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# The Dangers of Plastics to Public Health: A Review

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**Abstract**

*Plastic materials are ubiquitous in our environment due to increased demand and poor management. Therein, these materials find their way into biological systems on land and water, leading to public health problems. Plastics become fragmented or degraded to yield smaller particles that enter into the body, which may be retained or translocated to organs and tissues. Thus, this paper identifies common fates and biochemical interaction with biological system and creates awareness and measures to curtail the escalating trend of plastics dangers in our environment.*

## 1. Introduction

The word plastic was derived from Greek words "plasticos" meaning for moulding and "plastos" meaning moulded; the term plastics refers to a material's ductility during manufacture. This property gives the material capacity to be cast or shaped into diverse forms for diverse uses [1, 2]. Plastics can be classified as conventional and bioplastics. Conventional plastics are those sourced from fossil fuels such as coal, natural gas, crude oil; bioplastics are those sourced from biomass/ renewable materials such as grains, vegetables, potatoes, sugarcane, palm, starch, vegetable oils etc. Plastics can also be classified as thermoplastics, thermosets, and elastomers. Thermoplastics soften on heating and harden on cooling (for example, polyethylene, polyvinyl chloride, polyamide, polystyrene); thermosets never soften once they have been moulded (for example polyester, bakelite, epoxy resins, polyurethane). Whereas, elastomers are polymers which are elastic in character, they can return back to original shape after stretching for example, rubber, neoprene [3]. Plastics can further be considered as macroplastics and microplastics. Macroplastics are those ones that are large and whereas, microplastics are plastics of microscopic size, their size is less than 5mm in diameter. Microplastics are formed deliberately as virgin or primary microplastics such as pellets, films, in abrasives and personal care products; whereas, some microplastics are formed as a result of abrasion, degradation or fragmentation of macroplastics; they are called secondary microplastics.

Commonly available plastics include: Polyethylene Terepthalate, found in soft drinks bottles, mouthwash bottle, salad trays [4]; High Density Polyethylene, found in milk, water, and juice bottles, grocery bags, toys, detergent bottles [4]; Polyvinyl Chloride, found in food packaging, shampoo bottle. It is a thermoplastic found in pipes, plumbings, toys, dolls, beach balls, rubber duckies, Restmats, cosmetics, raincoats, shower curtains, food packaging [5]; Low Density Polyethylene, found in grocery bags, bread bags[4]; Polypropylene, found in youghurt bottles, medicine bottle [4]; Polystyrene, found in casette cases, compact disc, coffee cups, cutlery, TVs, computers, glasses, utensils, toys, electronics, insulators of buildings and construction [4].

Plastics pollution is one of the top environmental threats to humanity on earth, by 2050 there will be more plastics in the oceans than the fishes [7]. At every stage of plastic life, there are heavy toxic chemicals burden, which warrant its reduction in production by all means [8]. Food packaging is full of toxic chemicals leaked by the plastics [9]. Low doses of exposure to plastic chemicals are the same as high dosage impacts [9]. The hotter plastics get, the more it leaks into the food or drinks [10]. Even UV light is sufficient, let alone, heating. A study in 159 drinking water samples from 5 different continents shows 83% of them contained plastics [11]. Plastic is a serious promoter of climate change. Every stage of its lifecycle contributes to greenhouse effect. By 2050 plastic will contribute 13% to climate change carbon budget [12]. A normal plastic bottle takes about 450 years to breakdown completely; plastic bags take 25 years to break, and fishing nets take 600 years. In fact, no one actually knows how long plastics will remain in water [13]. Over 220 species have been reported for ingesting plastics, in natural conditions. Birds, turtles, mammals and invertebrates are all involved. 55% of the said species are commercial of importance, such as, mackerel, crabs, sardine, oysters, mussels, clams, scads, etc [14]. Toothpaste may contain 0.1-5% of microplastics [8]. In every week 10 billion plastic bags are used worldwide [15].

### 1.1 Socioeconomic and Climatic Impacts of Plastics

The socioeconomic impacts of plastics are many. Cost of cleanup of environment, degradation of areas and causing low tourism, and degradation of food safety are among the socioeconomic adverse impacts of plastics on humans [16]. Parable, plastic waste in Asia alone causes a loss of 1.3 billion USD per year in the tourism sector. In Europe, cleaning plastics on beaches and coasts lead to the spending of 630 million Euros per year. The total damage unto marine worldwide reaches 13 billion USD every year [16].

Plastics contribute to climate change at every point of its lifecycle, from production to refining, down to management, and disposal. Thus, it threatens the ability to meet up with the Paris agreement, because by 2050 it will amount to 13% carbon budget of the whole world. This is equivalent to 615 coal fired power plants. Particularly, one ethane cracker in Pennsylvania emit 2.25 million tons of $CO_2$ every year [12, 17].

### 1.2 Hazardous Substances in Plastics (Compounders /Additives)

Hazardous substances in plastics are grouped as follows:

Plasticizers e.g. dibutyls phthalate, diethyhexylpthalate, bisphenol A, dimethyl phthalate, butyl benzyl phthalate, Flame retardants e.g. organophosphate, Antioxidants e.g. amines, Heat stabilizers, Biocides, Pigments/ colourants, Lubricants, Fragrance, Monomers, Antistatic chemicals, Impact modifiers [18,19].

## 2. Biochemistry of Plastics

Fragmentation of plastics involves breaking down of smaller pieces through physical means. Whereas, degradation involved breaking down to smaller pieces, through chemical actions [20]. Plastic materials interacts with the prevailing environmental chemicals, especially the water hating ones (hydrophobic).Thus,it acts as vehicle for accumulating and transporting chemicals. Glassy-plastics (PS, PVC) are more prominent with adsorption, whereas rubbery-plastics (PP, PE) are more prominent with absorption; but the two properties are pervasive [18,21,22]. Plastics are ingested through the mouth along the GIT (gastrointestinal tract), their clour, fragrance and chemical contents make its ingestion more readily.Plastics and associated chemicals can traverse through the nose, eye, skin and relations. Upon ingestion, the plastics can be retain /bioaccumulate (stay for long), or translocated (transported) to some places(tissues, organs, systems) within the biological system ,then parts of it can be egested[23]. Biomagnification, the property of increasing in concentration, along the food chain at the higher level, is one of the proposed processes that bedeviled plastics along its metabolism in organisms [20].

Plastics causes oxidative stress, inflammation, granulocytoma formation, lysosomal membrane destabilization, neutrophil trap release, cytokine regulation, non-specific responses (internalization), lipid peroxidation, necrosis, perturbation of membranes, activation of detoxification pathways, deoxiribose nucleic acid (DNA) stand break [2].

At tissue-organ level, plastics destroy gastrointestinal tract (GIT), mucous production, disturb lipid and hepatic metabolism, glycogen depletion, fatty acid vacuolation. At organismal level, it causes false satiation (loss of appetite), reduced fitness, reduced survival, impaired respiration, impaired development and reproduction, and increased mortality [21,22]. Biofouling or biofilm is an interaction between the plastics and some organisms (microbes) which live on plastics e.g. algae, diatoms, bacteria. That behavior causes microbes to cling on plastics, which in turn serve as vehicle for shuttling of microbes to various destinations or biological systems [24].

### 2.1. Plastic Pollution in Land and Aquatic Environments

Plastics on land comes from intentional (primary) uses such as fertilizers, sludges, land fillings, plastic mulching or non-intentional (secondary) such as municipal waste, industrial waste, and organic composts [25,26,27]. More than 80% of plastics in the aquatic environment come from the land as a result of diverse activities [15,28]. Plastics get into the river and other comparatively smaller waterbodies, then some of it persists ,some are ingested by the biota , and some are channeled to the oceans and sea as ultimate acceptors.Therein, they pollute the prevailing water, harm organisms, and ultimately harm humans and other higher animals (through the food chain). The fishing, transport and other relations contributes their own quota to aquatic plastic pollution [13,25,26,29]. If we continue to handle plastic concern in this way, by the year 2050 the plastics in our waters will outnumber the fishes [27].

### 2.1 Hazards of Plastics on Human Health

Little is known about the harmful effects of plastic on biological systems, let alone on humans, but the researches are emerging. Plastics are inert, so they have the capacity to persists, bioaccumulate, and biomagnifies in the body to cause harm. It associated substances usually leach into the food in circumstances like heating, then ultimately harming us [8]. Parable, the plastics (or additives) are associated with increased risk of impaired brain and neurological functions, cancer, chemotherapy delay, obesity, early puberty, drug resistance, adult-onset diabetes, chromosomal and reproductive system abnormalities, cardiovascular damage among others. Particularly, a study by Centre for

Disease Control and Prevention (CDC) says 93% of the subjects have bisphenol A (a dangerous plastic additive) in their urine. Phthalates are also common and dangerous [27].

When plastics are burnt, hazardous substances are release, parable dioxin, a carcinogenic, hormone disruptor and persistent chemical [30]. Mercury, furan, and relations are also released on burning plastics; especially the home practice. Burning of plastics increases the risk of respiratory problems like asthma. It causes rashes on the body, nausea, headache, damages nervous system, kidney, liver and reproductive system [31].

Styrene, a component of polystyrene present in our air and can be inhaled .It is associated with increased cancer risk, it has reproductive effects, effects on central nervous system(CNS) (depression, fatigue, weakness, hearing loss etc.),effects on kidney, blood, stomach, and respiratory system [32].

Ranges of exposure to vinyl chloride can cause effects on Nervous system, liver damage, and cancer. Its concentration is higher in new cars, and drinking water [33]. In fact, polyvinyl chloride (PVC) is called poison plastic, for its dangers. It causes pollution due to chlorine, cancer causing vinyl chloride, and ethylene dichloride, dioxin, cadmium, lead, phthalates, tin etc. [34].

Plastic production and recycling consume much energy, in turn releasing greenhouse gases, and ultimately stimulating climate change. Parable, the energy need in recycling bioplastic waste is greater than the one needed in initial production [17].

## 3. Solutions to Prevailing Plastic Problems

There is need for concerted and systematic efforts involving all-hands on desk to prevent the more escalation of present plastic situation trend. Government, Nongovernmental Organizations (NGOs), experts, and individuals have roles to contribute quotas in solving the plastic lurk as follows:

a. Government

Government should ban most poisonous plastics in a systematic fashion. Parable, polymers like PVC, PS should be ban, at least in certain applications like foodstuff wrapping, single-used applications, water transport etc. Microbeads and intentional microplastics should be ban in entirety or to a large extent [4].

b. Taxation

Plastic industries should be compelled to pay very expensive charges that could be channeled in cleaning plastics pollution mess, and it will serve as deterrent that will minimize the patronage by the consumers [27].

c. Awareness creation

Media, experts, professionals and individuals should employ diverse campaign strategies to make the public conversant on pros and cons of plastic materials. It can trigger them to act positively, to the extent of been selective in consuming classics or avoiding it all, and also creating advocacy groups [35].

d. Reduction

At an individual level, a person should reduce his plastic use. We should patronage other safer to go back to our natural ways of doing things [35].

e. Re-using

If you use plastics material, try and keep it for further use. This will prolong its life cycle and delay it incorporation into the hazardous phases of the life cycle. Use the same straw, cup, take away, containers, bottles, for several times. Do not utilize them for single use [27].

f. Refusing

When you are given a material that contains plastics, try to refuse it. For example, when you are given plastic bags at stores, you can avoid it by carrying the items in your pocket [35].

g. Recycling

Our governments should revitalize efforts in creating enabling environment and lending support for recycling companies. As an individual, keep potentially recycle materials in separate containers [36].

h. Improvisation

The process of converting used plastic materials into another useful material. As a teacher, you are in best position to champion the improvisation of plastics considering the state of our educational systems. Parable, plastic bottles are used in building as blocks ,in places of bricks ; plastic bottles are used as feeding materials for birds etc. .Used plasticity are improvised as kites for play way method of teaching ,they can also be used for making ball, in psychomotor domain of learning [27, 29].

## 4. Conclusion

Plastics are very useful in our life, but they are harmful to biological system and ultimately public health. There is need to take appropriate measures to address plastics problems.

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