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Plastics & Health

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Introduction

So, what do we know?

Experts warn of growing health risk from plastic

PLASTIC poses a health risk to humans "at every stage of its lifecycle," a shocking international report warned yesterday. It linked plastic to diseases such as cancer and kidney, heart and reproductive problems.

EXPRESS

Health & wellbeing

Are we poisoning our children with plastic?

The chemical BPA is widely added to food and drink packaging, and more than 80% of teenagers have it in their bodies. But how dangerous is it?

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Science & Environment

Plastic: WHO launches health review

By David Shukman
Science editor

15 March 2018

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Introduction

Images of plastic waste are everywhere; clearly this ‘harms’ the environment, flora & fauna.

What about humans?

As we’ve seen, exposure to plastics is essentially inevitable.

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Exposure Scenarios

Ingestion of micro and nano plastics;

Inhalation exposure to fibrous particles;

Leaching.

Microplastics (MPs) are considered as particles sized between 1 micrometre (µm) and 5mm, nanoplastics (NPs) are 1 nanometre to 1µm.

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Characteristics & Inherent Hazards

‘Plastic’ is made of synthetic organic polymers; the majority being polyethylene, polystyrene, polypropylene, polyvinyl chloride, polyurethane and polyethylene terephthalate.

Additives may be added to basic plastics to improve their characteristics such as strength, coloration or flame retardant properties.

Some of these additives, eg Bisphenol A, phthalates, polybrominated diphenyl ethers, and metals or metalloids can be classified as carcinogenic or endocrine disrupting.

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Inhalation Exposure

Q: What's less than 5µm in length, less than 3µm wide and has an aspect ratio of at least 3:1?

A: A respirable fibre! So an airborne MP or NP could easily be respirable.

With that in mind:

In 2016, plastic textile fibre production reached 60 million tons (ref 1). Typical synthetic fibres include polypropylene, acrylic, polyamide, polyester and polythene.

Degradation of these products produces 'fibre-like' micro / nano-plastics.

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Inhalation Exposure (2)

So, smaller MPs or NPs may be inhaled and some may persist in the lung.

Similarly to other particulate matter, MPs / NPs may cause localised inflammation or associated contaminants may desorb with genotoxic or mutagenic effects (ref 1).

Intrinsic contaminants such as dyes or plasticizers may also be toxic / carcinogenic / mutagenic.

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Inhalation Exposure (3)

Studies among nylon flock (fibre) workers suggest there is no evidence of increased cancer risk, although workers had a higher prevalence of respiratory irritation.

Interstitial lung disease is a work-related condition that induces coughing, dyspnoea, and reduced lung capacity in workers processing materials such as polyester, and/or nylon fibres.

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Exposure via the food chain

MPs and NPs found in freshwater and marine ecosystems; mechanical actions, UV degradation & energetic environment means plastics continue to fragment.

Some successes – UK bans plastic microbeads in 2018 after US in 2015; plastic bag charge reducing demand.

But, 1,000,000 plastic bottles bought per minute (worldwide); these contribute 1/3 of all marine plastic litter.

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Exposure via the food chain

Drinking water?

US studies suggest microplastic particles were found to be removed mainly by primary water treatment - solid skimming and sludge settling processes (ref 2).

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Exposure via the food chain

Aquatic organisms may be contaminated by MPs and NPs, either through loaded water or bioaccumulation from other organisms.

Evidence of translocation of MPs / NPs across the digestive tract of marine animals is limited.

Where humans consume whole tissues, eg bi-valves, risk of plastic ingestion is higher (ref 2).

Evidence for plastic translocation in mammalian gut is mixed (ref 2).

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Exposure via the food chain

Microplastics have been identified in terrestrial ‘whole’ foods such as honey.

Abrasive behaviours of microplastics on GI tissue has been observed in animal studies. Effects seen at cellular level following exposure to polystyrene particles (ref 2).

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Exposure via the food chain

Absorption of external or intrinsic contaminants of MPs / NPs is poorly understood but obvious concerns for bioaccumulation upwards through food chain.

Health concerns may arise therefore via both[(ref 2)]:

the microplastics themselves particularly intrinsic contaminants;

but also through the plastics increasing the uptake of other environmental pollutants.

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Exposure via the food chain

Leaching

Legislation in place on food safety / packaging at EU level requires plastic food contact materials may not transfer any of their constituents to food in amounts hazardous to human health.

But, this covers food packaging only so accidental exposure to wider environmental contaminants not covered.

Water for human consumption is considered to be food and falls under legislation when bottled. Tap water must meet the specifications of the Drinking Water Directive.

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Exposure via the food chain

Research Position

EFSA report into the potential risks to consumers from microplastics and nanoplastics in food, especially seafood concluded that there are insufficient data on the occurrence, toxicity and fate after digestion of these materials to carry out a full risk assessment (ref 3).

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Manufacturing Impact

Plastics / rubber production uses ~6% of total industrial sector energy use and is the biggest user of coal in industry behind coke / petrochemicals and mineral manufacture. Indirectly, energy use also has a health impact.

Clearly emissions from the production of this energy (all energy sources) are a contribution to local and regional air pollutant levels.

Emissions of trace solvents, initiators, etc from manufacturing plant. Low concentrations emitted but used in large quantities.

Perhaps important to consider the impact of these emissions in the context of single use / disposable plastics.

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Reflections

Used widely.

Controls in place for controlled exposure scenarios – food and drink containers for example...

...But material widely lost into the environment.

Uptake into the food chain is inevitable and ongoing.

Any measure of potential for harm subject to uncertainly.

Stopping exposure is going to be exceedingly difficult!

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Further Reading

Several papers in “Environmental Science & Health” Current Opinion (2018) series, including:

1: Gasperi et al “Microplastics in air: Are we breathing it in?”

2: Revel et al, “Micro(nano)plastics: A threat to human health?”

3: EFRA research position:

https://ec.europa.eu/research/sam/index.cfm