Bulletin de veille émissions d'aérosols par l'appareil respiratoire humain N° 18 – Mars 2025

Objectifs : veille scientifique sur les émissions d'aérosols (gaz et particules) par l'appareil respiratoire humain (nez/bouche).

Les bulletins de veille sont disponibles sur le portail documentaire de l'INRS. L'abonnement permet de recevoir une alerte mail lors de la publication d'un nouveau bulletin (bouton « M'abonner » disponible après connexion à son compte).

Takano T, Xiang Y, Ogata M, Yamamoto Y, Hori S, Tanabe SI.

Effects of speech duration and voice volume on the respiratory aerosol particle concentration.

Environ Health Prev Med. 2025;30:14.

https://pmc.ncbi.nlm.nih.gov/articles/PMC11925707/pdf/ehpm-30-014.pdf

BACKGROUND: SARS-CoV-2 (COVID-19) is transmitted via infectious respiratory particles. Infectious respiratory particles are released when an infected person breathes, coughs, or speaks. Several studies have measured respiratory particle concentrations through focusing on activities such as breathing, coughing, and short speech. However, few studies have investigated the effect of speech duration. METHODS: This study aimed to clarify the effects of speech duration and volume on the respiratory particle concentration. Study participants were requested to speak at three voice volumes across five speech durations, generating 15 speech patterns. Participants spoke inside a clean booth where particle concentrations and voice volumes were measured and analyzed during speech. RESULTS: Our findings suggest that as speech duration increased, the aerosol number concentration also increased. Through focusing on individual differences, we considered there might be super-emitters who emit more aerosol particles than the average human. Two participants were identified as statistical outliers (aerosol number concentration, n = 1; mass concentration, n = 1). CONCLUSIONS: Considering speech duration may improve our understanding of respiratory particle concentration dynamics. Two participants were identified as potential super-emitters.

Hilger A, Stockman T, Murphey C, McCurdy J, Miller S.

Aerosol Emission During Speech: Investigating the Role of Glottal Configuration and Respiratory Effort.

medRxiv. 2025:2025.03.16.25324059.

http://medrxiv.org/content/early/2025/03/17/2025.03.16.25324059.abstract

https://www.medrxiv.org/content/medrxiv/early/2025/03/17/2025.03.16.25324059.full.pdf

*[This article is a **preprint** and has **not been peer-reviewed** [what does this mean?]. It reports new medical research that has yet to be evaluated and so should not be used to guide clinical practice.] Introduction Speech-driven aerosol generation plays a key role in airborne disease transmission, yet the physiological mechanisms remain poorly understood. While prior research suggests vocal fold vibration contributes to aerosol production, airflow turbulence and glottal configuration may be stronger determinants. This study examines how the type of phonation influences aerosol generation while controlling for respiratory effort. Methods Five healthy female adults (22–43 years) sustained vowels across six phonation types: modal voicing, glottal fry, falsetto, whispered speech, loud speech, and vowels preceded by /h/. Aerosol concentration and size distribution (0.1–20 µm) were measured using an aerodynamic particle sizer (APS). Laryngoscopy quantified normalized glottal gap, and CO2 range was recorded to control for respiratory effort. Bayesian regression models assessed relationships between phonation type, aerosol generation, and physiological predictors. Results Whispering and loud speech produced the highest aerosol concentrations, while glottal fry generated the least. Smaller aerosol particles (0.1–1 µm) were most prevalent across tasks, highlighting their potential for airborne transmission. Whispering exhibited a bimodal aerosol distribution, with increased emissions at both the smallest (0.1–1 µm) and largest (10–20 µm) particles sizes. Despite the assumption that vocal fold vibration is necessary for aerosol production, whispering, a voiceless phonation, generated the most aerosols, suggesting airflow turbulence and glottal configuration are stronger contributors. Normalized glottal gap was the strongest predictor of aerosol output, followed by CO2 range, while harmonics-to-noise ratio had a smaller effect. Conclusion Vocal fold vibration alone is not necessary for high aerosol generation; turbulent airflow through a partially open glottis is a key driver. These findings have implications for airborne disease transmission, particularly in densely occupied environments. Future research should explore real-world speech patterns to refine strategies for minimizing respiratory particle exposure.*

Xu JC, Zhai HY, So LK, Wang CT, Guo H.

Breathing dynamics and aerosol emissions from young people during cycling exercise.

Journal of Building Engineering. 2025;103:10.

https://www.sciencedirect.com/science/article/pii/S2352710225004693?via%3Dihub

Physical activity is important to maintain good physical and mental health. However, transmission of respiratory diseases in exercise facilities indicates the importance of maintaining good indoor air quality in these environments. Aerosols exhaled by infected individuals are a significant source of transmission of respiratory diseases. Thus, understanding breathing behaviour during exercise is critical. This study investigated breathing dynamics and aerosol emissions during cycling exercise and rest from 21 healthy participants (10 female and 11 male subjects, 19-37 years old). Key features such as minute ventilation, breathing patterns, peak inhalation and exhalation flow rate, and respiratory frequency were analysed. The results showed that exercise significantly increased minute ventilation, *and the variations of breathing flow rate over time followed a sinusoidal pattern. During maximal exercise, peak inhalation and exhalation flow rates were more than three times higher than those at rest, and respiratory frequency was approximately twice as high as that at rest. In addition, the size distribution of aerosols from breathing during exercise was mainly in the range of 0.3-2.5 mu m. Exercise significantly increased aerosol emissions of breathing, with average emission rates during maximal exercise being 9.0 times higher than at rest. These findings suggest that physical activity greatly affects breathing dynamics and aerosol emissions. Exercise facilities have unique characteristics that differ from other indoor settings. This study provides essential information that can serve as boundary conditions for computational fluid dynamics studies, aiding further research on aerosol dispersion, infection risk assessment, and the development of energy-efficient mitigation strategies for exercise facilities.*