

Impact of Indoor Air Quality on Health

Prof. Dr. Ulrich M. Zissler

Technical University of Applied Sciences Rosenheim

Director of Technology Transfer Center (TTZ) &

Max Aicher Endowed Chair for Building Biology, Airway and Indoor Health

Universities of Giessen and Marburg Lung Center (UGMLC)

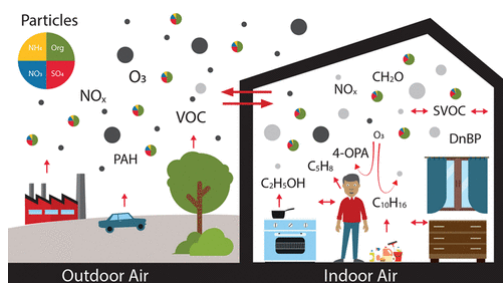
Institute for Lung Health (ILH), German Center for Lung Research (DZL)



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Impact of indoor air quality on health

Changes in building design starting after the 1930s

Goldstein AH, et al. *Envir Sci & Tech* 2020

- Buildings offer partial protection against pollutants of outdoor origin but enhance exposures to particles and gases that are emitted or produced indoors.
- Tighter building with lower heating or cooling costs -> attenuation of outdoor air vs concentration of indoor air
- Sources: Synthetic building materials, office machines, people, microbial reservoirs, and ventilation systems
- Contaminants: bioaerosols, CO, radon, and VOCs

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Common Indoor Air Pollutants with their pathogenic mechanisms

Indoor pollutants	Pathogenic mechanisms
 Volatile organic compounds	 Damage to epithelial barrier/epithelitis
 Cleaning agents	 Perturbation of the respiratory tract microbiome
 Pesticides	 Immune dysregulation, chronic and local systemic inflammation
 Mold/dampness	 Increased oxidative stress
 Microplastic	 Neurogenic dysfunction and inflammation
 Particulate matter	 Epigenetic and metabolic reprogramming
 Radon, asbestos	
 CO, NO ₂ , SO ₂ , CO ₂	

Agache I, et al, Allergy 2025

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Barrier Disruption

Journal of Molecular Medicine
<https://doi.org/10.1007/s00109-022-02182-7>

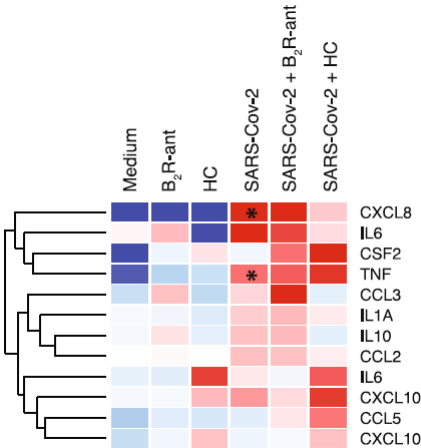
JMolMed

ORIGINAL ARTICLE

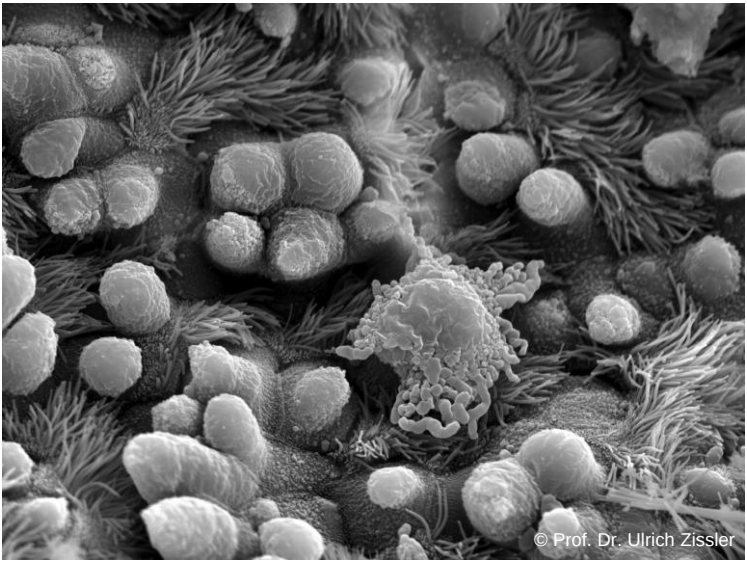
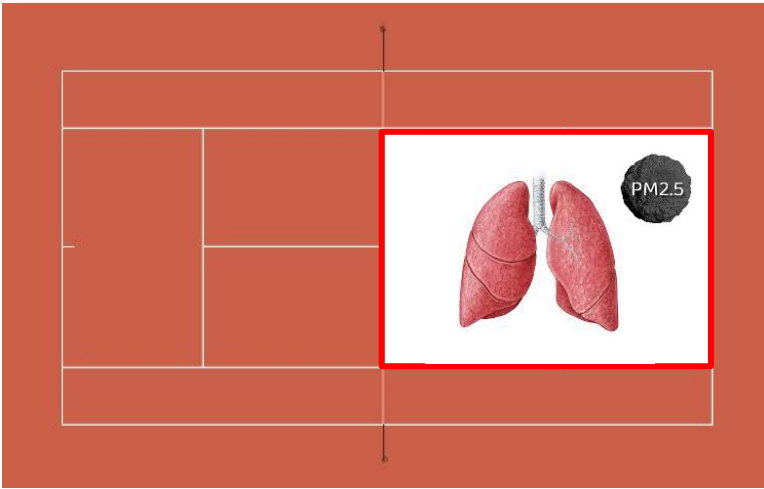


Early reduction of SARS-CoV-2-replication in bronchial epithelium by kinin B₂ receptor antagonism

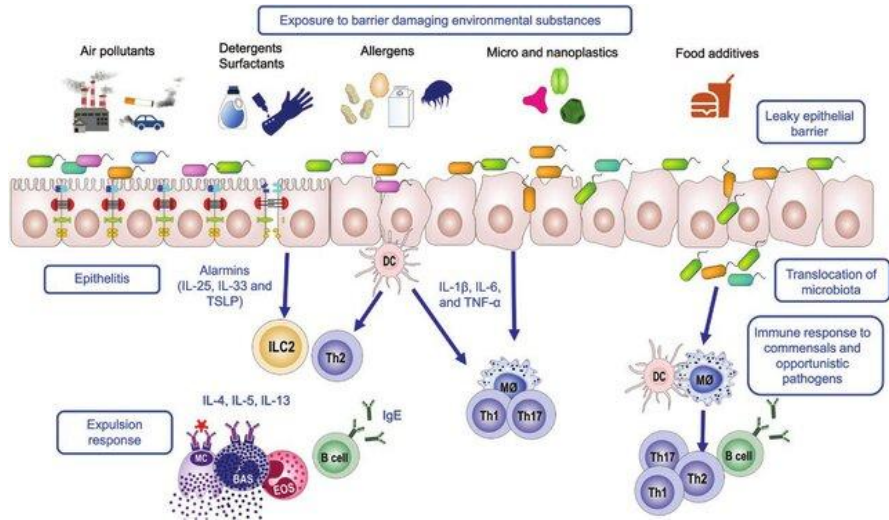
Constanze A. Jakwerth¹, Martin Feuerherd², Ferdinand M. Guerth¹, Madlen Oelsner¹, Linda Schellhammer³, Johanna Giggilberger^{1,6}, Lisa Pechtold⁶, Claudia Jerin^{1,6}, Luisa Kugler⁶, Carolin Mogler⁶, Bernhard Haller⁴, Anna Erb¹, Barbara Wollenberg⁶, Christoph D. Spinner⁷, Thorsten Buch³, Ulrike Protzer², Carsten B. Schmidt-Weber¹, Ulrich M. Zissler¹, Adam M. Chaker^{1,6}



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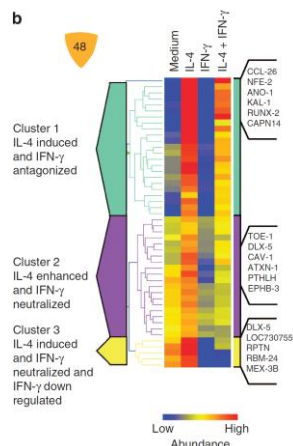


Common Indoor Air Pollutants with their pathogenic mechanisms

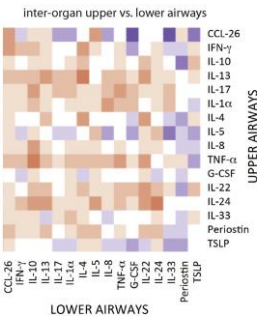


Pat Y, et al., Int Immunol 2024

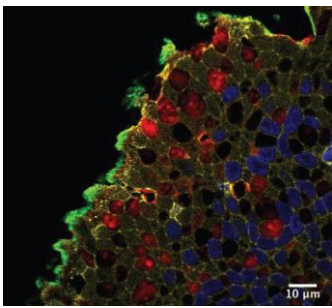
Impact of immune reactions on epithelial health



Zissler UM, et al. Mucosal Immunology 2016



Zissler UM, et al. J Allergy and Clin Immunol 2018

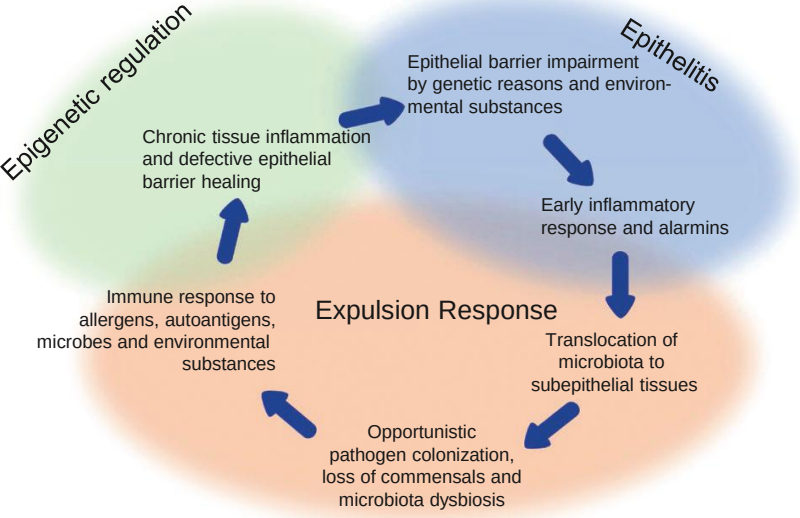


Zissler UM, et al. Allergy 2021

Epithelial barrier-damaging substances causing a vicious cycle

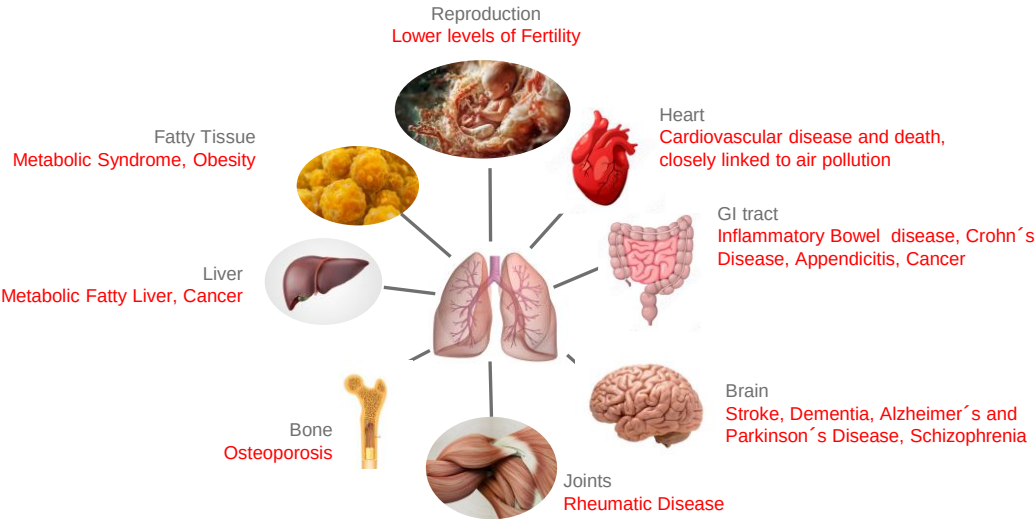
Epithelial Barrier
Damaging
Exposome

- Particles
- VOC
- Allergens
- Cleaning Agents
- Microplastics



Pat Y, et al., Int Immunol 2024

Ambient Air Pollution Effects



Impact of indoor air quality on health
Interaction between Fatty Tissue and Airways



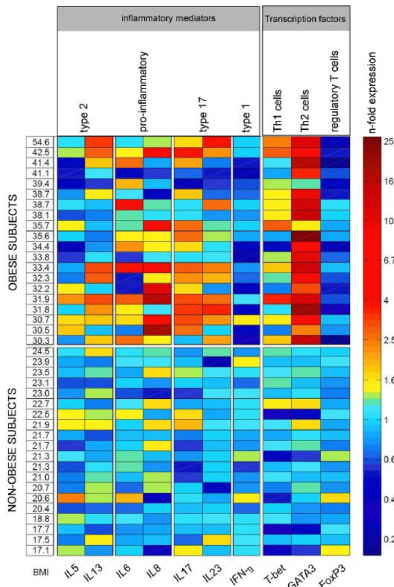
Proinflammatory pattern in the lower airways of non-asthmatic obese adolescents

Desiree Gutmann^{1,2}, Melanie Dressler^{3,4}, Olaf Eickmeier⁵, Eva Herrmann⁶, Marta Kirwil⁶, Ralf Schubert⁷, Stefan Zielhuis⁸, Ulrich M. Zissler⁹

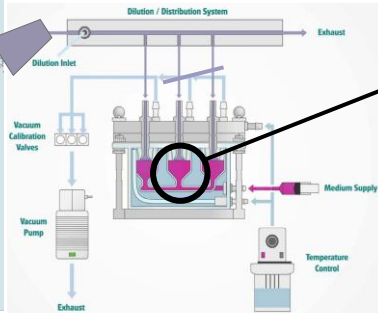
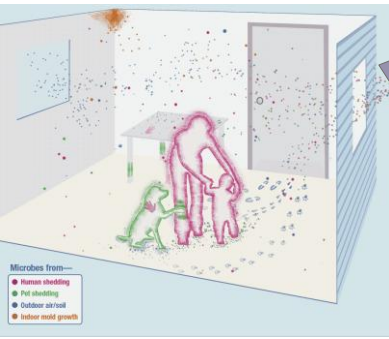
¹ Department for Children and Adolescents, Division of Allergology, Pneumology and Critical Illness, Goethe University, Frankfurt
² Institute of Biostatistics and Mathematical Modeling, Goethe University, Frankfurt, Germany
³ Center of Allergy & Environment (CAE), Technical University of Munich (TUM) and Helmholtz Center Munich, German Center for Environmental Health (GHEH)
⁴ Member of the German Center for Lung Research (DZL), CFAC, Munich, Germany

Patients' characteristics and differential sputum cell counts in induced sputum.

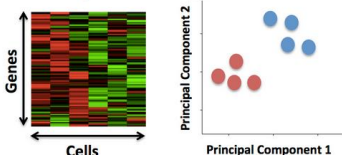
Parameter	Normal weighted control subjects (n = 20)	Non-asthmatic obese subjects (n = 20)	p-value
Age [years]	17.5 (15.3-20.1)	15.8 (14.3-18.9)	n.s.
Sex [f / m]	9 / 11	10 / 10	n.s.
BMI [kg/m ²]	21.5 (17.1-24.5)	35.0 (30.3-54.7)	<0.0001
FVC [% pred.]	106.3 (84.4-137.3)	113.0 (90.6-147.2)	n.s.
FEV1 [% pred.]	105.2 (81.6-140.1)	120.0 (96.8-166.2)	<0.05
FEV1/FVC	84.4 (80.8-95.4)	91.0 (74.5-97.2)	<0.05
PEF [pg]	2.84 (0.116-3.5)	2.16 (0.109-3.5)	n.s.
eCO [ppm]	2.1 (1.0-4.0)	2.9 (1.0-6.0)	n.s.
Serum CRP [mg/dL]	0.06 (0.00-0.90)	0.39 (0.02-1.85)	<0.001
Serum IL-6 [pg/mL]	3.39 (0.24-9.11)	15.02 (1.50-44.54)	<0.0001
Serum IL-8 [pg/mL]	9.09 (3.26-393.64)	27.99 (6.77-113.16)	<0.0001
Total IgE [kU/L]	29.2 (1.57-739.0)	23.5 (5.44-282.0)	n.s.
Cell Load [x 10 ⁶ /mL]	0.40 (0.01-1.32)	1.19 (0.03-2.40)	<0.01
Macrophages [%]	94.9 (83.5-96.7)	92.7 (86.2-96.2)	<0.05
Lymphocytes [%]	1.88 (0.25-6.50)	2.75 (1.25-8.25)	n.s.
Neutrophils [%]	2.38 (0.00-9.25)	2.75 (0.00-20.25)	n.s.
Eosinophils [%]	0.00 (0.00-2.00)	1.13 (0.00-8.50)	<0.001



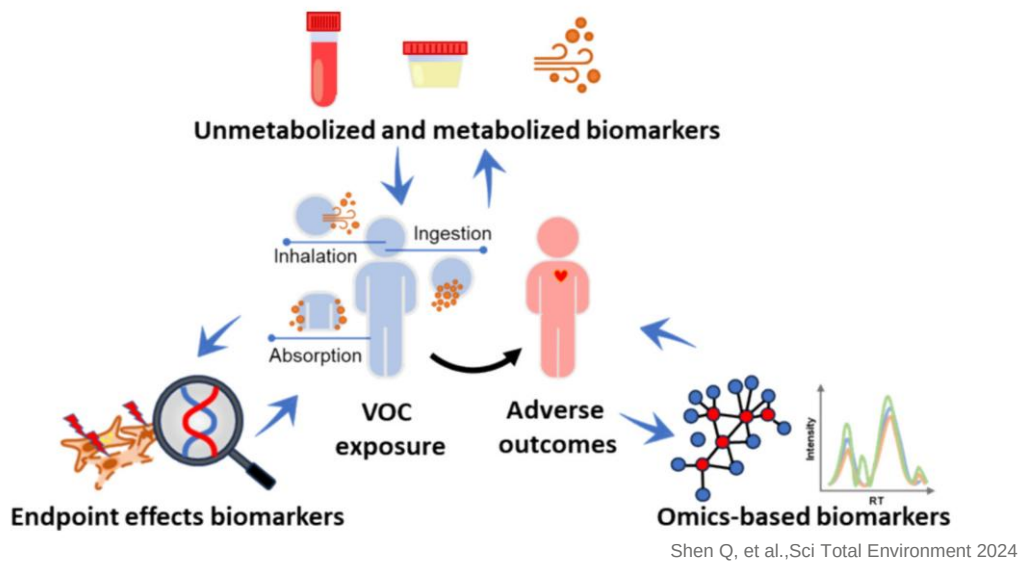
Impact of indoor air quality on health
Nexus of Outdoor Air Pollution, Indoor Environments, and Exposure



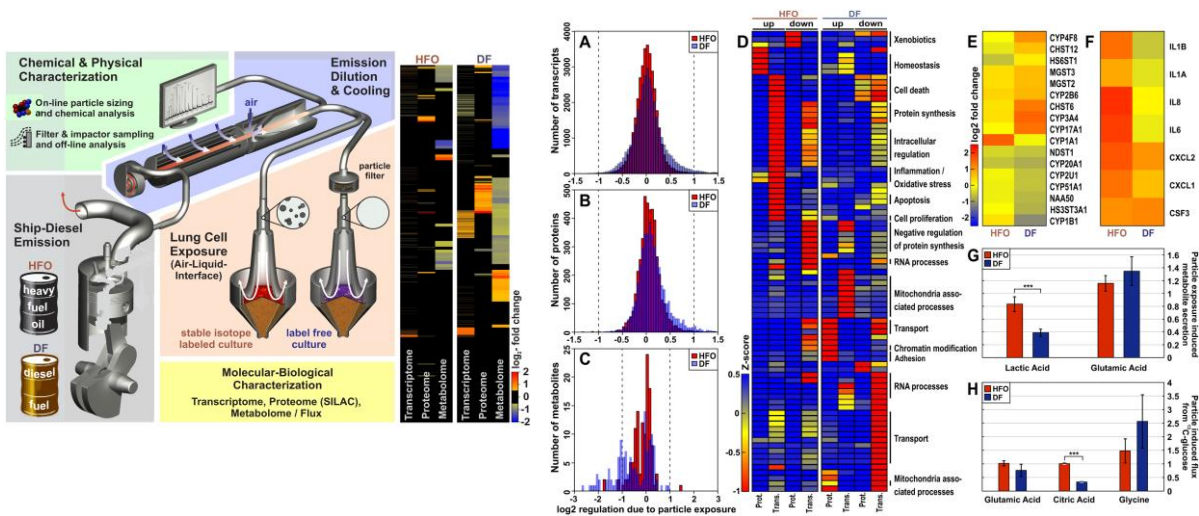
Compare gene expression profiles of single cells

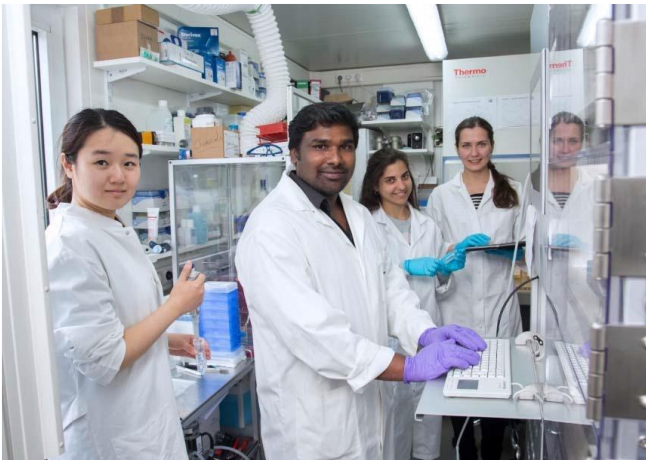


Impact of indoor air quality on health
Identification of molecular consequences



Impact of indoor air quality on health
Particulate Matter from Heavy Fuel Oil and Diesel Fuel Shipping Emissions





Heal the world



Contact Details

A circular portrait of a man with glasses and a beard, wearing a grey blazer over a black shirt.

Prof.Dr. Ulrich Zißler

Zentrum für Forschung, Entwicklung und Transfer

Direktor TTZ

ulrich.zissler@th-rosenheim.de

+49 (0)8031 / 805 - 2826