CGC International Journal of Contemporary Technology and Research
ISSN: 2582-0486 (online) Vol.-3, Issue-2 DOI: 10.46860/cgcijctr.2021.06.31.182

# Micro-plastics: An invisible danger to human health

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***Abstract:*** **Microplastics are small plastic pieces ranging between the size of 1-5 micrometre (µm). Because of their small size and their continuity, it has the potential to spread throughout all parts of our environment. These are ubiquitous environmental contaminants leading to inevitable human exposure. It can enter our bodies through ingestion, inhalation and dermal contact. It has already been found in various human foods, beers, drinking water, honey, seafood, sugar, table salt etc. It is demonstrated that marine organisms including zooplanktons, bivalves, crustaceans, worms, fish, reptiles etc. ingest microplastic. Around 2% to 40% of fishes were found to be contaminated with microplastic. It can reach our stomach and due to its size , these are either excreted, get entrapped in intestinal lining and stomach or move freely in body fluids like blood, thereby reaching various organs and tissues of body. To tackle this serious issue of microplastic pollution in environment and in human health, various effective policies must take under consideration all stages of lifecycle of plastic connecting producers to users and ultimately to waste managers. Thus, we have to seem for potential effects of microplastics in living beings, which specializes in the pathways of toxicity and exposure, way to reduce microplastic pollution, sources of invisible plastics. Present work was conducted to explore the possible threats of micro as well as nanoplastic particles to humanity as well as to our ecosystem. Under this study we summarized various aspects of this critical issue, which provide better scientific knowledge for future research.**

***Keywords:*** **Microplastics, human health, toxicity, awareness.**

## I. INTRODUCTION

A synthetic material which is made from a wide range of organic polymers such as polyethylene, nylon and polyvinylchloride etc. and which can be converted in various shapes at its soft stage and then set into a rigid or slightly elastic form, this type of material is known as plastic. It is discovered by famous German chemist Christian Schonbein in 1846. Plastic has enormous societal benefits. Global production currently exceeds 320 million tonnes [Mt] per year, over 40% of which is used as single-use packaging, resulting in plastic waste [1] [2]. A substantial proportion of the plastic produced each year is lost too and persists in the marine environment, with an estimated accumulative potential of 250 Mt by 2025 [3]. Most of the plastic in the oceans breaks up into very small particles and these small particles are called "Microplastics".

Microplastics were used in cosmetics or in various types of toothpaste. Floating waste is constantly exposing to UV radiation and crumbles it into smaller and smaller pieces into smaller and smaller pieces. Nearly, 51 trillion such particles are floating in the oceans where they are more easily swollen by all kinds of marine life. In cumulation with wind, abrasion, wave action, degraded plastic fragments (0.1-1000 µm) [4] and potentially nanosized (≤0.1µ) [5] particles, referred to from herein as micro and nanoplastics, respectively. Microplastics are manufactured for various applications such as exfoliates (micro-beads) in personal care products (cosmetics) [6]. Each time this material along with plastic microfibers from machine-washed clothing [7] is directly released to the environment in municipal sewage waste [8].

Recently, it was reported that although a wastewater treatment plant (WWTP) reduced the Microplastic concentration of effluents by >98%, an estimated 65 million Microplastics were still released into receiving water daily [9]. Marine debris including glass, metals, paper, textiles, wood and rubber is dominated by plastic [10]. Microplastics occur in a variety of shapes; fiberfibers are the most commonly reported form [7] , followed by fragments [11]. These are ubiquitous, having been reported in aquatic habitats worldwide from the poles [12] to the Equator [13]. An estimated 5.25 trillion plastic particles contaminate the global sea surface, [14] whereas approximately 4 billion fibers km 2 contaminate the deep Indian Ocean floor [15]. Even Arctic Sea ice represents a sink for Microplastics, indicated by their presence in ice cores from a remote location [16].

Nanoplastics are also increasingly being manufactured. Paints, adhesives, drug delivery vehicle, and electronics are some of the products that may contain nanoplastics, [17] 3D printing, for examples, can emit polymeric nanoplastics can absorb and concentrate hydrophobic organic contaminants (HOCs) such as polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides and polychlorinated biphenyls (PCBs) to a high extent. [18] [19]They also accumulate heavy metals such as cadmium, zinc, nickel and lead etc. [20] [21] [22]. Microplastics are considered as a priority for pollutants, [23] which are listed in the Stockholm Convention for their potential harmful outcome of health [24].

## II. SOURCES OF INVISIBLE PLASTICS

i. Synthetic fibers in the wash: Synthetic clothes like fleece, acrylic and polyester emit thousands of microscopic fibers with every wash. As estimated 1 million tons of these tiny fibers are discharged into wastewater each year, where more than half evade treatment and escape into the environment.
ii. Tire Dust: Styrene butadiene tire washed into sewers, and from there into streams, rivers, oceans. Cars and trucks emit more than 20 grams of tire dust for every 100 km they drive. It adds up. For example Norway produces a kilogram of the tire and road dust each year for every Norwegian woman, men, and child.

iii. Paints: Dust from road markings, ship paint and house paint contribute more than 10% of Microplastic pollution in the oceans. It is shown by studies that paint dust coats the ocean surface.

iv. Secondary Microplastics: At least 8 million tons of mishandled plastic waste washes into the world's oceans, rivers and lakes each year. Chemicals which are added in paints leads to high health risk.

v. Micro beads: These are banned in facial cleanser and some other cosmetics in US and Canada, it is estimated that more than 8 million micro beads polluted US waterways in 2015 [25].

vi. Synthetic fibers in the air: Scientists are beginning to examine how microscopic fiber reaches the atmosphere and their role as a source of land and marine pollution. One guess is that common abrasion – the simple frictions of your limbs brushing against each other, causes clothing fibers to break off into the air. A study in Paris in 2015 estimated that between 3 to 10 tons of airborne fiber reach that city's surface each year.

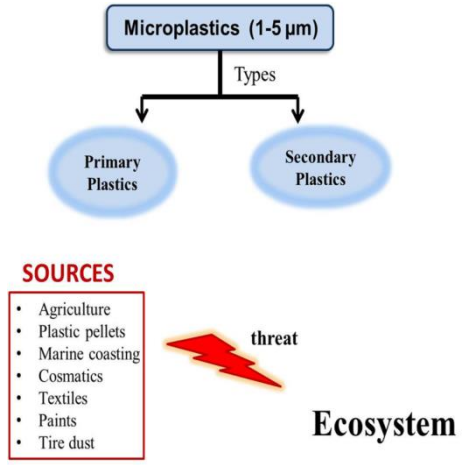


**Fig. 1: Pictorial representation of types, sources and threat of Microplastic**

### 2.1. Evidences for dietary exposure pathways

**Seafood:** Seafood is one of the most important food commodities consumed all over the world. Environmental contaminants such as PCBs and dioxins can also be rooted by Microplastic. If sea food were to exceed regulatory levels of contaminants, there could be negative health impacts following consumption;

**Fish** globally provides approximately 4.3 billion people with 15% of their animal protein intake. The capacity for fish to ingest Microplastics has been demonstrated in laboratory studies, although these employed substantially higher concentrations of Microplastics than those found in naturally in ecosystem [26].

The occurrence of Microplastics in the gastrointestinal tract (GIT) of fish does not provide direct evidence for human exposure, as the origin is usually not ingested. It has the capacity for the leaching and accumulation of associated chemical contaminants in edible tissue, post-Microplastic ingestion. Exposure of Microplastic is feasible via fish, because microplastics can move across the gastrointestinal tract or gills through trans-cellular uptake or Para-cellular diffusion and enter the circulatory fluid. The respiratory epithelium of the gill is much lighter tighter than that of mammalian lungs, decreasing the likelihood of this route of exposure; uptake across the fish gut is more likely [27]. Consumption of the skin or gills tissue could lead to direct exposure of microplastic to humans (≥1µm).

**Shellfish:** The most important source of dietary exposure to microplastics at present is via bivalved mollusc's shellfish). Shellfish is an important source of food, it comprises approximately 22Million tons of world fish production from capture and aquaculture in 2012 (almost 15 million USD) [28] . Bivalves feed by pumping large volumes of water through the pallial cavity within the shells, retaining particles from suspension ingestion [29] which is an direct indication for the capture and ingestion of microplastics by bivalves in laboratory studies, [30] [31] and microplastics in wild and aquaculture shellfish for human consumption has been detected.

Microplastics have recently been identified in 15 brands of shop-brought sea salt. Up to, 681 microplastic/kg sea salts were reported down to 45µm. Microplastic is contaminating the imminent of human food but its impacts are still unknown. The presence of microplastics in other foods also suggests they contaminate the atmospheric environment.

### 2.2. Microplastic and our food chain

If Microplastics are toxic then it is very harmful to the environment and for the humans because they travel up in the food chain. Such as, Zooplankton eat microplastic, small fish eat zooplankton, oyster, crabs and predatory fish eat small fishes and they all landed on our plates and enter into gut. In this way, it is affecting humans and marine life [32].

It is additionally found that microplastic is also entering our organic phenomenon through mosquitoes because the creatures consume flying insects. Mosquitoes also are an enormous problem due to their global habitat. It's found that microplastics is 0.22mm in size. As a larva matures into a pupa stage then enters into an adult mosquito, many of the plastics also are transferred. It's also a significant threat to animal organic phenomenon because creatures like, spiders, bats, birds which eat mosquitoes, also are ingesting plastic.

## III. POTENTIAL HUMAN HEALTH RISKS OF MICROPLASTICS:

### 3.1 Potential Toxicological Pathways

Plastics are considered as an inert material, henceforth, there are pathways through which Microplastics could cause harm, such as the deposition, of PVC granules causing remobilization of small vessels in animals following the far reaching execution [33]. If these types of conditions are sustained which could lead fibrosis, carcinogenesis and damage. Microplastics are toxic to an array of biological systems, ranging from tiny marine invertebrates to mammals to humans.

The level of toxicity depends on the size and specific chemical constituents of a particular micro-bead or micro plastic particles. In mammals, tiny microplastic particles have been found which could move through gastro intestinal tracts to the lymphatic and circulatory systems, which are absorbed into the lungs when inhaled. Microplastic can also affects the unborn foetus as it can travel through the placenta and impact the immune system.

### 3.2 Endogenous Chemical Additives

Plastic consists of a synthetic organic polymer to which chemical additives are integrated during manufacturing. These are included to inhibit photodegradation; to improve the strength, flexibility, rigidity alongwith the prevention of microbial growth. As they are not chemically bounded to the plastic and they have low molecular weight. Microplastics efficiently accumulate then they present a source of chemicals to tissues and fluids. This is a major concern for human health; it may also lead to reproductive toxicity; e.g.

i. Bis (2-ethylhexyl) phthalate [DEHP] the chemicals in plastic that makes them more flexible and hardy, and affects pregnant women and their babies. DEPH is also known as endocrine disruptors. The exposure of DEPH in women has been associated with endometriosis and ovarian toxicity in women and in men it causes endocrine toxicity which leads to the decrease in production of testosterone. It may also cause prostate cancer and is also linked with testicular toxicity [34].
ii. BPA makes plastic bottles transparent but there is also evidence that it interferes with our hormonal system and imbalances the hormones, linking it to the cause of breast cancer, infertility and miscarriage.
iii. Most of the studies reported that BPA from plastics accelerates fat cell-differentiation, causes insulin resistance, disrupts pancreatic functioning and ultimately leads to weight gain and obesity.
iv. Carcinogenicity (e.g. benzene and phenol) [35].
v. Plastic also leads to weight gain. Phthalates affect hormones and metabolism leading to weight gain, especially in women. Plastic food packaging also triggers weight gain.

### 3.3. Micro biome

A group of micro-organisms that are living together in a particular habitat is called micro-biome. It is like a complex acquisition of microscopic life forms. All animals, humans and plants have their peculiar distinctive micro-biomes. But different environmental conditions like soil, oceans; micro-biome play a very vital role, e.g:

i. Ocean micro-biome: These micro-biomes help to provide half of the oxygen generated on earth each year.
ii. Human gut micro-biome: It is essential for our digestion and nutrition but there is also evidences it may place a role in certain cancers and even influence processes in the brain and affects mental health.
iii. Micro-biome role in food security: It plays a major role particularly in those associated with food crops, livestock and we eat lots of micro-biome widely in industries like in the production of drinks and bio-fuels.
iv. Micro-biome in soil: These are fundamental to global processes like the nitrogen cycle.

Micro-biome is emphasized by the unique microbial accumulation that attracts plastic. The response of body to microplastic is influenced by its unique coating, by enhancing bio-availability or triggering an immune response. A range of environmental toxicity is metabolizing by the capacity of microbes.

## IV. FACE MASKS

The usage of medical face masks have increased dramatically after the emergence of the COVID-19 pandemic. The usage has reached approximately 89 million masks each month. Face masks were made up of polymers, such as polystyrene, polyurethane, polypropylene, poly-acrylonitrile, and polycarbonate which were used once. The litter of face masks has increased after the excessive production and consumption of face masks due to the addition of plastic particles it is added in the list of environmental challenges. Its size is changing even after the degradation of disposable face masks; it is converting into smaller size particles (under 5mm) and emerging into a new source of micro-plastics [36] .

## V. WAY TO REDUCE MICROPLASTICS

Micro-plastic or the chemicals found in plastic cannot be avoided completely. But these small steps can help to avoid at least unnecessary extra exposure-

Drinking water from tap: Drinking water is one of the biggest contributors to microplastic ingestion, but bottled water has about double the microplastic level of tap water, according to Sherri Mason who is sustainability coordinator at Penn State Behrens and a chemist who has studied plastic in sea salt, bottled water, tap water and beer.

Do not heat food in plastic: the heating of plastic has been well known to leach chemicals into food. It causes phthalates and BPA in plastic to leach into food

Minimize household dust: Exposure of household dust, chemicals, including phthalates and polyfluoroalkyl substances and flames retardants andflaws says is also dangerous to humans . Vacuuming can help to reduce household dust exposure if done regularly, according to the Silent Spring Institute.

Avoid plastic food containers: The AAP report noted that recycling codes “3,” “6,” and “7” respectively indicate the presence of styrene, phthalates, bisphenol and BPA. Bio-based or greenware, they do not contain bisphenol and these products should be added to kitchenware, or in daily use.

Buy non-synthetic eco-friendly clothes: Brands like SLO active are creating ocean-friendly swimwear and wetsuits while cleaning out oceans. Aizome Bedding is organic bedding that is made up of natural indigo, producing zero-waste, all cotton bedding with natural indigo-dyeing. These types of bed sheets are include natural fibers such as cotton, linen, silk and wool which is good for skin and allows the skin to breathe and rejuvenate. This type of chemical free clothes helps to reduce harmful effects.

## VI. ACTION FOR CREATING AWARENESS

Various groups advocated removing and banning products of microplastic for increasing awareness of the harmful effects of microplastic on the environment [37]. “Beat the micro-bead” is one such campaign which is focusing on removing plastic from cosmetics (Personal care products). The research and global assessment programs are sponsored by UNESCO because of the transboundary issues that microplastic pollution constitutes [38]. Companies are being pressurized by environmental groups to remove plastics from their products to maintain a healthy ecosystem. The “Trash-

Free Waters" initiative in 2013 is launched by The U.S Environmental Protection Agency (EPA) to prevent single use plastic wastes from ending up in waterways and ultimately the oceans.

Chave says, "The risk is, the restriction almost becomes a diversion for the difficult problem of tackling {Microplastics]." Before passing bans, companies say, scientific gaps need to be filled in.

Anne-Gaelle Collot, the senior manager for environmental affairs at industry body Plastic Europe said, "You need to identify the risks to have proportionate legislation."

## VII. TECHNIQUES TO REDUCE THE BURDEN OF MICROPLASTICS:

To reduce the microplastic pollution government, stakeholders and non-profitable organizations were trying to develop various strategies and multifaceted approach. Land based plastic waste could be managed via efficient waste management system by considering following points; adequate management of production capacity as well as consumption capacity, eco-friendly designs, maximum use of recycled plastic items, for recycling consider the renewable sources of energy, well designed waste collection strategies and increase the use of biodegradable products [39]. Removal of microplastics waste from oceans is actually a challenge. But use of downstream Reverse osmosis membranes is considered by the researchers [40]. Except the use of RO membranes the Waste water treatment plants is also comes under recommendation as it is an efficient techniques to reduce the microplastic waste [41]. Even though, various approach were comes in light but still improvement and up gradation of technologies is required to solve this critical issue.

## VIII. CONCLUSION

Marine plastic pollution has become an acquirable challenge for the modern era. Since the 1950s, 8300 million tons of plastic have been produced, 4600 million tons of plastic have been discarded and 600 million tons of plastic have been recycled, 400 million tons of plastics are produced annually and 8 million of plastic flows into our oceans annually. This type of pollution will double by 2030 and quadruple by 2050. Plastic pollution threatens human health and marine life, contributes to environmental change and has serious economic and financial applications (USD) 40 Billion per year. Larger pieces of plastics are known as macro plastics, accumulates in ocean gyres, wash up on beaches, harm marine ecosystems and impact coastal communities.

Smaller plastic is known as Microplastics (≤5mm) and nanoplastics (≤1mm) travel through the air and water bodies, breaker down from larger pieces or coming from the abrasion of tyres, loss of micro-beads, clothes fiber or paints; these particles enter into the food chain. So, from where does this plastic come from?

In the first place initially, a mineral oil recycled, the building blocks of all plastic are called repast, shaped into the different products( bottles, polyethylene, pipes ) and at the end of the life plastic can be incinerated or recycled but an important majority are improperly discarded which are accumulated in the landfills or the environment. Plastic pollution is caused by inadequate waste management systems as well as Microplastic leakages during the life span of plastic products. Sewage systems, rivers and discarded items at seas are some of the ways plastic enters into the oceans.

Every day around the world we use single use plastics. We need to shift today's linear take-make dispose model to a more circular economy and plastic bio- chain for products that are design to be reused or recycled and consumption reduced.

To address plastic pollution new materials are being developed such as bio-plastic- which is made from natural materials, biodegradable plastics are those which are broken down by living organisms and compostable plastics are those which are easily designed and decomposed in composing.

These innovations are still at an early stage and acquire to be properly managed and disposed off. Beyond these solutions, we need consumer behaviour change, new product technological innovations and comprehensive legal frameworks and tax incentives.

The more plastic initiative was launched in 2018 in 5 countries (South Africa, Mozambique, Kenya, Thailand, and Vietnam) and the ambition was to expand geo-graphical scope. It includes 4 main components: Increased knowledge, improved policies, engaged business and catalyses capacities. To protect yourself and your family, limit the use of plastic in your home and whenever you take food outside.

Use containers that are "BPA free", disposable food containers, and bamboo containers and avoid the use of plastic disposables and remember to recycle of plastic after use. Reducing the plastic not only saves the environment from pollution, but it also help to reduce suffocation in water bodies and producing diseases in fish and sea animals but it also plays a major role by enhancing the quality of your health and well-being.

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