



SARS-CoV-2 and Environment: Transmission and Green Combat

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Abstract

Severe acute respiratory syndrome corona virus 2 (SARS-CoV-2), a new zoonotic agent that emerged in December 2019, causes corona virus disease 2019 (COVID-19). The external environment, the internal environment of buildings and human behavior are among the main factors involved in the transmission of SARS-CoV-2. While the viral spread and transmission is significantly affected by the environment, certain green plants could provide stress alleviation from both physical and mental viewpoints. Some such green plants and development of green zones are suggested both at home and workplace, so that the planet too benefits from such greening initiatives.

Keywords: SARS-CoV-2, Covid 19, green spaces, mental health, green combat

Introduction

More than 60 per cent transmissible diseases found in humans and about 75 per cent rising communicable diseases are due to animals transferring pathogens to humans and are hence zoonotic in origin (UNEP 2020). The major reason behind this phenomenon is human interference and mindless destruction of natural ecosystems. Biodiversity loss results in survival of certain species which act as hosts for pathogen transfer to humans.

Novel coronavirus 2019 (2019-nCoV), also known as SARS-CoV-2, leads high morbidity and mortality in global epidemics (Gulzar, & Husssain,2020). Pro-environment planning, execution and life-styles can significantly control the spread of diseases like Covid 19. Dobson *et al.* (2020) highlighted that the risk and dangers of future pandemics may be largely controlled by Government measures and initiatives in curbing deforestation, wildlife trade, indiscriminate habitat fragmentation and unplanned urbanization.

Transmission of Virus

The external environment, the internal environment of buildings and human behavior are among the main factors involved in the transmission of SARS-CoV-2 (Lai *et al.* 2020). In SARS-CoV-2 infection, human-to-human transmission occurs mainly within family members, friends and relatives who intimately contacted the infected patients or incubation carriers (Ansar, 2020). The coronavirus belongs to a big family of viruses which cause various diseases, ranging from mild diseases such as common cold to severe ones like Middle East Respiratory Syndrome (MERS) and Severe acute respiratory syndrome (SARS)(Rahayu *et al.*2021).

Transmission is effected by exposure to respiratory fluids carrying the infectious virus—

Exposure could occur in three principal ways: (WHO, 2020)

- (1) Inhaling very fine respiratory droplets and aerosol particles,
- (2) Deposition of respiratory droplets and particles on exposed body parts like mucous membranes in the mouth, nose, or eye by direct splashes and sprays, and
- (3) Touching mucous membranes with hands that have been soiled either directly by virus-containing respiratory fluids or indirectly by touching surfaces infected with virus.

There are principally dual modes of transmission –droplet and airborne (Sungnak *et al.* 2020)

Droplet transmission

Where droplets (>5 µm diameter, traveling <1 m) containing viable viruses make contact with exposed body parts like nose, mouth, eyes, or upper respiratory tract; and

Airborne transmission

Where droplet nuclei (<5 µm diameter, which can travel >1 m) are inhaled by susceptible individuals

The risk of SARS-CoV-2 infection varies according to the amount of virus to which a person is exposed. The larger and heavier respiratory virus containing droplets fall to the ground or other exposed surfaces under gravitational impact while the finer droplets and aerosol particles remain suspended in the air (Morawska and Cao, 2020). Progressive loss of viral viability and infectiousness over time influenced are profoundly affected by environmental factors such as temperature, humidity, and ultraviolet radiation or sunlight.

Studies so far indicate that the risk of viral infection increases with factors like -

Enclosed spaces with poor ventilation or air handling within which the concentration of exhaled respiratory fluids, especially very fine droplets and aerosol particles, can considerably build-up.

Increased exhalation of respiratory fluids if the infectious or infected person is involved in physical exertion or exercise and is raising his voice in talking loudly, shouting, singing etc.

Prolonged exposure to the above mentioned conditions for typically more than 15 minutes.

Environmental Factors viz. Temperature Sunlight Humidity

SARS-CoV-2 is susceptible to heat treatment. Virus survival decreases with increase in temperature. Maintaining temperatures above 60 °C for more than 60 minutes usually inactivates most viruses.

In addition, sunlight can rapidly inactivate SARS-CoV-2. Sunlight may inactivate the virus rapidly on surfaces, suggesting that persistence and subsequent exposure risk may vary significantly between indoor and outdoor environments (Ratnesar *et al.* 2020).

Hot and humid climates are detrimental to the spread of the virus. Environmental factors and proper human behaviour are strong determinants. Characteristics of environmental air quality and surfaces contaminated by the virus are important factors that determine the infectivity retention. Environmental factors in buildings - including temperature, humidity, stability on fomites, ventilation and filtering systems in public places like healthcare settings, restaurants, hotels, recreation facilities or residential houses with large number of residents strongly affect viral retention.

Retention Elsewhere

Indoor Air Quality would include sufficient and effective ventilation, particle filtration, air sterilization as infection control measures inside buildings, number of individuals present in a particular space/area,

wearing masks (to control emitted aerosols), disinfection of fomites, healthy hand hygiene i.e. regular sanitization, uncrowded spacing i.e. physical distancing etc.

Surfaces or Fomites: objects or materials which are likely to carry infection, such as clothes, utensils, and furniture. Virus may be retained on plastic, stainless steel and glass surfaces for 2-4 days at room temperature. The virus can undergo Protein destabilization in the presence of copper ions. Copper ions have a direct effect on virus inactivation by causing aggregation of virus particles. This might explain the short survival of and SARSCoV-2 on copper surfaces compared with other metal surfaces (Smither *et al.* 2020; Chin *et al.* 2020)

The virus Survived on the inner and outer layers of surgical facemasks for 4 and 7 days respectively, and the virus could be recovered from a surgical mask after 7 days (22 °C, 65% RH).

SARS-CoV-2 survived for one day on cardboard, wood, and cloth while on banknote paper it could survive two days. The survival of the virus on paper and tissue paper was only for 30 minutes with complete perish after three hours (Smither *et al.* 2020; Chin *et al.* 2020).

The Three Cs

In Japan, epidemiological links to confirmed COVID-19 cases showed that clusters of cases occurred in fitness gyms, a restaurant boat on a river, and live music in February 2020 (MHLW, 2020a). Based on these findings, the expert panel for COVID-19 focused on the '3 Cs,' namely Closed spaces with poor ventilation, Crowded spaces with many people, Close contact (MHLW, 2020b).

Green Combat during and Post Covid

Green spaces serve as carbon sinks and help mitigate the adverse of climate change through carbon sequestration. Contact with nature can have restorative benefits by alleviating high stress levels, and promoting mental relaxation. Thus green zones play dual but interconnected roles of abatement of global climate change as well as individual physical and mental wellness (Sen, 2021).

Biswas and Sen, (2020) observed that 45per cent of their respondents in a survey reported a definite sense of gloom and restlessness during the Covid-19 'lockdown' while another 24 per cent complained of anxiety in moderation. That survey highlighted a significant majority feeling a sense of quiet and peace in green zones while 61per cent reported that they spent more than their usual time in green spaces during 'lockdown' which was therapeutic. The survey revealed that 42 per cent respondents spent more than an hour each day with flora and fauna.

Dwellers with access to green spaces enjoy (55%) and encourage gardening (72%), a healthy outdoor physical activity (WHO recommended). Houseplants brought emotional benefits to 74% of participants during COVID-19 lockdown. More than 55% of respondents said they wished for more plants in their homes at that difficult time. Participants who had no indoor plants and little natural light at home experienced negative emotions (like anxiety, fear, and stress) more frequently than those with houseplants. Nearly 63% said they wanted to devote more time to spend with plants even after resuming normal life and routine, as per the survey of Biswas and Sen (2020).

Another survey carried in March 2022 (Ray et al. 2022) revealed that green zones facilitated better teaching-learning as it improved both the physical and mental health of both the teacher and the pupil. The study also revealed that gardening became the hobby most respondents opted for due to its health benefits and stress abatement capacity.

Areca palm (*Dyopsis lutescens*), Spider plant (*Chlorophytum comosum*), Snake plant (*Dracaena trifasciata*), Money plant (*Epipremnum aureum*), Weeping Fig (*Ficus benjamina*) are apt for air-purification purpose. Besides, the spider plant, snake plant and money plant are also good indoor-plants with almost little or no maintenance. *Aloe vera* is also a popular choice being a good air-purifier.

As per reports of a study in 2020 on *Ocimum basilicum*, the odour of mint could lower frustration and promote awareness (Ayoub et al. 2020). A study on *Jasminum* revealed that its odour produced the same effect as Valium, a nerve soother (Sergeeva et al. 2010). Inhaling the fragrance of lavender for even 10 minutes lowered feelings of depression and had significant impact on the human nervous system (Matsumoto et al. 2013).

Such plants may thus be procured, cultivated and maintained both at home (indoors) and workplaces (outdoors) in various set ups like academic institutions, offices, hospitals etc.

The pandemic has ushered a radical shift in human behavior and lifestyle management. Significant ecological functions are provided by the green zones and spaces which not only need preservation and conservation but also new impetus (Sen, 2020a, b). This realization is in sync with SDG 11 'Make cities and human settlements inclusive, safe, resilient and sustainable', to strengthen resilience and the capacity to adapt to climate-related hazards and impact on natural resources (UN). Planning with the environment in view and seeking nature-based sustainable solutions could contribute significantly to human health care and restrict the occurrence of further pandemics and their subsequent devastation (Sen, 2022).

Conclusion

The pandemic has taught man to rebuild and reconstruct more sustainably i.e. seek nature-based solutions. The future must ensure a complete shift to a green, no-carbon economy based on renewable energy, eco-friendly technology, sustainable resource management and livelihoods. Solutions to worldwide problems must be equitably shared by the global community. The Universal Declaration on Human Rights, the declaration on the Right to Development, the Rio Declaration and such others must provide the legal framework based on which governments, civil society, private sector and all individuals will strive for universal human rights including the right to a clean, green and sustainable environment.

References

- Ansar, W. (2020). Periscopic View on COVID 19 Infection: A Review. *International Journal of Advancement in Life Sciences Research*, 3(3), 1-15. <https://doi.org/https://doi.org/10.31632/ijalsr.20.v03i03.001>
- Ayoub, N. N., Balgoon, M. J., Ali, S., Alnoury, I. S., ALmohaimeed, H. M., & AbdElfattah, A. A. (2020). *Ocimum basilicum* (basil) modulates apoptosis and neurogenesis in olfactory pulp of mice exposed to chronic unpredictable mild stress. *Frontiers in psychiatry*, 914. <https://doi.org/10.3389/fpsy.2020.569711>
- Biswas, R. and Sen, S. (2020). Urban Eco-Psychological Attitude during COVID 19 'Lockdown': A Survey, *International Journal of Creative Research Thoughts* 8(7): 3017-3037
- Chin AWH, Chu JTS, Perera MRA, Hui KPY, Yen HL, Chan MCW, Peiris M, Poon LLM. (2020) Stability of SARS-CoV-2 in different environmental conditions. *Lancet Microbe*. [https://doi.org/10.1016/S2666-5247\(20\)30003-3](https://doi.org/10.1016/S2666-5247(20)30003-3)
- Dobson, A. P., Pimm, S. L., Hannah, L., Kaufman, L., Ahumada, J. A., Ando, A. W., ... & Vale, M. M. (2020). Ecology and economics for pandemic prevention. *Science*, 369(6502), 379-381. <https://doi.org/10.1126/science.abc3189>
- Gulzar, S., & Hussain, S. (2020). Bioinformatics Study on Structural Protein of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-COV-2) For Better Understanding the Vaccine Development. *International Journal of Advancement in Life Sciences Research*, 3(4), 17-25. <https://doi.org/https://doi.org/10.31632/ijalsr.20.v03i04.003>
- Lai CC, Shih TP, Ko WC, Tang HJ, Hsueh PR. (2020). Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease-2019 (COVID-19): the epidemic and the challenges. *Int J Antimicrob Agents*. 2020;55:105924. <https://doi.org/10.1016/j.ijantimicag>
- Matsumoto, T., Asakura, H. & Hayashi, T. (2013) Does lavender aromatherapy alleviate premenstrual emotional symptoms?: a randomized crossover trial. *BioPsychoSocial Med* 7, 12. <https://doi.org/10.1186/1751-0759-7-12>

- MHLW (2020a). Measures to prevent the large-scale spread of COVID-19 in workplaces (March 31, 2020). No. 0331-2. Tokyo: Ministry of Health, Labour and Welfare; 2020. Available at: <https://www.mhlw.go.jp/content/11303000/000617466.pdf>. Assessed 31 Aug 2020. (In Japanese).
- MHLW (2020b). Methods of ventilation for improving "closed spaces with poor ventilation" (April 3, 2020). Tokyo: Ministry of Health, Labour and Welfare; 2020. Available at: <https://www.mhlw.go.jp/content/10900000/000618969.pdf>. Assessed 31 Aug 2020. (In Japanese)
- Morawska L, Cao J. (2020). Airborne transmission of SARS-CoV-2: the world should face the reality. *Environ Int.* 139:105730. <https://doi.org/10.1016/j.envint.2020.105730>
- Rahayu, S., Pertiwi, W. E., Meidina, L., & Poddar, S. (2021). The Roles of Knowledge and Perceptions in Covid-19 Transmission Prevention Behavior. *Malaysian Journal of Medicine & Health Sciences*, 17, 62-66.
- Ratnesar-Shumate S, Williams G, Green B, Krause M, Holland B, Wood S, Bohannon J, Boydston J, Freeburger D, Hooper I, Beck K, Yeager J, Altamura LA, Biryukov J, Yoltz J, Schuit M, Wahl V, Hevey M, Dabisch P. (2020). Simulated sunlight rapidly inactivates SARS-CoV-2 on surfaces. *J Infect Dis.* 222:214–22. <https://doi.org/10.1093/infdis/jiaa274>.
- Ray, R., Rudra, P., Bhattacharjee, AK, Chaudhuri, S., Mukherjee, N. and Sen, S. (2022) Teaching-Learning During The Pandemic And After: A Multi-Disciplinary Approach (In Press)
- Sen, S. (2020a). The City Greens: Ushering Sustainable Urbanization, *International Journal of Creative Research Thoughts*, 8(4):2689-2696
- Sen, S. (2020b). 'Green'-ing Kolkata: Creating A Sustainable City – An Overview, *International Journal of Research and Analytical Reviews*, 7(2): 743-752.
- Sen, S. (2021). Covid 19 and Forests : The Green Combat, *Harvest* 6(2):17-22
- Sen, S. (2022). Towards Sustainable Urbanization: Greening An Indian Metropolis *Indian Forester* (In Press)
- Sergeeva, O. A., O. Kletke, A. Kragler, A. Poppek, W. Fleischer, S. R. Schubring, B. Goerg, H. L. Haas, X.-R. Zhu, H. Luebbert, G. Gisselmann, H. Hatt. (2010). Fragrant dioxane derivatives identify 1 subunit-containing GABAA receptors. *Journal of Biological Chemistry*, <https://doi.org/10.1074/jbc.M110.103309>.
- Smither SJ, Eastaugh LS, Findlay JS, Lever MS. (2020) Experimental aerosol survival of SARS-CoV-2 in artificial saliva and tissue culture media at medium and high humidity. *Emerg Microbes Infect.* 9:1415–7. <https://doi.org/10.1080/22221751.2020.1777906>.
- Sungnak W, Huang N, Bécavin C, Berg M, Queen R, Litvinukova M, Talavera- López C, Maatz H, Reichart D, Sampaziotis F, Worlock KB, Yoshida M, Barnes JL. (2020) SARS-CoV-2 entry factors are highly expressed in nasal epithelial cells together with innate immune genes. *Nat Med.* 26:681–7. <https://doi.org/10.1038/s41591-020-0868-6>.
- UNEP (2020). Emerging zoonotic diseases and links to ecosystem health – UNEP Frontiers 2016 chapter. Retrieved from <https://www.unep.org/resources/emerging-zoonotic-diseases-and-links-ecosystem-health-unep-frontiers-2016-chapter>
- WHO. (2020) Transmission of SARS-CoV-2: implications for infection prevention precautions. Scientific brief on 9 July 2020. Geneva: World Health Organization