



Dist. Professor Magdalena Plebanski,

***Director:** Biomedical & Health Innovation Enabling Impact Platform (BHI-EIP)*

***Head:** Translational Immunology & Nanotechnology Theme & Cancer Ageing and Vaccines (CAVA) Research Group
School of Health & Biomedical Sciences, College of STEM*



RMIT University acknowledges the people of the Woi wurrung and Boon wurrung language groups of the eastern Kulin Nations on whose unceded lands we conduct the business of the University. RMIT University respectfully acknowledges their Ancestors and Elders, past and present. RMIT also acknowledges the Traditional Custodians and their Ancestors of the lands and waters across Australia where we conduct our business.

Nano/microplastics and the lung

Distinguished Professor Magdalena Plebanski

BScHon (Virology), Dip. St. (Psychology), MBA (Business), PhD (Immunology)

Director:

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Impact Platform (BHI-EIP)*

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Nanotechnology Theme
&
Cancer Ageing and Vaccines (CAVA)
Research Group*

*School of Health & Biomedical Sciences,
College of STEM*

Human trials,
Biomarkers,
LoC
Gold
drug
s

Vaccines,
Nanoparticles

What's next...

Cancer Ageing and Vaccines Research Group

Accelerator of Translational Research in Clinical Trials (ATRACT) Centre

School of Health and Biomedical Sciences, College of STEM



**CAVA Lab (key directly involved
in research shown)**

Dr. Kirsty Wilson
Dr. Jennifer Boer

Previous PhD Students

Dr. Amlan Chakraborty
Dr. Li Tan
Prof. Rohimah Mohamud

Prof. Magdalena Plebanski

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KEY COLLABORATORS

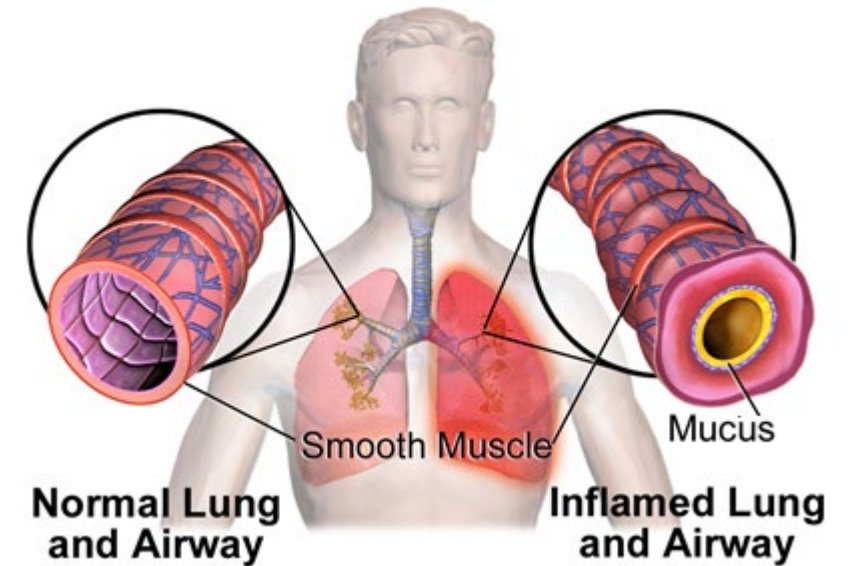
Only on Research Mentioned

Robyn O'Hehir
Jenny Rolland (Emeritus)
Charles Hardy
Cordelia Selomulya
Simon Royce
Jean-Pierre Scheerlinck
Deanne Greenwood
Rob Bischoff
Tim Moss
Deborah Glass
Martina Deaneekamp
Vasso Apostolopoulos

FINANCIAL SUPPORT

NHMRC, ARC, CRC for Asthma

- **1 in 7** Australians suffer from lung inflammation
- Chronic obstructive pulmonary disease (COPD) & asthma
- Third leading causes of death, >4 million deaths.
- Tobacco smoking and household air pollution major risk factors
 - Ultrafine nanoparticles <100 nm major contributing factor



**Influenced by size, shape, charge, chemistry,
adsorbed contaminants...**

Are nano-plastics a risk factor?

*Current Drug Delivery 46:176-90, 2014; Occup Environ Med. 74:868 , 2017;
Expert Rev Respir Med. 12:941, 2018; Hum Immunol. 81:634, 2020 ;
[https://www.who.int/news-room/fact-sheets/detail/chronic-obstructive-pulmonary-disease-\(copd\)](https://www.who.int/news-room/fact-sheets/detail/chronic-obstructive-pulmonary-disease-(copd))*



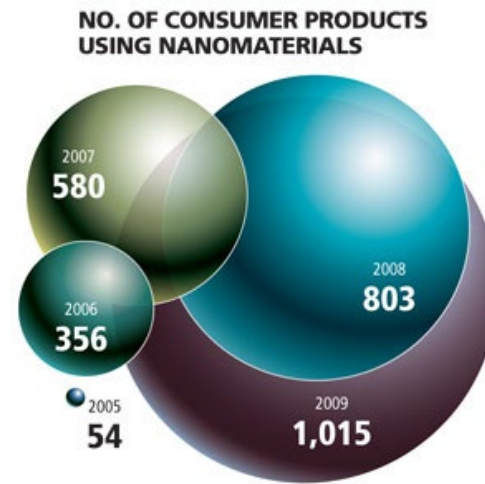
Polystyrene (PS) is a common environmental plastic

- PS microparticles (PSMP) 3 particles/m³
- PS-nanoparticles (PSNP) 13 particles/m³
- *In vitro* **positively charged** PSNPs in human alveolar macrophages and show **toxicity**
- Intranasal administration positively charged PSNPs facilitates brain entry

Gaston et al., 2020, Roshanzadeh et al., 2020; Liu et al., 2022

Negatively charged PSNPs

- Inert and **non-toxic** in mice when injected, in sheep (in-house) and rats (ICP Firefly)
- **No inflammatory** ERK or TNF pathway induction on murine DC
Karlson et al. (2013)



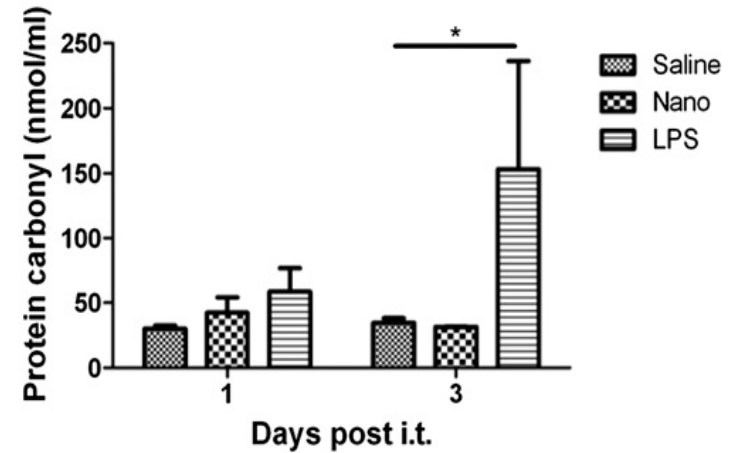
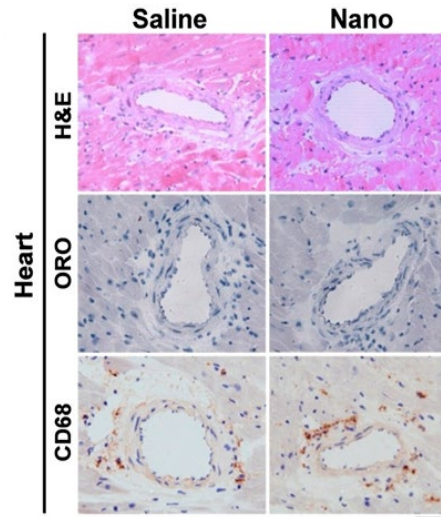
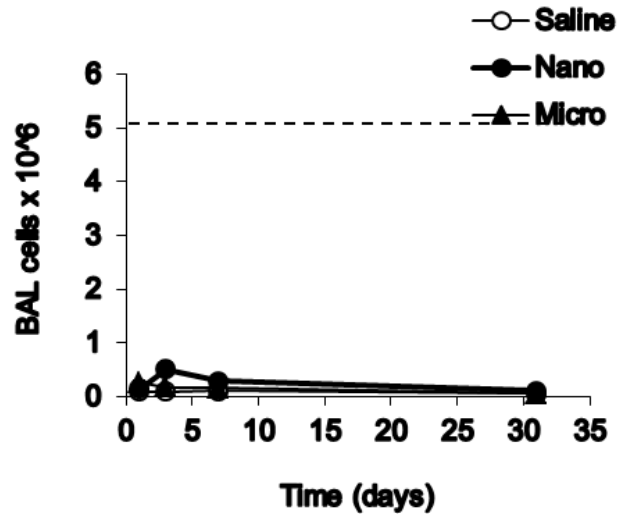
The global **nanomaterials market** valued at USD **11.99 billion** in 2022 and USD **61.96 billion** by 2032

Already in human medical products (PSMP&PSNP in human bone cement)

Non-toxic

Non-inflammatory

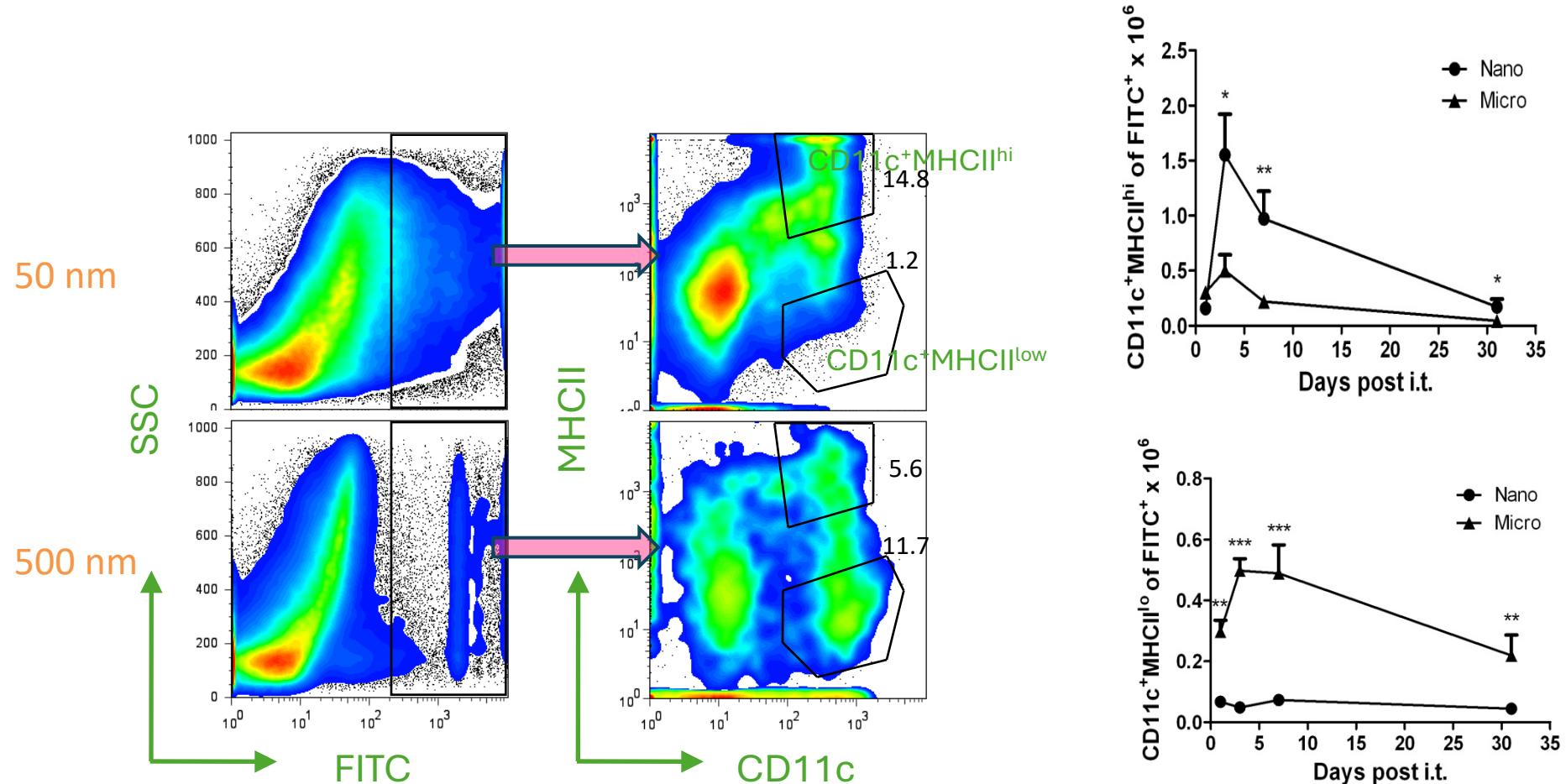
Effect of negatively charged 50 nm PSNPs or 500 nm PSMPs on the lung



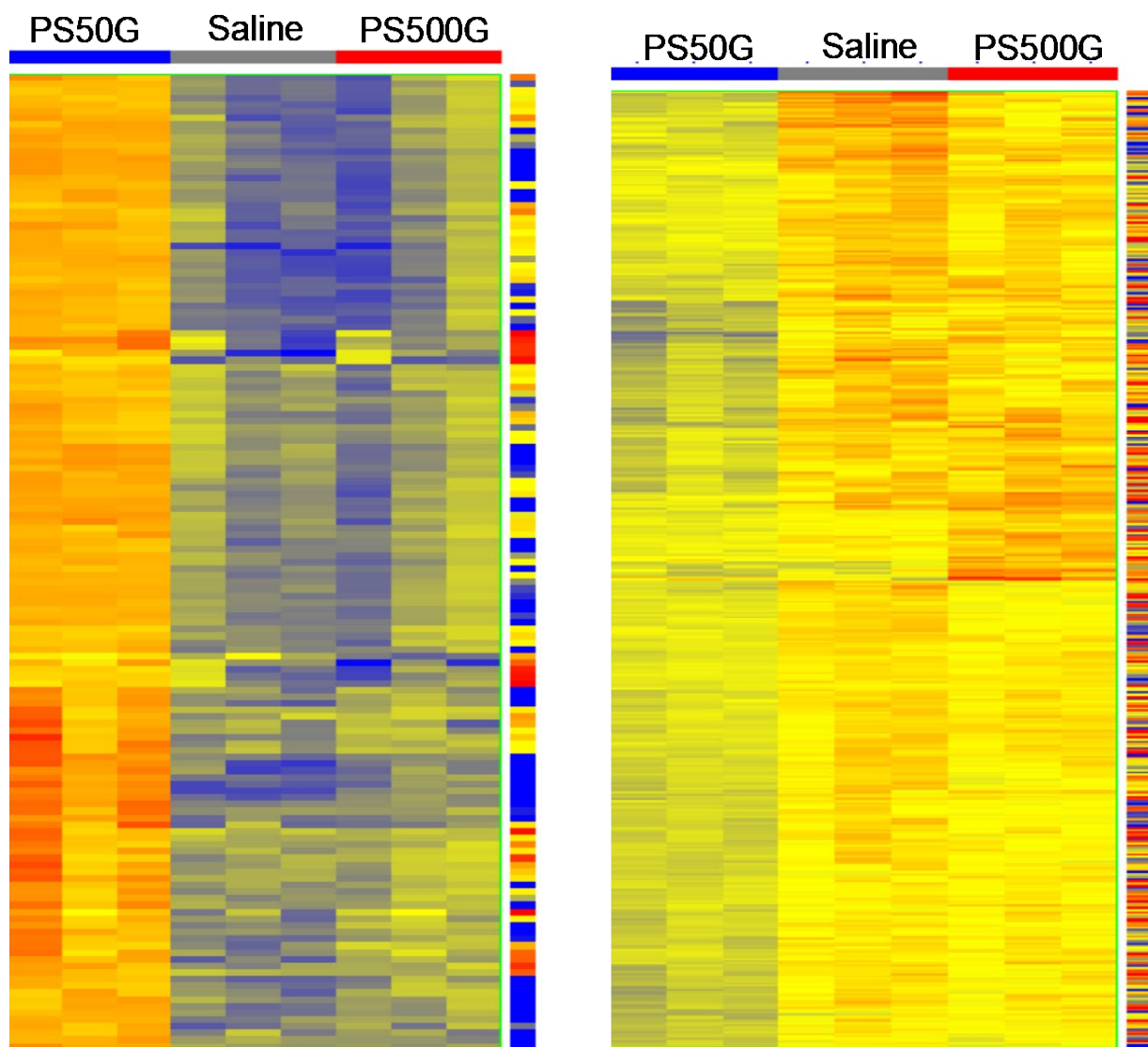
J. Immunol 188, 1431, 2012 (mice)
Sci Rep 7:14704, 2017 (sheep)
Occup Environ Med. 74:868 , 2017 (humans)

No lung inflammation or ROS production even at high doses PSNP or PSMP

Nanoparticles are primarily taken up by dendritic cells in the lung and microparticles by macrophages



Hardy et al., Journal of Immunology, 2013

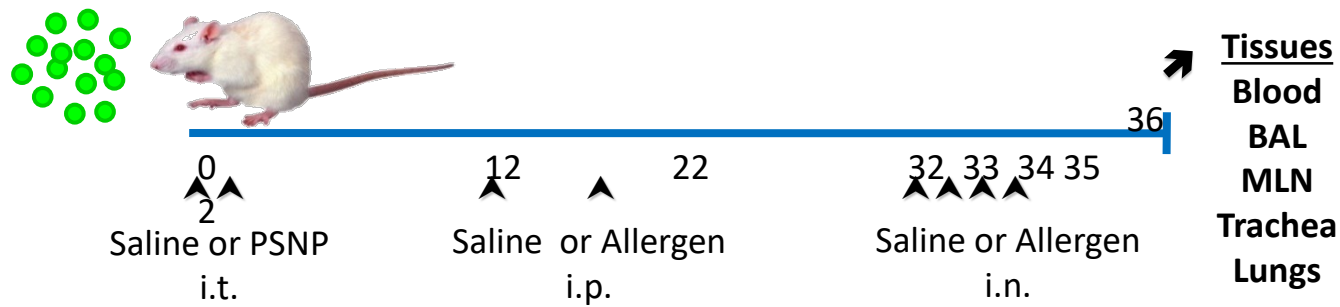


50 nm but not 500 nm **down-regulated** MAPK, Jak-STAT and PI3K **pro-inflammatory** signalling pathways

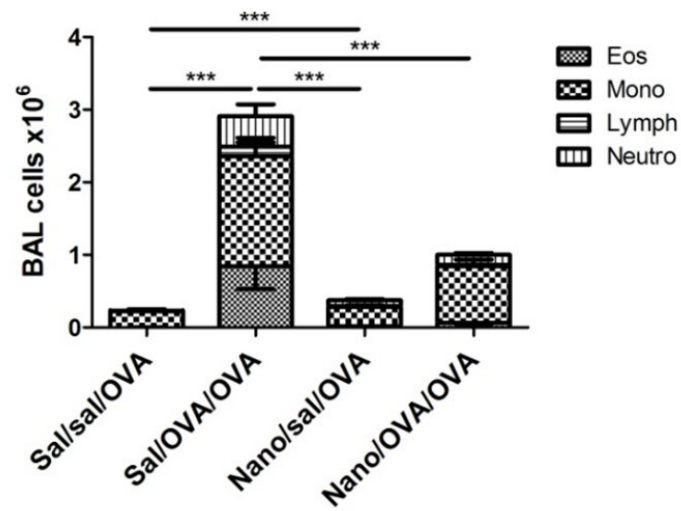
Dr. Ros Chapman (MIMR) (Tan et al., unpublished)

**But what about
downstream
consequences of
exposure?**



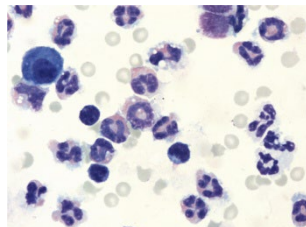


Decreased lung inflammation at time of allergen challenge

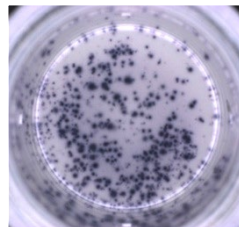


J. Immunol 188: 1431, 2012
J.Immunol. 191:5278, 2013
Front Immunol. 8:1812, 2017
Sci Rep 7:14704, 2017

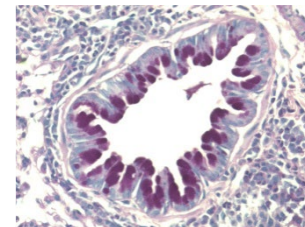
Eosinophilia



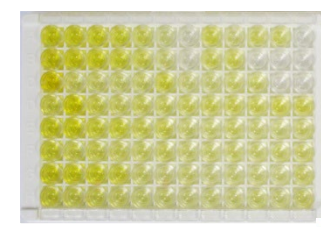
Th2 cytokines



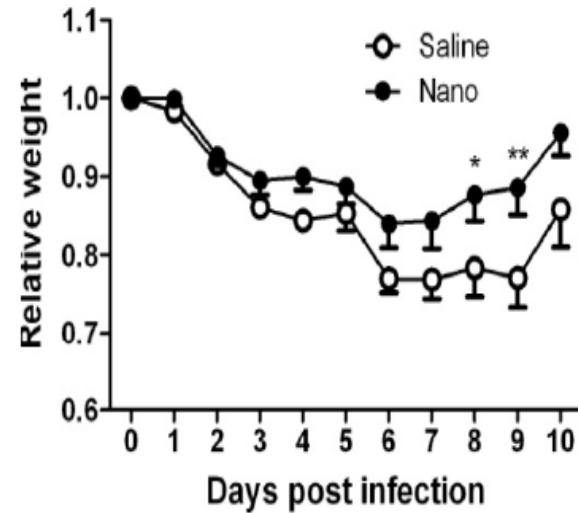
Mucus



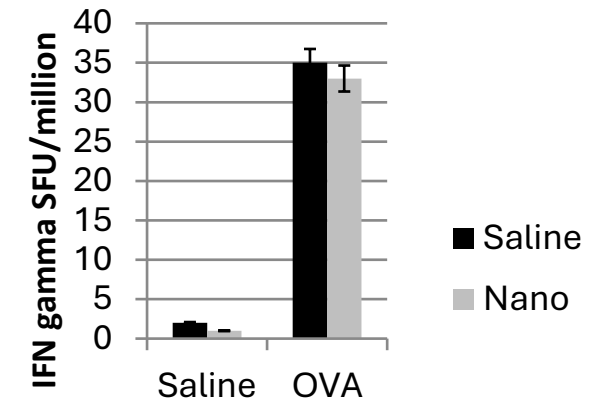
Specific IgE



Decrease lung inflammation ...and enhance clearance of influenza virus

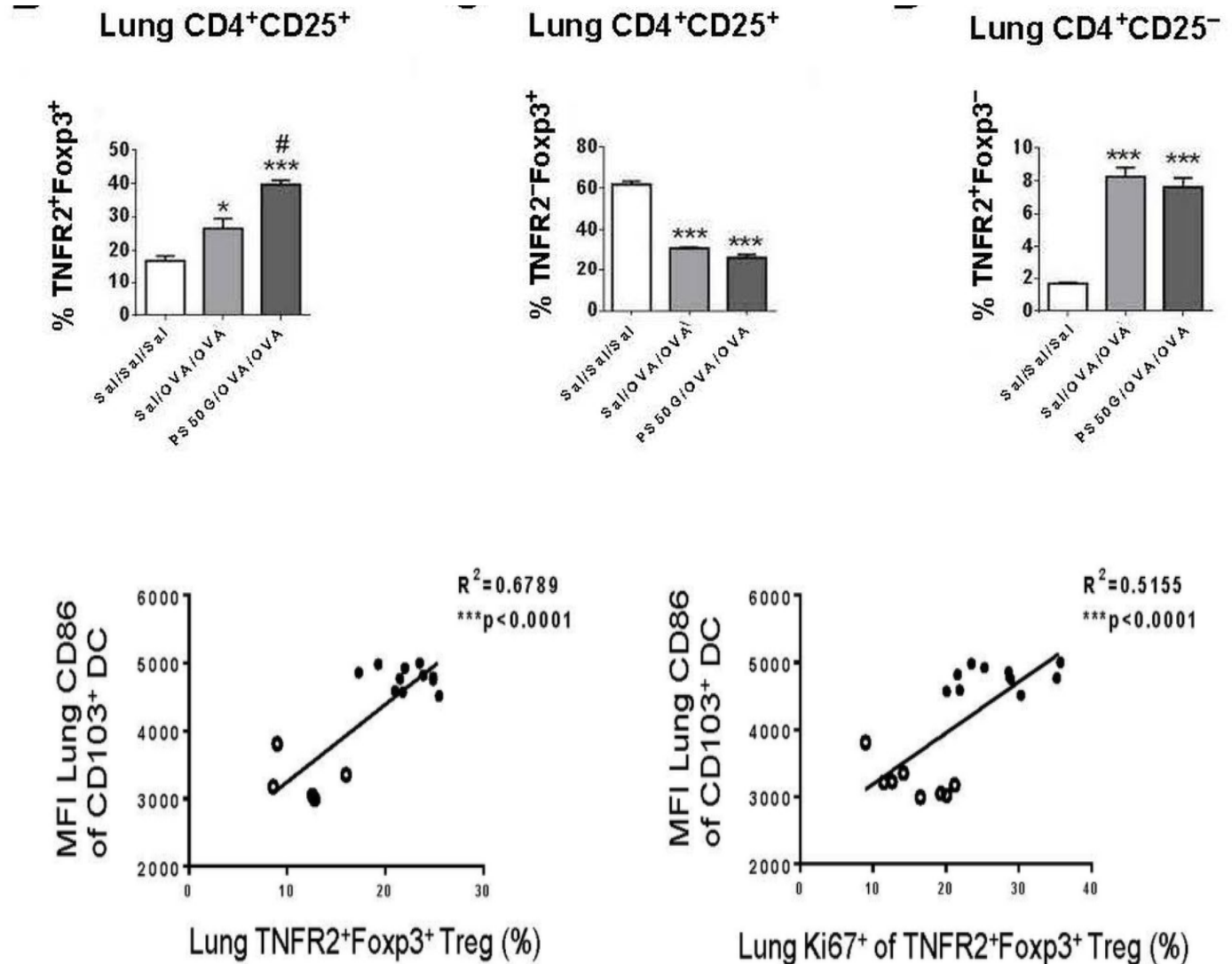


**IFN gamma (Th1) T cell
responses are not affected**



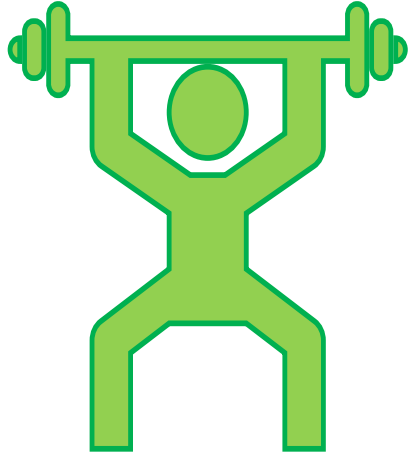
**PSNP pre-treatment
increases TNFR2+ Treg/T
effector ratio upon allergen
challenge**

**PSNP CD103 DC activation
correlates with TNFR2+Treg
expansion**



Mohamud et al., Front. Immunol., 2017

Novel homeostatic mechanism



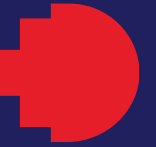
Negatively charged PSNPs in the lung:

- **imprint in the lung for resilience to allergic airways inflammation**
- **potentially non-specifically enhance immunity against viruses**

Debate



Speakers



**Dist. Professor
Magdalena Plebanski,
RMIT University**



**Professor
Deborah Glass,
Monash University**



**A/Professor
Mayur Garg,
University of Melbourne**



**Dr Kirsty Wilson,
RMIT University**

Health implications of plastics in our ecosystem

Ending Plastic Waste Symposium - Tuesday 6
August 2024

Facilitated by Professor Magdalena Plebanski
(RMIT University)

