

Long-term exposure to fine particulate matter from midlife to late life and risk of dementia: 30 years follow-up from the Whitehall II study

Boya Zhang, Yuntao Chen



Higher long-term residential PM_{2.5} exposure was associated with an increased risk of incident dementia in a cohort followed from midlife into late life. The consistency of associations across pre-landmark averages, annually updated exposure measures, multiple exposure windows, and two complementary PM_{2.5} series supports the relevance of sustained air pollution exposure to dementia risk.

INTRODUCTION

Dementia is a major and growing public health challenge. Air pollution, particularly PM_{2.5}, has been identified as a potentially modifiable risk factor for dementia.

Previous studies have often **focused on older populations** and **relatively short exposure windows**. Evidence based on long-term PM_{2.5} exposure from midlife to late life remains limited.

This study examined the association between long-term and time-varying residential PM_{2.5} exposure and incident dementia in the Whitehall II cohort.

RESULTS

Distribution of annual PM2.5 exposure

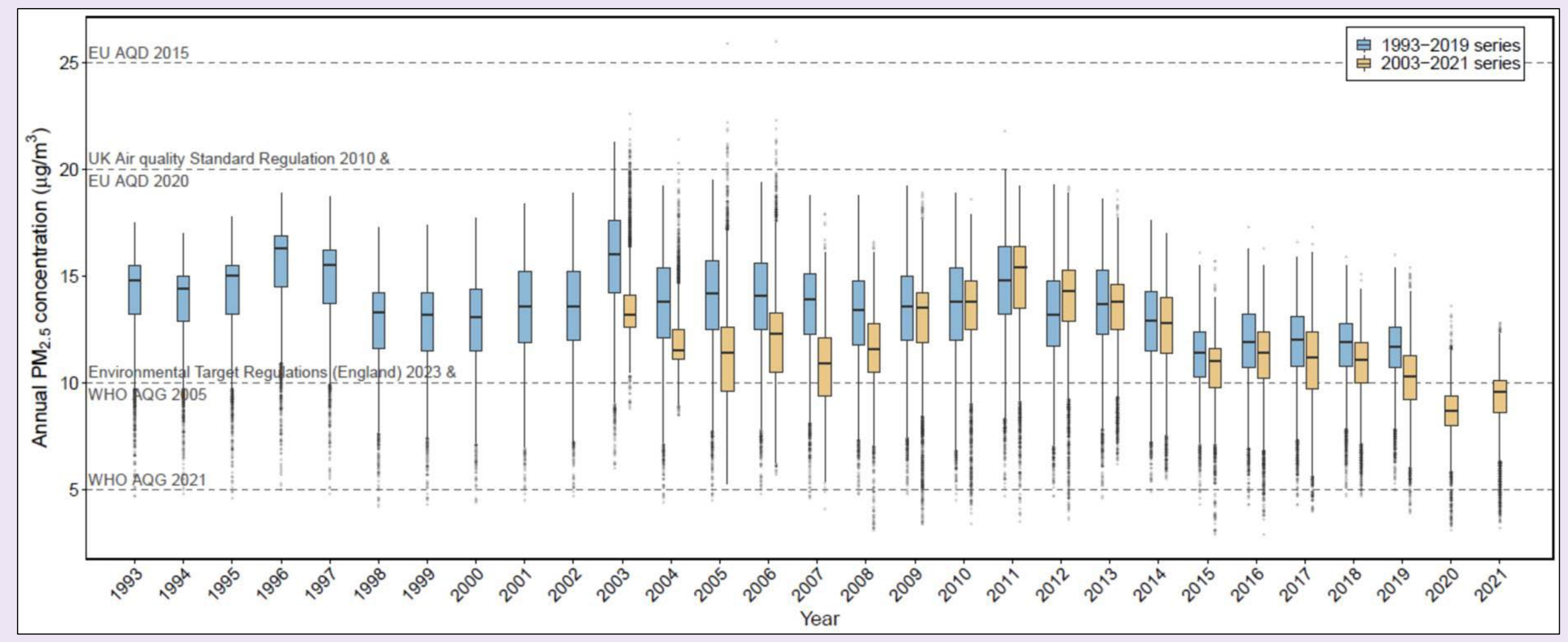


Figure 2. Distribution of annual average PM_{2.5} exposure among study participants.

PM_{2.5} concentrations declined over time but remained mostly above the current WHO guideline.

Pre-landmark average PM_{2.5} and incident dementia

	1993-2010 (18-year exposure)	2003-2010 (8-year exposure)
Cases/No.	784/7866	630/6546
Model1	1.12 (1.03, 1.21)	1.13 (1.03, 1.25)
Model2	1.10 (1.01, 1.19)	1.12 (1.02, 1.24)
Model3	1.09 (1.00, 1.18)	1.12 (1.01, 1.23)

Notes: Model 1 was stratified by sex and birth year and adjusted for ethnicity. Model 2 additionally included education and employment grade. Model 3 further included smoking status, alcohol consumption, physical activity, and BMI. HRs and 95% CIs were estimated per 2 µg/m³ increase in PM_{2.5}.

Higher pre-landmark PM_{2.5} exposure was associated with increased dementia risk, with HRs ranging from 1.09 to 1.13.

DESIGNS & METHODS

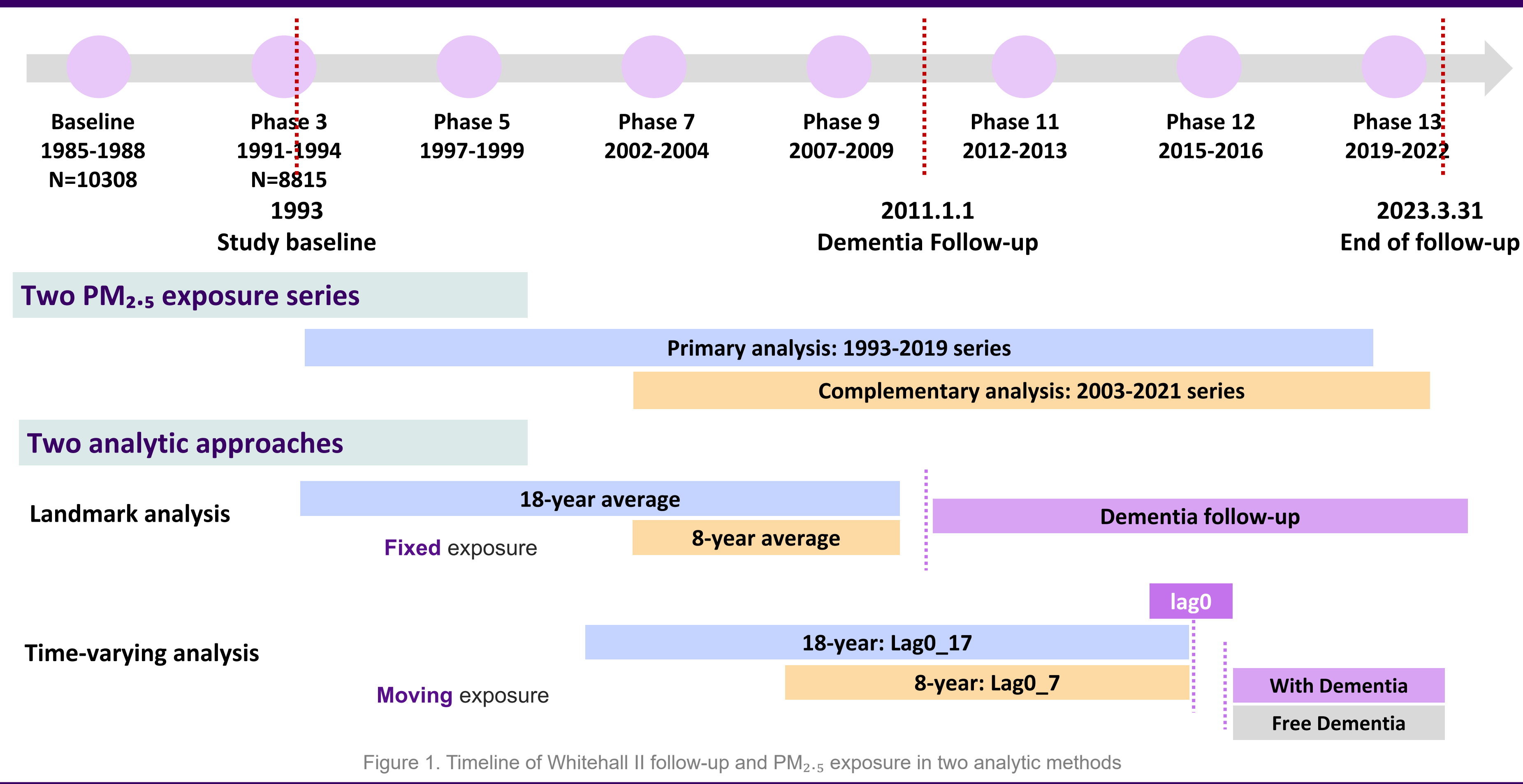


Figure 1. Timeline of Whitehall II follow-up and PM_{2.5} exposure in two analytic methods

Time-varying PM_{2.5} exposure and incident dementia

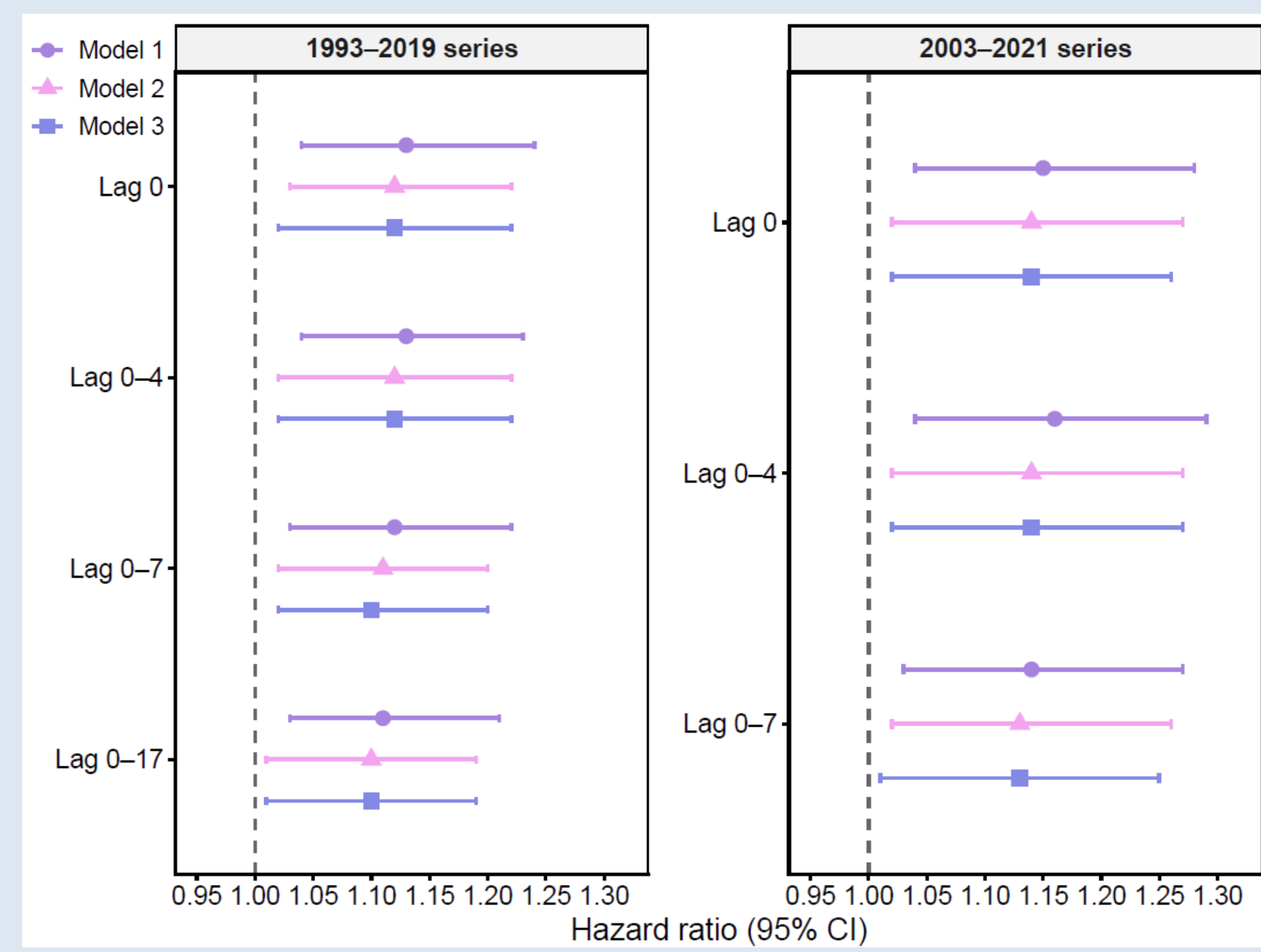


Figure 3. Association of time-varying PM_{2.5} exposure and incidence dementia

Time-varying analyses showed consistent positive associations across exposure windows, with HRs ranging from 1.10 to 1.13.

CONCLUSION

Long-term residential PM_{2.5} exposure from midlife to late life was associated with higher risk of incident dementia.

Further reductions in PM_{2.5} exposure may contribute to dementia prevention, even in settings with relatively low and declining pollution concentrations.

Key references:

Wilker et al., *BMJ*, 2023;
Weuve et al., *Environmental Health Perspectives*, 2021;
Shi et al., *Nature Communications*, 2021;
Grande et al., *JAMA Neurology*, 2020;
Mukadam et al., *The Lancet Healthy Longevity*, 2024.