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Auditory fatigue among professionals working in the amplified music sector

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Context

In the music sector, professionals are frequently exposed to sound **levels exceeding 100 dB(A)**. Hearing disorders are common among this population. By assessing auditory fatigue, situations that are deleterious for hearing can be identified, allowing the introduction of preventive actions before permanent impairment occurs. However, little is known about the **factors** contributing to auditory fatigue.

Goal

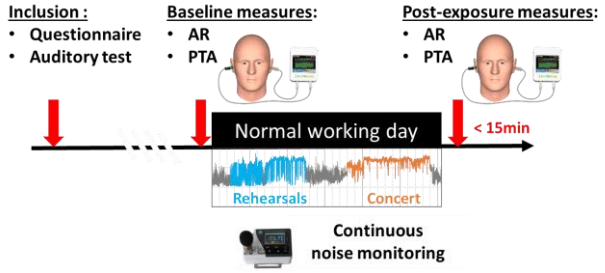
The main goal of this study was to determine the exposure parameters most influencing auditory fatigue during occupational exposure to amplified music with the aim of improving the prevention of hearing loss.

Auditory fatigue is defined as the temporary variation of hearing performances after a noise exposure. It is measured by the variation of **pure tone auditory threshold (ΔPTA**, subjective test) or **acoustic reflex thresholds (ΔAR,** objective test) with Echoscan®. This reflex is primarily linked to the contraction of the stapedius muscle in the middle ear (Venet et al, Noise and Health, 2012).

Mat & Meth

86 volunteers* measured during a normal working day.

- **Exposed group n=55**: Workday **including a concert** (sound and light engineer, stage technicians, barmen, security staff).
- **Unexposed group n=31**: Not exposed to high noise levels, administrative staff of venues.

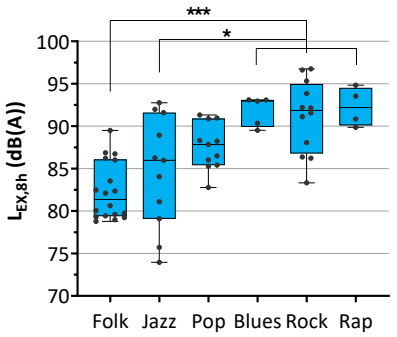


Linear regression models (stepwise selection with forward approach) were applied to investigate the factors influencing auditory fatigue. Two types of explanatory variables were used:

- **Information on the volunteer** (questionnaire & auditory performances at rest)
- **Noise exposure** indicators.

Results

NOISE EXPOSURE



Noise exposure level $L_{EX,8h}$; Box 25th to 75th percentiles ; whiskers min to max.

*ANOVA Bonferoni post-hoc *p < 0.05 ; *** p < 0,001*

Mean daily noise exposure

- **Exposed group 87.0±5.4 dB(A)**
- Unexposed group 66.5±4 dB(A)

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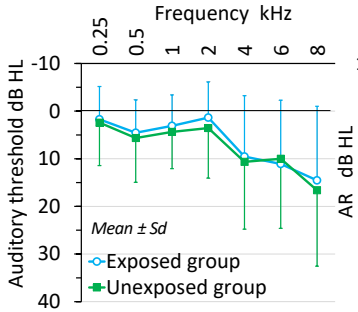
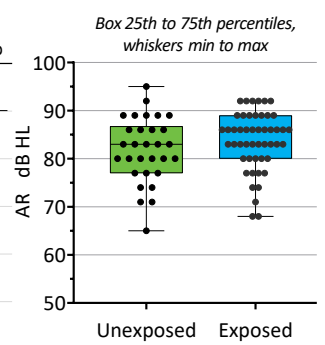
AUDITORY PERFORMANCES AT REST

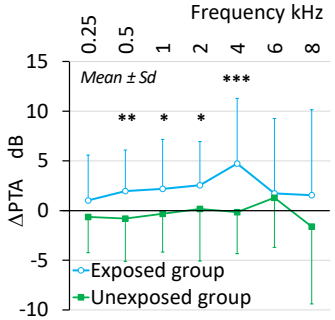


Baseline of pure tone hearing thresholds

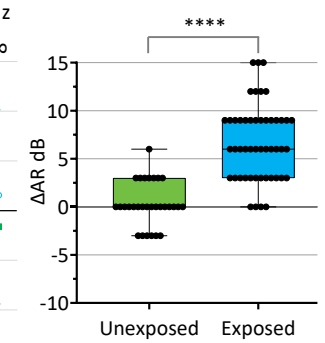


Threshold of the Acoustic Reflex (AR)

AUDITORY FATIGUE AFTER WORK DAY



Hearing threshold variations (ΔPTA)



Threshold variation of the Acoustic Reflex (ΔAR)

*t-test * p < 0.05 ; ** p < 0,01 ; *** p < 0,001 ; **** p < 0,0001*

MODELS OF AUDITORY FATIGUE

ΔAR RMSE = 3.1 dB	**R^2 = 0.63**	
Parameters	Coefficient	p value
Sound energy	**3.53**	< 0.001
Sound energy distribution	**-0.85**	0.013
Hearing threshold at 250 Hz	**-0.32**	< 0.001
Hearing threshold at 500 Hz	**0.16**	0.037
Hearing threshold at 6000 Hz	**0.06**	0.04
Constant	**3.43**	< 0.001

- The **sound energy** has the most weight on ΔAR. Its positive coefficient means that high level of noise exposure tends to increase the auditory fatigue.
- The second factor is the **distribution of sound levels**. The negative coefficient means that wide ranges of levels contribute to reduce ΔAR.
- The negative coefficient (250 Hz) is counterbalanced by the other two with positive coefficients (500 & 6000 Hz) in volunteers with good hearing. In contrast, volunteers with degraded hearing in the middle and high frequencies are associated with a higher ΔAR.

Discussion & Conclusions

- In the study population, noise exposure depends on the music genre but not on the job. Therefore, all professionals working in broadcasting space are at risk for hearing.
- ΔPTA and ΔAR were positively correlated with the **energy** of noise exposure and its **stability** over time, i.e, a **steady noise tends to create more auditory fatigue**.
- In addition to a global decrease of noise exposure, our results advocate for the provision of quiet periods within noise exposures as they reduce auditory fatigue accumulation and long-term risks for hearing.

* Approved protocol ID-RCB 2018 -A02832-53.

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