UNITED EUROPEAN GASTROENTEROLOGY ueg week

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Assessment of microplastic concentrations in human stool

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Disclosure of Conflicts of Interest

I herewith declare the following paid or unpaid consultancies, business interests or sources of honoraria payments since October 1, 2016, and anything else which could potentially be viewed as a conflict of interest:

→ **I have no conflicts of interest.**

Methods – A world-wide prospective pilot study

Recruitment of 8 healthy test persons around the globe via personal contacts

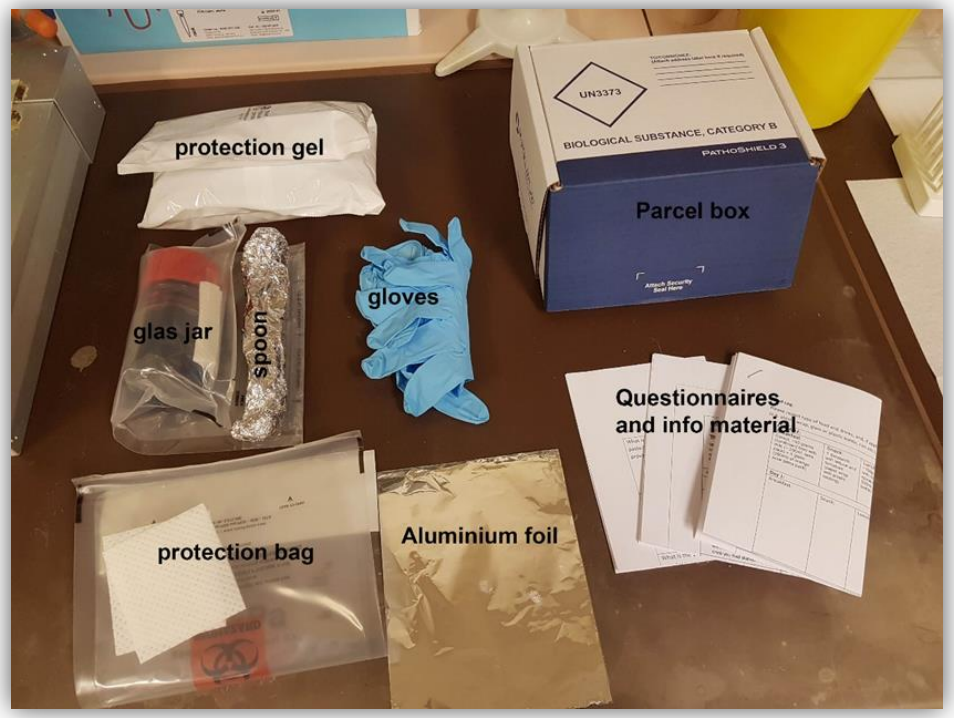
https://commons.wikimedia.org/wiki/File:Relief_map_of_Eurasia.png

Methods – exclusion criteria

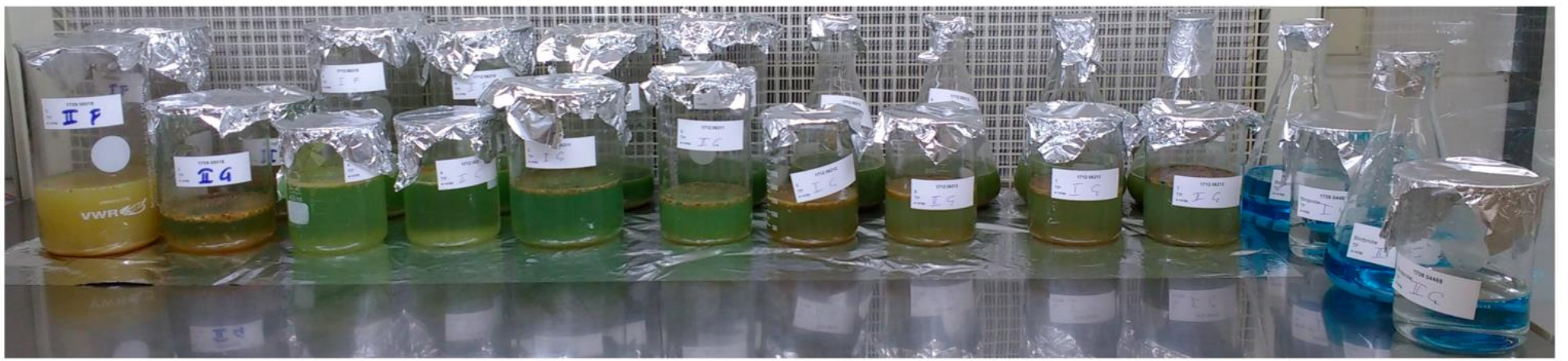
- Medical diet
- Diarrhoea or obstipation
- Antibiotics taken within the last 2 weeks
- Drugs affecting stool frequency and consistency (e.g. loperamide)
- Drugs affecting resorption (e.g. activated charcoal, cholestyramine)
- Diagnosed gastrointestinal disease (e.g. Ulcerative colitis, Crohn's disease)
- Invasive or abrasive dental treatment within the last 2 weeks

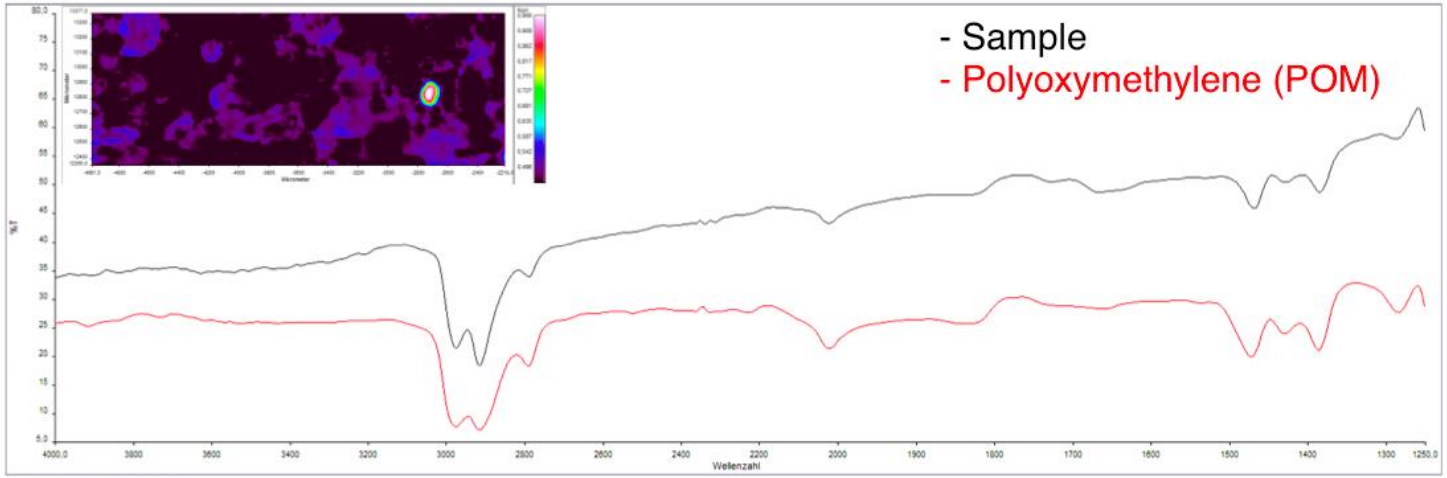
Methods – data collection & sampling

- Food protocol 6-7 days prior to stool sampling
- Brand name of tooth paste and cosmetic products
- Information about chewing gum and alcohol intake
- Information about drinking habits from PET bottles
- Plastic-free stool sampling and shipping to Vienna



Microplastic analysis by Fourier-transform infrared (FT-IR) micro-spectroscopy





Results – descriptive statistics

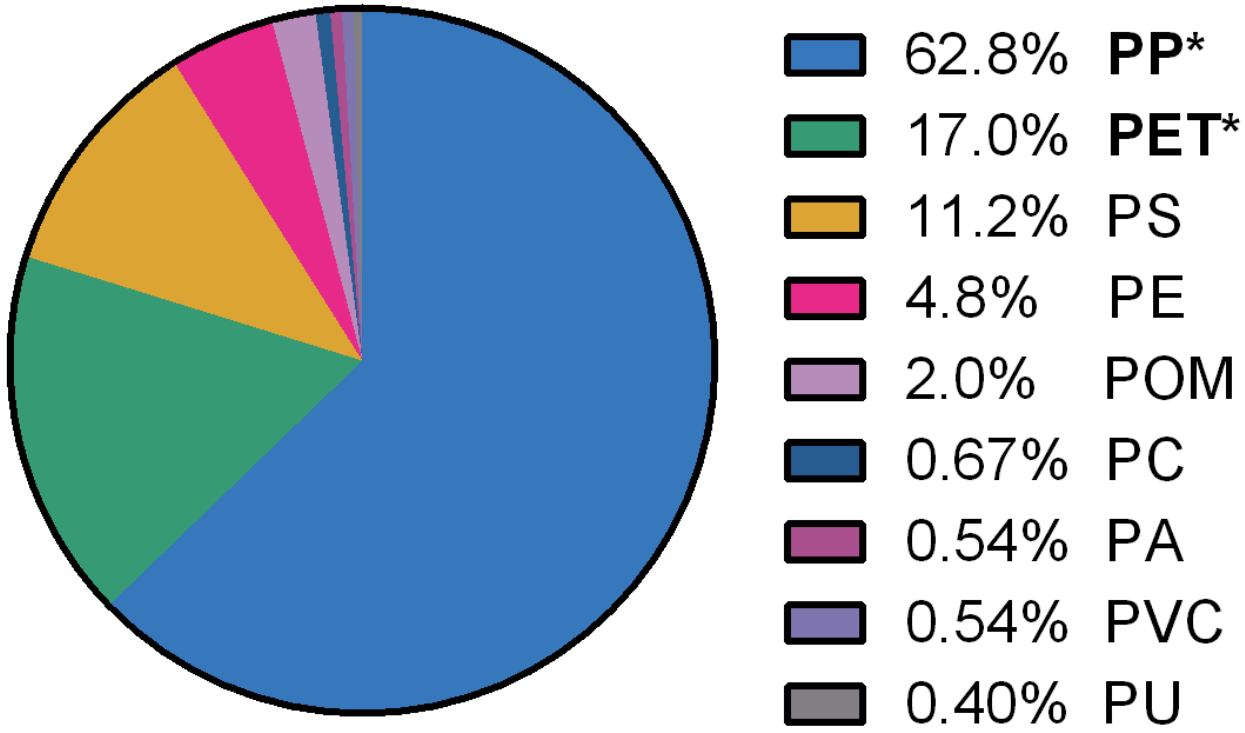
- 8 participants: 3 males, 5 females, aged 33-65 years
- 0/8 – vegetarian
- 2/8 – daily chewing-gum users
- 6/8 – ingested sea-food during the observation period
- 8/8 – had contact to plastic-wrapped food
- On average, 750 ml/day were drunk from PET bottles

Results – stool analysis

❖ Stool weight:	34 [8-39] g
❖Positive samples:	8/8
❖ Microplastic particles / 10g stool:	20 [18-172] particles
❖ Particle size:	50-500 µm
❖Plastic types detected:	9/10 (3-7 types /sample)

Values are displayed as median [Q1-Q3]

Results – relative frequency of different microplastic types



PP, PET, PS and PE: > 95%

*PP and PET were found in all 8/8 samples

Discussion

- How representative are these results?
- What are the sources of microplastics ingestion?
- What is the clinical impact of gastrointestinal microplastics?
- How can we reduce plastic pollution?

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Supplementary Slides

How representative are these results?

Consultation with our Department of Medical Statistics (Prof. Daniela Dunkler):

- In our study microplastics were present in 8/8 stool samples (100%).
- The confidence interval of this finding is 68-100%, when applying it to larger cohorts.
- Hence, more than 50% of the world population might have microplastics in their stool.
- However, only larger studies will be able to confirm this assumption.

What are the sources of microplastics ingestion?

- Food itself
  - ➔ Ingestion of sea-food correlated with microplastics content ($R=0.648$; $p=0.089$)

- Food contact materials
  - ➔ Packaging and processing

What is the clinical impact of gastrointestinal microplastics?

- Microplastic translocates from the intestine and particles with sizes up to 130µm have been detected in the blood stream, lymphatic vessels and the liver of fish [1,2] and various mammals [3-7]
- Microplastics may harm via bioaccumulation (causing local immunoreactions) or can serve as a vector for other chemicals [7-10].
- In birds and fish oral plastic caused remodeling of the intestinal villi, distortion of iron absorption and hepatic stress [1,9-12]
- Especially patients with intestinal bowel diseases might be vulnerable to microparticles [13,14].

1. Lu Y, et.al. Uptake and Accumulation of Polystyrene Microplastics in Zebrafish and Toxic Effects in Liver. Environ Sci Technol. 2016 Apr 5;50(7):4054-60.
2. Pitt JA, et.al. Uptake, tissue distribution, and toxicity of polystyrene nanoparticles in developing zebrafish. Aquat Toxicol. 2018 Jan;194:185-194.
3. Volkheimer G. Hematogenous dissemination of ingested polyvinyl chloride particles. Ann. NY Academy of Sciences. 1975;246:164-171.
4. Jani P, et.al. Nanoparticle uptake by the rat gastrointestinal mucosa: quantitation and particle size dependency. J Pharmacy & Pharmacol. 1990;42(12):821-826.
5. Hillery AM, et.al. Comparative, quantitative study of lymphoid and non-lymphoid uptake of 60 nm polystyrene particles. J Drug Target. 1994;2(2):151-6.
6. Araujo L, et.al. Uptake of PMMA nanoparticles from the gastrointestinal tract after oral administration to rats. Int. J Pharmaceutics. 1999;176(2):209-224.
7. Hussain N, et.al. Recent advances in the understanding of uptake of microparticulates across the gastrointestinal lymphatics. Adv drug del reviews. 2001;50(1-2):107-142.
8. Tanaka K, et.al. Accumulation of plastic-derived chemicals in tissues of seabirds ingesting marine plastics. Mar Pollut Bull. 2013 Apr 15;69(1-2):219-22.
9. Smith M, et.al. Microplastics in Seafood and the Implications for Human Health. Curr Environ Health Rep. 2018 Sep;5(3):375-386.
10. Wright SL, Kelly FJ. Plastic and Human Health: A Micro Issue? Environ Sci Technol. 2017 Jun 20;51(12):6634-6647.
11. Mahler GJ, et al. Oral exposure to polystyrene nanoparticles affects iron absorption. Nature nanotechnology. 2012;7(4):264-271.
12. Rochman CM, et.al. Ingested plastic transfers hazardous chemicals to fish and induces hepatic stress. Scientific reports. 2013;3:3263.
13. Schmidt C, et al. Nano- and microscaled particles for drug targeting to inflamed intestinal mucosa: a first in vivo study in human patients. J Controlled Release. 2013;165(2):139-145.
14. Lomer MC, et.al. Fine and ultrafine particles of the diet: influence on the mucosal immune response and association with Crohn's disease. Proc Nutr Soc. 2002 Feb;61(1):123-30.

How can we reduce plastic pollution?

- Increase awareness
- Reduce plastic usage where possible
- Increase plastics reuse & recycling
- Dispose plastic waste appropriately

09/2018: The European Parliament voted in favor of a EU wide microplastics ban in cosmetics.