Mercury concentration in human body: A new model for European populations affected by mercury chronic exposure

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Abstract

The dynamics of total mercury concentration in the human body is analysed by using a biologically based dynamic model, which is modified to consider the inputs via ingestion of both methylmercury and inorganic mercury. The modified biologically based dynamic (MBBD) model is used to reproduce the methylmercury and inorganic mercury concentrations in biological matrices and in main organs of European populations living in countries where chlor-alkali plants are located. The MBBD model inputs are the weekly intake of methylmercury and inorganic mercury estimated by EFSA for each European population and each age class. The calibration procedure of MBBD model parameters is based on the experimental datasets published in previous works, and the metabolism difference between the two genders is considered. The model is validated by using the total mercury concentrations measured in biological matrices, i.e. blood, urine and hair, collected in the adult population residing in the Augusta Bay between October 2012 and April 2013. The model results indicate that the total mercury concentrations in blood and urine of populations residing in Italy and Spain are higher than the risk level 1 fixed by Human Biomonitoring Commission and World Health Organization, while the total mercury concentration in urine is above the reference value fixed for Italian population. Conversely, the total mercury concentrations in biological matrices of the other European populations are below the risk level 1 and close to reference values although many chlor-alkali plants are located in these countries. These theoretical results are likely connected with the uncontrolled discharge of huge mercury amounts in aquatic ecosystems of Italy and Spain during the last decades, and the diet of Italian and Spanish populations characterized by higher consumption of seafood products respect to other European populations. Also, the high methylmercury concentrations in major organs of Italian and Spanish populations obtained numerically are enough to cause adverse effects on the liver, reproductive organs and nervous systems, while the high inorganic mercury concentrations in kidneys, obtained considering the methylmercury metabolism, can be responsible for diseases in this organ. The MBBD model could become a useful tool for studying and preventing diseases associated with mercury pollution in highly industrialized areas under chronic exposure conditions.

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