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Clinical effects and gene expression profiles in human volunteers in an office test room following three-day exposure to laser printer emissions

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Background & Aim: Laser printers release aerosols into the environment including solid, liquid and gaseous compounds. The side effects possibly caused by these aerosols are having come under scrutiny. To investigate clinical effects and gene expression profiles we conducted a controlled human exposure study with laser printer emissions in an office test room.

Methods: Eight healthy volunteers were exposed to laser printer emissions in 3 hour experiments under controlled conditions in an 80 m^3 office test room over three consecutive days. Lung functions and FeNO and inflammatory blood parameters were examined before and after exposure. Microarray experiments were conducted with peripheral venous blood using a whole genome gene chip.

Results: Mean sub micrometer particle (SMP) concentration during printing activities in the test room reached 15379±2799 P/cm^3 (background: 1904±540 P/cm^3). Lung function and blood parameters for inflammation (ECP, hsCRP) as well as FeNO showed no differences before and after exposure. The volunteers experienced temporary symptoms, such as irritation of the eyes, nose, throat and respiratory tract, coughing, headache and runny nose. We screened a total of 254 differentially expressed genes, of which 37 (15%) were down-regulated and 217 (85%) were up-regulated. Of the 217 up-regulated genes, 169 (78%) were directly related to an individual's immune regulation or response.

Conclusions: Laser printers emit SMPs particles during printing activity. The aerosols can induce irritation of eyes, skin and respiratory tract in the volunteers, but we cannot derive any severe acute dangerous health effects from the results of this study. The microarray study conducted here showed changes in terms of inflammation and immunological reactions in volunteers after exposure. Our results recommend that office workers should avoid laser printer emissions. Laser printers should be placed in a separate, well-ventilated room or at least equipped with appropriate filter techniques.

Recent Publications

1.Tang T, Hurraß J, Gminski R, Mersch-Sundermann V (2012) Fine and ultrafine particles emitted from laser printers as indoor air contaminants in German offices. Environ Sci Pollut Res Int.; 19(9): 3840-3849.

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2.Scungio M, Vitanzaa T, Stabilea L, Buonanno G, Morawska L (2017) Characterization of particle emission from laser printers. *Sci Total Environ*; 15(586): 623-630.

3.Karrasch S, Simon M, Herbig B, Langner J, Seeger S, Kronseder A, Peters S, Dietrich G, Gumperlein R, Schierl R, Nowak D, Jorres R A (2017) Health effects of laser printer emissions: a controlled exposure study. *Indoor Air;* 2017: 1-13.

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Biography

Volker Mersch-Sundermann is an expert on mutagenicity, genotoxicity and carcinogenicity of (airborne) environmental chemicals, especially indoor air pollutants. His particular area of expertise is particle toxicology; i.e., molecular mechanisms of fine and ultrafine particles (nanoparticles) responsible for mutagenicity and DNA damage in (cells of) the human respiratory tract. He is currently a Full Professor at the Faculty of Medicine, University of Freiburg, Germany and Head of the Institute of Environmental Health Sciences, Medical Centre, University of Freiburg in Germany.

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