.01, 1.07), 0.009	1.03 (1.00, 1.06), 0.04	1.03 (1.00, 1.07), 0.03
Vascular risk factors <sup>d</sup>	-	1.20 (1.07, 1.34), 0.002	-	-	-	-	-	-	-	-
Vascular diseases <sup>e</sup>	-	1.18 (1.05, 1.31), 0.004	-	-	-	-	-	-	-	-
Depression <sup>f</sup>	-	-	1.09 (1.04, 1.14), 0.0006	-	-	-	-	-	-	-
Cognition <sup>g</sup>	-	-	-	1.49 (1.37, 1.60), <0.0001	-	-	-	-	-	-
Motor function <sup>h</sup>	-	-	-	-	1.69 (1.51, 1.89), <0.0001	-	-	-	-	-
Total daily activity <sup>i</sup>	-	-	-	-	-	1.05 (0.92, 1.20), 0.5	-	-	-	-

Variable	Models									
	A HR (95% CI), p value	B HR (95% CI), p value	C HR (95% CI), p value	D HR (95% CI), p value	E HR (95% CI), p value	F HR (95% CI), p value	G HR (95% CI), p value	H HR (95% CI), p value	I HR (95% CI), p value	J HR (95% CI), p value
Frailty (Yes)	-	-	-	-	-	-	1.99 (0.87, 2.59), <0.0001	-	-	-
ADL disability (Yes)	-	-	-	-	-	-	-	1.91 (1.54, 2.37), <0.0001	-	-
IADL disability (Yes)	-	-	-	-	-	-	-	-	1.79 (1.47, 2.16), <0.0001	-
Mobility disability (Yes)	-	-	-	-	-	-	-	-	-	1.71 (1.41, 2.07), <0.0001

**Table S7. Fractal regulation metric  $\alpha_2$ , potential confounders, and risk of death.** <sup>a</sup>Results for 1-SD decrease in  $\alpha_1$ ; <sup>b</sup>Results for 1-year older; <sup>c</sup>Results for 1-year less education; <sup>d</sup>Results for 1-unit increase in the item for vascular risk factors; <sup>e</sup>Results for 1-unit increase in the item for vascular diseases; <sup>f</sup>Results for 1 more depressive symptom; <sup>g</sup>Results for 1-SD decrease in global cognition; <sup>h</sup>Results for 1-SD decrease in the composite score of motor function; <sup>i</sup>Results for 1-SD decrease in total daily activity. Abbreviations: CI = confidential interval; HR = hazard ratio; SD = standard deviation.

Variable	Models									
	A	B	C	D	E	F	G	H	I	J
	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value
$\alpha_2^a$	1.12 (1.02, 1.23), 0.01	1.10 (1.00, 1.20), 0.05	1.11 (1.02, 1.22), 0.02	1.12 (1.03, 1.22), 0.01	1.06 (0.96, 1.17), 0.3	1.10 (1.00, 1.20), 0.05	1.01 (1.00, 1.02), 0.03	1.01 (1.00, 1.02), 0.06	1.01 (1.00, 1.02), 0.06	1.01 (1.00, 1.02), 0.09
Age <sup>b</sup>	1.12 (1.10, 1.14), <0.0001	1.12 (1.10, 1.13), <0.0001	1.12 (1.10, 1.13), <0.0001	1.10 (1.08, 1.12), <0.0001	1.08 (1.06, 1.10), <0.0001	1.12 (1.10, 1.13), <0.0001	1.09 (1.08, 1.11), <0.0001	1.09 (1.08, 1.11), <0.0001	1.09 (1.08, 1.11), <0.0001	1.09 (1.07, 1.10), <0.0001
Sex (Male)	1.48 (1.21, 1.79), <0.0001	1.44 (1.18, 1.74), 0.0003	1.53 (1.25, 1.86), <0.0001	1.36 (1.12, 1.65), 0.002	1.89 (1.51, 2.34), <0.0001	1.47 (1.21, 1.78), 0.0001	1.51 (1.22, 1.86), <0.0001	1.47 (1.20, 1.78), 0.0001	1.47 (1.20, 1.78), 0.0001	1.62 (1.33, 1.98), <0.0001
Education <sup>c</sup>	1.06 (1.03, 1.09), 0.0002	1.05 (1.02, 1.08), 0.003	1.05 (1.02, 1.08), 0.0007	1.02 (0.99, 1.05), 0.2	1.04 (1.01, 1.08), 0.009	1.06 (1.03, 1.09), 0.0002	1.03 (1.00, 1.06), 0.06	1.04 (1.01, 1.07), 0.01	1.04 (1.01, 1.07), 0.01	1.03 (1.00, 1.06), 0.04
Vascular risk factors <sup>d</sup>	-	1.22 (1.09, 1.36), 0.0005	-	-	-	-	-	-	-	-
Vascular diseases <sup>e</sup>	-	1.18 (1.06, 1.32), 0.003	-	-	-	-	-	-	-	-
Depression <sup>f</sup>	-	-	1.10 (1.04, 1.15), 0.0002	-	-	-	-	-	-	-
Cognition <sup>g</sup>	-	-	-	1.52 (1.40, 1.64), <0.0001	-	-	-	-	-	-
Motor function <sup>h</sup>	-	-	-	-	1.71 (1.53, 1.92), <0.0001	-	-	-	-	-
Total daily activity <sup>i</sup>	-	-	-	-	-	1.15 (1.00, 1.33), 0.05	-	-	-	-

Variable	Models									
	A	B	C	D	E	F	G	H	I	J
	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value
Frailty (Yes)	-	-	-	-	-	-	2.21 (1.69, 2.84), <0.0001	-	-	-
ADL disability (Yes)	-	-	-	-	-	-	-	2.04 (1.65, 2.51), <0.0001	-	-
IADL disability (Yes)	-	-	-	-	-	-	-	-	2.04 (1.65, 2.51), <0.0001	-
Mobility disability (Yes)	-	-	-	-	-	-	-	-	-	1.79 (1.48, 2.16), <0.0001

**Table S8. Augmented models showing the associations of fractal regulation metrics with risk of death attenuate with longer survival time.** <sup>a</sup>Results for 1-year older; <sup>b</sup>Results for 1-year less education; <sup>c</sup>Results for 1-SD decrease in  $\alpha$ ; <sup>d</sup>Results for 1-SD  $\times$  year decrease in the interaction item. Abbreviations: CI = confidential interval; HR = hazard ratio; SD = standard deviation.

Variable	Model with $\alpha_1$	Model with $\alpha_2$
	HR (95% CI), <i>p</i> value	HR (95% CI), <i>p</i> value
Age <sup>a</sup>	1.12 (1.10, 1.13), <0.0001	1.12 (1.10, 1.14), <0.0001
Sex (Male)	1.41 (1.16, 1.71), 0.0008	1.50 (1.23, 1.82), <0.0001
Education <sup>b</sup>	1.06 (1.03, 1.09), 0.0002	1.05 (1.02, 1.09), 0.0004
$\alpha^c$	2.12 (1.72, 2.61), <0.0001	1.67 (1.28, 2.17), <0.0001
$\alpha \times$ time to death <sup>d</sup>	0.94 (0.91, 0.96), <0.0001	0.95 (0.93, 0.98), 0.002