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Short Communication

COVID-19: Is herd immunity the only option for fragile Yemen?

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ABSTRACT

The first case of COVID-19 in Yemen was confirmed on 10 April 2020. Having faced with a six-year long conflict that has destroyed half of its healthcare facilities and displaced millions, predictions of infections and mortality in Yemen suggested a looming healthcare catastrophe. Difficulty in implementing coordinated lockdowns and preventive measures due to the daily labor working nature of the majority of the population, provided the perfect breeding ground for the SARS-CoV-2 virus. However, official figures of infections and mortality are very low and there have not been confirmed reports of excess mortality. This could indicate that Yemen is silently marching towards forced herd immunity. Seroprevalence studies will provide useful insight into the COVID-19 transmission trajectory in Yemen, which can serve as a guide in planning vaccine distribution strategies and allocating the limited funds wisely.

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The emergence of the SARS-CoV-2 virus has renewed the debate on herd immunity. Although the concept seems plausible in an ideal setting, achieving this would possibly require intentional sacrifice of a section of the herd, not only in terms of loss of life but also in terms of long-term pain and suffering. For example, there have been suggestions that up to 2 million people would die before getting there in the USA alone (Aschwanden, 2020). Although commentators in the *Lancet* have concluded that “any proposed approach to achieve herd immunity through natural infection is not only highly unethical, but also unachievable”, it could be the only option for certain resource-poor and fragile nations (Jones and Helmreich, 2020).

In real life, attaining herd immunity to COVID-19 is not simple. Historically, no disease has been eradicated as a result of natural herd immunity (Aschwanden, 2020). Aiming for herd immunity would require a steadfast disease surveillance mechanism to track and analyze the course of the disease transmission, and a robust healthcare system to absorb any sudden turn of events leading to an unexpected explosion in the number of infections. A proponent of herd immunity, Sweden, has witnessed deaths reaching up to 1330 per 1 million population, which is approx. 9 to 11 times its neighbors – Norway (123) and Finland (153) – forcing it to implement incremental interventions. In December 2020, the Swedish Corona Commission concluded that “the single most

important factor behind the major outbreaks and the high number of deaths in [elderly] residential care is the overall spread of the virus in the society” (Claeson and Hanson, 2021).

Opponents to herd immunity propose measures like lockdowns, social distancing, wearing of face masks, etc., to buy time until better options, like vaccines or more effective treatment modalities, are developed. Although these measures come with a huge socioeconomic cost, studies have shown that they do help in slowing down transmission of the disease, eventually reducing mortality and morbidity (Alagoz et al., 2021; King et al., 2020). For example, it has been shown that implementing social distancing measures a week earlier in New York City could have reduced its number of infections by 80%, whereas a week’s delay could have caused it to increase by seven-fold (Alagoz et al., 2021; King et al., 2020). However, the rate of transmission could also vary depending on the level of adherence and transmission rate at a given time. It has been suggested that case fatality rates (CFR) in countries with mandatory or enforced population-wide masking have remained low, even with resurgences in cases after lifting lockdowns, which could be a result of a reduction in the viral inoculum (conceptualized as the LD50 or lethal dose of the virus) in mask wearers, leading to milder or asymptomatic infections (Gandhi and Rutherford, 2020; Memoli et al., 2015). However, even with preventive measures in place, developed and rich nations are reporting deadly second and third waves of the pandemic. As British public health expert Raj Bhopal put it: the situation can be likened to being in *zugzwang*, “a position

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in chess where every move is disadvantageous where we must examine every plan, however unpalatable” (Jones and Helmreich, 2020).

Much of the argument on herd immunity has revolved around attaining it in stable countries. However, would the concept hold ground in fragile nations like Yemen, battered by six years of conflict, devoid of a unified government, lacking nationwide robust and unified surveillance mechanisms, and with a crippled healthcare system? In Yemen, 51% of the healthcare facilities are fully functioning, there is a severe shortage of healthcare personnel and equipment, 62% of hospitals have medical specialists, and 18% of the 333 districts have no doctors. Additionally, several hospitals have either shut down or turned away patients during the epidemic due to lack of personal protective equipment (PPE) and supplies (Al-Ashwal et al., 2020). Since the start of the pandemic, Yemen has not been able to implement a strict lockdown due to the lack of coordination between ministries and governmental agencies, and the daily labor working nature of the majority of the population. More than 50% of the population are in need of water and sanitation assistance, and majority of the population cannot afford face masks or hand soap (Camacho et al., 2018). What relevance would R , R_0 and R_t have in such a context? For a population on the brink of famine, devastated by other disease outbreaks and a shattered economy as a result of ongoing conflict, COVID-19 is the least of their concerns.

How would the SARS-CoV-2 virus, which was shown to have infected >300,000 people from a single superspreading event in the USA, unleash its wrath in a conflict-devastated country like Yemen (Lemieux et al., 2021)? Based on the dynamics of the virus transmission and mathematical models, forecasters have predicted grim figures for infections and mortalities. For example, the London School of Hygiene and Tropical Medicine put the figures at 11 million infections and 62,000–85,000 deaths, while Altaf Musani (the World Health Organization’s (WHO) representative in Yemen) put the worst-case scenario infections at 28 million, almost the whole of Yemen’s population (Devi, 2020; Looi, 2020). From early on in the pandemic, aid agencies have been operating in Yemen on the basis of full-blown community transmission. However, at the time of writing this article – about 11 months after the first infection was confirmed in Yemen in April 2020 – the WHO’s official figures stand at 2367 confirmed infections and 644 deaths (Figure 1), which is obviously a huge underestimation. The WHO case-mortality graph for COVID-19 in Yemen shows an increase in the number of infections and mortality between May–July 2020, followed by a significant downward trend since September (WHO, 2021). Geospatial grave counting studies on excess mortality during that period partially (the study could not

distinguish the direct from the indirect virus-related deaths. Moreover, according to local government officials, hundreds died since early April 2020 due to flash floods and other diseases like dengue, chikungunya, and pneumonic plague, etc) confirms this transmission trajectory in Yemen, suggesting a waning of the epidemic by September 2020 (Figure 1) (Al Batati, 2020a; Besson et al., 2021). Since then, for more than five months, the WHO dashboard for COVID-19 in Yemen has indicated 322 of the total 2367 infections and 54 of the total 644 deaths to date (WHO, 2021).

As with other emerging diseases, the initial calculated/predicted case load and CFR of COVID-19 have been over-estimations; this could also be true in the case of Yemen. Most of the published susceptible-infected-recovered (SIR) mathematical models developed to predict COVID-19 have been shown to suffer from inconformity, as quantitative information for most of the parameters is not yet available (Moein et al., 2021). Moreover, the models which rely on population-level parameters – such as rates of movements, distancing, virus infectivity parameters and country-specific virus behavior – which are not yet fully understood and mainly rely on data from the epidemics of the global North, have also led to false predictions. The transmission has been slower and less intense in several countries, including Africa and the Indian subcontinent, and the rural areas of low and lower-middle income countries (LICs/LMICs) (Figure 2) (Van Damme et al., 2020). For example, the CFR in Kerala, the state in India to report the first case of COVID-19, is less than a third of Washington, even though its population density is about seven times that of Washington.

Crowded markets and hospitals and large funeral gatherings of COVID-19 patients, without any sign of preventive measures, as depicted by scenes from the British Broadcasting Corporation documentaries (BBC) filmed in April and July 2020, suggest that the disease transmission may have been more widespread in Yemen, with experts claiming in mid-September that up to one million people may have been affected by COVID-19 (BBC News, 2020; UN News, 2020). However, the official downward trend in the number of infections and deaths since September in the absence of preventive measures suggests the possibility that Yemen could be heading towards natural herd immunity. Currently, the general opinion among the public is that “corona has gone”. While several rich countries are once again imposing lockdowns due to repeated waves of the pandemic and schools are shutting down even in Sweden, which is a proponent of herd immunity, schools and universities in several parts of Yemen have opened since early September (Wyatt, 2020; Al Batati, 2020b). People are moving about freely in the markets and everywhere, neither practicing social distancing nor wearing face masks. Hundreds of

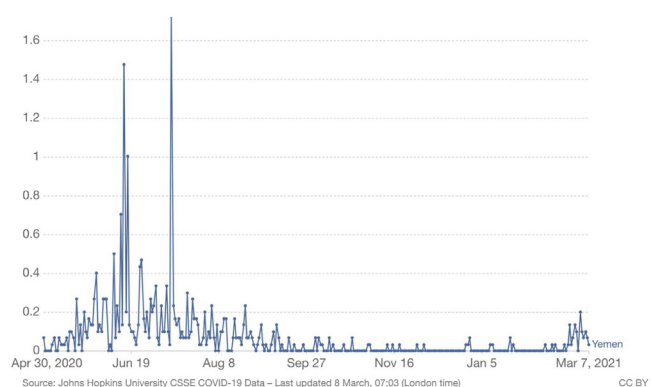


Figure 1. Daily new confirmed COVID-19 deaths per million people (Our World in Data).

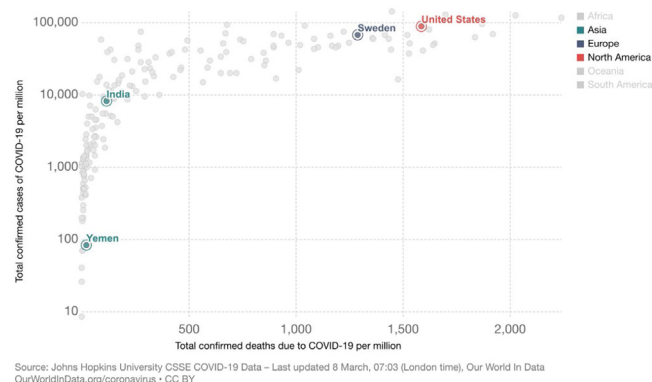


Figure 2. Total confirmed COVID-19 cases vs. deaths per million in Yemen compared to India, Sweden and the United States, 7 March 2021 (Our World in Data).

worshippers are praying side by side in packed Mosques five times a day. Social gatherings like weddings and khat chewing are going on as usual and friends and relatives are visiting the sick without taking any precautions. In spite of all this, there have not been any reports of mass graves or unprecedented mortality and morbidity by media channels like the BBC that have had access to Yemen, or international organizations like the UN, WHO, Medecins Sans Frontieres, etc. Moreover, mainstream scientific journals like the *Lancet* and *BMJ*, which reported at the beginning of the epidemic on the high CFR and looming catastrophic COVID-19 outcome in Yemen, have not reported any recent largescale mortality, although there have been several consistent reports on previous outbreaks of other diseases like cholera (Devi, 2020; Looi, 2020). This could indicate that Yemen is silently marching towards herd immunity without the projected scale of mortality.

Several reasons could be postulated for the low caseload and mortality from COVID-19 in Yemen. One of the reasons could be the hot climate in most parts of the country (Wu et al., 2020). Moreover, Yemen has a low population density of 54 people/km² with about 62% of people living in rural areas. With a median age of 20.2 years, more than 96% of the population is aged <60 years (Worldometer, 2021). A surveillance study on individuals hospitalized with confirmed infection in Yemen showed that about 40% of the mortality occurred in people aged >60 years (i.e., in <4% of the population) (Al-Waleedi et al., 2020). Yemenis have excellent family relations, with the majority of the population still following the joint family system. This could translate to the provision of high priority home care for members with mild-to-moderate symptoms suspected of infection. This is in line with the recommendations from the WHO that COVID-19 patients should recover at home, since most infections would be mild to moderate (WHO, 2020).

Yemen has a female population of about 50% and majority of them are already accustomed to wearing a face veil, which acts as a form of face mask. This could possibly prevent infections or lead to infections that are relatively mild or asymptomatic due to decreased viral inoculum, and also reduce transmissibility to others (Gandhi and Rutherford, 2020). The presence of cross-reactive memory T-cells and trained immunity from exposure to other RNA viruses – like dengue, chikungunya, Middle East respiratory syndrome-related Coronavirus (MERS-CoV), measles, etc. – could be important protective factors. Since the SARS-CoV-2 does not stimulate a robust interferon, a trained cell would be more likely to raise a response against it compared with a non-trained cell (Chinnaswamy, 2020; Lipsitch et al., 2020). Although cross immunity and trained immunity may not decrease the transmission rate, it could possibly be the reason for limited disease severity and mortality.

Seroprevalence studies will give a better understanding on the COVID-19 transmission trajectory in Yemen. Seroprevalence studies on COVID-19 in other countries have always indicated much higher infections than reported (Byambasuren et al., 2020). For example, a study in India indicated that the number of infections was 130 times higher than the reported number during the study period (Murhekar et al., 2020).

Severe shortages in testing capacity, PPE and supplies – highlighting major discrepancies in funding and logistics due to closure of air and seaports and as a result of the ongoing conflict – indicate expected future difficulties in attaining vaccine coverage. Therefore, herd immunity could be the only option for Yemen. Given the low mortality due to COVID-19 in cash-strapped Yemen, a country-specific strategy will be necessary to minimize the burden on the healthcare system and the population in general (Chakrabarti et al., 2020). This is especially true since the recent high-level UN international pledging event for Yemen has been “disappointing”. Lockdowns that lead to economic suffocation of the daily wage-earning population seem unnecessary in the

Yemeni context, a strategy that has especially been proven to have drastic consequences on migrant workers in India. Priority should also be given to allocation of the limited funds for restructuring the healthcare system, timely payment of wages to doctors and other healthcare personnel, improving facilities for testing and management of only critical COVID-19 cases, and protecting the vulnerable. In view of this, the need of the hour is implementation of seroprevalence studies, even at a small scale, especially in areas suspected of high COVID-19 burden. Seroprevalence studies will provide more accurate information on the rate of virus transmission and the country-specific behavior of the virus in Yemen, and also aid in pinpointing areas where future outbreaks can be expected. They will also serve as guides in planning future health strategies, to optimize vaccine distribution and prevent over-allocation of funds for COVID-19, bearing in mind the other concurrent disease outbreaks and a conflict-devastated healthcare system.

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