Reviewer's report

Title: Radiation Exposure and Cancer Risks from CT Examinations in Japan

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Reviewer: Cecile M Ronckers

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This study estimates the exposure to CT scans and the impact on cancer mortality in Japan by extrapolating numbers from one prefecture, based on actual patient data from one month. This is interesting given the high ranking of Japan in terms of the number of CT scanning machines and the associated high rate of scans per person, in comparison to other western countries.

A. Major Compulsory Revisions

A1. Methods, section “calculation of patient dose for each patient”, Abstract, and Discussion section on same topic

The study excludes the subpopulation (5%) of children who had CT scans because the dosimetry program does not provide phantoms for children. This is a pity as it limits the usefulness of the population attributable risks. Given relatively high doses in children and the large life-span (both acknowledged in the discussion section), it would be appropriate to have an estimate of the impact this omission may have on the size of the population attributable risks that are presented, for example by using the distribution of attributable deaths by age at CT scanning from other, comparable studies in other countries.

Also, there is a program that has a pediatric phantom, the so-called CT-EXPO software. Please clarify why this software was not used in this study.

A2. It is not clear from the methods section if the information on CT scans from responding clinics was adjusted to reflect the fact that only about half of the clinics and hospitals responded to the request for information. Please add this to the methods section. A related question is whether the radiology departments from clinics/hospitals that provided complete information on CT scans are expected to differ from those who did not, with respect to the numbers and types of CTs performed.

A3. Discussion section. The LAR is said to be overestimated, among others, by the fact that patients undergoing CT scans possibly are less healthy than the general population. However, the omission of cardiac scans and pediatric scans may counterbalance part of this overestimation and should be mentioned. Similarly, Table 5 shows that the annual medical cost per population is lower in Gunna prefecture compared to the Japan as a whole, which may indicate that fewer CT scans are done in Gunna than, on average, in the whole of Japan. This would also lead to an underestimate of risk for Japan as a whole.
A4. In the discussion section please compare the % excess deaths from CT scanning with those obtained from similar calculations for other countries, e.g. United States (Brenner et al) and Israel (Chodick et al), among others.

B. Minor Essential Revisions

B1. Table 1. The numbers in this table are confusing, probably because of unclear labeling. Please provide more elaborate labels and an explanatory table title to clarify the content of the table.

B2 Tables 3a and 3b can be combined.
Also, to improve readability it would be advisable to avoid the many digits per table entry, for example by expressing the individual risks as promille (0/00) or per 10,000.

B3. Methods, paragraph on “calculation of total LAR of fatal cancer”
“if one anatomical location was scanned more than twice, the LAR was multiplied by the number of scans”.
As written, it seems as if an examination that was done 2 times, was only counted once. If so, that would lead to underestimates of the risk. Probably this should read “if one anatomical location was scanned twice or more (…)” Please clarify.

B4. Results section, paragraph on “numbers of patients, CT examinations, and scanning” and Table 1
For clarity please add an extra line to the table reflecting totals, so that the number 471,557 not only appears in the text but also in the table.

B5. Discussion section, paragraph “limitations in the sample of patients studied”
Line 8: “the number of patients undergoing CT may be underestimated” Do you mean the patients undergoing CT in Japan?

B6. Discussion section, paragraph “limitations in the sample of patients studied”
Line 12 “(…) but the changes in the number of CT examinations in Japan were reported to be less than 2%. Please clarify what “changes” are meant in reference 10 – perhaps throughout the calendar year?

B7. Please clarify the label for the vertical axis in Fig 3. From the text it seems to be the absolute numbers for excess mortality attributable to CT examinations for the whole of Japan, this is not clear from the current label.

B8. The title of the manuscript should reflect the fact that the impact of CTs on cancer mortality is reported

C. Discretionary Revisions

C1. Abstract – results section line 6
“… approximately 73.2% of the collective dose”. Which total collective dose do you refer to, the collective dose from CT scans or the collective dose from medical radiation? Please specify.

C2. Abstract – conclusions
The reference to variation between hospitals should be mentioned in the results, not just in the conclusions

D. Minor issues not for publication
D1. Methods 1st paragraph line 5 “deaths” rather than " death"

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

**Quality of written English:** Needs some language corrections before being published

**Statistical review:** No, the manuscript does not need to be seen by a statistician.

**Declaration of competing interests:**
'I declare that I have no competing interests’