

Supplementary Information

Timing and intraindividual variability of daytime napping and Alzheimer's disease in older adults

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Supplementary Table 1. The relationship between naps in the morning and Alzheimer's dementia incidents.

	Model A HR (95%CI), p value	Model B HR (95%CI), p value	Model C HR (95%CI), p value	Model D HR (95%CI), p value	Model E HR (95%CI), p value
Age	1.12 (1.09-1.14), <0.001	1.12 (1.10-1.15), <0.001	1.12 (1.09-1.14), <0.001	1.12 (1.10-1.15), <0.001	1.13 (1.10-1.15), <0.001
Sex (male)	1.24 (0.91-1.67), 0.169	1.19 (0.86-1.65), 0.298	1.19 (0.88-1.62), 0.263	1.29 (0.94-1.76), 0.113	1.24 (0.88-1.74), 0.212
Education (year)	0.98 (0.93-1.02), 0.309	0.97 (0.93-1.02), 0.220	0.98 (0.93-1.02), 0.325	0.96 (0.92-1.01), 0.112	0.96 (0.92-1.01), 0.119
Race/Ethnicity (White)	0.92 (0.50-1.66), 0.771	0.82 (0.45-1.51), 0.531	0.90 (0.50-1.64), 0.740	1.02 (0.56-1.85), 0.955	0.91 (0.49-1.69), 0.769
Body mass index	0.99 (0.96-1.01), 0.271	0.98 (0.95-1.002), 0.075	0.99 (0.96-1.01), 0.331	0.99 (0.96-1.02), 0.442	0.98 (0.95-1.01), 0.157
Smoking (yes)	1.10 (0.84-1.44), 0.493	1.01 (0.76-1.34), 0.933	1.14 (0.81-1.61), 0.451	1.09 (0.82-1.43), 0.558	1.08 (0.74-1.57), 0.698
Alcohol consumption (≥ 1 drink/month)	0.74 (0.57-0.97), 0.028	0.77 (0.59-1.02), 0.072	0.78 (0.59-1.02), 0.074	0.69 (0.52-0.90), 0.007	0.73 (0.54-0.97), 0.033
Physical activity (hours/week) ^a	0.89 (0.77-1.02), 0.098	0.89 (0.77-1.03), 0.125	0.91 (0.79-1.04), 0.170	0.87 (0.76-1.003), 0.055	0.88 (0.75-1.02), 0.100
Nap duration (min) ^a	1.02 (0.80-1.30), 0.867	1.04 (0.79-1.35), 0.778	1.01 (0.79-1.29), 0.927	1.04 (0.81-1.34), 0.735	1.03 (0.78-1.37), 0.816
Nap frequency	1.04 (0.89-1.21), 0.643	1.05 (0.89-1.23), 0.541	1.05 (0.90-1.22), 0.566	1.02 (0.86-1.19), 0.847	1.05 (0.89-1.25), 0.554
am% ^a	1.15 (1.01-1.30), 0.035	1.15 (1.01-1.32), 0.040	1.14 (1.002-1.30), 0.047	1.11 (0.97-1.26), 0.124	1.10 (0.95-1.27), 0.192
Sleep and rest-activity rhythm					
Nighttime sleep duration (hour)	--	0.92 (0.81-1.06), 0.240	--	--	0.96 (0.84-1.10), 0.618
Sleep fragmentation index	--	1.04 (0.87-1.21), 0.638	--	--	1.08 (0.92-1.27), 0.326
Wake after sleep onset (min)	--	1.00 (0.997-1.005), 0.605	--	--	1.00 (0.997-1.004), 0.750
Interdaily stability	--	1.07 (0.31-3.71), 0.915	--	--	1.12 (0.31-4.06), 0.866
Intradaily variability	--	1.07 (0.57-2.00), 0.835	--	--	0.97 (0.51-1.82), 0.914
Comorbidities and medications					
Depression ^a	--	--	1.33 (1.13-1.56), <0.001	--	1.31 (1.10-1.55), 0.002
Thyroid disease (yes)	--	--	0.82 (0.60-1.11), 0.191	--	0.88 (0.64-1.23), 0.458
Vascular disease risk factors	--	--	0.96 (0.77-1.19), 0.707	--	0.95 (0.76-1.20), 0.697
Vascular disease burden	--	--	0.92 (0.75-1.11), 0.400	--	0.91 (0.73-1.13), 0.385
Anxiety (yes)	--	--	0.81 (0.47-1.40), 0.454	--	0.85 (0.47-1.53), 0.583
Insomnia (yes)	--	--	1.09 (0.73-1.64), 0.664	--	1.44 (0.94-2.20), 0.095
Analgesic (yes)	--	--	0.99 (0.73-1.33), 0.927	--	1.01 (0.74-1.40), 0.936
Anticonvulsant (yes)	--	--	0.92 (0.56-1.52), 0.756	--	0.95 (0.54-1.68), 0.863
Beta blocker (yes)	--	--	0.92 (0.69-1.22), 0.573	--	0.97 (0.71-1.31), 0.829
APOE e4 carrier (yes)	--	--	--	2.09 (1.57-2.78), <0.001	2.16 (1.60-2.93), <0.001

^aSquare-root transformed to improve normality.

Abbreviations: am% = proportion of daytime naps taken in the morning (9am-11am); APOE = apolipoprotein E; CI = confidence interval; HR = hazard ratio.

Supplementary Table 2. The relationship between naps in the early afternoon and Alzheimer's dementia incidents.

	Model A HR (95%CI), p value	Model B HR (95%CI), p value	Model C HR (95%CI), p value	Model D HR (95%CI), p value	Model E HR (95%CI), p value
Age	1.12 (1.09-1.14), <0.001	1.12 (1.10-1.15), <0.001	1.12 (1.09-1.14), <0.001	1.12 (1.10-1.15), <0.001	1.12 (1.10-1.15), <0.001
Sex (male)	1.25 (0.92-1.69), 0.147	1.20 (0.87-1.66), 0.269	1.22 (0.90-1.67), 0.198	1.30 (0.95-1.78), 0.098	1.27 (0.91-1.79), 0.164
Education (year)	0.98 (0.94-1.02), 0.342	0.97 (0.93-1.02), 0.235	0.98 (0.93-1.02), 0.325	0.96 (0.92-1.01), 0.110	0.96 (0.92-1.01), 0.086
Race/Ethnicity (White)	0.89 (0.49-1.61), 0.689	0.79 (0.43-1.46), 0.457	0.87 (0.48-1.59), 0.659	0.98 (0.54-1.78), 0.941	0.87 (0.47-1.61), 0.665
Body mass index	0.99 (0.96-1.01), 0.265	0.97 (0.95-1.002), 0.068	0.99 (0.96-1.01), 0.330	0.99 (0.96-1.02), 0.463	0.98 (0.95-1.01), 0.162
Smoking (yes)	1.12 (0.86-1.47), 0.402	1.04 (0.78-1.37), 0.809	1.15 (0.81-1.63), 0.429	1.10 (0.84-1.45), 0.486	1.08 (0.74-1.57), 0.685
Alcohol consumption (≥1 drink/month)	0.73 (0.56-0.95), 0.021	0.76 (0.58-1.01), 0.058	0.77 (0.59-1.02), 0.066	0.69 (0.52-0.90), 0.007	0.75 (0.56-1.00), 0.051
Physical activity (hours/week) ^a	0.89 (0.77-1.02), 0.104	0.89 (0.77-1.04), 0.134	0.91 (0.79-1.05), 0.205	0.88 (0.76-1.01), 0.062	0.89 (0.76-1.04), 0.133
Nap duration (min) ^a	1.03 (0.80-1.30), 0.821	1.05 (0.80-1.36), 0.743	1.02 (0.80-1.29), 0.901	1.05 (0.82-1.35), 0.683	1.03 (0.78-1.35), 0.840
Nap frequency	1.05 (0.90-1.22), 0.526	1.05 (0.90-1.23), 0.506	1.06 (0.91-1.23), 0.437	1.03 (0.88-1.20), 0.740	1.06 (0.89-1.25), 0.485
pm% ^a	0.97 (0.85-1.10), 0.581	0.98 (0.85-1.12), 0.718	0.99 (0.87-1.12), 0.846	1.02 (0.90-1.17), 0.721	1.08 (0.94-1.25), 0.271
Sleep and rest-activity rhythm					
Nighttime sleep duration (hour)	--	0.92 (0.81-1.06), 0.241	--	--	0.96 (0.84-1.11), 0.606
Sleep fragmentation index	--	1.05 (0.88-1.22), 0.572	--	--	1.08 (0.91-1.26), 0.328
Wake after sleep onset (min)	--	1.001 (0.997-1.004), 0.784	--	--	1.00 (0.997-1.004), 0.859
Interdaily stability	--	0.89 (0.26-3.04), 0.723	--	--	0.91 (0.25-3.29), 0.886
Intradaily variability	--	1.12 (0.60-2.08), 0.692	--	--	0.99 (0.52-1.85), 0.963
Comorbidities and medications					
Depression ^a	--	--	1.34 (1.14-1.58), <0.001	--	1.35 (1.13-1.61), <0.001
Thyroid disease (yes)	--	--	0.83 (0.61-1.12), 0.226	--	0.88 (0.64-1.22), 0.453
Vascular disease risk factors	--	--	0.97 (0.78-1.20), 0.749	--	0.96 (0.76-1.21), 0.722
Vascular disease burden	--	--	0.92 (0.75-1.11), 0.400	--	0.91 (0.73-1.12), 0.403
Anxiety (yes)	--	--	0.87 (0.51-1.50), 0.625	--	0.90 (0.50-1.61), 0.719
Insomnia (yes)	--	--	1.11 (0.74-1.66), 0.610	--	1.46 (0.95-2.24), 0.081
Analgesic (yes)	--	--	0.97 (0.72-1.31), 0.827	--	0.99 (0.72-1.37), 0.964
Anticonvulsant (yes)	--	--	0.94 (0.57-1.54), 0.796	--	0.98 (0.55-1.72), 0.939
Beta blocker (yes)	--	--	0.93 (0.70-1.24), 0.632	--	0.97 (0.72-1.32), 0.858
APOE e4 carrier (yes)	--	--	--	2.18 (1.64-2.90), <0.001	2.30 (1.69-3.14), <0.001

^a Square-root transformed to improve normality.

Abbreviations: APOE = apolipoprotein E; CI = confidence interval; HR = hazard ratio; pm% = proportion of daytime naps taken in the early afternoon (1pm-3pm).

Supplementary Table 3. The relationship between intraindividual variability of nap duration and Alzheimer's dementia incidents.

	Model A HR (95%CI), p value	Model B HR (95%CI), p value	Model C HR (95%CI), p value	Model D HR (95%CI), p value	Model E HR (95%CI), p value
Age	1.11 (1.09-1.14), <0.001	1.12 (1.09-1.15), <0.001	1.12 (1.09-1.14), <0.001	1.12 (1.09-1.15), <0.001	1.12 (1.10-1.15), <0.001
Sex (male)	1.26 (0.93-1.71), 0.130	1.21 (0.88-1.68), 0.244	1.24 (0.91-1.69), 0.170	1.31 (0.96-1.79), 0.091	1.28 (0.91-1.79), 0.161
Education (year)	0.98 (0.93-1.02), 0.309	0.97 (0.93-1.02), 0.218	0.98 (0.93-1.02), 0.293	0.96 (0.92-1.01), 0.111	0.96 (0.92-1.01), 0.107
Race/Ethnicity (White)	0.86 (0.47-1.56), 0.615	0.77 (0.42-1.42), 0.404	0.85 (0.47-1.55), 0.603	0.97 (0.53-1.76), 0.914	0.87 (0.47-1.61), 0.654
Body mass index	0.99 (0.96-1.01), 0.295	0.98 (0.95-1.002), 0.077	0.99 (0.96-1.01), 0.362	0.99 (0.96-1.02), 0.466	0.98 (0.95-1.01), 0.169
Smoking (yes)	1.12 (0.85-1.46), 0.423	1.03 (0.78-1.37), 0.824	1.15 (0.81-1.62), 0.433	1.10 (0.84-1.45), 0.486	1.10 (0.76-1.60), 0.619
Alcohol consumption (≥ 1 drink/month)	0.74 (0.57-0.97), 0.027	0.77 (0.59-1.02), 0.073	0.78 (0.59-1.03), 0.079	0.69 (0.52-0.91), 0.008	0.74 (0.55-0.99), 0.042
Physical activity (hours/week) ^a	0.90 (0.78-1.03), 0.121	0.90 (0.77-1.04), 0.153	0.92 (0.79-1.06), 0.224	0.88 (0.76-1.00), 0.059	0.88 (0.76-1.03), 0.117
Nap duration (min) ^a	1.16 (0.77-1.74), 0.478	1.20 (0.77-1.86), 0.421	1.18 (0.79-1.78), 0.415	1.19 (0.77-1.83), 0.430	1.30 (0.80-2.09), 0.281
Nap frequency	1.00 (0.81-1.23), 0.988	1.00 (0.79-1.23), 0.968	0.99 (0.81-1.22), 0.957	0.97 (0.77-1.21), 0.795	0.96 (0.75-1.21), 0.728
IIV in nap duration (min) ^a	0.93 (0.74-1.15), 0.490	0.92 (0.73-1.15), 0.452	0.90 (0.72-1.12), 0.363	0.92 (0.73-1.16), 0.493	0.86 (0.68-1.11), 0.248
Sleep and rest-activity rhythm					
Nighttime sleep duration (hour)	--	0.92 (0.81-1.06), 0.242	--	--	0.97 (0.84-1.12), 0.656
Sleep fragmentation index	--	1.05 (0.88-1.23), 0.544	--	--	1.10 (0.93-1.28), 0.245
Wake after sleep onset (min)	--	1.00 (0.997-1.004), 0.833	--	--	1.00 (0.997-1.004), 0.874
Interdaily stability	--	0.85 (0.25-2.93), 0.802	--	--	0.97 (0.27-3.50), 0.960
Intradaily variability	--	1.09 (0.58-2.04), 0.787	--	--	0.94 (0.49-1.77), 0.838
Comorbidities and medications					
Depression ^a	--	--	1.35 (1.15-1.58), <0.001	--	1.33 (1.11-1.57), 0.001
Thyroid disease (yes)	--	--	0.83 (0.61-1.13), 0.232	--	0.89 (0.64-1.23), 0.480
Vascular disease risk factors	--	--	0.96 (0.77-1.19), 0.726	--	0.95 (0.75-1.20), 0.660
Vascular disease burden	--	--	0.91 (0.74-1.11), 0.374	--	0.91 (0.73-1.12), 0.381
Anxiety (yes)	--	--	0.87 (0.51-1.50), 0.627	--	0.90 (0.50-1.61), 0.715
Insomnia (yes)	--	--	1.13 (0.75-1.69), 0.559	--	1.50 (0.97-2.30), 0.066
Analgesic (yes)	--	--	0.96 (0.71-1.30), 0.811	--	0.99 (0.72-1.36), 0.939
Anticonvulsant (yes)	--	--	0.93 (0.56-1.53), 0.775	--	0.96 (0.54-1.69), 0.886
Beta blocker (yes)	--	--	0.92 (0.70-1.23), 0.591	--	0.95 (0.70-1.30), 0.756
APOE e4 carrier (yes)	--	--	--	2.16 (1.63-2.86), <0.001	2.25 (1.66-3.04), <0.001

^a Square-root transformed to improve normality.

Abbreviations: APOE = apolipoprotein E; CI = confidence interval; HR = hazard ratio; IIV = intraindividual variability.

Supplementary Table 4. The relationship between naps in the morning and Alzheimer's dementia incidents (sensitivity analyses without AD incidents within two years of follow-up).

	Model A HR (95%CI), p value	Model B HR (95%CI), p value	Model C HR (95%CI), p value	Model D HR (95%CI), p value	Model E HR (95%CI), p value
Age	1.13 (1.10-1.16), <0.001	1.13 (1.10-1.16), <0.001	1.13 (1.11-1.16), <0.001	1.13 (1.10-1.16), <0.001	1.14 (1.11-1.17), <0.001
Sex (male)	1.04 (0.74-1.45), 0.828	1.04 (0.73-1.49), 0.816	1.00 (0.71-1.41), 0.986	1.11 (0.79-1.57), 0.548	1.10 (0.76-1.60), 0.620
Education (year)	0.99 (0.95-1.04), 0.748	0.99 (0.94-1.04), 0.732	0.99 (0.95-1.04), 0.732	0.98 (0.94-1.03), 0.532	0.98 (0.93-1.03), 0.475
Race/Ethnicity (White)	0.98 (0.50-1.92), 0.955	0.91 (0.46-1.80), 0.785	0.97 (0.49-1.90), 0.920	1.11 (0.56-2.18), 0.768	1.01 (0.50-2.02), 0.978
Body mass index	0.99 (0.97-1.02), 0.650	0.98 (0.95-1.01), 0.248	1.00 (0.97-1.02), 0.766	1.00 (0.97-1.03), 0.943	0.99 (0.96-1.02), 0.464
Smoking (yes)	1.11 (0.83-1.48), 0.468	1.06 (0.79-1.44), 0.685	1.17 (0.81-1.70), 0.403	1.10 (0.82-1.47), 0.544	1.13 (0.76-1.69), 0.550
Alcohol consumption (≥ 1 drink/month)	0.81 (0.61-1.07), 0.138	0.83 (0.62-1.12), 0.222	0.85 (0.63-1.13), 0.259	0.74 (0.56-0.99), 0.043	0.79 (0.58-1.07), 0.128
Physical activity (hours/week) ^a	0.92 (0.80-1.07), 0.280	0.93 (0.80-1.09), 0.386	0.93 (0.80-1.08), 0.315	0.91 (0.78-1.05), 0.180	0.92 (0.78-1.08), 0.306
Nap duration (min) ^a	1.03 (0.79-1.34), 0.809	1.03 (0.77-1.37), 0.840	1.04 (0.80-1.35), 0.770	1.06 (0.80-1.38), 0.680	1.05 (0.78-1.42), 0.739
Nap frequency	1.01 (0.85-1.19), 0.921	1.03 (0.86-1.22), 0.732	1.01 (0.85-1.19), 0.926	0.99 (0.83-1.17), 0.869	1.01 (0.84-1.22), 0.894
am% ^a	1.12 (0.98-1.28), 0.092	1.12 (0.97-1.29), 0.129	1.12 (0.98-1.29), 0.093	1.08 (0.94-1.23), 0.279	1.07 (0.92-1.24), 0.379
Sleep and rest-activity rhythm					
Nighttime sleep duration (hour)	--	0.91 (0.79-1.05), 0.175	--	--	0.93 (0.80-1.08), 0.352
Sleep fragmentation index	--	0.99 (0.82-1.17), 0.942	--	--	1.03 (0.86-1.23), 0.781
Wake after sleep onset (min)	--	1.00 (0.996-1.004), 0.973	--	--	1.00 (0.996-1.004), 0.916
Interdaily stability	--	0.89 (0.23-3.43), 0.861	--	--	0.92 (0.23-3.78), 0.913
Intradaily variability	--	0.94 (0.48-1.85), 0.862	--	--	0.86 (0.43-1.70), 0.657
Comorbidities and medications					
Depression ^a	--	--	1.25 (1.04-1.48), 0.014	--	1.20 (0.99-1.45), 0.060
Thyroid disease (yes)	--	--	0.79 (0.57-1.09), 0.157	--	0.83 (0.59-1.19), 0.316
Vascular disease risk factors	--	--	0.96 (0.76-1.21), 0.732	--	0.95 (0.74-1.22), 0.673
Vascular disease burden	--	--	0.88 (0.70-1.09), 0.263	--	0.89 (0.70-1.13), 0.333
Anxiety (yes)	--	--	0.80 (0.45-1.44), 0.460	--	0.81 (0.43-1.54), 0.529
Insomnia (yes)	--	--	0.99 (0.64-1.54), 0.960	--	1.31 (0.82-2.10), 0.266
Analgesic (yes)	--	--	0.92 (0.67-1.27), 0.629	--	0.92 (0.65-1.28), 0.607
Anticonvulsant (yes)	--	--	1.04 (0.61-1.77), 0.886	--	1.12 (0.62-2.02), 0.711
Beta blocker (yes)	--	--	0.89 (0.65-1.21), 0.445	--	0.96 (0.69-1.34), 0.814
APOE e4 carrier (yes)	--	--	--	2.03 (1.50-2.76), <0.001	2.10 (1.51-2.91), <0.001

^aSquare-root transformed to improve normality.

Abbreviations: am% = proportion of daytime naps taken in the morning (9am-11am); APOE = apolipoprotein E; CI = confidence interval; HR = hazard ratio.

Supplementary Table 5. The relationship between naps in the early afternoon and Alzheimer's dementia incidents (sensitivity analyses without AD incidents within two years of follow-up).

	Model A HR (95%CI), p value	Model B HR (95%CI), p value	Model C HR (95%CI), p value	Model D HR (95%CI), p value	Model E HR (95%CI), p value
Age	1.13 (1.10-1.16), <0.001	1.13 (1.10-1.16), <0.001	1.13 (1.10-1.16), <0.001	1.13 (1.10-1.16), <0.001	1.14 (1.11-1.17), <0.001
Sex (male)	1.05 (0.75-1.47), 0.789	1.05 (0.74-1.51), 0.778	1.02 (0.72-1.44), 0.908	1.12 (0.80-1.59), 0.507	1.13 (0.78-1.64), 0.522
Education (year)	0.99 (0.95-1.04), 0.793	0.99 (0.95-1.04), 0.752	0.99 (0.95-1.04), 0.725	0.98 (0.94-1.03), 0.508	0.98 (0.93-1.03), 0.378
Race/Ethnicity (White)	0.95 (0.49-1.87), 0.889	0.88 (0.44-1.74), 0.713	0.94 (0.48-1.84), 0.848	1.07 (0.54-2.10), 0.847	0.96 (0.48-1.93), 0.915
Body mass index	0.99 (0.97-1.02), 0.645	0.98 (0.95-1.01), 0.232	1.00 (0.97-1.02), 0.761	1.00 (0.97-1.03), 0.992	0.99 (0.96-1.02), 0.478
Smoking (yes)	1.13 (0.85-1.51), 0.396	1.08 (0.80-1.47), 0.599	1.18 (0.81-1.71), 0.383	1.11 (0.83-1.49), 0.491	1.13 (0.75-1.69), 0.557
Alcohol consumption (≥ 1 drink/month)	0.80 (0.60-1.06), 0.116	0.82 (0.61-1.11), 0.195	0.84 (0.63-1.12), 0.241	0.75 (0.56-1.00), 0.048	0.81 (0.59-1.10), 0.179
Physical activity (hours/week) ^a	0.92 (0.80-1.07), 0.302	0.93 (0.80-1.10), 0.404	0.93 (0.80-1.09), 0.366	0.91 (0.78-1.05), 0.207	0.93 (0.79-1.09), 0.368
Nap duration (min) ^a	1.04 (0.80-1.35), 0.767	1.04 (0.78-1.38), 0.809	1.04 (0.80-1.35), 0.751	1.07 (0.81-1.39), 0.628	1.05 (0.78-1.41), 0.760
Nap frequency	1.02 (0.86-1.20), 0.816	1.03 (0.87-1.22), 0.713	1.02 (0.86-1.20), 0.790	0.99 (0.83-1.18), 0.944	1.02 (0.85-1.22), 0.830
pm% ^a	0.98 (0.86-1.12), 0.723	0.99 (0.86-1.14), 0.896	0.99 (0.87-1.13), 0.921	1.04 (0.91-1.19), 0.566	1.10 (0.94-1.27), 0.225
Sleep and rest-activity rhythm					
Nighttime sleep duration (hour)	--	0.91 (0.79-1.05), 0.179	--	--	0.93 (0.80-1.08), 0.339
Sleep fragmentation index	--	1.00 (0.84-1.20), 0.986	--	--	1.02 (0.86-1.23), 0.790
Wake after sleep onset (min)	--	1.00 (0.996-1.004), 0.873	--	--	1.00 (0.995-1.004), 0.817
Interdaily stability	--	0.75 (0.20-2.86), 0.676	--	--	0.77 (0.19-3.09), 0.707
Intradaily variability	--	0.98 (0.50-1.91), 0.945	--	--	0.87 (0.44-1.72), 0.681
Comorbidities and medications					
Depression ^a	--	--	1.26 (1.05-1.50), 0.011	--	1.24 (1.02-1.51), 0.028
Thyroid disease (yes)	--	--	0.80 (0.58-1.11), 0.182	--	0.83 (0.59-1.19), 0.315
Vascular disease risk factors	--	--	0.96 (0.76-1.22), 0.759	--	0.95 (0.74-1.22), 0.699
Vascular disease burden	--	--	0.88 (0.70-1.09), 0.268	--	0.89 (0.70-1.13), 0.349
Anxiety (yes)	--	--	0.86 (0.48-1.54), 0.608	--	0.85 (0.45-1.59), 0.603
Insomnia (yes)	--	--	1.00 (0.64-1.56), 0.986	--	1.33 (0.83-2.13), 0.237
Analgesic (yes)	--	--	0.91 (0.66-1.25), 0.548	--	0.90 (0.64-1.26), 0.529
Anticonvulsant (yes)	--	--	1.05 (0.62-1.79), 0.846	--	1.15 (0.64-2.08), 0.641
Beta blocker (yes)	--	--	0.90 (0.66-1.22), 0.491	--	0.96 (0.69-1.34), 0.829
APOE e4 carrier (yes)	--	--	--	2.13 (1.56-2.90), <0.001	2.25 (1.61-3.13), <0.001

^a Square-root transformed to improve normality.

Abbreviations: APOE = apolipoprotein E; CI = confidence interval; HR = hazard ratio; pm% = proportion of daytime naps taken in the early afternoon (1pm-3pm).

Supplementary Table 6. The relationship between intraindividual variability of nap duration and Alzheimer's dementia incidents (sensitivity analyses without AD incidents within two years of follow-up).

	Model A HR (95%CI), p value	Model B HR (95%CI), p value	Model C HR (95%CI), p value	Model D HR (95%CI), p value	Model E HR (95%CI), p value
Age	1.13 (1.10-1.16), <0.001	1.13 (1.10-1.16), <0.001	1.13 (1.10-1.16), <0.001	1.13 (1.10-1.16), <0.001	1.14 (1.11-1.17), <0.001
Sex (male)	1.06 (0.76-1.48), 0.737	1.06 (0.74-1.52), 0.733	1.03 (0.73-1.46), 0.849	1.13 (0.80-1.60), 0.489	1.13 (0.77-1.64), 0.536
Education (year)	0.99 (0.95-1.04), 0.759	0.99 (0.95-1.04), 0.743	0.99 (0.94-1.04), 0.702	0.98 (0.94-1.03), 0.536	0.98 (0.93-1.03), 0.466
Race/Ethnicity (White)	0.93 (0.47-1.81), 0.820	0.86 (0.44-1.70), 0.665	0.91 (0.46-1.79), 0.787	1.06 (0.54-2.08), 0.868	0.96 (0.48-1.93), 0.912
Body mass index	0.99 (0.97-1.02), 0.699	0.98 (0.95-1.01), 0.258	1.00 (0.97-1.02), 0.817	1.00 (0.97-1.03), 0.988	0.99 (0.96-1.02), 0.494
Smoking (yes)	1.13 (0.85-1.50), 0.414	1.08 (0.80-1.46), 0.601	1.18 (0.81-1.71), 0.385	1.11 (0.83-1.49), 0.493	1.16 (0.77-1.73), 0.483
Alcohol consumption (≥ 1 drink/month)	0.81 (0.61-1.07), 0.143	0.84 (0.62-1.12), 0.235	0.85 (0.64-1.14), 0.280	0.75 (0.56-1.00), 0.051	0.80 (0.58-1.09), 0.157
Physical activity (hours/week) ^a	0.93 (0.80-1.08), 0.334	0.94 (0.80-1.10), 0.442	0.94 (0.80-1.09), 0.385	0.91 (0.78-1.05), 0.191	0.92 (0.78-1.08), 0.328
Nap duration (min) ^a	1.21 (0.77-1.88), 0.406	1.24 (0.76-1.99), 0.381	1.25 (0.80-1.95), 0.329	1.24 (0.78-1.98), 0.363	1.37 (0.82-2.29), 0.231
Nap frequency	0.96 (0.76-1.20), 0.707	0.96 (0.75-1.21), 0.722	0.95 (0.75-1.19), 0.643	0.93 (0.72-1.18), 0.540	0.91 (0.70-1.18), 0.462
IIV in nap duration (min) ^a	0.91 (0.72-1.15), 0.428	0.89 (0.70-1.14), 0.366	0.89 (0.70-1.13), 0.334	0.91 (0.71-1.16), 0.432	0.85 (0.65-1.10), 0.219
Sleep and rest-activity rhythm					
Nighttime sleep duration (hour)	--	0.91 (0.79-1.05), 0.179	--	--	0.93 (0.80-1.09), 0.375
Sleep fragmentation index	--	1.01 (0.83-1.19), 0.946	--	--	1.04 (0.87-1.25), 0.649
Wake after sleep onset (min)	--	1.00 (0.996-1.004), 0.814	--	--	1.00 (0.995-1.003), 0.797
Interdaily stability	--	0.73 (0.19-2.77), 0.638	--	--	0.81 (0.20-3.29), 0.772
Intradaily variability	--	0.94 (0.48-1.85), 0.855	--	--	0.81 (0.41-1.63), 0.563
Comorbidities and medications					
Depression ^a	--	--	1.26 (1.06-1.50), 0.010	--	1.21 (1.00-1.46), 0.051
Thyroid disease (yes)	--	--	0.80 (0.58-1.11), 0.186	--	0.84 (0.59-1.19), 0.330
Vascular disease risk factors	--	--	0.96 (0.76-1.21), 0.733	--	0.94 (0.73-1.21), 0.627
Vascular disease burden	--	--	0.88 (0.70-1.09), 0.253	--	0.89 (0.70-1.13), 0.335
Anxiety (yes)	--	--	0.86 (0.48-1.53), 0.601	--	0.85 (0.45-1.59), 0.604
Insomnia (yes)	--	--	1.02 (0.66-1.59), 0.926	--	1.36 (0.85-2.19), 0.202
Analgesic (yes)	--	--	0.90 (0.66-1.24), 0.531	--	0.89 (0.64-1.25), 0.504
Anticonvulsant (yes)	--	--	1.04 (0.61-1.77), 0.885	--	1.12 (0.62-2.02), 0.714
Beta blocker (yes)	--	--	0.89 (0.65-1.21), 0.448	--	0.94 (0.67-1.31), 0.714
APOE e4 carrier (yes)	--	--	--	2.09 (1.55-2.83), <0.001	2.17 (1.57-3.00), <0.001

^a Square-root transformed to improve normality.

Abbreviations: APOE = apolipoprotein E; CI = confidence interval; HR = hazard ratio; IIV = intraindividual variability.

Supplementary Table 7. The Associations between nap behaviors and amyloid beta level

	am% β (SE), p value	pm% β (SE), p value	IIV in nap duration β (SE), p value
Intercept	-1.19 (1.64), 0.468	-1.22 (1.62), 0.454	-1.63 (1.66), 0.328
Time between last actigraphy and death (year)	0.05 (0.10), 0.644	0.04 (0.10), 0.674	0.05 (0.10), 0.628
Age at death (year)	0.03 (0.02), 0.038	0.03 (0.02), 0.046	0.03 (0.02), 0.061
Sex (male)	0.15 (0.19), 0.425	0.15 (0.19), 0.426	0.18 (0.19), 0.343
Education (year)	-0.06 (0.03), 0.045	-0.05 (0.03), 0.060	-0.04 (0.03), 0.120
Race/Ethnicity (White)	-0.002 (0.51), 0.996	0.08 (0.50), 0.878	0.05 (0.51), 0.920
Body mass index	-0.02 (0.02), 0.295	-0.02 (0.02), 0.237	-0.01 (0.02), 0.419
Smoking (yes)	-0.24 (0.20), 0.220	-0.28 (0.20), 0.163	-0.22 (0.20), 0.256
Alcohol consumption (≥1 drink/month)	-0.10 (0.17), 0.570	-0.09 (0.17), 0.608	-0.10 (0.17), 0.543
Physical activity (hours/week) ^a	0.01 (0.08), 0.935	-0.01 (0.08), 0.914	0.005 (0.08), 0.952
Nap duration (min) ^a	-0.003 (0.18), 0.987	-0.004 (0.18), 0.983	-0.37 (0.24), 0.126
Nap frequency	-0.11 (0.09), 0.239	-0.11 (0.09), 0.209	0.04 (0.10), 0.676
am% ^a	0.15 (0.09), 0.085	--	--
pm% ^a	--	-0.19 (0.09), 0.034	--
IIV in nap duration (min) ^a	--	--	0.23 (0.11), 0.033
Sleep and circadian			
Nighttime sleep duration (hour)	-0.01 (0.08), 0.886	-0.02 (0.08), 0.835	-0.04 (0.08), 0.618
Sleep fragmentation index	0.02 (0.10), 0.857	0.03 (0.10), 0.777	-0.01 (0.10), 0.939
Wake after sleep onset (min)	0.002 (0.002), 0.335	0.002 (0.002), 0.353	0.001 (0.002), 0.520
Interdaily stability	-0.67 (0.69), 0.335	-0.66 (0.69), 0.343	-0.63 (0.69), 0.363
Intradaily variability	0.08 (0.32), 0.810	0.22 (0.33), 0.502	0.15 (0.32), 0.650
Comorbidities and medications			
Depression ^a	-0.08 (0.09), 0.403	-0.08 (0.09), 0.375	-0.05 (0.09), 0.616
Thyroid disease (yes)	-0.08 (0.18), 0.653	-0.10 (0.18), 0.557	-0.04 (0.18), 0.808
Vascular disease risk factors	0.06 (0.12), 0.637	0.06 (0.12), 0.593	0.05 (0.12), 0.664
Vascular disease burden	0.04 (0.09), 0.637	0.03 (0.09), 0.763	0.04 (0.09), 0.622
Anxiety (yes)	0.15 (0.27), 0.589	0.14 (0.27), 0.616	0.18 (0.27), 0.512
Insomnia (yes)	-0.34 (0.29), 0.242	-0.35 (0.29), 0.225	-0.34 (0.29), 0.236
Analgesic (yes)	-0.17 (0.18), 0.330	-0.17 (0.17), 0.332	-0.12 (0.17), 0.488
Anticonvulsant (yes)	-0.02 (0.25), 0.937	-0.04 (0.25), 0.876	<0.001 (0.25), 0.997
Beta blocker (yes)	-0.29 (0.16), 0.065	-0.26 (0.16), 0.096	-0.33 (0.15), 0.036
APOE e4 carrier (yes)	0.83 (0.20), <0.001	0.82 (0.19), <0.001	0.86 (0.19), <0.001

^aSquare-root transformed to improve normality.

Abbreviations: am% = proportion of daytime naps taken in the morning (9am-11am); APOE = apolipoprotein E; IIV = Intraindividual variability; pm% = proportion of daytime naps taken in the early afternoon (1pm-3pm); SE = standard error.

Supplementary Table 8. The Associations between nap behaviors and neurofibrillary tangles

	am% β (SE), p value	pm% β (SE), p value	IIV in nap duration β (SE), p value
Intercept	-3.31 (1.17), 0.005	-3.26 (1.17), 0.006	-4.08 (1.19), <0.001
Time between last actigraphy and death (year)	0.07 (0.07), 0.328	0.07 (0.07), 0.333	0.07 (0.07), 0.284
Age at death (year)	0.02 (0.01), 0.053	0.02 (0.01), 0.065	0.02 (0.01), 0.041
Sex (male)	-0.30 (0.14), 0.028	-0.30 (0.14), 0.028	-0.28 (0.13), 0.037
Education (year)	-0.02 (0.02), 0.238	-0.02 (0.02), 0.265	-0.01 (0.02), 0.502
Race/Ethnicity (White)	0.49 (0.38), 0.202	0.53 (0.38), 0.164	0.47 (0.37), 0.203
Body mass index	0.004 (0.01), 0.752	0.003 (0.01), 0.794	0.01 (0.01), 0.491
Smoking (yes)	-0.16 (0.14), 0.264	-0.17 (0.14), 0.240	-0.15 (0.14), 0.285
Alcohol consumption (≥ 1 drink/month)	0.18 (0.12), 0.135	0.19 (0.12), 0.122	0.18 (0.12), 0.137
Physical activity (hours/week) ^a	0.13 (0.06), 0.023	0.13 (0.06), 0.028	0.13 (0.06), 0.018
Nap duration (min) ^a	0.08 (0.13), 0.530	0.08 (0.13), 0.555	-0.21 (0.16), 0.185
Nap frequency	-0.07 (0.06), 0.315	-0.06 (0.06), 0.340	0.05 (0.07), 0.505
am% ^a	0.06 (0.06), 0.313	--	--
pm% ^a	--	-0.05 (0.07), 0.452	--
IIV in nap duration (min) ^a	--	--	0.21 (0.08), 0.006
Sleep and circadian			
Nighttime sleep duration (hour)	0.08 (0.06), 0.145	0.08 (0.06), 0.168	0.07 (0.06), 0.179
Sleep fragmentation index	0.15 (0.08), 0.057	0.15 (0.08), 0.055	0.13 (0.07), 0.081
Wake after sleep onset (min)	<0.001 (0.001), 0.919	<0.001 (0.001), 0.869	<0.001 (0.001), 0.727
Interdaily stability	-0.32 (0.51), 0.530	-0.35 (0.50), 0.484	-0.17 (0.50), 0.733
Intradaily variability	0.28 (0.24), 0.232	0.32 (0.24), 0.190	0.33 (0.23), 0.157
Comorbidities and medications			
Depression ^a	-0.08 (0.07), 0.233	-0.08 (0.07), 0.238	-0.06 (0.07), 0.385
Thyroid disease (yes)	-0.03 (0.13), 0.806	-0.04 (0.13), 0.758	0.004 (0.13), 0.977
Vascular disease risk factors	-0.02 (0.09), 0.818	-0.02 (0.09), 0.853	-0.03 (0.09), 0.737
Vascular disease burden	-0.10 (0.06), 0.125	-0.10 (0.06), 0.120	-0.11 (0.06), 0.084
Anxiety (yes)	0.16 (0.20), 0.429	0.16 (0.20), 0.413	0.15 (0.19), 0.433
Insomnia (yes)	0.01 (0.22), 0.948	0.02 (0.22), 0.941	-0.01 (0.21), 0.968
Analgesic (yes)	0.03 (0.13), 0.803	0.04 (0.13), 0.742	0.05 (0.12), 0.653
Anticonvulsant (yes)	0.06 (0.19), 0.756	0.05 (0.19), 0.791	0.09 (0.18), 0.640
Beta blocker (yes)	-0.01 (0.11), 0.907	-0.01 (0.11), 0.923	-0.03 (0.11), 0.783
APOE e4 carrier (yes)	0.86 (0.14), <0.001	0.86 (0.14), <0.001	0.86 (0.14), <0.001

^aSquare-root transformed to improve normality.

Abbreviations: am% = proportion of daytime naps taken in the morning (9am-11am); APOE = apolipoprotein E; IIV = Intraindividual variability; pm% = proportion of daytime naps taken in the early afternoon (1pm-3pm); SE = standard error.