nature portfolio

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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	No software was used to collect data.
Data analysis	R version 4.0.4 (2021-02-15) was used for the analysis and figure generation. Code to replicate the results in the main text and supplementary information are available at https://github.com/jeffwen/wildfire_smoke_education_public

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

The weather data used in this study is available through the Parameter elevation Regressions on Independent Slopes Model (PRISM) Climate Group at Oregon State University (https://prism.oregonstate.edu). Student test performance and district level covariate data are available through the Stanford Education Data Archive (SEDA) (https://purl.stanford.edu/db586ns4974). School location and student population data are available through the National Center for Education Statistics

(NCES). Fire perimeter data used to calculate the distance of school districts to fire perimeters is available through the National Interagency Fire Center (NIFC) (https://data-nifc.opendata.arcgis.com/datasets/nifc::interagency-fire-perimeter-history-all-years). Smoke plume annotations are available through the National Environmental Satellite, Data, and Information Service (NESDIS) Hazard Mapping System (HMS) (https://www.ospo.noaa.gov/Products/land/hms.html#data). Daily gridded estimates of PM2.5 concentrations are available from Di et al. (2021) (https://doi.org/10.7927/0rvr-4538; https://doi.org/10.1016/j.envint.2019.104909). Processed data to replicate the results in the main text and supplementary information are available at https://github.com/jeffwen/wildfire_smoke_education_public.

Human research participants

Policy information about studies involving human research participants and Sex and Gender in Research.

Reporting on sex and gender	Test scores are aggregated at the district-grade level in the SEDA dataset. Information on sex and/or gender are not included in the SEDA dataset.
Population characteristics	Test scores are aggregated at the district-grade level in the SEDA dataset. District-grade level covariates including race/ethnicity and economic disadvantage were used to estimate heterogeneous effects.
Recruitment	SEDA data is based on aggregated standardized testing data from all public-school students in grades 3-8. Data was provided to SEDA in aggregate from by the U.S. Department of Education.
Ethics oversight	Only aggregated data was used for this analysis. Approval of study protocol was not required.

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	Quantitative quasi-experimental method using observational data.
Research sample	The data sample used in this analysis consists of public school student test scores for students in US school districts from 3-8th grades from 2009-2016 in 11,639 districts. These data are compiled by the Stanford Education Data Archive (SEDA).
Sampling strategy	All US public school districts included in SEDA were used for analysis.
Data collection	The student test performance and district level covariate data used in this study are downloaded from the Stanford Education Data Archive (SEDA). School location and student population data is from the National Center for Education Statistics (NCES). Weather data is downloaded from the Parameter elevation Regressions on Independent Slopes Model (PRISM) Climate Group at Oregon State University. Fire perimeter data used to calculate the distance of school districts to fire perimeters is downloaded from the National Interagency Fire Center (NIFC). The smoke plume annotations are downloaded from the National Environmental Satellite, Data, and Information Service (NESDIS) Hazard Mapping System (HMS). Daily gridded estimates of PM2.5 concentrations are downloaded from Di et al. (2021).
Timing and spatial scale	Measurements used for this analysis were collected from 2009-2016.
Data exclusions	- 2 years of SEDA data (n=128,588 observations) were excluded because the gridded PM2.5 data used to estimate wildfire attributable PM2.5 extended until 2016 while SEDA extended to 2018. - n=100,700 observations dropped out due to missing English language arts and/or math scores. - n=7 observations dropped out because of missing average temperature data.
Reproducibility	Experiments were not conducted for this study.
Randomization	The authors did not conduct randomization. Instead, a quasi-experimental approach was used to analyze observational data.
Blinding	Blinding was not used during the data acquisition or analysis steps of this study.

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

Methods

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