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Editorial

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Microplastic and nanoplastic pollution and cardiovascular health

Contaminación por microplásticos y nanoplásticos y la salud cardiovascular

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The widespread use of plastic products is a hallmark of modern times. It is estimated that millions of tons of plastic are produced on an annual basis and utilized in over 1,000 different ways. A subset of these plastics becomes integrated into our daily environment and habits, such as industrial products like tires, cosmetics, and personal care items, textiles, processed nutritional products, and contaminated fresh vegetable or animal foods, among myriad others.[1] Unfortunately, many of these organic and inorganic materials are used only once and become waste that is both biodegradation-resistant and highly contaminating. Some of these materials take centuries (literally) to degrade. The soil, the oceans, diverse waterways, the atmosphere, and beyond, outer space, have been, are, and will be flooded by these human-made catastrophic by-products that damage everything: the physics and chemistry of nature, and the organisms of all terrestrial and marine animal and plant species with whom we share the common home of the Earth, imposing serious challenges to both the planet's biosphere and human health.[2]

Microplastics, submicroplastics, and nanoparticles (MPs, SMPs and NPs, whose sizes are 1 µm-5 mm, 100 nm-1 µm, and less than 100 nm, respectively) penetrate the human body mainly through ingestion and inhalation, and less frequently by skin contact.[1-3] The leading site of invasion is the intestine, and although the route of absorption is not known with certainty, it appears to occur via macrophages and the gut lymphatic system.[4] Once inside, plastic particles penetrate the cells at a rate that depends on the size of the particle and the type of cell, through diverse entrance mechanisms. It is well known that these particles can cause strong inflammatory and nitroxidative stress responses, inducing apoptosis and autophagy in cells across different organs and systems, as well as damage to the genome and immune system.[5] There is abundant clinical evidence linking plastic small particles with diverse cardiovascular lesions and outcomes, such as arrhythmias, ventricular dysfunction, pericarditis, myocardial degeneration and fibrosis, and the development and complications of aortic, carotid, and coronary atherosclerotic lesions, among others.[5-7]

The massive *per capita* consumption of minor plastic by-products, amounting to tens of kilograms annually in industrialized nations (400 tons worldwide production[8]), must have consequences for human health that are not yet precisely identified or quantified. For example, the pandemic explosion of obesity has been parallel to the skyrocketing increase in the production and human consumption of micro, submicro, and nanoplastics, although, of course, both problems can be independent in origin, even if the one and the other are expressions of the ecocide behavior and unhealthy living habits of contemporary human beings. Some authors have found that the imbalance of the caloric intake/energy expenditure pair is not the only cause of the considerable increase in

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body weight in the population of industrialized societies, pointing out that there must be other determinants of body weight, beyond the increase in caloric intake from the diet and the diminished energy expenditure from physical exercise.[9] The term «obesogenic»[10,11] has been recently coined to identify those substances that can increase the number and size of adipocytes, their differentiation and storage capacity, or their regulation, disrupting energy or lipid metabolism, and causing weight gain.[12] These substances (alone or mixed), called generically Endocrine-Disrupting Chemicals (EDC), can interfere with relevant aspects of hormonal and energetic metabolism.[10]

The tiny size of microplastics and nanoparticles allows not only easy penetration but also rapid diffusion throughout all organic compartments, crossing cell membrane barriers without difficulty and accumulating in lymphatic cells, the liver, the skin, and the brain, among many other systems and tissues.[12] Some plastics like polyethylene (PE), polypropylene (PP), and polystyrene (PS), in addition to plastic additives like phthalates, bisphenols, polybrominated diphenyl ethers, and organotins, among others,[13] can disrupt normal energetic physiology, eliciting strong immune, inflammatory, and nitroxidative reactions, as well as direct genome and mitochondrial damage.[13]

There are no easy, straightforward solutions to solve complex human problems. Human society must first be aware of the magnitude of the threat to act accordingly. To date, people are relatively aware of atmospheric pollution, the need to use water rationally, and the duty to manage garbage more effectively. Unfortunately, plastic pollution is less perceived. Few laypeople are fully aware of the real and potential damage caused by this particular type of pollution. A substantial proportion of physicians are either unaware of this and therefore cannot convey preventive messages to their patients. The first step, then, is to increase knowledge in this field, since the goal of prevention is achieved by following the path of understanding and recognition of the problem. Our Editorial Committee intends to invite an expert in the field to write a comprehensive review for the journal on the relationship between plastic pollution and cardiovascular and cardiometabolic diseases.

However, the final solution is rather more complex. It is not enough, in stores and supermarkets, to replace plastic bags and wrappers with other materials, such as paper (whose manufacture requires using wood, which contributes to deforestation, another very serious environmental problem). Nor is personal refusal to use single-use plastic products (diapers, straws, containers, etc.) sufficient, although it does help. Replacing all current plastic products with biodegradable alternatives is mandatory, but it is economically costly and technically complex. The industry alone will not do it. Government regulation, supported by a wide social consensus, is essential to achieving plastic conversion. Powerful economic and political forces will fight this change, as it represents a major effort and sacrifice by industry, commerce, and their allied governments. As is well known, when public health is pitted against profit, the latter usually wins.

Aside from the above, the present editorial serves as a call to action, urging us to incorporate plastic pollution into our preventive thinking. This preventative awareness is embodied in the splendid motto of our beloved association: «prevention is our goal».

REFERENCES

1. Pilapitiya, PGC, Ratnayake AS. The world of plastic waste: a review. Cean Mater. 2024; 11: 100220. doi: 10.1016/j.clema.2024.100220.
2. Yee MS, Hii LW, Looi CK, Lim WM, Wong SF, Kok YY et al. Impact of microplastics and nanoplastics on human health. Nanomaterials (Basel). 2021; 11 (2): 496. doi: 10.3390/nano11020496.
3. Zheng H, Vidili G, Casu G, Navarese EP, Sechi LA, Chen Y. Microplastics and nanoplastics in cardiovascular disease — a narrative review with worrying links. Front Toxicol. 2024; 6: 1479292. doi: 10.3389/ftox.2024.1479292.
4. Lehner R, Weder C, Petri-Fink A, Rothen-Rutishauser B. Emergence of nanoplastic in the environment and possible impact on human health. Environ Sci Technol. 2019; 53: 1748-1765. doi: 10.1021/acs.est.8b05512.
5. Kannan K, Vimalkumar K. A review of human exposure to microplastics and Insights Into microplastics as obesogens. Front Endocrinol. 2021; 12: 724989. doi: 10.3389/fendo.2021.724989.

6. Bishop B, Webber WS, Atif SM, Ley A, Pankratz KA, Kostelecky R et al. Micro- and nano-plastics induce inflammation and cell death in human cells. Front Immunol. 2025; 16: 1528502. doi: 10.3389/fimmu.2025.1528502.
7. Marfella R, Prattichizzo F, Sardu C, Fulgenzi G, Graciotti L, Spadoni T et al. Microplastics and nanoplastics in atheromas and cardiovascular events. N Engl J Med. 2024; 390: 900-910. doi: 10.1056/NEJMoa2309822.
8. Houssini K, Li J, Tan Q. Complexities of the global plastics supply chain revealed in a trade-linked material flow analysis. Commun Earth Environ-2025; 6: 257. doi: 10.1038/s43247-025-02169-5.
9. Brown RE, Sharma AM, Ardern CI, Mirdamadi P, Mirdamadi P, Kuk JL. Secular differences in the association between caloric intake, macronutrient intake, and physical activity with obesity. Obes Res Clin Pract. 2016; 10: 243-255. doi: 10.1016/j.orcp.2015.08.007.
10. Amato AA, Wheeler HB, Blumberg B. Obesity and endocrine-disrupting chemicals. Endocr Connect. 2021; 10: R87-R105. doi: 10.1530/EC-20-0578.
11. Heindel JJ. History of the Obesogen field: looking back to look forward. Front Endocrinol (Lausanne). 2019;10: 14. doi: 10.3389/fendo.2019.00014.
12. Warger J, Lucas M, Lucas A. Assessing the contribution of plastic-associated obesogenic compounds to cardiometabolic diseases. Curr Opin Endocrinol Diabetes Obes. 2023; 31: 98-103. doi: 10.1097/MED.0000000000000852.
13. Jayavel S, Govindaraju B, Michael JR, Viswanathan B. Impacts of micro and nanoplastics on human health. Bull Natl Res Cent. 2024; 48: 110. doi: 10.1186/s42269-024-01268-1.

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