

A biomonitoring pilot study in workers exposed to pigment-grade titanium dioxide (TiO₂) during paints production

M. Buglisi, E. Bergamaschi, V. Bellisario, G. Garzaro, G. Squillacioti, F. Ghelli, C. Riganti, I. Fenoglio, G. Castrignanò, M. Macrì, S. Bonetta, E. Carraro.
Department of Public Health and Pediatrics, Department of Oncology and Department of Chemistry, University of Torino, Italy.

BACKGROUND

TiO₂ is broadly used in many applications, although it is classified as suspected carcinogen via inhalation. A NIOSH REL for UF TiO₂ has been set at 0.30 mg/m³, whereas the ANSES has proposed a Toxicological Reference Value of 0.12 µg/m³ for TiO₂-NPs as a threshold to prevent chronic lung effects.

AIM OF THE STUDY

To assess early pulmonary and systemic effects in workers with mild TiO₂ exposure during paint production.

STUDY GROUPS

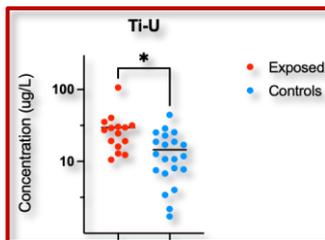
- 15 workers employed for 3-32 years in a plant producing paints and handling TiO₂ powders (SSA – BET: 56.2 m²/g) as a pigment
- 20 not exposed volunteers as a control group

EXPOSURE

- Respirable fraction of dusts in specific working areas and in the personal breathing zone (pbz) of workers.
- A NanoTracer™ was used to record background and pnc of UFP generated during the activities.

Company area / Type of sampling	Water based paint system	Quartz production plants	Grinding and dispersion	Admin. Office	Outdoor
Area monitoring Respirable dusts (mg/m ³ 8h-TWA)	0.064	0.013	0.112 – 0.137	0.033	
Area monitoring Respirable TiO ₂ (µg/m ³ 8h-TWA)	0.018	0.018 – 0.114	0.012 – 0.024	0.013	
PBZ - TiO ₂ µg/m ³ 8h-TWA	0.104 – 0.462	0.011 – 0.012	0.007 – 0.014	0.012	
Particle number concentration (avg aerod. diameter)	24,981-54,681 (64-73)	20,800 – 27,680 (78-93)	40,720-46,404 (65)	16,973 (71)	8,162 (72)

- Ti in urine as biomarker of exposure (ICP-MS)

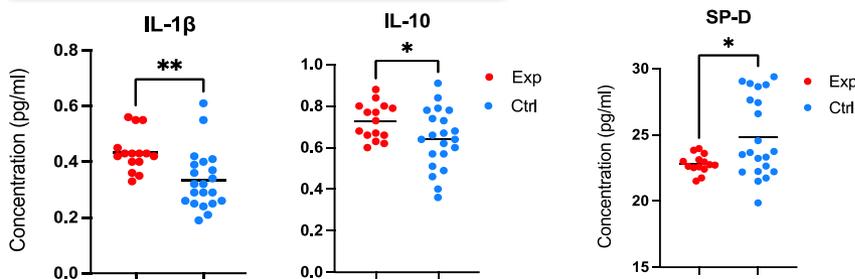


CONCLUSIONS

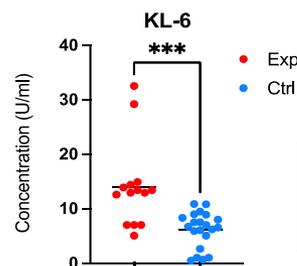
Biological sampling: exhaled breath condensate (EBC) by TURBO-DECCS™



Pro-inflammatory biomarkers in EBC



Surfactant protein D (SP-D) acts as a lung host defence protein and affects lung surfactant homeostasis



KL-6, a mucin-like glycoprotein reflecting changes of lung interstitium (pro-fibrogenic)

- ✓ Exposure to TiO₂ containing dusts well below the OELs, but close to the threshold for preventing fibro-proliferative and progressive alteration of epithelium, can result in subtle lung changes, as reflected by the increase in KL-6 and decrease of SP-D.
- ✓ A combined approach relying on both exposure assessment and biomarkers of effect can improve the risk assessment in occupational settings in which TiO₂ is handled, even though under strict control measures.
- ✓ Owing to the small number of subjects evaluated and the intrinsic variability of biomarkers, the observed changes along with their health significance must be assessed in a long-term perspective.