1

TINNITUS & HYPERACUSIS

Key Frequency for Loudness Discomfort Levels in Patients with Hyperacusis

Gyungsik Jeon[1], Woojae Han[1], Gibbeum Kim[2], Fatima Husain[2]

Division of Speech Pathology and Audiology, College of Natural Sciences, Hallym University, Chuncheon, Korea[1]

Department of Speech and Hearing Science, College of Applied Health Science, University of Illinois at Urbana−Champaign, Champaign, IL, USA[2]

ABSTRACT

Although people with normal hearing sensitivity are comfortable listening to slightly loud environmental sounds, people who are sensitive to even small changes in volume tend to avoid them. Hyperacusis refers to abnormal intolerance to ordinary environmental sounds, or a disorder in loudness perception. By doing systematic research and meta-analysis, 2 kHz was the largest mean difference compared to other frequencies. Suggesting that it is efficient to measure 2 kHz first and then test 4 kHz or 1 kHz in clinical settings.

OBJECTIVES

The present study aimed to efficiently evaluate patients with hyperacusis by creating standards or rules for the various testing frequencies by applying a systematic search and meta-analysis technique.

METHODS and METERIALS

From the systematic review of electronic journal databases, a total of 12872 articles were initially identified and 14 studies met our criteria for behavioral loudness measurement (fig.1).

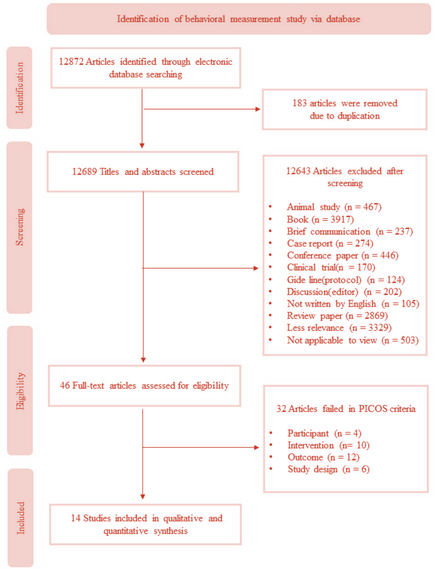

Fig. 1. Flow diagram of the studies for loudness discomfort levels selected for the systematic review and based on the PRISMA criteria

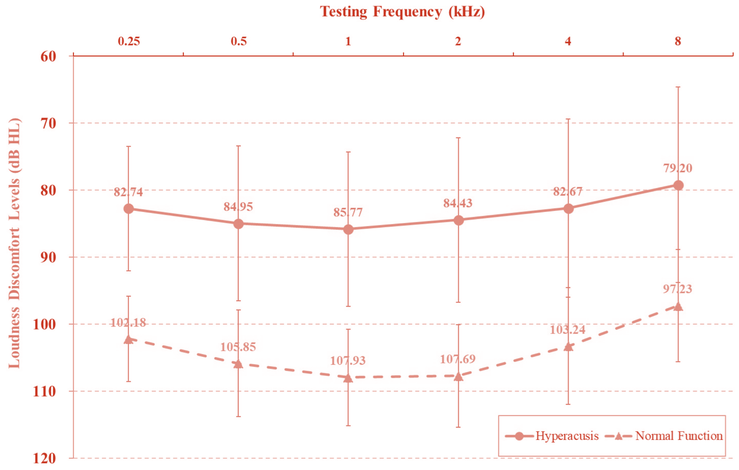

Fig. 2. Loudness Discomfort Level difference between Hyperacusis and Normal participants

Meta-analysis was also conducted to determine the most critical testing frequency that evaluates LDLs by using data extracted from 1783 subjects (1548 for hyperacusis and 235 for normal hearing function). The effect size for LDL values was estimated using the mean and standard deviation for the hyperacusis group and the control group.

RESULTS

In a pooled analysis, the LDL of the patients with hyperacusis was significantly lower than the LDL of those with normal sensitivity function (SMD=-2.3615, 95% CI, -3.1405 to -1.5825, p<0.001). However, the funnel plot was asymmetric and the Egger's regression test also detected publication bias in the studies. Due to that high heterogeneity, we conducted a subgroup analysis for the test frequency.

A subgroup analysis of six testing frequencies (0.25, 0.5, 1, 2, 3, 4 and 8 kHz) was performed to investigate which frequencies were most sensitive to LDL measurements in the hyperacusis. Although the hyperacusis group had overall lower LDL levels than the control group, there was no significant group difference in LDL level (Q = 1.70, df = 5, p = 0.8895). The largest difference in LDL between the two groups was at 2 kHz, followed by 4 kHz, 1 kHz, 0.5 kHz, 8 kHz, and 0.25 kHz. In addition, using a descriptive statistical analysis, the two frequencies showing the largest difference in LDL between the two groups was 23.26 dB at 2 kHz and 22.15 dB at 1 kHz.(fig.2)

CONCLUSIONS

Unfortunately, statistical significance by the test frequency could not be confirmed in our meta-analysis results, which were analyzed using data from 14 previous studies. However, when compared to the control group, the standardized mean difference (SMD) was the highest as -2.75 at 2 kHz, and the frequency with the largest difference in the descriptive mean at 23.26 dB HL was 2 kHz. When measuring LDL in hyperacusis, we suggest that it is clinically efficient to first measure at 2 kHz and also propose that the difference at 4 kHz (meta-anal) and/or 1 kHz (descriptive mean) was found to be largest in the next order. Through this systematic review and meta-analysis, we gain a clear perspective on what research needs to be done and generate hypotheses for further study.

REFERENCES

- Fackrell K, Potgieter I, Shekhawat GS, Baguley DM, Sereda M, Hoare DJ. (2017). Clinical Interventions for Hyperacusis in Adults: A Scoping Review to Assess the Current Position and Determine Priorities for Research. Biomed Res Int. 2017;2017:2723715. doi: 10.1155/2017/2723715.
- Vidal, J. L., Park, J. M., Han, J. S., Alshaikh, H., Park, S. N. (2022). Measurement of Loudness Discomfort Levels as a Test for Hyperacusis: Test-Retest Reliability and Its Clinical Value. Clinical and Experimental Otorhinolaryngology, 15(1): 84-90. https://doi.org/ 10.21053/ceo.2021.00318

** ACKNOWLEDGEMENT

THIS WORK WAS SUPPORTED BY THE NATIONAL RESEARCH FOUNDATION OF KOREA (NRF) GRANT FUNDED BY THE KOREA GOVERNMENT #2022S1A5A2A01044793.