A Simplified Estimation of Loss of Life Expectancy (LLE) Using Rectangular Approximation Method

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In order to evaluate the effects of short exposure period using a simple methodology, a plain rectangular approximation method to estimate loss of life expectancy (LLE) was devised and applied to evaluate cancer risk. The posed risk was expressed as the time of LLE, which is proportional to the period and concentration of exposure. This method assumes a rectangular survival curve and a flat cancer risk for all ages. In the survival curve, the survival rate of the population studied declined due to the risk such that the new survival curve became a trapezoid. The area difference between the initial rectangle and the trapezoid was converted to an LLE value. Lifetime exposure to the acceptable level concentration (ALC), which is equivalent to a $10^{-5}$ lifetime cancer risk, gave the base LLE, which was calculated to be 210 min. Exposure to the ALC between the ages of 20 and 25 years resulted in an LLE of 18.9 min, which is 9.0% of the base risk. One minute of exposure to carcinogens at 1000×ALC is equivalent to an LLE of 0.0075 min. Considering that the ALC of benzene is 2 μg/m$^3$, 1 min of exposure to 267 mg/m$^3$ benzene is equal to 1 min of LLE, which is as toxic as “smoking tobacco.”

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