

## • Perspective

# Can screening effects explain increased risk of thyroid cancer among population living near nuclear power plants in Korea?

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Following reports in Korea of an increased risk of thyroid cancer among those living near nuclear power plants (NPPs) [1], there has been debate regarding the interpretation of the findings. One suggested explanation is the screening effect on thyroid cancer risk. The basic assumption of this argument is that the screening process increases the number of detected thyroid cancer cases in a population, leading to an increase in incidence and relative risk. The Korea Hydro and Nuclear Power Company granted a project to support this assumption to gain an advantage in their legal litigation regarding thyroid cancer cases. However, these circumstances could occur in a limited condition and cannot always happen. Because the screening effect and causality are different issues, we must distinguish between the two different questions. Even if there is a screening effect, it does not mean that the observed increased risk of thyroid cancer does not result from living near NPPs. Therefore, I would like to make a few comments on this issue.

Screening increases absolute risk by increasing the number of detected cancer cases, but it does not directly affect the value of relative risk. If it did not occur differently, the relative risk would not be changed. For example, if a twofold increased screening occurred in both the exposed and non-exposed population, then the relative risk would not be changed. Previously, it was reported that the slope of the dose–response relationship between radiation and thyroid cancer did not differ significantly before and after screening among patients who had received radiation therapy, indicating that the association between radiation and thyroid cancer may not be changed by intensive screening [2]. A study from the Chernobyl accident also reported screening to be a weak confounder for radiation dose and thyroid cancer [3]. Furthermore, only a certain proportion of detected cases from screening would ultimately be confirmed as

cancer cases because the device used for screening (e.g., ultrasonography) is not a diagnostic method. Therefore, the twofold screening rate difference, for example, does not directly indicate a twofold difference in incidence rate. However, when the screening occurs differently, distortion of the relative risk may be occurred. Therefore, we should determine whether populations living near NPPs experience more screening than other populations. If so, we need to examine how much this occurred differentially in relation to distance from NPPs.

The next issue is to separately identify the proportion of observed relative risk associated with living near NPPs and with screening. A large proportion of thyroid cancer cases is likely to be due to screening in Korea [4], but it may not account for the observed relative risk of thyroid cancer entirely. The effect is probably small, but this does not mean there is no risk from living near NPPs. For example, in a study from Fukushima, intensive thyroid screening predicted that the thyroid cancer incidence would increase sevenfold and that 5 to 10 % of the incidence would be attributable to radiation exposure among all screened cancers [5]. Although we lack data, the gap between the difference in screening rate and observed relative risk of thyroid cancer should be further investigated.

Screening detects many small cancers but occult thyroid cancer could also be radiation related. Screening itself does not differentiate the cause of the thyroid cancer. Even if non-radiation-related cancers make up the majority, it does not change the causal relation between radiation and thyroid cancer. Based on International Agency for Research on Cancer classification (<http://www.iarc.fr>), radiation is the only confirmed carcinogen for the thyroid. It is important to acknowledge that screening also detected radiation-related thyroid cancers that were not diagnosed during routine medical care [6]. Although the in-

creasing risk of thyroid cancer has primarily been reported among children, recent literature has emphasized the possible association among adults [7]. Therefore, it is reasonable to expect that some thyroid cancers, whether detected through screening or not, may be related to radiation exposure.

The issue, however, is how much radiation the population living near NPPs was exposed to and what their sources were. Without estimates of the doses received by individuals, it is impossible to be certain whether the individuals who developed thyroid cancer were actually exposed to radiation. Although very low levels of measured doses have been reported in those living near NPPs in Korea, these are not directly related to organ doses, which incorporate all possible pathways of radiation exposure including milk, food, and water. Therefore, it is important to investigate the crucial issues such as estimating organ doses and identifying radiation sources whether from NPP, medical exposure, or others instead of focusing only on the screening effect. The study on populations living near NPPs in Korea is unique compared to other studies in terms of its study design and findings [8], so further studies with more detailed information on screening and thyroid organ doses could provide an excellent opportunity to distinguish between the effects of radiation and screening on thyroid cancer risk.

Screening can increase the number of thyroid cancer cases whether related to radiation or not. The majority of increased risk of thyroid cancer may be attributable to detection. However, the increased risk of thyroid cancer may also not be fully explained solely by improved detection and screening methods. Focusing exclusively on screening for the observed relative risk is scientifically unbalanced. Such an argument without any objective evidence could overlook important environmental risk factors for thyroid cancer in Korea.

## Conflict of Interest

The author has no conflicts of interest with material presented in this paper.

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