



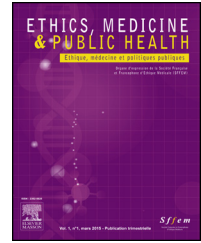
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## ORIGINAL ARTICLE

# Debate on mandatory COVID-19 vaccination

F.K. Cheng

*Hong Kong, Hong Kong*

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## KEYWORDS

Collectivism;  
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## Summary

**Background.** – Since January 2020, worldwide public health has been threatened by COVID-19, for which vaccines have been adopted from December 2020.

**Discussion.** – Although vaccines demonstrate effectiveness against this disease, vaccine hesitancy reveals concerns towards short-term and long-term side effects or adverse reactions such as post-inoculation death. Mandatory vaccination is used to provide herd immunity, but is refutable due to infringement of human rights and autonomy. Furthermore, the evidence testifies that vaccination cannot guarantee prevention of infection or re-infection, resulting in public resentment against this coercive measure, whilst post-inoculation anxiety continues.

**Perspective.** – This discussion suggests a holistic approach, involving the collective efforts of governments, medical experts and individuals, through basic preventive measures and alternative therapy to live with COVID-19 in a healthy and resourceful manner.

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## An abrupt pandemic

Cases of an unknown pneumonia in Wuhan were reported on December 31, 2019, following which a novel coronavirus was identified on January 7, 2020. This new virus was officially named COVID-19 (representing corona-virus-disease-2019) on February 11, 2020, by the World Health Organisation [1]. It was determined to be a public health emergency on January 30, and then a pandemic on March

11. The first imported case of this person-to-person infectious disease, even feasibly by asymptomatic carriers, was confirmed in Thailand by a Wuhan traveller on January 13, after which it spread abroad to Japan, Korea, Nepal, Malaysia, Hong Kong, the Philippines, India, Cambodia, Sri Lanka, the United Arab Emirates, the USA, France, Germany, the UK, Sweden, Spain and Russia inside of January [2], showing its high transmissibility. Although COVID-19 causes most infected patients to experience mild or moderate respiratory illness, such as cough, fever, headache and sore throat, a growing number of life-threatening cases occupies intensive care units, which imposes unanticipated

*E-mail address:* [oasischeng@yahoo.com](mailto:oasischeng@yahoo.com)

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burdens on medical resources and public health systems. Such severity pressures related authorities (including governments, health institutions, research centres, medicine companies) to urgently acquire effective solutions, among which vaccines have rapidly been developed since early 2020 and the one offered by Pfizer (an American multinational *biopharmaceutical* corporation) with BioNTech (a German biotech firm) was first approved for emergency use authorisation on December 2 [3], and its Biologics License Application (BLA) for COMIRNATY® was approved by the US Food and Drug Administration on August 23, 2021, for individuals 16 years old or above [4].

The main function of the COVID-19 vaccine serves to develop antibodies and an immune response in order to lessen infection and transmission of this virus. Scholars conceive that once a minimum of 60% [5] of the population achieved immunity, either by vaccination or having been infected, we will reach herd immunity for protecting individuals and other people around them, hopefully ending the pandemic. However, the vaccination coverage required is increasing because of mutations [6]. Also, the available vaccines can reduce severe symptoms, which will minimise complications, morbidity and mortality, and alleviate the tremendous needs of intensive care units to safeguard the healthcare system. Thus, getting vaccinated has become a public health priority; whereas prevalent vaccine hesitancy [7,8] on the one hand causes psychological indecision, under-vaccination and uptake delay, while on the other hand causing herd immunity to be a more remote hope. Mandatory vaccination is continually discussed to mitigate hesitation or refusal, yet this practice is controversial.

## Arguments regarding compulsory and voluntary jabs

Advocates consider herd immunity to be a common good and an altruistic procedure [9], which justifies the exercise of mandatory injections. It is not only a public health concern, but also a social issue associated with the economic and societal burdens, socioeconomic disparities and health inequalities [10] induced by this pandemic [11]. According to the fundamental principles of medical ethics, which include autonomy, non-maleficence (not harming the well-being of the patient), beneficence (promoting the well-being of the patient) and justice [12], pressure on healthcare frontline workers is particularly harsh since they, as role models [13], have an obligation to protect vulnerable patients [14]. Nevertheless, dissenters blame mandatory vaccination as a coercive means used to deprive individuals of freedom. In a nutshell, compulsory vaccination raises the debate between collectivism and individualism, whereas the former inclines towards social benefits and a strong sense of community while the latter focuses more upon self-concerns and autonomy.

Savulescu [15] suggests four conditions for mandatory vaccination: first, the disease is a stern threat to public health; second, the vaccines are safe and effective; third, mandatory vaccination proves a convincing cost-benefit profile compared with other alternatives; and lastly, the level of coercion is proportionate. Similarly, experts [16] propose

seven principles to make rational and transparent decisions, including three basic medical ethics (justice, autonomy and harm avoidance), public trust, solidarity and reciprocity, population health maximisation, and protection of the vulnerable. These discourses, from both practical and ethical perspectives, are used to evaluate the use of coercive jabs to combat COVID-19, which has caused more than 4.3 million deaths worldwide, among 210 million confirmed cases in the first 20 months [17], and remains ongoing.

Justice is manifested through fairly sharing the benefits, risks and costs, resulting in a defence of mandatory vaccination as part of the civic responsibility in this pandemic. Mill's harm principle [18] allows authorities to meddle with freedom and autonomy to prevent harm to others. "No jab, no pay" and "no jab, no play" tactics seem reasonable although they affect everyone from adults to children in workplace and school. Notwithstanding, opponents argue that these exercises incur financial sanctions and social exclusion, restricting individual interests and violating human rights. They persist that the principles of justice also support individuals in refusing vaccination [19].

Religious exemption [20,21] is allowed when adherents show reluctance in that vaccination deviates from their belief tenets, despite the simultaneous existence of opposite and permissive views among Hindu, Protestant, Buddhist, Muslim and Jewish communities [22]. Doubts have been raised as to whether freedom of religion is acceptable [23], and whether the issue of body integrity should be ratified to protect individual rights to decide what is done to one's own body [24]. In this sense, compulsory injection is then unfair to others who are not granted this exemption.

On the other hand, if compulsory inoculation is seen as *necessary* and *sufficient*, the decision is a more practical one: whether a shot is the single most effective vehicle, and whether it is a stand-alone method.

## Is vaccination the only intervention?

Clinical data testify to the effectiveness, efficacy and safety of available COVID-19 vaccines [25–27], although short-term side effects or adverse reactions have presented themselves; for instance, fever, fatigue, pain and tenderness [28], and even worse, post-inoculation death [29]. Based on the prediction that the benefits of vaccination are greater than the risks such as COVID-related death [30], even for cancer patients [31], medical experts recommend vaccination to attain herd immunity. However, vaccine-hesitant people worry about possible future and long-term effects induced by the fast development of these vaccines [32], especially for new vaccine technology such as mRNA and viral vector [33], when developing a vaccine takes 15 years on average [34]. Such post-injection anxiety [35] has not yet received an appropriate response. Additionally, these vaccines had only obtained emergency use authorisation without full approval [36] prior to August 2021 for COMIRNATY®, for which they bypassed the animal studies used to understand the action mechanism and the ability of the virus to resist the vaccine [37,38]. They directly used controlled human infection with limited geographical and ethnical disparities, which affects the safety, tolerability and efficacy of the vaccine. The race for emergency use and mass production may impact long-term

vaccine safety and infection decline. Therefore, vaccine antagonists perceive that vaccination is not necessarily the sole intervention for fighting this disease. They promote basic methods, involving public mask usage, which effectively curbs the spread of coronavirus when properly worn [39,40]; personal hygiene behaviour [41,42] such as frequent hand-washing and alcohol-based hand sanitizers; physical distancing [43,44] (maintaining a distance of 1–2 meters from each other and avoiding crowded places); and social distancing [45,46] (limiting gatherings). These instruments were evidently capable before vaccine use and the vaccine is not the only way to cope with COVID-19 for protecting oneself and others around us.

### Is mere vaccination sufficient?

The evidence has forced medical personnel to acknowledge that reinfection occurs among vaccinated people or patients who have recovered from COVID-19 [47,48] due to the decreasing durability of antibodies [49,50] and to incessant variants [51]. Specialists suggest a booster dose [52], especially for vulnerable groups [53,54]. The facts imply that achieving herd immunity to fully prevent contagion is unrealistic [55] to protect against infection and reinfection. This undesirable outcome reflects that vaccination, as a stand-alone method, is not strong enough to prevent outbreaks. Thereupon, even fully vaccinated people need to continuously undertake basic protective measures [56], including masking [57,58], personal hygiene [59], physical distancing [60] and social distancing [61]. Regarding healthcare workers, there is no substantial evidence to show higher risks of infection if they are provided with sufficient and proper personal protective equipment, enough rest, and adequate hospital ventilation [62].

### Coercion or voluntary shot?

Without fulfilling these factors (*necessary* and *sufficient*), mandatory vaccination is a gravely refutable proposition. Coercion is a top-down approach, encompassing threats, resulting in weakening trust in government and in the integrity of the medical system. A coercive measure which infringes on personal freedoms in order to protect public health may be imposed only if it can meet three conditions [63], particularly since a vaccine is an invasive precaution: first, it must be the most effective, sole and incontestable method; second, it must be necessary; and third, it should be proportionate. The above elaboration indicates that the available vaccines are unlikely to satisfy these requirements. Moreover, the World Health Organisation [64] emphasises that mandatory vaccination is not unconditionally compulsory; rather, criminal sanctions should not be used to penalise non-compliance and shots should not be a condition of international travel by national authorities and transportation operators. A vaccine passport is a certificate, which enables vaccinated people to travel restriction-free, albeit scientific, ethical and legal challenges are encountered [65]. It not only exhibits discrimination against unvaccinated people and impedes their freedom of movement [66], but unwelcomingly restricts domestic and international traveller flow, economic recovery, interpersonal communication, and cultural exchange.

Instead, voluntary participation can ease tensions between public interests and individual freedom because in this case individualism does not act against collectivism, in that it involves the interdependent self with shared interests [67]. The individual self is an essential component of the collective self, and these are not necessarily mutually exclusive. It simply means that an individual protects oneself before protecting the community; and taking care of oneself during this pandemic is beneficial to society. Even when vaccine-hesitant people resist the injection for fear of the unfamiliar, uncertain long-standing side effects, if they undergo proper preventive measures, they are carrying out their civic duty. In contrast, a compulsory shot ignores their fears and unreasonably pushes them to sacrifice their personal safety along physical and psychological dimensions: this is tantamount to collective bullying. Indeed, forcing them in name of civic responsibility is moral bullying. Mandatory vaccination is a presentation of misuse of governmental power, resulting not only in jeopardising solidarity, but also in expanding tensions between public health and individual health. Hence, decision-makers should be cautious about such an arguable policy.

### A holistic approach

Medical experts warn that COVID-19 has become endemic and its potency is gradually lessening [68]. Preventive measures are dispensable [69], for which governments, the medical community and individuals are collectively responsible for tackling this disease. Such a holistic approach [70] will be a long-lasting approach to living with COVID-19 [71].

Vaccine hesitancy is not the same thing as anti-vaccination. Whereas the former presents worries about newly developed vaccines, the latter denies this pandemic *per se* [72]. Findings uphold that vaccination is one of a number of effective interventions, but not an exclusive one. Mandatory vaccination is likely a force that will accelerate vaccination rates; however, coercion is unlikely to be successful in promoting vaccine uptake [73] and lowering hesitancy. Aside from risk calculation and collective obligation [74,75], Razai et al. [76] add confidence (importance, safety and efficacy of vaccines), complacency (perception of low risk and low disease severity), convenience (access issues dependent on the context, time and specific vaccine being offered), communications (sources of information), and context (sociodemographic characteristics, such as ethnicity, religion, occupation, social class). These conditions rely on the governmental effectiveness.

Having greater responsibilities for creating factors needed to strengthen notions of solidarity and reciprocity, official authorities must consolidate efforts to fight the pandemic. They must respect informed self-determination, personal autonomy and individual choice under the governmental role of informing, educating, recommending and providing incentives for vaccination [77]. They have to give an apolitical presentation, and pertinent measures should focus on public health and individual well-being [78]. Governments should also enhance regulatory and humanitarian elements to offer open and qualifying resources for building confidence and creating a positive perception of vaccination [79]. Simultaneously, monitoring is useful to fend off

outbreaks, including rapid screening, quick testing [80] and contact-tracing [81]. Relevant departments should maintain environmental hygiene in public facilities and clinical settings [82–84]; for instance, indoor ventilation [85] and ultraviolet disinfection systems [86].

Medical veterans are accountable for disclosing transparent science-based data [87] and discreet surveillance for vaccine efficacy against mutations [88]. In addition to developing mutation-resistant vaccines, antibody medicines [89] and curative and rehabilitative treatments [90–92] are critical for immune enhancement, antiviral response, and anti-inflammation or immune modulation. Researchers may investigate alternative medicines to augment the horizon of prevention and cure; for example, Chinese herbs [93], traditional herbal medicines [94] and essential oils [95].

As for the individual aspect, people need to cultivate community health awareness [96] and should keep up with masking, personal hygiene, crowd avoidance, physical distancing [97], and household cleaning [98] to reduce environmental risks [99]. They may also adopt diversified means to ameliorate physiological and psychological wellness [100,101]. Physical exercise [102,103] can enhance the immune system, physical and mental health, and well-being; for instance, yoga for prevention [104] and rehabilitation [105], meditation [106,107] or music [108] or gardening [109] to soothe stress, anxiety, depressive symptoms and harmful emotional effects, diet and nutrition to strengthen the immune system and maintain a good mental state [110–112], together with appropriate lifestyle, including sufficient sleep and rest, stopping smoking, limitation of alcohol consumption and weight control [113].

## Conclusion

Vaccination is an intrusive intervention; thus, safety must be its first priority. Vaccine hesitancy, in contrast to vaccine refusal, reveals personal worries about short-term and long-term side effects or adverse reactions, and post-inoculation death, particularly for vaccines, which have been developed in just a few months and are weak in building herd immunity. People have the right to protect themselves and secure their own lives, which downplays the role of individualism versus collectivism. This discussion suggests a comprehensive approach involving multi-faceted cooperation and interdisciplinary effort through governments, professional bodies and individuals through basic preventive measures and complementary therapy, to deal with physical and mental health during this pandemic.

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## Original work

This study is the author's original work. Its findings have not been published previously, and this manuscript is not being concurrently submitted elsewhere.

## Disclosure of interest

The author declares that she has no competing interest.

## References

- [1] World Health Organisation. Naming the coronavirus disease (COVID-19) and the virus that causes it; 2020 [Accessed August 27, 2020. [https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-\(covid-2019\)-and-the-virus-that-causes-it](https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it)].
- [2] Ravelo JL, Jerving S. COVID-19 in 2020 — A timeline of the coronavirus outbreak. <https://www.devex.com/news/covid-19-in-2020-a-timeline-of-the-coronavirus-outbreak-99634>. [Accessed August 2, 2021].
- [3] Ball P. The lightning-fast quest for COVID vaccines — and what it means for other diseases. *Nature* 2020 [Accessed August 4 2021. <https://www.nature.com/articles/d41586-020-03626-1>].
- [4] Pfizer Inc. Pfizer-BioNTech COVID-19 vaccine COMIRNATY® receives full US FDA approval for individuals 16 years and older; 2021 [Accessed August 24, 2021. <https://www.pfizer.com/news/press-release/press-release-detail/pfizer-biontech-covid-19-vaccine-comirnaty-receives-full>].
- [5] Dong M, He F, Deng Y. How to understand herd immunity in the context of COVID-19. *Viral Immunol* 2021;34:174–81, <http://dx.doi.org/10.1089/vim.2020.0195>.
- [6] Bolotin S, Wilson S, Murti M. Achieving and sustaining herd immunity to SARS-CoV-2. *Can Med Assoc J* 2021;19:E1089, <http://dx.doi.org/10.1503/cmaj.210892>.
- [7] Hou Z, Tong Y, Du F, Lu L, Zhao S, Yu K, et al. Assessing COVID-19 vaccine hesitancy, confidence, and public engagement: a global social listening study. *J Med Internet Res* 2021;23:1–11, <http://dx.doi.org/10.2196/27632>.
- [8] Rozek LS, Jones P, Menon A, Hicken A, Apsley S, King EJ. Understanding vaccine hesitancy in the context of COVID-19: the role of trust and confidence in a seventeen-country survey. *Int J Public Health* 2021;66:636255, <http://dx.doi.org/10.3389/ijph.2021.636255>.
- [9] Rus M, Grosej U. Ethics of vaccination in childhood — A framework based on the four principles of biomedical ethics. *Vaccines* 2021;9:1–16, <http://dx.doi.org/10.3390/vaccines9020113>.
- [10] Gill MK, Sahiba K, Mannan R, Gill A, Singh AP. Ethical issues in mandatory vaccination. *Glob Bioeth Enq Sch Publ UNESCO Chair Bioeth* 2018;6:5–12.
- [11] Gupta R, Morain SR. Ethical allocation of future COVID-19 vaccines. *J Med Ethics* 2021;47:137–41, <http://dx.doi.org/10.1136/medethics-2020-106850>.
- [12] Beauchamp T, Childress J. *Principles of biomedical ethics*. 8th ed. Oxford, UK: Oxford University Press; 2019.
- [13] Biswas N, Mustapha T, Khubchandani J, Price JH. The nature and extent of COVID-19 vaccination hesitancy in healthcare workers. *J Community Health* 2021;46:1244–51, <http://dx.doi.org/10.1007/s10900-021-00984-3>.
- [14] VanHooste WLC, Bekaert M. To be or not to be vaccinated? The ethical aspects of influenza vaccination among health-care workers. *Int J Environ Res Public Health* 2019;16:1–10, <http://dx.doi.org/10.3390/ijerph16203981>.
- [15] Savulescu J. Good reasons to vaccinate: mandatory or payment for risk. *J Med Ethics* 2021;47:78–85, <http://dx.doi.org/10.1136/medethics-2020-106821>.
- [16] Maeckelberghe E, Schroder-Back P. COVID-19: a test for our humanity. *Eur J Public Health* 2020;30:853–4, <http://dx.doi.org/10.1093/eurpub/ckaa180>.



- [17] Worldometer. Coronavirus; 2021 [Accessed August 17, 2021. <https://www.worldometers.info/coronavirus/>].
- [18] Mill JS. *On liberty*. Ontario, Canada: Batoche Books Limited; 2001.
- [19] Bowen RAR. Ethical and organisational considerations for mandatory COVID-19 vaccination of health care workers: a clinical laboratorian's perspective. *Clin Chim Acta* 2020;510:421–2.
- [20] Hadro M. Bioethicist: there must be conscience exemptions to vaccine mandates. Catholic News Agency; 2021 [<https://www.catholicnewsagency.com/news/248581/bioethicist-there-must-be-conscience-exemptions-to-vaccine-mandates>]. Accessed August 13, 2021].
- [21] Parsons M. As vaccine mandates spread, employers and colleges seek advice on religious exemptions. *The Washington Post*; 2021 [[https://www.washingtonpost.com/religion/as-vaccine-mandates-spread-employers-and-colleges-seek-advice-on-religious-exemptions/2021/08/09/f52595fa-f945-11eb-911c-524bc8b68f17\\_story.html](https://www.washingtonpost.com/religion/as-vaccine-mandates-spread-employers-and-colleges-seek-advice-on-religious-exemptions/2021/08/09/f52595fa-f945-11eb-911c-524bc8b68f17_story.html)]. Accessed August 13, 2021].
- [22] Pečić G, Karačić S, Mikirtichan GL, Kubar Oi, Leavitt FJ, Tai MCT, et al. Religious exception for vaccination or religious excuses for avoiding vaccination. *Croat Med J* 2016;57:516–21, <http://dx.doi.org/10.3325/cmj.2016.57.516>.
- [23] Pierik R. Mandatory vaccination: an unqualified defence. *J Appl Philos* 2018;35:381–98, <http://dx.doi.org/10.1111/japp.12215>.
- [24] Moorthy G. Compulsory COVID-19 vaccination? Only as a policy of last resort. *Voices Bioeth* 2020;6, <http://dx.doi.org/10.7916/vib.v6i.7301> <https://journals.library.columbia.edu/index.php/bioethics/article/view/7301>.
- [25] Baden LR, El Sahly HM, Essink B, Kotloff K, Frey S, Novak R, et al. Efficacy and safety of the mRNA-1273 SARS-CoV-2 vaccine. *N Engl J Med* 2021;384:403–16, <http://dx.doi.org/10.1056/NEJMoa2035389>.
- [26] Kaplan RM, Milstein A. Influence of a COVID-19 vaccine's effectiveness and safety profile on vaccination acceptance. *Proc Natl Acad Sci U S A* 2021;118:1–5, <http://dx.doi.org/10.1073/pnas.2021726118>.
- [27] World Health Organisation. Statement for healthcare professionals: how COVID-19 vaccines are regulated for safety and effectiveness: Joint Statement from the International Coalition of Medicines Regulatory Authorities and World Health Organisation; 2021 [Accessed August 2, <https://www.who.int/news/item/11-06-2021-statement-for-healthcare-professionals-how-covid-19-vaccines-are-regulated-for-safety-and-effectiveness>].
- [28] Menni C, Klaser K, May A, Polidori L, Capdevila J, Louca P, et al. Vaccine side effects and SARS-CoV-2 infection after vaccination in users of the COVID Symptom Study app in the UK: a prospective observational study. *Lancet Infect Dis* 2021;21:939–49, [http://dx.doi.org/10.1016/S1473-3099\(21\)00224-3](http://dx.doi.org/10.1016/S1473-3099(21)00224-3).
- [29] Jain VK, Iyengar KP, Ish P. Elucidating causes of COVID-19 infection and related deaths after vaccination. *Diabetes Metab Syndr Clin Res Rev* 2021;15:1–6, <http://dx.doi.org/10.1016/j.dsx.2021.102212>.
- [30] Cécile TK, Andronico A, Bosetti P, Paireau J, Alter L, Boëlle PY, et al. Benefits and risks associated with different uses of the COVID-19 vaccine Vaxzevria: a modelling study, France, May to September 2021. *Eurosurveillance* 2021;26:1–7, <http://dx.doi.org/10.2807/1560-7917.ES.2021.26.26.2100533>.
- [31] Hwang JK, Zhang T, Wang AZ, Li Z. COVID-19 vaccines for patients with cancer: Benefits likely outweigh risks. *J Hematol Oncol* 2021;14:1–11, <http://dx.doi.org/10.1186/s13045-021-01046-w>.
- [32] Razai MS, Chaudhry UAR, Doerholt K, Bauld L, Majeed A. COVID-19 vaccination hesitancy. *Br Med J* 2021;373:1–4, <http://dx.doi.org/10.1136/bmj.n1138>.
- [33] El Azhary K, Miyara K, Ait SSiS, Souat S, Badou A. Emerging COVID-19 vaccines: safety, efficacy and universality. *Moroccan J Public Heal* 2021;2:89–105.
- [34] Wibawa T. COVID-19 vaccine research and development: ethical issues. *Trop Med Int Heal* 2021;26:14–9, <http://dx.doi.org/10.1111/tmi.13503>.
- [35] Bradley E, Navin M. Vaccine refusal is not free riding. *Erasmus J Philos Econ* 2021;14:167–81, <http://dx.doi.org/10.23941/ejpe.v14i1.555>.
- [36] Eden AR, Coutinho AJ. Mandating clinician COVID-19 vaccination may hinder population-level uptake. *Fam Med* 2021;53:404–7, <http://dx.doi.org/10.22454/FamMed.2021.545121>.
- [37] Deb B, Shah H, Goel S. Current global vaccine and drug efforts against COVID-19: pros and cons of bypassing animal trials. *J Biosci* 2020;45:1–10, <http://dx.doi.org/10.1007/s12038-020-00053-2>.
- [38] Moothedath M, Muhamood M, Bhosale YS, Bhatia A, Gupta P, Reddy MR, et al. COVID and animal trials: a systematic review. *J Pharm BioAllied Sci* 2021;13:31–5, <http://dx.doi.org/10.4103/jpbs.JPBS.749.20>.
- [39] Howard J, Huang A, Li Z, Tukeki Z, Zdimal V, van der Westhuizen HM, et al. An evidence review of face masks against COVID-19. *Proc Natl Acad Sci U S A* 2021;118:1–12, <http://dx.doi.org/10.1073/pnas.2014564118>.
- [40] Lyu W, Wehby GL. Community use of face masks And COVID-19: evidence from a natural experiment of state mandates in the US. *Health Aff* 2020;39:1419–25, <http://dx.doi.org/10.1377/hlthaff.2020.00818>.
- [41] Shah SU, Loo EXL, Chua CE, Kew GS, Demutska A, Quek S, et al. Association between well-being and compliance with COVID-19 preventive measures by healthcare professionals: a cross-sectional study. *PLoS One* 2021;16:1–16, <http://dx.doi.org/10.1371/journal.pone.0252835>.
- [42] Muhammad F. Association between good personal hygiene and COVID-19 pandemic: a preventive measure. *Int J Heal Life Sci* 2020;6:e104268, <http://dx.doi.org/10.5812/ijhls.104268>.
- [43] Chu DK, Akl EA, Duda S, Solo K, Yaacoub S, Schünemann J, et al. Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. *Lancet* 2020;395:1973–87, [http://dx.doi.org/10.1016/S0140-6736\(20\)31142-9](http://dx.doi.org/10.1016/S0140-6736(20)31142-9).
- [44] Huang B, Wang J, Cai J, Yao S, Chan PKS, Tam THW, et al. Integrated vaccination and physical distancing interventions to prevent future COVID-19 waves in Chinese cities. *Nat Hum Behav* 2021;5:695–705, <http://dx.doi.org/10.1038/s41562-021-01063-2>.
- [45] Wellenius GA, Vispute S, Espinosa V, Fabrikant A, Tsai TC, Hennessy J, et al. Impacts of social distancing policies on mobility and COVID-19 case growth in the US. *Nat Commun* 2021;12:1–7, <http://dx.doi.org/10.1038/s41467-021-23404-5>.
- [46] Fazio RH, Ruisch BC, Moore CA, Samayoa JAG, Boggs ST, Ladanyi JT. Social distancing decreases an individual's likelihood of contracting COVID-19. *Proc Natl Acad Sci U S A* 2021;118:1–5, <http://dx.doi.org/10.1073/pnas.2023131118>.
- [47] Wang J, Kaperak C, Sato T, Sakuraba A. COVID-19 reinfection: a rapid systematic review of case reports and case series. *J Investig Med* 2021;69:1253–5, <http://dx.doi.org/10.1136/jim-2021-001853>.
- [48] Sevillano G, Ortega-Paredo D, Loaiza K, Zurita-Salinas C, Zurita J. Evidence of SARS-CoV-2 reinfection within the same

- clade in Ecuador: a case study. *Int J Infect Dis* 2021;108:53–6, <http://dx.doi.org/10.1016/j.ijid.2021.04.073>.
- [49] Pegu A, O'Connell S, Schmidt SD, O'Dell S, Talana CA, Lai L, et al. Durability of mRNA-1273 vaccine-induced antibodies against SARS-CoV-2 variants. *Science* 2021;373:1372–7, <http://dx.doi.org/10.1126/science.abj4176>.
- [50] Favresse J, Bayart J-L, Mullier F, Elsen M, Eucher C, van Eeckhoudt S, et al. Antibody titres decline 3-month post-vaccination with BNT162b2. *Emerg Microbes Infect* 2021;10:1495–8, <http://dx.doi.org/10.1080/22221751.2021.1953403>.
- [51] Aschwanden C. Five reasons why COVID herd immunity is probably impossible. *Nature* 2021;591:520–2.
- [52] Mahase E. COVID-19: third vaccine dose boosts immune response but may not be needed, say researchers. *Br Med J* 2021;373:1, <http://dx.doi.org/10.1136/bmj.n1659>.
- [53] Kamar N, Abravanel F, Marion O, Couat C, Izopet J, DelBello A. Three doses of an mRNA COVID-19 vaccine in solid-organ transplant recipients. *N Engl J Med* 2021;385:661–2.
- [54] Ducloux D, Colladant M, Chabannes M, Yannarakis M, Courivaud C. Humoral response after 3 doses of the BNT162b2 mRNA COVID-19 vaccine in patients on hemodialysis. *Kidney Int* 2021;100:702–4, <http://dx.doi.org/10.1016/j.kint.2021.06.025>.
- [55] Strizova Z, Smetanova J, Bartunkova J, Milota T. Principles and challenges in anti-COVID-19 vaccine development. *Int Arch Allergy Immunol* 2021;182:339–49, <http://dx.doi.org/10.1159/000514225>.
- [56] Kadkhoda K. Herd immunity to COVID-19: alluring and elusive. *Am J Clin Pathol* 2021;5:471–2, <http://dx.doi.org/10.1093/ajcp/aqaa272>.
- [57] Centres for Disease Control and Prevention. COVID-19: vaccines: key points; 2021 [Accessed August 17, 2021]. <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/fully-vaccinated-guidance.html>.
- [58] Teagun K. CDC and WHO recommend fully vaccinated should wear masks indoors. CNET; 2021 [Accessed August 17, 2021]. <https://www.cnet.com/health/cdc-and-who-recommend-fully-vaccinated-should-wear-masks-indoors-heres-the-latest/>.
- [59] Lio CF, Cheong HH, Lei CI, Lo IL, Yao L, Lam C, et al. Effectiveness of personal protective health behaviour against COVID-19. *BMC Public Health* 2021;21:1–10, <http://dx.doi.org/10.1186/s12889-021-10680-5>.
- [60] Sandmann FG, Davies NG, Vassall A, Edmunds WJ, Jit M, on behalf of the Centre for the Mathematical Modelling of Infectious Diseases COVID-19 working group. The potential health and economic value of SARS-CoV-2 vaccination alongside physical distancing in the UK: a transmission model-based future scenario analysis and economic evaluation. *Lancet Infect Dis* 2021;21:962–74, [http://dx.doi.org/10.1016/S1473-3099\(21\)00079-7](http://dx.doi.org/10.1016/S1473-3099(21)00079-7).
- [61] Day M. COVID-19: stronger warnings are needed to curb socialising after vaccination, say doctors and behavioural scientists. *Br Med J* 2021;372:1–2, <http://dx.doi.org/10.1136/bmj.n783>.
- [62] Gur-Arie R, Jamrozik E, Kingori P. No jab, no job? Ethical issues in mandatory COVID-19 vaccination of healthcare personnel. *BMJ Glob Heal* 2021;6:1–5, <http://dx.doi.org/10.1136/bmjgh-2020-004877>.
- [63] Haire B, Komesaroff P, Leontini R, MacIntyre CR. Raising rates of childhood vaccination: the trade-off between coercion and trust. *Bioethical Inq* 2018;15:199–209, <http://dx.doi.org/10.1007/s11673-018-9841-1>.
- [64] World Health Organisation. COVID-19 and mandatory vaccination: ethical considerations and caveats: policy brief, 13 April 2021; 2021 [Accessed August 8, 2021]. <https://apps.who.int/iris/handle/10665/340841>.
- [65] Pavli A, Maltezou HC. COVID-19 vaccine passport for safe resumption of travel. *J Travel Med* 2021;28:1–3, <http://dx.doi.org/10.1093/jtm/taab079>.
- [66] Sesa G, Wong BLH, Czabanowska K, Reid J, Davidovitch N, Martin-Moreno JM, et al. COVID-19 vaccine passports and vaccine hesitancy: freedom or control. *BMJ Opinion* 2021 [<https://blogs.bmj.com/bmj/2021/03/30/covid-19-vaccine-passports-and-vaccine-hesitancy-freedom-or-control/>]. Accessed August 23, 2021].
- [67] Lu JG, Jin P, English AS. Collectivism predicts mask use during COVID-19. *Proc Natl Acad Sci U S A* 2021;118:1–8, <http://dx.doi.org/10.1073/pnas.2021793118>.
- [68] Torjesen I. COVID-19 will become endemic but with decreased potency over time, scientists believe. *Br Med J* 2021;372:1–2, <http://dx.doi.org/10.1136/bmj.n494>.
- [69] Lavine JS, Bjornstad ON, Antia R. Immunological characteristics govern the transition of COVID-19 to endemicity. *Science* 2021;371:741–5.
- [70] Angelini S, Pinto A, Hrelia P, Malaguti M, Buccolini F, Donini LM, et al. The “elderly” lesson in a “stressful” life: Italian holistic approach to increase COVID-19 prevention and awareness. *Front Endocrinol (Lausanne)* 2020;11:1–7, <http://dx.doi.org/10.3389/fendo.2020.579401>.
- [71] Cohen AB. Living in a COVID-19 world. *Milbank Q A Multidisciplinary J Popul Heal Heal Policy* 2020;98:227–34.
- [72] Ransing R, Dashi E, Rehman S, Chepure A, Mehta V, Kundadak GK. COVID-19 anti-vaccine movement and mental health: challenges and the way forward. *Asian J Psychiatr* 2021;58:1–2, <http://dx.doi.org/10.1016/j.ajp.2021.102614>.
- [73] Pennings S, Symons X. Persuasion, not coercion or incentivisation, is the best means of promoting COVID-19 vaccination. *J Med Ethics* 2021;47:709–11, <http://dx.doi.org/10.1136/medethics-2020-107076>.
- [74] Machingaidze S, Wiysonge CS. Understanding COVID-19 vaccine hesitancy. *Nat Med* 2021;27:1338–9, <http://dx.doi.org/10.1038/s41591-021-01459-7>.
- [75] Matose T, Lanphier E. Rights don't stand-alone: responsibility for rights in a pandemic. *Am J Bioeth* 2020;20:169–72, <http://dx.doi.org/10.1080/15265161.2020.1779405>.
- [76] Razai MS, Oakeshott P, Esmail A, Wiysonge CS, Viswanath K, Mills MC. COVID-19 vaccine hesitancy: the five Cs to tackle behavioural and sociodemographic factors. *J R Soc Med* 2021;114:295–8, <http://dx.doi.org/10.1177/01410768211018951>.
- [77] D'Errico S, Turillazzi E, Zanon M, Viola RV, Frati P, Fineschi V. The model of “informed refusal” for vaccination: how to fight against anti-vaccinationist misinformation without disregarding the principle of self-determination. *Vaccines* 2021;9:1–13, <http://dx.doi.org/10.3390/vaccines9020110>.
- [78] Schoch-Spana M, Brunson EK, Long R, Ruth A, Ravi SJ, Trotochaud M, et al. The public's role in COVID-19 vaccination: human-centred recommendations to enhance pandemic vaccine awareness, access, and acceptance in the United States. *Vaccine* 2021;39:6004–12, <http://dx.doi.org/10.1016/j.vaccine.2020.10.059>.
- [79] Kubar OI, Asatryan AG, Roshchina MV, Mikirtichan GL, Nikitina AE. Towards ethical conception in legal regulation of vaccination in the Russian Federation. *JAHR Eur J Bioeth* 2019;10:325–36, <http://dx.doi.org/10.21860/j.10.2.3>.
- [80] Higgins T, Geld B, Signorelli L. Tactical responses to COVID-19 in a long-term care facility. *Acad Lett* 2021:1–5, <http://dx.doi.org/10.20935/AL468>, volume March (Article 468).

- [81] Colizza V, Grill E, Mikolajczyk R, Cattuto C, Kucharski A, Riley S, et al. Time to evaluate COVID-19 contact-tracing apps. *Nat Med* 2021;27:360–2, <http://dx.doi.org/10.1038/s41591-021-01236-6>.
- [82] Curryer C, Russo PL, Kiernan M, Wares KD, Smith K, Mitchell BG. Environmental hygiene, knowledge and cleaning practice: a phenomenological study of nurses and midwives during COVID-19. *Am J Infect Control* 2021;49:1123–8, <http://dx.doi.org/10.1016/j.ajic.2021.04.080>.
- [83] Sly PD, Trottier BA, Bulka CM, Cormier SA, Fobil J, Fry RC, et al. The interplay between environmental exposures and COVID-19 risks in the health of children. *Environ Heal* 2021;20:1–10, <http://dx.doi.org/10.1186/s12940-021-00716-z>.
- [84] Zhao L, Qi Y, Luzzatto-Fegiz P, Cui Y, Zhu Y. COVID-19: effects of environmental conditions on the propagation of respiratory droplets. *Nano Lett* 2020;20:7744–50, <http://dx.doi.org/10.1021/acs.nanolett.0c03331>.
- [85] Kwok KO, McNeil EB, Tsoi MTF, Wei VWI, Wong SYS, Tang JWT. Will achieving herd immunity be a road to success to end the COVID-19 pandemic. *J Infect* 2021;83:381–412, <http://dx.doi.org/10.1016/j.jinf.2021.06.007>.
- [86] Raeiszadeh M, Adeli B. A critical review on ultraviolet disinfection systems against COVID19 outbreak: applicability, validation, and safety considerations. *ACS Photonics* 2020;7:2941–51, <http://dx.doi.org/10.1021/acsphotonics.0c01245>.
- [87] Schwartz JL. Evaluating and deploying COVID-19 vaccines — The importance of transparency, scientific integrity, and public trust. *N Engl J Med* 2020;383:1703–5, <http://dx.doi.org/10.1056/NEJMp2026393>.
- [88] Noh J, Yun J, Won H, Shin E-C. SARS-CoV-2 mutations, vaccines, and immunity: implication of variants of concern. *Signal Transduct Target Ther* 2021;6:1–2, <http://dx.doi.org/10.1038/s41392-021-00623-2>.
- [89] Chen J, Gao K, Wang R, Wei G-W. Prediction and mitigation of mutation threats to COVID-19 vaccines and antibody therapies. *Chem Sci* 2021;12:6929–48, <http://dx.doi.org/10.1039/d1sc01203g>.
- [90] Baraniuk C. Where are we with drug treatments for COVID-19. *Br Med J* 2021;373:1–3, <http://dx.doi.org/10.1136/bmj.n1109>.
- [91] Beigel JH, Tomashek KM, Dodd LE, Mehta A, Zingman BS, Kalil AC, et al. Remdesivir for the treatment of COVID-19 — Final report. *N Engl J Med* 2020;383:1813–26, <http://dx.doi.org/10.1056/NEJMoa2007764>.
- [92] Farne H, Kumar K, Ritchie AI, Finney LJ, Johnston SL, Singanayagam A. Repurposing existing drugs for the treatment of COVID-19. *Ann Am Thorac Soc* 2020;17:1186–94, <http://dx.doi.org/10.1513/AnnalsATS.202005-566FR>.
- [93] Lam CS, Koon HK, Chun VC-H, Cheung YT. A public survey of traditional, complementary and integrative medicine use during the COVID-19 outbreak in Hong Kong. *PLoS One* 2021;16:1–15, <http://dx.doi.org/10.1371/journal.pone.0253890>.
- [94] Panyod S, Ho C-T, Sheen L-Y. Dietary therapy and herbal medicine for COVID-19 prevention: a review and perspective. *J Tradit Complement Med* 2020;10:420–7, <http://dx.doi.org/10.1016/j.jtcme.2020.05.004>.
- [95] Asif M, Saleem M, Saadullah M, Yaseen HS, AlZarzur R. COVID-19 and therapy with essential oils having antiviral, anti-inflammatory, and immunomodulatory properties. *Infammopharmacology* 2020;28:1153–61, <http://dx.doi.org/10.1007/s10787-020-00744-0>.
- [96] Cheng FK. Community health awareness model: discussion revisited on how Hong Kong people are combating the COVID-19 pandemic. *Moroccan J Public Heal* 2021;2:9–21.
- [97] Kelen GD, Maragakis LL. COVID-19 vaccine: what you need to know. *Johns Hopkins Medicine*; 2021 [Accessed August 5 2021]. <https://www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus/covid-19-vaccine-what-you-need-to-know>.
- [98] Shimabukuro PMS, Duarte ML, Imoto AM, Atallah AN, Franco ESB, Peccin MS, et al. Environmental cleaning to prevent COVID-19 infection. A rapid systematic review. *São Paulo Med J* 2020;138:505–14, <http://dx.doi.org/10.1590/1516-3180.2020.0417.09092020>.
- [99] Maipas S, Panayiotides IG, Tsiodras S, Kavantzaz N. COVID-19 pandemic and environmental health: effects and the immediate need for a concise risk analysis. *Environ Health Insights* 2021;15:1–3, <http://dx.doi.org/10.1177/1178630221996352>.
- [100] Al Dhaheri AS, Bataineh MF, Mohamad MN, Ajab A, Al Marzouqi A, Jarrar AH, et al. Impact of COVID-19 on mental health and quality of life: is there any effect? A cross-sectional study of the MENA region. *PLoS One* 2021;16:1–17, <http://dx.doi.org/10.1371/journal.pone.0249107>.
- [101] Pfefferbaum B, North CS. Mental health and the COVID-19 pandemic. *N Engl J Med* 2020;383:510–2, <http://dx.doi.org/10.1056/NEJMp2008017>.
- [102] Vancini RL, Andrade MS, Viana RB, Nikolaidis PT, Knechtel B, Campanharo CRV, et al. Physical exercise and COVID-19 pandemic in PubMed: two months of dynamics and one year of original scientific production. *Sport Med Heal Sci* 2021;3:89–92, <http://dx.doi.org/10.1016/j.smhs.2021.04.004>.
- [103] Després J-P. Severe COVID-19 outcomes — the role of physical activity. *Nat Rev* 2021;17:451–2, <http://dx.doi.org/10.1038/s41574-021-00521-1>.
- [104] Nagendra HR. Yoga for COVID-19. *Int J Yoga* 2020;13:87–8, <http://dx.doi.org/10.4103/ijoy.IJOY.27.20>.
- [105] Verma B, Kundu ZS. Exercise and yoga as modalities for post COVID-19 rehabilitation. *Int J Sci Res* 2021;10:75–85, <http://dx.doi.org/10.21275/SR201202155829>.
- [106] Behan C. The benefits of meditation and mindfulness practices during times of crisis such as COVID-19. *Ir J Psychol Med* 2020;37:1–8, <http://dx.doi.org/10.1017/ipm.2020.38>.
- [107] Zhu JL, Schülke R, Vatansever D, Xi D, Yan J, Zhao H, et al. Mindfulness practice for protecting mental health during the COVID-19 pandemic. *Transl Psychiatry* 2021;11:1–11, <http://dx.doi.org/10.1038/s41398-021-01459-8>.
- [108] Giordano F, Scarlata E, Baroni M, Gentile E, Puntillo F, Brienza N, et al. Receptive music therapy to reduce stress and improve well-being in Italian clinical staff involved in COVID-19 pandemic: a preliminary study. *Arts Psychother* 2020;70:1–5, <http://dx.doi.org/10.1016/j.aip.2020.101688>.
- [109] Corley J, Okely JA, Taylor AM, Page D, Welstead M, Skarabela B, et al. Home garden use during COVID-19: associations with physical and mental well-being in older adults. *J Environ Psychol* 2021;73:1–8, <http://dx.doi.org/10.1016/j.jenvp.2020.101545>.
- [110] Aman F, Masood S. How nutrition can help to fight against COVID-19 pandemic. *Pakistan J Med Sci* 2020;36:S121–3, <http://dx.doi.org/10.12669/pjms.36.COVID19-S4.2776>.
- [111] Moscatelli F, Sessa F, Valenzano A, Polito R, Monda V, Cibelli G, et al. COVID-19: role of nutrition and supplementation. *Nutrients* 2021;13:1–12, <http://dx.doi.org/10.3390/nu13030976>.
- [112] de Faria Coelho-Ravagnani C, Corgosinho FC, Sanches FLFZ, Prado CMM, Laviano A, Mota JF. Dietary recommendations during the COVID-19 pandemic: an extract. *Kompass Nutr Diet* 2021;1:3–7, <http://dx.doi.org/10.1159/000513449>.
- [113] Lange KW, Nakamura Y. Lifestyle factors in the prevention of COVID-19. *Glob Heal J* 2020;4:146–52, <http://dx.doi.org/10.1016/j.glohj.2020.11.002>.