

Controlling the COVID-19 Pandemic with Masks and Social Distancing

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ABSTRACT: Coronavirus disease 2019 (COVID-19) is a severe acute respiratory infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The pandemic has spread to 223 countries and regions around the world, and the total number of infections has exceeded 211 million, with over 4 million deaths. COVID-19 is causing substantial social and economic losses, while drugs and vaccines are still in the developmental stages or needing full evaluation. Therefore, some non-pharmaceutical interventions (NPI), such as wearing masks, social distancing, and isolating at home, are currently the most important measures for controlling disease spread. This article reviews the role and effects of wearing masks and maintaining social distancing in the control of COVID-19.

KEYWORDS: Translational Medical Sciences; Disease Prevention; COVID-19; SARS-CoV-2; Mask; Social Distance.

■ Introduction

Coronavirus disease 2019 (COVID-19) is a severe acute respiratory infection caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). As of August 22, 2021, the disease had become a pandemic, spreading to 223 countries and regions around the world, with a total of more than 211 million infections and approximately 4.4 million deaths.¹ In response to this global crisis, the World Health Organization (WHO) issued response guidelines.² Meanwhile, to control the epidemic to the greatest extent, each country introduced relevant policies based on their own conditions, endeavoring to stop the increasing of mortality rate and reduce the socioeconomic burden caused by COVID-19.

SARS-CoV-2 is a member of the coronavirus family (Coronaviridae). The virus particles are mostly round with a diameter of 80-120 nm.³ Particle envelopes are covered with corona-shaped spike proteins on the periphery, hence the name. The virus can be alive and infectious under cold conditions but easily inactivated by heat. Moreover, it can survive for 4-72 hours on a variety of objects, such as plastic, stainless steel, cardboard, and other surfaces. The main routes of transmission are droplet and contact transmission.⁴⁻⁶

COVID-19 caused by SARS-CoV-2 mainly manifests as fever, dry cough, and fatigue. A small number of patients have nasal congestion, runny nose, diarrhea, and other upper respiratory and digestive tract symptoms.^{7,8} Severe cases often cause difficulty in breathing after 1 week and rapidly progress to acute respiratory distress syndrome, even death. Most people with infections have a good outcome, especially children with mild symptoms, but elderly individuals and those with chronic underlying diseases can have more severe symptoms.

■ Discussion

The Transmission of SARS-CoV-2 is Enhanced by Personal Behavior:

At present, it is known that the transmission of SARS-CoV-2 mainly occurs through droplet and contact transmission. In some specific aerosol production processes or environments, it may be transmitted via aerosols.⁹

The incubation period of COVID-19 is 2-15 days, with an average of 5.1 days. Patients with asymptomatic infections and those in the incubation period are highly contagious.^{10,11} Studies on the dynamics of SARS-CoV-2 spread show that patients in the incubation period are capable of transmitting virus on average 2.3 days before symptom onset, and the intensity of infection reaches a peak 0.7 days before obvious symptoms.¹² A large viral load appears in the saliva of patients and asymptomatic infected persons and spreads through droplets formed by coughing, sneezing, talking, breathing, and other behaviors. Although infected children are mostly mildly ill, there is no significant difference in the viral load in their saliva compared to that of adults or between those who are asymptomatic and symptomatic. Statistical studies have shown that among all SARS-CoV-2 infections, 40-45 % of the sources of infection are from asymptomatic infections.¹³

Epidemiologically, the transmission ability of a pathogen or virus is expressed by the basic reproduction number (R_0). Referring to the situation in which no external force is involved, and everyone is assumed to have no immunity, the R_0 number is the average number of people infected by a person with a certain pathogen. The larger the R_0 number, the more difficult it is to control the epidemic. If $R_0 < 1$, the infectious disease will gradually disappear; if $R_0 = 1$, the infectious disease will become endemic in the population; and if $R_0 > 1$, the infectious disease will spread exponentially and eventually become a pandemic. It is estimated that the R_0 of SARS-CoV-2 is 2.4-3.9.¹⁴ For such a highly infectious disease, the goal of prevention and control is to employ medical and nonmedical methods to reduce the R_0 to less than 1.

Nonpharmaceutical Interventions (NPIs) to Control the COVID-19 Pandemic:

Although COVID-19 vaccines are currently being deployed on an emergency basis throughout China, the United States, the United Kingdom, and other countries, people are now facing different variant strains of SARS-CoV-2, and vaccine efficacy needs more evaluation. Therefore, the use of nonpharmaceutical interventions (NPIs) to reduce COVID-19 infections is particularly important at this stage, even over a long period of time. Although home isolation, community restrictions, and school closures are most effective measures during a pandemic, they also bring about a series of negative social and economic effects. Thus, some other nonmedical interventions that take into consideration various implementation convenience and economic factors, such as wearing masks and maintaining effective social distancing, are currently the most recommended WHO Preventive Measures and can effectively reduce the risk of virus transmission from potentially infected persons.²

Masks:

The use of masks can be traced back to the 14th century when people realized that covering the nose and mouth could block the spread of respiratory diseases. By 1910, the Chinese doctor Wu Liande designed the "Wu-style mask" during the plague epidemic, which played a vital role in protecting the population. His concept was known as "a milestone in modern comprehensive disease prevention and control".¹⁵ Since then, East Asia, including China, Japan, South Korea, and other regions, have gradually developed a "mask culture". During the high incidence of respiratory viruses in autumn and winter each year, many people wear masks spontaneously to prevent disease infection. However, due to cultural differences, this behavior in the eyes of Europeans and Americans is tantamount to declaring that I am a "patient" and that I am the source of infection on the street. Therefore, many healthy people refuse to wear masks to protect themselves and prevent disease infection. This difference in perception in the initial stages of the COVID-19 pandemic in 2020 meant that countries in Europe and the United States saw a surge of infections. Studies have shown that in countries and regions that do not require mandatory wearing of masks, the spread of SARS-CoV-2 is 7.5 times that of requiring mandatory wearing of masks.¹⁶ Comparing the incidence of COVID-19 per million people in Hong Kong, mainland China, Spain, Italy, and Germany in March 2020, we found that in Hong Kong, China, where 96 % of the population wore masks, the number of COVID-19 cases was only 129 per million people. In the same period in European countries without a mask culture, the number of COVID-19 cases per million population was 1,242 cases in Germany, 2,251 cases in Spain, and 2,983 cases in Italy, which was approximately 9.6–23.1 times higher than that in China.¹⁷

From medical databases, Chu and his colleagues used meta-analysis to review medical masks used in medical units in the COVID-19, SARS (Severe Acute Respiratory Syndrome) and MERS (Middle East Respiratory Syndrome) seasons. They found that in the group that does not wear medical

masks, the probability of contracting the virus is 17.4 %, while in the group wearing medical masks, the probability is only 3.1 %, which shows that medical masks can do a good job of personal protection in a high viral load environment. This protective effect is even greater when wearing N95 masks. Wearing a mask can not only reduce the direct transmission between people due to droplets but the physical barrier can also effectively limit the virus that is transmitted by potentially infected persons when they speak, cough, or sneeze, spreading emission clouds of viral particles and contaminating the surface of objects. In addition, because of wearing a mask, the diffusion range of emission-containing virus particles can be reduced from 2.4 m to 6 cm.¹⁸

However, some negative effects of wearing a mask for a long time cannot be ignored, such as the influence of facial recognition and emotional communication between people, the influence on talking, especially communications with the hearing impaired, the discomfort people have when wearing glasses that fog up, and for people with diseases that cause breathing difficulties. Moreover, crowd psychology in populations choosing to wear masks or not need to be considered when implementing mandatory mask-wearing measures. At present, more than 100 countries around the world have adopted the mandatory wearing of masks as a compulsory public health measure at the national level. Investigations have shown that if only voluntary mask wearing is recommended, it will lead to a weak or even ineffective epidemic prevention outcomes and even cause negative effects, such as social injustice.

Social Distancing Supports the Protective Effects of Masks:

Maintaining a certain social distance is of great significance in preventing infectious respiratory diseases, especially those that are spread by droplets. Droplet particles usually fall within 1–2 m, depending on the size of the droplets. Keeping effective social distancing can reduce the probability of transmission of respiratory viruses. A meta-analysis on confirmed cases involving COVID-19, SARS, and MERS revealed that when the social distance is less than 1 m, the probability of viral infection or transmission is 12.8 %; however, when the distance is more than 1 m, transmission probability is reduced to 2.6 %. Meaningfully, every additional meter of social distance can reduce the probability of infection by 2.02 times.¹⁹ Therefore, the social isolation strategy currently adopted by China is one-meter of space between persons, while in Western countries, it is 2 meters (approximately 6 feet) between people. However, a long time spent maintaining social distance, especially social isolation, may also bring certain negative effects, including psychological problems such as depression and anxiety.

Nevertheless, maintaining social distance can enhance the effectiveness of wearing masks to control epidemics. A mathematical statistical model shows that effective social distancing supported by related policies can reduce the number of hospitalized cases of COVID-19 patients by 92 % in the United States, which is very important for saving medical resources. Their predictions also show that if mask wearing in the population reaches 80 %, it is expected that

the spread of SARS-CoV-2 will eventually decrease. Most importantly, when social isolation and mask wearing are implemented at the same time, as long as the population mask coverage rate reaches 30 %, the goal of ultimately eliminating the spread of the virus in the community can be achieved.²⁰

Another tracking analysis of nearly 200,000 people in different communities in the United States showed that the incidence of COVID-19 in communities that maintain good social distance is nearly 31 % lower than that in communities that do not adopt social distancing. In some communities with high population density and relatively poor sanitation conditions, if people can spontaneously wear masks, the incidence of COVID-19 is expected to be reduced by 63 %.²¹

Although there are disadvantages such as high population density and relatively weak health infrastructure, we found that this epidemic was quickly controlled in some countries, especially mainland China, because of effective government intervention with the active cooperation of the public, including social quarantine and mandatory wearing of masks in public, which was implemented quickly and compulsorily during the high-incidence period. In Europe and the United States, where the level of medical care and health is relatively developed, the government can only recommend but not enforce the above methods. As a result, the number of confirmed cases has remained high.

■ Conclusions

In summary, as a new type of emerging infectious disease, priority response is controlling transmission of COVID-19 first. In-depth research on pathogenesis, epidemiological characteristics, treatment methods and vaccine use will ultimately control viruses and eradicate diseases. At this stage, nonmedical interventions, especially wearing masks and social distancing, are effective and necessary methods. Moreover, the cooperation and conscious implementation of these methods by everyone in society is needed to overcome the pandemic.

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