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IS THE COVID-19 PANDEMIC INCREASING THE MICROPLASTIC LOAD IN OUR ENVIRONMENT?

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ABSTRACT

The whole world is fighting against the pandemic and is using all its sources to prevent the spreading of corona virus. As a result, the production and usage of face masks and gloves has hiked tremendously thereby producing a huge amount of plastic waste also. Since these are made of single use plastics for safety concerns, they are increasing the load of plastic waste in the environment. These will degrade with time in the environment to release microplastics (MPs). Once released to the environment it is a very strenuous task to get rid of these plastic pollutants. Hand washes are identified as a source of MPs earlier. But now it is gaining more importance because hand washing is an important way to fight against the pandemic. Proper awareness about the impact of this pandemic on the environment should be given to the general public through more researches and studies. Also, the use of cloth face masks should be promoted among the public to reduce the dumping of plastic wastes.

KEY WORDS : Surgical masks, Gloves, Microplastics (MPs), Plastic pollution, Covid-19

INTRODUCTION

Plastic pollution was already an emerging threat to our planet even before the corona virus outbreak. There are enormous reports on plastic contamination in all type of ecosystems such as water, air, soil etc. Now it is again at its highest risk due to the covid-19 pandemic. Outbreak of Coronavirus disease 2019 (COVID-19) started in mid of December 2019 and spread very rapidly across the globe within a month of its outbreak. And it was declared as a pandemic by World Health Organization on 11 March 2020 (WHO, 2020). The Covid-19 crisis has spurred a rapid expansion in the production of desperately-needed plastic products such as surgical masks, gloves, protective equipment, with governments racing to boost their stockpiles and public clamouring for their share of supplies. According to the WHO estimates, an approx. of 89 million medical masks were required to face the pandemic each month (WHO, 2020). Such requirement has resulted in an unprecedented rise in the global production of face masks which are produced using non-degradable polymeric materials. Such a production is necessary, but all these plastics ends somewhere in the environment. Overtime these products breakdowns and add to the vast collections of MPs in our land, water and air.

Many residents in the industrialized world have been using disposable face masks in an attempt to protect their health from high particulate matter (PM) concentrations so far. But till now only people in some industries or labs those who were exposed to particulate matter, dust particles or toxic gases only used these face masks, but now the scenario has totally changed. Now face masks become an essential part in our daily life and now it's part of our daily attire. So, the usage of facemasks has raised very rapidly (Wu *et al.,* 2020). Not only face masks but also hand gloves also have increased in its usage and thereby production also. Due to lack of proper sanitising methods and safety reasons most of these self-protection gadgets are made of single use plastics. Single use plastic materials posed a great threat to the environment earlier itself (Schnurr

et al., 2018). Now these masks, gloves and personal protective equipments adds another load to this category.

Another major source of MPs, which can rapidly increase due to this ongoing pandemic is the microbeads and MPs in hand cleansers and soaps. As handwashing is one of the main steps to keep ourselves safe from corona virus, the use of hand washes and soaps have increased a lot. The presence or usage of microplastic beads in the handwashes were already reported previously (Gregory, 1996; Napper *et al*., 2015). Inaddition, due to the lockdown issues, the hotels started giving out more food parcels, and online shopping levels also surged. These increased the amount of packaging materials and there by more packaging wastes (Klemes, 2020). All of these add to the microplastic pollution in which facemasks, gloves and hand cleansers seems to be more important. Improperly discarded facemasks, gloves were already found in soil and water ecosystem which reveals the shocking speed at which the recent shift in human behaviour impacts the environment (Fadare and Okoffo, 2020).

Types of facemasks and gloves

Since the start of the COVID-19 pandemic, WHO and other health agencies recommended the use of facemasks to limit the spread of the novel corona virus via respiratory droplets. Since it was a medical emergency no one actually cared about the impact this pandemic would make on the environment.

According to Centre for Disease control and prevention, National Institute for Occupational Safety and Health (NIOSH) has classified different types of masks based on their usage. There are two different classifications for respirators; the letter and the numbers. Each mask can be N, R, or P, and each mask can be 95, 99, or 100. Each combination of letter and number indicates a particular kind of respirator, in which letters indicates how they relate to oil. The slippery nature of oil and fat-based particulates makes them capable of penetrating filters that non-oil particulates cannot, even when those particulates are small. These include a wide range of particulates from certain hazardous chemicals to viruses like SARS, which has a lipid (fat) shell around it. N rated respirators are not resistant to oil-based particulates, R rated is Resistant to oil-based particulates and P rated is classified as Oil-proof. In case of numbers, 95 –rated masks filter out 95% of particulate matter, 99-rated mask filter out 99% particulate matter and 100-rated masks filter out 99.7% oil and non-oil particulates (CDC, 2016 ; Oberg and Brosseau, 2008).

But the 3 most common types of mask which is prevalent during this pandemic period are

- N95 Respirators – A particulate-filtering face piece respirator that meets the N95 standard of the U.S. National Institute for Occupational Safety and Health air filtration rating because it filters at least 95% of airborne particles. Evaluated, tested, and approved by NIOSH as per the requirements in 42 CFR Part 84 (NIOSH, 1996).
- Surgical Face Masks – A mask intended to be worn by healthcare professionals during surgery to catch the bacteria shed in liquid droplets and aerosols from the wearer's mouth and nose.
- Cloth Face Mask -– Scarfs and homemade cloth face masks that cover the nose and mouth.

Usage of gloves also increased at a great extent in the public to reduce the risk of contamination and thereby preventing spreading of corona virus. Gloves were not at all a familiar item for the general public to use. These can be multiuse or disposable. The material of the glove depends on its intended use. In the current scenario, disposable single use gloves are more used among the general public. These single use gloves are made of different polymers, mainly latex, nitrile rubber, polyethylene, polyvinyl chloride and neoprene (ECDC, 2020).

What are these made from?

A surgical mask is a loose-fitting, disposable device that creates a physical barrier between the mouth and nose of the wearer and potential contaminants in the immediate environment. Surgical masks are regulated under 21 CFR 878.4040. And these are not to be shared and may be labelled as surgical, isolation, dental or medical procedure masks as per its application. These are often referred to as face masks, although not all face masks are regulated as surgical masks. Surgical masks are made in different thicknesses and with different ability to protect you from contact with liquids. These properties may also affect how easily you can breathe through the face mask and how well the surgical mask protects you.

If worn properly, a surgical mask is meant to help block large-particle droplets, splashes, sprays, or splatter that may contain germs (viruses and bacteria), keeping it from reaching your mouth and nose. Surgical masks may also help reduce exposure of your saliva and respiratory secretions to others.

Fig. 1. Face masks and gloves littered and in different levels of degradation sighted from Raipur city, Chattisgarh

Surgical masks are not intended to be used more than once.

Disposable face masks (single use face masks) are produced from polymers such as polypropylene, polyurethane, polyacrylonitrile, polystyrene, polycarbonate, polyethylene, or polyester (Potluri and Needham, 2005). They consist of three layers; an inner layer (soft fibres),middle layer (melt-blown filter), and an outer layer (nonwoven fibres, which are water-resistant and usually colored). The melt-blown filter produced by the conventional fabrication of micro- and nanofibers,where melted polymer is extruded through tiny nozzles, with highspeed blowing gasfunction as the main filtering layer of the mask (Dutton, 2008). A recent study also confirmed that the surgical masks were made of plastic polymers, especially polypropylene (Aragaw, 2020). There may exist variations in the formation of the product from one manufacturer to the other.

The major raw material for glove manufacturing is rubber latex. Before the latex is used for manufacturing, it is mixed with several chemicals such as sulphur, zinc oxide, pigments, stabilisers, antioxidants etc. After 24-36 hours of maturing time, the latex compound is ready for dipping. The molds are first dipped in slurry of calcium nitrate and calcium carbonate solution. The molds are then dipped in the latex compound which is then leached in hot water. The dried and cured gloves are then vulcanized which gives elasticity to the gloves. The finished gloves are then stripped off the molds using pneumatic air pump (Yip and Cacioli, 2002).

How Covid-19 contributes to microplastic pollution

The pandemic has forced the whole people to use the protective gears (mask, gloves) and wash hands properly at regular intervals. These circumstances are awfully new to the general public to handle. The mask and gloves which were used earlier by the

Table 1. Materials used in production of different personal protective equipments

Personal protective equipments	Materials used	References
N95 Mask (3M 9502)	Strap - Polyisoprene, Nose Foam- Polyurethane, Filter- Polypropylene, Valve- Polypropylene, Valve diaphragm- Polyisoprene, Nose clip- Aluminium	FDA,2020
Surgical mask	Polypropylene nanofibers	Aragaw, 2020
Surgical gloves	Latex, nitrile rubber, polyethylene, polyvinyl chloride and neoprene	ECDC,2020

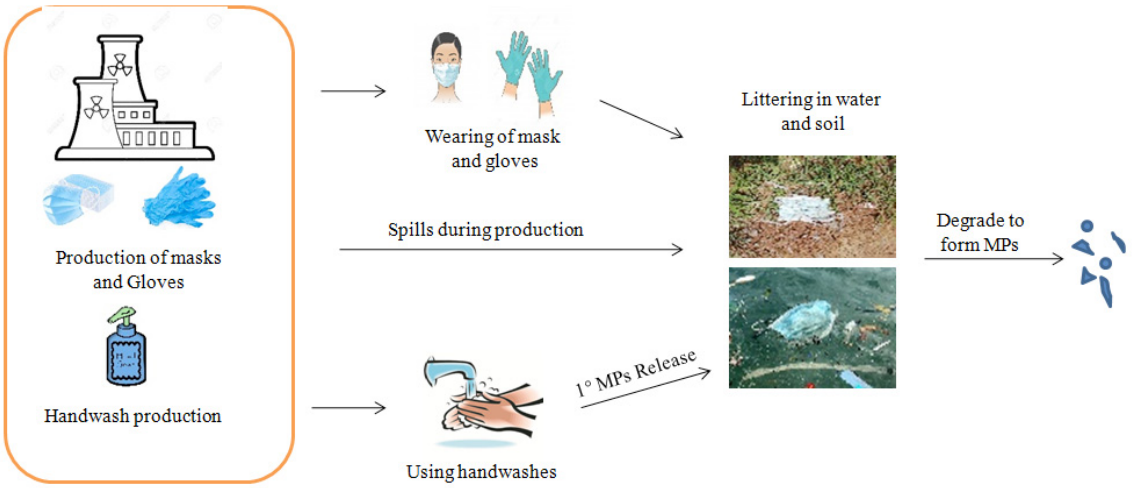

Fig. 2. Contribution of Covid-19 to MP load in environment

health professionals and disposed in proper way is now out for the public to use without any restrictions. Decontamination of masks is challenging because the filtration capacity of polypropylene is vulnerable to most commonly used sterilization methods, including autoclaving, bleach, and alcohol (Liu *et al.*, 2020). But the reuse of decontaminated masks may help in reducing the waste load produced from the category. Data demonstrate that corona virus can be effectively removed by heating at 65°C for 30 minutes (Kariwa *et al.*, 2006) and due to low crystallinity of polypropylene at 70 °C (Cheng *et al.*, 2020), it is suggested that dry heat at 65 °C to 70 °C for 30 min should be an effective condition to decontaminate used masks (Price and Chu, 2020). The efficiency of this method is yet to be determined and if it proved that the method is effective then it would be a very simple method for decontamination of masks (Liu *et al.*, 2020) and will provide a relief from the current problem of mask shortage and its environmental impacts. The disposed face masks and gloves will degrade in the environment gradually and releases MPs to water as well as soil which will be persistent in the environment for very long time. Also, these gloves and masks may mimic as prey for aquatic organisms, such as gloves may mimic as jelly fish etc. Another consequence of these disposed facemasks in the environment is the possibility of them to act as a vector for disease outbreak, as plastic particles are known to propagate microbes such as invasive pathogens (Reid *et al.*, 2019). This can affect microbial habitual and the environmental processes in aquatic ecosystems. Such microplastic accumulation in the environment drastically makes the ecological function consequences for the overall ecosystem and animal health including humans under stress. MPs contain toxic chemicals as an additive like phthalate, organotin, nonylphenol, polybrominated biphenyl ether, and triclosan. Those toxic chemicals can be released during the degradation processes of plastic polymers through chemically or biochemically in the open and aerobic environment. The occurrence of plastic and plastic particles in the environment will contribute a drought then after global warming due to carbon emission and disaster risk management will become burdensome (Aragaw, 2020; Shen *et al.*, 2020). In addition, the plastic particles are also getting into food meant for human consumption, raising a concern on global food security and social and mental stability (Fadare *et al.*, 2020).

The usage of handwashes has increased tremendously as it is a major way through which we could fight against this pandemic. A study shows that the google searches for keywords "facemasks" and "handwash" reached an all-time high since February 2020 (Lin *et al.*, 2020). Micro sized granulated polyethylene, polypropylene and polyester particles are found in hand cleansers as a substitute of natural exfoliants (Zitko and Hanlon, 1991). Industries use the terms 'microbeads, microspheres, nanospheres, plastic particulates etc. (UNEP, 2015). The purpose of these microbeads in the hand washes is to provide a friction during washing and remove contaminants from the hands. While using these handwashes, the microbeads which are primary MPs are directly washed out into the drains and thereby reaching the aquatic or soil ecosystem (Napper *et al.*, 2015).

Not only during and after the usage these are producing MPs, but also during the production microplastic particles are emitted. As the raw materials used are polymers or plastics the spill out during production is a pathway for MPs release.

CONCLUSION

Among the many consequences of covid-19 pandemic, one which is more persistent and riskier is the sudden surge of plastic waste especially the protective gears such as masks, gloves etc. Like the conventional plastic products such as plastic bags, bottles etc. as a relevant source for MPs, and have environmental consequences, these surgical face masks and gloves also should be investigated as an emerging source of MPs. Therefore, MPs from the face masks and gloves are contaminants of emerging concern, and researches should be conducted to assess the environmental risk, comprehensive data on their abundance, fate, sources, and biological effects are needed, and awareness creation is also very important. The disposal of the masks and other prevention and control measures which should not be neglected. Therefore, mask use must be combined with hand hygiene, ventilation improvement, reduction of gatherings, and social and physical distancing. The government must also spread the relevant knowledge through social media, display screens and billboards in public place, and hand out mask instruction materials to the public and carry out training and seminars in places such as hospitals, schools and kindergartens regarding the storage and proper disposable of masks without envisaged as environmental pollutants (Wang *et al.*, 2020). A novel scientific investigation has proposed that tandem catalytic cross alkane metathesis method for highly efficient degradation of polyethylene under mild conditions. Under the catalytic methods, different types of polyethylene with various molecular weights undergo complete conversion into useful liquid fuels and waxes. Therefore, common plasticwastes, such as postconsumer polyethylene bottles, bags, masks, gloves and films could be converted into valuable chemical feed stocks without any pre-treatment. This approach could also prevent the generating of plastic pollution in the natural environment (Jia *et al.*, 2016).

The Centre for Disease Control recommends that members of the public use simple cloth face coverings when in a public setting to slow the spread of the virus. Due to the sudden increase in usage of surgical and N95 masks, now there is shortage for the masks for the health professionals who are at higher risk of infection. If the general public use more cloth masks it will reduce the issue of the masks shortage and primarily it will reduce littering of the masks in the environment. In hospitals and other healthcare centres these personal protective equipments are disposed in proper ways. But the public is not aware about these disposal methods and thus creating the issues. Also, the usage of gloves also should be limited in situations where there are chances of contamination through touching only otherwise hand washing and/or hands sanitising at regular intervals are more entertained. Until or unless the dumping of these wastes is controlled, after the fight against the pandemic there would be another strenuous task for us which would be more severe and long lasting than the pandemic. In this juncture, through the critical thinking in research to provide eco-friendly alternative such as developing masks on nature based biodegradable biopolymers and non-harmful to biological system is also essential for effective waste management and sustainable solution to microplastic pollution.

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