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Effect of Plastic Waste on Human Health

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Abstract - Without plastic, contemporary society would seem to be a very varied place to live. A health risk assessment in India may have unintended repercussions due to plastic's modifying impact on human health and the environment. Plastics are crucial elements in contemporary society, and many items made from plastics and in many situations, they pose health and environmental problems. Many people in India do not aware that plastic is harmful to human health and the environment when they use it. There are a variety of health issues that may arise from the usage of hazardous plastics. These include eye irritation, eyesight loss, breathing difficulties, respiratory disorders, liver malfunction and malignancies as well as skin illnesses, headaches and dizziness. Plastics have a negative impact on the environment, including soil, water, and air pollution. Toxic effects of plastics on human health and the environment may be mitigated via the implementation of appropriate laws and regulations for their manufacturing and usage.

Keywords - Plastic; Bisphenol A; Phthalates; Pollution

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INTRODUCTION

Growing plastic trash and the forces driving it are expected to continue for some time. Even if plastic output has decreased lately, this is not expected to continue. Plastic is a very valuable material, and as more new goods and plastics are produced to suit demand, its uses are projected to grow. [1]

Because of the rising usage and manufacturing of plastic in emerging and merging nations, their waste management infrastructure may not be improving quickly enough to keep up with their increasing volumes of plastic garbage. [2]

Plastic has become a valuable and adaptable material during the last 60 years, with a broad variety of uses. As the plastics business continues to evolve, its applications are only going to grow. Future solutions to some of the world's most pressing problems, such as climate change and food shortages, might benefit greatly from the use of plastics. As one example, wind turbines employ plastic rotors and polyethylene tunnels to produce crops in otherwise adverse settings. [3]

The plastics industry's goal is to meet the rising demand for particular types of materials. As plastic production and usage continues to rise in developing countries, waste management infrastructure will have to adapt to keep up with demand. Even while plastic is desired because of its long-term utility, lightweight, and low cost, same features also make it difficult to dispose of. [4]

As a result of their durability, plastics, particularly packaging and sheets, are often thrown away after a single usage. Plastic, because of its low density, tends to float to the surface of the ocean when it reaches there. [5]

LITERATURE REVIEW

Sarah Johnson (2020) The possible effects of microplastics in the food chain on human health are the focus of this review. It talks about how microplastics may get into a person's body via several entry points including eating them or breathing them in. The study evaluates the hazards to human health from microplastic deposition in tissues and organs, underlining the need for more investigation and preventative action to address this developing environmental health concern.[6]

Michael Brown et al. (2019) The possible adverse health consequences of plastics' chemical additions are the primary topic of this research study. The potential and actual health risks associated with common chemicals including bisphenol A (BPA), phthalates, and flame retardants are discussed. The assessment stresses the need for further research into the health effects of these chemicals and calls for the use of less hazardous materials in plastic manufacturing.[7]

Emily White et al. (2019) The effects of plastic garbage burning on environmental and human health are discussed in this review, with an emphasis on the effects on the lungs. In this research, we look at how plastic incineration contributes to air pollution and respiratory difficulties in vulnerable populations due to the

discharge of harmful chemicals and poisonous compounds. To safeguard human health from the adverse consequences of plastic garbage burning, the assessment urges for strict controls and alternate waste management strategies.[8]

CLAUDIA CAMPANALE ET AL (2020) Scientists look at micro plastics as a sign of a new historical era because of how widely distributed and abundant they are over the planet. The Plasticize is a plasticizer. Even still, we don't know all about the dangers of micro plastics. Because of their many physical and chemical characteristics, micro plastics are a complicated stressor that is difficult to explain. Toxic chemicals may be transported by micro plastic particles, but they are also a cocktail of dangerous chemicals that have been added intentionally during their synthesis in order to enhance the polymer's qualities and extend its life. When it comes to significant plastic additives of concern, we know very little about their destiny after micro plastics are dumped into the environment or their resulting consequences on human health when found in conjunction with micro and NANOplastics. These hazardous chemicals' impacts and consequences on human health are discussed, with an overview of research that have examined their abundance in micro plastics, in this paper, which focuses on some of the most poisonous and deadly compounds found in all plastic items. In-depth investigation on micro- and nanoplastic exposure pathways and the health risks they posewas undertaken in this study to synthesize existing understanding and better concentrate future research in this area, with the goal of filling knowledge gaps. [9]

JAVID MANZOOR ET AL (2020) Humanity has benefited much from plastics. PVC (polyvinyl chloride) and polyethylene (polyethylene glycol) are two examples of synthetic polymers, which may be used to replace conventional natural polymeric materials (wood, stone, ceramics, etc.). To put it another way, plastics have distorted our daily lives; their use is on the rise, and output is expected to top 300 million tons a year by 2010. Here, the writers combine current knowledge of the advantages and disadvantages of plastics with future goals, difficulties, and possibilities. Plastics are a major source of contamination in all three of these ecosystems. Plastics' harmful impacts on human health and the environment may be mitigated by following the right set of laws and regulations while manufacturing and using the material. [10]

CATEGORIES OF PLASTICS

Type 1 polyethylene terephthalate or stomach plastic

Disposable water bottles are often made from stomach plastic. There are many more uses for stomach plastics, such as making utensils and containers that may be used for a wide range of foods and beverages. The weight of the stomach plastic is light, translucent, and smooth. The stomach is a common choice for plastic water and other food packaging since it is completely liquid and anti-inflammatory. The stomach plastic, which was anti-air, blocked the passage of oxygen. Liquids in stomach bottles are difficult to remove. Antimony trioxide is used in the production of Type 1 plastic bottles, which do not contain any hazardous bacteria or hamates. It's probable that antimony might cause cancer when it enters the body. When the container comes in touch with drinking water for an extended length of time, antimony is released from the container. Antimony excretion is more likely when the beverage is in touch with the container. Toxic antimony from the stomach bottle was identified in a research to be used in long-term heat. As a result, it is critical that these stomach bottles not be exposed to extreme heat. Keep in mind that stomach plastic, also known as type 1, is designed to be used just once (one time use only). In the "once used" category, the stomach bottle is quite safe.

Type 2 High-density polyethylene

Polyethylene is the most widely used plastic in the world today. Polyethylene is a high-density polyethylene, a heat-resistant plastic made from petroleum. Plastic milk containers, detergent bottles, refrigerators, toys, and several types of plastic shopping bags are all created from Type 2 plastic. It has a tendency to be irritable and 'heat-prone' in nature because of its high density. BPA and theaters, which are known to be carcinogens, are absent from this product. The usage of this kind of plastic has no recognized health risks. Although some research have showed that nanalifenal may be recovered from type 2 plastic by exposing it to UV radiation when exposed to sunlight for an extended period of time. When it comes to food and drink, type 2 containers are regarded to be more secure.

Type 3 plastic containers

Fruit juice, cooking oil, and other products are all made from these containers. 'Heat-resistant' polymers include Polyvinyl Chloride (PVC). Type 3 plastic, when left unplasticized, is pliable and undetectable. Theaters are often used to soften PVC, which is harmful to human health. Theaters are also found in PVC pipes and siding, which is why it is important to avoid using these products. BPA, theaters, lead, dioxin, crater, and cadmium are just a few of the harmful chemicals found in PVC. Due to the serious health and environmental hazards associated with PVC's manufacture, usage, and disposal, PVC use has decreased significantly. In spite of its cheap price and broad variety of uses, PVC remains a popular material in consumer products and household appliances. When PVC plastic is used in a way that is harmful

to the body, it may lead to a wide range of health problems including cancer and birth defects as well as changes in the genes that cause diseases including chronic bronchitis, ulcers, and skin diseases.

Type 4 low-density polyethylene

Made of type 4 plastic petroleum, this polymer is heat-resistant yet may be translucent or opaque. Flexible and stiff, yet brittle, low-density polyethylene is a versatile material. In addition to packaging frozen meals, these plastics are also employed in the manufacturing of juice and milk cartons. The container or bottled fluid is not separated from the user. Type 4 plastic containers are suitable for food and drink storage since they don't contain any potentially dangerous substances.

Type 5 polypropylene

A plastic polymer called polypropylene is often robust and semi-transparent; it is also strong, heat resistant, and water-resistant. Polyethylene, on the other hand, is lighter and more pliable. Foods such as yoghurt and ketchup are typically packaged in polypropylene containers. Polypropylene plastic does not contain any hazardous chemicals in food or drink. While most polypropylene plastics may be heated in the microwave or washed in the dishwasher, they pose no health risks. Polypropylene containers, like type 4 plastic, are safe for food and drink storage in the human body.

Type 6 polystyrene

Polyethylene is a plastic made from petroleum. Polystyrene, which is known to cause cancer in humans, is made using the carcinogen 'benzene.' Plastic polystyrene (PPS) is used extensively in the packaging and insulation industries. Styrene poses a significant health danger. Toxic, hematological, cytogenetic, and carcinogenic consequences have been shown to be associated with long-term exposure to steroid. Human carcinogen Styrene was recognized by the International Agency for Cancer Research (IARC).

Type 7 polycarbonate

All plastics, with the exception of the aforementioned, are classified as Type 7 plastics. BPA is found in polycarbonate containers. Because of this, BPA is released from the container when the beverage or food is kept in it. Since several studies have shown that BPA poses a health hazard, the usage of type 7 or polycarbonate plastic has reduced significantly. Packages made of polycarbonate are mostly used to protect consumer products. Baby bottles, 3 and 5 gallon bottles (reusable), and other items of this size are all made of Type 7 plastic. There is a health risk associated with the usage of type 7 or polycarbonate plastic.

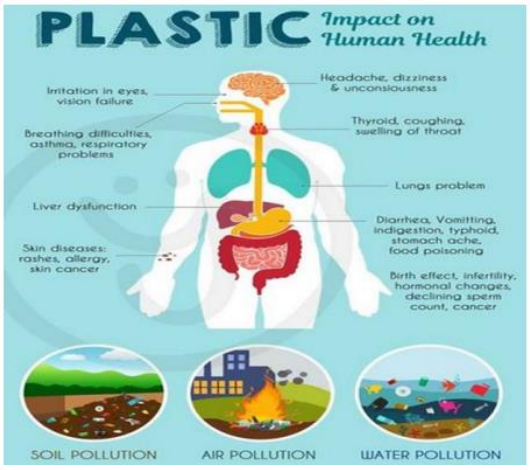
EFFECTS OF PLASTIC ON HUMAN HEALTH

Many additives and residual monomers presumed to be maintained from plastic polymers are suspected of posing health hazards, despite the fact that these polymers themselves are widely accepted as safe. Over a hundred plastic additives are known endocrine disruptors and cancer-causing agents. People are exposed to these chemicals mostly via skin contact (dermatitis), oral intake, and inhalation. There are a variety of health difficulties that may be caused by microplastics in marine and freshwater animals because of their role as a key toxin. Researchers have found evidence that plastic additives and microplastics are present in human tissues in animals that have been exposed to plastic additives and microplastics. It's not only the townships of South Africa that face the same issues as the rest of the globe; they're universal.

Fish consumption in India rose by some aquatic organisms pose a threat to human health, a 26% increase between 1994 and 2009may transmit micro plastics, poisons, and pathogens to people when ingested. Ref. WHO studies on the dangers of micro plastics to people found that there is insufficient data to form solid judgments on NANOparticle toxicity since no credible evidence shows it is a problem. A wide range of plastics has been found in mussels and shrimp in fifty nations in Europe, the Persian Gulf, and China, depending on the population's reliance on seafood. Unlike fish, which is usually washed beforehand to remove micro plastics from the digestive system, these food categories are consumed whole. While brown mussels and four estuarine-fish species have been studied for micro plastics in South Africa, there is no evidence on the transmission of these micro plastics from these animals to people, which is a major concern. Many marine species particularly filter feeders, have been shown to contain microscopic plastic particles, which may be consumed by humans.

More than 90 percent of the micro plastics identified in human excrement have been eliminated. The lymphatic and circulatory systems can pick up some particles from the stomach, but the blood-brain barrier, the placenta, and other cell tissues are more likely to pick them up. When these particles enter the body, the immune system is activated and the body's inflammatory response is altered. Even though there is a gap in the literature on Indian seafood consumption at present moment, this subject should be prioritized for future research due to India's high level of seafood consumption. Human micro plastic absorption seems to be mostly by inhalation and drinking water, with ingestion as a secondary route. Mngomezulu, Nkosi, and Muchapondwa have found evidence of waste burning in townships, and the particles created by this may be breathed or swallowed when they drop on water. Humans may

be more concerned about ingesting the chemicals associated with micro plastics than ingesting the plastics themselves; hence, micro plastics are considered dangerous vectors of chemical transfer.



Global Production of Plastics and Generation of Waste

These days, plastics are everywhere. In ancient Mesoamerica, about 1600 B.C., natural rubber was first moulded and polymerized by human hands into a variety of useful objects. PS and vulcanised rubber were discovered in 1839, opening the path for a broad variety of uses and manufacturing of plastics and plastic goods. Despite being developed in Belgium in 1907, bakelite was already extensively employed in a variety of industries by the 1930s, including fashion, communication, electronics, and automobiles. A decade later, mass manufacturing of plastics began and has been steadily increasing over the previous half-century. Global plastic output peaked in 2008 at 245 million tonnes per year. As of right now, single-use packaging accounts for about 40% of total European plastic use, followed by consumer products (22%) and materials for building (75%), automotive (60%), electrical (6%) and agricultural (3%) applications. In 2015, it was projected that Asia had the greatest rate of production, followed by North America and Europe, each with 19 percent of output. While less important in terms of plastic use, the rest of the world's output does not necessarily reflect this.

Recycling of plastics

In plastic recycling, used plastic fragments or waste are turned into new products. The primary goal is to reduce waste emissions, manage and recycle the wastes that come from plastics that are non-biodegradable in nature. In order to decrease the 8 million metric tonnes of plastic waste that enters the ocean each year, plastic recycling is essential. Since plastic may be recovered and recycled in so many various ways, the nomenclature used to describe the process is confusing, according to Hopewell et al. The four main categories of recycling are: primary, secondary, tertiary, and quaternary.

When compared to lucrative metal recycling, plastic recycling is more difficult due to its low density and poor value. However, it is comparable to the low value of recycled glass in terms of difficulty. There are a slew of technical issues to be dealt with when recycling plastic. The oil and water phases that form when different polymers are heated together are what form the layers that eventually solidify. Due to the ensuing phase barriers, this polymer mix has been restricted in its use due to its structural fragility. Polyethylene and polypropylene, two of the most prevalent plastics, can't be recycled since they're too hard to break down. Recently, block copolymers, a kind of macromolecular welding flux, have been presented as a way to tackle the difficulty of phase-separation during plastic recycling. Packaging producers may enhance the proportion of plastics with the potential for complete recycling if they decrease the mixing of packaging components and remove impurities. As a result, the Association of Plastics Recyclers created a design standard for plastics that makes it easier to recycle them. Corrugated fiberboard and newspaper are still much more abundant in recycling than post-consumer plastics, despite the fact that it has grown steadily in that time since 1990. There were roughly 33.6 million tonnes of post-consumer plastic garbage created in the United States in 2008, of which 6.5 percent was recycled, while the remaining 8 percent was burnt and 86 percent was landfilled.

EU Directive on packaging and packaging waste (94/62/EC) encourages postconsumer recycling in several countries. Due to this, Germany passed laws enacting the die Gru nePunkt (Green Dot) packaging recovery and recycling programme, which resulted in an expanded level of producer accountability. A programme for creating and selling package recovery notes, as well as a landfill fee to finance a variety of waste reduction efforts, were both implemented in the UK to enforce producer accountability. Because of all the above-mentioned changes, recycled polymer is now worth far more than it was only a few years ago, and recycled polymer is now a viable alternative to landfilling and incineration, which together account for around 9 percent of the plastic waste created in 2015. Global recycling rates increased to roughly 14 percent of the total plastic garbage created in 2016. According to Japan's Plastic Waste Management Institute, plastic waste recycling climbed from 39 percent in 1996 to 83 per cent in 2014, which is a major contribution to this increase.

Effects of Micro and Nanoplastics on Human Health

According to a recent assessment from the "World Health Organization," microplastics are pervasive in the environment and have the potential to harm human health. Ingesting contaminated food is a common way for nano- and microplastics to enter

the human body. Sugar had 0.44 MPs/g of nano and microplastics, salt had 0.11 MPs/g, alcohol had 0.03 MPs/g, and bottled water had 0.09 MPs/g of nano and microplastics. Plants that acquire MPs via absorption from contaminated soil might potentially be a source of microplastics for humans, with an estimated daily consumption of 80 g. Almost everyone knows that microplastics have made their way into the food chain of marine creatures that are intended for human consumption. For example, Mytilus edulis and Mytilus galloprovincialis mussels from five European countries have between 3 and 5 microplastic fibres per 10 grammes of mussels. Evidence that synthetic particles smaller than 150 m may cross the gastrointestinal epithelium in mammalian bodies and create systemic exposure indicates that human absorption following food intake can occur. While just 0.3 percent of these particles are predicted to be absorbed, Only 0.1 percent of particles bigger than 10 nm are expected to cross the blood-brain barrier and the placenta, according to specialists. Obtaining data on micro- and nanoplastics in the environment is presently challenging due to analytical and technical challenges, characterising, and quantifying them from ambient matrices despite the low projected exposure levels.

Particles smaller than 2.5 mm may enter the gastrointestinal tract after consumption thanks to endocytosis by M cells of Peyer's patches. Through the paracellular persorption, M cells or intestinal lumen-to-mucosal lymphoid cell transfer is possible. Villi towards the end of the gastrointestinal tract are filled with holes, which allow solid particles to be mechanically mixed with fluids and pass through. Microplastics' specific features, such as hydrophobicity and chemical composition, and their persistent nature lead to inflammation-based toxicity, which is thought to have an accumulative impact based on dosage. The discovery of microplastics in human faeces further supports this hypothesis about the gastrointestinal levels of microplastics in men: For every 10 grammes of faeces, there were 20 plastic particles, the majority of which were PE and PP. Micro and nano-plastics consumed by humans should be eliminated by the human excretory system.

Inhalation of aerosolized microplastics into the lungs is another route by which they enter the human body. Synthetic fibres ingested via mussel intake are fewer than those absorbed from household dust, according to the authors of the study. During precipitation episodes, the authors found 18 threads and four fragments/L of rain, according to their findings. Airborne microplastics may come from a variety of sources, such as agricultural and fertilised fields being washed away by rain or wind erosion, dried sewage sludges and wastewater treatment byproducts, synthetic clothing fabrics, industrial emissions, road dust, and marine aerosols. Toxic and inflammatory consequences and autoimmune disorders in males might result from the spread of this disease in men. A tissue barrier as thin as 1 m in the human lung might enable nanoparticles to enter the circulation and the whole human body. The alveolation surface of the human lung is around 150 m2. The pulmonary epithelial cells and macrophages were shown to be genotoxic and cytotoxic when exposed to polystyrene particles 50 nm in size (Calu-3 and THP-1). Inhaled particles may cause symptoms such as asthma-like reactions, granulomas with fibre inclusions, widespread interstitial fibrosis, inflammation and fibrosis of the bronchial and peribronchial tissues, interalveolar septa lesions, and inflammation of these tissues. Workers in the textile sector who were exposed to nylon, polyester, polyolefin, and acrylic fibres had comparable impacts, as shown by the studies mentioned above. Patients with lung cancer have been discovered to have little degradation of microfibers, proving the bio-persistence of these synthetic particles. For example, macrophage-to-lung transport of fibres with diameters of 15–20 nm is ineffective because the fibres are too large. Reduced cell viability and a slowing of cell cycle progression were produced by smaller polystyrene nanoparticle, and activated an inflammatory gene, as well as altered protein expression related with the cell cycle and pro-apoptosis, was also observed in. The danger of germs being transmitted by airborne microplastics should not be underestimated. Microorganisms might infect humans by clinging to microplastic surfaces and so being shielded from UV radiations and becoming a new source of infection.

In-vitro research on heavy metal absorption and desorption in the human digestive system was undertaken using non-degradable and degradable MPs to examine the effects of chromium (Cr) on the human digestive system (polylactic, PLA). Results demonstrated that stomach acid conditions increased the release of Cr (VI) and Cr (III) from MPs into the digestive-gastric phase. Based on human absorption models for different industrial processes, it is still conceivable to analyse the probable impacts of nanoparticles on other parts of the body that are currently under investigation. Studies on T98G and HeLa cell lines have shown that metal nanoparticles (NPs), graphene (C60), and other carbon nanoparticles, as well as microplastics made of PE and PS, elicit harmful effects. It has also been shown that the concentration and size of polypropylene (PP) particles employed in various assays might have varying but detrimental effects on certain cell lines. Since microplastics may cause cytotoxicity, hypersensitivity, undesired immunological responses and acute reactions such hemolysis when they contact with people, they constitute a potential danger to human health.

CONCLUSION

Several studies on global plastic manufacture and the accompanying waste pollution have identified

plastic waste as a severe environmental hazard. Ecosystems are under threat from plastic pollution, which necessitates rescuing them from extinction. To protect human health and the environment, although plastics are useful, the toxic ingredients from which they are manufactured must be rigorously monitored. Toxicants generated by plastic garbage may harm human health and the environment if they are not reduced.Government, law enforcement, and health officials need to do more to guarantee that plastics are manufactured, utilised, and disposed of in an environmentally friendly way." In particular, consumer items and products that come into direct touch with children should be free of phthalates, which are a known carcinogen. All materials that come into touch with food and drinks, as well as thermal receipts, should be banned from using bisphenols in the long term. In order to reduce excessive plastic usage, each organization must assume responsibilities. All chemicals used in consumer items must be made clear to the public so that they may make informed decisions about whether or not to use them.

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