Title: Putting fine particulate matter and dementia in the wider context of non-communicable disease, where are we now and what should we do next? A systematic review. – supplementary file.

Ruth **Peters**ab, Ian **Mudway**c, Andrew **Booth**d, Jean **Peters**d Kaarin J. **Anstey**ab

Supplementary text 1

Search terms for the relationship between Particulate Matter 2.5 and dementia or cognition

1 (alzheime\* or dementia or cogniti\*).af.

2 (air pollut\* or particulate matter or roadway or PM10 or Particle Size or PM\* or vehicle or diesel).af.

3 1 and 2

4 limit to yr="2018 -Current" (extending a prior review from inception to 20 Sept 2018)

5 limit to humans

Search terms for the relationship between Particulate Matter 2.5 and non-communicable disease

1. air pollut\* or particulate or PM10 or PM2 5 or Roadway or Vehicle or Diesel.ti.
2. systematic review.ti.
3. 1 and 2

Supplementary Table 1 Reasons for exclusion after full text review, for incident non-communicable disease and PM2.5

|  |  |  |
| --- | --- | --- |
|  | **Reviewed Systematic Review** | **Reasons for exclusion** |
| 1 | Liu et al 2019 [1] | More recent review available |
| 2 | Balti et al 2014 [2] | More recent review available |
| 3 | Moore et al 2016 [3] | More recent review available |
| 4 | Orellano et al 2017 [4] | Data from children and adults combined |
| 5 | Park et al 2014 [5] | More recent review available |
| 6 | Li et al 2016[6] | More recent review available |
| 7 | Wang et al 2014 [7] | A review of the same date but with a greater time range. |
| 8 | Janghorbani et al 2014 [8] | More recent review available |
| 9 | Mustafic et al 2012 [9] | More recent review available |
| 10 | Eze et al 2015 [10] | More recent review available |
| 11 | Braithwaite et al 2019 [11] | More recent review available |
| 12 | Yang et al 2014[12] | More recent review available |
| 13 | He et al 2017[13] | More recent review available |
| 14 | Meo et al 2015[14] | More recent review available |
| 15 | Gowers et al 2012[15] | More recent review available |
| 16 | Li et al 2012[16] | More recent review available |
| 17 | DeVries et al 2017[17] | More recent review available |
| 18 | Chen et al 2015[18] | Not incident disease |
| 19 | Wang et al 2018[19] | Review of methodology |
| 20 | Cui et al 2014[20] | Search dates match Hamra et al [21] |
| 21 | Scheers et al 2015[22] | No separate data for PM2.5 |
| 22 | Song et al 2014[23] | More recent review available |

Supplementary Table 2 Reasons for exclusion after full text review, for incident dementia, Alzheimer’s Disease and PM2.5

|  |  |
| --- | --- |
| **Reviewed publication** | **Reasons for exclusion** |
| Andersson et al 2018 [24] | No results for PM2.5 |
| Chen 2017 [25] | Same population as Chen 2017 [26] and PM2.5 included primarily as a co-variate. |
| Cerza et al 2019 [27] | Unable to determine if dementia measures only reflect incident dementia |
| Ilango et al 2019 [28] | Population appears to overlap with Chen et al 2017 |
| Petkus et al 2020 [29] | Population appears to be from the same study as Cacciolotto et al 2017 |
| Younan et al 2020 [30] | Population appears to be from the same study as Cacciolotto et al 2017 |
| Shin et al 2019 [31] | Cognitive measure not dementia and cross temporal not incident decline. |
| Lo et al 2019 [32] | Cognitive measure not dementia and cross temporal not incident decline. |
| Lee et al 2019 [33] | Prevalent dementia |
| Li et al 2019 [34] | Prevalent dementia |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Supplementary Table 3.** Assessment of bias [35] | | | | | | | | |
|  | **Risk of Bias (RoB)** | | | | | | | |
|  | clear aims (lower risk of bias with clear aims reported) | appropriate methodology (lower risk of bias with use of appropriate methodology) | generalizability (lower risk of bias where samples are generalizable) | exposure measurement (lower risk of bias where standard methods used to assess exposure) | outcome measurement  (lower risk of bias where standard tools/criteria used to assess outcome) | un-addressed  confounds (lower risk of bias where adjustments include known confounders) | adjustments | overall RoB rating |
| Weuve [36] et al., 2012 | Low | Low | Moderate (female nurses) | Low | Low | Low | age, education, husband's education, long term physical activity, long term alcohol consumption States that secondary analyses using further adjustment found similar pattern of results | Low-moderate |
| Loop [37] et al., 2013 | Low | Low | Low | Low | Low | Low | length of follow up, temperature, season, incident stroke, age, race, region, education, income, behavioral factors (alcohol, smoking, exercise, body mass index), depression, dyslipidemia, diabetes, hypertension | Low |
| Tonne [38] et al., 2014 | Low | Low | Moderate (male civil servants) | Low | Low | Low | time, age, sex, ethnicity, socioeconomic status, physical activity, consumption of alcohol, age x time and main effect of exposure | Low-moderate |
| Carey [39] et al., 2018 | Low | Low | Low | Low | Moderate (used health care records, likely to be subject to bias) | Low | Age, sex, ethnicity, smoking, body mass index, Index of Multiple Deprivation (area socioeconomic status), ischemic heart disease, stroke, diabetes, heart failure, night time noise. Each pollutant also adjusted for exposure to others. | Low |
| Chen [26] et al., 2017 | Low | Low | Low | Low | Moderate (used health care records, likely to be subject to bias) | Low | living in the Toronto area, age, sex, region, comorbidity, socioeconomic status, treatment for diabetes, hypertension, coronary heart disease, stroke, heart failure, arrhythmias, traumatic brain injury, income, urban residence, recent migration, education, unemployment rate | Low-moderate |
| Cleary [40] et al., 2018 | Low | Low | Moderate (selected from an ongoing longitudinal study) | Low | Moderate (used participants from an existing dementia focused study, likely to be subject to bias) | Low | age, gender, education, race, APOE genotype, smoking, B12 deficiency and population density | Moderate |
| Jung [41] et al., 2015 | Low | Low | Low | Low | Moderate (used health care records and Alzheimer’s disease only, not mixed or vascular dementia, likely to be subject to bias) | Low | age, sex, income, diabetes, hypertension, myocardial infarction, stroke, asthma | Low-moderate |
| Cacciottolo [42] et al., 2017 | Low | Low | Moderate (female only, from the Women’s Health Initiative Memory Study) | Low | Low-moderate (cognitive function and dementia diagnosis was periodic and time to event analyses requires a date of onset whereas actual onset is insidious so potential for bias) | Low | Age, geographic region, education, income, employment status, smoking, alcohol use, physical activities, use of hormone treatment, depression, body mass index, hypercholesterolemia, hypertension, diabetes, history of cardiovascular disease | Low-moderate |
| Oudin [43] et al., 2018 | Low | Low | Low | Low | Low-moderate (dementia assessment was periodic and cox regression requires a date of onset whereas actual onset is insidious so potential for bias) | Low | Physical activity, smoking, sex, body mass index, waist hip ratio, alcohol and age. PM2.5 from residential wood burning and PM2.5 from vehicle exhaust. | Low |
| Cullen [44] et al 2018 | Low | Low | Low-moderate (Subgroup from a larger study) | Low | Low (touch screen cognitive testing with automated scoring) | Low | Duration between baseline and  follow-up as well as baseline age, gender, ethnic group, Townsend score (socioecomonic), education,  smoking status, physical activity time outdoors, major road proximity, traffic  intensity, and population density category. | Low |
| Kulick [45] et al 2020 | Low | Low | Low-moderate (Subgroup from a larger study) | Low | Low (neuropsycholgical test battery) | Low | Visit number, visit by pollutant interaction, age, sex, race-ethnicity, education,  neighbourhood socioeconomic status, and an indicator for cohort  wave to account for secular trends. | Low |
| Grande [46] et al., 2020 | Low | Low | Low-moderate (a study population from a particular geographical area) | Low | Low (robust assessment of dementia) | Low (study also included evaluation of moderation and mediation for cardiovascular risk factors) | Age, sex, education, smoking, physical inactivity, socioeconomic status, early retirement, BMI, depression, baseline MMSE and cardiovascular risk factors. | Low |
| Yuchi., [47]et al 2020 | Low | Low-moderate (methods lack some details) | Low | Low-moderate (methods lack some details) | Moderate (used health care records, likely to be subject to bias) | Low | Age, sex, comorbidities including traumatic brain injury, diabetes, hypertension, stroke, coronary heart disease, arrhythmia plus household income, ethnicity. | Low-moderate |

References for the supplementary tables.

1. Liu, F., et al., *Associations between long-term exposure to ambient air pollution and risk of type 2 diabetes mellitus: A systematic review and meta-analysis.* Environ Pollut, 2019. **252**(Pt B): p. 1235-1245.

2. Balti, E.V., et al., *Air pollution and risk of type 2 diabetes mellitus: A systematic review and meta-analysis.* Diabetes Research and Clinical Practice, 2014. **106**(2): p. 161-172.

3. Moore, E., et al., *Global Associations between Air Pollutants and Chronic Obstructive Pulmonary Disease Hospitalizations. A Systematic Review.* Ann Am Thorac Soc, 2016. **13**(10): p. 1814-1827.

4. Orellano, P., et al., *Effect of outdoor air pollution on asthma exacerbations in children and adults: Systematic review and multilevel meta-analysis.* PloS one, 2017. **12**(3): p. e0174050-e0174050.

5. Park, S.K. and W. Wang, *Ambient Air Pollution and Type 2 Diabetes: A Systematic Review of Epidemiologic Research.* Curr Environ Health Rep, 2014. **1**(3): p. 275-286.

6. Li, J., et al., *Major air pollutants and risk of COPD exacerbations: a systematic review and meta-analysis.* International journal of chronic obstructive pulmonary disease, 2016. **11**: p. 3079-3091.

7. Wang, Y., M.N. Eliot, and G.A. Wellenius, *Short-term changes in ambient particulate matter and risk of stroke: a systematic review and meta-analysis.* J Am Heart Assoc, 2014. **3**(4).

8. Janghorbani, M., F. Momeni, and M. Mansourian, *Systematic review and metaanalysis of air pollution exposure and risk of diabetes.* Eur J Epidemiol, 2014. **29**(4): p. 231-42.

9. Mustafic, H., et al., *Main air pollutants and myocardial infarction: a systematic review and meta-analysis.* Jama, 2012. **307**(7): p. 713-21.

10. Eze, I.C., et al., *Association between ambient air pollution and diabetes mellitus in Europe and North America: systematic review and meta-analysis.* Environmental health perspectives, 2015. **123**(5): p. 381-389.

11. Braithwaite, I., et al., *Air Pollution (Particulate Matter) Exposure and Associations with Depression, Anxiety, Bipolar, Psychosis and Suicide Risk: A Systematic Review and Meta-Analysis.* Environmental health perspectives, 2019. **127**(12): p. 126002-126002.

12. Yang, W.S., et al., *An evidence-based appraisal of global association between air pollution and risk of stroke.* Int J Cardiol, 2014. **175**(2): p. 307-13.

13. He, D., et al., *Association between particulate matter 2.5 and diabetes mellitus: A meta-analysis of cohort studies.* J Diabetes Investig, 2017. **8**(5): p. 687-696.

14. Meo, S.A. and F. Suraya, *Effect of environmental air pollution on cardiovascular diseases.* Eur Rev Med Pharmacol Sci, 2015. **19**(24): p. 4890-7.

15. Gowers, A.M., et al., *Does outdoor air pollution induce new cases of asthma? Biological plausibility and evidence; a review.* Respirology, 2012. **17**(6): p. 887-98.

16. Li, X.Y., et al., *Meta-analysis of association between particulate matter and stroke attack.* CNS Neurosci Ther, 2012. **18**(6): p. 501-8.

17. DeVries, R., D. Kriebel, and S. Sama, *Outdoor Air Pollution and COPD-Related Emergency Department Visits, Hospital Admissions, and Mortality: A Meta-Analysis.* Copd, 2017. **14**(1): p. 113-121.

18. Chen, G., et al., *Traffic-related air pollution and lung cancer: A meta-analysis.* Thoracic cancer, 2015. **6**(3): p. 307-318.

19. Wang, N., et al., *Lung cancer and particulate pollution: A critical review of spatial and temporal analysis evidence.* Environ Res, 2018. **164**: p. 585-596.

20. Cui, P., et al., *Ambient particulate matter and lung cancer incidence and mortality: a meta-analysis of prospective studies.* Eur J Public Health, 2015. **25**(2): p. 324-9.

21. Hamra, G.B., et al., *Outdoor particulate matter exposure and lung cancer: a systematic review and meta-analysis.* Environmental health perspectives, 2014. **122**(9): p. 906-911.

22. Scheers, H., et al., *Long-Term Exposure to Particulate Matter Air Pollution Is a Risk Factor for Stroke: Meta-Analytical Evidence.* Stroke, 2015. **46**(11): p. 3058-66.

23. Song, Q., et al., *The global contribution of outdoor air pollution to the incidence, prevalence, mortality and hospital admission for chronic obstructive pulmonary disease: a systematic review and meta-analysis.* International journal of environmental research and public health, 2014. **11**(11): p. 11822-11832.

24. Andersson, J., et al., *Road traffic noise, air pollution, and risk of dementia - results from the Betula project.* Environ Res, 2018. **166**: p. 334-339.

25. Chen, H., et al., *Living near major roads and the incidence of dementia, Parkinson's disease, and multiple sclerosis: a population-based cohort study.* The Lancet, 2017. **389**(10070): p. 718-726.

26. Chen, H., et al., *Exposure to ambient air pollution and the incidence of dementia: A population-based cohort study.* Environ Int, 2017. **108**: p. 271-277.

27. Cerza, F., et al., *Long-term exposure to air pollution and hospitalization for dementia in the Rome longitudinal study.* Environmental health : a global access science source, 2019. **18**(1): p. 72-72.

28. Ilango, S.D., et al., *The role of cardiovascular disease in the relationship between air pollution and incident dementia: a population-based cohort study.* International Journal of Epidemiology, 2019. **49**(1): p. 36-44.

29. Petkus, A.J., et al., *Exposure to fine particulate matter and temporal dynamics of episodic memory and depressive symptoms in older women.* Environment International, 2020. **135**: p. 105196.

30. Younan, D., et al., *Particulate matter and episodic memory decline mediated by early neuroanatomic biomarkers of Alzheimer’s disease.* Brain, 2019. **143**(1): p. 289-302.

31. Shin, J., S.-H. Han, and J. Choi, *Exposure to Ambient Air Pollution and Cognitive Impairment in Community-Dwelling Older Adults: The Korean Frailty and Aging Cohort Study.* International journal of environmental research and public health, 2019. **16**(19): p. 3767.

32. Lo, Y.-T.C., et al., *Air Pollution Exposure and Cognitive Function in Taiwanese Older Adults: A Repeated Measurement Study.* International journal of environmental research and public health, 2019. **16**(16): p. 2976.

33. Lee, M., et al., *Long-term effect of fine particulate matter on hospitalization with dementia.* Environ Pollut, 2019. **254**(Pt A): p. 112926.

34. Li, C.-Y., et al., *Association between air pollution and risk of vascular dementia: A multipollutant analysis in Taiwan.* Environment International, 2019. **133**: p. 105233.

35. Peters, R., et al., *Air Pollution and Dementia: A Systematic Review.* J Alzheimers Dis, 2019. **70**(s1): p. S145-s163.

36. Weuve, J., et al., *Exposure to Particulate Air Pollution and Cognitive Decline in Older Women.* Arch Intern Med 2012. **172**(3): p. 219-27.

37. Loop, M.S., et al., *Fine particulate matter and incident cognitive impairment in the REasons for Geographic and Racial Differences in Stroke (REGARDS) cohort.* PLoS One, 2013. **8**(9): p. e75001.

38. Tonne, C., et al., *Traffic-related air pollution in relation to cognitive function in older adults.* Epidemiology, 2014. **25**(5): p. 674-81.

39. Carey, I.M., et al., *Are noise and air pollution related to the incidence of dementia? A cohort study in London, England.* BMJ Open, 2018. **8**(9).

40. Cleary, E.G., et al., *Association of Low-Level Ozone with Cognitive Decline in Older Adults.* J Alzheimers Dis, 2018. **61**(1): p. 67-78.

41. Jung, C.R., Y.T. Lin, and B.F. Hwang, *Ozone, particulate matter, and newly diagnosed Alzheimer's disease: a population-based cohort study in Taiwan.* J Alzheimers Dis, 2015. **44**(2): p. 573-84.

42. Cacciottolo, M., et al., *Particulate air pollutants, APOE alleles and their contributions to cognitive impairment in older women and to amyloidogenesis in experimental models.* Transl Psychiatry, 2017. **7**(1): p. e1022.

43. Oudin, A., et al., *Association between air pollution from residential wood burning and dementia incidence in a longitudinal study in Northern Sweden.* PLoS One, 2018. **13**(6): p. e0198283.

44. Cullen, B., et al., *Cross-sectional and longitudinal analyses of outdoor air pollution exposure and cognitive function in UK Biobank.* Scientific Reports, 2018. **8**(1): p. 12089.

45. Kulick, E.R., et al., *Long-term exposure to ambient air pollution, APOE-ε4 status, and cognitive decline in a cohort of older adults in northern Manhattan.* Environment International, 2020. **136**: p. 105440.

46. Grande, G., et al., *Association Between Cardiovascular Disease and Long-term Exposure to Air Pollution With the Risk of Dementia.* JAMA Neurology, 2020.

47. Yuchi, W., et al., *Road proximity, air pollution, noise, green space and neurologic disease incidence: a population-based cohort study.* Environmental Health, 2020. **19**(1): p. 8.