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	Data were collected from published randomized controlled trials identified through systematic searches in PubMed, Embase, and the Cochrane Library. Reference management and deduplication were performed using EndNote v19 (Clarivate Analytics), and study screening was conducted using Rayyan (version 2022).
Data analysis	All statistical analyses were conducted in R version 4.3.3, using the packages netmeta (v2.5-0) and gemtc (v1.0-1) for network meta-analysis and meta-regression.

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 promote transparency and reproducibility, the analysis code and dataset have been made publicly available in an open-access repository (Digital-Health-in-

Smoking (https://github.com/Xch20030923/digital-smoking-nma.git)). Please note that data sharing is intended for academic research purposes only and not for other purposes.

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 meta-analysis systematically included studies that reported data disaggregated by sex, allowing for detailed subgroup analyses to investigate potential differences in outcomes across biological sexes. Gender considerations were also examined in studies where such data were available and relevant. All studies included in this meta-analysis adhered to the ethical standards of reporting and obtaining consent for sex- and gender-specific data, ensuring that both biological and sociocultural factors were appropriately considered in our analyses.
Reporting on race, ethnicity, or other socially relevant groupings	In our meta-analysis, we carefully selected socially relevant variables such as gender, race, and socioeconomic status due to their importance in addressing our research questions. Definitions for these categories were sourced from the original studies, with most classifications based on self-reported data, ensuring consistency across the datasets.We strictly avoided using any social variables as proxies for another to maintain clear and accurate analyses. For example, race was not used to infer socioeconomic status.To control for confounding variables and mitigate potential biases, we employed robust statistical methods. This involved adjusting our models according to identified confounders based on literature and expert advice, ensuring that our findings are both valid and applicable.
Population characteristics	Across the 152 included randomized controlled trials, a total of 129,536 participants were analyzed. The median age was 40.5 years (IQR 35.7–45.7), with a slight male predominance (51.4%). Baseline daily cigarette consumption averaged 16.7 units (IQR 14.2–19.3). Covariate-relevant characteristics assessed in subgroup or meta-regression analyses included age, gender, baseline smoking intensity, pharmacotherapy use, financial incentives, and biochemical validation status.
Recruitment	We searched PubMed, Embase and the Cochrane Library (CENTRAL) for publications from the date of their inception to 19 January 2024, regardless of language. Duplicate articles were removed using Endnote software (Clarivate Analytics, Philadelphia, PA, USA). Three reviewers (LS, LYY and SHZ) independently used the web-based document management system Rayyan (RAYYAN, version 2022) for the initial screening of titles and abstracts. Eligible studies were then reviewed in full text by four independent reviewers (LS, LYY, SHZ and XCH), and data on study characteristics, interventions and outcomes were extracted. Any disagreements were resolved by third-party (MXL) assessment and discussion.
Ethics oversight	This study is a meta-analysis based on previously published data; therefore, no ethical approval was required. All analyzed datasets were obtained from publicly available sources, and all necessary permissions for use of these datasets were secured by the original studies.

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 quantitative meta-analysis, which involves systematically reviewing and synthesizing findings from previously published quantitative research studies. By pooling numerical data from various sources, this study aims to derive a more precise estimate of effects and provide comprehensive insights into the research topic.
Research sample	This meta-analysis did not involve direct sampling of participants, as it is based on existing datasets from 152 previously published RCTs. The aggregated sample included 129,536 participants with a median age of 40.5 years (IQR 35.7–45.7) and a male predominance (51.4%). Baseline daily cigarette consumption averaged 16.7 cigarettes/day (IQR 14.2–19.3). Studies included varied demographic populations across different geographic regions, with the majority conducted in the United States (48.8%) and a subset from China (7.5%). All data were extracted from publicly available peer-reviewed publications retrieved from PubMed, Embase, and Cochrane CENTRAL.
Sampling strategy	No participant-level sampling was conducted for this meta-analysis. The included studies employed various sampling strategies (e.g., randomized, stratified) as reported in their original publications. For the purpose of this synthesis, we selected eligible studies based on predefined inclusion criteria without performing additional sampling. Thus, the final analytical dataset represents a comprehensive convenience sample of available evidence from eligible RCTs.
Data collection	Data collection was conducted by multiple independent reviewers who extracted study-level information from published reports. All data were recorded and synthesized using statistical software (R v4.3.3) to ensure consistency and accuracy. Reviewers were not

	blinded to the study hypothesis or intervention types, given the nature of secondary data synthesis, but followed a standardized protocol to minimize bias during data extraction and coding.
Timing	The data used in this meta-analysis were collected from eligible RCTs published from January 2005 to September 10, 2024, the date of the final systematic search. Literature screening and data extraction were conducted between January 2024 and March 2024, as detailed in the Methods section of the manuscript.
Data exclusions	A total of 4,027 records were initially identified (PubMed: 1,543; Embase: 1,735; Cochrane Library: 649), of which 1,157 duplicates were removed. Following title and abstract screening of 2,770 records, 2,474 studies were excluded for the following reasons: duplicates (n = 432), protocol/design-only publications (n = 388), lack of clear outcomes (n = 456), inconsistency in experimental purpose (n = 756), and non-RCT study designs (n = 442). After retrieval of 296 full-text articles, 20 could not be obtained. Of the remaining 276 articles, 144 were excluded based on predefined criteria: lack of comparable intervention indicators (n = 34), protocol/design-only (n = 20), no clear results (n = 34), non-RCTs (n = 10), and irrelevant intervention types (n = 46).Additionally, 20 studies were split into separate comparisons to allow for independent modeling (13 with multiple outcome types and 7 with multiple control groups), resulting in 152 unique studies (from 132 articles) included in the final analysis.All exclusion criteria were pre-specified in the study protocol and applied consistently by multiple independent reviewers.
Non-participation	This study is a meta-analysis and did not involve direct recruitment of human participants. All data were derived from previously published randomized controlled trials (RCTs). Therefore, issues of participant non-participation were not applicable.
Randomization	As this is a secondary analysis of existing RCT data, no new participant allocation or randomization was performed by the authors. Randomization procedures were conducted in the original included trials and were reported accordingly in those studies. Thus, randomization was not applicable at the meta-analysis level.

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

Plants

Seed stocks	NA
Novel plant genotypes	NA
Authentication	NA