

Otoacoustic Emission findings from a large group of young people, and their relationship to other audiological findings.

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Introduction:

The National Acoustic Laboratories (NAL) collected audiometric data for just over 1400 young individuals (age range 11 to 35 years), in a large-scale study entitled "The Prevalence of Hearing Loss and Its Relationship to Leisure-Sound Exposure," (known as "iHEAR"). One aim of this study is to examine the relationship between the different Otoacoustic Emission (OAE) measures and Pure Tone Audiometry (PTA) results, as well as reported tinnitus and reported leisure noise exposure.

Method:

Each participant was assessed using four different OAE protocols:

- Transient Evoked (TE),
- Distortion Product (DP)
 - equal level stimuli (L1=L2=70dB) -- DP1
 - unequal level stimuli (L1=70dB, L2=60dB) – DP2
 - DP Input/Output function at 2kHz.

OAEs for approximately 1300 participants were obtained. In addition: pure tone audiometry; tympanometry; and a contralateral acoustic reflex measure at 2kHz were carried out. Each participant also completed a survey containing case history information and a noise exposure profile.



Much of the testing occurred onsite at schools & workplaces therefore testing of PTA and OAEs was performed using insert-earphones covered with noise excluding earmuffs.

Notes & References

¹ Correlations within this range were also found by Collet et al. (1991)

² Dhar, Long & Culpepper (1998) found when L1=70, a difference of 10dB between L1 and L2 elicited the largest OAE response.

³ Measures that take noise levels into account, such as SNR, have been found to predict hearing loss more accurately than amplitude (Gorga, et al., 1993)

⁴ Tinnitus ears were found to have reduced DPOAE amplitude by Shiomi et al. (1997) and Nottet et al. (2006).

Results:

Variability in OAE SNR:

For any given pure tone threshold there was great variability in OAE amplitude and SNR values.

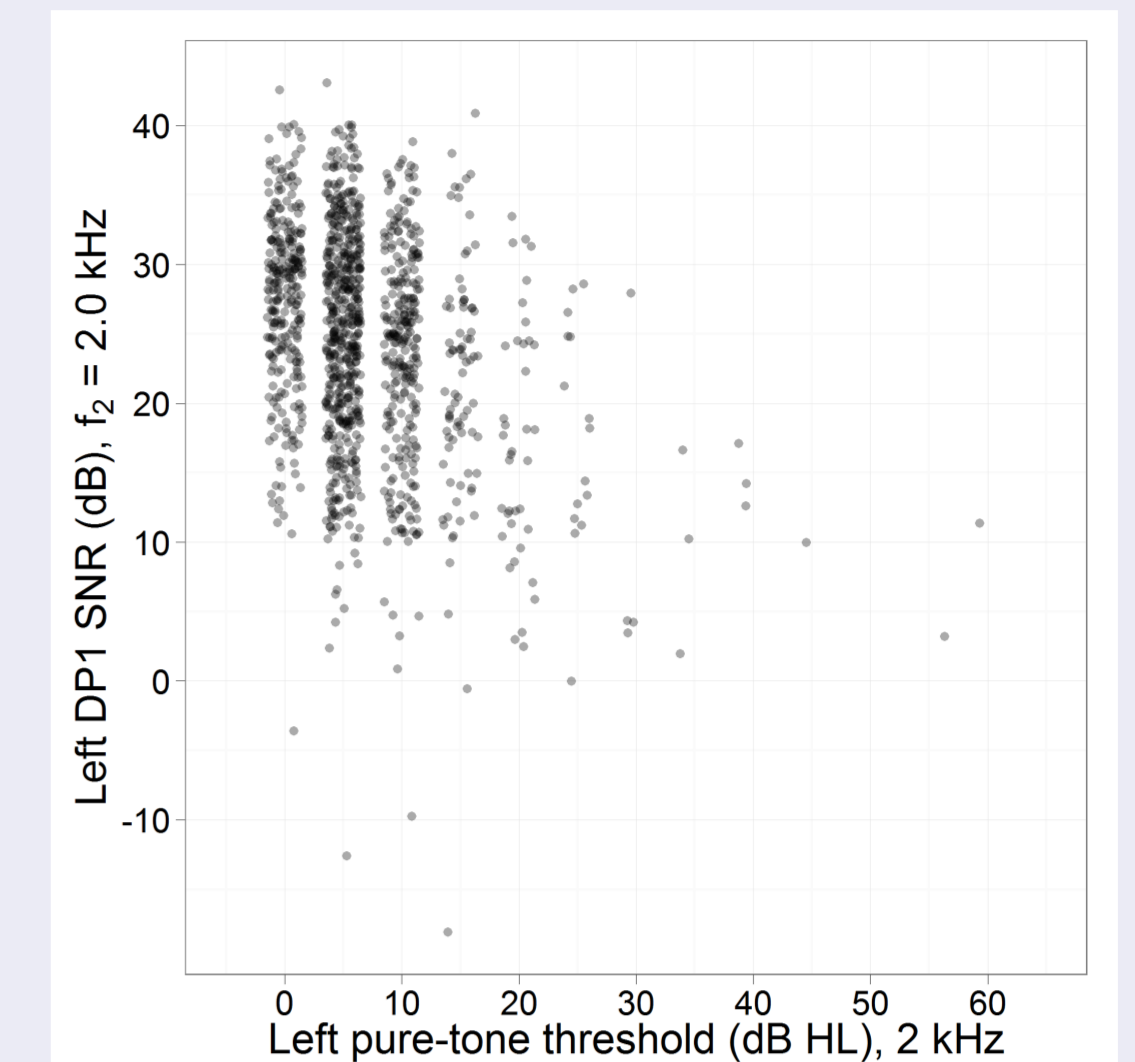


Figure 1: Variability of SNR at 2kHz for the left ear

Relationship to Age and Gender :

OAE SNR was related to both Age and Gender. Females had SNRs approximately 4 dB higher on average than males and SNR decreased approximately 0.2 dB per year as participants got older.

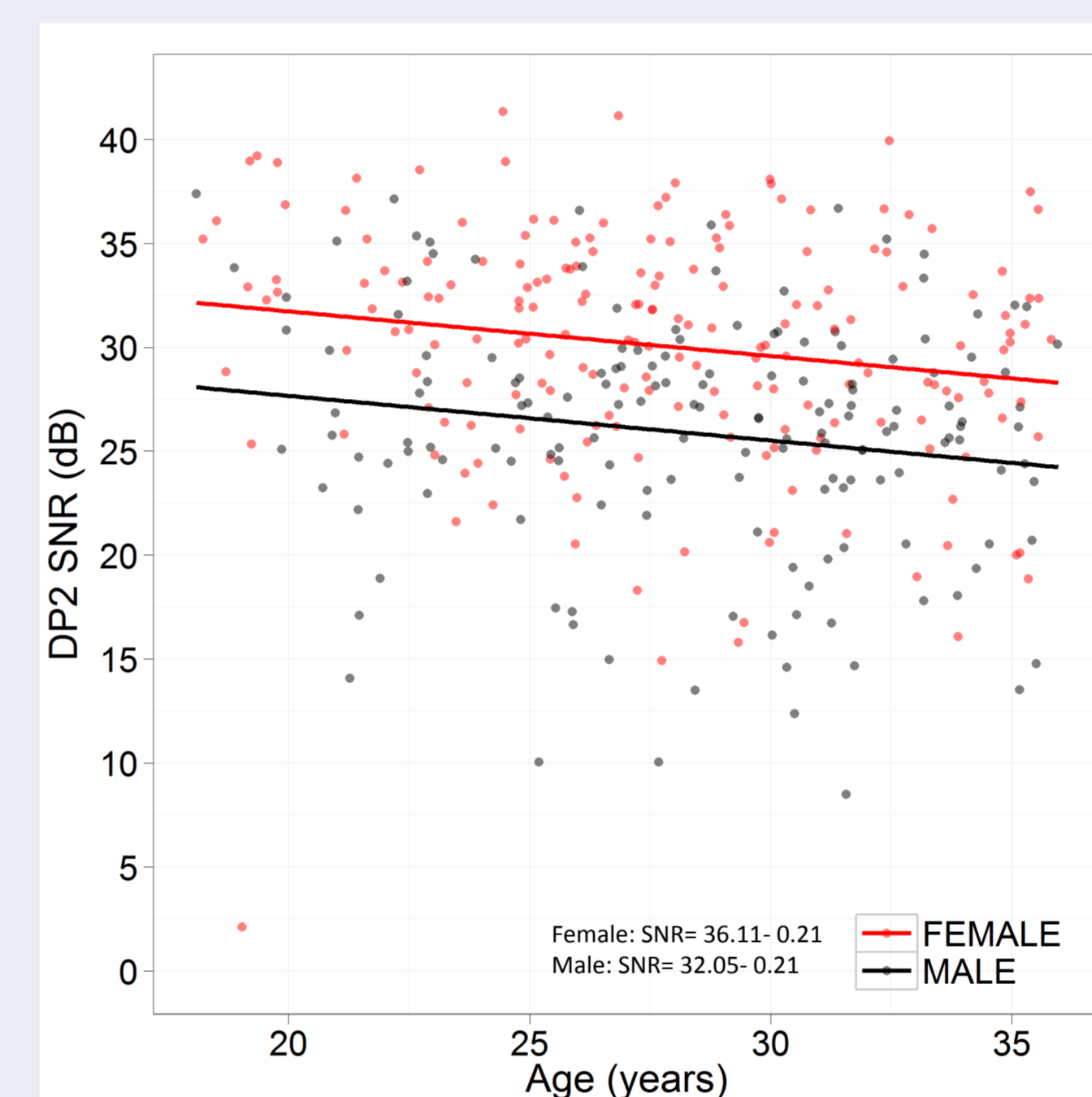


Figure 2: Regression lines for adult males and females showing the relationship between SNR and age (with noise exposure levels held constant). N=353 (not all participants had complete survey data).

Correlations with Other Audiological Factors: PTA

- TE, DP1 & DP2 all significantly correlated with PTA ($p < 0.05$) from 2- 8 kHz. But correlations were weak-moderate ranging from -0.19 to -0.5¹.
- Correlation between TEs and PTA had a greater range than those between DP OAEs and PTA
- In general DP2 showed significantly ($p < 0.05$) higher correlations with PTA than DP1 or TE especially at higher frequencies².

Tinnitus

- No significant relationship between OAE SNR³ at 4-6 kHz and tinnitus was found when controlling for gender and age differences⁴.

Reported Noise Exposure

- We have not found any sig. relationship between OAE SNR and reported levels of noise exposure. A closer examination of these results is yet to be completed.

Summary: our preliminary exploration of the OAE data collected from the iHEAR study shows SNR is affected by age and gender but not by reported tinnitus or reported levels of noise exposure. Weak but significant ($p < 0.05$) relationships were found between OAEs and PTA thresholds.

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