A DIOXIN DOSE-RESPONSE CALCULATION FROM PUBLISHED EPIDEMIOLOGICAL DATA

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Introduction

Some epidemiological studies [1, 2, 3] have suggested that occupational exposure to 2,3,7,8-tetrachlorodibenzo-p-dioxin increases the risk of death from lung cancer or from all cancers together. A multiplicative dose-response model is used to estimate the dependence of death rate on degree of dioxin exposure.

Materials and Methods

Aylward et al. [1] and Flesch-Janys et al. [3] give estimated time-integrated dioxin concentrations in serum lipids for subgroups of the NIOSH study cohort and a cohort of German workers, respectively. The time-averaged concentration is calculated from these data. A formula for steady-state concentration as a function of dioxin intake is used to calculate an intake dose which would produce a steady-state concentration equal to the time-averaged concentration. This intake average daily dose (IADD, units of pg/kg/day) is used as the dose variable in a dose-response calculation. The ratio (number of expected cancer deaths in an exposure group)/(number of deaths expected with no exposure) is assumed to increase linearly with dioxin exposure, with the rate of increase described by a slope constant b. The number of observed deaths in a group is assumed to be Poisson distributed with mean equal to the number of expected deaths in that group. The number of expected deaths depends on the slope constant b, which is computed by maximum likelihood estimation. The increase in lifetime cancer risk per pg/kg/day dose is obtained by multiplying b by the background lifetime risk of death from cancer.

Results and Discussion

The data from the NIOSH cohort study give a increase in lifetime risk of death from lung cancer of 1.24×10^{-4} per pg/kg/day. The German cohort data give an increase of 1.2×10^{-3} per pg/kg/day. Combining the two data sets gives an increase of 1.36×10^{-4} per pg/kg/day. The increases for the NIOSH data set and the combined data sets are significant at the 5% level; the increase for the German data set is not.

The data from the NIOSH cohort study give a increase in lifetime risk of death from all cancers of 4.77×10^{-4} per pg/kg/day. The German cohort data give an increase of 6.8×10^{-3} per pg/kg/day. Combining the two data sets gives an increase of 5.69×10^{-4} per pg/kg/day. All increases are significant at the 5% level.

References

1. Aylward LL, Hays SM, Karch NJ and Paustenbach, DJ; *Environ. Sci. Technol.* **1996**, 30, 3534

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3. Flesch-Janys D, Steindorf K, Gurn P and Becher H; *Environ. Health Persp.* **1998**, 106 Suppl 2, 655