

Reporting Summary

Nature Portfolio wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Portfolio policies, see our [Editorial Policies](#) and the [Editorial Policy Checklist](#).

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a	Confirmed
☐	☒ The exact sample size (<i>n</i>) for each experimental group/condition, given as a discrete number and unit of measurement
☐	☒ A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
☐	☒ The statistical test(s) used AND whether they are one- or two-sided <i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i>
☐	☒ A description of all covariates tested
☐	☒ A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
☐	☒ A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
☐	☒ For null hypothesis testing, the test statistic (e.g. <i>F</i> , <i>t</i> , <i>r</i>) with confidence intervals, effect sizes, degrees of freedom and <i>P</i> value noted <i>Give P values as exact values whenever suitable.</i>
☒	☐ For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
☒	☐ For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
☒	☐ Estimates of effect sizes (e.g. Cohen's <i>d</i> , Pearson's <i>r</i>), indicating how they were calculated

Our web collection on [statistics for biologists](#) contains articles on many of the points above.

Software and code

Policy information about [availability of computer code](#)

Data collection	Grass twin PSG is a commercial software used to collect overnight PSG data.
Data analysis	opensource python package were used for EEG analysis: MNE, Pingouin, statsmodels, yasa, pandas. Free surfer opensource package was used for derving cortical thickness form T1w MRI images Python scripts showing how to calculate cortical involvement and slow wave propagation are available at GitHub: https://github.com/omersharonPhD/travellingWaves.

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio [guidelines for submitting code & software](#) for further information.

Data

Policy information about [availability of data](#)

All manuscripts must include a [data availability statement](#). This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our [policy](#)

All source data for the main figures and Extended Data figures will be made available upon publication.

Research involving human participants, their data, or biological material

Policy information about studies with [human participants or human data](#). See also policy information about [sex, gender \(identity/presentation\), and sexual orientation](#) and [race, ethnicity and racism](#).

Reporting on sex and gender	Sex was reported and accounted for in the study, there were no discrepancies between sex and gender in the study participants therefore sex is reported throughout.
Reporting on race, ethnicity, or other socially relevant groupings	n/a
Population characteristics	age, sex, Amyloid-Beta status if available, cortical thickness Apnea-Hypopnea Index (AHI)
Recruitment	Participants in the Berkeley cohort were recruited from the easy bay community through flyers and online ads. Some of them were first recruited for BACS and were recruited by the sleep lab and then included in BACS. Participants in the BASE cohort were recruited from the Saint Louis, Missouri community through "Volunteer for Health online system": https://sites.wustl.edu/wuvfh/ We don't think there should be any bias in the sample.
Ethics oversight	Human studies committees at the University of California Berkeley and Lawrence Berkeley National Laboratory (Berkeley Committee for Protection of Human Subjects Protocol Numbers 2010-01-595 and 2015-03-7268); Human Research Protection Office at Washington University in St. Louis (Protocol 201804006)

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☒ Life sciences ☐ Behavioural & social sciences ☐ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see nature.com/documents/nr-reporting-summary-flat.pdf

Life sciences study design

All studies must disclose on these points even when the disclosure is negative.

Sample size	All available data was used
Data exclusions	2 older subjects that showed less than 25 slow waves were excluded from cortical involvement measures, and none for the BASE cohort. 7 older subjects from the Berkeley cohort and 4 subjects from the BASE cohort were excluded from the slow wave propagation analysis for not having a minimum of 25 waves simultaneously detected in 2 electrodes. This criteria was established in the Berkeley cohort and applied to the BASE cohort. Having a minimal amount of data per subject is a common practice, and rationale is not to contaminate the group data with subjects that have low amount of clean slow waves that could be analyzed and contribute to the conclusions.
Replication	We followed up with a second cohort to extend the findings using lumbar puncture measures rather than PET imaging, the main results were replicated but it was not as robust as these measures are different- this is clearly described and discussed in the paper. A subset of the participants were followed longitudinally to further confirm the findings. Beyond that, we believe that once our findings made public that could be easily replicated in additional cohorts of healthy agers as well as AD and MCI patients.
Randomization	Not relevant, there was no allocation to conditions. We controlled for intervening factors such as age, sex, AHI, brain atrophy and Amyloid-beta burden.
Blinding	EEG data in the Berkeley cohort was collected while blinded to cognitive and biomarker status.

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☒	☐ Animals and other organisms
☐	☒ Clinical data
☒	☐ Dual use research of concern
☒	☐ Plants

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☐	☒ MRI-based neuroimaging

Clinical data

Policy information about [clinical studies](#)

All manuscripts should comply with the ICMJE [guidelines for publication of clinical research](#) and a completed [CONSORT checklist](#) must be included with all submissions.

Clinical trial registration	BASE is not a clinical trial and therefore not required to be registered on clinicaltrials.gov, Berkeley cohort is studying healthy population and therefore not a clinical study.
Study protocol	BASE is not a clinical trial and therefore not required to be registered on clinicaltrials.gov
Data collection	Data collection was at wash U school of medicine from March 2019 to June 2022.
Outcomes	sleep quality: awakenings, total sleep time, sleep efficiency, WASO; CSF: Ab40, Ab42, tau, ptau levels and tau/ab42 ratio

Plants

Seed stocks	n/a
Novel plant genotypes	n/a
Authentication	n/a

Magnetic resonance imaging

Experimental design

Design type	n/a
Design specifications	n/a
Behavioral performance measures	n/a

Acquisition

Imaging type(s)	structural	
Field strength	3T	
Sequence & imaging parameters	MPRAGE, Repetition Time (TR) = 1900 echo time (TE) = 2.52 ms, Flip Angle (FA) = 9°, 1mm isotropic voxels	
Area of acquisition	whole brain	
Diffusion MRI	☐ Used	☒ Not used

Preprocessing

Preprocessing software	FreeSurfer version 5.3
Normalization	data is coregisted to MNI305, but not normalized such that values are in native space.
Normalization template	no
Noise and artifact removal	n/a
Volume censoring	n/a

Statistical modeling & inference

Model type and settings	n/a
Effect(s) tested	n/a
Specify type of analysis:	☐ Whole brain ☐ ROI-based ☒ Both
Anatomical location(s)	Frontal ROI, described in the paper
Statistic type for inference	Area-wise, regression
(See Eklund et al. 2016)	
Correction	FDR

Models & analysis

n/a	Involvement in the study
☒	☐ Functional and/or effective connectivity
☒	☐ Graph analysis
☒	☐ Multivariate modeling or predictive analysis