Supplementary files

Association of dietary meat consumption habits with neurodegenerative

cognitive impairment: an updated systematic review and dose-response meta-

analysis of 24 prospective cohort studies

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Online Supplementary Material

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Supplementary Method.

[STATA commands]

(1) GLST program

. gen double se=(logciu-logcil)/(2*invnormal(.975))

/*calculate the standard error (se)*/

/*logciu, natural logarithm of the upper limit of confidence interval (CI); logcil,

natural logarithm of the lower limit of CI*/

. glst logrr dose, se(se) cov(n cases) [cc|ir|ci]

/*generate the GLS equation and provide a correct estimate of the linear trend; cc

specifies case-control data; ir specifies incidence-rate data; ci specifies cumulative incidence data*/

/*logrr, natural logarithm of dependent variable; dose, independent variable; n,

number of participants; cases, number of outcome cases*/

(2) Establishment of cubic spline models

. gen se=(logciu-logcil)/(2*invnorm(0.975))

. glst logrr dose, se(se) cov(personyr case) pfirst(id type) ts(r) eform

```
. capture drop doses*
```

```
. _pctile dose, percentile(5 35 65 95)
```

. ret list

```
. mkspline doses=dose, knots(=r(r1)' =r(r2)' =r(r3)' =r(r4)') cubic displayknots
```

```
. glst logrr doses*, se(se) cov(personyr case) pfirst(id type)
```

```
. testparm doses2 doses3
```

- . glst logrr dose, se(se) cov(personyr case) pfirst(id type) ts(r)
- . predictnl lrr_lin=_b[dose]*dose
- . gen rr_lin=exp(lrr_lin)
- . glst logrr doses*, se(se) cov(personyr case) pfirst(id type)
- . predictnl logrrwithref = b[doses1]*doses1 + b[doses2]*doses2 +

```
_b[doses3]*doses3, ci(lo hi)
```

```
. gen rrwithref = exp(logrrwithref)
```

```
. gen lbwithref = exp(lo)
```

. gen ubwithref = exp(hi)

. sort doses1

(3) Increment analysis

. lincom dose*dose0, eform

/*calculate the relative risk (RR) and 95% CI based on the above GLS equation when the independent variable equals dose0*/

(4) Meta-analysis

. metan rr cil ciu, label(namevar=author, yearvar=year) by(appendix) wgt(weight) nooverall

/*perform the meta-analysis after the increment analysis of each included study is completed*/

/*rr, RR; cil, lower limit of CI; ciu, upper limit of CI; author, surname of first author; year, publication year; appendix, subgroup variables; weight, weighed by random effects model (inverse variance heterogeneity)*/

Supplementary Table 1. PRISMA Checklist for this systematic review and meta-analysis

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	2
INTRODUCTION			
Rationale	Rationale 3 Describe the rationale for the review in the context of existing knowledge.		3
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	3
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	5, 6
Information sources 6 Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.		5	
Search strategy	7	7 Present the full search strategies for all databases, registers and websites, including any filters and limits used.	
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	
Data collection process			5, 6
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	5, 6
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	5, 6
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	6, 7
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	6, 7
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	6, 7
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	6, 7
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	6, 7

Section and Topic	Item #	Checklist item	Location where item is reported			
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	6, 7			
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	6,7			
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	6,7			
Reporting bias assessment	14	14 Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).				
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome. 7				
RESULTS						
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	7			
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	7			
Study characteristics	17	Cite each included study and present its characteristics.				
Risk of bias in studies	18	Present assessments of risk of bias for each included study.				
Results of individual studies			8			
Results of	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	8-10			
syntheses	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	8-10			
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	8-10			
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	8-10			
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	10			
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	10			
DISCUSSION						
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	12			

Section and Topic	Item #	Checklist item			
	23b Discuss any limitations of the evidence included in the review.				
	23c	Discuss any limitations of the review processes used.	15, 16		
	23d	Discuss implications of the results for practice, policy, and future research.	15, 16		
OTHER INFORMA	OTHER INFORMATION				
Registration and	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	4		
protocol	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	4		
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	4		
Support	25	5 Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.			
Competing interests	interests 26 Declare any competing interests of review authors.		17		
Availability of data, code and other materials	vailability of data, de and other 27 Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.		17		

Supplementary	Table 2.	MOOSE	Checklist	for this	systematic	review	and meta-
analysis							

√ 1 √ 7 √ 7 √ 7 Repor incluc	de Problem definition Hypothesis statement Description of study outcomes Type of exposure or intervention used Type of study designs used Study population rting of search strategy should	Accumulating epidemiological studies suggest that meat consumption is associated with risk of neurodegenerative cognitive disorders, but results remain inconsistent. Different types of meat related to the increased risk of neurodegenerative cognitive disorders Neurodegenerative cognitive disorders Different types of meat, red meat, fish, poultry We included prospective cohort studies People without neurodegenerative cognitive disorders The credentials of the two investigators WQ and YJ are indicated
√ 1 √ 7 √ 7 √ 7 Repor incluc	Hypothesis statement Description of study outcomes Type of exposure or intervention used Type of study designs used Study population rting of search strategy should de Qualifications of searchers	consumption is associated with risk of neurodegenerative cognitive disorders, but results remain inconsistent. Different types of meat related to the increased risk of neurodegenerative cognitive disorders Neurodegenerative cognitive disorders Different types of meat, red meat, fish, poultry We included prospective cohort studies People without neurodegenerative cognitive disorders The credentials of the two investigators WQ and YJ are indicated
√ 1 √ 7 √ 7 √ 5 Repor incluc	Description of study outcomes Type of exposure or intervention used Type of study designs used Study population rting of search strategy should de Qualifications of searchers	neurodegenerative cognitive disorders Neurodegenerative cognitive disorders Different types of meat, red meat, fish, poultry We included prospective cohort studies People without neurodegenerative cognitive disorders The credentials of the two investigators WQ and YJ are indicated
$\frac{\sqrt{1}}{\sqrt{2}}$	Type of exposure or intervention used Type of study designs used Study population rting of search strategy should de Qualifications of searchers	Different types of meat, red meat, fish, poultry We included prospective cohort studies People without neurodegenerative cognitive disorders The credentials of the two investigators WQ and YJ are indicated
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√ 5 Repor <i>incluc</i> √ 6	Study population rting of search strategy should de Qualifications of searchers	People without neurodegenerative cognitive disorders The credentials of the two investigators WQ and YJ are indicated
Reportincluc	rting of search strategy should de Qualifications of searchers	The credentials of the two investigators WQ and YJ are indicated
incluc √ (de Qualifications of searchers	
	Search strategy, including time	in the author list.
		PubMed from 1990 – December 2021
1 4	period included in the synthesis and	EMBASE from 1990 – December 2021
	keywords	MEDLINE 1990 – December 2021
		Web of Knowledge 1990 – December 2021 The Cochrane Library 1990 – December 2021
		Keywords See search strategy section in the article
√ 1	Databases and registries searched	PubMed, Embase, MEDLINE, Web of Knowledge, and the
		Cochrane Library
$\sqrt{2}$	Search software used, name and	We did not employ a search software. EndNote was used to merge
	version, including special features	retrieved citations and eliminate duplications
1	Use of hand searching	We have hand-checked the reference lists of original publications and previous meta-analyses or reviews
	List of citations located and those	Details of the literature search process are outlined in the flow
	excluded, including justifications	chart. The citation list is available upon request
1	Method of addressing articles published in languages other than English	We limited to studies published in the English language
	Method of handling abstracts and unpublished studies	Unpublished data, conference papers, editorials, theses, and patents were not included
	Description of any contact with authors	We contacted corresponding authors of studies that did not reported sufficient data in an effort to complete our data set.
	rting of methods should include	
	Description of relevance or	Detailed inclusion and exclusion criteria were described in the
8	appropriateness of studies assembled for assessing the hypothesis to be tested	methods section.
	Rationale for the selection and coding of data	Data extracted from each of the studies were relevant to the first author's name; year of publication; country; duration of follow- up; age range; number of participants and incident cases; diagnostic method and criteria of outcome; dietary assessment method; food items; multivariate-adjusted risk estimate; and confounding factors of interest
	Assessment of confounding	Restricted the analysis to meat estimates only.
i	Assessment of study quality, including blinding of quality assessors; stratification or	The Newcastle–Ottawa Scale (NOS) adapted for cohort studies was used by two investigators (Ye Jiao and Wei Quan) to assess the quality of the included articles.

	regression on possible predictors of study results			
V	Assessment of heterogeneity	Heterogeneity of the studies were explored within two types of study designs using Cochrane's Q test of heterogeneity and I ² statistic that provides the relative amount of variance of the summary effect due to the between-study heterogeneity.		
\checkmark	Description of statistical methods in sufficient detail to be replicated	Description of methods of meta-analyses, sensitivity analyses, subgroup analysis and assessment of publication bias are detailed in the methods.		
\checkmark	Provision of appropriate tables and graphics	We included 1 flow chart,1 summary table, 1 table of subgroup analysis, 4 forest plot of all studies, 1 table of sensitivity analyses.		
Re	porting of results should include			
	Graph summarizing individual study estimates and overall estimate	Figure 1		
\checkmark	Tablegivingdescriptiveinformation for each study included	Table 1		
\checkmark	Results of sensitivity testing	Supplementary Table 1		
\checkmark	Indication of statistical uncertainty of findings	95% confidence intervals were presented with all summary estimates, I ² values and results of sensitivity analyses		
	porting of discussion should include			
\checkmark	Quantitative assessment of bias	Sensitivity analyses indicate heterogeneity in strengths of the association due to most common biases in observational studies.		
\checkmark	Justification for exclusion	We excluded studies that had not reported for the meat consumption as exposure		
\checkmark	Assessment of quality of included studies	We discussed the results of the sensitivity analyses, and potential reasons for the observed heterogeneity.		
	porting of conclusions should lude			
V	Consideration of alternative explanations for observed results	We discussed that potential unmeasured confounders such as Maillard reaction harmful products may related to the risk of cognitive disorders.		
V	Generalization of the conclusions	A high consumption of total meat (especially for processed total meat and red meat) is associated with increased risk of neurodegenerative cognitive disorders. While higher fish and poultry intakes is associated with decreased risk of neurodegenerative cognitive disorders		
\checkmark	Guidelines for future research	We recommend to exploring the potential mechanisms of processed meat products or their harmful products and the risk of cognitive impairment in the future.		
V	Disclosure of funding source	This work has been supported by the National Natural Science Foundation of China (Grant No. 3217160166), The Innovation and Exploration Fund of State Key Laboratory of Food Science and Technology, Jiangnan University (No. SKLF-ZZA-202001).		

Supplemental Table 3 Detailed search strategy in the three databases PubMed, Embase and MEDLINE

pig meat [mh] OR b OR meat products [
pig meat [mh] OR b OR meat products [[mb] OD most [mb] OD most mosts [m1] OD
OR meat products [[mh] OR meat [mh] OR prok meats [mh] OR
	acon [mh] OR cured ham [mh] OR ham [mh]
OD 1 05 11 05 1	tiab] OR red meat [tiab] OR meat, red [tiab]
OR beef tiab OR la	amb meat [tiab] OR lamb [tiab] OR veal [tiab]
OR poultry [tiab] O	R chickens [tiab] OR ducks [tiab] OR geese
	[tiab] OR poultry meat [tiab] OR poultry
	nimals [tiab] OR seafood [tiab] OR fish [tiab]
	OR fish products [tiab] OR fish flour [tiab] OR
	o] OR poultry protein [tiab]
#2 "Cognitive Dysfur	ction" [mh] OR Dementia [mh] OR
"Parkinsonian Disor	ders" [mh] OR cognitive [tiab] OR cognition
	[tiab] OR dementias [tiab] OR "intellectual
	OR "intellectual disability" [tiab] OR
	nction" [tiab] OR alzheimer [tiab] OR
	R alzheimer's [tiab] OR parkinson [tiab] OR
	R parkinson's [tiab] OR parkinsonism [tiab]
OR "lewy body	disease" [tiab] OR "frontotemporal lobar
	b] OR neurodegenerative [tiab] OR
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¥	tiab] OR "Prospective Studies" [tiab] OR
	· · · ·
* *	lies" [tiab] OR "Studies, Prospective " [tiab]
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#1 Diet/exp OR food/e	xp OR meat/exp OR prok meats/exp OR pig
	on/exp OR cured ham/exp OR ham/exp OR
	OR red meat:ti,ab OR meat, red:ti,ab OR
	meat:ti,ab OR lamb:ti,ab OR veal:ti,ab OR
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	ultry meat:ti,ab OR poultry products:ti,ab OR
animals:ti,ab OR sea	food:ti,ab OR fish:ti,ab OR shellfish:ti,ab OR
fish products:ti,ab O	R fish flour:ti,ab OR shellfish protein:ti,ab OR
poultry protein:ti,ab	· · ·
	exp OR cognition/exp OR 'intellectual
	R 'Alzheimer disease'/exp OR 'Parkinson
1	cognitive:ti,ab OR cognition:ti,ab OR
	R dementias:ti,ab OR 'intellectual
dementia:ti,ab O	
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impairment':ti,ab OF dysfunction':ti,ab OF parkinson:ti,ab OR 'lewy body dia degeneration':ti,ab neurodegeneration:ti#3'Cohort Studies'/ez 'Epidemiologic Studies#4#1 AND #2 AND #3	R 'intellectual disability':ti,ab OR 'intellectual PR alzheimer:ti,ab OR alzheimers:ti,ab OR parkinsons:ti,ab OR parkinsonism:ti,ab OR sease':ti,ab OR 'frontotemporal lobar OR neurodegenerative:ti,ab OR ,ab xp OR 'Prospective Studies'/exp OR ies':ti,ab OR 'Studies, Prospective':ti,ab
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pig meat [mh] OR bacon [mh] OR cured ham [mh] OR ham [mh] OR meat products [tiab] OR red meat [tiab] OR meat, red [tiab] OR beef [tiab] OR lamb meat [tiab] OR lamb [tiab] OR veal [tiab] OR poultry [tiab] OR chickens [tiab] OR ducks [tiab] OR geese [tiab] OR turkeys [tiab] OR poultry meat [tiab] OR poultry products [tiab] OR animals [tiab] OR seafood [tiab] OR fish [tiab] OR shellfish [tiab] OR fish products [tiab] OR fish flour [tiab] OR shellfish protein [tiab] OR poultry protein [tiab]
[mh "Cognitive Dysfunction"] OR [mh Dementia] OR [mh "Parkinsonian Disorders"] OR (cognitive):ti,ab OR (cognition):ti,ab OR (dementia):ti,ab OR (dementias):ti,ab OR ("intellectual impairment"):ti,ab OR ("intellectual disability"):ti,ab OR ("intellectual dysfunction"):ti,ab OR (alzheimer):ti,ab OR (alzheimers):ti,ab OR (alzheimer's):ti,ab OR (parkinson):ti,ab OR (parkinsons):ti,ab OR (parkinson's):ti,ab OR (parkinson):ti,ab OR ("lewy body disease"):ti,ab OR ("frontotemporal lobar degeneration"):ti,ab OR (neurodegenerative):ti,ab OR (neurodegeneration):ti,ab
"Cohort Studies" [tiab] OR "Prospective Studies" [tiab] OR "Epidemiologic Studies" [tiab] OR "Studies, Prospective " [tiab]
#1 AND #2 AND #3
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Supplementary	Table 4 References and	score range of diagno	osis criteria of outcome	s used in the included studies

Author (year)	Diagnosis criteria of outcome	Score range and reference for cognitive assessment
Anastasiou (2017)	DSM-IV; NINCDS/ADRDA	Ref: 1. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 4th ed ed. Washington, DC2000. 2. McKhann G, Drachman D, Folstein M, Katzman R, Price D, Stadlan EM. Clinical diagnosis of Alzheimer's disease: report of the NINCDS- ADRDA Work Group under the auspices of Department of Health and Human Services Task Force on Alzheimer's Disease. Neurology. 1984; 34(7):939–44.
Ashby-Mitchell (2014)	MMSE	Score range: cognitively impaired (score of 0–23) or not cognitively impaired (score of 24–30) Ref: Anstey, K.J.; von Sanden, C.; Luszcz, M.A. An 8-year prospective study of the relationship between cognitive performance and falling in very old adults. J. Am. Geriatr. Soc. 2006, 54, 1169–1176.
Roberts (2010)	DSM-IV	Ref: American Psychiatric Association: Diagnostic and Statistical Manual of Mental Disorders, ed 4. Washington, American Psychiatric Association, 1994.
Tanaka (2018)	MMSE	Score range: No dementia (MMSE score>26), dementia (MMSE score≤26) Ref: Folstein, M.F.; Folstein, S.E.; McHugh, P.R. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J. Psychiatr. Res. 1975, 12, 189–198.
Barberger-Gateau (2002)	DSM-IIIR	Ref: American Psychiatric Association. Diagnostic and statistical manual of mental disorders, 4th ed. Washington, DC: APA Press, 1994.
Barberger-Gateau (2007)	DSM-IIIR	Ref: American Psychiatric Association. Diagnostic and statistical manual of mental disorders, 4th ed. Washington, DC: APA Press, 1994.
Chen (2012)	MMSE-r	 Score range: Normal cognitive (MMSE-r score>18), cognitive decline (MMSE-r score≤18) Ref: 1. Gu D DM, authors; Zeng Y, Poston DL, Vlosk Da, gu D, editors. assessment of reliability of mortality and morbidity in the 1998-2002 CLhLS waves. healthy longevity in China: Demographic, socioeconomic, and psychological dimensions. Dordrecht, The netherlands: Springer Publisher. 2008:p. 99–115. 2. Zeng Y VJ, Xiao Z, Zhang C, Liu Y,. The healthy longevity survey and the active life expectancy of the oldest old in China. Population. an english Selection 2001. p. 95–116. 3. Zhang Z. gender differentials in cognitive impairment and decline of the oldest old in China. J gerontol B Psychol Sci Soc Sci. 2006;61(2):S107-15.
Fischer (2018)	DSM- IV; NINCDS ADRDA	 Score range: scoring 0–55 with a higher score indicating a better performance Ref: 1. McKhann, G.; Drachman, D.; Folstein, M.; Katzman, R.; Price, D.; Stadlanet, E.M. Clinical diagnosis of Alzheimer's disease: Report -of the NINCDS-ADRDA Work Group under the auspices of Department of Health and Human Services Task Force on Alzheimer's Disease. Neurology 1984, 34, 939–944. 2. Román, G.C.; Tatemichi, T.K.; Masdeu, J.C.; Garcia, J.H.; Amaducci, L.; Orgogozo, J.M.; Brun, A.; Hofman, A. Vascular dementia: Diagnostic criteria for research studies. Report of the NINDS-AIREN International Workshop. Neurology 1993, 43, 250–260.

Supplementary Table 4 Continued

Author (year)	Diagnosis criteria of outcome	Reference for cognitive assessment
Vercambre (2009)	OCDS	 Score range: cognitive decline (DECO score <33); cognitive troubles (non-null 4-IADL score) Ref: 1. Ritchie K & Fuhrer R (1996) The validation of an informant screening test for irreversible cognitive decline in the elderly: performance characteristics within a general population sample. Int J Geriatr Psychiatry 11, 149–156. 2. Barberger-Gateau P, Fabrigoule C, Helmer C, et al. (1999) Functional impairment in instrumental activities of daily living: an early clinical sign of dementia? J Am Geriatr Soc 47, 456–462.
Rahman (2007)	MSQ	Score range: No dementia (MSQ score≥28), dementia (MSQ score≤28) Ref: no reference
Katsiardanis (2013)	MMSE	Score range: No dementia (MMSE score>24), cognitive impairment (MMSE score≤24) Ref: Fountoulakis K, Tsolaki M, Chantzi H, Kazis A: Mini-Mental State Examination (MMSE): a validation study in Greece. Am J Alzheimer's Dis Other Demen 2000;15:342–345.
Ritchie (2010)	SICT	Ref: Artero S, Petersen R, Touchon J, Ritchie K. Revised criteria for mild cognitive impairment: validation within a longitudinal population study. Dement Geriatr Cogn Disord 2006;22:465-70
Chuang (2019)	MMSE ICD-9	 Score range: No dementia (MMSE score >25), cognitive impairment (MMSE score ≤25); dementia codes (ICD-9-CM: 331.0 and 290.0-290.4) Ref: 1. Pfeiffer E. A short portable mental status questionnaire for the assessment of organic brain deficit in elderly patients. J Am Geriatr Soc 1975;23: 433e441. 2. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975; 12:189e198. 3. Katzman R, Zhang MY, Ouang YQ, et al. A Chinese version of the Mini-Mental State Examination: Impact of illiteracy in a Shanghai dementia survey. J Clin Epidemiol 1988;41:971e978
Trichopoulou (2015)	MMSE	 Score range: mild performance decline (change in MMSE -4 to -1), substantial performance decline (change in MMSE ≤-5) Ref: 1. Folstein MF, Folstein SE, McHugh PR (1975) "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 12(3):189–198. 2. Fountoulakis KN, Tsolaki M, Chantzi H, Kazis A (2000) Mini mental state examination (MMSE): a validation study in Greece. Am J Alzheimers Dis Other Dement 15(6):342–345.
Albanese (2009)	ICD-10	 Ref: 1. Copeland JR, Dewey ME, Griffiths-Jones HM. A computerized psychiatric diagnostic system and case nomenclature for elderly subjects: GMS and AGECAT. Psychol Med 1986;16:89–99. 2. WHO. Clinical descriptions and diagnostic guidelines, MNH/MEP/87.1. In: WHO, ed. Tenth revision of the International Classification of Diseases. Geneva, Switzerland: WHO, 1987.

Supplementary Table 4 Continued

Author (year)	Diagnosis criteria of outcome	Reference for cognitive assessment
Wang (2010)	MMSE	 Score range: MCI (MMSE score 19-24), normal (MMSE score 25-30) Ref: 1. Huang CQ, Dong BR, Wu HM, Zhang YL, Wu JH, Lu ZC, Flaherty JH: Association of cognitive impairment with serum lipid/lipoprotein among Chinese nonagenarians and centenarians. Dementia and geriatric cognitive disorders 2009, 27:111-116. 2. Dufouil C, Clayton D, Brayne C, Chi LY, Dening TR, Paykel ES, O'Connor DW, Ahmed A, McGee MA, Huppert FA: Population norms for the MMSE in the very old: estimates based on longitudinal data. Mini-Mental State Examination. Neurology 2000, 55:1609-1613.
Ylilauri (2022)	MMSE ICD-10	 Score range: AD (ICD-10 codes F00 and G30) Ref: 1. Ylilauri MPT, Voutilainen S, Lönnroos E, Mursu J, Virtanen HEK, Koskinen TT, Salonen JT, Tuomainen T, Virtanen JK (2017) Association of dietary cholesterol and egg intakes with the risk of incident dementia or Alzheimer disease: the Kuopio Ischaemic Heart Disease Risk Factor Study. Am J Clin Nutr 105:476–484. Koivisto K (1995) Population-based dementia screening program in the city of Kuopio, Eastern Finland: evaluation of screening methods, prevalence of dementia and dementia subtypes. Dissertation, University of Kuopio
Franca (2018)	MMSE	Ref: Bertolucci PHF, Brucki SMD, Campacci SR, Juliano Y. O Mini Exame do Estado Mental em uma população geral: impacto da escolaridade. Arq. Neuropsiquiatr. 1994; 52(1): 1–7.
Tsurumaki (2019)	LTCI	 Score range: The Dementia Scale is classified into six ranks (0, I–IV and M), dementia-related behavioural disturbance (rank M), dementia (rank≥II) Ref: 1. Ikeda A, Yamagishi K, Tanigawa T, et al. (2008) Cigarette smoking and risk of disabling dementia in a Japanese rural community: a nested case-control study. Cerebrovas Dis 25, 324–331. 2. Imahashi K, Kawagoe M, Eto F, et al. (2007) Clinical status and dependency of the elderly requiring long-term care in Japan. Tohoku J Exp Med 212, 229–238.
Jiang (2018)	MMSE	Score range: No dementia (MMSE score>24), cognitive impairment (MMSE score≤24) Ref: Feng L, Chong MS, Lim WS, Ng TP (2012) The Modified MiniMental State Examination test: normative data for Singapore Chinese older adults and its performance in detecting early cognitive impairment. Singap Med J 53(7):458–46.
Zhang (2021)	ICD-9 ICD-10	Score range: AD (ICD-9 code 331.0 and ICD-10 codes F00 and G30); dementia (ICD-9 codes 290, 291.2, 294.1, 331.0–331.2, and 331.5, and ICD-10 codes A81.0, F02, F05.1, F10.6, G31.0, G31.1, and G31.8) Ref: Power MC, Weuve J, Sharrett AR, Blacker D, Gottesman RF. Statins, cognition, and dementia—systematic review and methodological commentary. Nat Rev Neurol 2015;11:220–9.
Ngabirano (2019)	DSM-IV; NINCDS/ADRDA	Ref: 1. American Psychiatrique Association (1994) Diagnostic and statistical manual of mental disorders, 4th ed., APA Press, Washington, DC. 2. McKhann G, Drachman D, Folstein M, Katzman R, Price D, Stadlan EM (1984) Clinical diagnosis of Alzheimer's disease: report of the NINCDS-ADRDA Work Group under the auspices of Department of Health and Human Services Task Force on Alzheimer's Disease. Neurology 34, 939-944.

Supplementary Table 5 References for FFQs used in the included studies

Author (year)	Food frequency assessment	Reference for food frequency assessment
Anastasiou (2017)	Semi-quantitative food frequency questionnaire	Bountziouka V, Bathrellou E, Giotopoulou A, Katsagoni C, Bonou M, Vallianou N, et al. Development, repeatability and validity regarding energy and macronutrient intake of a semi-quantitative food frequency questionnaire: methodological considerations. Nutr Metab Cardiovasc Dis. 2012; 22(8):659–67.
Ashby-Mitchell (2014)	121 items Semi-quantitative food frequency questionnaire	Grantham, N.M.; Magliano, D.J.; Hodge, A.; Jowett, J.; Meikle, P.; Shaw, J.E. The association between dairy food intake and the incidence of diabetes in Australia: The Australian diabetes obesity and lifestyle study (AusDiab). Public Health Nutr. 2013, 16, 339–345.
Roberts (2010)	128 items Health Habits and History Questionnaire	Block G, Coyle LM, Hartman AM, Scoppa SM: Revision of dietary analysis software for the Health Habits and History Questionnaire. Am J Epidemiol 1994;139:1190–1196.
Tanaka (2018)	food frequency questionnaire	Bartali, B.; Turrini, A.; Salvini, S.; Lauretani, F.; Russo, C.R.; Corsi, A.M.; Bandinelli, S.; D'Amicis, A.; Palli, D.; Guralnik, J.M.; et al. Dietary intake estimated using different methods in two Italian older populations. Arch. Gerontol. Geriatr. 2004, 38, 51–60.
Barberger-Gateau (2002)	food frequency questionnaire	Barberger Gateau P, Fabrigoule C, Helmer C, Rouch I, Dartigues JF. Functional impairment in instrumental activities of daily living: an early clinical sign of dementia? J Am Geriatr Soc 1999;47:456>62.
Barberger-Gateau (2007)	food frequency questionnaire	Barberger Gateau P, Fabrigoule C, Helmer C, Rouch I, Dartigues JF. Functional impairment in instrumental activities of daily living: an early clinical sign of dementia? J Am Geriatr Soc 1999;47:456>62.
Chen (2012)	8 items interviewer- administrated questionnaire	Wang Z, Dong B, Zeng g, Li J, Wang W, Wang B, et al. Is there an association between Mild Cognitive Impairment and Dietary Pattern in Chinese elderly? Results from a Crosssectional Population Study. BMC Public health. 2010;10(1):595.
Fischer (2018)	8-item "cognitive health" food intake screener	Cooper, B.; Bickel, H.; Schaufele, M. The ability of general-practitioners to detect dementia and cognitive impairment in their elderly patients—A study in Mannheim. Int. J. Geriatr. Psychiatry 1992, 7, 591–598.
Vercambre (2009)	dietary questionnaire	van Liere MJ, Lucas F, Clavel F, et al. (1997) Relative validity and reproducibility of a French dietary history questionnaire. Int J Epidemiol 26, Suppl. 1, S128–S136.
Rahman (2007)	food frequency questionnaire	No references
Katsiardanis (2013)	*	Gnardellis C, Trichopoulou A, Katsouyanni K, Polychronopoulos E, Rimm EB, Trichopoulos D: Reproducibility and validity of an extensive semiquantitative food frequency questionnaire among Greek school teachers. Epidemiology 1995;6:74–77.

Supplementary Table 5 Continued

Author (year)	Food frequency assessment	Reference for food frequency assessment
Ritchie (2010)	food frequency questionnaire	Akbaraly TN, Portet F, Fustinoni S, Dartigues JF, Artero S, Rouaud O, et al. Leisure activities and the risk of dementia in the elderly: results from the Three-City Study. Neurology 2009;73:854-61.
Chuang (2019)	79-item food-frequency questionnaire	Pan WH, Lee MM, Yu SL, Huang PC. Foods predictive of nutrient intake in Chinese diet in Taiwan: II. Vitamin A, vitamin B1, vitamin B2, vitamin C and calcium. Int J Epidemiol 1992;21:929e934. Lee MM, Pan WH, Yu SL, Huang PC. Foods predictive of nutrient intake in Chinese diet in Taiwan: I. Total calories, protein, fat and fatty acids. Int J Epidemiol 1992;21:922e928.
Trichopoulou (2015)	150 items Semi-quantitative food frequency questionnaire	Katsouyanni K, Rimm EB, Gnardellis C, Trichopoulos D, Polychronopoulos E, Trichopoulou A (1997) Reproducibility and relative validity of an extensive semi-quantitative food frequency questionnaire using dietary records and biochemical markers among Greek schoolteachers. Int J Epidemiol 26(Suppl 1):S118–S127.
Albanese (2009)	food frequency questionnaire	Prince M, Ferri CP, Acosta D, et al. The protocols for the 10/66 dementia research group population-based research programme. BMC Public Health 2007;7:165
Wang (2010)	food frequency questionnaire	Huang CQ, Dong BR, Wu HM, Zhang YL, Wu JH, Lu ZC, Flaherty JH: Association of cognitive impairment with serum lipid/lipoprotein among Chinese nonagenarians and centenarians. Dementia and geriatric cognitive disorders 2009, 27:111-116
Ylilauri (2022)	food recording of 4 days	Willet W (2013) Implications of total energy intake for epidemiologic analyses. In: Willet W (ed) Nutritional epidemiology. Monographs in epidemiology and biostatistics, 3rd edn. Oxford University Press, Oxford, pp 260–286
Franca (2018)	food frequency questionnaire	World Health Organization. Diet, nutrition and the prevention of chronic diseases. Report of a Joint WHO/FAO Expert Consultation. WHO Technical Report Series 916. Geneva. 2003
Tsurumaki (2019)	39 items Semi-quantitative food frequency questionnaire	Ogawa K, Tsubono Y, Nishino Y, et al. (2003) Validation of a food-frequency questionnaire for cohort studies in rural Japan. Public Health Nutr 6, 147–157.
Jiang (2018)		Talaei M, Wang YL, Yuan JM, Pan A, Koh WP (2017) Meat, dietary heme iron, and risk of type 2 diabetes mellitus: the Singapore Chinese Health Study. Am J Epidemiol 186(7):824–833.
Zhang (2021)		Bradbury KE, Young HJ, Guo W, Key TJ. Dietary assessment in UK Biobank: an evaluation of the performance of the touchscreen dietary questionnaire. J Nutr Sci 2018;7:e6.
Ngabirano (2019)	food frequency questionnaire	Larrieu S, Letenneur L, Berr C, Dartigues JF, Ritchie K, Alperovitch A, Tavernier B, BarbergerGateau P (2004) Sociodemographic differences in dietary habits in a population-based sample of elderly subjects: the 3C study. J Nutr Health Aging 8, 497-502.

		Selec (0-			Comparability (0-2)		Outcome (0-3)			
Author, (year)	Representative of cases	Selection of controls	Exposure ascertainment	No history of outcome	Comparable on confounders	Outcome assessment	Adequate follow- up	Follow-up rate	Overall quality	
Anastasiou (2017)	0	1	1	1	1	1	0	0	5	
Ashby-Mitchell (2014)	0	1	1	1	1	1	1	0	4	
Roberts (2010)	0	1	1	0	1	1	1	0	5	
Tanaka (2018)	1	1	1	1	2	1	1	0	8	
Barberger-Gateau (2002)	1	0	1	1	0	1	0	0	4	
Barberger-Gateau (2007)	1	1	1	1	1	1	1	0	7	
Chen (2012)	1	1	1	1	2	1	1	0	8	
Fischer (2018)	1	1	1	0	2	1	1	1	8	
Vercambre (2009)	1	1	1	0	2	0	1	1	7	
Rahman (2007)	1	1	1	0	1	1	0	0	5	
Katsiardanis (2013)	0	1	1	1	1	1	0	0	5	
Ritchie (2010)	0	1	0	1	0	0	0	1	3	
Chuang (2019)	0	1	1	1	1	1	0	0	5	
Trichopoulou (2015)	0	1	1	0	1	1	1	0	5	
Albanese (2009)	1	1	1	1	2	1	0	0	7	
Wang (2010)	0	1	0	1	1	1	1	0	5	
Ylilauri (2022)	0	1	1	1	0	1	1	0	5	

Supplementary Table 6 Quality assessment of the publications included in the meta-analysis

			Suj	pplementary fil	es				
Franca (2018)	0	1	1	0	1	1	1	0	5
Tsurumaki (2019)	1	1	1	1	1	1	1	1	8
Jiang (2018)	1	1	1	1	2	1	1	1	9
Zhang (2021)	1	1	1	1	2	1	1	1	9
Ngabirano (2019)	0	1	1	1	2	1	1	1	8

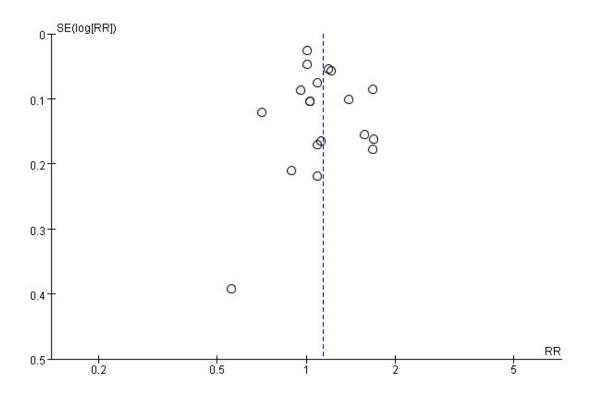
Study	Author	logRR	Variance	Cat	Cases	Per years	Dose	Se
			F	ish				
1	Roberts	0	0	0	58	353	8.7	0
1	Roberts	0.0086	0.007529	1	58	354	15	0.08676′
1	Roberts	-0.00436	0.008273	2	47	363	21.3	0.09095
2	Ylilauri	0	0	0	78	623	0	0
2	Ylilauri	0.049218	0.004493	1	94	625	18	0.067032
2	Ylilauri	-0.08619	0.005184	2	72	624	48	0.07199
2	Ylilauri	0.033424	0.004733	3	93	625	102	0.06879
3	Tsurumaki	0	0	0	336	15536	17.05	0
3	Tsurumaki	-0.04576	0.002018	1	132	7913	43.75	0.04492
3	Tsurumaki	-0.07058	0.001139	2	344	21452	74.9	0.03375
3	Tsurumaki	-0.07572	0.001415	3	306	20029	96.4	0.03761
4	Jiang	0	0	0	652	4237	28.46	0
4	Jiang	-0.04096	0.000845	1	605	4237	45.77	0.02906
4	Jiang	-0.06048	0.000775	2	593	4237	61.11	0.02784
4	Jiang	-0.05061	0.000883	3	593	4237	83.95	0.02972
			Tota	l meat				
1	Roberts	0	0	0	54	357	41.6	0
1	Roberts	0.064458	0.007676	1	59	353	107.75	0.08761
1	Roberts	-0.05061	0.00856	2	50	360	132.3	0.09252
2	Ylilauri	0	0	0	89	624	77	0
2	Ylilauri	0.0086	0.004564	1	88	625	128	0.06755
2	Ylilauri	0.012837	0.004688	2	86	623	174	0.06847
2	Ylilauri	0.004321	0.006386	3	74	624	261	0.07991
3	Zhang	0	0	0	146	77261	63	0
3	Zhang	0.053078	0.002278	1	188	90065	86	0.04772
3	Zhang	0.068186	0.001881	2	322	162570	96	0.043372
3	Zhang	0.143015	0.00196	3	316	143519	113	0.04427
4	Zhang	0	0	0	459	77261	63	0
4	Zhang	-0.02228	0.000775	1	509	90065	86	0.02784
4	Zhang	-0.01773	0.000637	2	875	162570	96	0.02523
4	Zhang	0.082785	0.000652	3	959	143519	113	0.02554
			Red	meat				
1	Jiang	0	0	0	610	4237	11.81	0
1	Jiang	-0.01323	0.000893	1	585	4237	23.75	0.02987
1	Jiang	0.049218	0.000927	2	636	4237	33.06	0.03045

Supplementary Table 7. Data extracted for dose-response analysis.

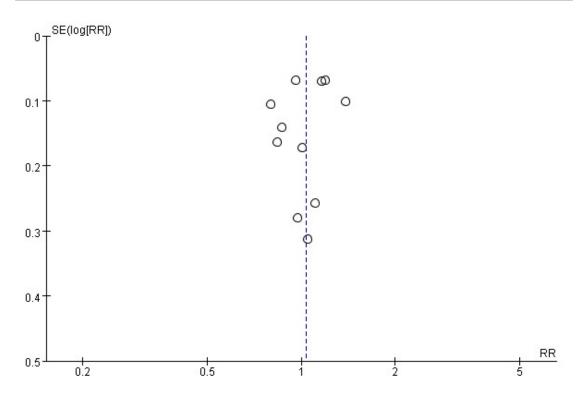
			Suppleme	entary fi	les			
1	Jiang	0.064458	0.000879	3	612	4237	48.61	0.029656
2	Ylilauri	0	0	0	91	624	65	0
2	Ylilauri	-0.00877	0.004307	1	88	625	113	0.065625
2	Ylilauri	-0.01323	0.004605	2	85	624	156	0.06786
2	Ylilauri	-0.03152	0.006028	3	73	624	230	0.077642
3	Zhang	0	0	0	369	57433	24	0
3	Zhang	-0.06048	0.000775	1	812	153797	35	0.027843
3	Zhang	-0.10237	0.000775	2	722	138648	44	0.027843
3	Zhang	-0.01773	0.000833	3	791	110441	54	0.028864
4	Zhang	0	0	0	146	57433	24	0
4	Zhang	-0.10237	0.002122	1	284	153797	35	0.046069
4	Zhang	-0.14267	0.003509	2	253	138648	44	0.059237
4	Zhang	-0.09691	0.002173	3	255	110441	54	0.046613
			Por	ultry				
1	Jiang	0	0	0	645	4237	6	0
1	Jiang	-0.02687	0.000792	1	642	4237	15.22	0.028139
1	Jiang	-0.04096	0.000928	2	602	4237	22.68	0.030461
1	Jiang	-0.05061	0.000883	3	554	4237	37.18	0.029721
2	Zhang	0	0	0	425	53001	19	0
2	Zhang	-0.06048	0.000714	1	1063	177074	28	0.026718
2	Zhang	-0.05552	0.000625	2	1190	227200	39	0.025002
2	Zhang	0.017033	0.003456	3	65	11142	61	0.058788
3	Zhang	0	0	0	46	53001	19	0
3	Zhang	-0.08619	0.001969	1	143	177074	28	0.044369
3	Zhang	-0.03621	0.001761	2	364	227200	39	0.041967
3	Zhang	0.041393	0.010762	3	433	11142	61	0.103741
			Process	sed mea	t			
1	Jiang	0	0	0	95	637	10	0
1	Jiang	0.025306	0.004424	1	91	608	40	0.066514
1	Jiang	0.045323	0.004761	2	83	626	76	0.069003
1	Jiang	0.049218	0.00579	3	78	626	139	0.07609
2	Zhang	0	0	0	724	150758	16	0
2	Zhang	0.053078	0.000508	1	796	144076	22	0.022528
2	Zhang	0.136721	0.000509	2	914	133365	28	0.022557
2	Zhang	0.222716	0.001415	3	170	19331	32	0.037614
3	Zhang	0	0	0	263	150758	16	0
3	Zhang	0.029384	0.001456	1	256	144076	22	0.038153
3	Zhang	0.193125	0.001462	2	325	133365	28	0.03824

	Supplementary files								
3	Zhang	0.227887	0.004942	3	49	19331	32	0.070302	

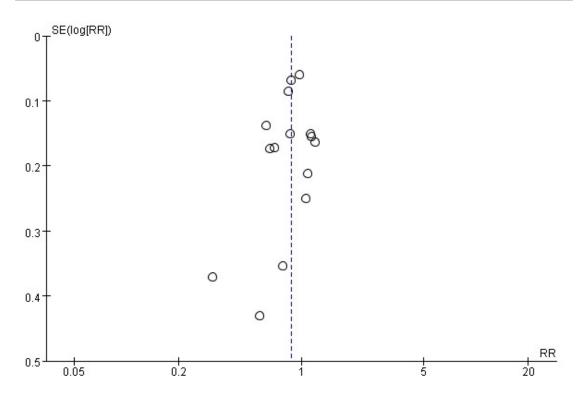
NOTE: Cat: categories; Person year: no. of participants multiplied by follow-up years; Cases: no. of cases multiplied by follow-up years; the unit of dose: g/day.



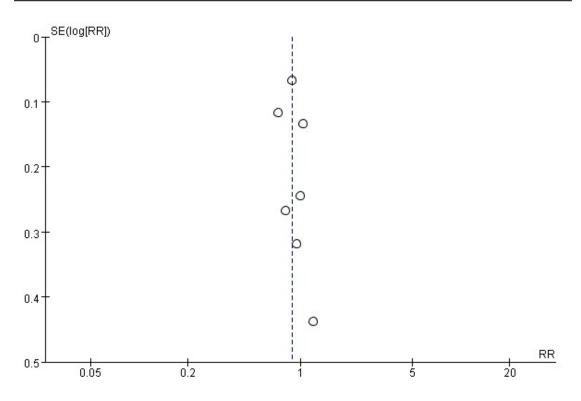
Supplementary Figure 1. Funnel plots of total meat intakes and neurodegenerative cognitive disorders risk in the highest *versus* lowest analysis.



Supplementary Figure 2. Funnel plots of read meat intakes and neurodegenerative cognitive disorders risk in the highest *versus* lowest analysis.



Supplementary Figure 3. Funnel plots of fish intakes and neurodegenerative cognitive disorders risk in the highest *versus* lowest analysis.



Supplementary Figure 4. Funnel plots of poultry intakes and neurodegenerative cognitive disorders risk in the highest *versus* lowest analysis.

2003 I.I. 1883-1		1-12-12		Risk Ratio	Risk Ratio
Study or Subgroup	log[Risk Ratio]	SE	Weight	IV, Random, 95% Cl	IV, Random, 95% Cl
3.1.1 AD					
Fischer 2018	0.5128		3.9%	1.67 [1.18, 2.36]	
Ngabirano 2019	0.0862		7.2%	1.09 [0.94, 1.26]	
Zhang 2021	0.3293		6.3%	1.39 [1.14, 1.69]	
Zhang 2021	0.5247	0.1621	4.3%	1.69 [1.23, 2.32]	
Subtotal (95% CI)			21.7%	1.39 [1.12, 1.73]	-
Heterogeneity: Tau ² = 0.0)3; Chi ² = 10.38, df =	: 3 (P = 0	0.02); I ^z =	71%	
Test for overall effect: Z =	2.94 (P = 0.003)				
3.1.2 MCI					
Ashby-Mitchell 2014	0.01	0.0259	8.6%	1.01 [0.96, 1.06]	+
Katsiardanis 2013	-0.0408	0.0867	6.8%	0.96 [0.81, 1.14]	
Katsiardanis 2013	0.0296	0.104	6.2%	1.03 [0.84, 1.26]	_ +
Roberts 2010	-0.1165	0.2097	3.2%	0.89 [0.59, 1.34]	
Wang 2010	0.01	0.0476	8.1%	1.01 [0.92, 1.11]	+
Subtotal (95% CI)			33.0%	1.01 [0.97, 1.05]	•
Heterogeneity: Tau ² = 0.0	00; Chi ² = 0.71, df =	4 (P = 0.	95); I ² = 0	1%	
Test for overall effect: Z =	0.30 (P = 0.76)	1	550.0		
3.1.3 Dementia					
Albanese 2009	0.174	0.0542	7.9%	1.19 [1.07, 1.32]	-
Barberger-Gateau 2002	-0.5798		1.2%	0.56 [0.26, 1.21]	
Ngabirano 2019	0.4511		4.5%	1.57 [1.16, 2.12]	
Ylilauri 2022	0.0862	0.1707	4.1%	1.09 [0.78, 1.52]	
Zhang 2021	0.5128	0.0863	6.8%	1.67 [1.41, 1.98]	
Zhang 2021	0.1906	0.058	7.8%	1.21 [1.08, 1.36]	
Subtotal (95% CI)			32.4%	1.28 [1.09, 1.50]	•
Heterogeneity: Tau ² = 0.0	12 [.] Chi ^z = 19.26 df =	5 (P = (1 002) [,] F		
Test for overall effect: Z =					
3.1.4 Cognitive decline					
Chen 2012	-0.3425	0.1211	5.6%	0.71 [0.56, 0.90]	
Tanaka 2018	0.1133		4.2%	1.12 [0.81, 1.55]	
Trichopoulou 2015	0.0862		3.0%	1.09 [0.71, 1.67]	
Subtotal (95% CI)			12.8%	0.93 [0.67, 1.29]	-
Heterogeneity: Tau ² = 0.0	06; Chi ² = 6.21, df =	2 (P = 0.			
Test for overall effect: Z =		1			
Total (95% CI)			100.0%	1.15 [1.04, 1.26]	◆
Heterogeneity: Tau ² = 0.0)2; Chi ² = 84.71. df =	17 (P <	0.00001		
Test for overall effect: Z =					0.2 0.5 1 2 5
Test for subaroup differe		df - 2 /D	- 0.001)	IZ-01 106	Favours [experimental] Favours [control]

Supplementary Figure 5. Subgroup analysis (stratified by different types of adverse cognitive outcome) for total meat intakes and risk of neurodegenerative cognitive

disorders.

Study or Subgroup	log[Risk Ratio]	SE VVelulit	IV, Random, 95% Cl	IV, Random, 95% Cl
1.1 Processed				
Albanese 2009	0.174 0.0	0542 0.0%	1.19 [1.07, 1.32]	
lgabirano 2019	0.5128 0.1		1.67 [1.18, 2.36]	
nang 2021	0.5247 0.1		1.69 [1.23, 2.32]	· · · · · · · · · · · · · · · · · · ·
nang 2021	0.5128 0.0		1.67 [1.41, 1.98]	
ubtotal (95% CI)		6.6%	1.67 [1.46, 1.92]	•
eterogeneity: Tau² = 0.00				
est for overall effect: Z = 1	7.36 (P < 0.00001)			
.2 Unprocessed				
hby-Mitchell 2014	0.01 0.0	0259 3.9%	1.01 [0.96, 1.06]	+
atsiardanis 2013	0.0296 0	.104 2.7%	1.03 [0.84, 1.26]	
oberts 2010	-0.1165 0.2	2097 1.4%	0.89 [0.59, 1.34]	
anaka 2018	0.1133 0.1	653 1.8%	1.12 [0.81, 1.55]	
Frichopoulou 2015	0.0862 0.2	1.3%	1.09 [0.71, 1.67]	
ubtotal (95% CI)		11.1%	1.01 [0.97, 1.06]	*
leterogeneity: Tau ² = 0.00	0; Chi² = 0.90, df = 4 (ł	^o = 0.92); ² = 0		
est for overall effect: Z = I	0.51 (P = 0.61)			
.1.3 Quanlity score ≥7				
Albanese 2009	0.174 0.0	0542 3.6%	1.19 [1.07, 1.32]	
Fischer 2018	0.0862 0.0		1.09 [0.94, 1.26]	+
Ngabirano 2019	0.5128 0.1		1.67 [1.18, 2.36]	
Ngabirano 2019	0.4511 0.1		1.57 [1.16, 2.12]	
Tanaka 2018	0.1133 0.1		1.12 [0.81, 1.55]	
Zhang 2021	0.3293 0.1		1.39 [1.14, 1.69]	No. of State of State
Zhang 2021	0.5128 0.0		1.67 [1.41, 1.98]	
Zhang 2021		.058 3.5%	1.21 [1.08, 1.36]	
Zhang 2021	0.5247 0.1		1.69 [1.23, 2.32]	
Subtotal (95% CI)	0.0247 0.1	23.5%	1.34 [1.20, 1.50]	•
Heterogeneity: Tau ² = 0.02	2. Chiz - 25.02 df - 0			
est for overall effect: Z = :		(i = 0.002), F	- 0070	
.1.4 Quanlity score<7				
Ashby-Mitchell 2014	0.01 0.0	0259 3.9%	1.01 [0.96, 1.06]	+
ashby-witcheil 2014 Barberger-Gateau 2002	-0.5798 0.3			
1997 - 199 7 - 1997 19			0.56 [0.26, 1.21]	
Chen 2012 Katelardapie 2012	-0.3425 0.1		0.71 [0.56, 0.90]	
Katsiardanis 2013 Deborto 2010		.104 2.7%	1.03 [0.84, 1.26]	
Roberts 2010 Triskensulau 2015	-0.1165 0.2		0.89 [0.59, 1.34]	20 10 10 10 10 10 10 10 10 10 10 10 10 10
Trichopoulou 2015	0.0862 0.2		1.09 [0.71, 1.67]	28 State 5
Nang 2010	0.01 0.0		1.01 [0.92, 1.11]	
Ylilauri 2022 Subtotol (05%, CI)	0.0862 0.1		1.09 [0.78, 1.52]	
Subtotal (95% CI)		17.7%	0.98 [0.90, 1.06]	T
Heterogeneity: Tau² = 0.00 Test for overall effect: Z = 1		(m = 0.13); l ^e =	31%	
.1.5 Europe	0.5700	004.5 0.5**	0.00 10 00 4.000	
Barberger-Gateau 2002	-0.5798 0.3		0.56 [0.26, 1.21]	
Fischer 2018	0.0862 0.0		1.09 [0.94, 1.26]	
≺atsiardanis 2013	0.0296 0		1.03 [0.84, 1.26]	
Ngabirano 2019	0.4511 0.1	544 2.0%	1.57 [1.16, 2.12]	
Ngabirano 2019	0.5128 0.1	772 1.7%	1.67 [1.18, 2.36]	
Frichopoulou 2015	0.0862 0.2	1.3%	1.09 [0.71, 1.67]	
/lilauri 2022	0.0862 0.1		1.09 [0.78, 1.52]	
Zhang 2021	0.5128 0.0		1.67 [1.41, 1.98]	
Zhang 2021		.058 3.5%	1.21 [1.08, 1.36]	
Zhang 2021	0.5247 0.1		1.69 [1.23, 2.32]	
Zhang 2021		012 2.8%	1.39 [1.14, 1.69]	
Subtotal (95% CI)	0.5255 0.1	24.3%	1.29 [1.13, 1.47]	•
Heterogeneity: Tau ² = 0.03	3: Chiž = 32.75 df = 10			•
Fest for overall effect: Z = 3		5 _V = 0.0003),		
.1.6 Asian and other				
shby-Mitchell 2014	0.01 0.0	0259 3.9%	1.01.00.06.1.061	+
			1.01 [0.96, 1.06]	
Chen 2012 Nong 2010	-0.3425 0.1		0.71 [0.56, 0.90]	
Vang 2010 Subtotal (05% CI)	0.01 0.0		1.01 [0.92, 1.11]	
Subtotal (95% CI)	1. ONB_ 0.40	10.1%	0.95 [0.84, 1.07]	\neg
Heterogeneity: Tau² = 0.01 Fest for overall effect: Z = 1		~ = 0.02);	0%0	
.1.7 America			4 4 9 10 9 1 9 1 9 1	
Albanese 2009	0.174 0.0		1.19 [1.07, 1.32]	
Roberts 2010	-0.1165 0.2		0.89 [0.59, 1.34]	200 C C C C C C C C C C C C C C C C C C
Tanaka 2018	0.1133 0.1		1.12 [0.81, 1.55]	
Subtotal (95% CI)		6.8%	1.16 [1.06, 1.28]	•
Heterogeneity: Tau² = 0.00 Test for overall effect: Z = 3		P = 0.39); I ^z = ()%	
	5.54 (r = 0.002)			
Fotal (95% CI)		100.0%	1.17 [1.10, 1.24]	, , ◆
	2: Chi≆ = 212.63. df = /	41 (P < 0.0000	1): I ² = 81%	
Heterogeneity: Tau ² = 0.02	2, Offi = 212.00, ar = -		17,1 = 01.0	06 07 4 46 2
Heterogeneity: Tau² = 0.02 Test for overall effect: Z = 1			17,1 = 01.0	0.5 0.7 1 1.5 2 Favours [experimental] Favours [control]

meat, location and quality score of studies) for total meat intakes and risk of neurodegenerative cognitive disorders.

Study or Subgroup	log[Risk Ratio]	SE	Weight	Risk Ratio IV. Random, 95% Cl	Risk Ratio IV, Random, 95% Cl
3.2.1 AD	loginuorratio	02	Trongine	in run and on or	
Anastasiou 2017	-0.0305	0.2803	3.4%	0.97 [0.56, 1.68]	
Zhang 2021	-0.2231	0.1059	11.4%	0.80 [0.65, 0.98]	
Zhang 2021		0.1012	11.8%	1.39 [1.14, 1.69]	
Subtotal (95% CI)			26.5%	1.03 [0.68, 1.58]	-
Heterogeneity: Tau ² =	= 0.11; Chi ² = 14.3	3, df = 2 (P = 0.000	08); I² = 86%	
Test for overall effect	: Z = 0.16 (P = 0.88	3)			
3.2.2 MCI					
Jiang 2018	0.1484	0.0706	14.6%	1.16 [1.01, 1.33]	-
Rahman 2007	0.1044	0.2576	3.9%	1.11 [0.67, 1.84]	
Subtotal (95% CI)			18.4%	1.16 [1.01, 1.32]	◆
Heterogeneity: Tau ² =	= 0.00; Chi ² = 0.03	df = 1 (F	e = 0.87);	I ² = 0%	
Test for overall effect					
3.2.3 Dementia					
Ylilauri 2022	0.01	0.1727	6.9%	1.01 [0.72, 1.42]	
Ylilauri 2022	0.1484	0.0706	14.6%	1.16 [1.01, 1.33]	-
Ylilauri 2022	-0.1744	0.1632	7.4%	0.84 [0.61, 1.16]	
Zhang 2021	-0.0408	0.0681	14.8%	0.96 [0.84, 1.10]	
Subtotal (95% CI)			43.6%	1.02 [0.89, 1.16]	•
Heterogeneity: Tau ² =	= 0.01; Chi ² = 5.48	df = 3 (F	e = 0.14);	I² = 45%	
Test for overall effect	: Z = 0.23 (P = 0.82	2)			
3.2.4 Cognitive decli	ne				
Franca 2018	0.0488	0.3117	2.8%	1.05 [0.57, 1.93]	-
Vercambre 2009	-0.1393	0.1409	8.7%	0.87 [0.66, 1.15]	
Subtotal (95% CI)			11.5%	0.90 [0.70, 1.16]	-
Heterogeneity: Tau ² =	= 0.00; Chi ² = 0.30	df = 1 (F	e = 0.58);	I ² = 0%	
Test for overall effect	Z = 0.84 (P = 0.40))			
Total (95% CI)			100.0%	1.03 [0.92, 1.15]	•
Heterogeneity: Tau ² =	= 0.02; Chi ² = 23.8	0, df = 10	(P = 0.00)	08); I² = 58%	0.2 0.5 1 2 5
Test for overall effect	Z = 0.54 (P = 0.59	3)	15		U.2 U.5 1 2 5 Favours [experimental] Favours [control]
Test for subaroup dif	ferences: Chi ² = 3	.69. df = 3	3 (P = 0.3	0). I² = 18.6%	Favours (experimental) Favours (control)
Supplementa	rv Figure '	7. Suł	ogrou	n analysis (str	atified by different types of adverse
"rpromonta	- J - 15410		- 51 U U		annea of annerent types of adverse

cognitive outcome) for read meat intakes and risk of neurodegenerative cognitive disorders.

tudy or Subgroup log[O	dds Ratio] SE	Weight I	Odds Ratio IV, Random, 95% Cl	Odds Ratio IV, Random, 95% Cl
.5.1 Processed		0.271		
iang 2018	0.174 0.0687	5.6%	1.19 [1.04, 1.36]	-
lilauri 2022	0.1484 0.0706	5.5%	1.16 [1.01, 1.33]	+
hang 2021	0.3293 0.1012		1.39 [1.14, 1.69]	
ubtotal (95% CI)		15.7%	1.22 [1.11, 1.34]	•
leterogeneity: Tau ² = 0.00; C	:hi ² = 2.29 df = 2.(P			
est for overall effect: Z = 4.1		- 0.02/,1 -		
.5.2 Unprocessed				
lilauri 2022	-0.1744 0.1632	2.9%	0.84 [0.61, 1.16]	
hang 2021	-0.0408 0.0681	5.6%	0.96 [0.84, 1.10]	
hang 2021	-0.2231 0.1059		0.80 [0.65, 0.98]	
ubtotal (95% CI)		12.9%	0.90 [0.79, 1.01]	•
leterogeneity: Tau ² = 0.00; C	hi ² = 2.31, df = 2 (P	= 0.31); I ² =		
est for overall effect: Z = 1.8				
.5.3 Quanlity score ≥7				
iang 2018	0.174 0.0687	5.6%	1.19 [1.04, 1.36]	
ercambre 2009	-0.1393 0.1409	3.4%	0.87 [0.66, 1.15]	-++
hang 2021	-0.0408 0.0681	5.6%	0.96 [0.84, 1.10]	+
hang 2021	-0.2231 0.1059	4.4%	0.80 [0.65, 0.98]	
hang 2021	0.3293 0.1012		1.39 [1.14, 1.69]	
ubtotal (95% CI)		23.5%	1.03 [0.86, 1.24]	•
leterogeneity: Tau² = 0.03; C est for overall effect: Z = 0.3;		P = 0.0003)	i; I² = 81%	
	, _v = 0.10)			
.5.4 Quanlity score<7	0.0005 0.0000	4 0.00	0.07 10 50 4.05	
nastasiou 2017	-0.0305 0.2803	1.3%	0.97 [0.56, 1.68]	
ranca 2018	0.0488 0.3117	1.1%	1.05 [0.57, 1.93]	
ahman 2007	0.1044 0.2576	1.5%	1.11 [0.67, 1.84]	
lilauri 2022	0.01 0.1727	2.7%	1.01 [0.72, 1.42]	
lilauri 2022	0.1484 0.0706	5.5%	1.16 [1.01, 1.33]	
lilauri 2022	-0.1744 0.1632		0.84 [0.61, 1.16]	
ubtotal (95% CI)		15.0%	1.08 [0.97, 1.21]	•
leterogeneity: Tau² = 0.00; C est for overall effect: Z = 1.43		= 0.59); l ² =	= 0%	
.5.5 Europe		4.000	0.07 10 50 4 001	
nastasiou 2017	-0.0305 0.2803	1.3%	0.97 [0.56, 1.68]	
ercambre 2009	-0.1393 0.1409	3.4%	0.87 [0.66, 1.15]	
lilauri 2022	0.01 0.1727	2.7%	1.01 [0.72, 1.42]	
lilauri 2022	0.1484 0.0706	5.5%	1.16 [1.01, 1.33]	
lilauri 2022	-0.1744 0.1632		0.84 [0.61, 1.16]	
hang 2021	-0.0408 0.0681	5.6%	0.96 [0.84, 1.10]	- T
hang 2021	-0.2231 0.1059	4.4%	0.80 [0.65, 0.98]	
hang 2021	0.3293 0.1012	4.5%	1.39 [1.14, 1.69]	1
ubtotal (95% CI)		30.3%	1.00 [0.87, 1.15]	•
leterogeneity: Tau² = 0.02; C est for overall effect: Z = 0.0		P = 0.003);	I² = 67%	
.5.6 America				
ranca 2018	0.0488 0.3117	1.1%	1.05 [0.57, 1.93]	
ahman 2007	0.10488 0.3117	1.1%	1.11 [0.67, 1.84]	
ubtotal (95% CI)	0.1044 0.2370	2.6%	1.09 [0.74, 1.60]	•
leterogeneity: Tau ² = 0.00; C	hiz = 0.02 df = 1./0			T
est for overall effect: Z = 0.4		- 0.09), 111	- 070	
.5.7 Asian and other				
ubtotal (95% CI)			Not estimable	
leterogeneity: Not applicable	2			
est for overall effect: Not app				
otal (95% CI)		100.0%	1.03 [0.96, 1.11]	•
leterogeneity: Tau ² = 0.02; C	$hi^2 = 70.04$, df = 26			
est for overall effect: Z = 0.9		45		0.05 0.2 1 5 20 Favours [experimental] Favours [control]

meat, location and quality score of studies) for read meat intakes and risk of neurodegenerative cognitive disorders.

Study or Subgroup	log[Risk Ratio]	er.	Moight	Risk Ratio IV, Random, 95% Cl	Risk Ratio IV. Random, 95% Cl
3.3.1 AD	IUGIRISK RALIUJ	3E	weight	IV, Rahuom, 95% CI	IV, Randolli, 95% Ci
Fischer 2018	-0.0202	0.0607	12.5%	0.98 [0.87, 1.10]	+
Ngabirano 2019	0.0583		4.0%	1.06 [0.65, 1.73]	
Subtotal (95% CI)	0.0303	0.2435	16.5%	0.98 [0.88, 1.10]	•
Heterogeneity: Tau ² = 0.0	00. Chiž – 0.00. df –	1 (P - 0			
Test for overall effect: Z =		1 (1 = 0.	70),1 = 0		
3.3.2 MCI					
Jiang 2018	-0.1278	0.0681	12.1%	0.88 [0.77, 1.01]	-
Jiang 2018	0.1823	0.1641	6.8%	1.20 [0.87, 1.66]	+
Ritchie 2010	0.1222	0.1513	7.3%	1.13 [0.84, 1.52]	
Subtotal (95% CI)			26.2%	1.02 [0.82, 1.26]	•
Heterogeneity: Tau ² = 0.0	02; Chi ² = 4.60, df =	2(P = 0.	10); I ² = 5	7%	
Test for overall effect: Z =					
3.3.3 Dementia					
Anastasiou 2017	-1.1712	0.3704	2.1%	0.31 [0.15, 0.64]	20 19 19 19 19 19 19 19 19 19 19 19 19 19
Barberger-Gateau 2002	-0.4155	0.1732	6.4%	0.66 [0.47, 0.93]	
Barberger-Gateau 2007	-0.2485	0.3537	2.3%	0.78 [0.39, 1.56]	40 mm 60 mm 60
Barberger-Gateau 2007	-0.5447	0.4294	1.6%	0.58 [0.25, 1.35]	
Chuang 2019	-0.3567	0.1717	6.4%	0.70 [0.50, 0.98]	
Ngabirano 2019	0.0862	0.2116	5.0%	1.09 [0.72, 1.65]	
Tsurumaki 2019	-0.1744	0.0858	11.0%	0.84 [0.71, 0.99]	+
Ylilauri 2022	0.131	0.1558	7.1%	1.14 [0.84, 1.55]	
Subtotal (95% CI)			42.0%	0.79 [0.64, 0.97]	•
Heterogeneity: Tau ² = 0.0		= 7 (P = 1	0.02); I ^z =	57%	
Test for overall effect: Z =	2.26 (P = 0.02)				
3.3.4 Cognitive decline					
Chen 2012		0.1387	8.0%	0.63 [0.48, 0.83]	
Tanaka 2018	-0.1508	0.1507	7.4%	0.86 [0.64, 1.16]	
Subtotal (95% CI)			15.3%	0.73 [0.54, 0.99]	-
Heterogeneity: Tau ² = 0.0		1 (P = 0.	13); I² = 5	7%	
Test for overall effect: Z =	2.01 (P = 0.04)				
Total (95% CI)			100.0%	0.87 [0.78, 0.98]	
Heterogeneity: Tau ² = 0.0	02; Chi ² = 33.13, df:	= 14 (P =	0.003); P	²= 58%	
Test for overall effect: Z =	2.34 (P = 0.02)				Favours (experimental) Favours (control)
Test for subaroup differe	nces: Chi ² = 6,49, c	f= 3 (P =	= 0.09), I ²	= 53.8%	Favours (experimental) Favours (control)

Supplementary Figure 9. Subgroup analysis (stratified by different types of adverse

cognitive outcome) for fish intakes and risk of neurodegenerative cognitive disorders.

Study or Subgroup	log[Risk Ratio] SI	Weight	Risk Ratio IV, Random, 95% Cl	Risk Ratio IV, Random, 95% Cl
I.6.1 Quanlity score ≥7			80	CHS 2.10
Fischer 2018	-0.0202 0.060	7 7.4%	0.98 [0.87, 1.10]	+
Jiang 2018	-0.1278 0.048	7.9%	0.88 [0.80, 0.97]	+
Jiang 2018	0.1823 0.184	0.0%	1.20 [0.84, 1.72]	
Ngabirano 2019	0.0583 0.249	5 1.9%	1.06 [0.65, 1.73]	8 8
Ngabirano 2019	0.0862 0.221		1.09 [0.71, 1.68]	
Tanaka 2018	-0.1508 0.150		0.86 [0.64, 1.16]	-+
Tsurumaki 2019	-0.1744 0.085		0.84 [0.71, 0.99]	-
Subtotal (95% CI)		29.4%	0.91 [0.85, 0.97]	•
Heterogeneity: Tau ² = 0.0 Test for overall effect: Z =				
4.6.2 Quanlity score<7				
Anastasiou 2017	-1.1712 0.370	4 1.0%	0.31 [0.15, 0.64]	
Barberger-Gateau 2002	-0.4155 0.173:		0.66 [0.47, 0.93]	
Barberger-Gateau 2007	-0.2485 0.353		0.78 [0.39, 1.56]	
Barberger-Gateau 2007	-0.5447 0.429		0.58 [0.25, 1.35]	
Chen 2012	-0.462 0.138		0.63 [0.48, 0.83]	
Chuang 2019	-0.3567 0.171		0.70 [0.50, 0.98]	
Ritchie 2010	0.1222 0.151:		1.13 [0.84, 1.52]	-+
Ylilauri 2022	0.131 0.155		1.14 [0.84, 1.55]	-+
Subtotal (95% CI)		20.6%	0.74 [0.58, 0.96]	•
Heterogeneity: Tau ² = 0.0 Test for overall effect: Z =		: 0.002); I²:		
4.6.3 Europe	4 4 7 4 2 0 2 7 0	4 4 0 00	0.04 10 45 0.041	
Anastasiou 2017	-1.1712 0.370-		0.31 [0.15, 0.64]	
Barberger-Gateau 2002	-0.4155 0.173		0.66 [0.47, 0.93]	
Barberger-Gateau 2007	-0.2485 0.353		0.78 [0.39, 1.56]	
Barberger-Gateau 2007	-0.5447 0.429		0.58 [0.25, 1.35]	
Fischer 2018	-0.0202 0.060		0.98 [0.87, 1.10]	
Ngabirano 2019	0.0583 0.249		1.06 [0.65, 1.73]	26. 5 . 80
Ngabirano 2019	0.0862 0.211		1.09 [0.72, 1.65]	
Ritchie 2010	0.1222 0.151		1.13 [0.84, 1.52]	
Ylilauri 2022	0.131 0.155		1.14 [0.84, 1.55]	A
Subtotal (95% CI)	1. O. 2. 10. 20. 46. 0. (D.	24.9%	0.90 [0.74, 1.09]	
Heterogeneity: Tau ² = 0.0 Test for overall effect: Z =		: 0.02); I* =	57%	
4.6.4 America				
Tanaka 2018	-0.1508 0.150	7 3.8%	0.86 [0.64, 1.16]	-+
Subtotal (95% CI)		3.8%	0.86 [0.64, 1.16]	◆
Heterogeneity: Not applic	able		N 85% 5	
Test for overall effect: Z =				
4.6.5 Asian and other				
Chen 2012	-0.462 0.138	7 4.1%	0.63 [0.48, 0.83]	The second se
Chuang 2019	0.1387 0.171		1.15 [0.82, 1.61]	
Jiang 2018	-0.1278 0.048	1 7.9%	0.88 [0.80, 0.97]	
Jiang 2018	0.1823 0.164	0.0%	1.20 [0.87, 1.66]	
Tsurumaki 2019 Subtotal (95% CI)	-0.1744 0.085	6.2% 21.5%	0.84 [0.71, 0.99] 0.85 [0.72, 0.99]	•
Heterogeneity: Tau ² = 0.0 Test for overall effect: Z =		0.04); I² = 6	i3%	
Total (95% CI)		100.0%	0.87 [0.81, 0.94]	•
Heterogeneity: Tau ² = 0.0	2; Chi ² = 59.94, df = 27 (P			
		/		0.05 0.2 1 5 20
Test for overall effect: Z =				Favours (experimental) Favours (control)

Supplementary Figure 10. Subgroup analysis (stratified by processing method of meat, location and quality score of studies) for fish intakes and risk of neurodegenerative cognitive disorders.