The necessity of wearing facemasks correctly especially for students during the epidemic

Yuan Zhou\textsuperscript{a,†}, Meidan Zhao\textsuperscript{b,†}, Huan Wang\textsuperscript{c,†}, Qi Wang\textsuperscript{d,*}, Kai Zhang\textsuperscript{e,*}

a. College of Continuing Education, Tianjin Conservatory of Music, Tianjin, 300171, China.
b. School of Acupuncture & Moxibustion and Tuina, Tianjin University of Traditional Chinese Medicine, Tianjin, 301617, China.
c. Outpatient Office, Tianjin Gong An Hospital, Tianjin, 300042, China.
d. Department of Acupuncture and Moxibustion, First Teaching Hospital of Tianjin University of Traditional Chinese Medicine, Tianjin, 300193, China.
e. Department of Acupuncture and Moxibustion, Tianjin Gong An Hospital, Tianjin, 300042, China.

†Author Contributions: Yuan Zhou, Meidan Zhao and Huan Wang contributed equally to this work and are co-first authors.

*Corresponding authors: Kai Zhang, MD, Department of Acupuncture and Moxibustion, Tianjin Gong An Hospital, Tianjin, China. No. 78 Nanjing Road, Heping District, Tianjin, 300042, China. Tel:008613043295598. E-mail address: coolzhangkai@163.com. Kai Zhang ORCID 0000-0002-7248-1451. Qi Wang, MD, Department of Acupuncture and Moxibustion, First Teaching Hospital of Tianjin University of Traditional Chinese Medicine, Tianjin, 300193, China. No.88,Chang Ling Road, Xi Qing District, Tianjin, 300381, China. E-mail address: 1539221488@qq.com.

https://orcid.org/0000-0002-6780-6338
Yuan Zhou, MD. E-mail address: lark.zhou@126.com.
Meidan Zhao, MD. E-mail address: zhaomeidan2012@163.com.
Huan Wang, MD. E-mail address: gaywh@126.com.

**Keywords:** Facemasks; COVID-19; advantage; disadvantage.
Ever since the outbreak of COVID-19, the public started to know more about the features of this disease. It spreads fast and has a strong infection rate. Meanwhile, it also results in massive deaths on a global scale.\textsuperscript{1,2} COVID-19 can have person-to-person transmission through sneezing or respiratory droplets caused by caught. Its major infection tunnels are mouth and nose.\textsuperscript{3} Asymptomatic people may play a crucial part in the disease spread.\textsuperscript{3} To reduce the spread of COVID-19, wearing masks and keeping proper hand hygiene are of great importance. Fig.1 shows the situation of teachers and students wearing facemasks in class in a university in China.

Do facemasks cause carbon dioxide (CO\textsubscript{2}) accumulation?
Facemasks are a simple and powerful tool used to reduce the spread of COVID-19. One of the major concerns of the public is about the side effects. There are a variety of rumors about it, such as immune system weakness, hypercapnia, and hypoxia. People are concerned that inhaling high levels of carbon dioxide (CO\textsubscript{2}) in excess of human tolerance is life-threatening because of the likelihood of CO\textsubscript{2} accumulation from wearing masks. However, CO\textsubscript{2} accumulation caused by wearing a mask does not have any scientific base. Many studies have already debunked that myth. An observational study of 20 healthy volunteers revealed mild increases in physiological responses (respiratory rate, heart rate, oxygen saturation, and so on) from wearing a surgical mask for 1 hour at moderate operating frequency. However, this does not have clinical significance.\textsuperscript{4} Only minor effects were caused by wearing masks when people are doing aerobic exercise. Additionally, surgical masks only have a mild impact on end-tidal CO\textsubscript{2} and seem exclusively to be engaged in strenuous exercise. Therefore, it's safe for healthy individuals to wear a face mask.\textsuperscript{5} A study exploring new N95 masks designed for children indicated that the physiological parameters, including the end-tidal CO\textsubscript{2}, fractional concentration of inspired CO\textsubscript{2}, oxygen saturation, and pulse rate, all fell within an acceptable range when children wear a mask. Most children did not experience breathing difficulties.\textsuperscript{6} Therefore, masks with or without micro fans were comfortable and safe for children aged 7 to 14 years old when they imitated daily routine activities.\textsuperscript{6} A recent study focusing on the influence
of masks over the gas exchange in chronic obstructive pulmonary disease (COPD) patients and healthy people found that COPD patients did not show significant physiological changes in gas exchange after a 6-minute walk test with a surgical mask, especially in terms of the CO$_2$ retention.\textsuperscript{7} Altogether, it implies from the current evidence that although perceived force may be altered and breathing difficulties may increase during activity, there is only limited effect of wearing a mask on blood gas, respiration, and other physiological parameters. Such an effect is even undetectable during strenuous exercise. Moreover, most masks often do not fit the face perfectly, especially when speaking or exhaling. Compared with respiratory droplets, which carry the virus causing COVID-19, CO$_2$ molecules are so small that they can pass easily through cloth masks.\textsuperscript{8} Therefore, the CDC clearly states that wearing a facemask does not raise the level of CO$_2$.\textsuperscript{8}

\textbf{Conclusion}

More measures should be taken to prevent infection in the current outbreak. Wearing a facemask is considered as the first step of preventing and controlling the spread of the virus and pandemic. Health professionals should educate the public that masks are important for keeping the pandemic controlled. Students, as they have classes and are in the crowd, should be particularly careful.

\textbf{Author Contributions}

KZ and QW contributed to the conception and design of the work. YZ, KZ and QW drafted the manuscript. MZ and HW revised the manuscript. All authors gave final approval and agreed to be accountable for all aspects of work, ensuring integrity and accuracy.
Funding
The authors received no financial support for the research, authorship, and/or publication of this article.

Ethical statement
In this study, we used a photograph and we have received authorization of agreement from people in the photograph. No ethical approval was required for this manuscript as this study did not involve human subjects or laboratory animals.
Reference


Fig. 1 The situation of teacher and students wearing facemasks in class in a university in China.