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# Exhaled respiratory particles during singing and talking

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## Background

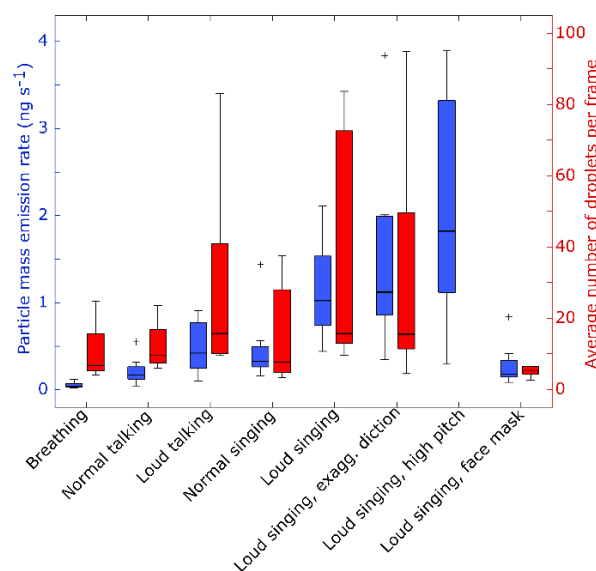
Choir singing has been suspended in many countries during the Covid-19 pandemic due to incidental reports of disease transmission. The main mode of transmission has been attributed to exhaled droplets, but with the exception of a study on tuberculosis from 1968, there is almost no scientific evidence of increased particle emissions from singing. The aim of this study was to investigate emissions of aerosol particles (dry size 0.6-10  $\mu\text{m}$ ) and droplets (before evaporation, no upper size limit) during singing, as compared to talking and breathing, and the efficacy of face masks to reduce emissions.

## Method

Twelve volunteer singers were included in the study (7 professional/5 amateurs). The size and concentration of aerosol particles were measured by an aerodynamic particle sizer (Model 3321, TSI Inc.). A high-speed camera (Photron FastCAM SA-X2) imaged the droplet emissions. Air samples were also collected close to two singing patients with Covid-19.

## Results

Singing generated significantly more aerosol particles than talking and breathing ( $p=0.002$ ), see Figure 1. Loud singing produced more particles than normal singing ( $p=0.002$ ). Singing with a face mask reduced the emitted aerosol particles and droplets to the level of normal talking. No SARS-CoV-2 was found in the air samples.



**Figure 1.** Aerosol particle emission rate (blue boxes, left y-axis) and the number of emitted droplets per frame (red boxes, right y-axis) during respiratory activities [1].

## Conclusions

In this study we saw that not only droplets generated from the mouth, but also smaller aerosols,  $<5 \mu\text{m}$ , are generated from sustained vocalization. Thus, singing while having a respiratory infection is likely to generate infectious bioaerosols. Singing together should be considered as a risk during the Covid-19 pandemic, especially since many of the infected individuals are the most contagious before symptom onset. Compared to talking, singing is also usually performed by many people simultaneously, which further increase emissions.

- [1] Alsved, M., Matamis, A., Bohlin, R., Richter, M., Bengtsson, P. E., Fraenkel, C. J., Medstrand, P., Löndahl, J. Exhaled respiratory particles during singing and talking. *Aerosol Sci. Technol.*, (just-accepted), 1-5, (2020).