Reviewer's report

Title: The Impact of Long-Term PM2.5 Exposure on Specific Causes of Death: Exposure-Response Curves and Effect Modification among 53 million U.S. Medicare Beneficiaries

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Reviewer: George Thurston

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This manuscript provides valuable new insights into the shape and nature of the fine particulate matter air pollution relationship with mortality in older adults, but it has limitations that need acknowledgement. The abstract says they applied "age, gender, race, ZIP code, and SES-adjusted models", but SES was not known, in this case, at the individual level, but instead at the spatial contextual level (e.g., zip code level). Also, no information about individual risk factors, such as body mass index, or smoking or non-smoking, are available. Thus, this is not a strict cohort study that is well controlled for other risk factors at the individual level, and this fact should be made clearer in the text.

The calculation and consideration of non-combustion PM2.5 using a two-stage analysis is innovative, but needs more historical context. Prior studies have looked at long-term exposure to PM2.5 components and mortality, including Ozkaynak and Thurston, 1987 (which considered sulfate PM2.5 and PM2.5 source-specific PM2.5 components: similarly finding soil PM2.5 to be non-significant in US mortality analyses), the Six-City Study (Dockery et al, 1983, which showed the sulfate component of PM2.5 to be strongly associated), the ACS Cohort (Pope et al. 2002, which similarly noted in its abstract that fossil fuel combustion was the driving force in the PM2.5 - mortality relationship), and the AARP Cohort (Thurston et al, 2016) which found traffic and coal PM2.5 to be significant, but not soil or biomass. This prior work all needs to be acknowledged and noted as further confirmation of the non-combustion vs. combustion PM2.5 conclusions of this new work. The policy implications of the importance of fossil-fuel combustion PM2.5 in the US PM2.5 - mortality to the developing world application of these effect estimates, and cautions about direct application of US relationship elsewhere bear noting.

The use of 12-month moving average of PM2.5 is not common. It would seem the 12 months prior to death would be more appropriate, as the 12 month moving average would potentially include 6 months of exposures occurring after death. Would using the prior-12 months' moving average give different results?
Another issue that needs further discussion is that of the ethnicity-specific results. It seems strange that the Hispanic group is "positively" affected by PM2.5. This may have to do with the way that SES is only controlled at the contextual level, and not the individual level. Discussion of possible confounding from the SES and other contextual controlling variable adjustments needs to be considered. Also, please discuss how these results compare with the MESA study, which has focused specifically on ethnic populations.

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