

Ultrafine particles in the air – what has been studied epidemiologically to date?

<http://ludok.swisstph.ch> – E-mail: ludok.swisstph@unibas.ch

Kutlar Joss Meltem^{1,2}, Dyntar Daniela^{1,2}, Rapp Regula^{1,2}.

¹ Swiss Tropical and Public Health Institute, Basel, Switzerland, Department of Epidemiology and Public Health

² University of Basel, Switzerland

Background

Since 1985 the documentation database of 'LUDOK: Dokumentationsstelle Luft und Gesundheit' selects, categorizes and summarizes relevant international research papers on the topic of air pollution and health outcomes on behalf of the Swiss Federal Office of the Environment (BAFU: Bundesamt für Umwelt). The number of population based studies published on the effects of ultrafine particles on human health is increasing. We aim to give an overview on the current state of knowledge.

Methods

From a monthly systematic search query in PubMed and alerts from important journals the research team selects continuously relevant papers for the LUDOK database. This database has been searched for papers that studied (up to May 2015) health effects of ultrafine particles, measured as number of particles usually of less than 100 nm in diameter. Publications which have studied combined effects of ultrafine particles and other air pollutants have been examined more closely.

Results

Studied Health Effects	Duration of Exposure:	
	short-term	long-term
Mortality	10	----
Cardiovascular Diseases and Parameters	53	1
Biochemical or Cellular Changes	37	1
Respiratory Health (Lung function, Respiratory Diseases)	21	2
Emergency or Hospital Admissions	12	----
Others (Skin, Depression, Brain function)	1	2
Total	134	6
Multipollutant Models applied	10	----

Tab. 1: Number of publications on health effects and ultrafine particles (PNC) in LUDOK since 2007

To date, the database contains over 4000 articles on particles, around 400 of them deal with ultrafine particles (UFP) and their impact on health. After excluding cell and animal studies, overviews and discussions and concentrating only on studies which have applied as indicator for UFP the number of particles (PNC), about 170 publications remain. Since 2007 these studies have been included more systematically and are presented in detail (Tab 1). Almost all of them studied short-term effects (hours to days) of ultrafine particles on health. Twelve short-term, but none of the long-term studies, analyzed associations of health effects with PNC while simultaneously adjusting for other pollutants from similar sources or with similar spatial resolution (Tab 2).

Year	First Author	Significant PNC-Effect in single pollutant model	Multipollutant model with	independent (0=dependent)	partially independent
2008	Halonen JI	Emergency Room Visits for Asthma and COPD	NO2/PM2.5/PMcoarse/CO	0	
2011	Leitte AM	Respiratory Emergency Room Visits	PM10/NO2		X
2010	Andersen ZJ	Hospital Admissions for Stroke	PM10/NOx/CO		X
2012	Strak M	Lung Function (FVC) and Airway Inflammation Marker (FeNO)	PM10/PM2.5/NO2/NOx/SO42-/NO3-/EC/OC/Metals		X
2013	Strak M	Thrombin Generation	PM10/PM2.5/NO2/NOx/SO42-/NO3-/EC/OC/Metals		X
2013	Steenhof M	Pro-inflammatory Markers (Blood and nasal lavage)	PM10/PM2.5/PM2.5-10/NO2/O3/SO42-/NO3-/EC/OC/Metals		X
2014	Gong J	Biomarkers for Cardiovascular Disease Risks (BP, sCD62P, vWF)	SO2/NO2/CO/O3/EC/OC		X
2014	Rückerl R	Blood Markers for inflammation and coagulation	PM2.5		X
2014	Steenhof M	White Blood Cell Counts	PM10/PM2.5/PM2.5-10/NO2/O3/SO42-/NO3-/EC/OC/Metals		X
2015	Sun Y	SDNN (Heart Rate Variability)	BC/NO2/O3/CO	X	

Tab. 2: All studies from 2007-May 2015 with significant ultrafine PNC (<100nm) Health Effects in the single pollutant model, which have used also multipollutant models, adjusting for other pollutants. 'Independent' = PNC-Effect is not changed by the other pollutant included in the model. 'Dependent' = The other pollutant in the model confounds the PNC effect. 'Partially independent' = The PNC-Effect remains unchanged with some but not all of the other pollutants, or only in subgroups, or in some but not all of the outcomes.

Conclusion

There is a gap in the current research on effects of ultrafine particles and their long-term effects on human health. Short-term effects have been studied more often. However, the independence of their effects from effects of other air pollutants still has to be evaluated. Whether the number of particles, a non-specific indicator for ultrafine particles, shows independent effects of other air pollution metrics still has to be shown in future research.