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REVIEW ARTICLE

FATE OF THE FACE MASKS IN THE ENVIRONMENT AFFECT HUMAN AND WILDLIFE: TONS OF FACE MASKS ARE NEW SOURCE FOR THE ENDOCRINE DISRUPTING CHEMICALS

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ABSTRACT

COVID-19 pandemic has become a major public health problem affecting the lives of billions of people worldwide. There is an effective vaccine treatment for the coronavirus infection, but self-isolation and self-protection are the important options to stop the spread of the virus. Usage of the surgical and other face masks are must during COVID-19 pandemic and millions of used masks are accumulating as trash in the environment every day worldwide. Face masks are made of plastic materials mainly polypropylene which is categorized as endocrine disruptor affecting both humans and wildlife. Contamination of face masks to soil, oceans, sea and air may have increased the amount of microplastics concentration and these microplastics from the face masks may have various negative effects on the environment. However, what needs to be done to protect the environment and public health is to dispose of these masks in a very convenient way. Therefore, accurate elimination and collection of used face masks from the environment should be considered to protect our world. Nowadays there are different types of vaccines are in the protecting against death, hospitalization and seriousness of the COVID-19 infection but using face masks are simple, seems safe and effective way from protection against the disease. In this review, we aimed to draw attention to the fact that a using a face mask is very important for staying safe, but they may cause environmental pollution and have adverse effects on directly health and environment.

Keywords: COVID-19; pandemic; endocrine disruptors; face masks

INTRODUCTION

COVID-19 pandemic has completely changed the world since December 2019. Cough, sore throat, muscle pain and fever like flu are described symptoms of COVID-19, severity of disease has worsened by age and comorbidities such as diabetes, cardiovascular diseases, metabolic syndrome, cancer and neurological disorders. Although various drugs and vaccines have been proposed to treat COVID-19, using face masks are simple, seems safe and effective way from protection against the disease. (1-6). The first vaccine news was announced on 9 November 2020, a drug company reported that they have a vaccine candidate and for the immunization,

the individuals must take two consecutive doses in seven days (7). However, after synthesis of the vaccine there is need for time for the distribution of the COVID-19 vaccine to all countries and immunization of the individuals will take time after vaccination. The vaccination against COVID-19 infection is very crucial because vaccination protects against death, hospitalization and severity of the COVID-19 infection (7,8). Additionally, people are still infected and die because of COVID-19 even they are vaccinated. Thus the best way for the self-protection from COVID-19 can be achieved via self-isolation, social distance, wahing hands and using face masks beside vaccination, that enable us to stop the spread the virus as well.

Nowadays third wave of COVID-19 has started with the Omicron variant of the virus leading to the restrictions and limitations in some countries because of increased number of infected people and deaths compared to the first wave (6). On the other hand,excessive use of the face masks will bring environmental pollution and cause many problems on the ecosystems and human health .It was reported by the Conversation that there are more masks than jellyfish in the oceans. Plastic materials existing in the face masks are mainly polypropylene which easily contaminates the earth, air, soil, rivers, sea and oceans causing environmental pollution (9).

In this review, we aimed to draw attention to wearing face mask is very crucial and fundamental for the health but disposal or discarding of these face masks after using them may be more crucial for protection environment and protection nature and our world.

Surgical masks and endocrine disruptors

There are different types of face masks such as cloth masks, surgical masks and N-95 masks and all of them made from various materials such as N-95 masks made from a nose clip (aluminum), and filter (polypropylene) (10). Polypropylenes are considered one of the safest plastic products, however degraded polypropylene by heat may expose hazardous chemicals to the environment. Additionally, various heavy metals including bromine, zinc and chrome are added in the polypropylene causing additional poisoning and toxic properties that can be harmful to human health and wildlife (11). Mussels are accepted as an important indicator of environmental microplastic pollution, since marine microplastic contamination can be measured the mussels. Microplastic particles of polypropylene have been investigated in the mussels (12). Plastic materials such as polypropylene and heavy metal including aluminum, zinc, copper and bromine can act as endocrine disruptors. Endocrine disruptors are the chemicals that can affect endocrine function both human and wildlife causing various diseases, tissue damage including kidney, liver and testis because of elevated levels of oxidative stress and its side effects (12-17).

Aluminium is categorized an endocrine disruptor that has adverse effects on ion, protein, lipid, and hormone metabolisms. This metal is found in high concentrations in the Earth's crust and reported that aluminium affects thyroid autoimmunity, reproduction system of various organisms such as Nile tilapia, Astyanax altiparanae, Prochilodus argenteus. On the other hand, cadmium (Cd), copper (Cu), and lead (Pb) have also adverse effects on endocrine system, reproductive processes, signaling, and even tissue damage. Additionally, Al-related toxicity causes neurotoxicity and contributes to Alzheimer’s disease pathogenesis (18-21). Neurological disorders are very common in elderly population compared to younger individuals, since progression of neurological alterations is enhanced by aging. Generally unhealthy aging is dependent on high concentrations of reactive oxygen species (ROS) that cause oxidative stress that damages macromolecules and leads to cellular senescence and neuron death. On the other hand, exposure to environmental pollutants, heavy metals, toxic compounds, endocrine disruptors can elevate risk of neuroinflammation, accumulation of abnormal proteins, cause of nerve deaths and neurodegenerative diseases by increasing oxidative stress (22-27). Aluminum also causes encephalopathy, anemia, and bone diseases (21).

Heavy metals are generally known as enzyme inhibitors but various heavy metals, including bromine, zinc exist in the polypropylene and are categorized as endocrine disruptors and impairs thyroid hormone metabolism in the organisms (28-40). Additionally, zinc and cadmium impair mineral metabolism and parathyroid hormone function leading to the dysfunction in the endocrine metabolism in the organisms (32,41).

Face masks are made by polymers and comprised phthalates. On the other hand, some of the endocrine disruptor chemicals which are found in the face masks have semi-volatile properties. Phthalates directly enter human lungs due to their semi-volatile

properties and both phthalates and their metabolites have potential risk in human health and environment as reported previously (42, 43). Single-use disposable face masks are containing six different non-phthalate plasticizers beside phthalates according to a recent paper (44). The face masks which are used in the daily life for protecting from coronavirus infection have the property of highly degraded properties that contain synthetic polymers such as polypropylene, polyethylene terephthalate and polystyrene with a multiple amount of organic and inorganic compounds. These compounds and their degradation products also have hazardous effects on living organisms (45, 46). It was investigated that the used face masks may be contaminated with various types of pathogens viruses, bacteria and wearing of face masks could not completely block the transmission of virus droplets. However, the usage of face masks has some protection from the transmission of infection of COVID-19 (47).

In conclusion, surgical and other types of masks are accumulating in the nature worldwide because daily usage of facemasks during COVID-19 pandemic. In the decomposition process of face masks, hazardous chemicals, toxins and heavy metals are released to the environment that is harmful for human and wildlife. Thus, proper ways for the elimination of the face mask should be considered to protect the environment, human and wildlife. During COVID-19 infection, usage of face masks will continue leading to the excessive environmental pollution affecting both human and wildlife until pandemic is over.

CONCLUSION

Environmental pollution is another major problem of the world and currently another pollutant has alerted the world: face masks. We must get learned lessons from COVID-19, we are not the only living thing on earth and we have to protect our environment to avoid next disasters Face masks contain some various kinds of endocrine disrupting chemicals such as non-phthalate plasticizers beside phthalates and millions of face masks are used worldwide.

Thus, disposal of facemasks must be organized and controlled by the governments and there must be rules in their disposal like battery waste management to protect the harmful effects of face masks from the environment.

REFERENCES

1. Pascarella G, Strumia A, Piliego C, Bruno F, Del Buono R, Costa F, Scarlata S, Agrò FE. COVID-19 diagnosis and management: a comprehensive review. J Intern Med 2020;288:192-206.
2. Aydemir D, Ulusu NN. Correspondence: Importance of the validated serum biochemistry and hemogram parameters for rapid diagnosis and to prevent false negative results during COVID-19 pandemic. Biotechnol Appl Biochem 2021;68(2):390-391.
3. Aydemir D, Ulusu NN. Influence of Lifestyle Parameters - Dietary Habit, Chronic Stress and Environmental Factors, Jobs - on the Human Health in Relation to the COVID-19 Pandemic. Disaster Med Public Health Prep 2020;14:e36-e37.
4. Aydemir D, Oztascı B, Barlas N, Ulusu NN. Influence of the butylparaben administration on the liver, kidney and spleen. Turk J Biochem 2020;45:689–694.
5. Aydemir D, Ulusu NN. Is glucose-6-phosphate dehydrogenase enzyme deficiency a factor in Coronavirus-19 (COVID-19) infections and deaths? Pathog Glob Health 2020;114:109-110.
6. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public
7. Pfizer, 2020. https://www.pfizer.com/news/press-release/press-release-detail/pfizer-and-biontech-announce-vaccine-candidate-against
8. Slifka MK, Amanna I. How advances in immunology provide insight into improving vaccine efficacy. Vaccine 2014;32:2948-57.
9. https://theconversation.com/millions-of-face-masks-are-being-thrown-away-during-covid-19-heres-how-to-choose-the-best-one-for-the-planet-147787
10. Correia TG, Narcizo AM, Bianchini A, Moreira RG. Aluminum as an endocrine disruptor in female Nile tilapia (Oreochromis niloticus). Comp Biochem Physiol C Toxicol Pharmacol. 2010;151:461-6.
11. Campanale C, Massarelli C, Savino I, Locaputo V, Uricchio VF. A Detailed Review Study on Potential Effects of Microplastics and Additives of Concern on Human Health. Int J Environ Res Public Health 2020;17:1212.
12. Wardlaw C, Prosser RS, (2020). Investigation of microplastics in freshwater mussels (Lasmigona costata) from the grand river watershed in ontario, Canada. Water Air Soil Pollut 231, 405.

13. Teuten EL, Saquing JM, Knappe DR, Barlaz MA, Jonsson S, Björn A, Rowland SJ, Thompson RC, Galloway TS, Yamashita R, Ochi D, Watanuki Y, Moore C, Viet PH, Tana TS, Prudente M, Boonyatumanond R, Zakaria MP, Akkhavong K, Ogata Y, Hirai H, Iwasa S, Mizukawa K, Hagino Y, Imamura A, Saha M, Takada H. Transport and release of chemicals from plastics to the environment and to wildlife. Philos Trans R Soc Lond B Biol Sci 2009;364:2027-2045.
14. Aydemir D, Karabulut G, Şimşek G, Gok M, Barlas N, Ulusu NN. Impact of the Di(2-Ethylhexyl) Phthalate Administration on Trace Element and Mineral Levels in Relation of Kidney and Liver Damage in Rats. Biol Trace Elem Res 2018;186:474-488.
15. Aydemir D, Öztaşcı B, Barlas N, Ulusu NN. Effects of butylparaben on antioxidant enzyme activities and histopathological changes in rat tissues. Arh Hig Rada Toksikol 2019;70:315-324. doi: 10.2478/aiht-2019-70-3342.
16. Aydemir D, Karabulut G, Gok M, Barlas N, Ulusu NN. Data the DEHP induced changes on the trace element and mineral levels in the brain and testis tissues of rats. Data Brief 2019;26:104526. doi: 10.1016/j.dib.2019.104526.
17. Aydemir D, Oztascı B, Barlas N, Ulusu NN. Influence of the butylparaben administration on the liver, kidney and spleen. Turk J Biochem 2020;45:689–694.
18. Benvenga S, Elia G, Ragusa F, Paparo SR, Sturniolo MM, Ferrari SM, Antonelli A, Fallahi P. Endocrine disruptors and thyroid autoimmunity. Best Pract Res Clin Endocrinol Metab 2020;34:101377.
19. Kida BM, Abdalla RP, Moreira RG. Effects of acidic water, aluminum, and manganese on testicular steroidogenesis in Astyanax altiparanae. Fish Physiol Biochem 2016;42:1347-56.
20. Paschoalini AL, Savassi LA, Arantes FP, Rizzo E, Bazzoli N. Heavy metals accumulation and endocrine disruption in Prochilodus argenteus from a polluted neotropical river. Ecotoxicol Environ Saf 2019;169:539-550.
21. Colomina MT, Peris-Sampedro F. Aluminum and Alzheimer's Disease. Adv Neurobiol 2017;18:183-197.
22. Ulusu NN. Glucose-6-phosphate dehydrogenase deficiency and Alzheimer's disease: Partners in crime? The hypothesis. Med Hypotheses 2015;85:219-23.
23. Ulusu NN, Yilmaz G, Erbayraktar Z, Evlice AT, Aras S, Yener G, Avci A. A Turkish 3-center study evaluation of serum folic acid and vitamin B12 levels in Alzheimer disease. Turk J Med Sci 2015;45:1159-66.
24. Ulusu NN, Yilmaz G, Erbayraktar Z, Evlice A, Metin G, Sevgi A, Avci A, Yener G. A comparative study on thyroid function in Alzheimer's disease: Results from a Turkish multi-centre study. J Neurol Sci Turk 2015;32: 335-47.
25. Evlice A, Ulusu NN. Glucose-6-phosphate dehydrogenase a novel hope on a blood-based diagnosis of Alzheimer's disease. Acta Neurol Belg 2017;117:229-234.
26. Webers A, Heneka MT, Gleeson PA. The role of innate immune responses and neuroinflammation in amyloid accumulation and progression of Alzheimer's disease. Immunol Cell Biol 2020;98:28-41.
27. Erbayraktar Z, Turan Evlice A, Yilmaz G, Yazici C, Yener G, Ulusu NN. Evaluation of Renal Function in Alzheimer's Disease and Geriatric Patients: Results from a Turkish Two-center Study. J Med Biochem 2017;36:54-61.
28. Legler J, Brouwer A. Are brominated flame retardants endocrine disruptors? Environ Int 2003;29:879-85.
29. Tanyel FC, Ulusu NN, Tezcan EF, Büyükpamukçu N. Total calcium content of sacs associated with inguinal hernia, hydrocele or undescended testis reflects differences dictated by programmed cell death. Urol Int 2003;70:211-5.
30. Tanyel FC, Ulusu NN, Tezcan EF, Büyükpamukçu N. Less calcium in cremaster muscles of boys with undescended testis supports a deficiency in sympathetic innervation. Urol Int 2002;69:111-5.
31. Tandogan B, Ulusu NN. Inhibition of purified bovine liver glutathione reductase with some metal ions. J Enzyme Inhib Med Chem 2010;25:68-73.
32. Tandogan B, Ulusu NN. Effects of cadmium and zinc ions on purified lamb kidney cortex glucose-6-phosphate dehydrogenase activity. J Enzyme Inhib Med Chem 2006;21:225-30.
33. Aydemir D, Simsek G, Ulusu NN. Dataset of the analyzing trace elements and minerals via ICP-MS: Method validation for the mammalian tissue

and serum samples. Data Brief 2020;29:105218. doi: 10.1016/j.dib.2020.105218.
34. Aydemir D, Salman N, Karimzadehkhouei M, Alaca BE, Turan B, Ulusu NN. Evaluation of the Effects of Aging on the Aorta Stiffness in Relation with Mineral and Trace Element Levels: an Optimized Method via Custom-Built Stretcher Device. Biol Trace Elem Res 2021;199(7):2644-2652.
35. Turan B, Acan NL, Ulusu NN, Tezcan EF. A comparative study on effect of dietary selenium and vitamin E on some antioxidant enzyme activities of liver and brain tissues. Biol Trace Elem Res 2001;81:141-52.
36. Ulusu N, Acan N, Turan B, Tezcan E. Inhibition of glutathione reductase by cadmium ion in some rabbit tissues and the protective role of dietary selenium. Biol Trace Elem Res 2003;91:151-6.
37. Tandoğan B, Ulusu NN. The inhibition kinetics of yeast glutathione reductase by some metal ions. J Enzyme Inhib Med Chem 2007;22:489-95.
38. Ulusu NN, Turan B. Beneficial effects of selenium on some enzymes of diabetic rat heart. Biol Trace Elem Res 2005;103:207-16.
39. Ulusu NN. Curious Cases of the Enzymes. J Med Biochem 2015;34:271-281.
40. Ulusu NN. Evolution of Enzyme Kinetic Mechanisms. J Mol Evol 2015;80:251-7.
41. Suzuki T, Kajita Y, Katsumata S, Matsuzaki H, Suzuki K. Zinc Deficiency Increases Serum Concentrations of Parathyroid Hormone through a Decrease in Serum Calcium and Induces Bone Fragility in Rats. J Nutr Sci Vitaminol (Tokyo) 2015;61:382-90. doi: 10.3177/jnsv.61.382.
42. Min K, Weng X, Long P, Ma M, Chen B, Yao S. Rapid in-situ analysis of phthalates in face masks by desorption corona beam ionization tandem mass spectrometry. Talanta. 2021;231:122359.
43. Xie H, Han W, Xie Q, Xu T, Zhu M, Chen J. Face mask-A potential source of phthalate exposure for human. J Hazard Mater. 2022;422:126848.
44. Vimalkumar K, Zhu H, Kannan K. Widespread occurrence of phthalate and non-phthalate plasticizers in single-use facemasks collected in the United States. Environ Int. 2022;158:106967.
45. Sendra M, Pereiro P, Yeste MP, Novoa B, Figueras A. Surgical face masks as a source of emergent pollutants in aquatic systems: Analysis of their degradation product effects in Danio rerio through RNA-Seq. J Hazard Mater. 2022;428:128186.
46. Vimalkumar K, Zhu H, Kannan K. Widespread occurrence of phthalate and non-phthalate plasticizers in single-use facemasks collected in the United States. Environ Int. 2022;158:106967.
47. Ueki H, Furusawa Y, Iwatsuki-Horimoto K, Imai M, Kabata H, Nishimura H, Kawaoka Y. Effectiveness of Face Masks in Preventing Airborne Transmission of SARS-CoV-2. mSphere. 2020;5(5):e00637-20.