The possibilities of biological monitoring shall be shown on hand of such carcinogenic substances that are of great relevance for public health. Internal exposure and biochemical effects of groups of the general population shall be shown on hand of polyaromatic hydrocarbons (PAH), aromatic amines, acrylamide, tobacco smoke, etc.

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Assessment of occupational exposures and biological variability by using biological monitoring

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Biological monitoring (BM) and biomarkers are used in occupational toxicology for a more accurate risk assessment of groups of workers. Although acceptable exposure limits have been fixed for the working environment, it has become clear that various factors can affect exposure, including additional skin absorption, differences in individual uptake, the degree of working practice, different workload, and the use of personal protection devices. BM is mainly aimed at (i) defining the existence of an occupational exposure; (ii) quantifying the level of internal dose; (iii) verifying that exposure limits (BEI®, BAT, BLV) are respected. As compared to ambient monitoring, BM is more expensive and complex. Several biomarkers are available for the same chemical and the meaning of the marker may depend on the sampling time. Therefore, practical issues, including cost and selection of an adequate sampling strategy, should be dealt with when planning a BM program for specific purposes. In addition, several biological and analytical sources of variability may influence biomarker levels, thus making the interpretation of BM data a difficult task. If analytical variance could be kept under control by quality assurance programs, inter-individual differences in uptake, biotransformation, susceptibility to damage, and repair capacity can result in different dose–response relationships for different groups of individuals. However, we should recognize that the main aim of BM is not to reduce, but to explain biological variance. Finally, the decreasing trend in occupational exposure levels highlighted the specificity problems of traditional biomarkers of exposure and prompted the research to the development of new biomarkers, e.g. unchanged volatile compounds in urine, minor metabolites, DNA and protein adducts. Depending on the scope and context (research or routine) different requirements of biomarkers can be envisaged in terms of validation and acceptable variability.

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Monitoring of genetic effects of occupational toxicants and modulating factors

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Sequence variations in a number of genes for DNA repair and phase I/phase II metabolising enzymes have recently been studied in many biomonitoring studies as putative biomarkers of individual susceptibility to cancer (and possibly other diseases), measured alongside markers of exposure and effect. This facilitates the quantification of potential risk of exposure at the level of individuals. We are monitoring single nucleotide polymorphisms (SNPs) to investigate how environmental exposure, nutrition and genetic factors together can influence genomic stability. This molecular epidemiological approach will allow us to assess the potential risk of environmental exposure and other factors at the level of individuals.

We conducted a biomonitoring study in three factories in Slovakia producing asbestos, glass fibres and rockwool. Altogether 239 exposed and 148 controls were investigated. Polymorphism in glutathione *S*-transferase *GSTP1 a* and *b* were determined in the A → G transition at nucleotide +313 by PCR. *GSTM1 and GSTT1* deletions were characterised by multiplex PCR. SNPs in five DNA repair genes were also determined: *XRCC1* (exon 10, G/A, Arg399Gln); *XPD* (exon 10, G/A, Asp312Asn and exon 23, A/C, Lys751Gly); *XPA* (5′ non-coding region, 23A/G); and O^6-methylguanine-DNA methyltransferase (*MGMT*, promotor-enhancer, 1099C/T). We also measured DNA damage (strand breaks, base oxidation and alkylation, using modified comet assay); individual DNA repair capacity in lymphocyte extracts; micronuclei and chromosome aberrations; cellular defences (intrinsic antioxidants, antioxidant enzymes); humoral and cellular immune markers, growth factors and proinflammatory mediators.

We analysed the association between SNPs in repair genes and the various biomarkers of DNA stability,