Correcting for Exposure Measurement Error in a Reanalysis of Lung Cancer Mortality for the Colorado Plateau Uranium Miners Cohort

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ABSTRACT

The exposure estimates used to date for the analysis of lung cancer mortality in the Colorado Plateau Uranium Miners cohort were developed from radon progeny measurements taken in mines beginning in 1951. Since uranium miners were often exposed over long periods of time and since mines were not continuously monitored, much extrapolation and/or interpolation of measured dose-rates was needed in order to develop estimates of exposure for each of the miners in the cohort. We have recently re-examined the interpolation scheme used to create the histories in the light of the fit of a statistical model for the radon progeny measurements taken in mines within the Plateau, and we have computed revised exposure estimates for the large majority of miners in the cohort. This report describes the use of these new model-based revised exposure estimates in the analysis of lung cancer mortality, using follow-up data current through 1990. Specific issues addressed here are (1) the strength of the association between exposure and risk of lung cancer mortality; (2) effects of attained age and time since exposure upon risk of lung cancer mortality; and (3) exposure-rate effects upon risk. Results using the revised exposure estimates are compared to those obtained fitting the same models using the original Public Health Services (PHS) exposure estimates. We found evidence that new exposure histories provide a better fit to the lung cancer mortality data than do the histories based upon the original PHS dose-rate estimates. In general, the new results show a stronger overall relationship (larger slope estimate) between lung cancer mortality and exposure per unit exposure compared to those obtained with the original estimates, while displaying similar age at exposure and time since exposure effects. In the reanalysis the impact of low dose-rate exposure is found to be relatively unchanged before and after exposure error correction, while the estimate of the effect of high dose-rate exposure is considerably increased. Even after applying our measurement error corrections, evidence of inverse dose-rate effects is found, since the estimate of the impact of high dose-rate exposure is still below that of the low dose-rates. The magnitude and statistical significance, however, of the dose-rate effect estimates are diminished when fit using the revised exposure estimates.

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