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SCIENTIFIC FACTS IN THE MEME AGE

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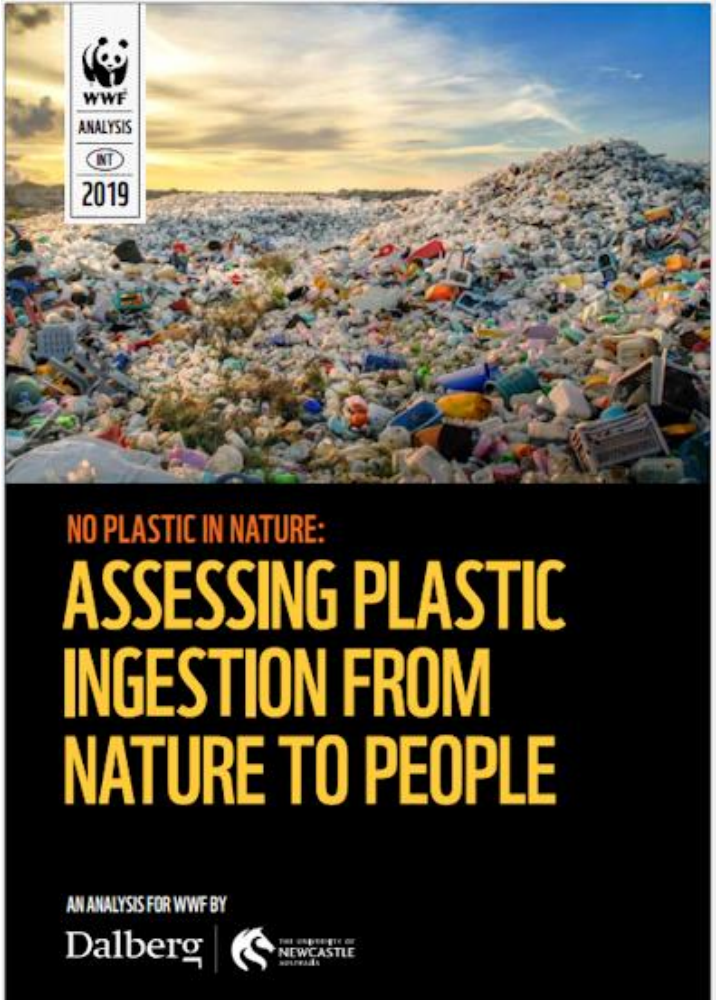
CREATIVE DIRECTOR
MJPHD, LLC

21 March 2024

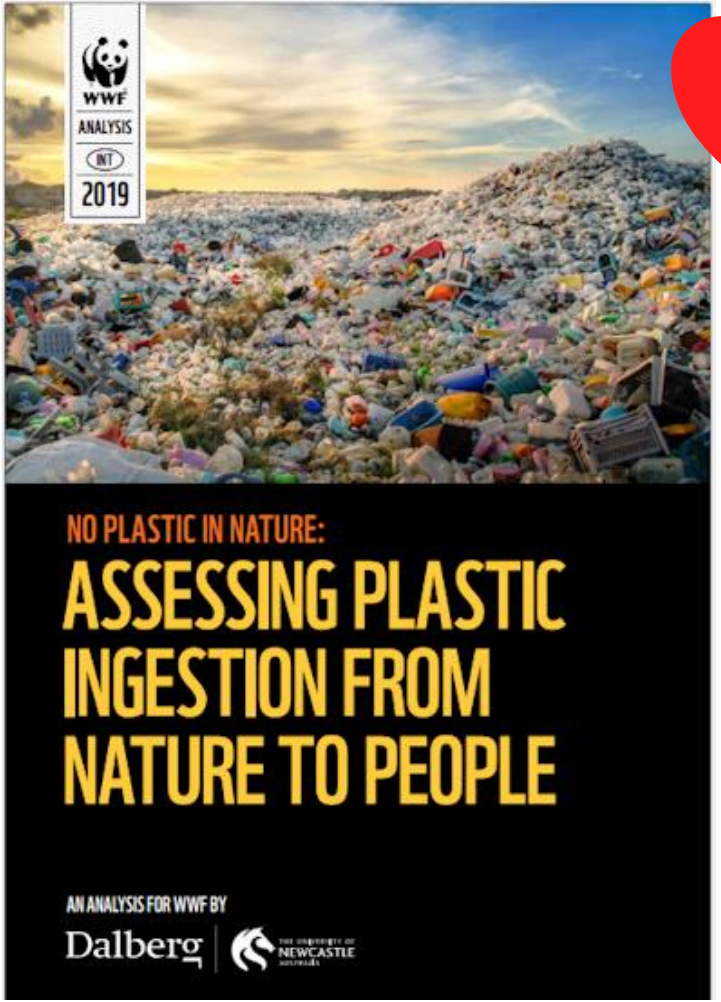
PAPER: 4003833

Scientific Facts in the Meme Age

Most have heard we consume 5 grams of plastic per week. That is the weight of a credit card's worth of plastic hiding in our food as microplastics. Many may have seen the reporting showing a credit card between two chopsticks. I saw that image and immediately had my doubts. Planting the picture that each bite contained a credit card's worth of plastic – 5 grams – clearly was intentionally misleading. A little digging showed how misleading it is. Actual consumption is about a million times lower. I'll examine where the error occurred, how it spread and how subsequent measurements in peer-reviewed papers failed to change the perception.



wwfint.awsassets.panda.org/downloads/plastic_ingestion_web_spreads.pdf



A new study by the University of Newcastle, Australia suggests that an average person could be ingesting approximately 5 grams of plastic every week. The equivalent of a credit card's worth of microplastics. This summary report highlights the key ways plastic gets into our body, and what we can do about it.

wwfint.awsassets.panda.org/downloads/plastic_ingestion_web_spreads.pdf

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Plastic ingestion by people could be equating to a credit card a week

Wednesday, 12 June 2019 Tweet LinkedIn

A new study finds on average people could be ingesting approximately 5 grams of plastic every week, which is the equivalent weight of a credit card.

Dr Thava Palanisami

The analysis *No Plastic in Nature: Assessing Plastic Ingestion from Nature to People* prepared by Dalberg, based on a study commissioned by WWF and carried out by University of Newcastle, Australia, suggests people are consuming about 2000 tiny pieces of plastic every week. That's approximately 21 grams a month, just over 250 grams a year.

The University of Newcastle is the first to combine data from over 50 studies on the ingestion of microplastic by people. The findings are an important step towards understanding the impact of plastic pollution on humans. It also further confirms the urgent need

www.newcastle.edu.au/newsroom/featured/plastic-ingestion-by-people-could-be-equating-to-a-credit-card-a-week

wwf.panda.org/wwf_news/?348337/Revealed-plastic-ingestion-by-people-could-be-equating-to-a-credit-card-a-week

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World

You may be eating a credit card's worth of plastic each week - study

Reuters

June 11, 2019 9:29 PM EDT · Updated 5 years ago

Aa

www.reuters.com/article/us-environment-plastic/you-may-be-eating-a-credit-cards-worth-of-plastic-each-week-study-idUSKCN1TD009/

www.cnn.com/2019/06/11/health/microplastics-ingestion-wwf-study-scn-intl/index.html

per week

whole card = 5 g

per day

1/7 card = 710 mg

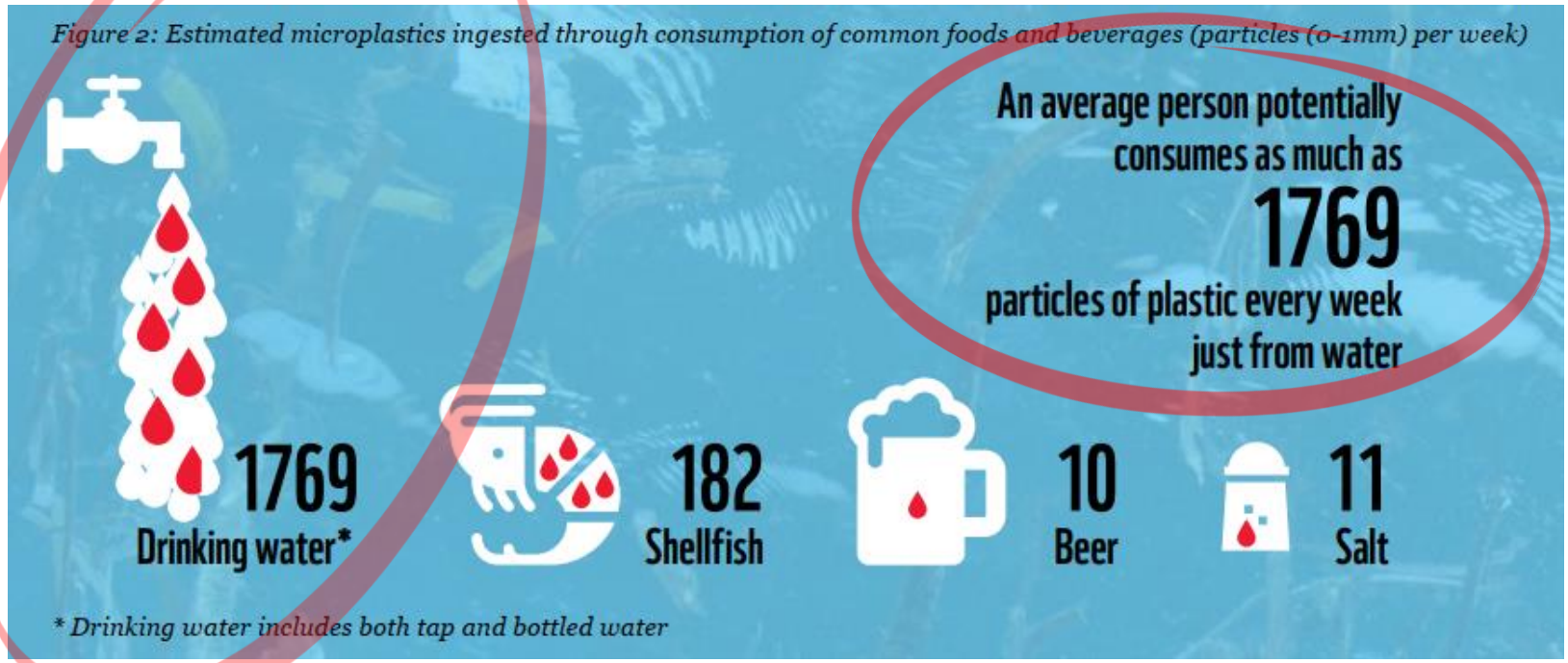
per meal

1/21 card = 240 mg

per bite

1/21 card = 20 mg

2.5 mg average particle to reach 5 grams.




TOXIC

Average 2.5 mg particles.

Plastic microparticles, 0.65 grams consisting of 523 particles, in a liter of water equaling the concentration in order to ingest 5 grams per week. Such a high concentration is easily seen both in water and upon drying. The particles are cut from 1.5 mm plastic monofilament.

click to watch video

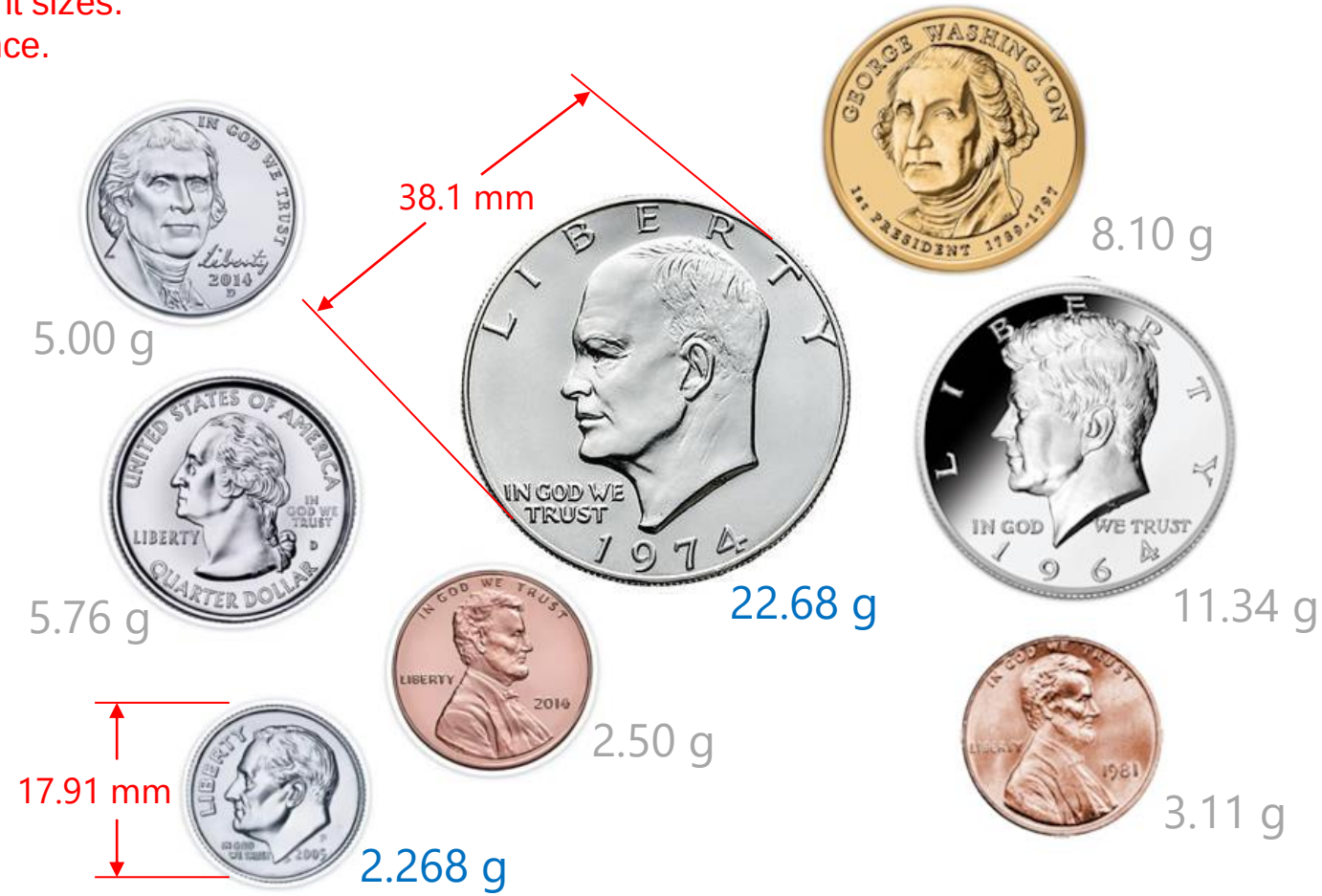
Dimes weigh 2.268 g

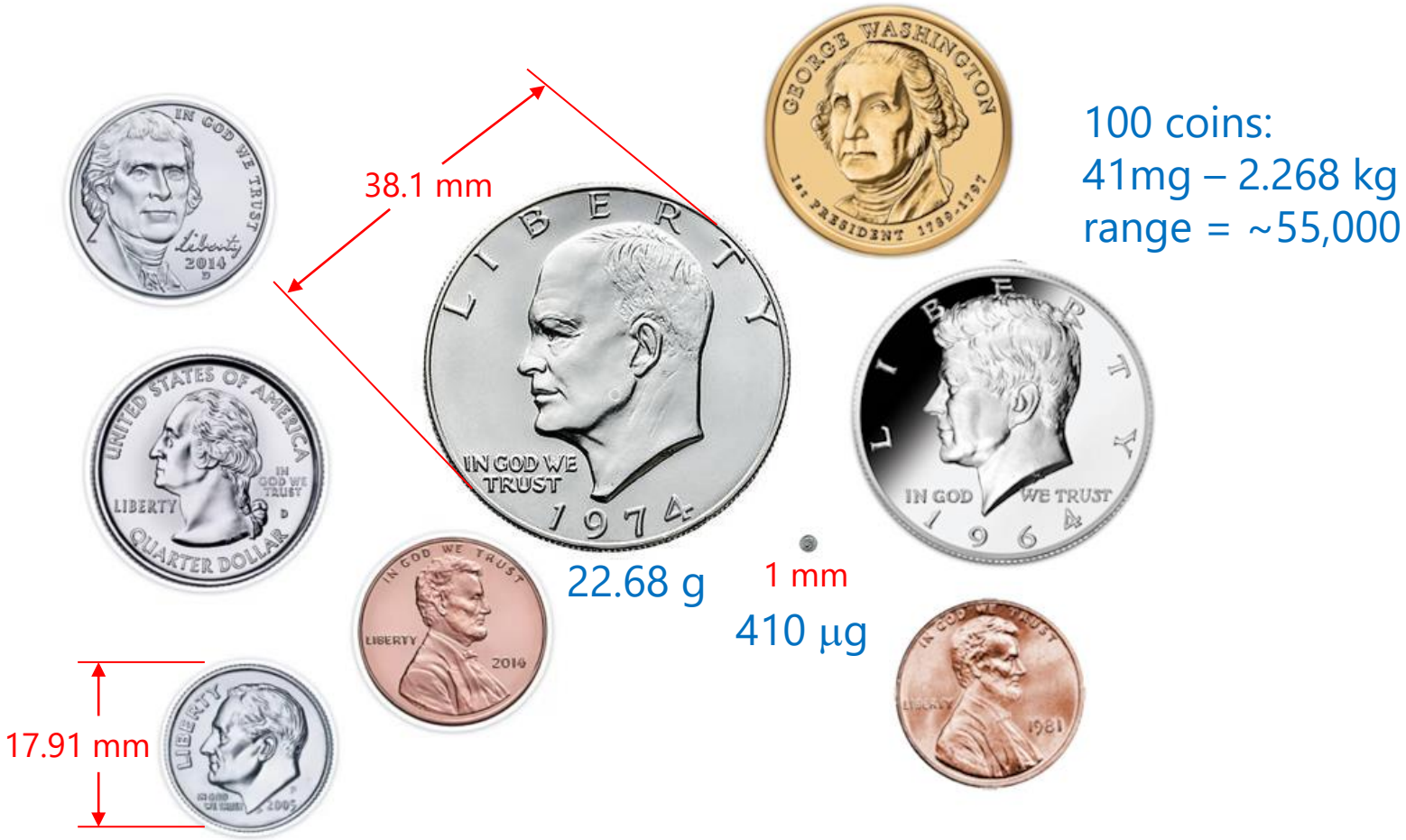
Diameter is 17.91 mm

dimes weigh 2.268 g

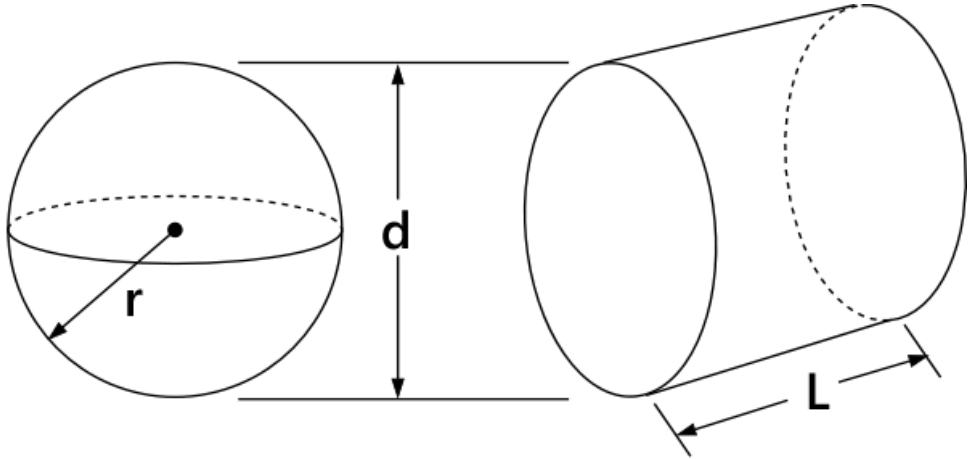
Coins of last 50 years
Pennies changed weight
in 1982.

Only 8 different sizes.
2.13X difference.




38.1 mm
17.91 mm
22.68 g
1 mm
410 µg
100 coins:
41mg – 2.268 kg
range = ~55,000

Guessing Particle Mass



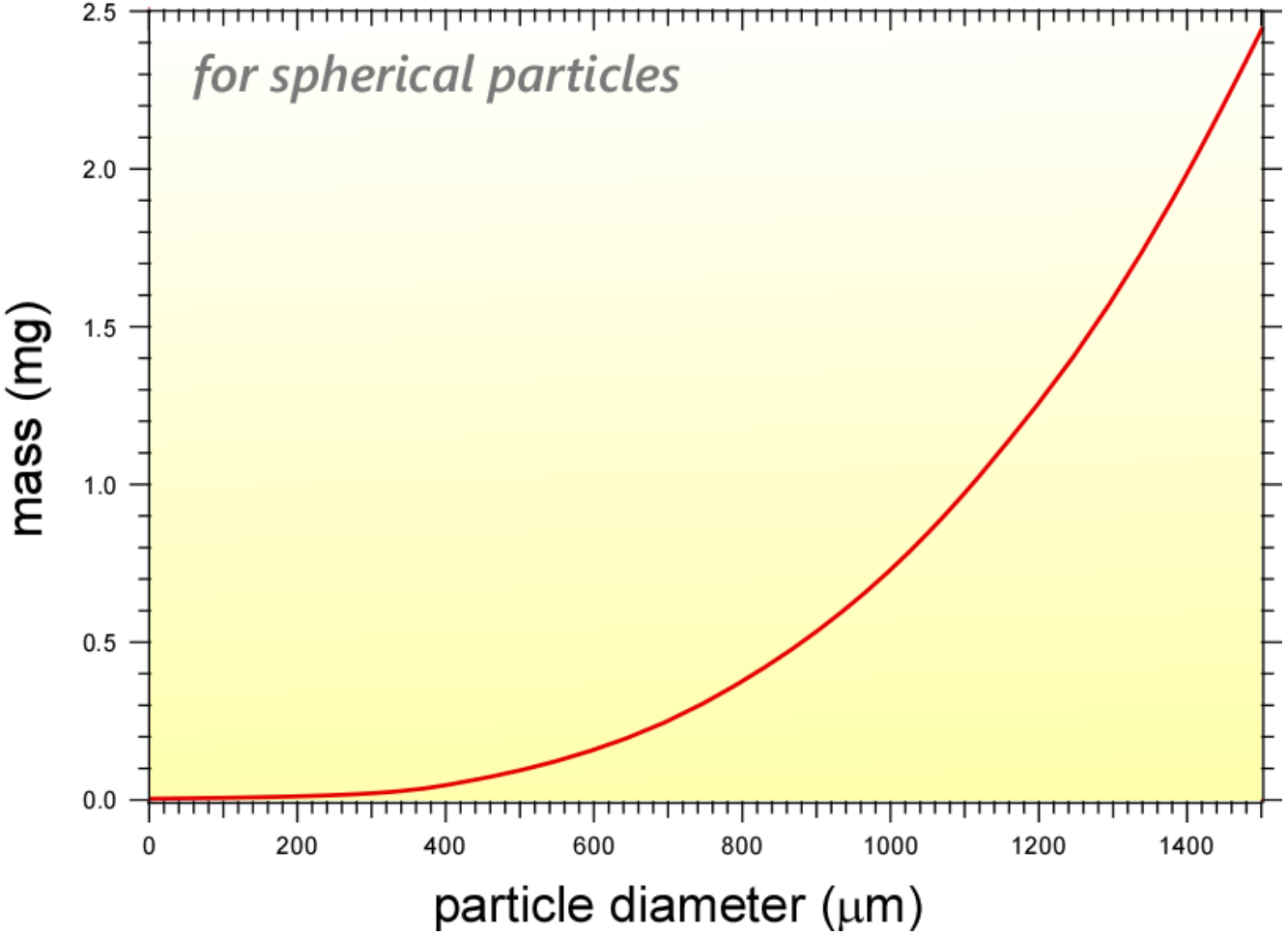
$$m = \rho V = \frac{\pi \rho d^3}{6}$$

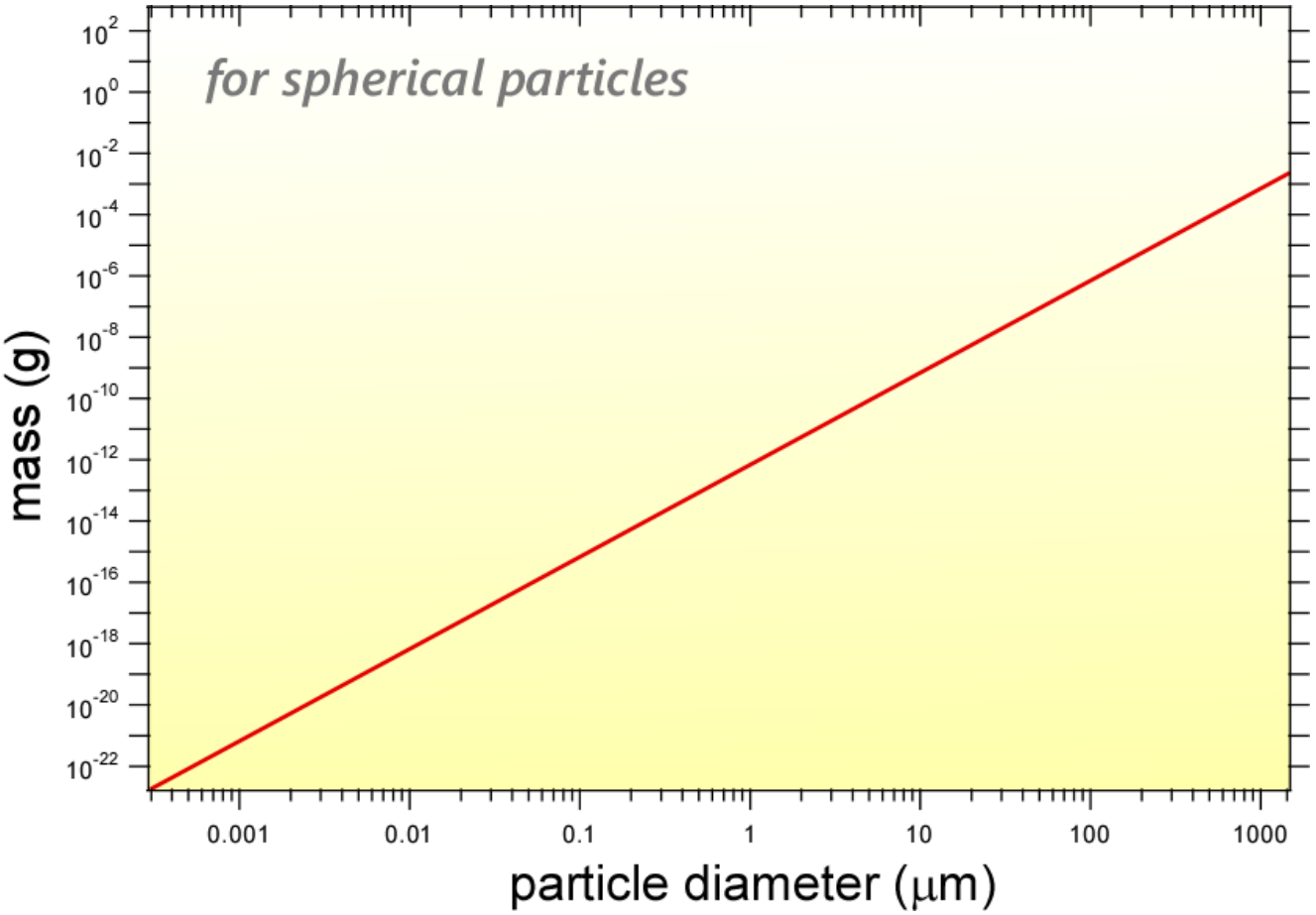
$$m = \frac{\pi \rho d^2 L}{4}$$

$$\text{let } A = \frac{L}{d}$$

$$m = \frac{\pi \rho d^3 A}{4}$$

polymer	density(g/cc)
PE	0.92-0.97
PP	0.88-0.91
PET	1.30-1.40


for spherical particles
mass (mg)
2.5
2.0
1.5
1.0
0.5
0.0
0
200
400
600
800
1000
1200
1400
particle diameter (μm)


for spherical particles
mass (g)
10^{2}
10^{0}
10^{-2}
10^{-4}
10^{-6}
10^{-8}
10^{-10}
10^{-12}
10^{-14}
10^{-16}
10^{-18}
10^{-20}
10^{-22}
0.001
0.01
0.1
1
10
100
1000
particle diameter (μm)

Journal of Hazardous Materials 404 (2021) 124004

Contents lists available at ScienceDirect

Journal of Hazardous Materials

journal homepage: www.elsevier.com/locate/jhazmat

Research paper

Estimation of the mass of microplastics ingested – A pivotal first step towards human health risk assessment

Kala Senathirajah [a], Simon Attwood [b], Geetika Bhagwat [c], Maddison Carbery [c], Scott Wilson [d], Thava Palanisami [a,*]

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ARTICLE INFO

Keywords:
Exposure pathways
Human health
Ingestion
Microplastics
Plastic pollution
Risk

ABSTRACT

The ubiquitous presence of microplastics in the food web has been established. However, the mass of microplastics exposure to humans is not defined, impeding the human health risk assessment. Our objectives were to extract the data from the available evidence on the number and mass of microplastics from various sources, to determine the uncertainties in the existing data, to set future research directions, and derive a global average rate of microplastic ingestion to assist in the development of human health risk assessments and effective management and policy options. To enable the comparison of microplastics exposure across a range of sources, data extraction and standardization was coupled with the adoption of conservative assumptions. Following the analysis of data from fifty-nine publications, an average mass for individual microplastics in the 0–1 mm size range was calculated. Subsequently, we estimated that globally on average, humans may ingest 0.1–5 g of microplastics weekly through various exposure pathways. This was the first attempt to transform microplastic counts into a mass value relevant to human toxicology. The determination of an ingestion rate is fundamental to assess the human health risks of microplastic ingestion. These findings will contribute to future human health risk assessment frameworks.

> “humans may ingest 0.1-5 g of microplastics weekly through various exposure pathways”

https://doi.org/10.1016/j.jhazmat.2020.124004

Table 6
Summary of the annual average number of microplastics (particles) ingested (particles), and global average rate of microplastics ingested (g) per person per year.

Source of particles	$ANMP_{ingested}$ (particles)	GARMI (0–1 mm) Scenario 1 (g)	GARMI (0–1 mm) Scenario 2 (g)	GARMI (0–1 mm) Scenario 3 (g)
Shellfish	9,445	26.4	0.0	0.0
Salt	565	1.6	7.4	14.2
Beer	523	1.46	0.3	0.5
Drinking water	91,994	257.5	0.0	0.0
Total (per year)	**102,527**	**287.0**	**7.7**	**14.7**
TOTAL (PER WEEK)	*1,972*	*5.5*	*0.1*	*0.3*

https://doi.org/10.1016/j.jhazmat.2020.124004

0.02 credit cards worth

one model **another model**

> an average person could be ingesting approximately 5 grams of plastic every week.

wwfint.awsassets.panda.org/downloads/plastic_ingestion_web_spreads.pdf

Environmental Science & Technology

pubs.acs.org/est

Article

Lifetime Accumulation of Microplastic in Children and Adults

Nur Hazimah Mohamed Nor,* Merel Kooi, Noël J. Diepens, and Albert A. Koelmans

Cite This: *Environ. Sci. Technol.* 2021, 55, 5084−5096

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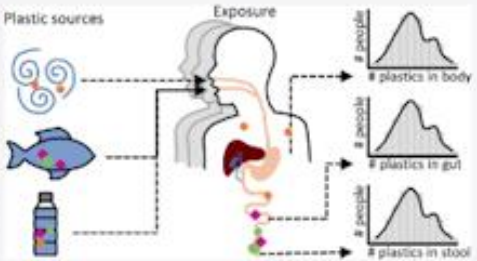
ABSTRACT: Human exposure to microplastic is recognized as a global problem, but the uncertainty, variability, and lifetime accumulation are unresolved. We provide a probabilistic lifetime exposure model for children and adults, which accounts for intake via eight food types and inhalation, intestinal absorption, biliary excretion, and plastic-associated chemical exposure via a physiologically based pharmacokinetic submodel. The model probabilistically simulates microplastic concentrations in the gut, body tissue, and stool, the latter allowing validation against empirical data. Rescaling methods were used to ensure comparability between microplastic abundance data. Microplastic (1−5000 μm) median intake rates are 553 particles/capita/day (184 ng/capita/day) and 883 particles/capita/day (583 ng/capita/day) for children and adults, respectively. This intake can irreversibly accumulate to 8.32×10^3 (90% CI, 7.08×10^2−1.91×10^6) particles/capita or 6.4 (90% CI, 0.1−2.31×10^3) ng/capita for children until age 18, and up to 5.01×10^4 (90% CI, 5.25×10^3−9.33×10^6) particles/capita or 40.7 (90% CI, 0.8−9.85×10^3) ng/capita for adults until age 70 in the body tissue for 1−10 μm particles. Simulated microplastic concentrations in stool agree with empirical data. Chemical absorption from food and ingested microplastic of the nine intake media based on biphasic, reversible, and size-specific sorption kinetics, reveals that the contribution of microplastics to total chemical intake is small. The as-yet-unknown contributions of other food types are discussed in light of future research needs.



883 particles per person per day

583 ng/person/day

https://pubs.acs.org/doi/full/10.1021/acs.est.0c07384

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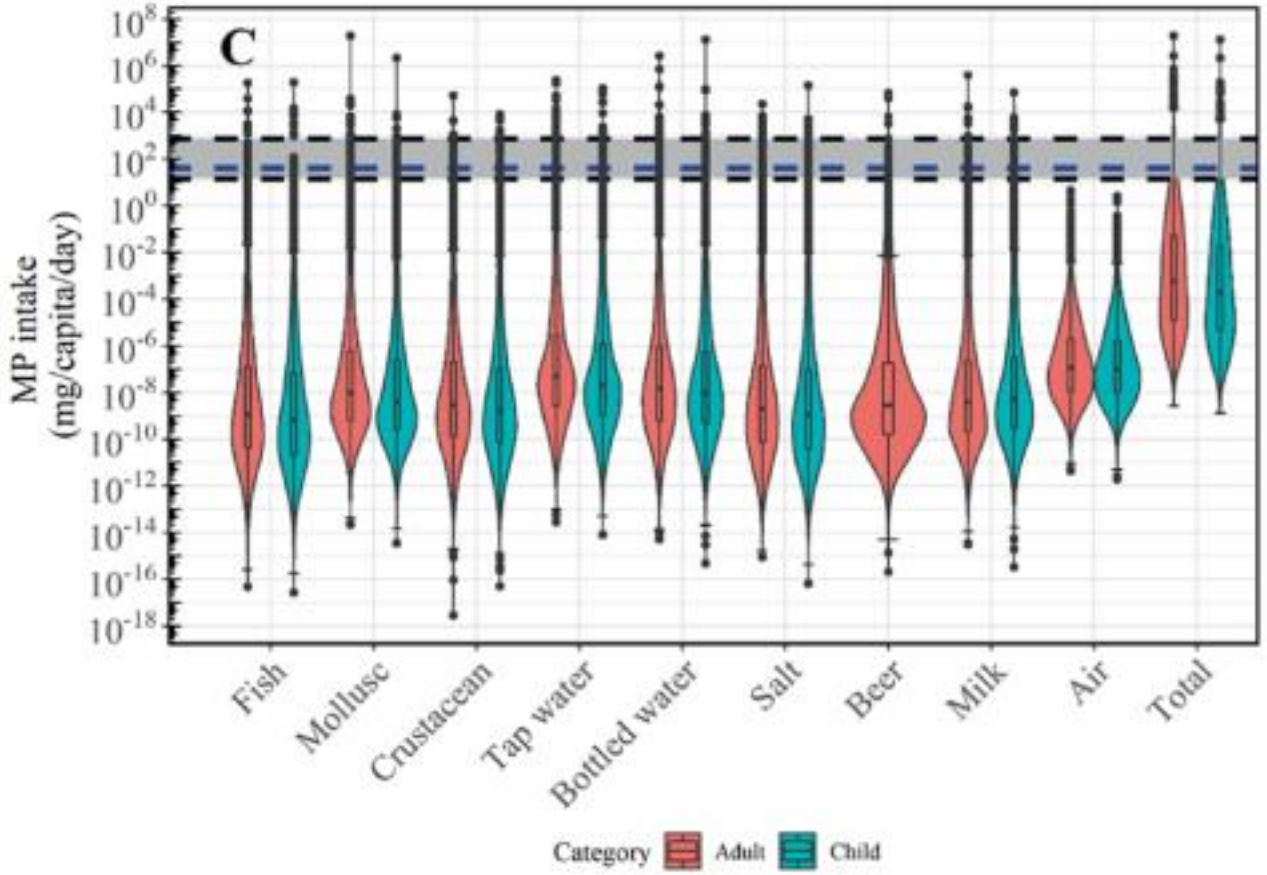

https://pubs.acs.org/doi/full/10.1021/acs.est.0c07384

Bert Koelmans makes point that a week's ingestion is like a grain of salt between chopsticks – mere micrograms.

Exposure and Health (2023) 15:33–51
https://doi.org/10.1007/s12403-022-00470-8

REVIEW PAPER

To Waste or Not to Waste: Questioning Potential Health Risks of Micro- and Nanoplastics with a Focus on Their Ingestion and Potential Carcinogenicity

Elisabeth S. Gruber[1] · Vanessa Stadlbauer[2,3] · Verena Pichler[4] · Katharina Resch-Fauster[5] · Andrea Todorovic[5] · Thomas C. Meisel[6] · Sibylle Trawoeger[7] · Oldamur Hollóczki[8] · Suzanne D. Turner[9,10] · Wolfgang Wadsak[3,11] · A. Dick Vethaak[12,13] · Lukas Kenner[3,14,15,16]

Received: 8 October 2021 / Revised: 30 December 2021 / Accepted: 11 February 2022 / Published online: 22 March 2022

Abstract
Micro- and nanoplastics (MNPs) are recognized as emerging contaminants, especially in food, with unknown health significance. MNPs passing through the gastrointestinal tract have been brought in context with disruption of the gut microbiome. Several molecular mechanisms have been described to facilitate tissue uptake of MNPs, which then are involved in local inflammatory and immune responses. Furthermore, MNPs can act as potential transporters ("vectors") of contaminants and as chemosensitizers for toxic substances ("Trojan Horse effect"). In this review, we summarize current multidisciplinary knowledge of ingested MNPs and their potential adverse health effects. We discuss new insights into analytical and molecular modeling tools to help us better understand the local deposition and uptake of MNPs that might drive carcinogenic signaling. We present bioethical insights to basically re-consider the "culture of consumerism." Finally, we map out prominent research questions in accordance with the Sustainable Development Goals of the United Nations.

Keywords Microplastic · Nanoplastic · Carcinogenesis · Human health · Bioethics issue

"Translated into more imaginable numbers, on average we ingest five grams of MPs per week per person (roughly corresponding to the mass of a credit card)."

https://link.springer.com/article/10.1007/s12403-022-00470-8

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Menu

Health risk due to micro- and nanoplastics in food

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All News

2022-03-24 – MEDICINE & SCIENCE

(Vienna, 24-03-2022) Five grams of plastic particles on average enter the human gastrointestinal tract per person

> Five grams of plastic particles on average enter the human gastrointestinal tract per person per week

www.meduniwien.ac.at/web/en/ueber-uns/news/default-0f889c8985-1/gesundheitsrisiko-durch-mikro-und-nanoplastik-in-lebensmitteln/

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Science News *from research organizations*

Health risk due to micro- and nanoplastics in food

Date: March 24, 2022

Source: Medical University of Vienna

Summary: Five grams of plastic particles on average enter the human gastrointestinal tract per person per week. This is roughly equivalent to the weight of a credit card. Whether ingested micro- and nanoplastics pose a health risk is being investigated in numerous studies but is largely unknown to date. A research team has now summarized the current state of scientific knowledge.

> Five grams of plastic particles on average enter the human gastrointestinal tract per person per week

www.sciencedaily.com/releases/2022/03/220324130253.htm

NEW YORK POST
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HEALTH

You're eating a credit card's worth of plastic a week — and it's killing your gut

By Brooke Kato

Published March 30, 2022 | Updated March 30, 2022, 4:47 p.m. ET

Junk Food and Tainted Water: People Ingest a Credit Card Worth of Nanoplastics Weekly, Study Says

Mar 31, 2022 at 5:09 PM EDT

Bottled water or tap?

How you answer that question could have some major implications for your long-term health, a new study into the health effects of ingested plastic particles shows.

That study also contained this startling fact: People are eating the equivalent of one plastic credit card every week in their diet. The plastic particles enter the human food chain through plastic waste contained in fish, sea salt and drinking water, the study shows.

Scientists say such nanoplastics disrupt the human gut bacteria and can lead to killer diseases like cancer and diabetes.

TastingTable. RECIPES NEWS EXCLUSIVES RESTAURANTS COOK DRINK

COOK

You Probably Eat A Credit Card's Worth Of Plastic Every Week

BY GILLIE HOUSTON / UPDATED: OCT. 19, 2022 6:53 PM EST

www.tastingtable.com/1062298/you-probably-eat-a-credit-cards-worth-of-plastic-every-week/

Journal of Hazardous Materials Letters 3 (2022) 100071

Contents lists available at ScienceDirect

Journal of Hazardous Materials Letters

journal homepage: www.sciencedirect.com/journal/journal-of-hazardous-materials-letters

Ingested microplastics: Do humans eat one credit card per week?

Martin Pletz

Designing Plastics and Composite Materials, Department of Polymer Engineering and Science, Montanuniversitaet Leoben, Austria

ARTICLE INFO

Keywords:
Microplastics
Size distribution
Ingestion
Human health

ABSTRACT

Ingested Microplastic (MP) particles can harm the human body. Estimations of the total mass of ingested MP particles correspond to 50 plastic bags per year (Bai et al., 2022), one credit card per week (Gruber et al., 2022), or a median value of 4.1 μg/week for adults (Mohamed Nor et al., 2021). The first two estimations are based on an analysis (Senathirajah et al., 2021) that predicts a total ingested mass of MP particles $m_{i,MP}$ of 0.1–5 g/week. This work revisits and evaluates this calculation and compares its results and methods to Mohamed Nor et al. (2021). Senathirajah combines data of averaged MP particle masses $\bar{m}_{MP}$ from papers that reported MP particle sizes and MP particle counts n_{MP} in shellfish, salt, beer, and water based on other papers that detected MP particles. Combined with the estimated weekly consumption of those consumables, they compute $m_{i,MP}$. This work raises some serious issues of Senathirajah in the way they combine data and they obtained particle sizes. It concludes that Senathirajah overestimates $m_{i,MP}$ by several orders of magnitude and that $m_{i,MP}$ can be considered as a rather irrelevant factor for the toxic effects of MP particles on the human body.

> a human eats a credit card worth of MPs not every week but every 23 thousand years.

https://www.sciencedirect.com/science/article/pii/S2666911022000247?via%3Dihub

Chapter 10

Emerging Aquatic Contaminants

One Health Framework for Risk Assessment and Remediation in the Post COVID-19 Anthropocene

ook • 2023

Sources, consequences, and control of nanoparticles and microplastics in the environment

A. Guhananthan [a], Aswin Kuttykattil [b], Thavamani Palanisami [b] and Selvakumar Rajendran [a,b]

[a] *Department of Nanobiotechnology, PSG Institute of Advanced Studies, Coimbatore, Tamil Nadu, India,* [b] *Environmental Plastic and Innovation Cluster (EPIC), Global Innovation Centre for Advanced Nanomaterials (GICAN), University of Newcastle, Callaghan, NSW, Australia*

10.1 Introduction

Nanoparticles (NP) and microplastics (MPs) are the most recent anthropogenic contaminants which pose threat to the environment and health. Both NPs and MPs from various sources interact with water, air, and soil in a complex way affecting aquatic and terrestrial ecosystems (Fred-Ahmadu et al., 2020). Their bioaccumulation leads to, cytotoxicity, genotoxicity, organ failure, and sometimes death in living organisms. Nanoparticles can be classified into different types based on their origin (natural nanoparticles (NNPs) and engineered nanoparticles (ENPs)), dimension, size, and chemical composition (Ealia and Saravanakumar, 2017). Fig. 10.1 illustrates various sources of nanoparticles.

“Senathirajah and Palanisami (2019) estimated that on average, humans may consume 5 g of MPs per week”

ACS ES&T Water

pubs.acs.org/estwater

Review

Strategies to Reduce Risk and Mitigate Impacts of Disaster: Increasing Water Quality Resilience from Microplastics in the Water Supply System

Kala Senathirajah* and Thava Palanisami

Cite This: *ACS EST Water* 2023, 3, 2816−2834

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ABSTRACT: Microplastics contaminating the water supply system qualifies as a disaster. This has major far-reaching implications, posing significant threats to economic growth and human livelihoods, as well as environmental and human health and well-being. Thus, we need to reduce the risk and mitigate against the effects of microplastics to build resilience and ensure continuity and efficiency of water supply system functions. To date, microplastics in the water supply cycle have not been considered in the context of disaster management. Hence, we provide an understanding of the disaster risk that microplastics pose using a conceptual mathematical framework. Additionally, we enhance understanding of the resilience of the social and physical infrastructure by highlighting hazards that people and infrastructure in the community face. Insights of the social, economic, and other human factors that make them vulnerable highlights capacities required to reduce risk and mitigate impacts. By evaluating the social and physical infrastructure resilience to microplastics in the water supply system and recommending multidisciplinary strategies to build resilience over time, we aim to catalyze action to address the problem. This will also contribute toward achieving targets of the Sendai Framework for Disaster Risk Reduction 2015−2030 and UN Sustainable Development Goals.

1. INTRODUCTION

Plastics are versatile, synthetic, widely used, persistent materials found in all aspects of our lives, in all sectors, and as pollution all around the globe. The plastic pollution crisis meets all criteria to qualify as a slow-onset disaster.[1] Microplastics are ubiquitous plastic fragments, spheres, fibers, filaments, and films, viz., plastic particles greater than 100 nm and less than 5 mm in size. Nanoplastics are particles less than 100 nm.[2] Microplastics have been detected in the air, water, and terrestrial environments, found from Mount Everest to the Marianna trench.[3] Microplastics have been found in plants,[4] animals, and humans,[5] in human placenta,[6] lungs, blood, and even breastmilk.[7] A recent study estimated that we could be ingesting cumulatively 0.1 to 5 g of microplastics a week[8] from a combination of sources, including from drinking water which is a fundamental need for survival. Microplastics have been detected in water supply sources, tap water, and bottled water around the world.[8,9]

Microplastics contaminate the water supply system (WSS) due to numerous reasons, including the existing social systems' policies and consumptive behaviors, and limitations in treatment. The fate and transport of microplastics through the water supply cycle (WSC) are varied, and thus the timeframes and implications also range greatly depending on the entry and exit points. For example, microplastics exiting via ingestion by a human has different implications to microplastics exiting via biosolids application for agriculture, although notably both instances impinge on the health and well-being of humans[5] and ecosystems.[10] The transport and fate of microplastics are a function of numerous factors including polymer type, size, shape, specific surface area, density, crystallinity, molecular structure, formation of biofilm and additives, among others. These also influence the vulnerability of the WSS and its sensitivity to the microplastic contamination.

Access to safe drinking water and wastewater services (W&WWS) are a human right,[11,12] and are essential to ensure health and well-being, good hygiene practices, economic prosperity, and minimize the spread of water borne diseases.[13] There are many disruptive events that impact W&WWS. Key to the continuity of service is water quality (WQ). From a

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Revised: August 11, 2023
Accepted: August 14, 2023
Published: August 29, 2023

> A recent study estimated that we could be ingesting cumulatively 0.1 to 5 g of microplastics a week

https://pubs.acs.org/doi/abs/10.1021/acsestwater.3c00206

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Medical Xpress Topics Conditions

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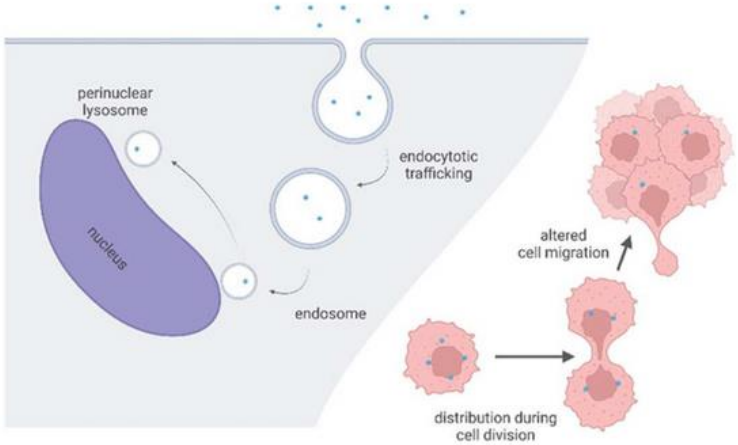
MARCH 6, 2024 Editors' notes

Micro- and nanoplastics in the body are passed on during cancer cell division, finds study

by Medical University of Vienna

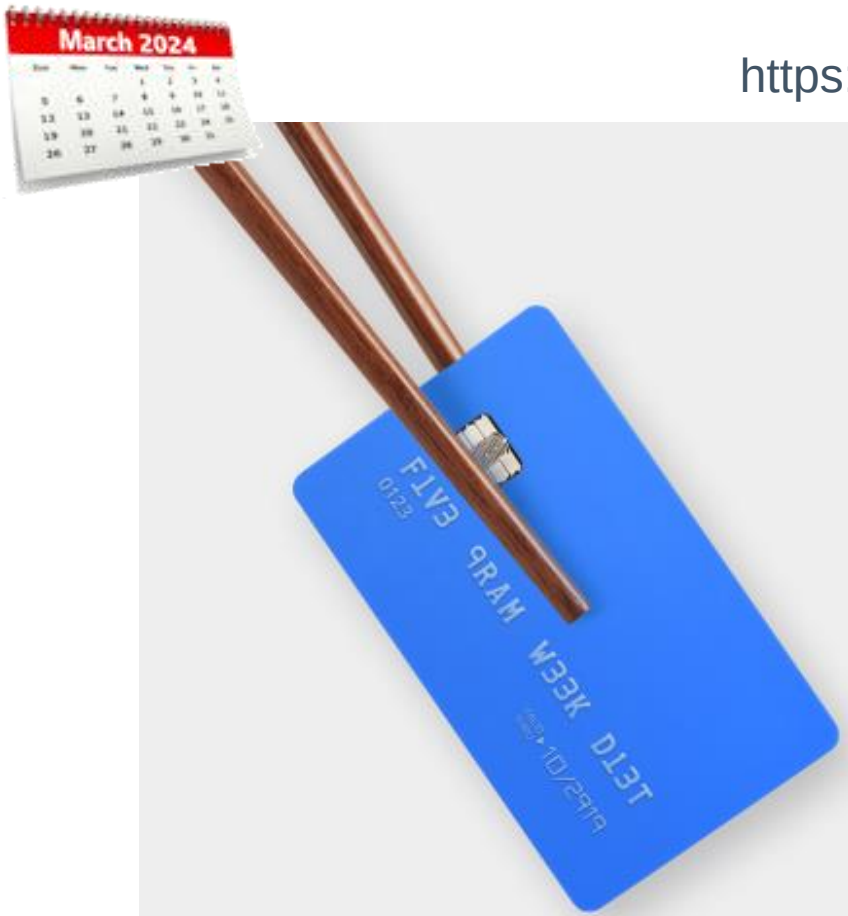


Credit: *Chemosphere* (2024). DOI: 10.1016/j.chemosphere.2024.141463

> Plastic particles up to the weight of a credit card (approx. 5 grams) enter the gastrointestinal tract every week.

medicalxpress.com/news/2024-03-micro-nanoplastics-body-cancer-cell.html

https://yourplasticdiet.org/



A credit card a week?

On average people could be ingesting around 5 grams of plastic every week, which is the equivalent weight of a credit card. Our study suggests people could be consuming on average over 100,000 microplastics every year. That's approximately 21 grams a month, just over 250 grams a year.

TAKE ACTION!

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Does it matter that 5 grams per week is wrong?

Journal of Hazardous Materials 404 (2021) 124004

Contents lists available at ScienceDirect

Journal of Hazardous Materials

journal homepage: www.elsevier.com/locate/jhazmat

Research paper

Estimation of the mass of microplastics ingested – A pivotal first step towards human health risk assessment

Kala Senathirajah [a], Simon Attwood [b], Geetika Bhagwat [c], Maddison Carbery [c], Scott W
Thava Palanisami [a,*]

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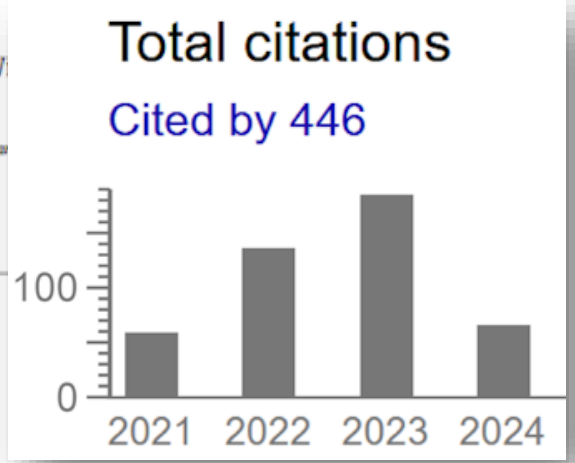
[d] Department of Environmental Science, Macquarie University, Sydney, Australia



https://doi.org/10.1016/j.jhazmat.2020.124004

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Streamed live on Apr 28, 2022

California Attorney General Rob Bonta makes a major announcement on the California Department of Justice's efforts to protect the environment from plastic pollution.

https://www.youtube.com/watch?v=fhaURS9U04s


iPhone Video
of
Unopened Water Bottles
click to watch video

A widely reported fact about microplastic consumption is wrong.

Correction in the scientific literature is slow to correct public perception and the scientific literature.

Plastic particles are everywhere.

https://www.rdworldonline.com/microplastics-are-bad-but-ignoring-science-is-worse/

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