Abstract

Association of age and sex with plasma and urine metabolite profiles from healthy humans

Manuela J. Rist[1], Alexander Roth[1], Lara Frommherz[2], Christoph H. Weinert[2], Diana Bunzel[2], Carina Mack[2], Björn Egert[2], Achim Bub[1], Ralf Krüger[1], Benedikt Merz[1], Sabine E. Kulling[2], Bernhard Watzl[1]

[1] Department of Physiology and Biochemistry of Nutrition, [2] Department of Quality and Safety of Fruit and Vegetables, Max Rubner-Institut, Haid-und-Neu-Str. 9, 76131 Karlsruhe, Germany

It has been shown that the human metabolome is influenced by age and sex. Most studies, however, have based their findings on either plasma or urine samples and have used only one analytical technique. Therefore, the goal of this study was to identify metabolite patterns that are associated with age or sex of healthy humans based on plasma and urine samples that were analysed with a combination of different analytical techniques.

In the cross-sectional KarMeN study (Karlsruhe Metabolomics and Nutrition) 301 healthy male and female participants, aged 18 – 80 years, were included. Volunteers were examined under strictly standardized conditions. In addition to the determination of numerous anthropometric and functional parameters, fasted plasma and 24h urine samples were collected and analysed by targeted and untargeted metabolomics methods using GC×GC-MS, GC-MS, LC-MS and NMR. Predictive modelling was applied on the combined data using the following machine learning algorithms: SVM, glmnet and PLS.

Based on combined metabolite profiles, it was possible to predict age in men and women with high accuracy from urine as well as plasma. Besides a number of unknown analytes, some metabolites important for this prediction could be identified, such as creatinine and sedoheptulose in urine. Classification of volunteers according to sex was also possible with high accuracy based on urine and plasma metabolite profiles. Plasma metabolites important for correct classification included creatinine and the branched-chain amino acids valine, leucine and isoleucine.

These results confirm that age and sex are associated with metabolite patterns of healthy humans. Many of the metabolites identified in the present study have been described in the context of age and sex before, pointing at robust associations with age and sex. These need to be considered in nutritional metabolomics studies that include volunteers of both sexes and different age ranges.