Reviewer’s report

Title: Mortality Associated with Wildfire Smoke Exposure in Washington State, 2006-2017: a case-crossover study

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Reviewer: Colleen Reid

Reviewer's report:

Summary: This study adds to the relatively scant literature on the effects of wildfire smoke exposure on mortality. This is incredibly important as wildfire smoke is becoming more of a problem in western North America, contributing to more of the air pollution that populations breathe. Additionally, most of the literature examining mortality impacts from wildfire smoke has been done in other countries and not the US, so this is an important study in that way. However, I have some concerns about the exposure assessment (which was not explained clearly enough in the methods to truly understand what was done) and the interpretation of the results, particularly in the discussion section, which implies a misunderstanding of the information one can derive from a confidence interval. I provide specific suggestions and comments below.

Major Points:

The results section has good information but it could benefit from reorganization. I would suggest presenting the distributed lag analysis first, then a table of all of the results for lag day 0 and lag day 1 in separate columns for each endpoint studied and each individual group (but for all causes of death). Then in the next table, put in the analyses (again with separate columns for lag day 0 and lag day 1) for the specific causes of death within respiratory by different age groups and race groups. This would also require reorganizing the writing in the results section.

Some more clarity on the exposure assessment in the methods and also on the statistical analysis is warranted (please see specific comments to this end below). The discussion section does a good job of highlighting the limitations of this exposure assessment, but that revealed much more to me about the exposure assessment that was lacking from the methods section. It is also unclear how the sensitivity analysis is different from the regular analysis as the threshold of 20.4 ug/m3 is referred to for both of these thresholds throughout the paper.

Also, please see the comments in the discussion section on the interpretation of the confidence intervals.

Abstract:

The findings of associations for different age groups seems very important to me and should be emphasized in the abstract if possible given word count restraints.
Introduction:

The referenced Haikerwal paper focused on cardiac arrests, but not just cardiac arrests that resulted in death. This should be noted as the authors are trying to paint a picture of what is known about the association between wildfire smoke and mortality specifically.

Methods:

Lines 131-132: Please justify the use of just June - September for the fire season in Washington.

Lines 144-147: Please provide in the text the spatial resolution of the grid as this is important to determine if this exposure method is appropriate for assessing exposures across the population.

Lines 149-151: Which grid cell were excluded? A map would be helpful. How many people live in those grid cells and/or how many deaths were dropped due to dropping those grid cells? Over the years studied, how affected were those grid cells by wildfire smoke? Again, knowing the size of the grid cells is important to know how much this exclusion may have biased the study.

Line 191: I thought that 20.4 ug/m³ was the threshold for defining a wildfire smoke affected day in the original analysis. Please clarify which is the main threshold and which is the sensitivity analysis.

In the statistical analysis section, I could tell if the exposure was wildfire-smoke affected day or PM2.5 that is then interacted with the binary variable of wildfire-smoke affected day. Please clarify this.

Also, more needs to be said about how the exposure data was spatially merged with the health data. Please state the software that was used and how the data were spatially analyzed.

Results:

Table 2 says that the average PM2.5 was 3.39 ug/m³ on referent days, but on line 172, it says that there were on average 3.39 referent days per decedent. I believe the statement on line 172 is correct. Please clarify what the average PM2.5 levels were on the referent days for Table 2 (although I think this is on the line above, so the third line in that section doesn't fit in that section which has a title of PM2.5 mean for that column).

Lines 229-231: Please clarify the wording here. The text reads: "The results indicate some evidence for an effect at two days prior to death, with no evidence for an effect in the preceding days." I think what the authors mean to say is: "The results indicate some evidence for an effect of exposure at two days prior to death, with no evidence for an effect of exposure during in the preceding days on death." Or something to that effect…
I suggest putting all of the findings related to Table 3 together, perhaps after the discussion of the lag days?

Given the evidence from the lag analysis that most of the effect on mortality is for exposure to wildfire smoke the day before death, why were the main analyses done for same day exposure? Additionally, when doing same day exposure, sometimes the death occurred so early in the day that the person was not truly "exposed" to the smoke that day. I would suggest moving the results for lag day 1 to the main results and putting the same day in the extra table. Or better yet, put one column in Table 3 for same day and one column for lag 1. Then Table 4 could be specifically looking at the stratified analyses by cause of death and by age/race/income etc. I think this would clarify the results better.

Lines 217-218: the negative sign on the 1 in the confidence interval gets lost as it is on a different line than the rest of the confidence interval and when I first read it, I thought it was 1-4 instead of -1 - 4, which has a different interpretation.

Line 242-243: The finding for respiratory mortality was already stated prior to Figure 1. I think it fits better here. I would suggest moving the finding about CVD mortality to this section as well.

Lines 252-254: Please clarify - are these stratified analyses?

Table 4: presumably these are results from an interaction term and the age group 5-14 is the reference group? Please state that somewhere to clarify. Also, should there also be a hyphen for the reference group for race (I think Other/Pacific Islander)?

Discussion:

Lines 273-274: I would not say that there is a protective effect of wildfire smoke on mortality. The confidence interval includes 0, which just means that we have 95% confidence that the true value falls within that confidence interval and because that interval includes 0, we can't say with confidence that the true value is positive - it does not mean that wildfire smoke is sometimes protective of mortality and sometimes adverse for mortality, as this statement implies. Lines 275-277 imply the same misunderstanding of confidence intervals that needs to be rectified.

Lines 281-285: My reading of the three papers cited here is that all of them demonstrated null associations (read confidence intervals that included the null) between wildfire smoke and respiratory mortality, such that the findings in those other papers is in line with the findings in this paper (that we cannot say with confidence that we can reject the null of no association). Again, this paragraph is showing a misinterpretation of confidence intervals. This paper does observe a borderline significant increase in respiratory mortality associated with wildfire smoke, which I think is stronger than can be said for those other studies. As for the cardiovascular findings, this paragraph is better - some of the previous papers have found borderline positive associations, whereas this paper finds a null association.
Lines 317-319: See (Henderson et al. 2011; Mott et al. 2005; Rappold et al. 2011; Reid et al. 2016) for studies that show higher effects of wildfire smoke for adults under 65 than for ages 65+ for some specific endpoints. Also check out a recent review that may have more citations (Reid and Maestas 2018).

References:


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