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A Narrative Review-Herd Immunity A Hidden Solution of COVID-19

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ABSTRACT

The Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) that causes Coronavirus disease 2019 (COVID-19) is currently the largest infectious disease pandemic of the 21st century. Its remarkable effects on politics, public health, medicine and research have raised many issues and revived several fundamental ideas in the fields of infectious diseases and immunology. Previous researchers have made an effort to forecast the total number of Coronavirus disease 2019 (COVID-19) cases in China. Since then, though, the virus has quickly changed into a global pandemic that affects numerous nations worldwide. Serious discussions have taken place regarding how to respond to the spread of this disease, especially by European nations. Possible responses have ranged from closing institute, universities and schools to lockdowns in major cities and nations. Another option would be to let the COVID-19 virus (SARS-CoV-2) propagate so that i will boost population herd immunity while simultaneously protecting the most vulnerable populations, which include the elderly and people with many comorbidities. Herd immunity is an important concept in epidemic regulation. It states that only a fraction of a population needs to be immune to an infectious agent (via vaccination or natural infection) for it to stop transmission of virus and decrease their ability to cause large incidences of disease. An important question to answer in the existing COVID-19 pandemic is when, how and at what cost community immunity or herd immunity can be achieved. Here, we go through the fundamental ideas of herd immunity and talk about how they apply to COVID-19.

Key words: COVID-19, Vaccination, Herd immunity, Pandemic, Comorbidities, Epidemic, Infection

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INTRODUCTION

Herd immunity, also referred to as community immunity, can be transmitted from one person to another using one of two methods. The first is vaccination, in which the individuals acquire immunity to the illness so that the infectious agent can be neutralized when they come into contact, greatly reducing the likelihood that it will spread to others. As a result, unlike vaccination, herd immunity is an indirect natural measure and does not provide significant levels of personal protection.

As a result, herd immunity becomes more effective as more people receive vaccinations. In contrast, if enough people are exposed to the virus, they will produce antibodies and gain natural immunity [1]. Second, virtually no one will spread the illness if nearly everyone is immune. Due to the surrounding immunity of those who have received vaccinations, even those who have not can benefit from herd immunity. In other words, the existence of immune individual's guards against infection in non-immune people. If a large enough population is immune to the cause of a disease, such as an infection or germs, it will not spread. Even though only one out of every four people may be secure, the group as a whole is confident. This is due to the fact that fewer high risk individuals exist overall. These include young children and people with weak immune systems who can't fight off infection on their own. Both the infection and contamination rates decline. In dangerous crowds, herd immunity offers protection. This is as we wait for vaccines, which will enable us to achieve herd immunity in the safest manner possible. However, in the case of COVID-19, the value of herd immunity as a long term control measure is unclear because other important questions to consider are whether antibody titers will wane over time and how long acquired immunity to the virus will last, SARS-CoV-2 would survive this or not and how it would behave in the community [2].

LITERATURE REVIEW

An epidemiological notion on a population's immune condition is herd immunity. Herd immunity, according to the Centers for Disease Control and prevention (CDC), occurs when a significant section of the population is immune to the infectious disease (either due to vaccination or prior illness), making the spread of the illness from one person to another extremely unlikely. When a sufficient percentage of immune people are present in a population, it refers to the indirect protection from infection given to vulnerable people. This population level effect is frequently taken into account when discussing vaccination campaigns, which seek to create herd immunity so that those who cannot receive vaccinations, such as the very young and immunocompromised individuals, nevertheless have protection from disease.

The introduction of an infected person will result in various results depending on how common existing immunity to a virus is in a population. Following effective exposure of susceptible hosts to sick individuals, a virus will spread through susceptible hosts in an unregulated way in an entirely ignorant community. The possibility of an effective interaction between infected and susceptible hosts is decreased, nevertheless, if a portion of the population is immune to the same virus because many immune hosts cannot transfer the pathogen. The infection cannot successfully propagate in a community if there are insufficient susceptible individuals and its prevalence will decrease. The herd immunity threshold is the point at which the fraction of vulnerable people is insufficient to prevent transmission [3]. When herd immunity is present, susceptible people receive indirect protection from infection above this degree of immunity.

In the most basic model, the basic reproduction number, or R_0, determines how high the herd immunity threshold should be. In other words, it is the average number of secondary infections brought by a single infectious person into an entirely vulnerable community is known as R_0. If we examine a hypothetical pathogen with a R_0 of 4, this means that, assuming no immunity in the population, on average, one infected host will infect four others throughout the infectious period. The proportion of the population that must be immune to prevent sustained transmission must therefore be higher for a disease with a higher related R_0. R_0 depends on organism and population in which it spread. Thus, a single microbe can have multiple R_0 values depending on population. Therefor herd immunity threshold will vary between populations [4]. Communicability of pathogen causing infectious disease depends on many factors like population structure, density and contact rates [3]. R_0 is also predicated on a number of fundamental presumptions, including the homogenous mixing of individuals within a population and the idea that upon vaccination or naturally occurring infection, all individuals acquire sterilizing immunity, which offers lifetime protection against reinfection. These epidemiological and immunological presumptions are frequently not met in real world circumstances and the degree of indirect protection attributable to herd immunity will vary depending on changes to these presumptions. Hence, they impact R_0 and the herd immunity threshold directly or indirectly. The herd immunity threshold is calculated mathematically as $1-1/R_0$ (for instance, if $R_0=4$, the appropriate herd immunity threshold is 0.75) [3].

The effective reproduction number (R_e or R_t) is also a comparable variable very crucial for comprehending population level immunity. Re is defined as the typical number of secondary cases produced by a single index case over the course of an infection in a community with partial immunity ($R_e=(1-PC)(1-pI)R_0$) [4]. Here, PC represents the proportional decrease in transmission rates brought on by non-pharmaceutical therapies and PI represents the percentage of immune people Re, in contrast to R_0, does not presume a population that is entirely vulnerable. As a result, Re will fluctuate based on the immunological status of a community at the time of an epidemic or vaccination campaign, which will alter dynamically. The ultimate aim of immunization campaigns is to reduce the value of Re to less than 1 that means herd immunity is achieved, which corresponds to one infected individual in a population producing less than one secondary case on average in the absence of interventions. With no control measures (PC=0) and for herd immunity $R_e<1$ so the equation $R_e=(1-pl)R_0$ is there for, achieved when the herd immunity threshold is calculated mathematically as $1-1/R_0$.

For SARS-CoV-2, most estimates of R_0 are in the range 2.5–4. The herd immunity barrier for SARS-CoV-2 is roughly 67 percent assuming a R_0 estimate of 3. With instance, for $R_0=3$, if the population is totally susceptible, transmission rates must be reduced by 67 percent, but only by 50 percent if just a third of the population is immune. It is clear from above equation that how population immunity increases and the severity of social isolation measures required limiting transmission reduces in the absence of herd immunity [5]. In some circumstances, herd immunity may develop before population immunity reaches $PI=1-1/R_0$. For instance, if some people are more likely to contract the disease and spread it because they have more contacts, these super spreaders will probably get it first. As a result, these super spreaders quickly disappear from the community of susceptible people, slowing the rate of transmission.

However, it is still challenging to determine how this affects COVID-19. As was previously mentioned, this model is based on oversimplifying assumptions that are unlikely to be accurate, such as homogeneous population mixing and uniform sterilizing immunity in recovered people across demographic groupings. But given an approximate herd immunity threshold and a country's population, this fundamental model can give us a general notion of the number of people who would need to contract the disease in order to acquire herd immunity in the absence of a vaccine.

There are also consequences of reaching the SARS-CoV-2 herd Immunity threshold in the absence of a vaccination which can be presumed with reference to case fatality rate and infection fatality rate. The CFR is the percentage of fatalities attributable to a given disease among all people who were diagnosed with it (*i.e.*, cases) during a given time period. CFRs can vary greatly over time and between different nations [6]. A non-uniform COVID-19 CFR has been recorded across age groups, similar to many other viral diseases, with most deaths occurring in people 60 years of age or older. Hence waiting for herd immunity in those unimmunized people with comorbidities showed disastrous result as this will increase the total death rate in that disease prone section of population. Same is with total infection fatality rate which is the most pertinent metric to assess the societal cost of acquiring global SARS-CoV-2 herd immunity (IFR). The IFR is described as the percentage of all infected people that die from a specific disease. The IFR will naturally be lower than the CFR as some cases won't be reported, particularly in asymptomatic hosts or people with minor symptoms. We may predict the anticipated number of fatalities as a result of attaining the herd immunity threshold if we combine infection fatality data with an estimate of the number of people who must gain immunity to reach that threshold [7]. The cost of achieving herd immunity through natural infection for COVID-19, which has an estimated infection fatality ratio of 0.3-1.3 percent [5,8] would be extremely high, especially in the absence of improved patient management and without optimal shielding of people at risk of serious complications. For nations like France and the USA, this would result in 100,000–450,000 and 500,000–2100,000 deaths, respectively, assuming an optimistic herd immunity threshold of 50%. Men, older people and people with comorbid conditions are disproportionately affected; infection fatality ratios for people over 60 years old are 3.3% and people with diabetes, heart disease, chronic respiratory diseases, or obesity have higher mortality rates. The anticipated effect would be far less noticeable in younger groups.

DISCUSSION

The most secure method of achieving herd immunity is with an effective vaccine. In India, over 97% of population that means almost 201 crores dose administration done so far *via* government vaccination center at free of cost. Recently they have also started 75 days long special vaccination drive by giving booster dose to all eligible candidates. Prior to this, from 16th march precaution doses were also available free of cost for front line worker, health care worker and people above 60 years and from 10th April it was available for age group of 18-59 years. A 75-day vaccination drive began from 15th July in government vaccination center to give precaution doses. Till date total of 6.77 crores precaution doses has been given to adult across country. And according to health ministry, 98% of adult population has already received at list 1 of the precaution dose of COVID vaccine. Again, on July 18, an approximate four crore eligible individuals will begin the COVID vaccination process throughout the nation, despite the fact that the government has made immunization, including booster doses, available to all for free. As part of the government's "Azadi Ka Amrit Mahotsav" to mark the 75th anniversary of India's Independence, the "COVID Vaccination Amrit Mahotsava" is being held with the goal of increasing the eligible population's uptake of COVID prophylactic doses [9].

Given that the virus is only a few years old, there is unavoidably a huge information gap. Research is being done all over the world using the data that is now accessible to learn more about the virus' genome, strain, virility, pathogenicity, treatment options, potential for vaccine development and availability of an effective vaccine against this novel virus. Clinical trials are conducted; however there aren't any published results yet. Numerous studies on antivirals, other drugs and vaccinations are now being conducted. Scientists are still unable to explain why some people get moderate symptoms while others experience severe infection, if a person will develop a second infection, whether the second infection will cause additional consequences, or any of these other issues [10]. Given that we do not currently know how long naturally acquired immunity to SARS-CoV-2 lasts (immunity to seasonal Coronaviruses is typically relatively short lived), particularly among those who had mild forms of disease and whether it might take several rounds of re-infection before robust immunity is attained, another question is what it would take to achieve 50% population immunity [11-15].

The immunity produced by vaccination or a natural infection must stop further transmission, not simply clinical illness, in order to create herd immunity. Clinical signs are a poor predictor of transmissibility for some infections, such as the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), as asymptomatic hosts can be extremely infectious and aid in the spread of an epidemic. The strength and duration of the acquired immunity have a significant role in how effective herd immunity is once it has been attained. Herd immunity is very effective and can stop the spread of a pathogen within a population for pathogens for which lifetime immunity is induced, as is the case with measles vaccine or infection. Due to the waning of antibodies to many other infectious diseases, including pertussis and Rotavirus, this circumstance is, however, rather uncommon [16-20]. Herd immunity is consequently less effective and sporadic outbreaks are still possible. Finally, clusters of susceptible hosts that often come into contact with one another may persist if immunity is unevenly distributed throughout a population. These pockets of susceptible people are still at risk for local outbreaks even if the population's overall immunization rate exceeds the herd immunity threshold. At this point, only non-pharmaceutical measures such as social withdrawal, patient quarantine, surgical masks and hygiene practices been shown to effectively stop the spread of the virus. As a result, these measures should be strictly enforced. A consideration for limited healthcare resources is especially important in the context of achieving herd immunity to SARS-CoV-2, as this strategy depends on letting a significant portion of the population contract the virus. Healthcare systems will be quickly overwhelmed if SARS-CoV-2 propagation is not stopped. Insufficient healthcare resources will result in higher COVID-19 mortality as well as higher mortality from all causes. This consequence will be especially catastrophic in nations with inadequate public health infrastructure, limited hospital surge capacity and vulnerable communities like the homeless and prisoner populations. In the upcoming months, potential antiviral medications that lower viral loads and hence minimize transmission, or therapies that stop complications and fatalities, might be crucial for epidemic control [21-25]. It is theoretically conceivable to develop SARS-CoV-2 herd immunity through spontaneous infection in the absence of a vaccine. The societal repercussions of reaching this goal are disastrous, thus there is no simple, moral way to do it.

CONCLUSION

Herd immunity functions by reaching a population level threshold immunity that, in theory, can break the chain of transmission of a certain infectious illness, whether it is acquired naturally through infection or through vaccination. This does not necessarily imply that a specific person is always safe or secure. When the threshold immunity is high enough, it can protect the majority, if not all, of a population in a specific geographic area for a specific amount of time. However, it is clear that the latter idea would be much influenced by how long each person's natural or vaccine induced immunity would last. Reinfection concept has been definitively proven in a few cases only so far and thus we cannot that whether this is unknown rare phenomenon or a frequent one. Additionally, it is unknown how a prior infection might influence the course of a subsequent infection and whether any pre-existing immunity would influence viral shedding and transmissibility. Only non-pharmaceutical interventions like social estrangement, patient isolation, face masks and hand hygiene have so far been shown to effectively stop the spread of the virus. As a result, they should be carefully enforced. In the upcoming months, potential antiviral medications that lower viral loads and hence minimize transmission, or therapies that stop complications and fatalities, might be crucial for epidemic control. This is as we wait for vaccines, which will enable us to achieve herd immunity in the safest manner possible.

REFERENCES

1. Barr S. Coronavirus: What is herd immunity and is it a possibility for the UK? Independent, 2020.
2. Yong E. The UK's Coronavirus 'herd immunity' debacle. The Atlantic, 2020.
3. Anderson RM, May RM. Vaccination and herd immunity to infectious diseases. Nature 1985; 318:323-329.
4. Delamater PL, Street EJ, Leslie TF, et al. Complexity of the basic reproduction number (R_0). Emerg Infect Dis 2019; 25:1–4.
5. Salje H, Tran Kiem C, Lefrancq N, et al. Estimating the burden of SARS-CoV-2 in France. Science 2020; 369:208-211.
6. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel Coronavirus in Wuhan, China. Lancet. 2020; 395:497–506.
7. Oke J, Heneghan C. Global Covid-19 Case Fatality Rates. The Centre for Evidence-Based Medicine, 2020.
8. Flaxman S, Mishra S, Gandy A, et al. Estimating the effects of non-pharmaceutical interventions on COVID-19 in Europe. Nature 2020; 584:257-261.
9. The times of India. 4 crore eligible people still to take 1st shot of COVID vaccine. 2022.
10. Iftikhar N. Health line, Herd immunity: What it means for COVID-19? 2020.