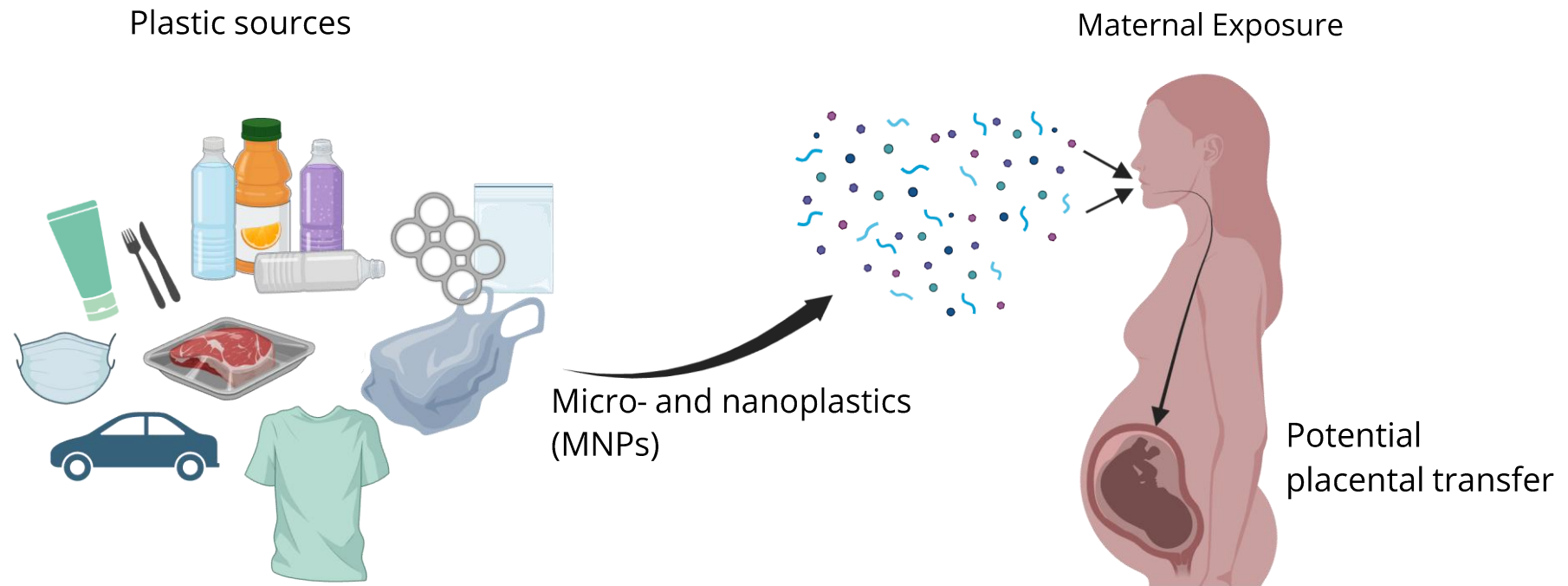


What do we know about the exposure of pregnant women to MNPs?

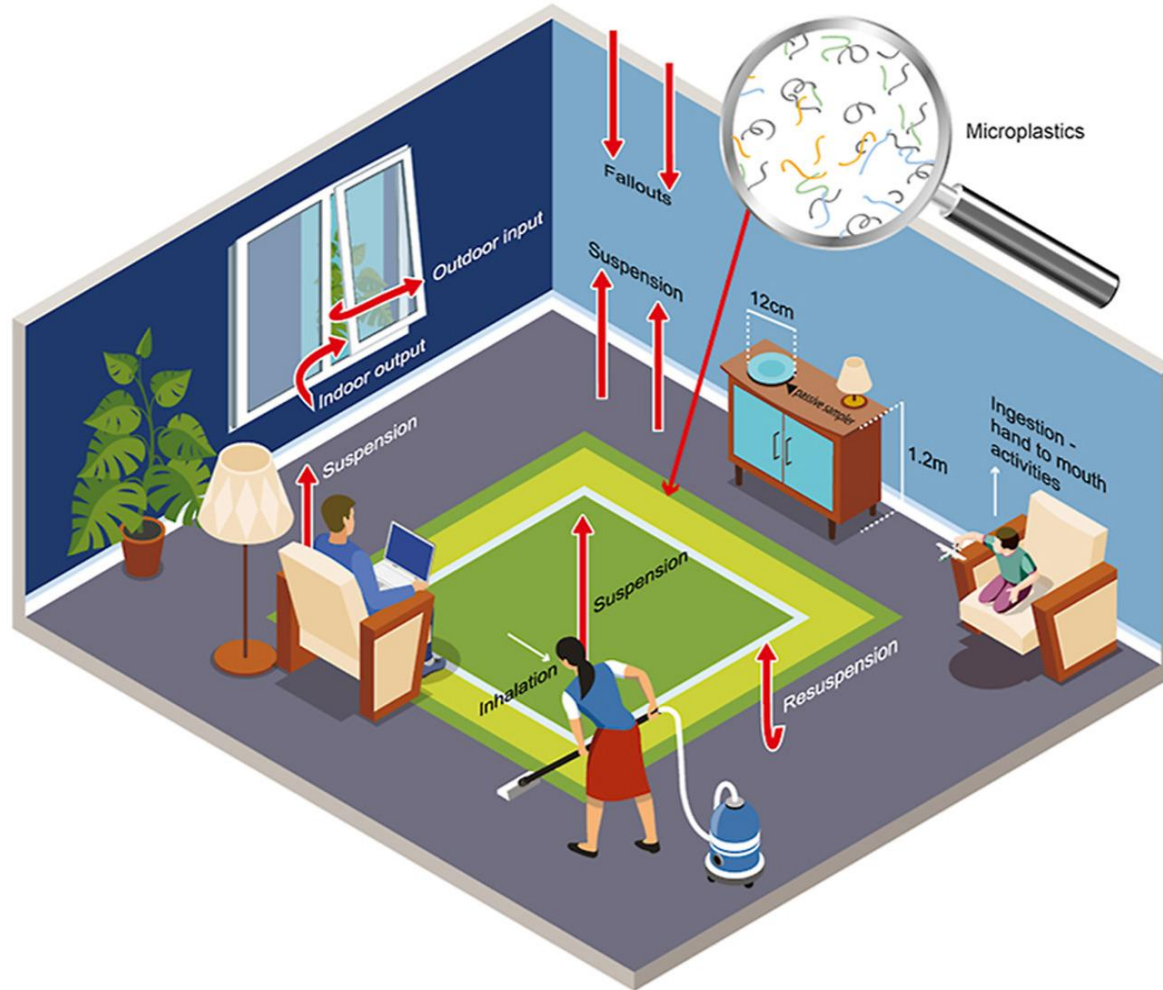
Amanda Durkin, AURORA researcher, UMC Utrecht



Pathways of Exposure Relevant for Pregnancy



MNPs in the Home



Adults spend
~90% of their
time indoors

Plastic Clusters	Common Household Sources
Polyethylene (C-PE)	Plastic bags, food packaging, bottles, shrink wrap
Polypropylene (C-PP)	Food containers, reusable bags, carpets, textiles
Polyethylene terephthalate (C-PET)	Water bottles, food packaging, polyester textiles
Polystyrene (C-PS)	Foam packaging, disposable foodware, takeout containers
Polyvinyl chloride (C-PVC)	Vinyl flooring, pipes, shower curtains, cable insulation
Polycarbonate (C-PC)	Consumer electronics, reusable bottles, optical lenses
Polymethyl methacrylate (C-PMMA)	Acrylic sheets, display panels, furniture, household decor
Polyamide 6 (C-PA6)	Nylon textiles, carpets, ropes, kitchen utensils
MDI-Polyurethane (C-MDI-PUR)	Insulation foams, furniture cushions, coatings, adhesives
Tire Wear Particles (TWP)	Tire abrasion particles



AURORA Household Plastics Study



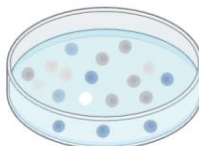
Visit 1

Body MNPs



measured in urine and blood

Household MNPs

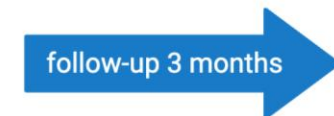


measured in house dust

Determinants of MNP exposure




measured with a questionnaire



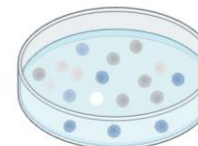
Visit 2

Body MNPs



measured in urine and blood

Household MNPs



measured in house dust

Determinants of MNP exposure



measured with a questionnaire



Possible determinants and sources

Sociodemographic Information

- Age (years)
- Education (higher education, yes/no)
- Household type (single person/multi-person)
- Occupancy density (m²/person)

Sample Characteristics

- Dust collection height (m)
- Season of collection (summer/fall/winter)

Home Characteristics

- Pet(s) in household (yes/no)
- Year home built (before/after 2000)
- Rug in living room (yes/no)
- Curtains in living room (yes/no)
- Living room floor type (natural/synthetic)
- Bedding material (natural/synthetic)

Environmental Characteristics

- Urbanicity (rural/urban)
- Road type (brick/asphalt)
- Traffic intensity (within 50m, Veh.day-1m)
- NO₂ (annual, mg/m³)
- UFP (annual, particles/cm³)
- PM₁₀ (annual, mg/m³)
- Tire and brake wear (annual, mg/m³)

Lifestyle and Behavior

- Current smoker (yes/no)
- Dryer usage (yes/no)
- Windows open (seldom/>1 day per week)
- Vacuum cleaning (seldom/>1 day per week)
- Time spend at home (low/medium/high)

Diet

- Microwave food in plastic containers
- Use a plastic electric kettle
- Use non-plastic food packaging
- Reuse single-use plastic containers



Dust Collection

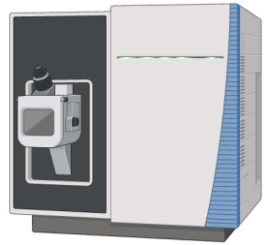
- 30-day passive collection
- Height designed to represent the breathing zone.



Photo courtesy of Bas Niemens (Utrecht University)



MNP Analysis



Analysis Method:

- Pyrolysis Gas Chromatography Mass Spectrometry



QA/QC Measures:

- Extensive contamination prevention procedures
- Field and procedural blank samples

Targeted Plastic Clusters

Polyethylene (C-PE)

Polypropylene (C-PP)

Polyethylene terephthalate (C-PET)

Polystyrene (C-PS)

Polyvinyl chloride (C-PVC)

Polycarbonate (C-PC)

Polymethyl methacrylate (C-PMMA)

Polyamide 6 (C-PA6)

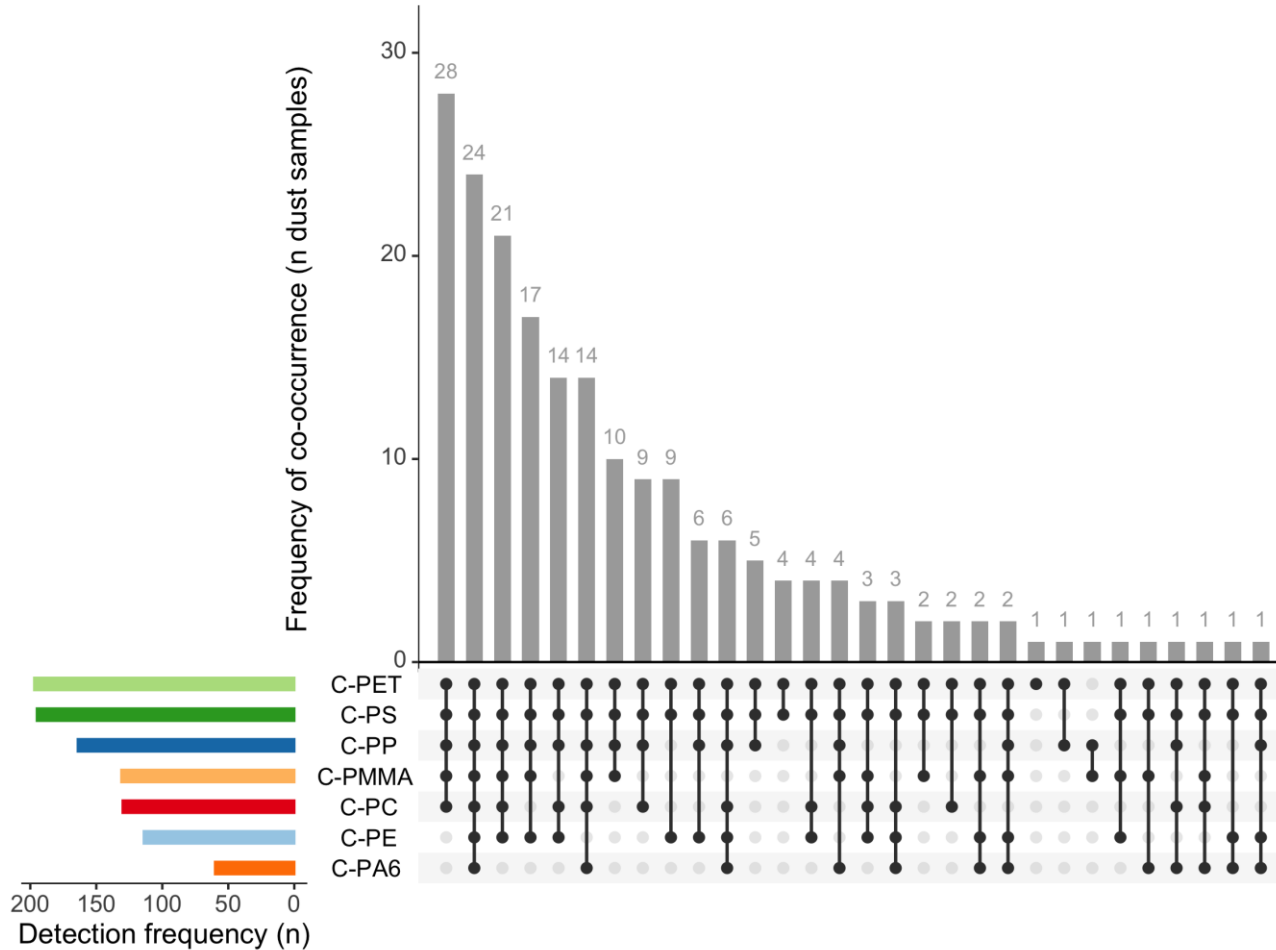
MDI-Polyurethane (C-MDI-PUR)

Tire Wear Particles (TWP)

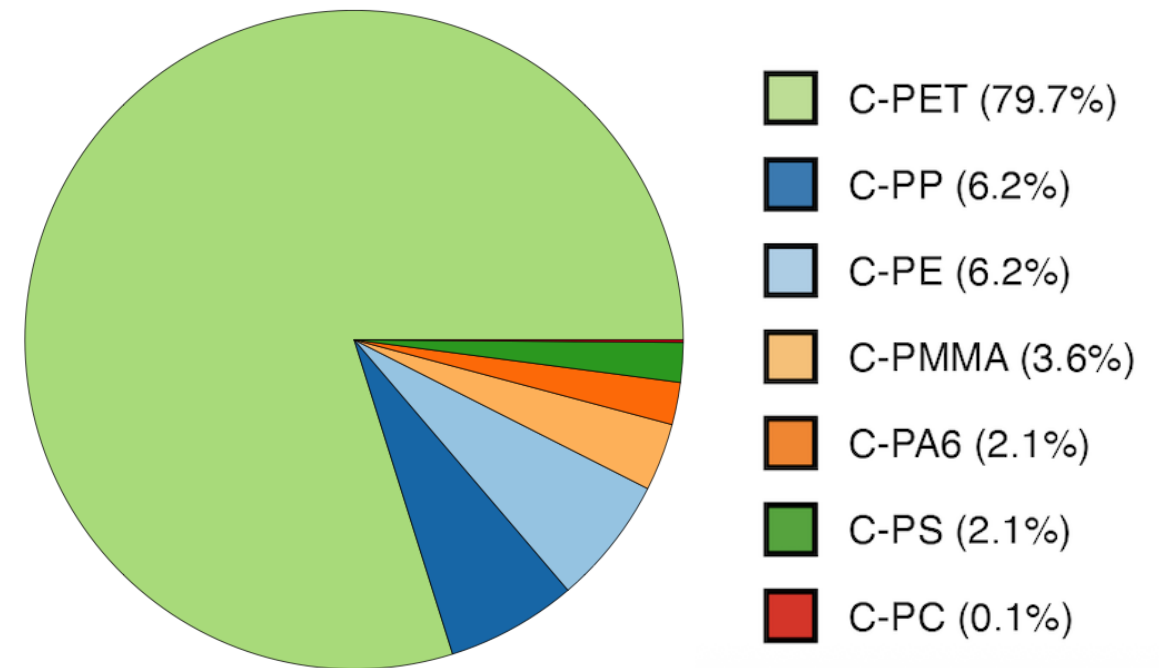


MNPs Detected in all Homes

Polymer Detection Frequency and Co-occurrence



Polymer Distribution (% of Total Deposition)



Determinants and Sources of MNPs in Dust

Sociodemographic Information

- ✓ • Age (years)
- ✗ • Education (higher education, yes/no)
- ★ • Household type (single person/multi-person)
- ★ • Occupancy density (m²/person)

Sample Characteristics

- ✓ • Dust collection height (m)
- ★ • Season of collection (summer/fall/winter)

Home Characteristics

- ✗ • Pet(s) in household (yes/no)
- ✗ • Year home built (before/after 2000)
- ✗ • Rug in living room (yes/no)
- ✓ • Curtains in living room (yes/no)
- ✗ • Living room floor type (natural/synthetic)
- ✗ • Bedding material (natural/synthetic)

Environmental Characteristics

- ✓ • Urbanicity (rural/urban)
- ✗ • Road type (brick/asphalt)
- ✗ • Traffic intensity (within 50m, Veh.day-1m)
- ✗ • NO₂ (annual, mg/m³)
- ✗ • UFP (annual, particles/cm³)
- ✗ • PM₁₀ (annual, mg/m³)
- ✗ • Tire and brake wear (annual, mg/m³)

Lifestyle and Behavior

- ✗ • Current smoker (yes/no)
- ✓ • Dryer usage (yes/no)
- ✗ • Windows open (seldom/>1 day per week)
- ✓ • Vacuum cleaning (seldom/>1 day per week)
- ✗ • Time spend at home (low/medium/high)

Key

- ★ Associated with multiple polymers
- ✓ Associated with one polymer
- ✗ Not associated with any polymer

Household Dust as a Useful Matrix for MNP Exposure Assessment

- Repeat samples indicated relatively stable exposure patterns within homes over time.
- Questionnaires explained 23 - 46% of variability in household MNP levels.
- Household dust may represent a useful matrix for exposure assessment in epidemiological studies.



Dust on filter at 220x magnification



Key messages

- Household exposure to MNPs is widespread, with PET identified as the dominant polymer.
- Household and lifestyle questionnaires captured only part of MNP exposure variability, supporting the need for direct exposure assessment methods.
- Indoor environments represent important and potentially modifiable sources of MNP exposure.



Photo courtesy of Bas Niemens (Utrecht University)

**Thank you to our
participants and
study team!**

