Intra-individual variations in hair minerals measured by PIXE in relation to epidemiological risk assessment of atopic dermatitis

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Abstract

Since 2005 we have been conducting a cohort study of 834-mother-infant pairs to determine the association between hair minerals at one month and the onset of atopic dermatitis (AD) at ten months after birth. Thirty-two minerals were measured by PIXE (particle induced X-ray emission) method. Yamada et al.[1) 2)] described a logistic model with explanatory variables Selenium (Se), Strontium (Sr) and a family history of AD whose performance in predicting the risk of AD was far better than that of any similar study.

In this initial research, we didn't consider the reliability of the measurement, namely intra-individual variations. Statistically, intra-individual variations should attenuate risk estimates if simply ignored. Therefore, we carried out the additional survey for 6-year-old children from our original cohort sample and divided each child's hair to make two specimens for PIXE analysis.

This paper focuses Baby-Sr levels which are not distributed as normal (or lognormal) and require sophisticated modeling of the variations. We develop the "true-equivalent sample (TES)" method and determine the inter-individual distribution as well as the intra-individual variance of Baby-Sr. The TES method appears to be also useful for determining the distribution of other minerals and obtaining an association between minerals and diseases overcoming the intra-individual variations. This will allow the PIXE method to play a more important role in medical and epidemiological research.