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LETTER TO THE EDITOR (AUGUST 24, 2017) CONCERNING THE PAPER "OCCUPATIONAL EXPOSURE TO RADON FOR UNDERGROUND TOURIST ROUTES IN POLAND: DOSES TO LUNG AND THE RISK OF DEVELOPING LUNG CANCER"

Dear Editor,

We are writing with regard to the paper authored by Walczak et al. entitled "Occupational exposure to radon for underground tourist routes in Poland: Doses to lung and the risk of developing lung cancer" [1]. The authors of this paper evaluated the radon concentrations in 31 Polish underground tourist routes and calculated the equivalent dose to the lung. They also calculated the effective dose and the relative risk of lung cancer for the employees. The authors have reported that the relative risk of developing lung cancer for the people working in underground tourist routes was higher than for the general population. They have also reported that after 40 years of work, exposure to radon would be the cause of lung cancer in 42.3% of the cohort of all employees of the surveyed tourist routes. The authors used the Biological Effects of Ionizing Radiation (BEIR) VI Report [2] model for calculating the relative risk of developing lung cancer.

This paper has some major shortcomings. The first shortcoming comes from the assumed model which does not have supporting evidence. The BEIR VI report stated that based on the analysis of available residential radon studies, it could not determine the shape of dose-response and so it decided to utilize the linear no-threshold (LNT) model to estimate the lung cancer risk from residential radon. The report dismissed the ecological study of Cohen [3] (that showed the invalidity of the LNT model) by claiming that confounding by smoking can explain the reduction of lung cancers observed by Cohen with increasing radon levels. Such a criticism is not valid, and confounding by smoking cannot explain the observations, as described by Siegel et al. [4].

Since the time of the BEIR VI report, numerous studies have shown a negative correlation between lung cancer mortality and radon concentration. For example, the retrospective case-control study by Thompson et al. [5] showed substantial reduction of lung cancer rates between radon levels of 50 Bq/m^3 and 123 Bq/m^3 relative to a group at 0–25 Bq/m^3. Analogous findings were reported by other authors as described by Becker [6]. A recent study by Denton et al. has also shown reduction of lung cancers with increasing radon levels in Guam [7] whereas pooled studies [8,9] have claimed increased lung cancers with increasing residential radon levels, the Bayesian analysis of many of those studies [10] shows that the collection of published data does not support a conclusion that below 800 Bq/m^3 lung cancer risk increases with radon concentration. Furthermore, Scott's analysis of both residential and uranium miner data clearly shows that beneficial effects are observed for a broad range of radon concentrations [11].

In addition to the radon concentration, comparison of underground and aboveground radon dosimetry is complex and depends on a number of factors. The paper does not convincingly account for differences in occupancy factors, attached and unattached fractions, ambient dust size distributions, particle shape distributions, age distributions, concentrations of other inhaled materials, and ventilation characteristics that describe the underground and aboveground environments [12,13]. Although the Ramsar (Iran) factors noted below constitute the dominant consideration, these other factors must be addressed before drawing specific dosimetry conclusions.

One major problem with many radon studies is that they are very much under-powered, resulting in uncertain and contradictory conclusions. Another problem with many of the studies is that they have utilized the LNT model as an integral part of the analysis [4], and so are deeply flawed, since much evidence has accumulated against the LNT model over the years [14].

Additional evidence against the LNT model is provided by the study of populations who live in high background radiation areas (HBRAs) of Ramsar, the city which lies on the coast of the Caspian Sea. Residents of the HBRAs are exposed to indoor radon (^{222}Rn) levels up to 31 000 Bq/m^3 [15], which is more than 200 times higher than the action level suggested for radon by the United States Environmental Protection Agency (US EPA) (148 Bq/m^3) [16]. Data obtained from the Ramsar health network has shown that age-adjusted lung cancer rates in the district with the highest recorded levels of radon concentration are lower than those of the other 7 districts [17].

It has, indeed, been standard practice to use measured radon data with the LNT model to estimate lung cancer risk, for example in the recent publication by Axelsson et al. [18]. Though it is standard practice, it is not correct because the LNT model is not supported by evidence.

In summary, the use of the LNT model to estimate lung cancer risk due to radon in this study is not justifiable. A proper model that takes into account the observed reduction of lung cancers in residential areas with higher radon levels should be utilized to estimate the lung cancer risk due to occupational exposure to radon for underground tourist routes in Poland.

Key words:
Occupational exposure, Radon, Lung cancer, Risk, Poland, Underground routes

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