Screening effects on thyroid cancer risk estimates for populations affected by the Chernobyl accident

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Body of Abstract: Simulation calculations are performed in order to explore the ecological bias in studies as they are performed with settlement specific data in the aftermath of the Chernobyl accident. Based on methods, that were developed by Lubin for exploring the ecologic bias due to smoking in indoor radon studies of lung cancer, the influence of the introduction of ultrasound devices and enhanced medical surveillance on the detection and reporting of thyroid cancer cases was investigated. Calculations were performed by simulating thyroid doses of one million children in a total of 744 settlements and assuming a linear dependence of the risk on dose and various scenarios of the screening. The dose distributions simulate the distributions similar to those used in previous ecologic studies of the thyroid cancer risk in Ukraine after the Chernobyl accident. The ecologic bias was defined as the ratio of risk coefficients derived from an ecological study to the corresponding risk factor in the underlying risk model. The ecologic bias was estimated for each of the screening scenarios. Analytical equations were derived that allow the exact numerical computation of the bias which is determined by covariance terms between the increased detection and reporting on one side and thyroid dose values (individual and averaged for the settlements) on the other side. Nested in the population data, a cohort study was simulated with 10 000 individuals and an average thyroid dose of 0.3 Gy. The present study underlines the different scopes of the ecologic and cohort study designs performed in the aftermath of the Chernobyl accident. Whereas the ecologic studies give an estimate of the excess thyroid cancer risks per unit dose under the conditions of a health care system as it is typical for the affected countries after the Chernobyl accident, the cohort study gives risk estimates within a well screened cohort. Due to the strong screening effects, excess absolute risks in the ecological study cohort are considerably lower than what can be expected for the cohort study. Assuming less expressed screening effects for radiation induced cancers, excess relative risks in the population are considerably higher than what would be the outcome of the cohort study. Results of ecologic studies are useful for estimations of populations risks due to accidental releases of radioiodine to the environment, results of cohort studies have the potential to improve the understanding of the carcinogenesis after incorporation of radioiodine.