Journal of Research in Medical and Dental Science
2022, Volume 10, Issue 10, Page No: 265-269

Available Online at: www.jrmds.in
eISSN No.2347-2367: pISSN No.2347-2545

Role of Herd Immunity in SARS-CoV-2 (COVID-19) Control

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ABSTRACT

Introduction: The coronavirus disease is also known as COVID-19. It is caused by an infectious from SARS-CoV-2 virus. Population affected usually have less severe respiratory symptoms, it is minimal to moderate and doesn't require any specific medical care. However, some will become seriously ill and needs special treatment. The steep increase in amount of positive cases of COVID-19 around the world rendered health officials to find the best way to protect people from the disease; with this "herd immunity" was frequently cited and considered as long term solution of the pandemic. WHO suggests herd immunity should be achieve through immunization by vaccine and not by permitting expansion of disease through any segment of population as it is scientifically problematic, unethical, dangerous, irrational and can be fatal.

Objectives: Study aims, to provide a review of relevant and authorized data on the herd immunity's importance in COVID-19 disease. This review will provide information about herd immunity, difficulties and problems, its effect in COVID-19.

Methodology: A comprehensive review was undertaken by searching the Google Scholar, PubMed, Cochrane, Research gate, Web of Science, for literatures and articles published on herd immunity and COVID-19. Database search terms included keywords such as Herd Immunity, COVID-19 virus and disease, SARS-CoV-2, vaccination, immunity and immunization. By combining these words variety of terms have been searched and literatures were accessed.

Discussion: COVID-19 has created global burden and novel challenges. World has been facing lots of difficulties in different domains medical, psychological, social, economic etc. every aspect has been disturbed. It has created urge or necessity to achieve some kind of protection or exit strategies. With the rise of pandemic and difficulties created by it herd immunity has been one of the most common term which is widely searched and been interest of topic among researchers. As herd immunity has been reliable source for eradication of various deadliest diseases before.

Conclusion: Herd immunity has been proven effective before but the challenge this time world facing is far more lethal and fatal. Relying on herd immunity, especially which has been achieving with natural infection with exposure of population isn't best strategy. As it has lots of drawbacks and most importantly it can cause human life it is unrealistic goal. However if it achieved with vaccination it can be found beneficial and can serve as exit strategy but the strength and duration of immunity achieved would still be unknown. Further studies on large scale with larger number of population are necessary for better understanding.

Key words: Herd immunity (indirect immunity), COVID-19 virus and disease, SARS-CoV-2, Vaccination, Immunity and immunization

HOW TO CITE THIS ARTICLE: Mayank Yadav, Swarupa Chakole, K Himabindu Reddy, Role of Herd Immunity in SARS-CoV-2 (COVID-19) Control, J Res Med Dent Sci, 2022, 10 (10): 265-269.

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E-mail: khbr.nix@gmail.com
Received: 02-Aug-2022, Manuscript No. JRMDS-22-49600;
Editor assigned: 04-Aug-2022, Pre QC No. JRMDS-22-49600 (PQ);
Reviewed: 18-Aug-2022, QC No. JRMDS-22-49600;
Revised: 03-Oct-2022, Manuscript No. JRMDS-22-49600 (R);
Published: 13-Oct-2022

INTRODUCTION

The novel coronavirus disease is also known as COVID-19. It is cause by an infectious from Severe Acute Respiratory Syndrome Corona Virus-2 (SARS-CoV-2 virus). It has been initially identified in Wuhan city, in China in the month of December 2019 [1]. It has been declared as global pandemic in the month of March, 11, 2020 by World Health Organization (WHO) [2]. Globally, as of 28 September 2021, 232,075,351 numbers of positive cases of COVID 19, including 4,752,988 number of mortality have been reported to WHO. In India, at present, as on, 29 September 2021 there have been 33,697,581 numbers of positive cases of COVID-19 with 447,373 number of mortality. Globally, as of 26 September 2021 administration of 5,924,819,985 vaccine doses has been done and 33.4% of population has been fully vaccinated. In India it is 818, 513, 827 and the rate is 16.9% [3,4]. The steep increase in the cases of COVID-19 around the world rendered health officials to find the best way to protect people from the disease; with this "herd immunity" was frequently cited and considered as long term solution of the pandemic.

LITERATURE REVIEW

COVID-19 disease

The Corona virus disease is also known as COVID-19. It is cause by an infectious from SARS-CoV-2 virus. Population affected usually have less severe respiratory symptoms, it is minimal to moderate and doesn't require any specific medical care. However, some will become seriously ill and needs special treatment. However, some will become seriously ill and needs special treatment [1,5].

Transmission, SARS-CoV-2 can transmits through contact and transmission of droplet, transmission through air, transmission from fomite, and with other modes of transmission such as blood borne, mothers to children, and animals to humans transmission. Infection caused by with COVID-19 virus, usually results into respiratory illness ranging from very mild disease to very severe disease and can be fatal resulting into deaths, however sometimes few cases remains asymptomatic and doesn't develop symptoms ever [5,6]. Aappearance of symptoms may take period of two-fourteen days after exposure to the COVID-19 virus. Chief symptoms includes fever or chills, cough, fatigue, Shortness of Breath (SOB) and difficulty in breathing, muscles and body aches, headaches, loss of taste, loss of smell, sore-throat, nausea and vomiting, congestion and running nose, diarrhoea, etc. [7].

The most effective strategy to prevent infection is to stay safe and informed about the condition. It is very helpful to protect yourself as well as others. Following guidelines, maintaining social distancing, isolation of infected and suspected person, wearing masks, sanitization, hand washing, quarantine etc. has been found effective in reducing spread. Out of various strategies to counter the disease, best are hospital preparedness, primary health care reinforcement, community health care improvement, following safety guidelines and maintaining social distancing, basic healthy habits, general sanitization, isolation and quarantine [8,9].

Herd immunity

Herd immunity: It is also known by the name of immunity of population as it is doesn't provide direct protection against the disease. Basic concept of herd immunity is the population can be immune to disease even if not all of its individuals are immunized, as long as sufficient individuals are immune. In this immunity is acquired at individual level, either with pathogenic organism through naturally occurring infection or passively by vaccine. When remarkably abundant fragment of population those are immune exists in population it shields vulnerable groups of population from infection [10,11].

Previously, various diseases have been blocked or eradicated with the help of herd immunity. One of the commonest examples is of smallpox, which was considered deadliest and fatal during ancient times and has been responsible for mortality from ancient to recent times. It was officially declared eliminated and eradication of it was achieved with the help of herd immunity which was achieved with extensive vaccination strategy [12-14].

WHO suggests herd immunity should be achieve through immunization by vaccine and not by permitting expansion of disease through any segment of population as it is scientifically problematic, unethical, dangerous, irrational and can be fatal [10,15]. This effect is often taken into consideration while developing structure of vaccination with the objective of establishing herd immunity so that to provide protection to the groups that cannot be vaccinated (Children, individuals with specific diseases, immuno compromised group etc.). Outcome differs with diseases, depending upon number of immunized individuals. Researchers are still figuring out strength and the duration of immunity, it also varies with respect to the severity of infection. Research led by Dr. Daniela Weiskopf, Alessandro Sette, and Shane Crotty, from the La Jolla Institute for Immunology, suggested that the infection that occurs naturally induces powerful response and duration of response is also good as it lasts. They further suggested nearly same type of response will emerge from vaccine and it will last for period of time [16].

Difficulties and problems

Firstly, as the name suggests novel corona virus, disease is new and Immunity from COVID-19 is vast subject, hence lots of things are yet to learn. Development of immunity has shown frequent variations. Most people develop immune response within weeks but its efficacy and duration is uncertain. There have also been reported cases of reinfection. Though it is considerable that elderly population and population with other comorbidities are highly susceptible for infection they aren't exclusive those are at risk. These difficulties and challenges are preventing, strategies to build up immunity by natural infection [15,17].

Secondly, vaccinating such large group of population isn't easier task. As at present (September 2021), almost 2 years from the appearance of first case not even half of population has been vaccinated despite the extensive work done by governments and health professionals. Globally, as of 26 September, administration of 2021 5,924,819,985 vaccine doses has been done and 33.4% of population has been fully vaccinated. Also it varies between age groups, as not all the age groups are eligible for vaccination [4].

Third, possibility of breakthrough infection will always be there although vaccines are found effective and have proven to decrease rate and severity of infection, risk is still there and it doesn't provide 100% surety. Vaccinated people can become infected this renders vaccination program difficult and forces to achieve higher level of vaccination to establish herd immunity [6,10].

Forth, if some of the fraction of community will remain unprotected they will be susceptible for getting infected and later on they can spread infection to other groups as

well especially those are at high risk, and even if immunity gets established it won't nullify the risk.

Finally, to survive herd immunity virus will try to mutate and maintenance of herd immunity is only possible if virus won't mutate genetically. For effective immunization to establish it is necessity virus won't mutate There is constant potential threat of genetic mutation of virus and it is one of the biggest barrier in achieving herd immunity [17,18].

Objectives: Study aims, to provide a brief review of relevant and authorized data on the importance of herd immunity and population immunity in COVID-19. This review will provide detailed and authorized information about herd immunity, difficulties and problems arising because of it and its effect in COVID-19.

Methodology: A comprehensive review was undertaken by searching the Google scholar, PubMed, Cochrane library, Research gate, Web of Science, for studies, literature and articles published on herd immunity and COVID-19. Database search terms included keywords such as Herd Immunity, population immunity, indirect immunization, COVID-19 virus and disease, SARS-CoV-2, vaccination, immunity and immunization. By combining these words variety of terms has been formed, searched and literature were accessed, reviewed and relevant studies were included in our study.

RESULTS

Total number of studies taken was 13, which includes systematic review, original articles, review articles, experimental study, perspective study etc. The following table shows information about all the studies that has been reviewed with the name of author, study type, title and the conclusion of studies (Table 1).

Table 1: Represents name of author, type of study, study title, and conclusion.

Author	Study Nature	Title	Conclusion
Qiang Wang, September 2021	Systematic review	Vaccination against COVID-19: A systematic review and meta-analysis of acceptability and its predictors	Study concluded Intervention and safety measures should be take nationally and individually to enhance acceptance of vaccine against COVID-19 and future apprehension [19].
Suneela Garg, March 2021		Critical interpretative synthesis of herd immunity for COVID-19 pandemic	Study concluded that in the context of mortality and morbidity, population immunity is a strategy for preventing and controlling the COVID-19 pandemic. Vaccines can be beneficial, but if herd immunity is to be gained naturally, preparation is required [17].
Kamran Kadkhoda, January 2021		Herd immunity to COVID-19: Alluring and Elusive	Study concluded that it's not advisable to consider vaccine as elixir but rather tool to help eliminate COVID-19 in combination with other controllable strategies [20].
Sheema Fatima Khan, January 2021	Review article	Herd Immunity in India: A review	Study concluded that it would not be rational in the modern era to depend on herd immunity achieved naturally [21].
Devi Sridhar, January 2021	Perspective study	Herd immunity by infection isn't an option	Study suggests that depending upon herd immunity acquire by natural infection isn't advisable [22].
Sankha Shubhra chakrabarti, December 2020	Experimental study	Are biological and environmental factors helping to stem the incidence and severity?	Study suggests that immunity achieve from subjection to different human corona virus (cross-immunity) results into decreasing the mortality and morbidity ratio [23].
Saad B. Omer, November 2020	Original article	Herd Immunity and Implications for SARS-CoV-2 Control	Study suggested that population immunity is key guarding mechanism against out-breaks and has manifested benefits in regions with satisfactory vaccination rates [24].
Monica Neagu, October 2020	Review article	The bumpy road to achieve herd immunity in COVID-19	Study concluded that immunity can be achieve with effective vaccine and pandemic can be control while herd immunity will be helpful to reduce further outbreaks [25].
Yuanqing Xia, September 2020	Review article	How to understand 'herd immunity' in COVID-19 pandemic	Study concluded that only vaccination can provide herd immunity safely. Obtaining population immunity through exposure of community to virus is neither desirable nor practical [26].
Jung F, July 2020	Research article	Herd immunity or suppression strategy to combat COVID-19	Study suggests that herd immunity if achieve artificially is effective, however

			best strategy to eradicate is prevention [27].
Haley E. Randolph, May 2020		Herd Immunity: Understanding COVID-19	Study concluded that there are two approaches to develop immunity against SARSCoV-2, however achieving herd immunity should not be goal in case where vaccination program isn't going on [11].
Boris M Hogema, April 2020	Research article	Herd immunity isn't realistic exit strategy during COVID-19 outbreak	Study concluded that depending solely on herd immunity isn't wise as it is very far goal and can also fuel the pandemic [28].
Adamik B, March 2020		Mitigation and Herd immunity strategy for COVID-19 is likely to fail	Study concluded that herd immunity will not provide ample of safety against second wave [18].

DISCUSSION

COVID-19 has created global burden and novel challenges. World has been facing lots of difficulties in different domains medical, psychological, social, economic etc. every aspect has been disturbed. It has created urge or necessity to achieve some kind of protection or exit strategies. With the rise of pandemic and difficulties created by it herd immunity has been one of the most common term which is widely searched and been interest of topic among researchers. As herd immunity has been reliable source for eradication of various deadliest diseases before.

Yuan J, et al. in their study suggests that with the evolution it is predicted that different intervention will help to reduce real time reproduction number, on the basis of which secondary cases infected by primary are predicted. As it is known herd immunity can be achieve naturally as well as artificially, officials and lawmakers can take it into consideration [29].

However it varies significantly, Boris M. Hogema, et al. Suggests that herd immunity can vary with number of cases; also it has gender difference and can also vary amongst different age groups. Antibodies are identified more frequently in youth persons (18-30 years), which could be linked to various social etiquette and a larger virus exposition, prior to the implementation of social distance [28].

Okba, et al. and Huang AT, et al. in their study conclude that it's unclear if the existence of SARS-CoV-2 antibodies gives protection or if it indicates presences of shorter long-term immunity. These data suggest that antibodies to SARS-CoV-2 may have restricted neutralizing power in person without symptoms and patients with just mild symptoms [30,31].

Devi Sridhar, et al. in their suggest depending solely on herd immunity which is achieve through natural infection isn't wisest. As virus is harmful and fatal to all the age groups exposure of population to it is dangerous, and even if immunity is achieved, its validity, duration protection of it will provide is not known [22].

Gilbert et al. in their study suggested that initially only those individuals should continue to live normal lifestyle those are recovered from infection and are seropositive, followed by population on the basis of risk stratification so that it will minimize global burden which has been placed on social and economic domain [9]. Such strategy would gradually build up immunity among population, minimizing the strain on hospital setups and ICU, while also help to decrease the severity of further pandemic waves. Also it won't be costly for human life which can be case if exit strategy is based on natural herd immunity.

CONCLUSION

Herd Immunity has been proven effective before but the challenge this time world facing is far more lethal and fatal. Relying on herd immunity, especially which has been achieving with natural infection with exposure of population isn't best strategy. As it has lots of drawbacks and most importantly it can cause human life it is unrealistic goal. However if it achieved with vaccination it can be found beneficial and can serve as exit strategy but the strength and duration of immunity achieved would still be unknown. Further studies on large scale with larger number of population are necessary for better understanding.

AUTHORS CONTRIBUTION

The design of the study has been formed by SC. MY and SC lead the creativity and type of the study-design. Manuscript of the study has been written by MY. SC read and gave approval to for publishing it.

FUNDING

None of the public and private organization's direct support will be taken for funding this research. Essential materials for the study will be provided by the Department of Community Medicine, under Datta Meghe Institute of Medical Sciences, Deemed to be University, (DMIMSDU).

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