

Maternal and fetal responses to microplastics: implications for pregnancy and long-term health

Professor Cathy Thornton
Professor of Human Immunology
Head, Swansea University Medical School



Climate change and pregnancy

- Adverse environmental exposures *in utero* and early childhood (first 1000 days) can programme long term health; transgenerational effects.
- Extreme weather events that disrupt infrastructure, food and water supply, etc., have detrimental effect on maternal and perinatal health.
- Vector borne diseases – mosquitoes, ticks, etc. – can have particularly detrimental effects in pregnancy, e.g., Zika virus (mosquito borne virus) - changes in vector abundance and geographical distribution of immense concern to perinatal health.
- Pandemics and outbreaks – e.g., Mpox.
- Air pollution, plastic pollution and heat

Physiological change with pregnancy



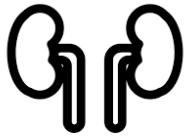
- Increased oxygen consumption and increased tidal volume
- Pregnancy nose



- Blood volume increases 40 – 50% peaking at end of second trimester
- Hemodilutional anaemia and decrease in serum albumin



- Cardiac output increases
- Heart rate increases



- Increased water and sodium retention in the kidney;
- Increase in total body water



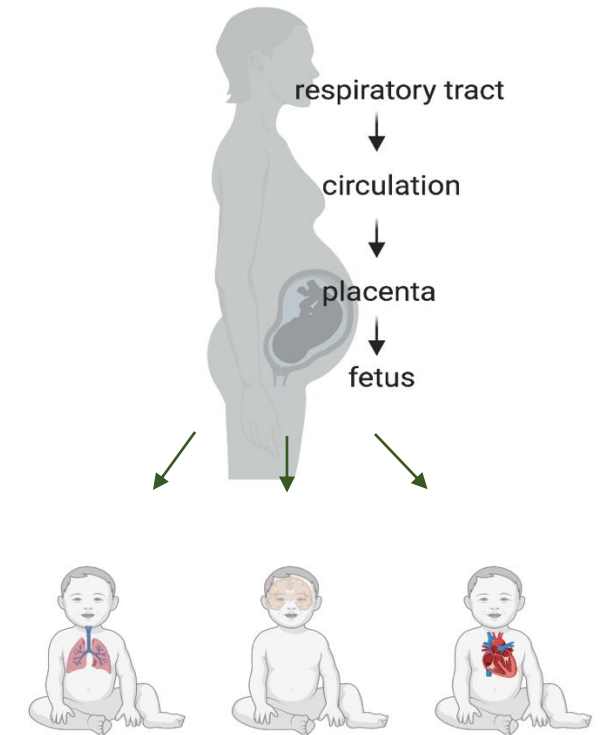
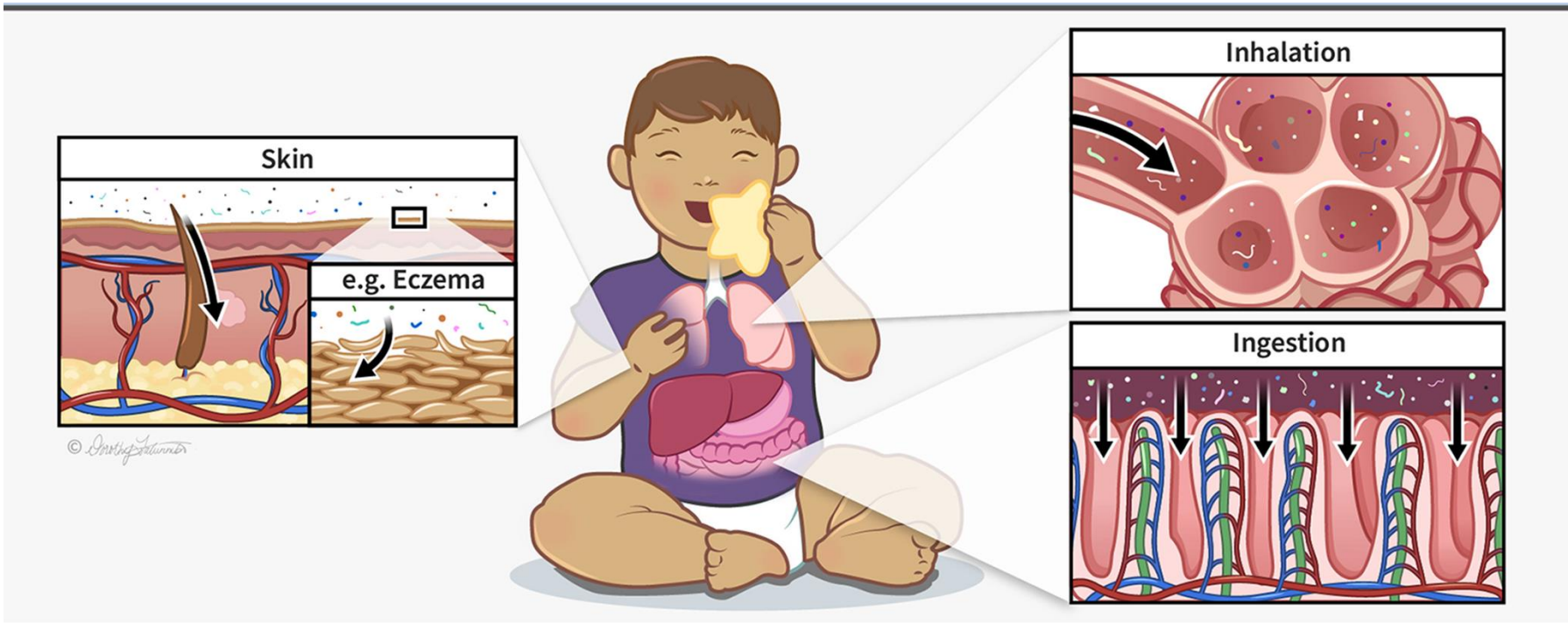
- Increased insulin resistance
- Changes in absorption/metabolism of drugs/toxins, e.g., caffeine



- Delayed gastric emptying
- Prolonged gastric transit time of 30 – 50%

Micro/nanoplastic (MNP) exposure routes

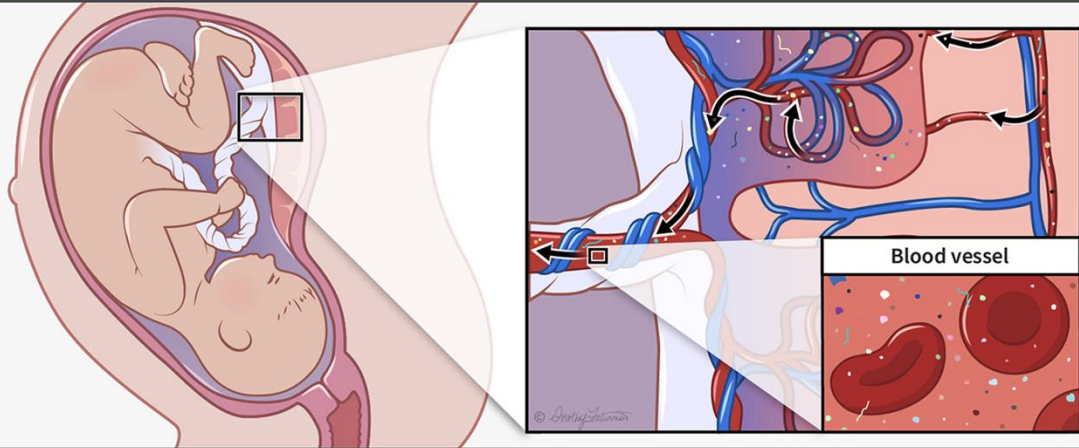
Exposure routes common to all



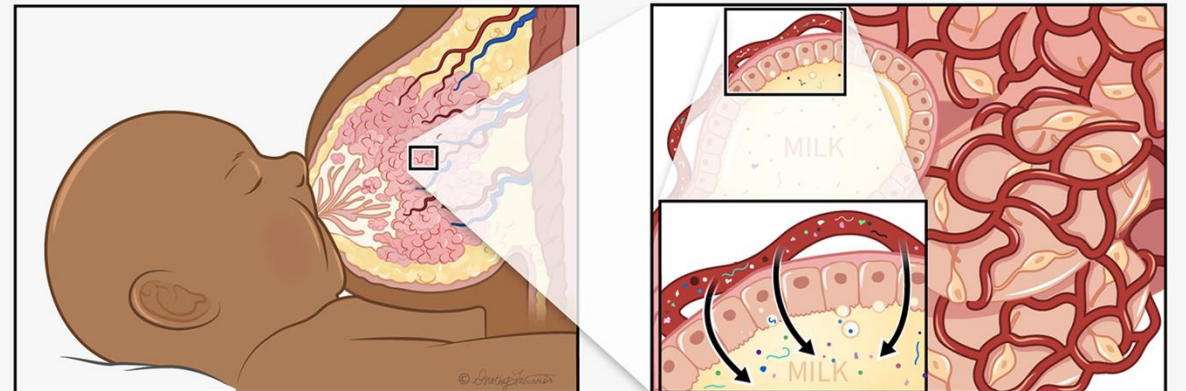
MNP exposure routes

Unique perinatal exposure routes

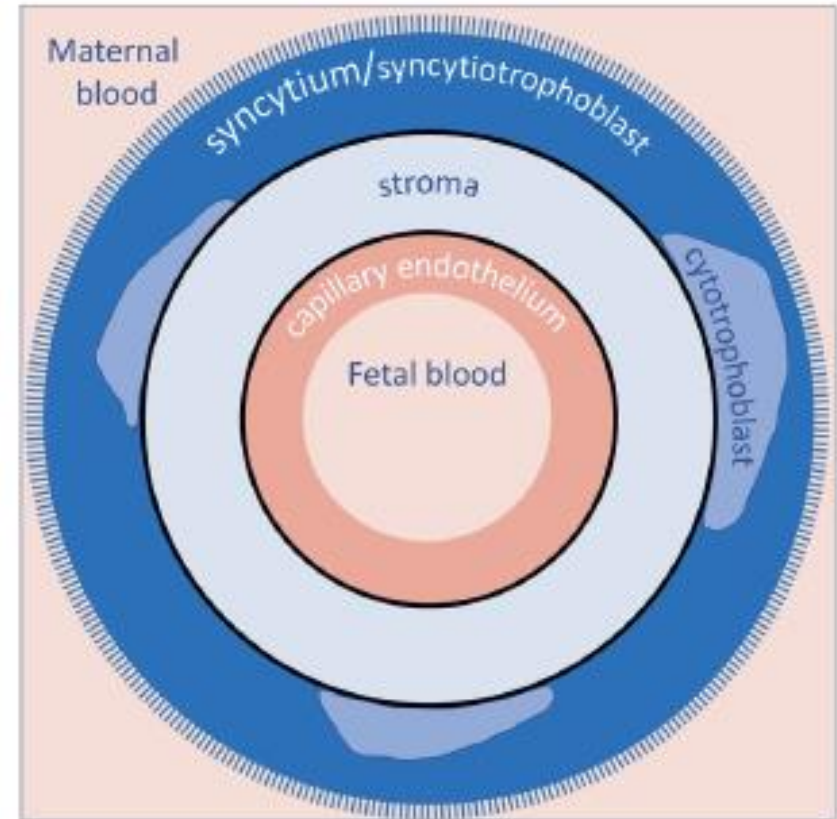
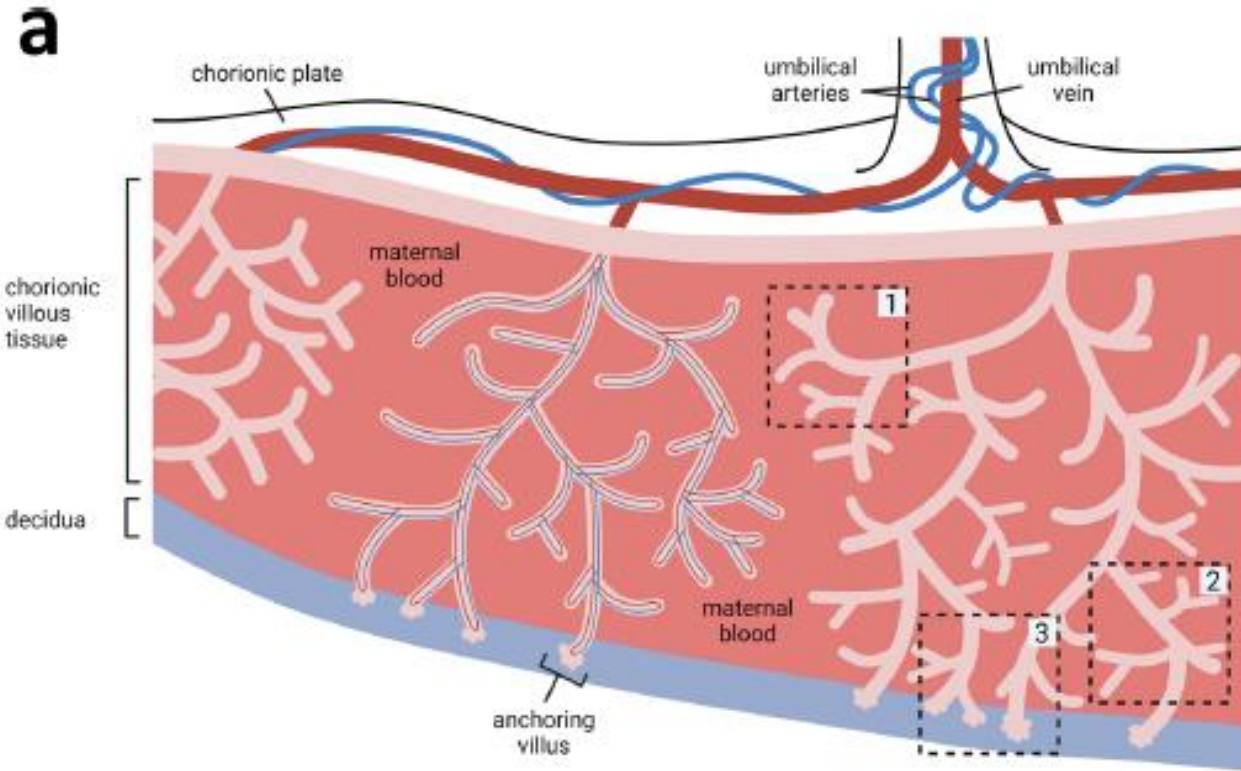
Placental transfer



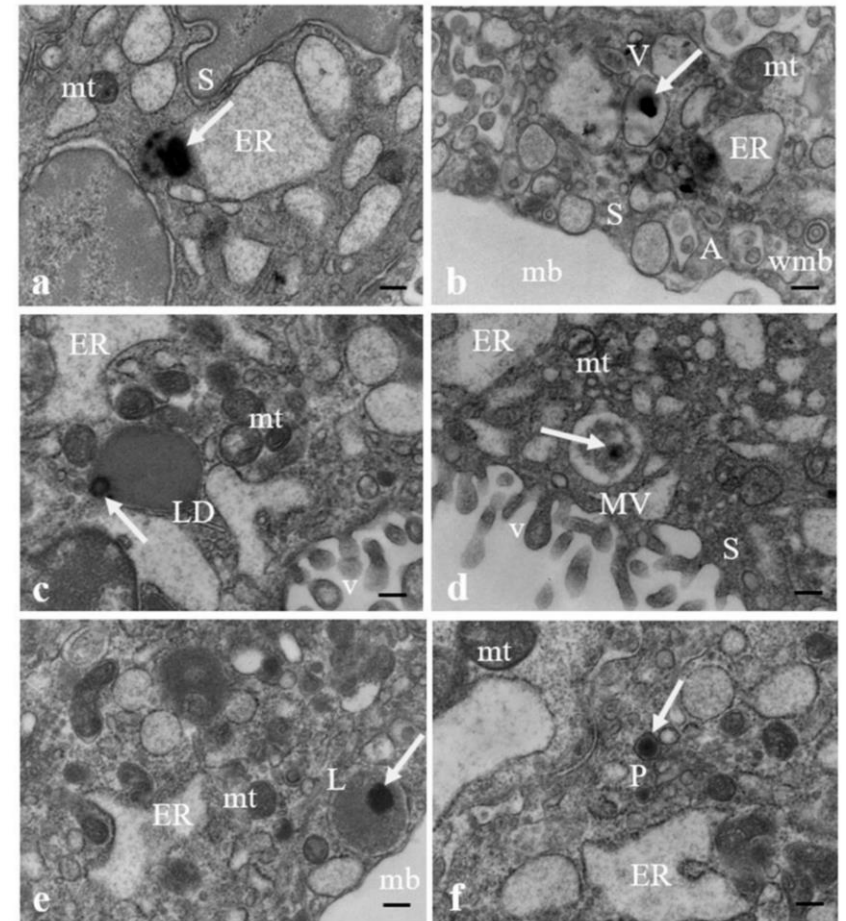
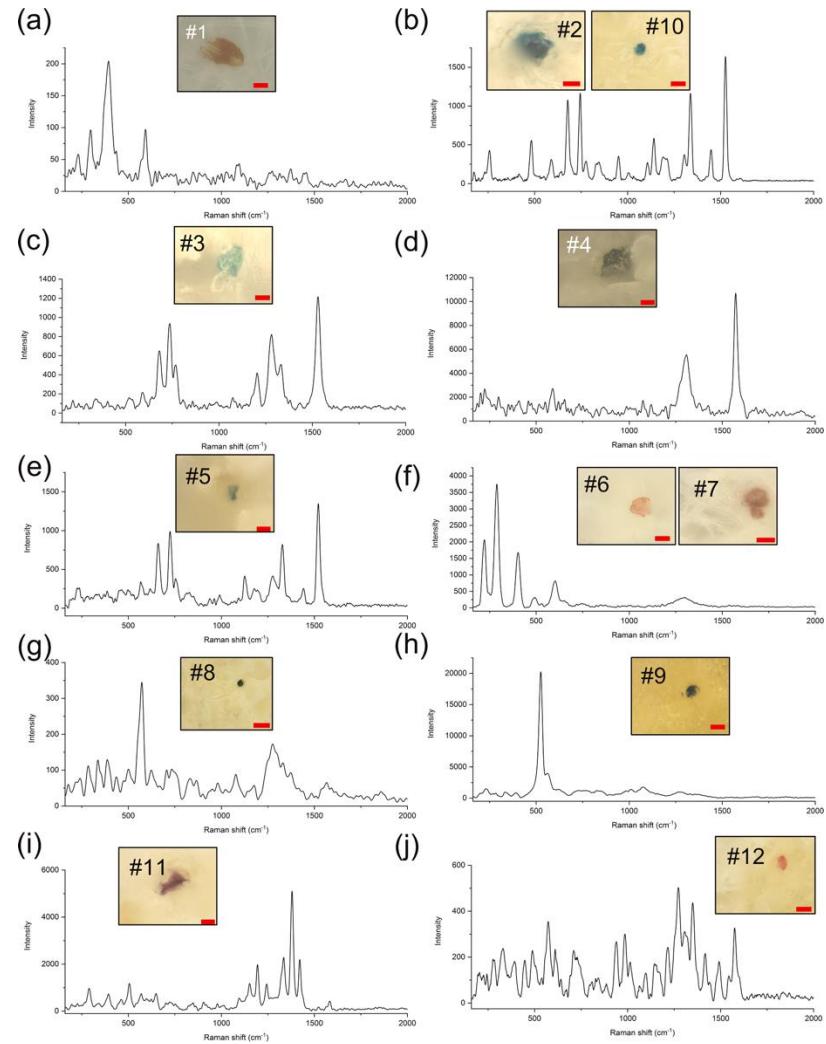
Breastmilk transfer



The placenta

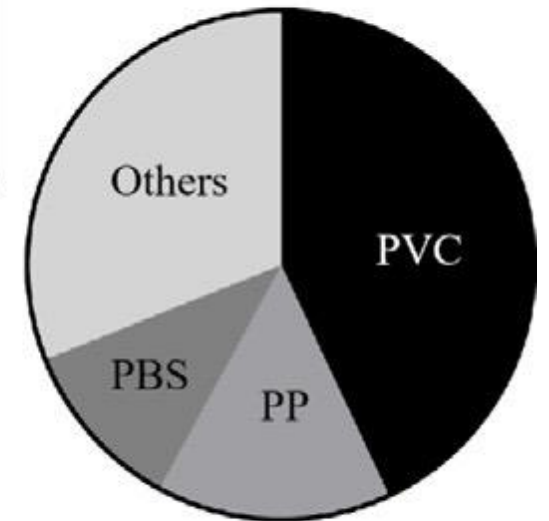
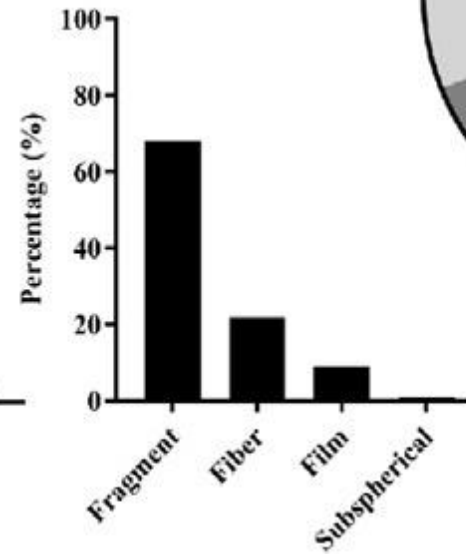
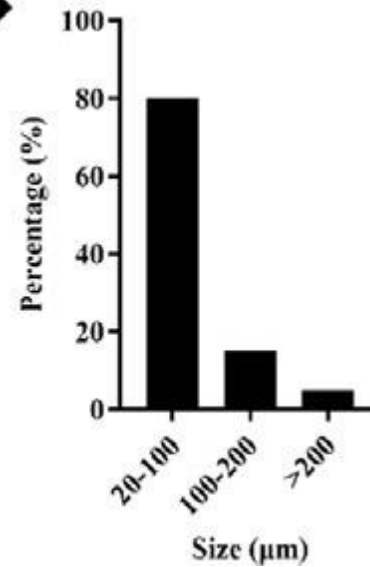
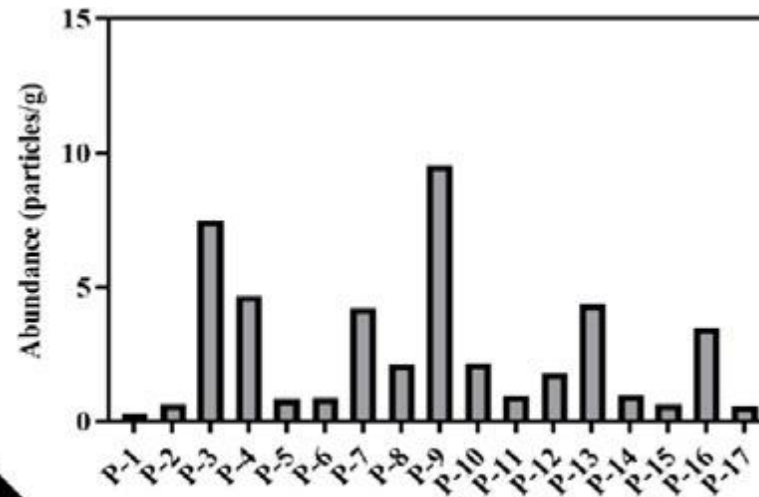


MNPs in human placenta



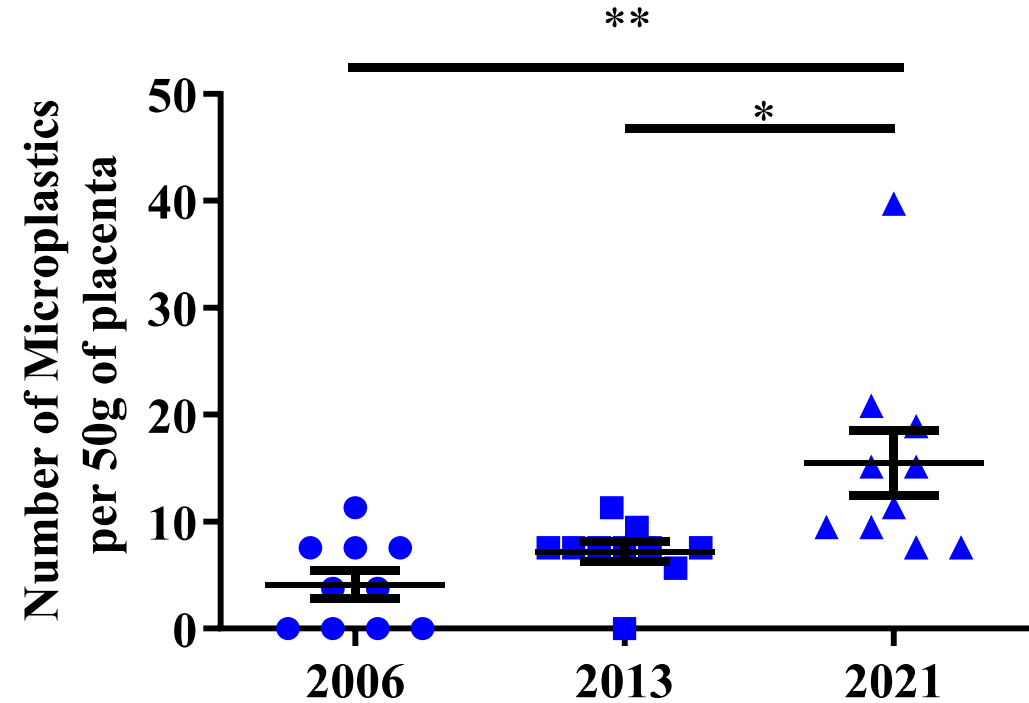
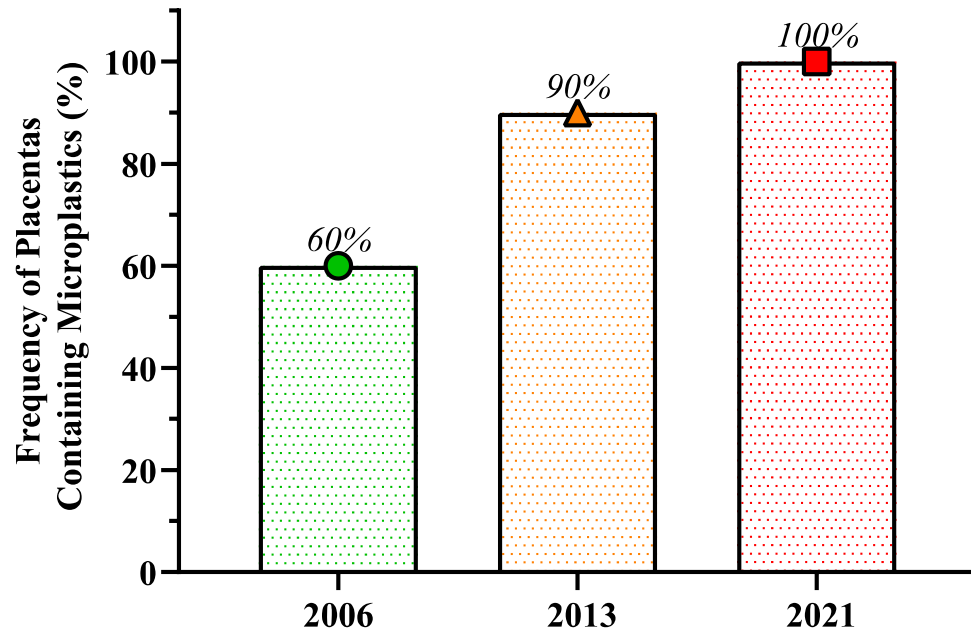
Impact organelle ultrastructure
Found in fetal microvessels

MNPs in human placenta



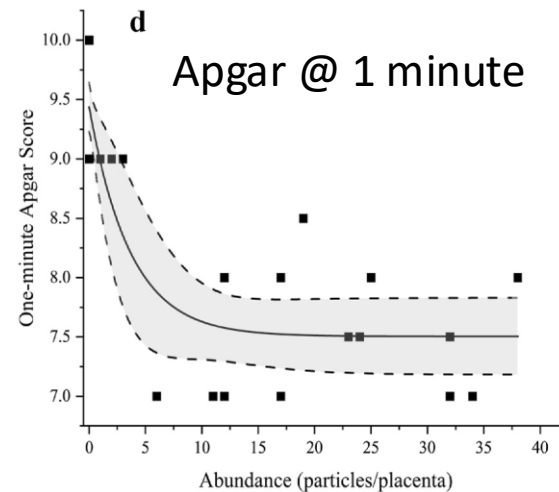
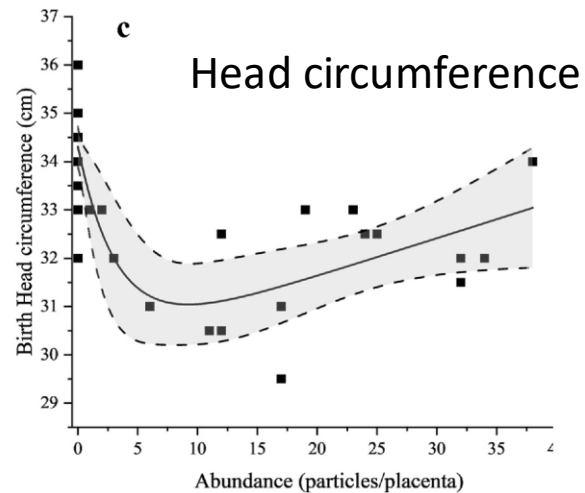
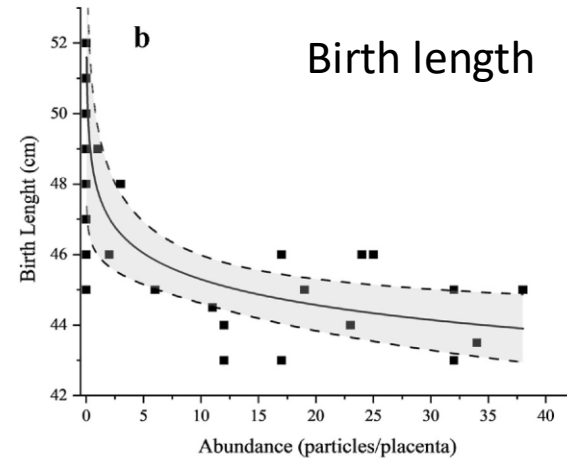
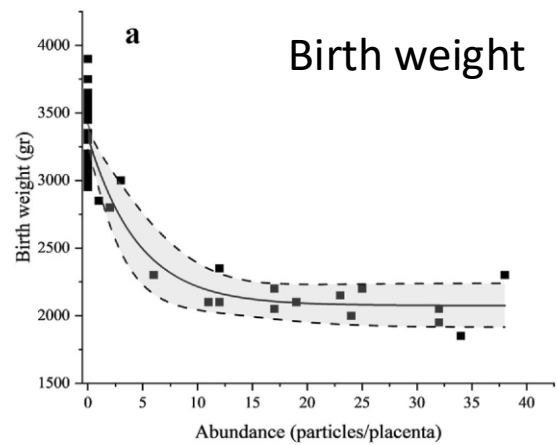
PVC = polyvinyl chloride
PP = polypropylene
PBS = polybutylene succinate

MNPs in human placenta

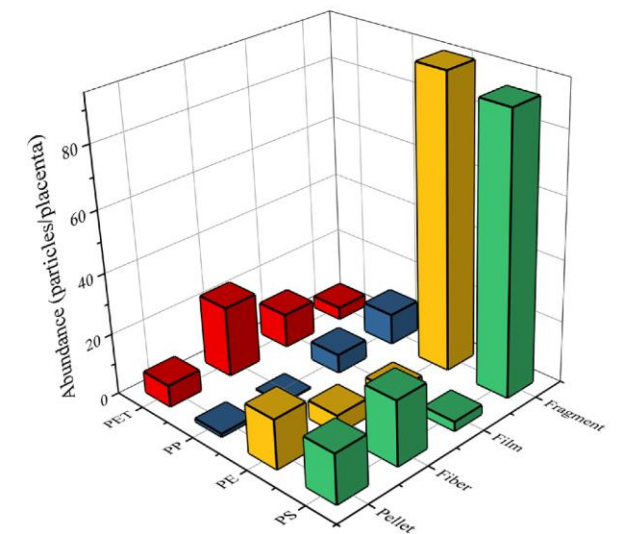
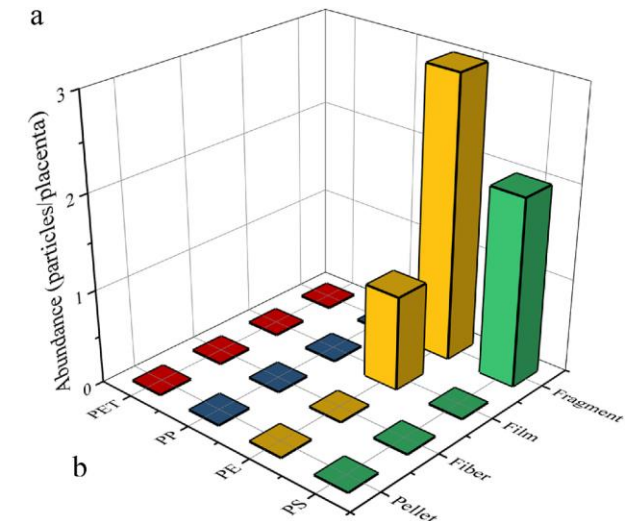


Changes in MNP contamination of placenta over time in Hawai'i

MNPs and intrauterine growth restriction

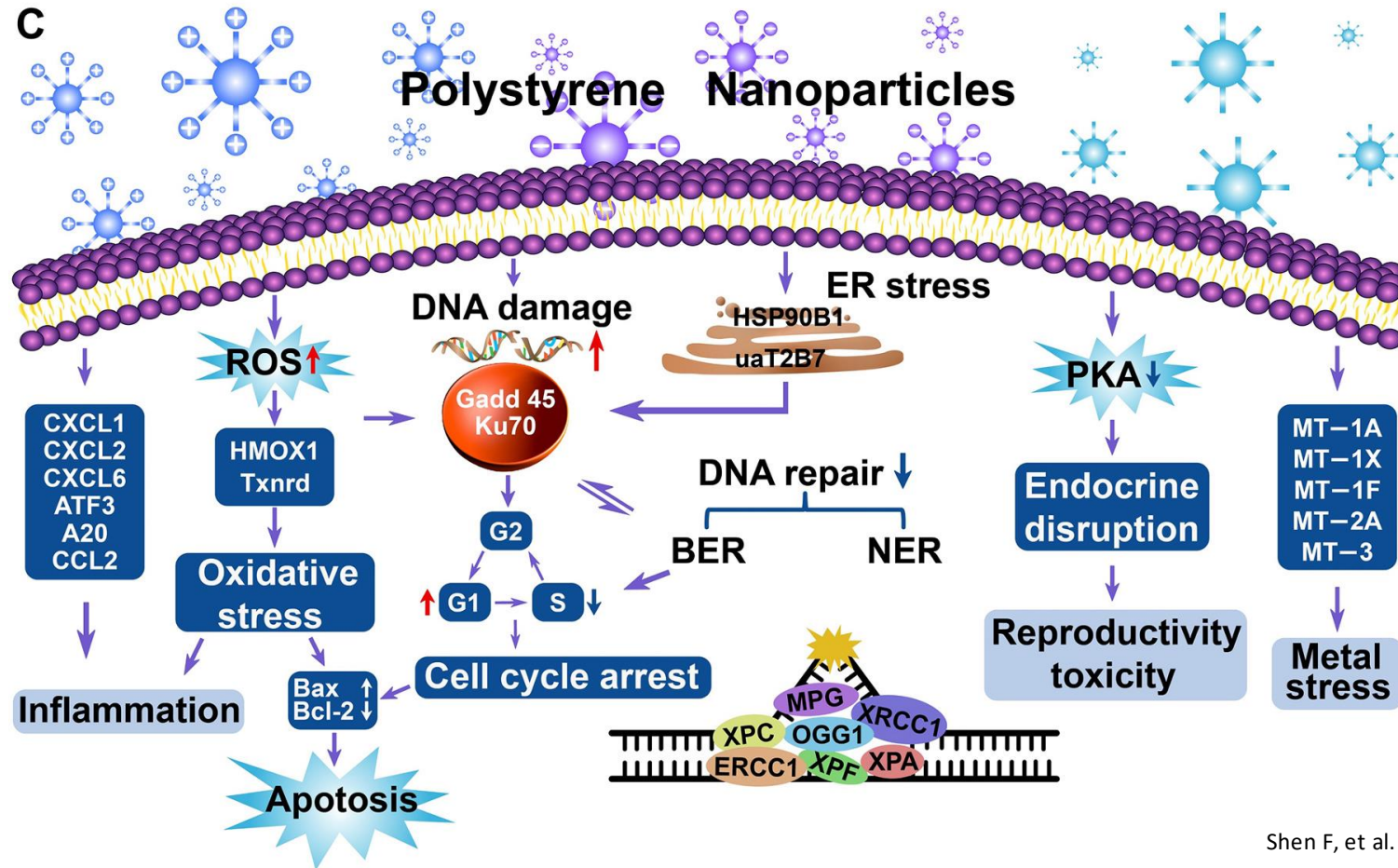


Normal



IUGR

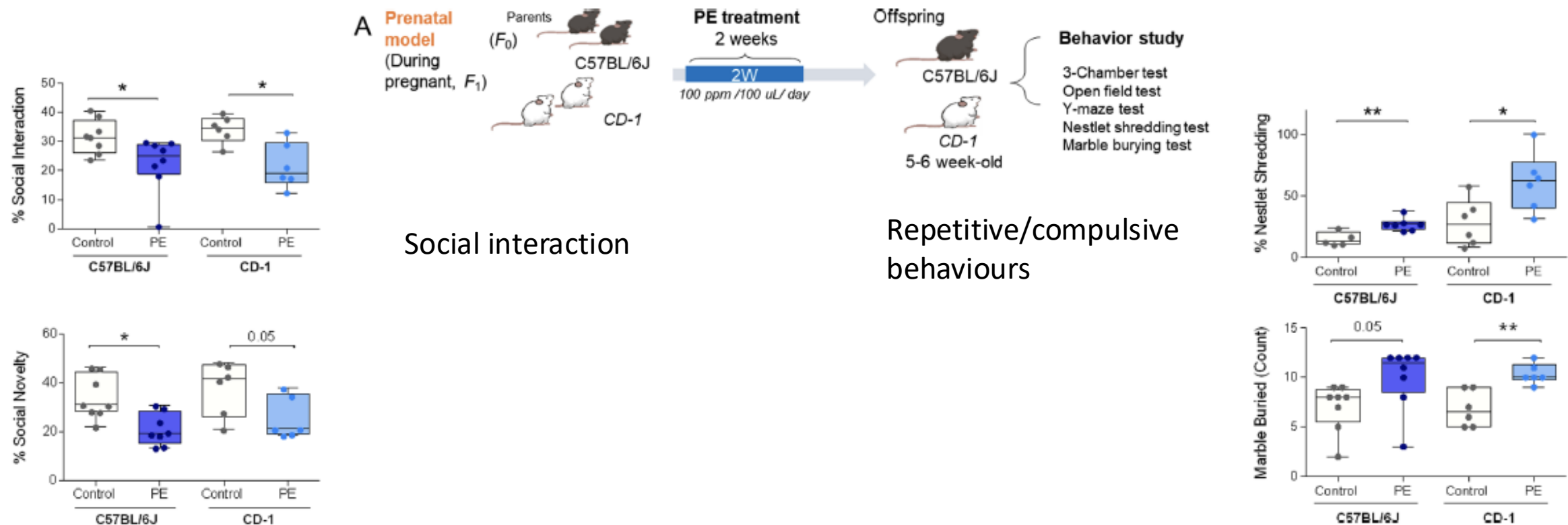
Biological effects of MNPs



Share many effects with other particulates, e.g., air pollution - PM_{2.5}

Pregnancy, plastics and child health

Maternal polyethylene consumption and autism-like response in pups



MNPs and pregnancy

- Pregnancy (infancy and childhood) - sensitive windows for environmental exposures
- Adverse pregnancy outcomes and future burden of chronic diseases – especially non-communicable diseases but potentially altered resilience to communicable diseases
- Better understanding of impacts of MNPs on maternal and child health needed urgently – from particles to populations
- Need to fill research gaps and stimulate governments and industry to address impacts of MNPs on pregnant women and children
- Inform climate and other action plans through to changes to public health policy BUT needs an international approach

Climate change and maternal and child health

Nearly 90% of the existing burden of disease due to climate change occurs in children < 5 years of age.

Zhang Y, et al. *J Environ Health* 2007;70:32-362007



<https://www.weforum.org/agenda/2021/09/unicef-children-climate-risk-index/>



<https://www.bbc.co.uk/news/world-asia-india-58419717>