

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 (n) 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
Only common tests should be described solely by name; describe more complex techniques in the Methods section.
- 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. F , t , r) with confidence intervals, effect sizes, degrees of freedom and P value noted
Give P values as exact values whenever suitable.
- 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 d , Pearson's r), 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

Data analysis https://www.r-project.org). Code used for this study can be made immediately available to any approved researchers on the All of Us Research Workbench platform by contacting our study team."/>

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](#)

To ensure privacy of participants, data used for this study are available to approved researchers following registration, completion of ethics training and attestation of a data use agreement through the All of Us Research Workbench platform, which can be accessed via <https://workbench.researchallofus.org/>.

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	Self-reported sex was collected via The Basics survey by the All of Us research program. Among the 6,785 participants included in the analyses, 4,802 (70.8%) identified as female, 1,801 (26.5%) identified as male, and 182 (2.7%) had unknown sex. Self-reported sex was included as a covariate in all analyses.
Reporting on race, ethnicity, or other socially relevant groupings	Self-reported race was collected via The Basics survey by the All of Us research program and further categorized into White, Black or African American, Other, and Unknown. Self-reported race was included as a covariate in all analyses but was not used as a proxy for socioeconomic status.
Population characteristics	See below in "Behavioral & social sciences study design" section.
Recruitment	The All of Us research program (AoU) is a National Institutes of Health-funded initiative to gather health data from over one million diverse persons living in the United States (U.S.). Participants who provide consent and enrolled in the program to share multiple sources of health-related information, including electronic health records (EHRs), genomics, physical measures, and participant surveys. Participants who owned Fitbit devices have the opportunity to voluntarily share their Fitbit data under the Bring Your Own Device project, including physical activity and sleep patterns.
Ethics oversight	The All of Us research program's institutional review board has reviewed the protocol, informed consent, and other participant-facing materials for the All of Us Research Program. The IRB follows the regulations and guidance of the Office for Human Research Protections for all studies, ensuring that the rights and welfare of research participants are overseen and protected uniformly. To ensure privacy of participants, data used for this study was accessed and available to approved researchers only following registration, completion of ethics training, and attestation of a data use agreement through the All of Us Research Workbench platform, which can be accessed via https://workbench.researchallofus.org/login .

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](https://www.nature.com/documents/nr-reporting-summary-flat.pdf)

Behavioural & social sciences study design

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

Study description	Observational longitudinal cohort study of quantitative data.
Research sample	6,785 adult participants who possess their own Fitbit and consented to link Fitbit data with electronic health records (EHR) within the All of Us Research Program, had at least 6 months of Fitbit sleep data, and had fewer than 30% of nights with < 4 hours of sleep. These thresholds were informed by mathematical models as the theoretical cutoff at which insufficient sleep would be unsustainable. The study cohort is relatively young (median age was 50.2 years), majority female (71%), white (84%), and college educated (71%), which is not representative of underrepresented minorities or those in areas of deprivation.
Sampling strategy	All of Us Research Program is an initiative that is accumulating multiple streams of health-related information (e.g., electronic health records (EHRs), genomics, physical measures, participant surveys and wearables such as Fitbit) in 1,000,000 or more Americans and includes a focus on populations usually under-represented in biomedical research to date. We used a convenience sampling procedure because our analysis was limited to the All of Us dataset. To determine the sample size, we followed the convention of having at least 10 events per predictor.

Data collection	For this study, we used All of Us Registered and Controlled Tier data (C2022Q4R9) available on the All of Us Researcher Workbench. This dataset included information on physical measurements and vital signs collected at enrollment, surveys, EHR and Fitbit data from participants enrolled from May, 2018 to July, 2022. Our analyses focused on participants who owned a Fitbit and agreed to share their Fitbit and EHR data. We included participants with at least 6 months of Fitbit sleep data and had fewer than 30% of nights with < 4 hours of sleep. The researchers were not blinded to the experimental conditions or study hypothesis.
Timing	For this study, data from participants enrolled from May, 2018 to July, 2022 in All of Us Research Program were used.
Data exclusions	Of the 413,457 All of Us participants available at the time of our analysis, 14,892 shared their Fitbit sleep data. Of those sharing Fitbit data, 6,785 participants consented to linking their Fitbit data with electronic health record data, had at least 6 months of Fitbit sleep data, and had fewer than 30% of nights with < 4 hours of sleep.
Non-participation	We are using data from All of Us Research Program. As noted in the All of Us Responsible Conduct of Research training, the Researcher Workbench employs a data passport model, through which we are not conducting human subjects research with All of Us data for two reasons:(1) The research will not directly involve participants, however, it only includes their data; and (2) the data available in the Researcher Workbench has been carefully checked and altered to remove identifying information while preserving its scientific utility. Therefore, we do not have access to information around non-participation to the program.
Randomization	All discovery phenome-wide analyses were adjusted for age, sex, average daily step count across the entire Fitbit monitoring period, and electronic health record (EHR) length. All Cox models were adjusted for age, sex, baseline body mass index (BMI), baseline systolic blood pressure, smoking status, alcohol drinking status, education status, time-varying average daily step count, and prior diagnoses of cancer or coronary artery disease (CAD). Participant demographics (age, self-reported sex, self-reported race/ethnicity, education) and lifestyle factors (smoking, alcohol intake) were derived from survey data completed at time of enrollment. Average daily step count was derived from the Fitbit physical activity data. We calculated total EHR length as the time between the first and last billing code (diagnosis or procedure), vital sign documentation, or laboratory measurement in the participant's EHR. CAD and cancer were ascertained using ICD9CM/ICD10CM or Current Procedural Terminology (CPT4) codes as well as ICD9CM/ICD10CM codes, respectively.

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
<input checked="" type="checkbox"/>	<input type="checkbox"/> Antibodies
<input checked="" type="checkbox"/>	<input type="checkbox"/> Eukaryotic cell lines
<input checked="" type="checkbox"/>	<input type="checkbox"/> Palaeontology and archaeology
<input checked="" type="checkbox"/>	<input type="checkbox"/> Animals and other organisms
<input checked="" type="checkbox"/>	<input type="checkbox"/> Clinical data
<input checked="" type="checkbox"/>	<input type="checkbox"/> Dual use research of concern
<input checked="" type="checkbox"/>	<input type="checkbox"/> Plants

Methods

n/a	Involved in the study
<input checked="" type="checkbox"/>	<input type="checkbox"/> ChIP-seq
<input checked="" type="checkbox"/>	<input type="checkbox"/> Flow cytometry
<input checked="" type="checkbox"/>	<input type="checkbox"/> MRI-based neuroimaging

Plants

Seed stocks	N/A
Novel plant genotypes	N/A
Authentication	N/A