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Samuel IC Dibia
Department of Human
Kinetics and Health
Education, University of
Nigeria, Nsukka, Nigeria

Kelachi T Wala
Department of Chemical
Pathology, Rivers State
University, Port-Harcourt,
River, Nigeria

Uloma Onwuzurike
Department of Social Science
Education, University of
Nigeria, Nsukka, Nigeria

Benjamin Anabaraonye
Institute of Climate Change
Studies, Energy and
Environment, University of
Nigeria, Nsukka, Nigeria

Chukwudi P Arinze
Department of Zoology and
Environmental Biology,
University of Nigeria, Nsukka,
Nigeria

Corresponding Author:
Samuel IC Dibia
Department of Human
Kinetics and Health
Education, University of
Nigeria, Nsukka, Nigeria

The impacts of plastic pollution on public health in Nigeria

Samuel IC Dibia, Kelachi T Wala, Uloma Onwuzurike, Benjamin Anabaraonye and Chukwudi P Arinze

Abstract

Plastic, one of the most preferred materials in today's industrial world is posing serious threat to environment and consumer's health in many direct and indirect ways. Exposure to harmful chemicals during manufacturing, leaching in the stored food items while using plastic packages or chewing of plastic tethers and toys by children are linked with severe adverse health outcomes such as cancers, birth defects, impaired immunity, endocrine disruption, developmental and reproductive effects, among others. Plastic pollution is one of the glitches at the epicenter of the challenges plaguing the universe status quo with more than estimated eighty million tons of plastic related wastes being released into the sea annually. This study identified the impacts of plastic pollution on public health in Nigeria. It further identified the need for plastic pollution education across various communities, cities and institutions in Nigeria. The study also recommended the innovative tools of poetry, music and educational blogs among others for use in plastic pollution education for sustainable development in Nigeria. It concluded with the clarion call for more intensive research on the impacts of plastic pollution on public health in Nigeria.

Keywords: climate change, education, plastic pollution, public health, sustainable development

Introduction

Plastic pollution has remained one of the glitches at the epicenter of the challenges plaguing the universe status quo with more than estimated eighty million tons of plastic related wastes being released into the sea annually (Awuchi & Awuchi, 2019) [4]. Plastic pollution is one of several man-made environmental threats including ocean warming, overharvesting, ocean acidification, eutrophication, deoxygenation, shipping and underwater noise, invasive species, habitat destruction and fragmentation, as well as other forms of chemical pollution. Economic development and people's changing patterns of consumption and production have led to a drastic increase in plastic wastes all over the world (Chow *et al* 2017) [8]. Plastic pollution combines with other threats to marine life to form a precarious cocktail. The effects of plastic on marine ecosystems should not be considered in isolation. Ingested plastic can move right up the marine food chain – and is now found in human diets, too. When marine animals ingest plastics, field and laboratory studies have demonstrated that those plastics – and their associated chemical pollutants – can pass further up the marine food chain. Plastic pollution is everywhere in the global ocean, and levels have grown exponentially. The United Nations (UN) called it a 'planetary crisis' (MacLeod, Arp, Tekman, & Jahnke, 2021) [23], while Daltry, Merone, and Tait (2021) [21] referred to it as 'plastic pandemic'. From the poles to the remotest islands, from the surface of the sea to the deepest ocean trench, the marine plastic pollution problem has grown exponentially, plastic pollution is now ubiquitous and is projected to increase even if current corporate and government commitments are met (Borrelle *et al.*, 2020) [7]. Global and systemic actions are needed urgently in response (Elhacham, Ben-Uri, Grozovski, Bar-On, & Milo, 2020) [11]. The staggering figures of the impact of plastic pollution to life are frightening. As at 2018, about 380 million tonnes of plastic is produced worldwide per year. From the 1950s up to 2018, more than 7.8 billion tons of plastics have been produced globally. An estimated 12 per cent has been incinerated and 9 percent recycled (The Economist, 2018). Between 1996 and 2014, more than 23,400,000 tons of plastics were imported into Nigeria's technological sector, yet, less than 12% of the ensuing garbage was recycled. There is a need for sustainable management of this significant waste and resource category, given the threats this volume poses to local and global habitats and human health (Ugochukwu *et al.*, 2018) [39].

In some regions there have been substantial efforts to lessen plastic pollution by promoting plastic recycling and reducing consumption of plastic (Walker, Tony and Xanthos, 2018) [41]. Many researchers suggest that by 2050 there may be more plastic wastes than fish in the world oceans by weight (Sutter, 2016) [35]. Globally, there have been a consistent and persistent increase in the production of plastic over the past fifty years, from 2 million metric tons in 1950 to 381 million metric tons in 2015, and is estimated to increase by 100% in 2020 (J and K Envis Hub, 2018) [19]. The total global production of plastics from its inception to 2018 is estimated at 8,300 million metric tons (Royer *et al.*, 2018). Globally, plastic waste constitutes more than 60% of the total global municipal solid waste of which 22% were recovered and 78% disposed of (Ogwo *et al.*, 2013; Ayo *et al.*, 2018) [25]. An estimated 367 million tonnes of plastic were produced in 2020 with the production rate of about 12 tonnes of plastic waste produced per second (Sogbanmu, 2022) [33]. Over 280 million tons of plastics are produced annually and approximately 75% of the demand comes from four major sectors: packaging, construction, automotive and electrical or electronics. (Thevenon and Oliver, 2014) [38]. Plastic is a generic term used for polymeric materials that may contain other substances (additives) to improve efficiency, reduce cost and produce desired color (Hahladakis, 2018; Van *et al.*, 2020) [15, 40]. The polymers used to make plastic materials are diverse, consisting of seven types of polymer resins (Bashir, 2013) [6]. These include Polyethylene Terephthalate (PETE), High Density Polyethylene (HDPE), Polyvinyl Chloride (PVC), Low Density Polyethylene (LDPE), Polypropylene (PP), Polystyrene (PS) and others (which includes many polymer types, such as Polycarbonate (PC), Acrylic and Nylon) (Seaman, 2020) [30].

Methodology

This paper examined “the impacts of plastic pollution on public health in Nigeria” through existing literature review. The main purpose of this research work was to survey theoretical backgrounds and previous studies on the subject matter. It also examined the current progress on how to mitigate the public health impacts of plastic pollution in Nigeria.

Understanding plastic pollution

Plastic, one of the most preferred materials in today's industrial world is posing serious threat to environment and consumer's health in many direct and indirect ways. Exposure to harmful chemicals during manufacturing, leaching in the stored food items while using plastic packages or chewing of plastic tethers and toys by children are linked with severe adverse health outcomes such as cancers, birth defects, impaired immunity, endocrine disruption, developmental and reproductive effects, among others (Rustagi, Pradhan & Singh, 2011) [29]. Plastic pollution is the buildup of plastic particles, such as plastic bottles, plastic bags, and much more, in the global environment that adversely affects wildlife habitat, wildlife, and humans (Laura, 2018) [21]. Based on size plastics pollutants are categorized into macro-, meso-, or micro debris (Hammer *et al.*, 2012) [17]. Plastics are durable and inexpensive, and consequently plastic production levels by humans are high (Hester and Harrison, 2011) [18]. Nevertheless, the chemical structure of some plastics makes

them resistant to various natural degradation processes and therefore they degrade slowly (Le Guern, 2018) [22]. These two factors have together led to a very high incidence of plastic pollution in the world. Plastic pollution is destroying wildlife, damaging ecosystems, clogging drainage systems, and harming fisheries and tourism. Solving the plastic pollution problem is part of solving the climate change problem ravaging the world. Solutions for plastic waste and plastic substitutes will need to come through innovations. New skills, knowledge and education can help create enduring solutions to plastic pollution and develop systems whereby communities can turn waste into wealth, a concept that helps to view waste management of all types as a resource rather than a refuse (Sosale *et al.*, 2021) [34].

The need for plastic pollution education in Nigeria

Plastic pollution education is a veritable approach to tackle the growing plastic pollution pandemic. Designing educational programmes at all levels of education promises to bring forward an in-depth understanding of the problems, equips people with the tools and strategies to manage the plastic pollution crises that are ravaging our planet. Urgent action is needed to curb plastic waste that pollutes the land, flows into rivers, and ends up in ocean (Sosale, Shepardson, Aedo & Jha, 2021) [34]. Education and skills can drive innovative solutions. First, education is important for changing human behaviour. Well designed educational programmes and innovative educational toolkits for plastic waste management can instill good environmental habits and behaviours and ultimately impart change to parents and communities (Anabaraonye, Nji, Hope, 2018) [1, 3]. Second, education can equip young people with skills that can help them develop innovative climate solutions. Tertiary education is critical for such solutions. Training on climate change aspects and university-industry linkages can stimulate innovation, build education pathways between the technical environment, climate jobs and tertiary education, and expand opportunities. Third, education can promote innovation to expand solutions and equip people with skills to build with environmentally friendly, energy efficient, and climate resilient materials and renewable options. Such curriculum content that is focused on climate change adaptation and mitigation can also change behaviours and foster knowledge that can lead to climate action (Anabaraonye, Okafor, Hope, 2018) [1, 3]. Fourth and finally, through climate change research and development in higher education, the education sector can build knowledge and skills for adaptation, mitigation, and for articulating appropriate policy responses to address the transition to a fully decarbonized economy. More so, the education sector can impart solutions for collective action around innovation, including the scaling up of investments in all forms of capital.

The public health implications of plastic pollution in Nigeria

While once considered inert, untreated monomers and other harmful substances can be found within plastics. Some plastics may be chemically harmful, either directly toxic themselves or because they absorb and carry other pollutants (Rochman *et al.*, 2013) [26]. Chemical effects include damage to the heart, nervous system, reproductive system and potential cancers (Sharma & Chatterjee, 2017) [32]. Monomers and other substances in plastics can mimic

the effects of Oestrogen in living organisms. Pesticides and organic toxins are found on plastic particles at harmful concentrations – 100 times more than found in sediments and a million times more than in seawater (Rochman *et al.*, 2013) ^[26]. Seafood, alcohol and plastic-bottled water are the greatest sources of micro-plastic ingestion in humans (Cox *et al.*, 2019) ^[9]. While the investigation of the toxic effects of micro-plastics in food webs is complex and ongoing (Seltenrich, 2015) ^[31], evidence suggests that ingestion of these micro-plastics in humans may be associated with infertility, obesity and suspected endocrine dysfunction including oestrogen mimicking, which in women has been associated with breast cancer. While difficulty lies in separating the comparative exposure from pollution and food webs and exposure via food packaging (Seltenrich, 2015) ^[31], it could be argued that this separation is a moot point should significant human health effects begin to unfold. Human health risks from plastics stem from their component monomers such as bisphenol A (BPA), additives such as plasticizers, or a combination of the two (Halden, 2010) ^[16]. While there is very limited information about the long-term human health effects of plastics, research has demonstrated high levels of (BPA) in women and young infants (Rolland *et al.*, 2020) ^[27] and this may cause alterations in neurological white matter in children (Ellahi & Rashid, 2017) ^[12]. These findings require more long-term research. BPA is both a plastic monomer component and an additive to many varieties of plastic. Ingestion is the commonest route of exposure via plastic packaging, particularly re-usable plastic packaging where repeated washing and storage results in polymer breakdown. Studies have determined that around 95% of humans have detectable serum and urinary levels of BPA. The overall health risks of BPA are still under debate and are by no means fully comprehended; it is currently classified as an oestrogen mimic and endocrine disruptor in that it is known to bind to oestrogen receptors.

Animal studies have noted the effects of BPA to include: increased postnatal growth, early sexual maturation (in females), sex hormone imbalances in both males and females, decreased fertility in males, prostatic hyperplasia, alterations in immune system function, hyperactivity and more. Replacement phenols for BPA may be just as harmful to human health and research into alternative safe materials is required (Moon, 2019) ^[24]. The healthcare system in Nigeria utilizes an abundance of plastics owing to their inexpensive production and single-use sterile nature (Halden, 2010) ^[16]. Medical devices such as those used in dialysis, blood transfusion and extra-corporeal membrane oxygenation (ECMO) contain phthalates. These compounds can also be ingested from food contaminated from plastic packaging. Despite being rapidly metabolized, health concerns associated with phthalates include endocrine disruption and malformations of the male reproductive system in animals. Human studies have also drawn an association between serum phthalate levels, increased waist circumference and insulin resistance (Halden, 2010) ^[16]. The human health risks of phthalates remain under some scientific debate; however, there is evidence from longitudinal birth cohort studies in animals that peri-natal phthalate exposure can impair brain development and there is emerging evidence that phthalate exposure increases the risk of learning and attention deficits in children (Engel *et al.*, 2021) ^[13]. While the risks and impacts of plastic-related

toxin exposure need further investigation, more extensive and integrated safe recycling and disposal of plastics must increase significantly on a global scale to prevent potential harms. Additional to chemical effects, plastics disrupt ocean ecosystems with an indirect effect on human health. For instance, alongside climate-change-related ocean warming, plastic pollution is having a direct effect on coral reefs. Corals feed on zooplankton and similar small species, thereby ingesting micro-plastics. Coral reefs are essential coastal structures, not only functioning as vital components of food webs and ecosystems but also providing natural physical barriers to storms and cyclones. This compounds the impacts of greenhouse gas emissions and other anthropogenic effects on the oceans; 87% worldwide of coral reefs have some level of degradation (Jones *et al.*, 2018) ^[20]. Plastic-related health damage to coral reefs contributes to their declining health in an already increasingly hostile environment.

Recommendations

1. Inclusion of plastic pollution education in Nigeria's educational curricula at all levels is pertinent in entrenching the right attitudes to plastic pollution mitigation. There is dire need to educate the populace on the 5 "R" strategies of plastic waste management in Nigeria.
2. Plastic pollution prevention is partially addressed by the slogan: reduce, refuse, reuse, repurpose and recycle. This focuses on what individuals can do to divert pollution from the environment. Other sources of micro-plastics such as cosmetic beads and clothing also have relatively straightforward solutions but require legislative change as well as consumer information. The more complex issue of our societies' reliance on plastic needs discussion, policy development and decisions about production, use and waste management (Daltry *et al.*, 2021) ^[10].
3. Long-term planning towards effective plastic waste management in major industries and infrastructure in Nigeria is greatly needed. We need to work hard to prevent new contamination of plastic pollution. Targeting the causes of plastic pollution before it happens is far more effective than cleaning it up afterwards (Tekman, Walther, Peter, Gutow, & Bergmann, 2022) ^[36].
4. Similar to the climate crisis, this issue of plastic pollution affects the entire planet. Plastic pollution levels are continuously increasing, and global collaborations and systemic solutions will succeed in response. Encouragingly, public attention is now focused on the issue, and calls are growing for decisive international action to turn the tide before plastic pollution overwhelms the resilience of a critical number of marine species and ecosystems (Walther, 2015) ^[42].
5. A far more important approach is simply to prevent plastic waste entering the environment in the first place, which also implies a major reduction in primary plastic production. Such an approach would have additional benefits including reduced resource use and pollution from manufacturing, transportation and disposal of plastic waste.
6. Poetry, music and educational blogs are recommended as veritable tools which can be used to educate individuals, communities and institutions across Nigeria

- on climate change issues as well as plastic pollution mitigation for sustainable development (Anabaraonye, Nji & Hope, 2018) ^[1,3].
7. The Nigerian Government should provide sufficient funds to passionate and capable youths to enable them appreciate and maximize the green entrepreneurial opportunities in plastic waste recycling thereby helping to eradicate plastic pollution in Nigeria (Anabaraonye, Nwobu, Nwagbo, Ewa & Okonkwo, 2022) ^[2].
 8. More efforts have to be put towards increasing people's awareness about bio-based and biodegradable products, their properties, their use, and the environmental and human health impacts (Filho, Barbir, Abubakar, *et al.* 2022) ^[14].

Conclusion

Plastic pollution education is an urgent task which needs to be undertaken by passionate individuals, educationists and professionals across various communities, cities and institutions in Nigeria. Furthermore, there is a great need for more intensive research to further identify the public health impacts of plastic pollution and ways to mitigate to achieve sustainable development in Nigeria.

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