Immunomodulatory effects of short-term exposure to fine particulate matter from smog episode in Ostrava region: *in vitro* study

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Many efforts were devoted to reduce air pollution in industrialized countries during the past few decades in response to findings that heavily polluted air is significantly associated with increased morbidity and mortality of exposed population (Pope et al., 1992; Dockery et al., 1993). However, despite these attempts, there are still many regions, where extended presence of air pollution sources hampers to achieve air pollution levels considered to be without significant adverse impact on human health.

An example of such a region, where limit values for PM_{10} and $PM_{2.5}$ recommended by WHO guidelines, as well as national legislative limits, are regularly exceeded, is the Ostrava region. The Ostrava region is located in the northeast of the Czech Republic and represents an area with one of the most polluted air in Europe. This undesirable state is caused by geomorphological and meteorological conditions of the Ostrava basin in combination with various and numerous air pollution sources. Temperature inversion occurring during the winter season further contributes to the accumulation of air pollutants by constraining their dispersion. Under inversion conditions, concentrations of $PM_{2.5}$ can achieve few hundreds $\mu g/m^3$.

Thus, population in Ostrava is exposed to high concentrations of airborne particles with diverse sizes and chemical compositions. Other pollutants present in the air can bind to the particle surface and together, they form a "chemical cocktail", a multicomponent mixture whose adverse health effects are difficult to predict or estimate from measurement of PM concentrations in the air. Data from epidemiology studies suggest the adverse health impact on the local population and shortened life expectancy associated with heavy pollution by airborne particles (Tomášková *et al*., 2007).

The precise mechanisms of how inhaled airborne particles exert their adverse health effects remain still unclear. However, recent research suggests the crucial role of the immune system in the development, as well as in the worsening of many serious pulmonary and cardiovascular disorders (Seaton *et al*., 1999; Li *et al*., 2008).

The presented study was aimed at *in vitro* evaluating of potential harmful health effects of a fine particulate matter sample ($PM_{2.5}$) mediated through changes in various types of the immune response. The tested particle sample was collected during a smog episode in Ostrava-Radvanice and represents real airborne particulate matter to which the population in the Ostrava region is exposed during inversion situations. Using four *in vitro* immunological assays, we evaluated the changes in selected parameters of the immune response (reactive oxygen species generation, allergenic properties, T-lymphocyte proliferation, selected cytokine release), which could serve as markers of non-specific adverse action of particulate matter on human health.

Even if certain immunomodulatory effects of airborne particles were observed, changes in evaluated immune response parameters were not significant to prove impact on the immune cells´ functions of healthy persons during short-term exposure. Obtained data indeed cannot exclude health risks of long-term exposure to airborne particles, especially for individuals with genetic predisposition to certain diseases or already existing disease.

This study emphasizes the *in vitro* assessment of complex effects of airborne particles in conditions similar to actual ones in an organism exposed to particle polluted air.

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