The Contradiction of Social Distancing

IN THE FIGHT AGAINST COVID-19

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CONSEQUENCES TO MICROBIAL DIVERSITY

With the declaration of the coronavirus COVID-19 pandemic in 2020, Australians implemented major restrictions to reduce the respiratory droplet and aerosol contact[1] transmission of the novel severe-acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The pandemic prompted public health messaging advising Australians to minimise physical contact, maintain 1.5 metres distance from others, wear a face mask[2] and wash and sanitise hands regularly,[3] particularly after contact with others.

As a predominantly respiratory infection, COVID-19 binds with alveolar and small intestinal epithelial angiotensin-converting enzyme 2 (ACE2) receptors, drawing attention to the gut and respiratory microbiome.[4]

The microbiota

The human microbiome is influenced by our hygiene practices, vaccination protocols, antibiotic use, and how we are born.[1] An infant's microbiome is enriched through the contact they have with objects explored with their hands and tongue, allowing them to ingest a diverse range of microorganisms. Modern-day behaviours contribute to changes in our ancestral microbial heritage. Recent increases in the use of antibacterial products and hand washing can interfere with the natural microbial inoculation in children.[5]

The microbiota is responsible for immune system development[4] and regulation of T-regulatory, T helper 1, and T helper 17 cells impacting inflammation and immune responses.[6] Increased COVID-19 severity has been demonstrated in the elderly, obese, and those with chronic conditions, with the microbiota playing a role in the development of chronic, non-communicable diseases.[4]

The skin microbiota

Beneficial skin and gastrointestinal bacteria are susceptible to destruction from hand sanitisers and alcohol, leading to dysbiosis-producing gastrointestinal symptoms, inflammatory bowel diseases, obesity, and chronic heart disease,[7] ironically increasing the risk and severity of COVID-19.

> **Exposure to the antibacterial triclosan may lead to lifelong metabolic changes, including childhood obesity,[8] and a reduction in microbial diversity in breastfed infants.[9]**

The lung microbiome

The lung microbiome is a dynamic environment with the continuous bidirectional movement of air and mucus into the alveoli, with dysbiosis connected to lung pathologies.[1] Exposure to unhygienic environments and air microbes support stronger respiratory immune response development and may be associated with the variation of COVID-19 death rates in different countries.[1]

> **Dysbiosis leads to a reduction in the protective symbiotic bacteria involved in the prevention of immune and autoimmune disease,[5] and can lead to hyperinflammation and contribute to the cytokine storm associated with COVID-19.[10]**

The gastrointestinal microbiome

COVID-19 infection induces gut dysbiosis through the reduction in short-chain fatty acid production, with beneficial bacteria inversely associated with viral load, COVID-19 severity, inflammation, and upregulation of ACE2 receptors in the gut,[11] lungs, and oesophagus.[4]

Microbial samples from the gut of COVID-19 patients demonstrate reduced bacterial diversity, with increases in opportunistic pathogens associated with the severity of COVID-19 and inversely related to the number of beneficial bacteria present.[1] COVID-19 is associated with increases in interleukin-6 and interleukin-10, relative to disease severity,[2] prompting the recommendation for prophylactic inflammation and immune modulation to reduce and prevent COVID-19 disease.[12]

Future generations born during the pandemic may have altered microbiomes. A higher caesarean delivery rate during COVID-19 has been found in both infected and uninfected women[11,13] which is proven to impact the newborn microbiota.[14]

Social connection and the microbiota

Social connection allows humans to share microorganisms and maintain commensal bacteria,[14] supporting health and the immune response. While social distancing may limit the spread of COVID-19, it also reduces intestinal and oropharyngeal microbial diversity, impacting pulmonary viral infection progression and negatively impacting the prognosis for COVID-19 patients.[5]

The physiological impact of lockdowns

Low vitamin D levels contribute to the body's decreased antiviral response in the pulmonary and gastrointestinal epithelial cells, connecting a reduction in vitamin D levels due to reduced skin exposure to sunlight during lockdowns with increased COVID-19 severity.[15]

Alterations in sleep patterns and circadian rhythm can be the product of dysbiosis reducing serotonin and melatonin production,[15] increasing the risk of diabetes, cardiovascular disease, cancer, and metabolic syndrome and, in-turn, increasing the risk of severe COVID-19.[16]

Stress adversely impacts microbial diversity by increasing proinflammatory cytokine secretion, impairing tight-gap junctions, and increasing gut permeability, and dysbiosis thereby increasing the susceptibility for COVID-19 infection.[15]

WHERE TO FROM HERE?

It is important to establish and maintain microbial diversity in the face of lockdowns, social distancing, and new hygiene challenges.

We can do this through the use of probiotics[4] and the promotion of a diet rich in diverse prebiotic and probiotic foods to support epithelial cell health.[8]

Dietary soluble and insoluble fibre support the microbial production of short-chain fatty acids for optimal enterocyte and respiratory tract health, a healthy diverse microbiota[4] and a reduction in inflammation.[12]

The consumption of essential fatty acids, zinc, diverse and colourful fruits and vegetables also support the immune response, and the natural antioxidant and anti-inflammatory functions of the body. Vitamin D supplementation may benefit those with reduced synthesis and exposure to the sun,[15] while vitamin A supplementation may support the intestinal barrier function and immune responses.[6]

References

1. Khatiwada S, Subedi A. (2020). Lung microbiome and coronavirus disease 2019 (COVID-19): Possible link and implications. Hum Microbiome J 2020;100073. https://doi.org/10.1016/j.humic.2020.100073
2. Villapol S. Gastrointestinal symptoms associated with COVID-19: impact on the gut microbiome. Translational Research 2020;226:57-69. https://doi.org/10.1016/j.trsl.2020.08.004
3. Expósito Ò, Guirado A, Robustillo D, Vallecillo R, Gallego A, Mas M, Riera P, Luna D, Laplana S, Ruiz T, Ruiz S. Addressing sensitive skin and the microbiome. Personal Care 2021:1-2
4. Janda L, Mihalčin M, Šťastná M. Is a healthy microbiome responsible for lower mortality in COVID-19? Biologia 2021;76(2):819-829. https://doi.org/10.2478/s11756-020-00614-8
5. Domingues CPF, Rebelo JS, Dionisio F, et al. The social distancing imposed to contain COVID-19 can affect our microbiome: a double-edged sword in human health. MSphere 2020;5(5). https://doi.org/10.1128/msphere.00716-20
6. He LH, Ren LF, Li JF, et al. Intestinal flora as a potential strategy to fight SARS-CoV-2 infection. Frontiers in Microbiology 2020 (June). https://doi.org/10.3389/fmicb.2020.01388
7. Chandanapalli Sai Himabindu CSH, Bitra Tanish BT, Damodara Padma Priya, DP, et al. Hand sanitizers: is over usage harmful? World J Curr Med Pharmaceut Res 2020:296-300. https://doi.org/10.37022/wjcmpr.v1.157
8. Ejtahed HS, Hasani-Ranjbar S, Siadat SD, Larijani B. The most important challenges ahead of microbiome pattern in the post era of the COVID-19 pandemic. J Diabetes Metab Dis 2020;19(2):2031-2033. https://doi.org/10.1007/s40200-020-00579-0
9. Sanidad KZ, Xiao H, Zhang G. Triclosan, a common antimicrobial ingredient, on gut microbiota and gut health. Gut Microbes 2019;10(3):434-437. https://doi.org/10.1080/19490976.2018.1546521
10. Yu L. Restoring good health in elderly with diverse gut microbiome and food intake restriction to combat COVID-19. Indian J Microbiol 2021,61(1):104-107. https://doi.org/10.1007/s12088-020-00913-3
11. Littlejohn P, Finlay B.B. When a pandemic and an epidemic collide: COVID-19, gut microbiota, and the double burden of malnutrition. BMC Medicine, 2021;19(1):1-8. https://doi.org/10.1186/s12916-021-01910-z
12. Walton GE, Gibson GR, Hunter KA. Mechanisms linking the human gut microbiome to prophylactic and treatment strategies for COVID-19. BJN 2020. https://doi.org/10.1017/S0007114520003980
13. Zhang L. The associated factors of cesarean section during COVID-19 pandemic: a cross-sectional study in nine cities of China. Environmental Health Prevent Med 2020;25. https://doi.org/10.1186/s12199-020-00899-w
14. Dowd JB, Renson,A. "Under the skin" and into the gut: social epidemiology of the microbiome. Curr Epidemiol Rep 2018;5(4):432-441. https://doi.org/10.1007/s40471-018-0167-7
15. Anderson G, Reiter RJ. COVID-19 pathophysiology: interactions of gut microbiome, melatonin, vitamin D, stress, kynurenine and the alpha 7 nicotinic receptor: Treatment implications. Melatonin Res 2020;3(3):322-345. https://doi.org/10.32794/mr11250066
16. Burchill E, Lymberopoulos E, Menozzi E, Budhdeo S. (2021). The unique impact of COVID-19 on human gut microbiome research. Front Med 2021;3:1-8. https://doi.org/10.3389/fmed.2021.652464