

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	Mobility data were collected by BlogWatcher through a smartphone application with a built-in BlogWatcher location module. The authors did not use custom software to collect participant data. Public park, population and land-price datasets were obtained from the official MLIT NLNI/KSJ download service. The specific version of the BlogWatcher data-collection software was not available to the authors.
Data analysis	Data processing and analysis were performed in Python 3.11 using Jupyter/IPython. Main dependencies included NumPy, pandas, SciPy, scikit-learn, Matplotlib, GeoPandas, Shapely, PyProj, NetworkX, OSMnx, DuckDB, PyArrow and related Python packages. Exact package versions were not locked in the original analysis environment. Custom analysis code is publicly available at https://github.com/SuH-Studio/Quantifying-parks-as-preventive-health-assets and is permanently archived in Zenodo at https://doi.org/10.5281/zenodo.21903066 .

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](#)

Urban-park inventory and attribute data were obtained from Japan's National Land Numerical Information (NLNI/KSJ) Urban Park dataset (P13) provided by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) (<https://nlftp.mlit.go.jp/ksj/gml/datalist/KsjTmplt-P13.html>). Urban park boundary geometries were obtained from OpenStreetMap (<https://www.openstreetmap.org/>) using a snapshot dated 1 January 2019. Population distribution data were obtained from the NLNI/KSJ Population Concentrated Districts (DID) dataset (A16; 2019) (https://nlftp.mlit.go.jp/ksj/gml/datalist/KsjTmplt-A16-v2_3.html). Land-price data were obtained from the NLNI/KSJ Official Land Price Publication dataset (L01; 2019, reference date 1 January 2019) (<https://nlftp.mlit.go.jp/ksj/gml/datalist/KsjTmplt-L01-2019.html>). These NLNI/KSJ datasets and OpenStreetMap data are publicly available from their respective data services. The individual-level mobile-phone location data used in this study were provided by BlogWatcher Inc. under a third-party data-use agreement. The authors are not permitted to redistribute or publicly deposit these data because they contain fine-grained individual mobility information and are subject to privacy protections and contractual restrictions. Access to the original mobility data is controlled by BlogWatcher Inc. and must be requested directly through the BlogWatcher Inc. contact webpage (<https://www.blogwatcher.co.jp/contact>). Access is subject to BlogWatcher Inc.'s approval and to the terms, conditions, data-protection requirements and licensing provisions applicable to the relevant data-use agreement. Eligibility requirements, the review process, the response timeframe and the duration of approved access are determined by BlogWatcher Inc. on a case-by-case basis in accordance with the applicable agreement. A privacy-preserving demonstration dataset is publicly available together with the associated processing and analysis code at the GitHub repository (<https://github.com/SuH-Studio/Quantifying-parks-as-preventive-health-assets>). The demonstration dataset uses de-identified user identifiers and randomly perturbed home and park-stay coordinates and is intended to demonstrate the processing workflow rather than reproduce exact individual locations or the complete restricted analytical dataset. The archived version of the repository is permanently available in Zenodo under DOI 10.5281/zenodo.21903066.

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	This study used anonymized mobile-phone location data that contained no individual-level sex or gender information. The source data did not include personal attributes such as name, age, or gender. Sex- and gender-based analyses were therefore not possible and were not performed. Sex/gender was neither self-reported nor assigned by the authors, because these variables were unavailable in the source data.
Reporting on race, ethnicity, or other socially relevant groupings	No race, ethnicity, or other socially relevant individual-level grouping variables were available in the source data, and no such variables were used in the analyses. The study did not classify participants into race-, ethnicity-, or identity-based categories.
Population characteristics	The study analyzed anonymized mobility records from approximately 0.32 million mobile-phone users contributing 1.79 million park activity episodes across Greater Tokyo in 2019. Because the source data were anonymized before access, no individual-level demographic characteristics such as age, sex, or gender were available to the authors.
Recruitment	Participants were not recruited by the authors through a study-specific enrollment process. The mobility records were obtained from BlogWatcher, a provider of location information services, and were collected through a smartphone application with a built-in location module under user consent to the application's terms and conditions. Because the dataset derives from an existing location-based service, self-selection bias and uneven app coverage cannot be excluded; these limitations are acknowledged in the manuscript.
Ethics oversight	No study-specific ethics approval was obtained for this secondary analysis. The study used previously collected, de-identified mobility data provided by BlogWatcher under a data-use agreement. The researchers did not recruit or interact with participants and had no access to directly identifying personal information. Users had consented to the collection and analysis of their location data under the terms and conditions of the original location-based service. The use of the BlogWatcher data complied with the requirements of the data provider. No separate ethics approval or application number was assigned for this secondary data-use arrangement.

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

Behavioural & social sciences study design

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

Study description	This study is a retrospective observational quantitative study using anonymized population-scale mobility data, geospatial park inventory data, and administrative cost and population layers to estimate park-attributable walking-related health benefits and park-level economic returns in Greater Tokyo.
Research sample	The analytical sample comprised anonymized mobility records from approximately 0.32 million mobile-phone users contributing 1.79 million park activity episodes in 2019, linked to 4,139 urban parks across Tokyo, Chiba, Saitama, and Kanagawa. The mobility dataset was obtained from BlogWatcher, and public geospatial datasets were obtained from the MLIT National Land Numerical Information service. Because the source mobility data were anonymized before access, demographic characteristics such as age, sex, and gender were not available. The sample should be interpreted as a large observational mobility sample rather than a statistically representative survey sample.
Sampling strategy	No prospective sampling or sample-size calculation was performed by the authors. The study used an existing observational dataset of anonymized mobility records collected through a mainstream location-based smartphone service. Analytical sample sizes were determined by data availability and by pre-specified inclusion and exclusion criteria applied during preprocessing, including restriction to the study region, inference of a primary residential location where required, exclusion of parks smaller than 0.1 ha, exclusion of users whose inferred residence fell within a park or within 10 m of the park boundary, and exclusion of parks with fewer than five unique visitors. The resulting population-scale dataset provided large numbers of observations across park types and residential-distance bands for the planned descriptive and regression analyses.
Data collection	Mobility records were collected by BlogWatcher Inc. through a smartphone application with a built-in location module. Urban-park inventory and attribute data were obtained from the MLIT NLNI/KSJ P13 dataset, park boundary geometries from OpenStreetMap using a snapshot dated 1 January 2019, population data from MLIT NLNI/KSJ A16, and land-price data from MLIT NLNI/KSJ L01. The authors were not involved in the original mobility-data collection and had no direct contact with participants.
Timing	The mobility data covered 1 January to 31 December 2019. All analyses were restricted to this study period.
Data exclusions	Pre-specified data-quality exclusions were applied. Parks smaller than 0.1 ha were excluded. Users whose inferred primary residence fell within a park polygon or within 10 m of the park boundary were excluded to reduce potential positional-error and pass-through effects. Parks with fewer than five unique visitors were excluded to avoid unstable estimates. For residence-based analyses, records for which a primary residence could not be reliably inferred were not included.
Non-participation	No study-specific participant recruitment was conducted by the authors, so conventional participation, refusal, or dropout rates do not apply. The analysis used an existing anonymized mobility dataset derived from users of a location-based smartphone service.
Randomization	This was an observational study. Participants were not allocated to groups, and no randomization was performed.

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

Seed stocks

Report on the source of all seed stocks or other plant material used. If applicable, state the seed stock centre and catalogue number. If plant specimens were collected from the field, describe the collection location, date and sampling procedures.

Novel plant genotypes

Describe the methods by which all novel plant genotypes were produced. This includes those generated by transgenic approaches, gene editing, chemical/radiation-based mutagenesis and hybridization. For transgenic lines, describe the transformation method, the number of independent lines analyzed and the generation upon which experiments were performed. For gene-edited lines, describe the editor used, the endogenous sequence targeted for editing, the targeting guide RNA sequence (if applicable) and how the editor was applied.

Authentication

Describe any authentication procedures for each seed stock used or novel genotype generated. Describe any experiments used to assess the effect of a mutation and, where applicable, how potential secondary effects (e.g. second site T-DNA insertions, mosaicism, off-target gene editing) were examined.