Reviewer's report

Title: Different radon thresholds and their associations with geographic risk characterization and lung cancer mortality trends in British Columbia, Canada

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Reviewer: Tor Erik E Danielsen

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Major Compulsory Revisions

1. The authors have stated that the background for this study is that: "There is no safe concentration of radon gas", and "--there is no radon concentration at which there is no risk of developing lung cancer". Based on the background for the study, the result of the study should be obvious. Lowering exposure level reduces risk.

I would have appreciated a more comprehensive discussion of the scientific basis for this background.

2. Besides this the objective of the study was to "examine how different threshold were associated with geographic risk and lung cancer mortality trends". Geographical risk seems to have been constructed by the authors, but not defined or explained further in detail.

Within evidence based "hazard and risk assessment", risk is normally calculated by different parameters and algorithms based on an exposure situation where understanding and description of hazard is an essential part. It seems that the authors use geographical as a surrogate for individual exposure to radon in buildings in different areas. The term geographical risk should have been better explained to ensure reliability and improve the outcome of the information.

3. The authors have constructed the term "radon vulnerability" as a part of the hazard situation. This construction is nor explained or argued for.

As vulnerability usually is used for increased risk based on personal predisposing susceptibility, radon vulnerability is rather confusing for this reviewer and should be further explained.

4. To assess exposure, 13 independent variables are constructed. It is not sufficiently scientifically argued why the 13 constructed "independent variables" should be a significant assessment of individual exposure to radon.

5. A binary classification of smoking based on information from local health areas was constructed. The confounding from the poor exposure assessment and the binary smoking classification might add more to bias than findings in the study. However, confounding and bias in the assessments are hardly discussed at all. Also, in variants of ecological studies - like this one - references to, and
discussions about, ecological fallacies should be obligatory. There is hardly any information or discussion of ecological fallacies in the paper.

6. The authors should address if the exposure assessment is truly blinded towards outcome data. Any indirect influence on social factors or occupation could potentially affect the results.

7. The number total numbers of lung cancer deaths have not been reported. The authors should have given an estimate of the potential for reducing disease burden (lung cancer) when reducing threshold concentration.

8. Given p.7, the authors should have discussed the lack of change between in the distance between high and low vulnerability liners with decreasing radon thresholds. In my opinion, this could be an indication on confounded results.

Minor Essential Revisions

1. "Susceptibility to high radon concentrations" is in my opinion incorrectly used to describe exposure level – not susceptibility.

2. It is rather unclear what kind of study this is. It is a mixture of dichotomous comparison in some aspect and crude estimate of dose response based on poor exposure assessment in other aspect. There are measurements - one or more - of radon concentration from 1054 of the 36051 BDA – 3% of the BDA. There is no information or discussion of how representative the measurements are as assessment of individual exposure, and no information or discussion of how representative measurement in the 1054 BDA are for individual exposure in the other BDAs.

3. Could migration within the populations during latency for the development of lung cancer affect the outcome?

4. The authors should have explained the measured time trends (figure 5 and 6) in more detail.

Level of interest: An article whose findings are important to those with closely related research interests

Quality of written English: Acceptable

Statistical review: Yes, but I do not feel adequately qualified to assess the statistics.

Declaration of competing interests:

I declare that I have no competing interests