

## Reply to 'Comment on '30 years follow-up and increased risks of breast cancer and leukaemia after long-term low-dose-rate radiation exposure''

Wan-Hua Hsieh<sup>1</sup>, I-Feng Lin<sup>2</sup>, Jung-Chun Ho<sup>3,4</sup> and Peter Wushou Chang<sup>\*,5,6</sup>

<sup>1</sup>Department of Public Health, Tzu Chi University, Hualien, Taiwan; <sup>2</sup>Institute of Public Health, School of Medicine, National Yang-Ming University, Taipei, Taiwan; <sup>3</sup>School of Oral Hygiene, Taipei Medical University, Taipei, Taiwan; <sup>4</sup>Department of Nursing, Kang-Ning University, Taipei, Taiwan; <sup>5</sup>Taipei Hospital, Ministry of Health and Welfare, New Taipei City, Taiwan and <sup>6</sup>National Health Research Institute, Miaoli, Taiwan

Sir,

In their response, Doss (2018) argued mainly on standardised incidence ratios (SIRs) for all-cause mortality and the specific SIR based on the observed all cancer cases (observed), which was based on the exposed cohort divided by the expected cancer cases, itself based on a general population throughout Taiwan. Unfortunately, the argued expected value calculated by the authors did not take into account the potential social-economic effects and cannot rule out a healthy resident effect, which potentially incurred a lower expected number of cancer cases by the authors. While SIRs were widely used in environmental studies when individuals' exposures were not available, SIRs assumed that the general population was an appropriate equivalent reference population and the social-economic and behaviour variables were similar or not available. However, in this cohort study, the majority of the Taiwan RBC cohort resided and moved into newly built apartments and building complexes, or studied in new school buildings, in the metropolitan capital Taipei during early 1980; an economic booming period in Taiwan. Therefore, the majority of the exposed had relatively better socio-economic and educational status than the average in Taiwan. After the incidences were disclosed, the government provided health examinations for the exposed residents and students, and the registered exposed cohort were assumed as having higher healthy literacy.

With these considered, further analysis based on internal comparison between the exposed or dose responses among the exposed individuals were conducted, including very low (<1 mSv) to very high (over 1500 mSv) exposure. Regression models were further conducted based on individual factors, such as personal radiation exposure, age at initial exposure, sex, and duration of exposure, while assuming minimum latent periods. Via the regression models, the hazard ratio was estimated (relatively high exposure vs relatively low), conditional on the other covariates held constant. Results from the cancer registry showed an increase in expected cancer cases at older ages, while confounding effects by ageing were already adjusted within the models.

The authors argued 'statistical fluctuations' and its impacts on the results. The sampling variation had been considered due to an elevated standard error of the parameter estimates, especially in a smaller sample. In this study, the significance level was kept at 0.05. Both 90% CI (corresponding to a one-sided test) and a two-sided *p*-value (corresponding to 95% CI) were presented in the manuscript. These presentations have been widely applied in substantial studies, using either an excess relative rate (ERR) or log-linear model type, in cancer studies.

### ACKNOWLEDGEMENTS

#### Announcements

All the authors agree to this response.

### CONFLICT OF INTEREST

The authors declare no conflict of interest.

### REFERENCES

Doss M (2018) Comment on '30 years follow-up and increased risks of breast cancer and leukaemia after long-term low-dose-rate radiation exposure'. *Br J Cancer*; e-pub ahead of print 8 February 2018; doi: 10.1038/bjc.2017.481.

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\*Correspondence: PW Chang; E-mail: peter.chang3@gmail.com

Published online 13 February 2018

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