Supplementary table A. Search Strategy

Database	Full search string
MEDLINE	(("ultra-processed food"[All Fields] OR "ultraprocessed food"[All Fields] OR "ultra-processed foods"[All Fields] OR "ultraprocessed foods"[All Fields] OR "UPF"[All Fields] OR "nova food classification system"[All Fields] OR "nova food classification system"[All Fields]) AND ("meta-analysis"[All Fields] OR "metaanaly*"[All Fields] OR "meta regression"[All Fields] OR "metareg*"[All Fields] OR "systematic-review"[All Fields] OR "systematic-review"[All Fields])) AND 2009:2023[pdat]
PsycINFO	(**Any Field**: "ultra-processed food" *OR* **Any Field**: "ultraprocessed food" *OR* **Any Field**: "ultra-processed foods" *OR* **Any Field**: "ultraprocessed foods" *OR* **Any Field**: UPF *OR* **Any Field**: "NOVA food classification system" *OR* **Any Field**: "Nova food classification system") AND (**Any Field**: "meta-analysis" *OR* **Any Field**: metaanaly* *OR* **Any Field**: "meta regression" *OR* **Any Field**: metareg* *OR* **Any Field**: "systematic review" *OR* **Any Field**: "systematic-review") AND **Year**: 2009 *To* 2023
Embase	("ultra-processed food" OR "ultraprocessed food" OR "ultra-processed foods" OR "ultraprocessed foods" OR UPF OR "NOVA food classification system" OR "Nova food classification system") AND ("meta-analysis" OR metaanaly* OR "meta regression" OR metareg* OR "systematic review" OR "systematic-review") AND (2009:py OR 2010:py OR 2011:py OR 2012:py OR 2013:py OR 2014:py OR 2015:py OR 2016:py OR 2017:py OR 2018:py OR 2019:py OR 2020:py OR 2021:py OR 2022:py OR 2023:py)
Cochrane Database of Systematic Reviews	(("ultra-processed food" OR "ultraprocessed food" OR "ultra-processed foods" OR "ultraprocessed foods" OR UPF OR "NOVA food classification system" OR "Nova food classification system")

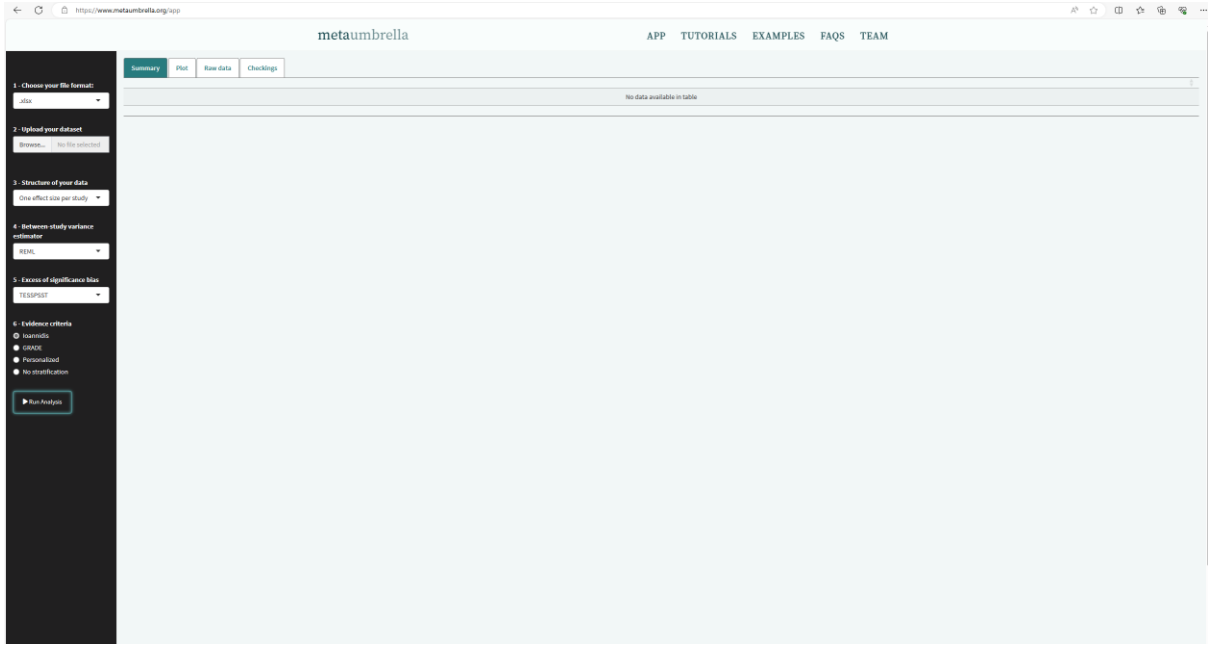
AND

("meta-analysis" OR metaanaly* OR "meta regression" OR metareg* OR "systematic review" OR "systematic-review"))

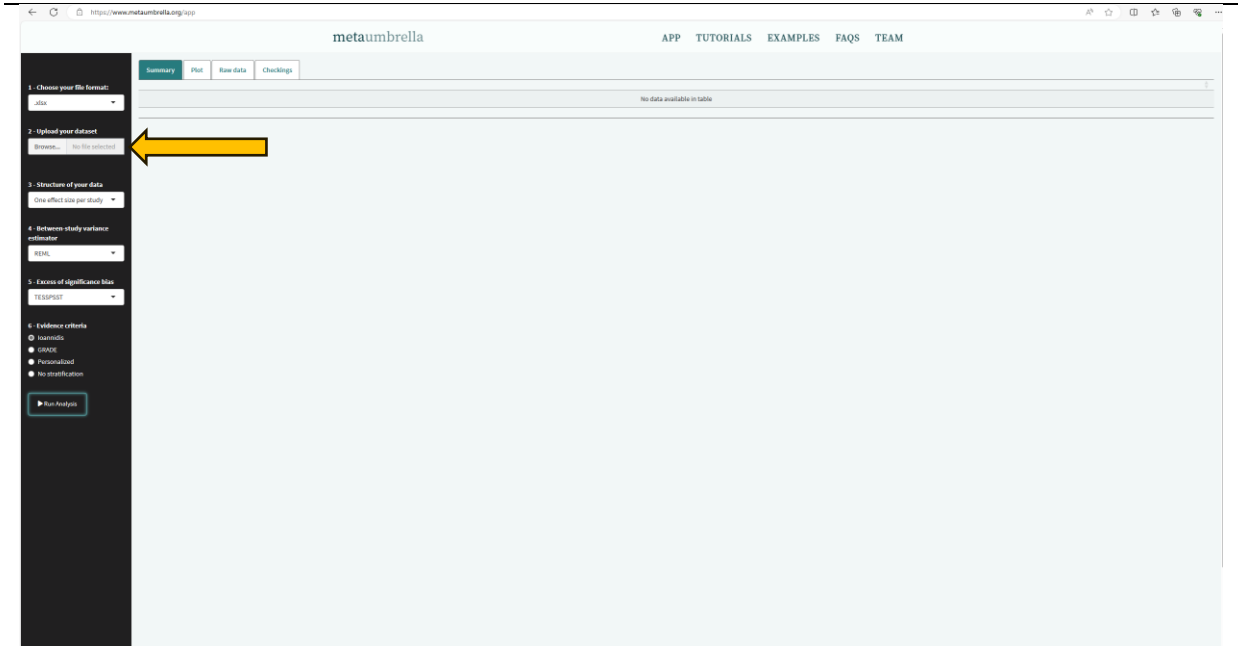
Supplementary table B. Step-by-step coding guide for recreating analysis for publication entitled '**Ultra-processed food exposure and adverse health outcomes: an umbrella review of epidemiological meta-analyses**' by Lane et al. 2024

1. Download the dataset used for this analysis from the Open Science Framework (OSF): OSF link: <https://osf.io/8j2gt/>

2. Go to the online/web browser version of the R statistical package called *metaumbrella*: *metaumbrella* link: <https://www.metaumbrella.org/app>

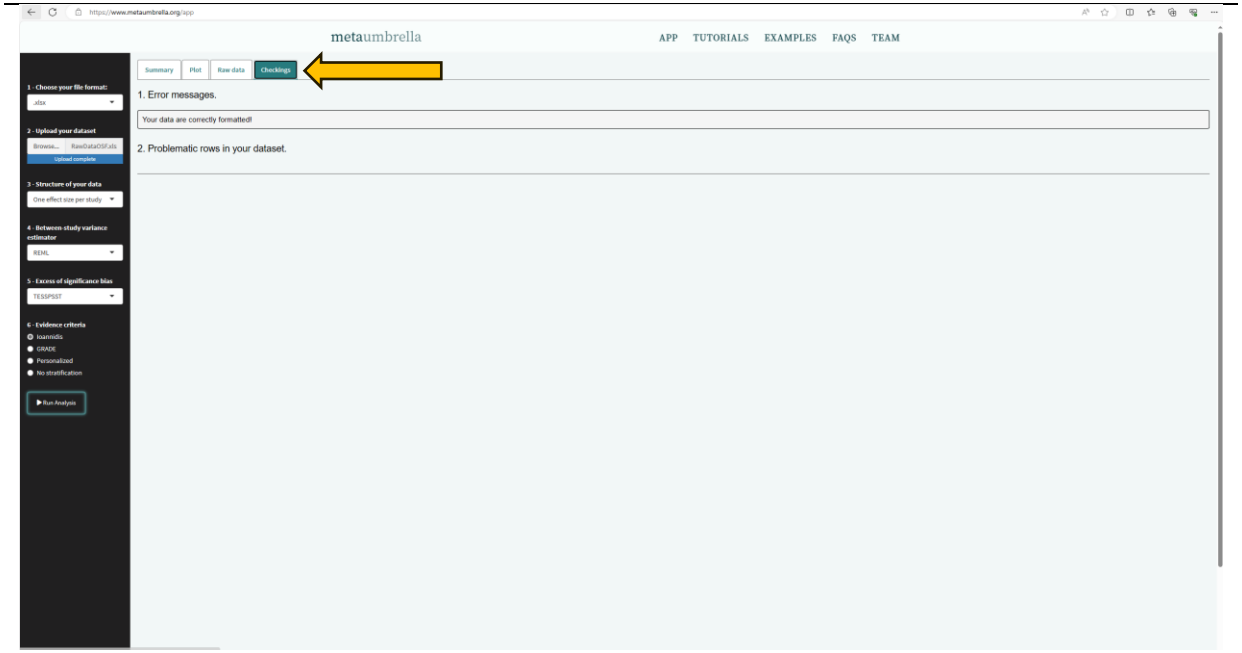


3. Click the Browse button under "2. Upload your dataset" on the left menu bar

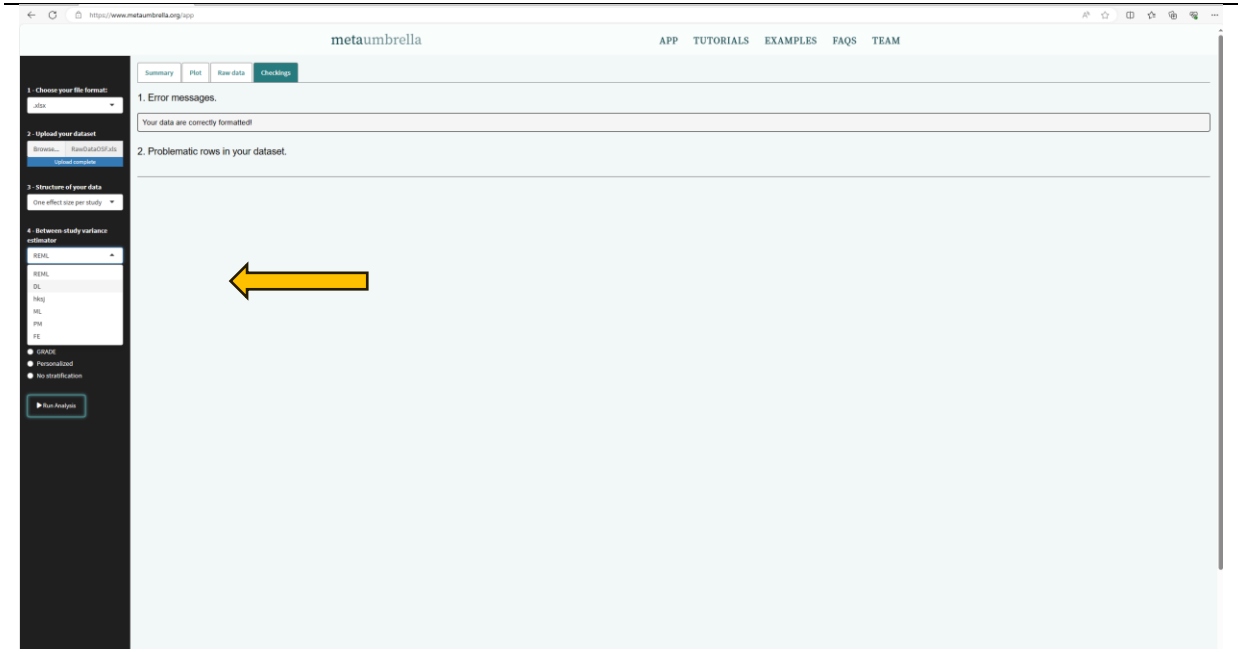


4. Navigate to where you downloaded the OSF dataset (see step 1) and upload this file

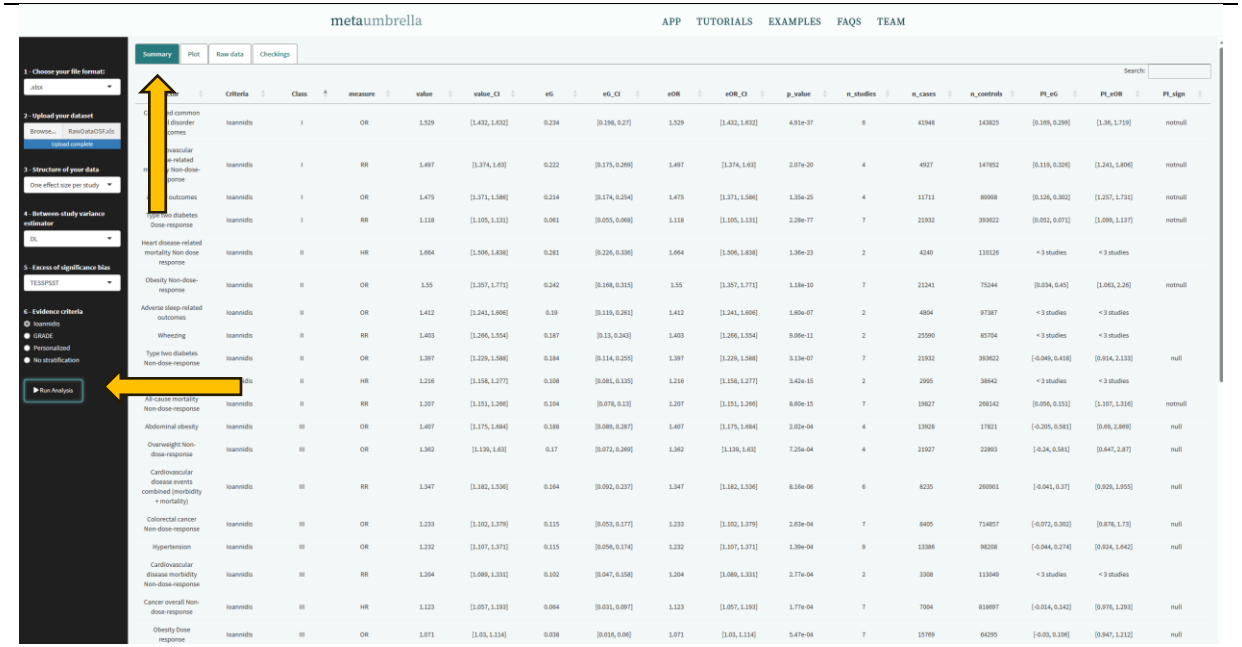
5. Navigate to the “Checkings” tab at the top of the screen to confirm dataset is coded correctly and to ensure that no warning messages have been produced while checking the formatting of your dataset



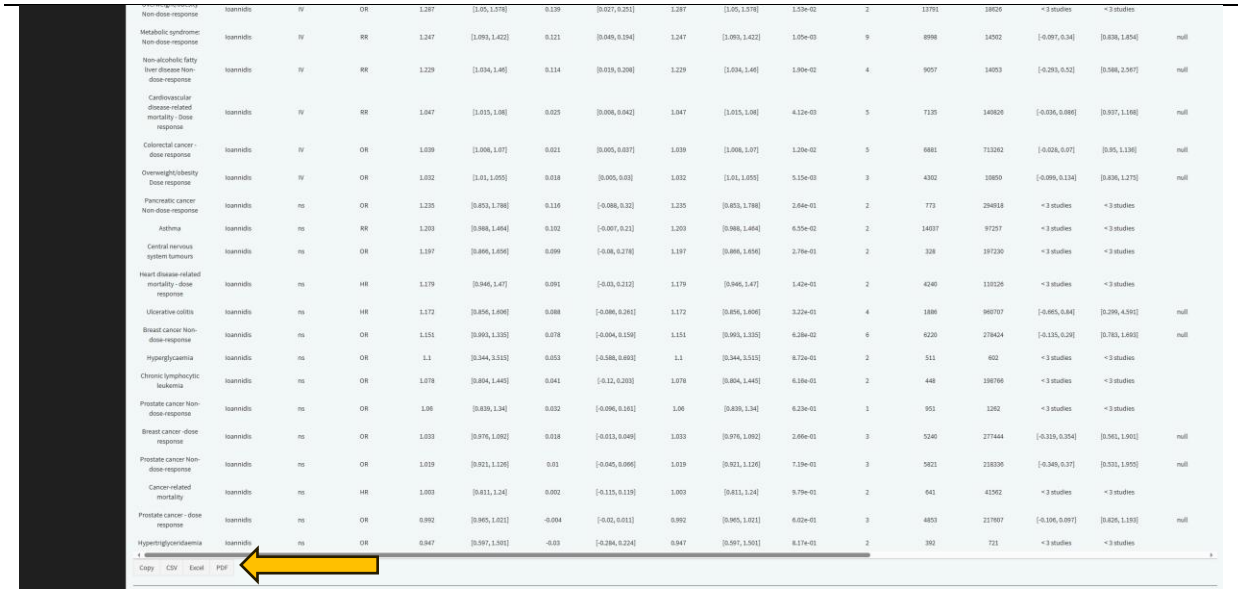
6. Select “DL” (DerSimonian-Laird method) from the pulldown menu under “4. Between-study variance estimator” on the left menu bar



7. Navigate to the “Summary” tab at the top of the screen and then click “Run Analysis” on the left menu bar



8. To export data, scroll to the bottom of the dataset and export as either a CSV, Excel, or PDF file



Non-dose-response	Ioannidis	IV	OR	1.287	[1.05, 1.578]	0.139	[0.027, 0.251]	1.287	[1.05, 1.578]	1.53e-02	2	13791	18826	< 3 studies	< 3 studies	
Metabolic syndrome: Non-dose-response	Ioannidis	IV	RR	1.247	[1.093, 1.422]	0.121	[0.049, 0.194]	1.247	[1.093, 1.422]	1.05e-03	9	8998	14502	[-0.097, 0.34]	[0.838, 1.854]	null
Non-alcoholic fatty liver disease Non-dose-response	Ioannidis	IV	RR	1.229	[1.034, 1.46]	0.114	[0.019, 0.208]	1.229	[1.034, 1.46]	1.90e-02	4	9057	14053	[-0.293, 0.52]	[0.588, 2.567]	null
Cardiovascular disease-related mortality - Dose response	Ioannidis	IV	RR	1.047	[1.015, 1.08]	0.025	[0.008, 0.042]	1.047	[1.015, 1.08]	4.12e-03	5	7135	140626	[-0.036, 0.086]	[0.937, 1.168]	null
Colorectal cancer - dose response	Ioannidis	IV	OR	1.039	[1.008, 1.07]	0.021	[0.005, 0.037]	1.039	[1.008, 1.07]	1.20e-02	5	6881	713262	[-0.028, 0.07]	[0.95, 1.136]	null
Overweight/obesity Dose response	Ioannidis	IV	OR	1.032	[1.01, 1.055]	0.018	[0.005, 0.03]	1.032	[1.01, 1.055]	5.15e-03	3	4302	10850	[-0.099, 0.134]	[0.836, 1.275]	null
Pancreatic cancer Non-dose-response	Ioannidis	ns	OR	1.235	[0.853, 1.788]	0.116	[-0.088, 0.32]	1.235	[0.853, 1.788]	2.64e-01	2	773	294918	< 3 studies	< 3 studies	
Asthma	Ioannidis	ns	RR	1.203	[0.988, 1.464]	0.102	[-0.007, 0.21]	1.203	[0.988, 1.464]	6.55e-02	2	14037	97257	< 3 studies	< 3 studies	
Central nervous system tumours	Ioannidis	ns	OR	1.197	[0.866, 1.656]	0.099	[-0.08, 0.278]	1.197	[0.866, 1.656]	2.76e-01	2	328	197230	< 3 studies	< 3 studies	
Heart disease-related mortality - dose response	Ioannidis	ns	HR	1.179	[0.946, 1.47]	0.091	[-0.03, 0.212]	1.179	[0.946, 1.47]	1.42e-01	2	4240	110126	< 3 studies	< 3 studies	
Ulcerative colitis	Ioannidis	ns	HR	1.172	[0.856, 1.606]	0.088	[-0.086, 0.261]	1.172	[0.856, 1.606]	3.22e-01	4	1886	960707	[-0.665, 0.84]	[0.299, 4.591]	null
Breast cancer Non-dose-response	Ioannidis	ns	OR	1.151	[0.993, 1.335]	0.078	[-0.004, 0.159]	1.151	[0.993, 1.335]	6.28e-02	6	6220	278424	[-0.135, 0.29]	[0.783, 1.693]	null
Hyperglycaemia	Ioannidis	ns	OR	1.1	[0.344, 3.515]	0.053	[-0.568, 0.693]	1.1	[0.344, 3.515]	8.72e-01	2	511	602	< 3 studies	< 3 studies	
Chronic lymphocytic leukemia	Ioannidis	ns	OR	1.078	[0.804, 1.445]	0.041	[-0.12, 0.203]	1.078	[0.804, 1.445]	6.16e-01	2	448	198766	< 3 studies	< 3 studies	
Prostate cancer Non-dose-response	Ioannidis	ns	OR	1.06	[0.839, 1.34]	0.032	[-0.096, 0.161]	1.06	[0.839, 1.34]	6.23e-01	1	951	1262	< 3 studies	< 3 studies	
Breast cancer -dose response	Ioannidis	ns	OR	1.033	[0.976, 1.092]	0.018	[-0.013, 0.049]	1.033	[0.976, 1.092]	2.66e-01	3	5240	277444	[-0.319, 0.354]	[0.561, 1.901]	null
Prostate cancer Non-dose-response	Ioannidis	ns	OR	1.019	[0.921, 1.126]	0.01	[-0.045, 0.066]	1.019	[0.921, 1.126]	7.19e-01	3	5821	218336	[-0.349, 0.37]	[0.531, 1.955]	null
Cancer-related mortality	Ioannidis	ns	HR	1.003	[0.811, 1.24]	0.002	[-0.115, 0.119]	1.003	[0.811, 1.24]	9.79e-01	2	641	41562	< 3 studies	< 3 studies	
Prostate cancer - dose response	Ioannidis	ns	OR	0.992	[0.965, 1.021]	-0.004	[-0.02, 0.011]	0.992	[0.965, 1.021]	6.02e-01	3	4853	217607	[-0.106, 0.097]	[0.826, 1.193]	null
Hypertriglyceridaemia	Ioannidis	ns	OR	0.947	[0.597, 1.501]	-0.03	[-0.284, 0.224]	0.947	[0.597, 1.501]	8.17e-01	2	392	721	< 3 studies	< 3 studies	

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Supplementary table C. The evidence classification criteria

Convincing (Class I)	• The number of cases is >1000 (or >20,000 for continuous outcomes) • P of $<1 \times 10^{-6}$ • $I^2 < 50\%$ • 95% prediction interval excludes the null hypothesis • ~~The largest included individual study exhibits $P \leq 0.05$~~ • No small-study effects • No excess significance bias
Highly suggestive (Class II)	• Class I criteria not all met • The number of cases is >1000 • P of $<1 \times 10^{-6}$ • The largest included individual study exhibits $P \leq 0.05$
Suggestive (Class III)	• Class I—II criteria not all met • The number of cases is >1000 • P of $< 1 \times 10^{-3}$
Weak (Class IV)	• Class I—III criteria not all met • $P \leq 0.05$ •

No evidence (Class V)	• $P > 0.05$

Table D. Quality Assessment Using the GRADE Framework of Each Pooled Analysis Assessing Associations Between Ultra-Processed Food Exposure and Adverse Health Outcomes

Outcome: Level of exposure comparison	Studies, *n*	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Certainty
Mortality								
All-cause mortality [1]: Non-dose-response	7	Observational	Not Serious	Not Serious	Not Serious	Not Serious	None	Low
All-cause mortality [1]: Dose-response	9	Observational	Not Serious	Not Serious	Not Serious	Not Serious	Dose-Response Gradient	Moderate
Cancer-related mortality [2]: Non-dose-response	2	Observational	Not Serious	Not Serious	Not Serious	Not Serious	None	Low
Cardiovascular disease-related mortality [1]: Non-dose-response	4	Observational	Not Serious	Serious[a]	Not Serious	Not Serious	None	Very Low
Cardiovascular disease-related mortality [1]: Dose-response	5	Observational	Not Serious	Serious[a]	Not Serious	Not Serious	Dose-Response Gradient	Low

Outcome: Level of exposure comparison	Studies, *n*	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Certainty
Heart disease-related mortality [2]: Non-dose-response	2	Observational	Not Serious	Not Serious	Not Serious	Not Serious	None	Low
Heart disease-related mortality [2]: Dose-response	2	Observational	Not Serious	Serious[a]	Not Serious	Not Serious	Dose-Response Gradient	Low
Cancer								
Breast cancer [3]: Non-dose-response	6	Observational	Not Serious	Not Serious	Not Serious	Serious[b]	None	Very Low
Breast cancer [3]: Dose-response	3	Observational	Not Serious	Serious[a]	Not Serious	Not Serious	Dose-Response Gradient	Low
Cancer overall [4]: Non-dose-response	7	Observational	Serious[c]	Not Serious	Not Serious	Not Serious	None	Very Low
Central nervous system tumours [3]: Non-dose-response	2	Observational	Not Serious	Serious[a]	Not Serious	Serious[d]	None	Very Low
Chronic lymphocytic leukemia [3]:	2	Observational	Not Serious	Not Serious	Not Serious	Serious[d]	None	Very Low

Outcome: Level of exposure comparison	Studies, *n*	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Certainty
Non-dose-response								
Colorectal cancer [3]: Non-dose-response	7	Observational	Not Serious	Serious[a]	Not Serious	Not Serious	None	Very Low
Colorectal cancer [3]: Dose-response	5	Observational	Not Serious	Serious[a]	Not Serious	Not Serious	Dose-Response Gradient	Low
Pancreatic cancer [3]: Non-dose-response	2	Observational	Not Serious	Serious[a]	Not Serious	Serious[d]	None	Very Low
Prostate cancer [3]: Non-dose-response	4	Observational	Not Serious	Not Serious	Not Serious	Not Serious	None	Low
Prostate cancer [3]: Dose-response	3	Observational	Not Serious	Not Serious	Not Serious	Not Serious	Dose-Response Gradient	Moderate
Mental Health								
Adverse sleep-related outcomes [5]: Non-dose-response	2	Observational	Not Serious	Not Serious	Not Serious	Not Serious	None	Low

Outcome: Level of exposure comparison	Studies, *n*	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Certainty
Anxiety outcomes [6]: Non-dose-response	4	Observational	Not Serious	Not Serious	Not Serious	Not Serious	None	Low
Combined common mental disorder outcomes [6]: Non-dose-response	6	Observational	Not Serious	Not Serious	Not Serious	Not Serious	None	Low
Depressive outcomes [6]: Non-dose-response	2	Observational	Not Serious	Not Serious	Not Serious	Not Serious	None	Low
Respiratory Health								
Asthma [7]: Non-dose-response	2	Observational	Not Serious	Not Serious	Not Serious	Serious[b]	None	Very Low
Wheezing [7]: Non-dose-response	2	Observational	Not Serious	Not Serious	Not Serious	Not Serious	None	Low
Cardiovascular Health								

Outcome: Level of exposure comparison	Studies, *n*	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Certainty
Cardiovascular disease events combined (morbidity + mortality) [1]: Non-dose-response	6	Observational	Not Serious	Serious[a]	Not Serious	Not Serious	None	Very Low
Cardiovascular disease events combined (morbidity + mortality) [1]: Dose-response	8	Observational	Not Serious	Serious[a]	Not Serious	Not Serious	Dose-Response Gradient	Low
Cardiovascular disease morbidity [1]: Non-dose-response	2	Observational	Not Serious	Not Serious	Not Serious	Not Serious	None	Low
Cardiovascular disease morbidity [1]: Dose-response	2	Observational	Not Serious	Serious[a]	Not Serious	Not Serious	Dose-Response Gradient	Low
Hypertension [8]: Non-dose-response	9	Observational	Serious	Serious[a]	Not Serious	Not Serious	None	Very Low

Outcome: Level of exposure comparison	Studies, *n*	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Certainty
Hypertriglyceridaemia [9]: Non-dose-response	2	Observational	Serious	Not Serious	Not Serious	Serious[d]	None	Very Low
Low high-density lipoprotein concentration [9]: Non-dose-response	2	Observational	Serious	Not Serious	Not Serious	Serious[d]	None	Very Low
Gastrointestinal Health								
Crohn's disease [10]: Non-dose-response	4	Observational	Not Serious	Not Serious	Not Serious	Not Serious	None	Low
Ulcerative colitis [10]: Non-dose-response	4	Observational	Not Serious	Serious[a]	Not Serious	Serious[d]	None	Very Low
Metabolic Health								
Abdominal obesity [11]: Non-dose-response	4	Observational	Not Serious	Serious[a]	Not Serious	Not Serious	None	Very Low

Outcome: Level of exposure comparison	Studies, *n*	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Certainty
Abdominal obesity [11]: Dose-response	6	Observational	Not Serious	Serious[a]	Not Serious	Not Serious	Dose-Response Gradient	Low
Hyperglycaemia [9]: Non-dose-response	2	Observational	Serious	Serious[a]	Not Serious	Very Serious[e]	None	Very Low
Metabolic syndrome [12]: Non-dose-response	9	Observational	Not Serious	Serious[a]	Not Serious	Not Serious	None	Very Low
Non-alcoholic fatty liver disease [13]: Non-dose-response	4	Observational	Serious	Not Serious	Not Serious	Not Serious	None	Very Low
Obesity [11]: Non-dose-response	7	Observational	Not Serious	Not Serious	Not Serious	Not Serious	None	Low
Obesity [11]: Dose-response	7	Observational	Not Serious	Serious[a]	Not Serious	Not Serious	Dose-Response Gradient	Low
Overweight [11]: Non-dose-response	4	Observational	Not Serious	Serious[a]	Not Serious	Not Serious	None	Very Low

Outcome: Level of exposure comparison	Studies, *n*	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Certainty
Overweight [11]: Dose-response	2	Observational	Not Serious	Serious[a]	Not Serious	Not Serious	Dose-Response Gradient	Low
Overweight + obesity [11]: Non-dose-response	2	Observational	Not Serious	Not Serious	Not Serious	Not Serious	None	Low
Overweight + obesity [11]: Dose-response	3	Observational	Not Serious	Not Serious	Not Serious	Not Serious	Dose-Response Gradient	Moderate
Type two diabetes [14]: Non-dose-response	7	Observational	Not Serious	Serious[a]	Not Serious	Not Serious	None	Very Low
Type two diabetes [14]: Dose-response	7	Observational	Not Serious	Not Serious	Not Serious	Not Serious	Dose-Response Gradient	Moderate

Note GRADE=Grading of Recommendations, Assessment, Development, and Evaluation
a. I^2 value >50
b. Wide confidence intervals that include null effect and increased risk
c. Majority of studies rated as poor/fair quality by study authors
d. Wide confidence intervals that cross decision threshold
e. Very wide confidence intervals that cross decision thresholds

Supplementary table E. The A Measurement Tool to Assess Systematic Reviews – Second Edition (AMSTAR 2) Quality Assessment Tool, by Health Outcome Domains

Author / Year	Outcomes investigated	*1	*2	*3	*4	*5	*6	*7	*8	*9	*10	*11	*12	*13	*14	*15	*16
Yuan et al. 2023	All-cause mortality, Cardiovascular disease events combined (morbidity + mortality), Cardiovascular disease morbidity	2	2	0	1	2	2	2	2	2	0	2	2	2	2	2	2
Suksatan et al. 2021	Cancer-related mortality, Heart disease-related mortality	2	0	0	1	2	2	2	2	2	0	2	2	2	2	2	2
Lian et al. 2023	Breast cancer, Central nervous system tumours, Colorectal cancer, Pancreatic cancer, Prostate cancer	2	0	0	1	0	2	2	2	2	0	2	2	2	0	2	2
Isaksen et al. 2023	Cancer overall	2	0	0	1	0	0	2	2	2	0	2	0	2	0	0	2
Delpino et al. 2023	Adverse sleep-related outcomes	2	2	0	1	2	2	2	2	2	0	2	0	2	0	0	0
Lane et al. 2023	Combined common mental disorder outcomes, Anxiety outcomes, Depressive outcomes	2	2	0	0	2	2	2	2	2	0	2	0	2	0	0	2
Lane et al. 2021	Asthma, Wheezing	2	2	0	0	2	2	2	2	2	0	2	2	2	2	0	2
Wang et al. 2022	Hypertension	2	0	0	1	2	0	2	2	2	0	2	2	2	0	2	2
Pagliai et al. 2021	Hypertriglyceridaemia, Low high-density lipoprotein	2	1	0	1	2	2	2	2	2	0	2	0	2	2	2	2

	concentration, Hyperglycaemia																
Narula et al. 2023	Crohn's disease, Ulcerative colitis	2	2	0	1	2	2	0	2	2	0	2	2	2	0	2	2
Moradi et al. 2023	Abdominal obesity, Obesity, Overweight, Overweight + obesity	2	0	0	1	2	2	2	2	2	0	2	0	2	2	2	0
Shu et al. 2023	Metabolic syndrome	2	0	0	1	2	2	2	2	2	0	2	2	2	2	2	2
Henney et al. 2023	Non-alcoholic fatty liver disease	2	2	0	1	2	2	2	2	2	0	2	2	2	0	2	2
Chen et al. 2023	Type two diabetes	2	2	0	1	2	2	2	2	2	0	2	0	2	2	0	2

Note 0 = No; 1 = Partial Yes; 2 = Yes. Shaded columns = AMSTART 2 critical domains

**1. Did the research questions and inclusion criteria for the review include the components of PICO?*

****2. Did the report of the review contain an explicit statement that the review methods were established prior to the conduct of the review and did the report justify any significant deviations from the protocol?***

**3. Did the review authors explain their selection of the study designs for inclusion in the review?*

****4. Did the review authors use a comprehensive literature search strategy?***

**5. Did the review authors perform study selection in duplicate?*

**6. Did the review authors perform data extraction in duplicate?*

****7. Did the review authors provide a list of excluded studies and justify the exclusions?***

**8. Did the review authors describe the included studies in adequate detail?*

****9. Did the review authors use a satisfactory technique for assessing the risk of bias (RoB) in individual studies that were included in the review?***

**10. Did the review authors report on the sources of funding for the studies included in the review?*

****11. If meta-analysis was performed, did the review authors use appropriate methods for statistical combination of results?***

**12. If meta-analysis was performed, did the review authors assess the potential impact of RoB in individual studies on the results of the meta-analysis or other evidence synthesis?*

****13. Did the review authors account for RoB in primary studies when interpreting/discussing the results of the review?***

**14. Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review?*

**15. If they performed quantitative synthesis did the review authors carry out an adequate investigation of publication bias (small study bias) and discuss its likely impact on the results of the review?*

**16. Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review?*

Supplementary table F. Summary Characteristics of Included Original Research Articles

Outcome	Author	Year	Stud design	Population	Exposure measurements
Mortality					
All-cause mortality					
	Schnabel et al.	2019	Prospective cohort	Adults	24-hr recall
	Rico-Campa et al.	2019	Prospective cohort	Adults	FFQ
	Kim et al.	2019	Prospective cohort	Adults	24-hr recall
	Blanco-Rojo et al.	2019	Prospective cohort	Adults	Diet history
	Zhong et al.	2021	Prospective cohort	Adults	FFQ
	Bonaccio et al.	2021	Prospective cohort	Adults	FFQ
	Orlich et al.	2022	Prospective cohort	Adults	FFQ
Cancer-related mortality					
	Rico-campa et al.	2019	Prospective cohort	Adults	FFQ
	Bonaccio et al.	2021	Prospective cohort	Adults	FFQ
Cardiovascular disease-related mortality					
	Rico-Campa et al.	2019	Prospective cohort	Adults	FFQ
	Kim et al.	2019	Prospective cohort	Adults	24-hr recall
	Zhong et al.	2019	Prospective cohort	Adults	FFQ
	Bonaccio et al.	2021	Prospective cohort	Adults	FFQ
Heart disease-related mortality					
	Bonaccio et al.	2021	Prospective cohort	Adults	FFQ
	Zhong et al.	2021	Prospective cohort	Adults	FFQ

Outcome	Author	Year	Stud design	Population	Exposure measurements
Cancer					
Breast cancer					
	Romaguera et al.	2021	Case-control	Adults	FFQ
	Fiolet et al.	2018	Prospective cohort	Adults	24-hr recall
	Jacobs et al.	2022	Case-control	Adults	FFQ
	Romieu et al.	2022	Case-control	Adults	FFQ
	Queiroz et al.	2018	Case-control	Adults	FFQ
	Chang et al.	2023	Prospective cohort	Adults	24-hr recall
Cancer overall					
	Fiolet et al.	2018	Prospective cohort	Adults	24-hr recall
	Fiolet et al.	2018	Prospective cohort	Adults	24-hr recall
	Fiolet et al.	2018	Prospective cohort	Adults	24-hr recall
	Fiolet et al.	2018	Prospective cohort	Adults	24-hr recall
	Wang et al.	2022	Prospective cohort	Adults	FFQ
	Wang et al.	2022	Prospective cohort	Adults	FFQ
	Zhong et al.	2022	Prospective cohort	Adults	Diet history
Central nervous system tumours					
	Esposito et al.	2023	Case-control	Adults	FFQ
	Chang et al.	2023	Prospective cohort	Adults	24-hr recall
Chronic lymphocytic leukemia					
	Solans et al.	2021	Case-control	Adults	FFQ

Outcome	Author	Year	Stud design	Population	Exposure measurements
	Chang et al.	2023	Prospective cohort	Adults	24-hr recall
Colorectal cancer					
	Romaguera et al.	2021	Case-control	Adults	FFQ
	Fiolet et al.	2018	Prospective cohort	Adults	24-hr recall
	Jafari et al.	2022	Case-control	Adults	FFQ
	Wang et al.	2022 -	Prospective cohort	Adults - Men	FFQ
	Wang et al.	2022	Prospective cohort	Adults - Women	FFQ
	El Kinany et al.	2022	Case-control	Adults	FFQ
	Chang et al.	2023	Prospective cohort	Adults	24-hr recall
Pancreatic cancer					
	Zhong et al.	2022	Cohort	Adults	Diet history
	Chang et al.	2023	Cohort	Adults	24-hr recall
Prostate cancer					
	Romaguera et al.	2021	Case-control	Adults	FFQ
	Fiolet et al.	2018	Cohort	Adults	FFQ
	Trudeau et al.	2020	Case-control	Adults	FFQ
	Chang et al.	2023	Cohort	Adults	24-hr recall
Mental Health					
Adverse sleep-related outcomes					
	Sousa et al.	2020	Cross-sectional	Adolescents	FFQ
	Werneck et al.	2020	Cross-sectional	Adolescents	FFQ

Outcome	Author	Year	Stud design	Population	Exposure measurements
Anxiety outcomes					
	Werneck et al.	2021	Cross-sectional	Adolescents - Females	FFQ
	Werneck et al.	2021	Cross-sectional	Adolescents - Males	FFQ
	Coletro et al.	2022b	Cross-sectional	Adults	FFQ
	Noll et al.	2022	Cross-sectional	Adults	24-hr recall
Combined common mental disorder outcomes					
	Werneck et al.	2021	Cross-sectional	Adolescents - Females	FFQ
	Werneck et al.	2021	Cross-sectional	Adolescents - Males	FFQ
	Zheng et al.	2020	Cross-sectional	Adults	24-hr recall
	Silva et al.	2021	Cross-sectional	Adolescents	24-hr recall
	Coletro et al.	2022b	Cross-sectional	Adults	FFQ
Depressive outcomes					
	Gomez-Donoso et al.	2019	Prospective cohort	Adults	FFQ
	Adjibade et al.	2019	Prospective cohort	Adults	24-hr recall
Respiratory Health					
Asthma					
	Melo et al.	2018	Cross-sectional	Adolescents	FFQ
	Azerado et al.	2020	Cross-sectional	Children and adolescents	FFQ
Wheezing					
	Melo et al.	2018	Cross-sectional	Adolescents	FFQ
	Azerado et al.	2020	Cross-sectional	Children and adolescents	FFQ

Outcome	Author	Year	Stud design	Population	Exposure measurements
Cardiovascular Health					
Cardiovascular disease events combined (morbidity + mortality)					
	Rico-Campa et al.	2019	Prospective cohort	Adults	FFQ
	Kim et al.	2019	Prospective cohort	Adults	24-hr recall
	Srour et al.	2019	Prospective cohort	Adults	24-hr recall
	Zhong et al.	2019	Prospective cohort	Adults	FFQ
	Bonaccio et al.	2021	Prospective cohort	Adults	FFQ
	Du et al.	2021	Prospective cohort	Adults	FFQ
Cardiovascular disease morbidity					
	Srour et al.	2019	Prospective cohort	Adults	24-hr recall
	Du et al.	2021	Prospective cohort	Adults	FFQ
Hypertension					
	Ivancovsky-Wajcman et al.	2021	Cross-sectional	Adults	FFQ
	Lavinge-Robichaud et al.	2018	Cross-sectional	Adults	FFQ
	Martinez Steele et al.	2019	Cross-sectional	Adults	FFQ
	Mendoca et al.	2017	Prospective cohort	Adults	FFQ
	Monge et al.	2021	Prospective cohort	Adults	FFQ
	Nardocci et al.	2021	Cross-sectional	Adults	24-hr recall
	Nasreddine et al.	2018	Cross-sectional	Adults	FFQ

Outcome	Author	Year	Stud design	Population	Exposure measurements
	Rezende-Alves et al.	2021	Prospective cohort	Adults	FFQ
	Scaranni et al.	2021	Prospective cohort	Adults	FFQ
Hypertriglyceridaemia					
	Nasreddine et al.	2018	Cross-sectional	Adults	FFQ
	Lavigne-Robichaud et al.	2018	Cross-sectional	Adults	24-hr recall
Low high-density lipoprotein concentration					
	Nasreddine et al.	2018	Cross-sectional	Adults	FFQ
	Lavigne-Robichaud et al.	2018	Cross-sectional	Adults	24-hr recall
Gastrointestinal Health					
Crohn's disease					
	Lo et al.	2021	Prospective cohort	Adults	FFQ
	Narula et al.	2021	Prospective cohort	Adults	FFQ
	Chen et al.	2022	Prospective cohort	Adults	24-hr recall
	Meyer et al.	2022	Prospective cohort	Adults	FFQ
Ulcerative colitis					
	Lo et al.	2021	Prospective cohort	Adults	FFQ
	Narula et al.	2021	Prospective cohort	Adults	FFQ
	Chen et al.	2022	Prospective cohort	Adults	24-hr recall
	Meyer et al.	2022	Prospective cohort	Adults	FFQ
Metabolic Health					
Abdominal obesity					

Outcome	Author	Year	Stud design	Population	Exposure measurements
	Silva et al.	2018	Cross-sectional	Adults	FFQ
	Juul et al.	2018	Cross-sectional	Adults	24-hr recall
	Rauber et al.	2020	Cross-sectional	Adults	24-hr recall
	Sandoval-Insausti et al.	2020	Prospective cohort	Adults	24-hr recall
Hyperglycaemia					
	Nasreddine et al.	2018	Cross-sectional	Adults	FFQ
	Lavigne-Robichaud et al.	2018	Cross-sectional	Adults	24-hr recall
Metabolic syndrome					
	Barbosa et al.	2023	Cross-sectional	Adults	24-hr recall
	Canhada et al.	2023	Prospective cohort	Adults	24-hr recall
	Ivancokvsky-Wajcman et al.	2021	Cross-sectional	Adults	FFQ
	Magalhaes et al.	2022	Prospective cohort	Adults	FFQ
	Martinez-Steele et al.	2019	Cross-sectional	Adults	24-hr recall
	Nasreddine et al.	2018	Cross-sectional	Adults	FFQ
	Pan et al.	2023	Prospective cohort	Adults	24-hr recall
	Tavares et al.	2012	Cross-sectional	Adults	FFQ
	Lavigne-Robichaud et al.	2018	Cross-sectional	Adults	24-hr recall
Non-alcoholic fatty liver disease					
	Zhang et al.	2022	Prospective cohort	Adults	FFQ
	Ivancovsky-Wajcman et al.	2021	Cross-sectional	Adults	FFQ

Outcome	Author	Year	Stud design	Population	Exposure measurements
	Friden et al.	2022	Cross-sectional	Adults	FFQ
	Konieczna et al.	2022	Prospective cohort	Adults	FFQ
Obesity					
	Adams et al.	2015	Cross-sectional	Adults	24-hr recall
	Louzada et al.	2015	Cross-sectional	Adults	24-hr recall
	Silva et al.	2018	Cross-sectional	Adults	FFQ
	Juul et al.	2018	Cross-sectional	Adults	24-hr recall
	Nardocci et al.	2019	Cross-sectional	Adults	24-hr recall
	Nardocci et al.	2020	Cross-sectional	Adults	24-hr recall
	Rauber et al.	2020	Cross-sectional	Adults	24-hr recall
Overweight					
	Silveira et al.	2016	Cross-sectional	Adults	FFQ
	Silva et al.	2018	Cross-sectional	Adults	FFQ
	Juul et al.	2018	Cross-sectional	Adults	24-hr recall
	Nardocci et al.	2019	Cross-sectional	Adults	24-hr recall
Overweight/obesity					
	Adams et al.	2015	Cross-sectional	Adults	24-hr recall
	Louzada et al.	2015	Cross-sectional	Adults	24-hr recall
Type two diabetes					
	Sour et al.	2020	Prospective cohort	Adults	24-hr recall
	Levy et al.	2021	Prospective cohort	Adults	24-hr recall
	Llavero-Valero et al.	2021	Prospective cohort	Adults	FFQ

Outcome	Author	Year	Stud design	Population	Exposure measurements
	Duan et al.	2022	Prospective cohort	Adults	FFQ
	Chen (NHS - women only) et al.	2023	Prospective cohort	Adults	FFQ
	Chen (NHSII - women only) et al.	2023	Prospective cohort	Adults	FFQ

Note 24-hr call=twenty-four-hour dietary recall; FFQ=food frequency questionnaire

Supplementary table G. Summary of Included Adverse Health Outcomes and Their Reanalysed Associations with Ultra-Processed Food Exposure and Credibility Assessment

Outcome	Level of exposure comparison	Studies, *n*	Participants, *n*	Cases, *n*	Pooled effect size metric	Pooled effect size	95%CIs	*P* value	I^2	95%PIs	Excess significance bias	Small-study effects	Largest study significance	Evidence Class
Mortality														
All-cause mortality [1]	Non-dose-response	7	287969	19827	RR	1.21	(1.15, 1.27)	<0.001	11.9	[1.11, 1.32]	sig.	sig.	sig.	II
All-cause mortality [1]	Dose-response	9	295651	35080	RR	1.02	(1.01, 1.03)	<0.001	45.6	[1.00, 1.05]	sig.	sig.	sig.	III
Cancer-related mortality [2]	Non-dose-response	2	42203	641	HR	1.00	(0.81, 1.24)	0.98	0.0	na	na	na	ns	V
Cardiovascular disease-related mortality [1]	Non-dose-response	4	152779	4927	RR	1.50	(1.37, 1.63)	<0.001	0.0	[1.24, 1.81]	ns	ns	sig.	I
Cardiovascular disease-related mortality [1]	Dose-response	5	147961	7135	RR	1.05	(1.02, 1.08)	0.004	85.4	na	ns	ns	sig.	IV
Heart disease-related mortality [2]	Non-dose-response	2	114366	4240	HR	1.66	(1.51, 1.84)	<0.001	75.5	na	na	na	sig.	II
Heart disease-related mortality [2]	Dose-response	2	114366	4240	HR	1.18	(0.95, 1.47)	0.14	0.0	na	na	na	sig.	V
Cancer														
Breast cancer [3]	Non-dose-response	6	284644	6220	OR	1.15	(0.99, 1.34)	0.06	45.8	[0.78, 1.69]	ns	sig.	ns	V

Outcome	Level of exposure comparison	Studies, *n*	Participants, *n*	Cases, *n*	Pooled effect size metric	Pooled effect size	95%CIs	*P* value	I^2	95%PIs	Excess significance bias	Small-study effects	Largest study significance	Evidence Class
Breast cancer [3]	Dose-response	3	282684	5240	OR	1.03	(0.98, 1.09)	0.26	59.2	[0.56, 1.89]	ns	ns	ns	V
Cancer overall [4]	Non-dose-response	7	825701	7004	HR	1.12	(1.06, 1.19)	<0.001	33.3	[0.98, 1.29]	ns	ns	ns	III
Central nervous system tumours [3]	Non-dose-response	2	197558	328	OR	1.20	(0.87, 1.65)	0.27	68.2	na	na	na	sig.	V
Chronic lymphocytic leukemia [3]	Non-dose-response	2	199086	448	OR	1.08	(0.80, 1.45)	0.62	0.0	na	na	na	ns	V
Colorectal cancer [3]	Non-dose-response	7	723262	8405	OR	1.23	(1.10, 1.38)	<0.001	67.1	[0.88, 1.73]	ns	ns	ns	III
Colorectal cancer [3]	Dose-response	5	720143	6881	OR	1.04	(1.01, 1.07)	0.01	55.9	[0.95, 1.14]	ns	ns	ns	IV
Pancreatic cancer [3]	Non-dose-response	2	295691	773	OR	1.24	(0.85, 1.79)	0.26	59.5	na	na	na	ns	V
Prostate cancer [3]	Non-dose-response	4	226370	6772	OR	1.02	(0.93, 1.12)	0.63	0.0	[0.84, 1.26]	ns	ns	ns	V
Prostate cancer [3]	Dose-response	3	222460	4853	OR	0.99	(0.97, 1.02)	0.60	0.0	[0.83, 1.19]	ns	ns	ns	V
Mental Health														
Adverse sleep-related outcomes [5]	Non-dose-response	2	102191	4804	OR	1.41	(1.24, 1.61)	<0.001	41.6	na	na	na	sig.	II

Outcome	Level of exposure comparison	Studies, *n*	Participants, *n*	Cases, *n*	Pooled effect size metric	Pooled effect size	95%CIs	*P* value	I^2	95%PIs	Excess significance bias	Small-study effects	Largest study significance	Evidence Class
Anxiety outcomes [6]	Non-dose-response	4	101709	11711	OR	1.48	(1.37, 1.59)	<0.001	0.0	[1.26, 1.73]	ns	ns	sig.	I
Combined common mental disorder outcomes [6]	Non-dose-response	6	185773	41948	OR	1.53	(1.43, 1.63)	<0.001	9.1	[1.36, 1.72]	ns	ns	sig.	I
Depressive outcomes [6]	Non-dose-response	2	41637	2995	HR	1.22	(1.16, 1.28)	<0.001	0.0	na	na	na	sig.	II
Respiratory Health														
Asthma [7]	Non-dose-response	2	111294	14037	RR	1.20	(0.99, 1.46)	0.07	36.1	na	na	na	sig.	V
Wheezing [7]	Non-dose-response	2	111294	25590	RR	1.40	(1.27, 1.55)	<0.001	7.6	na	na	na	sig.	II
Cardiovascular Health														
Cardiovascular disease events combined (morbidity + mortality) [1]	Non-dose-response	6	269136	8235	RR	1.35	(1.18, 1.54)	<0.001	62.1	[0.93, 1.96]	ns	ns	sig.	III
Cardiovascular disease events combined (morbidity + mortality) [1]	Dose-response	8	289077	11054	RR	1.04	(1.02, 1.06)	<0.001	75.9	[0.99, 1.10]	ns	ns	sig.	III

Outcome	Level of exposure comparison	Studies, *n*	Participants, *n*	Cases, *n*	Pooled effect size metric	Pooled effect size	95%CIs	*P* value	I^2	95%PIs	Excess significance bias	Small-study effects	Largest study significance	Evidence Class
Cardiovascular disease morbidity [1]	Non-dose-response	2	116357	3308	RR	1.20	(1.09, 1.33)	<0.001	0.0	na	na	na	sig.	III
Cardiovascular disease morbidity [1]	Dose-response	2	117298	3308	RR	1.04	(1.02, 1.06)	<0.001	0.0	na	na	na	sig.	III
Hypertension [8]	Non-dose-response	9	111594	13386	OR	1.23	(1.11, 1.37)	<0.001	52.0	[0.92, 1.64]	sig.	ns	ns	III
Hypertriglyceridaemia [9]	Non-dose-response	2	1113	392	OR	0.95	(0.60, 1.50)	0.82	0.0	na	na	na	ns	V
Low high-density lipoprotein concentration [9]	Non-dose-response	2	1113	475	OR	2.02	(1.27, 3.21)	0.003	0.0	na	na	na	sig.	IV
Gastrointestinal Health														
Crohn's disease [10]	Non-dose-response	4	962593	889	HR	1.71	(1.37, 2.14)	<0.001	0.0	[1.04, 2.80]	ns	ns	ns	IV
Ulcerative colitis [10]	Non-dose-response	4	962593	1886	HR	1.17	(0.86, 1.61)	0.32	73.9	[0.30, 4.59]	ns	ns	ns	V
Metabolic Health														
Abdominal obesity [11]	Non-dose-response	4	31749	13928	OR	1.41	(1.18, 1.68)	<0.001	62.3	[0.70, 2.87]	sig.	ns	sig.	III
Abdominal obesity [11]	Dose-response	6	66235	17011	OR	1.05	(1.02, 1.07)	<0.001	76.5	[0.98, 1.12]	ns	ns	sig.	III

Outcome	Level of exposure comparison	Studies, *n*	Participants, *n*	Cases, *n*	Pooled effect size metric	Pooled effect size	95%CIs	*P* value	I^2	95%PIs	Excess significance bias	Small-study effects	Largest study significance	Evidence Class
Hyperglycaemia [9]	Non-dose-response	2	1113	511	OR	1.10	(0.34, 3.52)	0.87	67.4	na	na	na	sig.	V
Metabolic syndrome [12]	Non-dose-response	9	23500	8998	RR	1.25	(1.09, 1.42)	0.001	85.0	[0.84, 1.85]	sig.	sig.	sig.	IV
Non-alcoholic fatty liver disease [13]	Non-dose-response	4	23110	9057	RR	1.23	(1.03, 1.46)	0.02	89.9	[0.59, 2.57]	sig.	ns	sig.	IV
Obesity [11]	Non-dose-response	7	96485	21241	OR	1.55	(1.36, 1.77)	<0.001	54.8	[1.06, 2.26]	sig.	ns	sig.	II
Obesity [11]	Dose-response	7	80064	15769	OR	1.07	(1.03, 1.11)	0.001	88.4	[0.95, 1.21]	sig.	sig.	ns	III
Overweight [11]	Non-dose-response	4	44820	21927	OR	1.36	(1.14, 1.63)	0.001	72.6	[0.65, 2.87]	ns	ns	ns	III
Overweight [11]	Dose-response	2	24954	14530	OR	1.06	(1.03, 1.10)	0.001	54.2	na	na	na	sig.	III
Overweight + obesity [11]	Non-dose-response	2	32417	13791	OR	1.29	(1.05, 1.58)	0.02	0.0	na	na	na	ns	IV
Overweight + obesity [11]	Dose-response	3	15152	4302	OR	1.03	(1.01, 1.06)	0.005	38.9	[0.84, 1.28]	ns	ns	sig.	IV
Type two diabetes [14]	Non-dose-response	7	415554	21932	OR	1.40	(1.23, 1.59)	<0.001	88.1	[0.91, 2.13]	sig.	ns	sig.	II
Type two diabetes [14]	Dose-response	7	415554	21932	RR	1.12	(1.11, 1.13)	<0.001	2.2	[1.10, 1.14]	ns	ns	sig.	I

Note 95%CIs, ninety-five percent confidence intervals; 95%PIs, ninety-five percent prediction intervals; HR, hazard ratio; I^2, I-squared statistic; na, not applicable; ns, non-significant; *n*, number; OR, odds ratio; *P value*, probability value; RR, risk ratio; sig., significant. Evidence class criteria—class I: statistical significance at P < 10−6, >1000 cases (or >20,000 participants for continuous outcomes); the 95% prediction interval

excluded the null, no large heterogeneity (I^2 < 50%), no evidence of small-study effects and excess significance bias; class II: significance at P < 10−6, >1000 cases (or >20,000 participants for continuous outcomes), the largest component study reported a significant effect (P ≤ 0.05); class III: statistical significance at P < 10−3, >1000 cases (or >20,000 participants for continuous outcomes); class IV: the remaining significant associations at P ≤ 0.05; and, class V: P > 0.05.

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