Appendix

Leisure activities and the risk of dementia: A systematic review and meta-analysis

Table e-1: PRISMA 2009 Checklist.

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4-5
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	5
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5-6
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5-6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Table e-3
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	5-6
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	5-6
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	5-7
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	6-8
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	6-8
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	7-8
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	6-8
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	6-8
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	8-9
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Figures e-4-7

Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	Figures 2-4, Figures e-1-3
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	8-11
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	11
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	8-11
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	11-14
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	14-15
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	15
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	16

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed10000

Table e-2. MOOSE Checklist.

Item No	Recommendation	Reported on Page No
Reporting of background should include		
1	Problem definition	4
2	Hypothesis statement	-
3	Description of study outcome(s)	6
4	Type of exposure or intervention used	6-7
5	Type of study designs used	5-6
6	Study population	5
Reporting of search strategy should include		
7	Qualifications of searchers (eg, librarians and investigators)	16
8	Search strategy, including time period included in the synthesis and key words	5, Table e-3
9	Effort to include all available studies, including contact with authors	6
10	Databases and registries searched	5
11	Search software used, name and version, including special features used (eg, explosion)	5
12	Use of hand searching (eg, reference lists of obtained articles)	5-6
13	List of citations located and those excluded, including justification	Figure 1, Table 1, Table e-5
14	Method of addressing articles published in languages other than English	5
15	Method of handling abstracts and unpublished studies	5-6
16	Description of any contact with authors	6
Reporting of methods should include		
17	Description of relevance or appropriateness of studies assembled for assessing the hypothesis to be tested	5-6
18	Rationale for the selection and coding of data (eg, sound clinical principles or convenience)	5-6
19	Documentation of how data were classified and coded (eg, multiple raters, blinding and interrater reliability)	5-6
20	Assessment of confounding (eg, comparability of cases and controls in studies where appropriate)	5-6
21	Assessment of study quality, including blinding of quality assessors, stratification or regression on possible predictors of study results	6-8
22	Assessment of heterogeneity	8
23	Description of statistical methods (eg, complete description of fixed or random effects models, justification of whether the chosen models account for predictors of study results, dose-response models, or cumulative meta-analysis) in sufficient detail to be replicated	7-8
24	Provision of appropriate tables and graphics	Figures 1-5, Figures e-1-7, Table 1, Tables e-3-6
Reporting of results should include		
25	Graphic summarizing individual study estimates and overall estimate	Figure 2

26	Table giving descriptive information for each study included	Table 1, Table e-5
27	Results of sensitivity testing (eg, subgroup analysis)	Figure 5, Figures e-1-3; Figures e-6-7; Table e-6,
28	Indication of statistical uncertainty of findings	8-11
Reporting of results should include		
29	Quantitative assessment of bias (eg, publication bias)	13, Figures e-4-5
30	Justification for exclusion (eg, exclusion of non-English language citations)	14-15
31	Assessment of quality of included studies	Table e-5
Reporting of results should include		
32	Consideration of alternative explanations for observed results	11-15
33	Generalization of the conclusions (ie, appropriate for the data presented and within the domain of the literature review)	15
34	Guidelines for future research	14-15
35	Disclosure of funding source	16

From: Stroup DF, Berlin JA, Morton SC, et al, for the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) Group. Meta-analysis of Observational Studies in Epidemiology. A Proposal for Reporting. JAMA. 2000;283(15):2008-2012. doi: 10.1001/jama.283.15.2008.

Table e-3. Search strategy.

	Search strategy
Dementia	(dementia[MeSH Terms]) OR (dementia) OR (Alzheimer disease[MeSH Terms]) OR (Alzheimer disease) OR (vascular dementia[MeSH Terms]) OR (vascular dementia)
Leisure activities	(leisure activities[MeSH Terms]) OR (leisure activities) OR (leisure activity) OR (recreation[MeSH Terms]) OR (recreation) OR (cognitive stimulation) OR (cognitive activities) OR (cognitive activity) OR (intellectual activitities) OR (intellectual activitity) OR (metal activities) OR (metal activity) OR (exercise[MeSH Terms]) OR (exercise) OR (physical activities) OR (physical activity) OR (social activities) OR (social activity)
Longitudinal studies	(cohort studies[MeSH Terms]) OR (cohort studies) OR (cohort study) OR (cohort) OR (longitudinal studies[MeSH Terms]) OR (longitudinal studies) OR (longitudinal study) OR (longitudinal) OR (prospective studies[MeSH Terms]) OR (prospective studies) OR (prospective study) OR (prospective) OR (nested case control studies[MeSH Terms]) OR (nested case control studies) OR (nested case control study)

Table e-4. Quality of studies included in the meta-analysis.

	Scores			
Study	**Selection**	**Comparability**	**Outcome**	**Total**
Akbaraly, 2009[6]	***	**	**	7
Blasko, 2014[7]	***	*	***	7
Chang, 2010[27]	**	**	**	6
de Bruijn, 2013[28]	***	**	***	8
Floud, 2020[29]	***	**	***	8
Floud, 2021[30]	***	**	***	8
Gelber, 2012[31]	**	**	***	7
Grasset, 2017[32]	***	**	***	8
Hansson, 2019[18]	***	**	***	8
Hughes, 2010[33]	***	**	***	8
Kishimoto, 2016[34]	***	**	***	8
Larson, 2006[35]	***	*	***	7
Laurin, 2001[36]	***	*	***	7
Lee, 2018[20]	***	**	***	8
Llamas-Velasco, 2015[37]	***	**	**	7
Luck, 2014[38]	***	**	**	7
Marioni, 2015[39]	**	**	**	6
Marseglia, 2019[40]	****	**	***	9
Morgan, 2012[41]	**	*	***	6
Nabe-Nielsen, 2021[42]	***	**	***	8
Najar, 2019[16]	****	**	***	9
Neergaard, 2016[43]	***	*	***	7
Paganini-Hill, 2016[44]	***	*	**	6
Palta, 2019[45]	****	**	***	9
Podewils, 2005[46]	***	**	***	8
Ravaglia, 2008[17]	***	*	**	6
Sabia, 2017[47]	***	*	***	7
Scarmeas, 2001[48]	***	**	**	7
Scarmeas, 2009[15]	***	**	***	8
Sommerlad, 2020[49]	***	**	***	8
Sorman, 2014[19]	***	**	***	8
Tan, 2017[50]	***	**	***	8
Tolppanen, 2015[e51]	**	**	***	7
Verdelho, 2012[e52]	***	*	**	6
Verghese, 2003[5]	****	**	***	9
Wilson, 2007[e53]	***	*	***	7
Wu, 2020[e54]	***	**	***	8
Zotcheva, 2018[e55]	***	**	***	8

Table e-5. Supplementary characteristics of the studies that were included in the meta-analysis.

Study	Name of cohort	Specific types of leisure activities	Level of leisure activities	Covariates used for adjustment
Akbaraly, 2009[6]	Three-City Cohort Study (Bordeaux, Dijon, and Montpellier)	PA: doing odd jobs, gardening, and walking; CA: doing crosswords, playing cards, attending organizations, going to cinema/theater, practicing an artistic activity, watching television, listening to the radio, listening to music, and knitting/sewing; SA: visiting or inviting friends or relatives	low: score <3; mild: score 3, 4; high: score >4	gender, educational level, occupational grade, study center, marital status, hypertension, diabetes, vascular diseases history, hypercholesterolemia, depressive symptoms, apolipoprotein E genotype, incapacity in daily life activity, and cognitive impairment assessed by the mini-mental state examination
Blasko, 2014[7]	Vienna Transdanube Aging Study	PA: walking for exercise, gymnastics, gardening, playing soccer, jogging, hiking, dancing, bicycling, playing golf or tennis, swimming, and housekeeping; CA: reading, books, reading newspapers, writing letters, hobbies, and telephoning	0: no; 1: seldom; 2: occasionally; 3: frequently	gender, years of education, presence of apolipoprotein E e4 allele
Chang, 2010[27]	Age Gene/Environment Susceptibility—Reykjavik Study	sports or exercise	none; ≤ 5 h/week; > 5 h/week; 1 MET = 1 kcal/kg/h	age, sex, education, midlife body mass index, systolic blood pressure, smoking, and cholesterol
de Bruijn, 2013[28]	Rotterdam Study	walking, cycling, gardening, diverse sports, and hobbies, and housekeeping activities		age, sex, score on mini-mental state examination, low educational level, smoking, apolipoprotein E e4 carrier status, hypertension, body mass index, diabetes, total cholesterol, and high density lipoprotein-cholesterol
Floud, 2020[29]	The Million Women Study	housework, walking, gardening, cycling, and strenuous activity	inactive: < 1 time per week; active: ≥ 1 time per week	region of residence, educational qualifications, area deprivation, height, smoking, alcohol consumption, use of menopausal hormones, and body mass index
Floud, 2021[30]	The Million Women Study	adult education, groups for art, craft, or music, and voluntary work	yes/no	education, area deprivation, frequency of strenuous physical activity, body mass index, smoking, alcohol consumption and use of menopausal hormones (never, past, or current)
Gelber, 2012[31]	Honolulu-Asia Aging Study	sitting, standing, walking, gardening, carpentry, shoveling and digging	low: less hours than high; high: 7.2 ± 3.2 h/day typically spent in slight activity or 4.4 ± 3.0 h/day spent in moderate activity	age, years of education, apolipoprotein E e4 status, childhood years spent in Japan, occupational status, high cholesterol, and history of hypertension, diabetes mellitus, and cardiovascular disease but not for the other components of the low-risk profile
Grasset, 2017[32]	Personnes Age´es QUID study	sports	yes/no	age, gender, education, baseline mini-mental state examination score, stroke, diabetes, anti-hypertensive drug use
Hansson, 2019[18]	Malmo Diet and Cancer Study cohort	walking, gardening, running and so on	based on tertiles of physical activity divided into three groups: high; intermediate; low	age, sex, education, smoking, systolic blood pressure, body mass index, alcohol consumption, diabetes, cardiovascular disease, blood pressure-lowering medication, lipid-lowering medication, and physically heavy work
Hughes, 2010[33]	Monongahela Valley Independent Elders Survey project	reading books, magazines, and newspapers, and engaging in hobbies including board games, crafts, crossword puzzles, jigsaw puzzles, musical instruments, bridge, other card games, gardening, word find puzzles, baking and painting	low: 0-3 h/week medium: 4-6 h/week high: > 6 h/week	age, gender, education, depressive symptoms, physical exercise, functional impairment, self-reported health, medication use, and recruitment status

Kishimoto, 2016[34]	Hisayama Study	light or brisk walking, calisthenics, gateball, golf, dancing, jogging, hiking, bowling, cycling, hunting, gardening, Japanese traditional dance (Nihon Buyo), and other types of exercise	inactive: < 1 time/week; active: ≥ 1 time/week	age, sex, low education level, systolic blood pressure, antihypertensive agents, diabetes, total cholesterol, body mass index, electrocardiogram abnormalities, history of stroke at entry, smoking habits, and alcohol consumption
Larson, 2006[35]	Adult Changes in Thought study	walking, hiking, bicycling, aerobics or calisthenics, swimming, water aerobics, weight training or stretching, or other exercise	< 3 times/week; ≥ 3 times/week	age, sex, ethnicity, supplement use, smoking, alcohol use, comorbid conditions, self-rated health status, years of education, cognitive ability, depression, physical performance, and presence of apolipoprotein E e4 allele
Laurin, 2001[36]	Canadian Study of Health and Aging	exercise	low: all other combinations of frequency and intensity; moderate: ≥ 3 times/week at an intensity equal to walking; high: ≥ 3 times/week at an intensity greater than walking	sex, age, educational level
Lee, 2018[20]	Elderly Health Centres	PA: exercise; CA: reading books, newspapers, or magazines; playing board games, Mahjong, or card games, betting on horse racing, watching television, listening to radio, shopping, and going to a teahouse; SA: joining a social center, participating in voluntary work, meeting relatives or friends, and attending religious activities	yse/no	age, sex, educational level, cardiovascular risk factors, visual and hearing impairments, poor mobility, depression, smoking, adequate consumption of fruits and vegetables, regular physical exercise, and other types of leisure activities
Llamas-Velasco, 2015[37]	Neurological Disorders in Central Spain	walking, regular housework and so on	sedentary: only minimal house chores or short walks at home; slight: regular house chores, walks independently at home; moderate: regular house chores, walks up to 1 km per day; high: heavy housework, walks more than 1 km or practices any sport regularly	age, sex, education, alcohol consumption, stroke, hypertension and Charlson Index
Luck, 2014[38]	Ageing, Cognition, and Dementia Study	PA: cycling, hiking or doing long walks, swimming, gymnastics, doing housework or gardening, babysitting, doing other activities such as bowling or playing golf; CA: doing crossword puzzles, doing memory training/exercises, participating in voluntary work in a church, a nursing home, a political party, etc., playing board games or cards, reading books or newspapers, writing stories, poems or letters, and playing a musical instrument	every day or several times/week; once/week; less than once/week; never	age, gender, education, alcohol consumption, smoking, mini-mental state examination score, mental activity and co-morbidity at follow-up
Marioni, 2015[39]	Personnes Age'es QUID study	travelling, visiting family and friends, looking after others e.g., grandchildren, and participation in a club, association or a 'golden age' club	tertile-based groups: 0–4 activities, 5–7 activities, or 8–12 activities	age, sex, education, marital status, social network, network satisfaction, feel well understood, stroke, ischemic heart disease, stroke, diabetes, depression, Instrumental Activities of Daily Living

Marseglia, 2019[40]	Swedish National Study on Aging and Care in Kungsholmen	reading books, playing chess/cards, playing a musical instrument, listening to music, using the Internet or playing computer games, and painting/drawing/working with clay, sports events, cinema/theater/concerts, museums/ art exhibitions, restaurants/bar/caf´es, bingo, dancing, church service, traveling, volunteering, study circles/courses, and other social meetings, walking, jogging, bicycling, gym/golf/ other sports, gardening, strolling through the woods and countryside, picking mushrooms/berries, going hunting/ fishing, and home repair or car/other mechanical repair	low: score 0–1 moderate: score 2–3 high: score 4–6	age, sex, education, smoking, body mass index, hypertension, cerebrovascular diseases, depression, and apolipoprotein E e4
Morgan, 2012[41]	Caerphilly Prospective study	sports and so on	using tertiles defining “high activity”, “moderate activity”, and “low activity” based on the scores	age, social class, National Adult Reading Test score, smoking status, marital status, self-reported history of vascular disease (one or more of heart attack/angina/any ischemic heart disease/stroke/claudication), alcohol consumption, body mass index, common mental disorder, Spielberger’s State-Trait Anxiety Index score
Nabe-Nielsen, 2021[42]	Copenhagen Male Study	exercise	mainly sedentary; light for ≥ 4 h/week; vigorous for≥ 3 h/week high intensity (competitive sport) for several times/week	age, socioeconomic position, marital status, psychological stress, calendar period, and exposure age, lifestyle-related cardiovascular risk factors
Najar, 2019[16]	Prospective Population Study of Women in Gothenburg	PA: walking, gardening, bowling, cycling running, tennis, or swimming; CA: reading books, writing, visiting concerts, theatres or art exhibitions, playing instruments, singing, painting, needlework, having memberships, and church attendance	PA: active: light intense activity 4 h/week or regular intense activity ≥ 2 h/week; inactive: all other combinations of frequency and intensity CA: score 0–2; score 3–10;	ACD: age, physical activity, smoking cigarettes and socioeconomic status; AD: age, physical activity, major depression, socioeconomic status; VD: age, physical activity, socioeconomic status, hypertension.
Neergaard, 2016[43]	Prospective Epidemiologic Risk Factor Study	physical activity other than walking	never 1 time/week 2 times/week ≥ 3 times/week	age, education level, body mass index, smoking, alcohol consumption, physical activity, history of depression, history of cerebral embolism/hemorrhage, systolic blood pressure, fasting glucose levels and total cholesterol levels
Paganini-Hill, 2016[44]	90+ Study	active exercise	0 hours/day; <1 hours/day; ≥ 1 hours/day;	age, sex and education
Palta, 2019[45]	Atherosclerosis Risk in Communities cohort study	sports	tertiles of MET minutes/week to assign low, middle, or high levels	age, sex, education, race center, apolipoprotein E e4, ever versus never smoking status, annual household income, and neighborhood SES summary score at visit 3, diabetes, hypertension, and body mass index at visit 4
Podewils, 2005[46]	Cardiovascular Health Study	walking, household chores, mowing, raking, gardening, hiking, jogging, biking, exercise cycling, dancing, aerobics, bowling, golfing, general exercise, and swimming	<248 kcal/week; 248–742 kcal/week; 743–1,657 kcal/week; >1,657 kcal/week	age, educational level, gender, ethnicity, apolipoprotein E, baseline Modified mini-mental state examination score, magnetic resonance imaging white-matter-grade score, activities of daily living impairment, instrumental activities of daily living impairment, Lubben Social Network Score and social support score

Ravaglia, 2008[17]	Conselice Study of Brain Ageing	walking, climbing stairs, house and yard work, gardening, light carpentry, bicycling, farming, heavy carpentry and ballroom dancing	< 4,774 Kcal/week; 4,774–8,090 Kcal/week; > 8,090 Kcal/week	age, gender, education, apolipoprotein E genotype, cardiovascular disease, hypertension, and hyperhomocysteinemia
Sabia, 2017[47]	Whitehall II study	weeding, general housework, bicycle repair, dancing, cycling, leisurely swimming, running, hard swimming, playing squash and so on	< 8 hours/week; 8-12 hours/week; ≥ 12 hours/week	age, sex, ethnicity, education, occupational position, marital status, smoking status, alcohol consumption, and fruit and vegetable consumption
Scarmeas, 2001[48]	Health Care Financing Administration	knitting or music or other hobby, walking for pleasure or excursion, visiting friends or relatives, being visited by relatives or friends, physical conditioning, going to movies or restaurants or sporting events, reading magazines or newspapers or books, watching television or listening to the radio, doing unpaid community volunteer work, playing cards or games or bingo, going to a club or center, going to classes, and going to church or synagogue or temple	low: ≤6 points; high: >6 points	ethnicity, education, occupation, health limitations interfering with desired leisure activities, depression, history of heart disease, hypertension, diabetes or stroke
Scarmeas, 2009[15]	Washington Heights - Inwood Columbia Aging Project	vigorous:aerobic dancing, jogging, playing handball; moderate: bicycling, swimming, hiking, playing tennis; light: walking, dancing, calisthenics, golfing, bowling, gardening and horseback riding	no: 0 h some: 0.1 h of vigorous, 0.8 h of moderate, 1.3 h of light or a combination much: 1.3 h of vigorous, 2.3 h of moderate, 3.8 h of light or a combination	age, sex, ethnicity, education, apolipoprotein E ε4 allele, caloric intake, body mass index (calculated as weight in kilograms divided by height in meters squared), smoking, depression, leisure activities, comorbidity index, baseline Clinical Dementia Rating score, and time between first dietary and first physical activity assessment
Sommerlad, 2020[49]	Whitehall II study	reading, listening to music, using a home computer for leisure, courses and education/evening classes, involvement in clubs and organisations, voluntary or official, cultural visits to stately homes, galleries, theatres, cinema, or live music events, positions of office; school governor, councillor, social indoor games, cards, bingo, chess, gardening, do-it-yourself projects, maintenance, decorating, pottery, drawing, religious activities/observance, going to pubs and social clubs, visiting friends or relatives	0 point; ≥ 1 point	age, sex, occupational position, education, ethnicity, employment status, marital status, smoking, physical activity, alcohol consumption, body mass index, diabetes mellitus, hypertension, coronary heart disease, and stroke
Sorman, 2014[19]	Betula prospective cohort study	CA: reading books and magazines, movies/concerts/theater, playing musical instrument, needlework, hunting/fishing SA: travel/trips, restaurant visits, spend time with family, relatives, and friends, attending courses/workshops, religious assemblies, association work	0: never; 1: occasionally or a few times a month; 2: some time per week or every day	age, gender, education, diseases, smoking, alcohol use, marital status, general stress, feelings of depression

Tan, 2017[50]	Framingham Study Original and Offspring cohorts	sedentary, slight, moderate and heavy activities	physical activity index scores	age, sex, high school degree, apolipoprotein E e4 allele status, log plasma homocysteine, systolic blood pressure, diastolic blood pressure, antihypertensive, medication, total cholesterol, current smoking, prevalent cardiovascular disease, diabetes, stroke, and atrial fibrillation
Tolppanen, 2015[e51]	Cardiovascular Risk Factors, Aging, and Dementia study	leisure-time physical activity that lasts at least 20–30 minutes and causes breathlessness and sweating	high: daily or 2-3 times/week moderate: once/week or 2-3 times/month low: a few times/year or never because of illness or injury	age, sex, education, midlife occupational physical activity level, midlife leisure-time physical activity level, marital status, smoking, cardiorespiratory and musculoskeletal conditions, and change in body mass index from mid- to late life
Verdelho, 2012[e52]	Leukoaraiosis and Disability study	not reported	active: ≥ 30 min of activity on at least 3 days/week; incative: all other combinations of frequency	age, education, white matter change severity, medial temporal atrophy, previous and incident stroke, and diabetes
Verghese, 2003[5]	Bronx Aging Study	PA: playing tennis or golf, swimming, bicycling, dancing, participating in group exercises, playing team games such as bowling, walking for exercise, climbing more than two flights of stairs, doing housework, and babysitting; CA: reading books or newspapers, writing for pleasure, doing crossword puzzles, playing board games or cards, participating in organized group discussions, and playing musical instruments	PA: < 9 points; 9-16 points; > 16 points; CA: < 8 points; 8-11 points; > 11 points;	age, sex, educational level, presence or absence of medical illnesses, baseline score on the Blessed Information–Memory–Concentration test
Wilson, 2007[e53]	Rush Memory and Aging Project	reading a newspaper, playing games like chess or checkers, visiting a library, or attending a play	5-points rated from 1 (once/year or less) to 5 (every day or about every day)	age, sex, and education
Wu, 2020[e54]	Shanghai Aging Study	yoga, taichi, qigong, volunteer activities, bowling, walking for exercise, fishing, calisthenics (such as push ups, sit ups, pull-ups, lunges), soccer, table tennis, volleyball, croquet, stair climbing, running, on a mini-tramp, weight training, badminton, health club exercise, jogging, swimming, wrestling, basketball, high jump, running, general, tennis, general dancing, mountain climbing, rope jumping, running, marathon	low: < 10.5 METs/week; medium to high: ≥ 10.5 METs/week	age, sex, years of education, apolipoprotein E e4, cigarette smoking status, alcohol consumption, hypertension, diabetes, and body mass index
Zotcheva, 2018[e55]	Nord-Trøndelag Health Study	walk, skiing, swimming, exercising, or participating in organized sports	moderate-to-vigorous: taking part in moderate-to-vigorous physical activity at least once a week; no: all other combinations of frequency and intensity	sex, education, marital status, smoking, alcohol, longstanding physical illness, and distress

ACD, all-cause dementia; AD, Alzheimer's disease; CA, cognitive activity; PA, physical activity; SA, social activity; VD, vascular dementia.

Table e-6. Univariate meta-regression analyses for moderators on the protective role of leisure activities in the risk of all-cause dementia, Alzheimer's disease and vascular dementia.

	Number of studies	Adjusted R^2 (%)	p value
All-cause dementia			
Types of leisure activities	41	-4.61	0.636
Number of participants	41	-1.61	0.345
Percentage female	40	-4.81	0.832
Age at baseline	40	-6.07	0.874
Follow up duration	41	-3.81	0.651
Region	41	-3.14	0.561
Alzheimer's disease			
Types of leisure activities	19	7.84	0.228
Number of participants	19	13.08	0.109
Percentage female	19	-5.81	0.773
Age at baseline	18	-8.25	0.933
Follow up duration	19	-5.33	0.571
Region	19	3.74	0.188
Vascular dementia			
Types of leisure activities	10	-9.87	0.465
Number of participants	10	-28.32	0.707
Percentage female	10	-18.07	0.777
Age at baseline	9	-26.51	0.782
Follow up duration	10	-20.00	0.637
Region	10	8.34	0.291

Adjusted R^2 = goodness of fit; $P < 0.05$ indicates statistically significant.

Figure e-1. Forest plot of the protective role of different types of leisure activities in the risk of all-cause dementia. Leisure activities included physical activity (PA), cognitive activity (CA), and social activity (SA). The results are expressed as relative risks (RRs) and 95% confidence intervals (95% CIs).

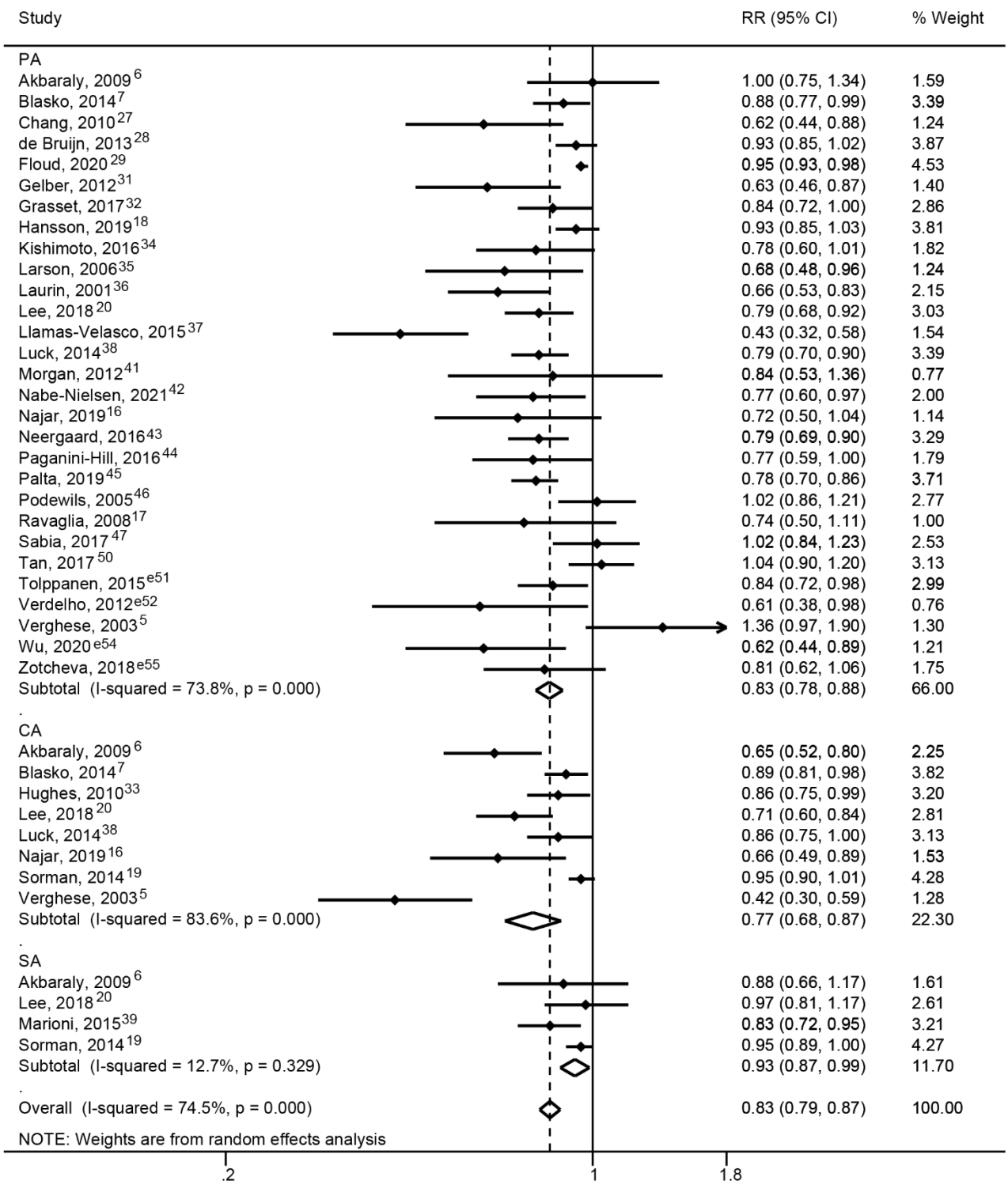


Figure e-2. Forest plot of the protective role of different types of leisure activities in the risk of Alzheimer's disease. Leisure activities included physical activity (PA), cognitive activity (CA), and social activity (SA). The results are expressed as relative risks (RRs) and 95% confidence intervals (95% CIs).

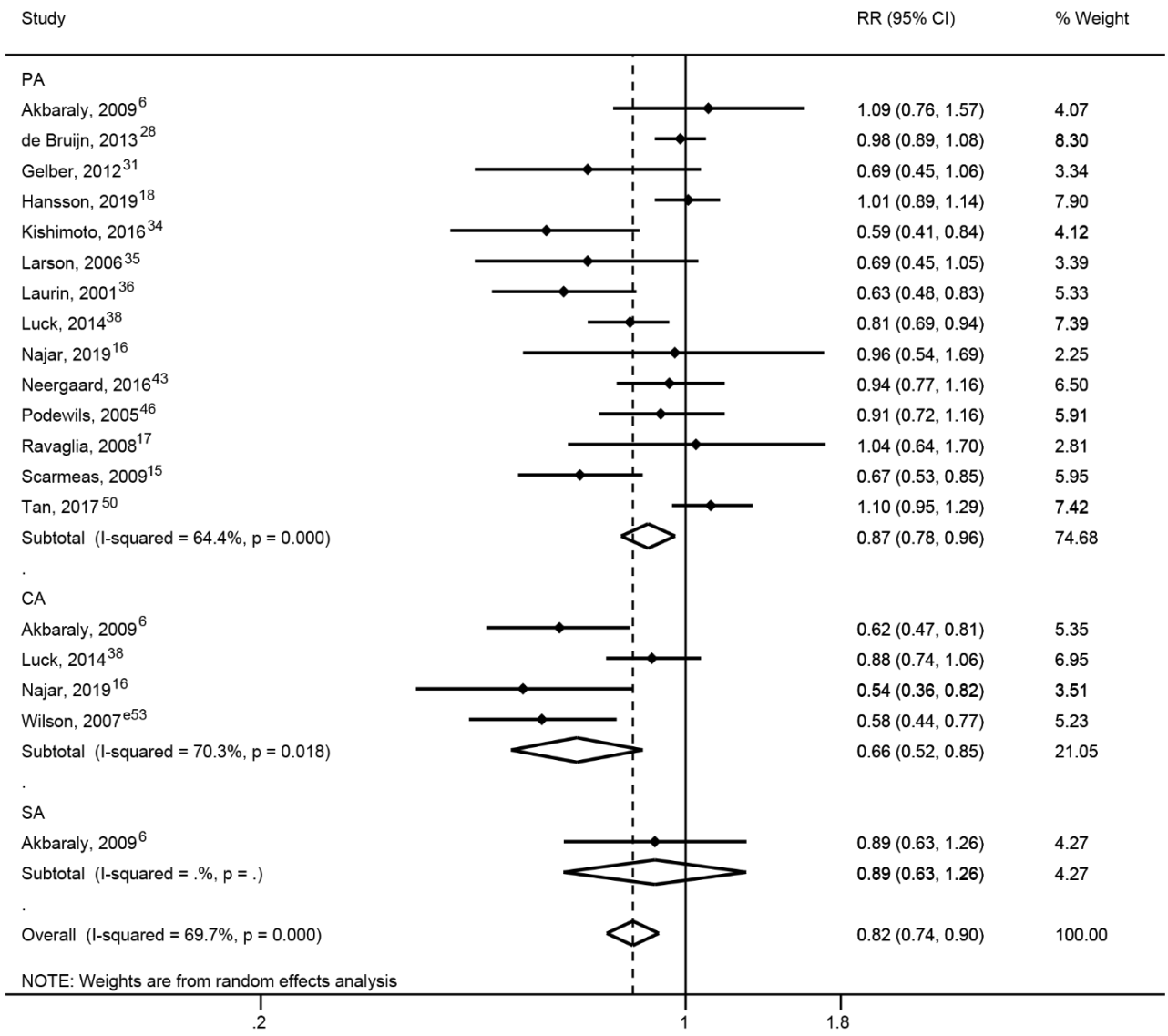


Figure e-3. Forest plot of the protective role of different types of leisure activities in the risk of vascular dementia. Leisure activities included physical activity (PA) and cognitive activity (CA). The results are expressed as relative risks (RRs) and 95% confidence intervals (95% CIs).

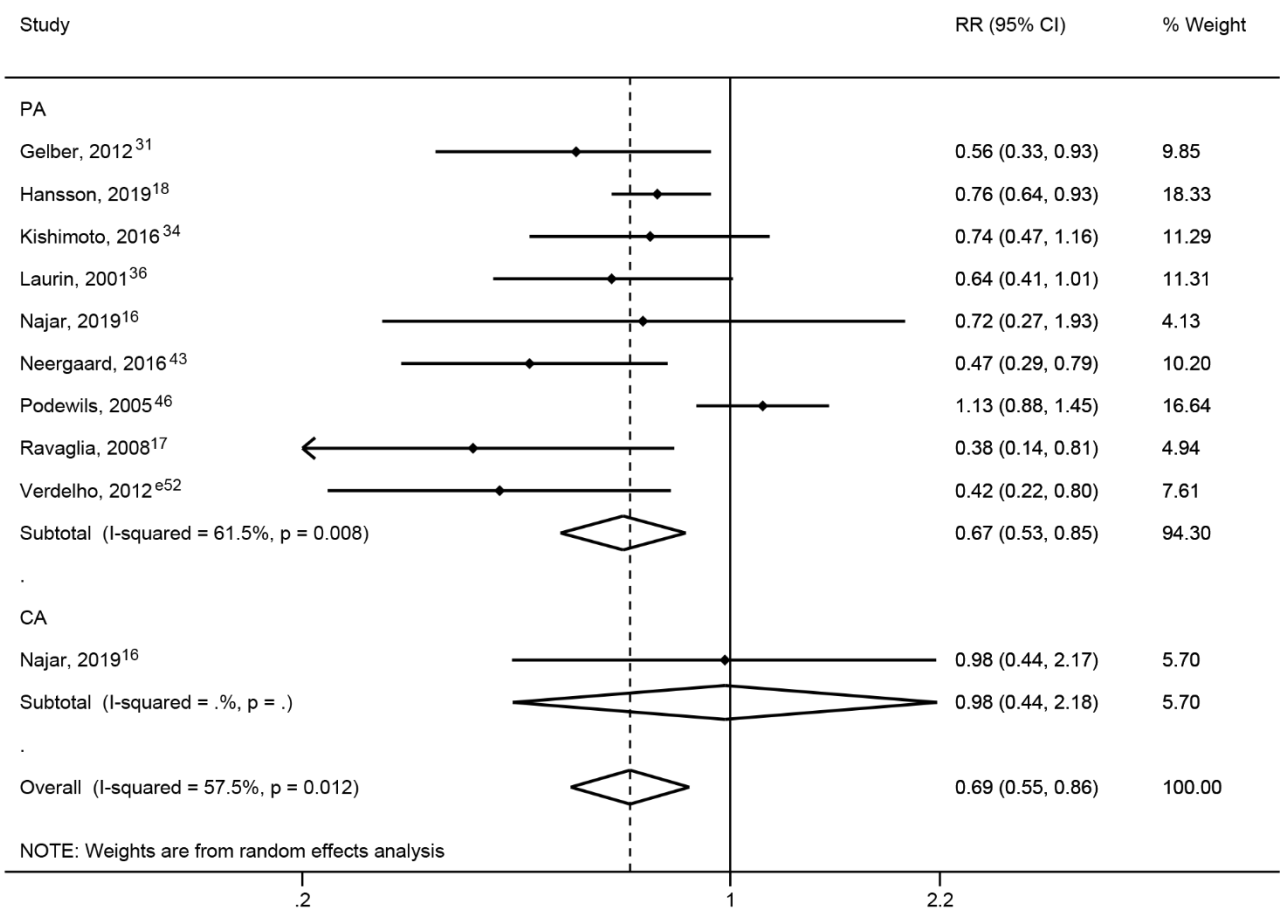
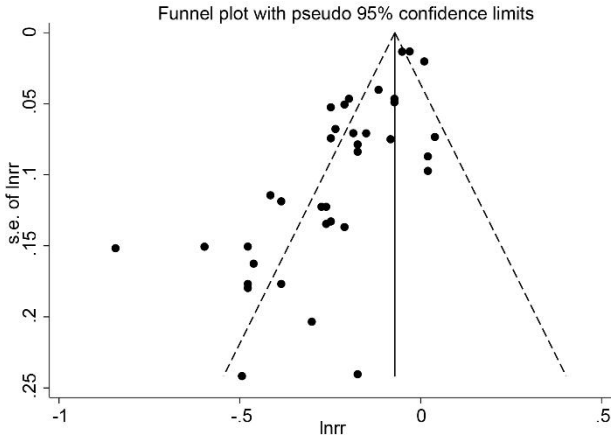
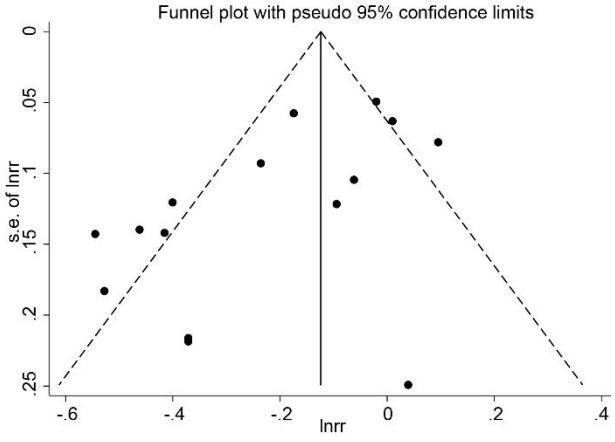


Figure e-4. Funnel plots of the publication bias analysis.

A. Leisure activities and all cause dementia



B. Leisure activities and Alzheimer's disease



C. Leisure activities and vascular dementia

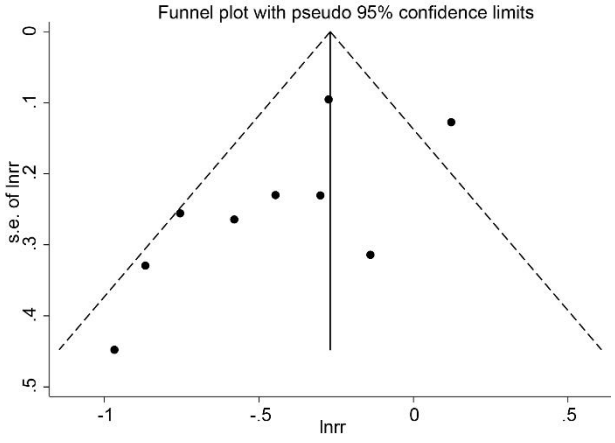
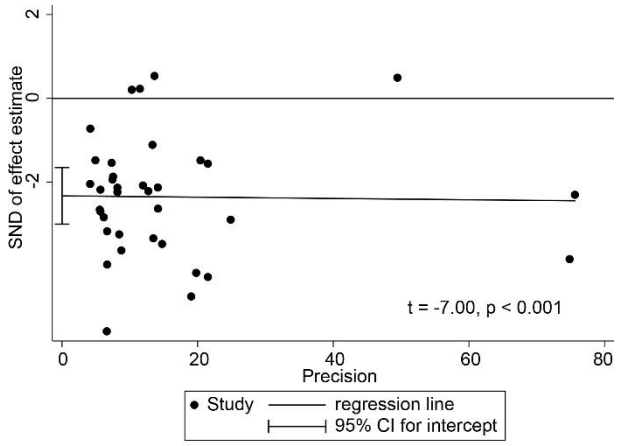
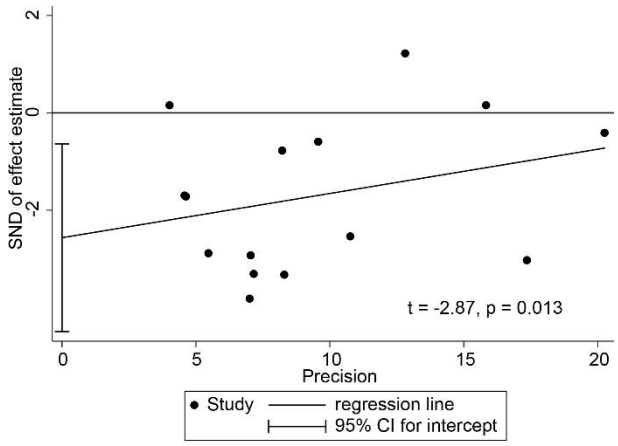


Figure e-5. Egger's funnel plots of the publication bias analysis.

A. Leisure activities and all cause dementia



B. Leisure activities and Alzheimer's disease



C. Leisure activities and vascular dementia

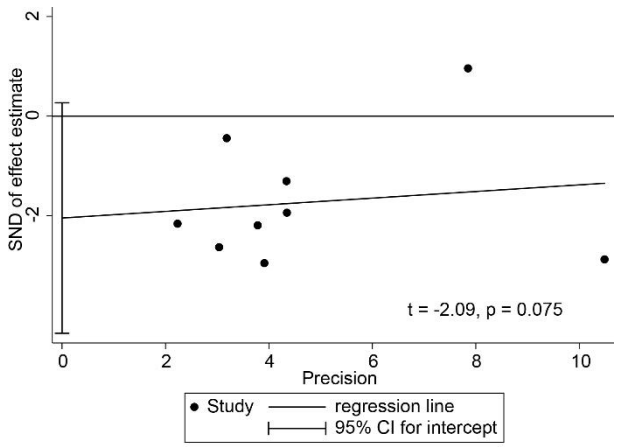
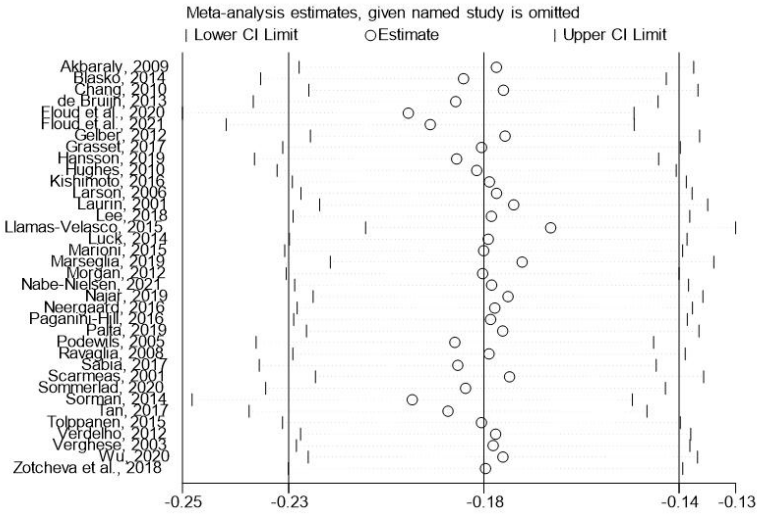
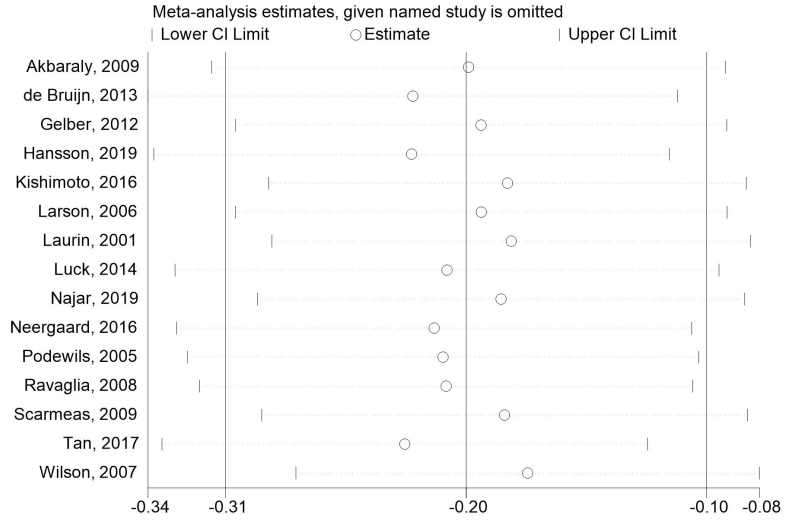


Figure e-6. Sensitivity analysis for all studies.

A. Leisure activities and all cause dementia



B. Leisure activities and Alzheimer's disease



C. Leisure activities and vascular dementia

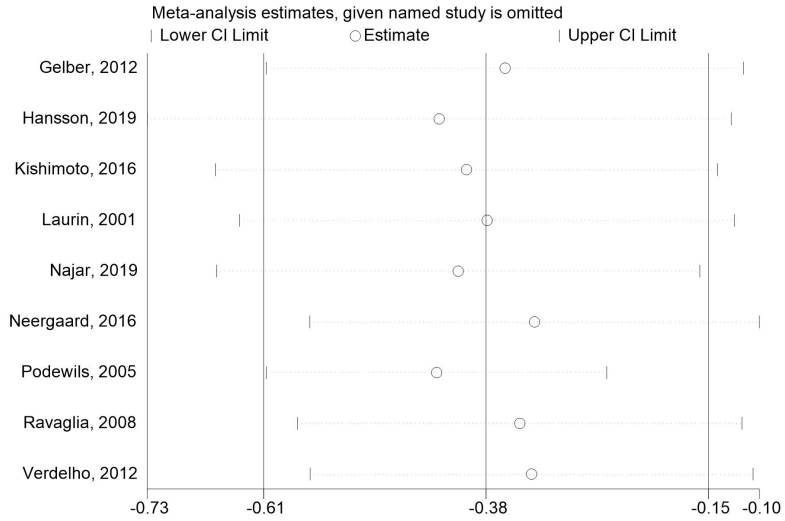
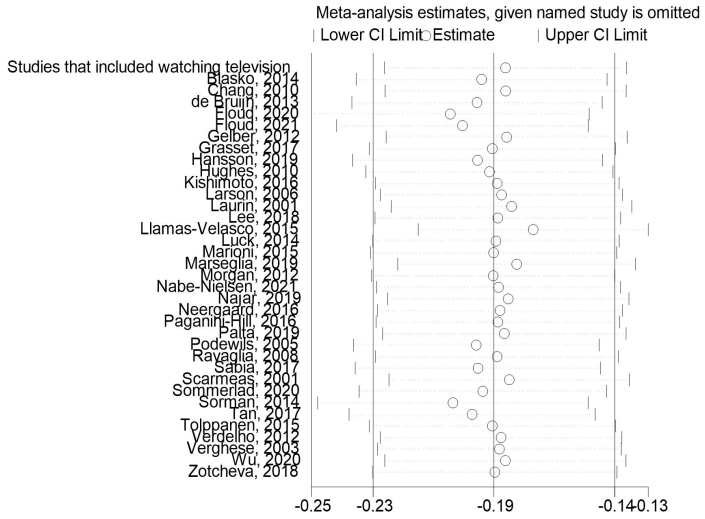
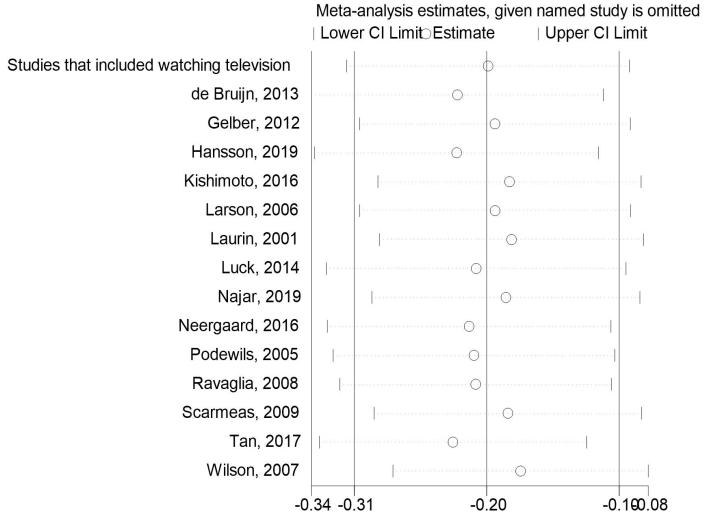


Figure e-7. Sensitivity analysis for studies that included watching television.

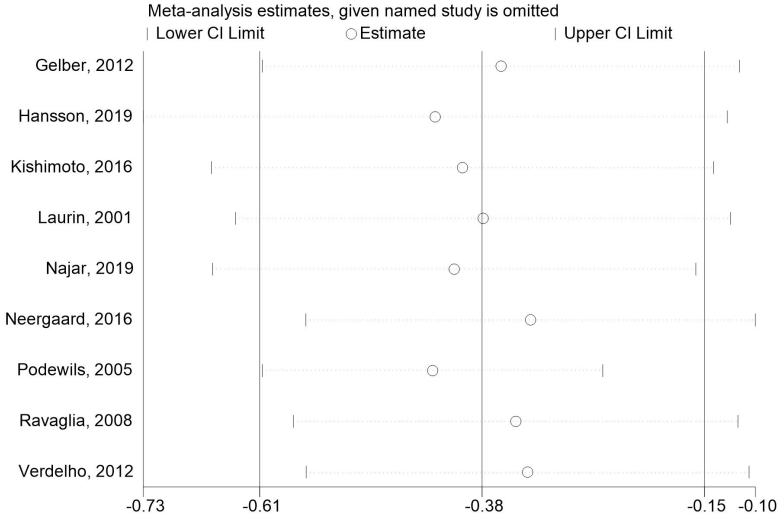
A. Leisure activities and all cause dementia



B. Leisure activities and Alzheimer's disease



C. Leisure activities and vascular dementia



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