Estimation of Exposure Concentrations of Toluene Using Multiple Regression Analyses of Five Biological Exposure Indicators

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Abstract

In order to estimate exposure concentrations of toluene from its five biological exposure indicators, multiple regression analyses (MRA) were performed. Single correlation analyses showed that the five biological indicator variables were significantly correlated with exposure concentrations of toluene. The multiple correlation coefficients of biological exposure indicator were higher than the single correlation coefficients for each individual indicator. Biological indicators for eight hours were used for the MRA, except for blood toluene (TOL-B) where values for the last four hours of the shift were used.

For the MRA using two variables, the multiple correlation coefficient (M-r) of toluene in exhaled air (TOL-EXH) and hippuric acid in urine (HA-U) with exposure concentration of toluene (TOL-EXP) was 0.914, and the highest among MRAs using two variables followed by the M-r of TOL-EXH and urinary o-cresol (CR-U). Concentrations of TOL-EXH, TOL-U and TOL-B are closely correlated with each other. Therefore, HA-U or CR-U and any one of TOL-EXH, TOL-U and TOL-B are appropriate for use as the variable in MRA. For the MRA using three variables, the M-r of toluene in urine (TOL-U), HA-U and CR-U with TOL-EXP was 0.778. For the MRA using four variables, the M-r of TOL-EXH, TOL-U, HA-U and CR-U with TOL-EXP was 0.945, the highest M-r using four variables. In the case of five variables, the M-r of TOL-EXH, TOL-B, TOL-U, HA-U and CR-U with TOL-EXP were 0.946. For evaluation of the MRA, M-r square adjusted, P value by F test and Akaike's information criterion were applied.