

Prevalence, Effectiveness of Vaccination and Genomics of Omicron-A New Variant of SARS-CoV-2

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Abstract

Omicron is a new variant of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) and globally it created a challenging and hostile situation. It is highly contagious and has spread to more than 150 countries. Omicron variant has critical mutations in the spike protein than other Variants of Concern (VoC) -Alpha, Beta, Gamma and Delta and Variants of Interest (VoI) – Mu, Lambda. According to the latest WHO report, the United Kingdom has reported the highest number of SARS-CoV-2 Omicron variant cases. Unlike the previous SARS-CoV-2 variants including Delta, the present variant, Omicron does not lead to severe respiratory infection. The variant's spike protein has a higher affinity for the human Angiotensin-Converting Enzyme 2 (ACE2) receptor. The present context explores the details about the epidemiology, risk assessment and the genetic comparison of Omicron with other SARS-CoV-2 variants along with the impact of vaccines on Omicron infection.

Keywords: Omicron • Corona virus 2 • B.1.1.529 • Epidemiology • Transmissibility

Introduction

Human Corona Viruses (HCoV) are viruses that primarily cause Severe Acute Respiratory Syndrome Coronavirus type-2 [1]. Coronavirus disease 2019 (COVID-19) is first identified in Wuhan province, China in late 2019. Soon after, it spread rapidly all over the world and became a pandemic. The primary means of spread of the pandemic was through respiratory droplets under closed conditions among the sick, asymptomatic and healthy people.

Globally the word Omicron became very familiar from the past few months. B.1.1.529 (Omicron) infection was first confirmed in a specimen collected from a living 59-year-old male using a nasopharyngeal swab and was sequenced using a NanoporeMinION device in South Africa on 9 November 2021 and the same was reported to World Health Organization (WHO) on 24 November 2021 [2]. The WHO's Technical Advisory Group on Virus Evolution (TAG-VE) designated the variant B.1.1.529 and named it asOMICRON on 26 November 2021. Omicron is a highly complex variant with around 30 mutations in the spike protein; few of them are associated with humoral immune escape potential. The Omicron variant comprises four lineages including B.1.1.529, BA.1, BA.2 and BA.3. The transmissibility rate is very high with B.1.1.529 variant. Most of the global population was not vaccinated in early 2021 when delta was the dominant variant. The transmission rate, hospitality, ICU admission, oxygen requirement and mortality rate were high at that time. But in the era of Omicron the situation is different, even though omicron is highly contagious; many people are not affected by this variant. The reason behind this is the effectiveness of Covid-19 vaccination.

In case, if two different strains of corona virus include Delta and Omicron

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infected in same person at the same time called as Deltacron. The first case of Deltacron was reported on 7 January 2022 at the University of Cyprus in Nicosia by a virologist Leondios Kostrikis and team. Omicron has rapid spreading capacity, whereas Delta has severe infection with high mortality. These two combinations may become more dangerous with high death rates [3]. The present paper focuses on prevalence, transmissibility, genomic changes in virus and other significant factors of Omicron.

Epidemiology

Omicron is a highly contagious among the many SARS-CoV-2 variants (Table 1, 2 and 3). It has become prevalent in more than 150 countries in the world. According to recent statistics published by WHO (14 March 2022) the two developed countries United Kingdom (776370) and United States of America (660734) have been significantly impacted by this variant. Among the European countries Denmark (127533), Germany (109893) and have also recorded many cases of omicron [4]. The neighboring countries of South Africa including Eswatini, Zimbabwe, Mozambique and Namibia have also reported a massive increase of weekly number of new Covid-19 cases. Top ten countries which were reported highest Omicron cases till 14 March 2022 are graphically represented in Figure 1.

Transmissibility

First case of Omicron variant is reported in South Africa and it continues to increase rapidly day by day. More than 60000 new cases were reported within one week (Nov 29 to Dec 05), the transmissibility rate is 111% when compared to previous week (Nov 20 to Nov 28). According to WHO latest report, the positivity rate was increased from 1.2 to 22.4 % in South Africa in span of 25 days [4].

Vaccines

Vaccines are the key tools in prevention and control of various communicable diseases including SARS-CoV-2. So far, 57.1% population are fully vaccinated in the world. The two highly populated countries China and India are vaccinated with 87.8% and 59.2 % respectively. Other countries like Brazil, United States of America and Indonesia are vaccinated with 74.4%, 65.8 %, 59.2% and 55.7% respectively. In South Africa, only 25-30% of the population are fully vaccinated and this could be the major factor for rapid spread and for the growth of higher R value. According to National Institute for Communicable Diseases (NICD), South Africa, during November 2021 the R value in Gauteng provinces was 2. During the delta variant prevalence, the

Table 1. SARS-CoV-2 Variants of Concern (VOC).

S.No	WHO label (Pango Lineage)	No. of Spike Protein Substitutions	Spike Protein Substitutions	Country first detected (Year)	R value
1.	Omicron (B.1.1.529)	30	A67V, del69-70, T95I, del142-144, Y145D, del211, L212I, ins214EPE, G339D, S371L, S373P, S375F, K417N, N440K, G446S, S477N, T478K, E484A, Q493R, G496S, Q498R, N501Y, Y505H, T547K, D614G, H655Y, N679K, P681H, N764K, D796Y, N856K, Q954H, N969K, L981F	South Africa (November 2021)	2.5-4.2
2.	Delta (B.1.617.2)	10	T19R, (V70F*), T95I, G142D, E156-, F157-, R158G, (A222V*), (W258L*), (K417N*), L452R, T478K, D614G, P681R, D950N.	India (December 2020)	5-8
3.	Gamma (P.1)	8	D138Y, K417T, L18F, P26S, R190S, T1027I, T20N, V1176F.	Brazil (December 2020)	-
4.	Beta (B.1.351)	6	A701V, D215G, D80A, Δ241, Δ242, Δ243.	Nelson Mandela Bay, South Africa (October 2020)	-
5.	Alpha (B.1.1.7)	4	A570D, D1118H, S982A, T71I.	United Kingdom (November 2020)	4-5

Table 2. SARS-CoV-2 Variants of Interest (VOI).

S.No	WHO label (Pango Lineage)	Spike mutations of interest	Country first detected (Year)
1.	Mu (B.1.621, B.1.621.1)	R346K, E484K, N501Y, D614G, P681H	Colombia (January 2021)
2.	Lambda(C.37)	L452Q, F490S, D614G	Peru (December 2020)
3.	n/a (AY.4.2)	L452R, T478K, D614G, P681R, A222V, Y145H	United Kingdom (June 2021)

Table 3. SARS-CoV-2 Variants of Monitoring (VOM).

S.No	WHO label (Pango Lineage)	Spike mutations of interest	Country first detected (Year)
1.	n/a (B.1.1.318)	E484K, D614G, P681H	Unclear (January 2021)
2.	n/a (B.1.617.2 + K417N)	L452R, T478K, D614G, P681R, K417N	United Kingdom (June 2021)
3.	n/a (C.1.2)	D614G, E484K, H655Y, N501Y, N679K, Y449H	South Africa (June 2021)
4.	n/a (B.1.617.2 + E484X (d))	L452R, T478K, D614G, P681R, E484X (d)	India (April 2021)
5.	n/a (B.1.617.2 + Q613H)	L452R, T478K, D614G, P681R, Q613H	India (April 2021)
6.	n/a (B.1.617.2 + Q677H)	L452R, T478K, D614G, P681R, Q677H	India (April 2021)
7.	n/a (B.1.640)	D614G, F490R, N394S, N501Y, P681H, R346S, Y449N, 137-145del	The Republic of Congo (September 2021)

n/a= Not applicable, No WHO label has been assigned for the particular variant at this time

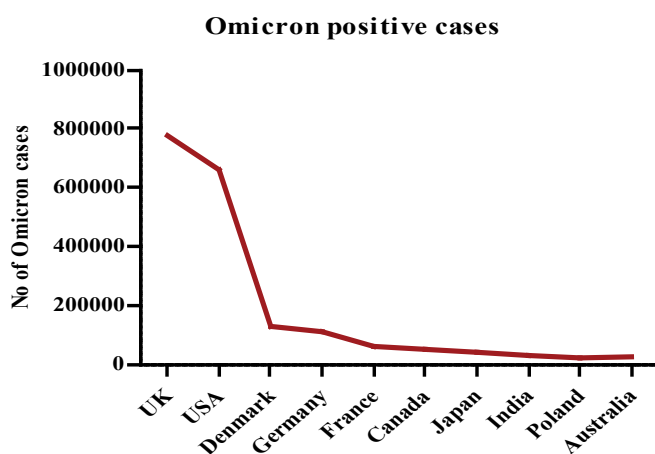


Figure 1. Omicron cases across the world.

R value was 1 whereas in omicron case it is multiplied in the same province. This indicates that omicron variant has higher transmissibility rate. The epidemiological studies still are in progress to understand the precise factors involve in the increasing the transmission of omicron variant.

Clinical symptoms

The clinical symptoms of delta variant range from 3-7 days after infection, while in the case of omicron it is different, factors like vaccination, person's

immunity and presence of antibodies may influence the incubation period 1-3 days after the infection. Clinical descriptions of Omicron cases from mild to moderate with common symptoms headache, sore throat, runny nose, cold and mild fever. The reinfection rate is less in both vaccinated and people having past history of SARS-CoV-2 infection compared to people who were not come in the above cases.

Severity of the omicron

Enough data is not available to understand the severity of omicron variant across the world. However, hospitalization or ICU admissions and oxygen requirement are minimal compared to delta variant. Nicole Wolter et al., stated that the hospital admission and severity are relatively high in the patients over 60 years of age [5]. Ewen Callaway & Heidi Ledford in their commentary mention that despite less severity of omicron infection, the spreading rate is 3-6 times higher than Delta [6].

Impact of omicron on immunity

Omicron variant has higher rate of immune escape capabilities than other variants. The levels of pre-existing immunity acquired by natural (due previous infection) or vaccination significantly influence the reduced severity or preventability of omicron variant.

Phylogenetic analysis showed that the Omicron closely resembles to the Gamma variant. The structural analyses showed that several mutations are localized to the region of the S protein that is the major target of antibodies, suggesting that the mutations in the Omicron variant may affect the binding

affinities of antibodies to the S protein. Due to extensive mutations in the spike protein, the Omicron variant might evade the immunity in the vaccinated individuals. On re-infection, the preliminary study suggests that the mutations present in the Omicron variant "may reduce neutralizing activity of antibodies resulting in reduced protection from natural immunity".

T cells derived antibodies are less affected by Omicron mutations than are antibody responses including natural killer cells. Extensive vaccination across the world would be helpful to prevent number of mutations and to improve the immunity against SARS-CoV-2 infections.

Treatment for omicron

Therapeutic interventions for the management of omicron patients is to improve hosts immune response and to prevent the secondary infections. Most of the countries follow the empirical therapy to treat omicron infections. However the preliminary data suggest that monoclonal antibodies developed against SARS-CoV-2 have impaired in neutralization of Omicron.

Omicron genomics

Multiple variants of SARS-CoV-2 have been identified globally including alpha, beta, gamma, delta and recently Omicron with mutations in their spike proteins. Severe Acute Respiratory Syndrome Corona virus 2 is a single-stranded RNA genome and a nucleocapsid of helical symmetry [7]. This enveloped virus has three major proteins. The envelope (E) protein- minor structural protein that forms pentameric ion channels, the membrane (M) protein- main structural protein and the spike (S) protein- consists of head (S1) and stem (S2) subunits. Since omicron is RNA virus chances of mutations high than in DNA viruses. Omicron genome contains 60 mutations from the wild type variant (Wuhan-derived reference genome) [8]. Out of 60 mutations 37 occurred in the receptor-binding domain (RBD) of Spike (S) protein [9]. As per literature the main binding site for Omicron is angiotensin-converting enzyme 2 receptor (ACE-2) [10]. The Omicron variant has two mutations which increase the spike protein's affinity to ACE-2 receptor, which may contribute to the current concern [11]. Other specific Omicron mutations have a theoretical risk of increasing transmissibility while another set of mutations may result in evasion of the immune system [12,13].

Conclusion

Omicron variant of the SARS-CoV-19 has spread to every corner of the world. The most prominent finding about this variant is that it leads to milder cold like symptoms. Unlike other variants, it has not much effect on respiratory system and does not change the smell and taste sensibility of the infected person as observed in Delta variant. The scientists and researchers are trying to decode the nature of Omicron to find the right cure and method to prevent this variant. Further, strictly adhere Covid-19 norms, ramping up covid-19 vaccination might not only put a forceful dent in the Omicron wave spread but also prevent other waves.

Conflict of interest

The author declares no conflict of interest.

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Ethical approval

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