

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 <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. F , t , r) with confidence intervals, effect sizes, degrees of freedom and P 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 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	SAS 9.4
Data analysis	ArcGIS 10.8; SAS 9.4; Python 3.10; R 4.2.1

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](#)

Sources of raw public dataset used within the paper are summarised in the 'Methods' section. Data of air pollutants can be obtained from The China National Environmental Monitoring Centre (<https://air.cnemc.cn:18007/>). Data of surface water can be obtained from Ministry of Ecology and Environment of China (<http://www.cnemc.cn/>). Data of cancer incidence can be obtained from China Cancer Registry Annual Report. The sharing of ecological environment data, including

surface water and air pollutants, is built upon a series of national and local technical standards. The authors are not authorized to disclose the original data. For access to the original data, please contact the relevant departments listed in the methodology section.

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 is a study of population rates and does not involve individual information.
Reporting on race, ethnicity, or other socially relevant groupings	This is a study of population rates and does not involve individual information.
Population characteristics	All of these analysis areas (totaling 219) constituted the study area, covering a population of 377 million.
Recruitment	The selection of monitoring stations follows the principles of representativeness, comparability, integrity, foresight and stability, taking into account factors such as environmental and socio-economic characteristics comprehensively. The surface water monitoring sections were strategically chosen to accurately represent the natural characteristics of river network density, runoff supply, and hydrological features. We included all the prefecture-level areas that simultaneously contained all three components (air monitoring site, water monitoring section, and cancer registry institute as analysis areas.
Ethics oversight	All the data used in this study are from the national monitoring data set, which does not contain individual information and does not involve ethical issues.

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

Ecological, evolutionary & environmental sciences study design

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

Study description	This study used air and water monitoring and population-level cancer data from across China to examine spatial associations between environmental pollutants and types of cancer.
Research sample	This study included 219 basic analytic units, each bringing together three components—air monitoring site, water monitoring section and cancer registry institute (CRI)—defined based on prefecture-level areas.
Sampling strategy	We included prefecture-level areas if they contained all three components (i.e., air monitoring site, water monitoring section, and CRI).
Data collection	Air pollutants in 2015 were obtained from the China National Environmental Monitoring Centre through 1,436 air monitoring sites in 331 prefectural areas across mainland China. Surface water quality data were derived from all (3632) monitored sections of the National Surface Water Environmental Quality Monitoring Network, Ministry of Ecology and Environment of China. Cancer incidence data were extracted from the Annual Report of the China Cancer Registry, which was drawn from 487 registries in 31 provincial-level places in mainland China
Timing and spatial scale	Annual data; 219 prefecture-level areas across Chinese mainland
Data exclusions	We excluded prefecture-level areas if they did not contain any of the three components (i.e., air monitoring site, water monitoring section, and CRI).
Reproducibility	Not applicable.
Randomization	Not applicable.
Blinding	Not applicable.

Did the study involve field work? ☐ Yes ☒ No

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