J Environ Sci Public Health 2022;6 (1):104-108 *DOI: 10.26502/jesph.96120158*

Short Commentary

Plastic on Plate-Plasticizers and Child Health

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Received: 18 February 2022; **Accepted:** 25 February 2022; **Published:** 04 March 2022

Citation: Ankan Mukherjee Das. Plastic on Plate-Plasticizers and Child Health. Journal of Environmental Science and Public Health 6 (2022): 104-108.

An estimated 400 million metric tonnes of plastics were globally produced in 2019 and with the advent of covid-19 pandemic, the production and distribution of plastics has dramatically escalated, leading to unintended massive environmental contamination [1-3]. This colossal indiscriminate production caters to the unregulated demand for plastic-made consumer products (including covid-19 masks, shields, gloves and protective medical gears), utilized on a daily basis, consequently leading to increased production and leaching of plasticizers, which are added to improve the quality of plastics and associated products. These plasticizing chemicals are also worryingly used in food processing and packaging industry [4] leading to increased migration into food items and human body through ingestion, inadvertently exposing the population to their endocrine and immune-disrupting properties. Moreover, recent evidence of increasing human, wildlife and marine contamination with micro-plastics, microbeads and nano-plastics [5-9], which are also deliberately added to several consumer and personal-care items such as toothpaste and cosmetics, and are detectable in table salt, tea bags, fish, shellfish and seaweed, industrially processed, packaged and canned food, have incrementally contributed to the gargantuan problem of plastic ingestion and chemical toxicity.

The momentous debate on the mutagenicity, genotoxicity including endocrine-disrupting and immunomodulatory potential of these industrially-

made plasticizing chemicals has been intensifying raising crucial concerns on the ubiquitous and pervasive existence of these chemicals, and their potential role in the pathophysiology of women and child health concerns including adverse reproductive outcomes such as low birth weight, preterm births and abnormal newborn cord blood telomere length, along with early-onset chronic conditions in children and young adults. The US Environmental Protection Agency (EPA) categorize these chemical contaminants as hormone-modulating agents having the potential to thwart body's natural detox system and pollute the endocrine, genetic and/or epigenetic pathways, with adverse implications in human development, reproduction and behaviour. Although several chemicals have already been assessed for their role in hormone dysfunction and disease pathophysiology, the utmost focus and public health concern has remained on persistent as well as non-persistent industrially-made chemicals, such as polychlorinated biphenyls, phthalates, bisphenol A, per- and polyfluoroalkyl substances (PFAS), due to their unregulated and indiscriminate use in everyday consumer products including single use plastics, personal care and cosmetic products used by women and children, children toys and diapers, electronic items and importantly in food processing and contact packaging materials.

In recent decades of rapid industrialization, the dynamics and etiopathology of chronic diseases seems have gone through a paradigm shift with reports suggesting ever-increasing cases of metabolic disorders, particularly obesity among young children [10], which has become one of the most important global public health challenges, with subsequent implications in development of early-onset diabetes, cardiovascular conditions and lifestyle-associated cancers later in life. The recent National Family Health Survey of India has also indicated towards an increasing trend of obesity among children and adults. The sustainable development goals 2 and 3 have strongly emphasized on expeditious action for good health and well-being including control of malnutrition (undernutrition, overnutrition and obesity) along with improving child health indicators by 2030. Despite this global initiative, the burden of obesity among young children have been escalating. Elevated cases of thyroid and health conditions associated with hormone and/or immune and neurological dysfunction are also seen, potentially suggestive of the role of pervasive chronic exposure to environmental contaminants, which are often overlooked. Epidemiological evidence suggests that plasticizers are strongly associated with increasing the risk of obesity, growth and developmental problems, respiratory and neurodevelopmental disorders in children [12]. Plasticizers are found to perturb the pubertal timings in both young boys and girls, modulate the lipid and glucose metabolism and cause neurocognitive and respiratory illness in children. Moreover, exposure not only during early life stages such as infancy, childhood and adult phases but also maternal insults to these chemicals during the critical prenatal and perinatal periods can influence the endocrine signalling and mediate pathophysiological effects in offspring later in life through perturbation of the hypothalamus-pituitary-thyroid axis [11-17]. However, it is currently not clearly understood if a specific single chemical alone or cumulative exposure to chemical mixtures are responsible for these effects, given that humans are exposed to several chemicals

every day, some of which have a higher shelf life such as PFAS and bioaccumulate at different organ sites within the body leading to persistent chronic exposures over time. Policy legislations in high-income countries such as the USA, Europe, and Japan, although not holistic, have been enforced, regulating use of plasticizers in specific consumer items such as children toys and personal care products. Recent roadmap and regulations implemented by the US Environmental Protection Agency and Denmark on controlling PFAS pollution and banning plastic and cardboard food packaging materials strongly indicate towards increased public and political awareness regarding the ecological and human health implications of plasticizers such as phthalates and PFAS [18]. However, in developing countries such as India, plasticizers are unregulated, not given enough research priority and are not considered an important public health problem. There is also limited public awareness regarding the toxic effects of plasticizers, even though current evidence suggests extensive environmental contamination, human bioaccumulation and exposure having potential detrimental effects on pathophysiology of several chronic diseases among children and young adults including cancer.

Therefore, the significant threat posed by plastics and plasticizer contamination with consequent ingestion and chemical exposure to children and adults should not be ignored and underestimated. The unregulated and indiscriminate use of plasticizers and/or microbeads in making consumer products, including industrially-processed, packaged and canned food is a major global public health concern which needs to be given high priority for public awareness, policy and research, particularly in developing countries like India, so as to limit the increasing burden of disease and disability among children and adults associated with chronic exposure to plasticizers. Regardless several alternatives are being introduced to control the menace of toxic plasticizers, the safety of these new chemicals are to be assessed before increasing their production, in which case, the existing list of toxic chemicals may get longer. Unlike the earlier testing concerns, low and very low exposure-dose testing for longer duration at different life stages, needs to be done by accredited agencies, as humans are not exposed to the chemical concentration levels normally found in the environment. In addition, immediate sustainable solutions for combatting plastic, micro/nano-plastic and electronic-waste pollution needs to be designed, so as to limit their evident ecological accumulation, disruption and migration into the food chain, subsequently leading to microplastic and plasticizer bioaccumulation in the human body, increasing the risk of endocrine and immune disruption and development of chronic conditions such as obesity, diabetes, cardiovascular diseases and cancer, with inter and transgenerational consequences. Further, well-designed longitudinal and ecological studies assessing the early life and long-term impact of plasticizing chemicals at the genetic and epigenetic levels are required to be implemented with careful effective assessment of plasticizers in biological samples. Accelerated biomonitoring of human samples such as breast milk, food items, packaging materials, air and drinking water is required, to provide stronger evidence linking specific chemical or chemical mixtures to rising incidence of child health issues, especially in low-income and middle-income countries like India.

Population and individual-level interventions for restricting intake of industrially-processed, packaged and canned food items and artificially sweetened drinks, which are widely preferred by children and young adults, along with reducing application of plasticizer composed personal care, cosmetics and children care products could help in reducing sustained everyday exposure.

References

1. Geyer R, Jambeck JR, Law KL. Production, use, and fate of all plastics ever made. Sci Adv 3 (2017): e1700782.
2. Benson NU, Bassey DE, Palanisami T. COVID pollution: impact of COVID-19 pandemic on global plastic waste footprint. Heliyon 7 (2021): e06343.
3. Yuan X, Wang X, Sarkar B, et al. The COVID-19 pandemic necessitates a shift to a plastic circular economy [published online ahead of print, 2021 Sep 27]. Nat Rev Earth Environ (2021): 1-2.
4. Edwards L, McCray NL, VanNoy BN, et al. Phthalate and novel plasticizer concentrations in food items from U.S. fast food chains: a preliminary analysis [published online ahead of print, 2021 Oct 27]. J Expo Sci Environ Epidemiol (2021):10.1038/s41370-021-00392-8.
5. Oliveri Conti G, Ferrante M, Banni M, et al. Micro- and nano-plastics in edible fruit and vegetables. The first diet risks assessment for the general population. Environ Res 187 (2020): 109677.
6. Song K, Ding R, Sun C, et al. Microparticles and microplastics released from daily use of plastic feeding and water bottles and plastic injectors: potential risks to infants and children in China. Environ Sci Pollut Res Int 28 (2021): 59813-59820.
7. Schwabl P, Köppel S, Königshofer P, et al. Detection of Various Microplastics in Human Stool: A Prospective Case Series. Ann Intern Med 171 (2019): 453-457.
8. Ragusa A, Svelato A, Santacroce C, et al. Plasticenta: First evidence of microplastics in human placenta. Environ Int 146 (2021): 106274.
9. Danopoulos E, Twiddy M, West R, et al. A rapid review and meta-regression analyses of the toxicological impacts of microplastic exposure in human cells. J Hazard Mater 427 (2022): 127861.
10. Sashindran VK, Dudeja P. Obesity in School Children in India. In: Anugwom EE, Awofeso N, editors. Public Health in Developing Countries [Internet]. Rijeka: IntechOpen (2020).
11. Rappazzo KM, Coffman E, Hines EP. Exposure to Perfluorinated Alkyl Substances and Health Outcomes in Children: A Systematic Review of the Epidemiologic Literature. Int J Environ Res Public Health 14 (2017): 691.
12. Naspolini NF, Machado PP, Moreira JC, et al. Maternal consumption of ultra-processed foods and newborn exposure to perfluoroalkyl substances (PFAS). Cad Saude Publica 37 (2021): e00152021.
13. Spratlen MJ, Perera FP, Lederman SA, et al. The association between prenatal exposure to perfluoroalkyl substances and childhood

neurodevelopment. Environ Pollut 263 (2020): 114444.

14. Gardener H, Sun Q, Grandjean P. PFAS concentration during pregnancy in relation to cardiometabolic health and birth outcomes. Environ Res 192 (2021): 110287.
15. Deierlein AL, Wolff MS, Pajak A, et al. Longitudinal Associations of Phthalate Exposures During Childhood and Body Size Measurements in Young Girls. Epidemiology 27 (2016): 492-499.
16. Szilagyi JT, Avula V, Fry RC. Perfluoroalkyl Substances (PFAS) and Their Effects on the Placenta, Pregnancy, and Child Development: a Potential Mechanistic Role for Placental Peroxisome Proliferator-Activated Receptors (PPARs). Curr Environ Health Rep 7 (2020): 222-230.
17. Das AM, Das BC. Exposure to endocrine-disrupting chemicals in utero and thyroid cancer risk in offspring. Lancet Diabetes Endocrinol 9 (2021): 255.
18. Mukherjee Das A, Janardhanan R. Accelerating Research and Policy on PFAS in India. Environ Epidemiol 6 (2022).