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Effects on heart rate variability of exposure to nano-sized airborne particles

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Airborne particles cause increased morbidity and mortality due to respiratory and cardiovascular diseases in polluted areas (Brook et al. 2004). There is a growing interest in the effects of exposure to particles with diameter < 100 nm. Most of the knowledge is based on epidemiological studies. There is a need for methods for controlled studies for risk of cardiovascular disease. Heart rate variability (HRV) is a non-invasive method for cardiovascular risk prediction. The aim of the study was to evaluate the impact of nano-sized particles on heart rate variability.

Exposures were performed as controlled chamber experiments with particle exposure from burning candles, terpen+ozon-reactions (female=22, mean age 31 yrs), welding (male=31, mean age 46 yrs), or filtered air in a double-blind cross over fashion. The participants (n=53) were healthy with normal ECG and without medication. After a period at rest of 10 minutes, time series of heart beats were collected (sampling frequency 200 Hz), during 10 minutes of different exposures. Various spectral components of the HRV were calculated mirroring different aspects of autonomic influence on the cardiovascular system. Mean particle number and mass concentrations during exposure were for welding 67 000 #/cm³, 100 µg/m³, burning candles 907 000 #/cm³, 200 µg /m³ and terpen+ozon 28000 #/cm³, 70 µg/m³, respectively.

During all exposures heart rate remained stable and unchanged from baseline values in all groups. There was no impact on HRV of repeated visits in the chamber. Burning candle tended to decrease power in low (LF) spectral band (p=0.056) while there were no changes in HRV parameters during terpen+ozon or filtered air. During welding, the inter-individual variability in total power (TP) of HRV were less prominent together with a more pronounced decrease (p=0.018) in LF in contrast to filtered air. The welders were more reactive in the HF power during filtered air (p=0.0004) (Figure 1), while no significant changes were noted during welding smoke exposure.

Exposure to nano-sized particles of burning candles and welding seem to have an impact on heart rate variability in healthy individuals, most prominent in a group of male welders, mediated by different aspects of autonomic cardiovascular control. Due to the biological individual variance of HRV and the

complexity of autonomous nervous control, these results need to be verified in further studies.

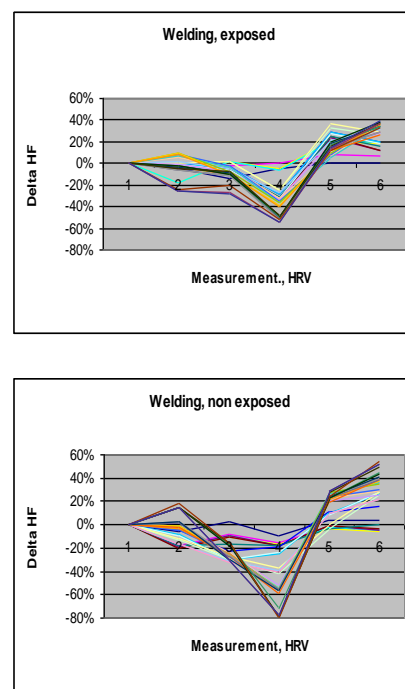


Figure 1. High Frequency variations, representing parasympathetic modulation of the heart frequency, for a selection of welders when exposed and not exposed. The variability is less when exposed, indicating that the heart then has less ability for autonomous modulation. Three test persons at the time were sitting in the chamber. Exposure time was 5 h. Six ECG records were performed, Nr 1 before exposure started and Nr 6 after exposure. Nr 4 was after a lunch break.

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Brook R.D., Franklin B., Cascio W., Hong Y.L., Howard G., Lipsett M., Luepker R., Mittleman M., Samet J., Smith S.C. & Tager I. (2004) *Circulation* 109, 2655-2671

