Letter to the Editor

Canadian tritium study misleading to the public

Re: ''Estimating cancer risk in relation to tritium exposure from routine operation of a nuclear-generating station in Pickering, Ontario'' by S. Wanigaratne, E. Holowaty, H. Jiang, T. A. Norwood, M. A. Pietrusiak, P. Brown (Chronic Diseases and Injuries in Canada, Vol 33, No 4, September 2013, p. 247–56).

Dear Editor,

We believe that the conclusions of the article are misleading due to limitations of the study.

All doses discussed in the study are estimates, based on hypothetical data, assumptions, modelling and standardized human physiology (ignoring the large variation of size/weight, metabolism, ethnicity and genetic radiosensitivity of the population). There are no actual measurements of tritium for any cohort members. There is much controversy as to the accuracy of these dose estimates, and true doses to local people may be manyfold higher.

Tritium emissions from the Pickering nuclear reactor are high (based on levels obtained from Ontario Power Generation via access to information). It is surprising that the estimated doses to the public are deemed to be so low in this study. The recent situation surrounding tritium sampling at the Shield Source Incorporated plant in Peterborough does not instill confidence in the Canadian Nuclear Safety Commission (CNSC)'s accuracy in measuring emissions. The stack sensor was found, after 18 years of operation and several CNSC inspections, to be underreporting by close to a factor of 10.

Children under 5 years old are not included in this study. This is a serious omission as some research has shown higher rates of leukemia in children under 5 who live in close proximity to a nuclear reactor.[1] The finding of an almost double risk of cancer in girls age 6 to19 years is very concerning. Tritium should not be dismissed as a cause because of the low dose estimates. It is theoretically possible that very tiny doses of tritium, incorporated into developing tissues in the fetus, could be enough to initiate a cancer in a child. Of note, there are many other carcinogenic radionuclides emitted from nuclear reactors, none of which have been addressed in this study.

The authors' effort to include a cohort of ''non-movers'' exposed to ''stable tritium'' is admirable, but 6 years is too short an interval to ascertain the effects of tritium exposure, which can cause cancer after a latency of several decades.

The choice of control group is problematic for two reasons: 1) incomes in this group (North Oshawa) are on average $10 000 lower than the Pickering group, which places the control group in a different, and potentially less healthy, demographic; and 2) North Oshawa is between the Pickering and Darlington reactor complexes. Given that tritium has a half-life of 12.3 years and will be circulating in the environment for several times that long, it is not a fair assumption that this population is not exposed.

The authors do not mention that there is much uncertainty regarding the half-life of organically bound tritium, which they claim is 48.5 days. Some scientists estimate the half-life to be as much as 500 days, which means even small amounts would accumulate over many years of exposure.

The study is underpowered and has significant limitations. Ontarians should not be reassured by the study's conclusion that people living in the vicinity of nuclear power plants in Ontario do not have elevated cancer risk due to tritium emissions.

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Reference

1. Kaatsch P, Spix C, Schulze-Rath R, Schmiedel S, Blettner M. Leukaemia in young children living in the vicinity of German nuclear power plants. Intl J Cancer. 2008;122(4):721-6.

Authors' response

The authors would like to thank Drs. Cathy Vakil and Linda Harvey for their letter regarding our study ''Estimating cancer risk in relation to tritium exposure from routine operation of a nuclear-generating station in Pickering, Ontario.''

Drs. Vakil and Harvey believe that our conclusions are misleading given the study's (acknowledged) limitations. However, we stand by our conclusions that tritium estimates were not significantly associated with increased risk of radiation-sensitive cancers in Pickering.

Firstly, we have not misrepresented the tritium estimates used in our regression models as individual dose estimates, as Drs. Vakil and Harvey seem to suggest. We do not refer to our tritium estimates as ''tritium dose'' for this specific reason. We have clearly stated that our estimates of tritium are modelled from real tritium emissions data (rather than ''hypothetical'' data as Drs. Vakil and Harvey suggest) and are indeed based on standard and accepted environmental, chemical and biological assumptions. Exposure assessment in environmental epidemiology is a difficult task, as explained by Rothman,[1] and would be prohibitively expensive and laborious if long-term individual monitoring and measurements were the only option. Faced with these difficulties, public health researchers attempting to address valid community concerns about health effects of environmental exposures often turn to proxies for such information. To the best of our knowledge, all previously published studies examining the relationship between radiation exposure from nuclear power generation and cancer either assumed exposure based on location or used distance-to-the-source as a proxy for exposure, a method that is likely to misclassify radiation exposures. The German study (Kaatsch et al[2]) referenced by Vakil and Harvey used this method. Given the advances in geographical and mathematical modelling methods used to estimate environmental exposures, and the acceptance of these methods in the scientific community,[3] we are justified in choosing this method to estimate tritium exposure for the Pickering cohort. We have stated that our modelled tritium estimates are consistent with that of on-site radiation monitors near the Pickering Nuclear Generating Station (PNGS). We also fully acknowledged that we are less confident that these estimates represent true dose to cohort members. We accept that modelled tritium estimates may not be the ideal method but we must emphasize that it improves on using location or distance-to-the-source as a proxy for exposure. Based on this method of tritium estimation, our findings clearly do not support a significant association between tritium estimates and increased cancer risk.

Drs. Vakil and Harvey found it surprising that our modelled tritium estimates translated to very low dose estimates. We reiterate that the average effective dose based on our modelled tritium estimates was calculated to be 0.47 μSv/year (range: 0–2.36 μSv/yr). This is several orders of magnitude lower than the typically referenced low-dose range (1000−100 000 μSv/yr),[4] and lower than both the annual dose from natural background radiation near PNGS (1338 μSv/yr)[5] and the 50 μSv radiation dose received from a chest x-ray.[6] If emissions data were under-reported by a factor of 10, as suggested by the example given by Vakil and Harvey, this would still translate into effective doses lower than levels of concern.

As to the assertion that we omitted children under 5 years old from our study, as we stated in our methods section, the property assessment file that was the data source for our cohort suffered from undercounting of the population aged less than 5 and over 85 years of age. For this reason, we were unable to draw any conclusions about cancer risk for those under 5 years of age. With respect to the findings of Kaatsch et al,[2] an editorial by Little et al[7] suggested that chance is the most likely explanation for the increased risk of leukemia observed in children under five years of age living near German nuclear power plants (NPPs). In addition, an interdisciplinary working group of international scientists (The Commission on Radiological Protection) was charged with evaluating that study's findings and concluded that increased cancer risk was not causally related to radiation emitted from NPPs.[8]

The finding of doubled cancer risk among girls aged 6 to 19 years should be a concern only if we were unable to find a reasonable explanation. However, we have highlighted several possible reasons for this finding, the most likely of which is the chance nature of the finding given multiple testing.

For clarification, our non-mover cohort was stable in terms of residential location for 6 years between 1979 and 1985 and we assumed a stable exposure of tritium over this 6-year time period. Drs. Vakil and Harvey mistakenly suggest that this cohort was only followed for 6 years when it was actually followed for 20 years (as was the rest of the cohort), which does sufficiently consider the long latency period between exposure to tritium and potential development of cancer.

Regarding Drs. Vakil and Harvey's concern about using north Oshawa as our control group: 1) we acknowledged that north Oshawa does have a lower average neighborhood income; however, we did adjust for neighborhood income in our regression analyses; 2) much of north Oshawa is more than 10 kilometres from Darlington Nuclear Generating Station and a much greater distance away from Pickering, which is why we deemed north Oshawa a reasonable comparison population.

Finally, our conclusions are directly relevant only for those Ontarians living in the vicinity of PNGS and no other NPP in Ontario. For interested readers, Lane et al[9] have since published a study examining cancer risk around three NPPs in Ontario (including Pickering) in relation to modelled radiation dose estimates.

We are sensitive to community concerns regarding cancer risks associated with

nuclear power generation; this is what prompted us to initiate this study. It could be that public concern may only be eased with comprehensive, individual-level tritium dose measurements and 20 years of meticulous follow-up of a well-defined cohort. However, considering both the enormity of such an endeavour as well as the weight of existing evidence regarding hazards from normally operating nuclear power plants, public health researchers must suggest feasible and practical means to address community concerns. There are limitations to our approach and we believe we described and adequately acknowledged these. However, these limitations do not outweigh the strengths of this work: 1) tritium estimation based on actual emissions data rather than using distance-to-the-source, which has commonly been used as a proxy for tritium exposure; and 2) use of a cohort design with consideration of a sufficient latency period between tritium exposure and development of cancer. The preceding two points are methodological improvements over previous studies. We therefore stand by our conclusions that tritium estimates in Pickering were not significantly associated with increased risk of those cancer sites examined. In regression analyses where we explicitly considered the association of tritium estimates and development of cancer, there was no evidence suggesting tritium estimates were significantly associated with lung cancer or female breast cancer. We could not look at other cancer sites, as we did not have adequate sample sizes to do so. However, in person-years analysis, observed risk of all cancers, female breast, leukemia, lung and thyroid cancers in the Pickering cohort were not higher than expected, given rates of these cancers in Ontario's general population. We have explained above why the finding of higher cancer risk in females aged 6 to 19 years should be interpreted with caution.

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