

# A study of sensorineural hearing loss prevalence in children with diabetes mellitus type 1 using otoacoustic emission



## 1. Highlights

- Hearing loss is the fourth largest cause of disability worldwide, standing as a barrier to communication and language development, related to the delay in cognitive growth in children, restricts education opportunities and hinders social interaction.
- The type 1 of diabetes is the most common metabolic disorder in childhood and adolescence.
- Auditory complications are considered one of D.M chronic complications associated with microangiopathy at the level of the vascular stria and spiral ligament.

## 2. Background

Considering that:

- The hearing impairment is the pre-clinical stage of hearing loss,
- And that the OAE is a fast, non - invasive, objective, highly reproducible, frequency-specific test tool and can detect subclinical cochlear dysfunction.

And since,

- The main challenge is to be able to detect hearing loss and initiate intervention as early as possible.

**The basis of our research was the use of OAE to detect subclinical SNHL and to start early intervention in children with T1D.M**

## 3. Aims

- Obtain recommendations that can be applied as an audiological screening in children with T1D.M to promote and enhance early identification and services for them.
- Study SNHL prevalence in children with T1D.M.
- Determine the possibility to concern T1D.M as an independent risk factor to develop hearing loss.

## 4. Methods

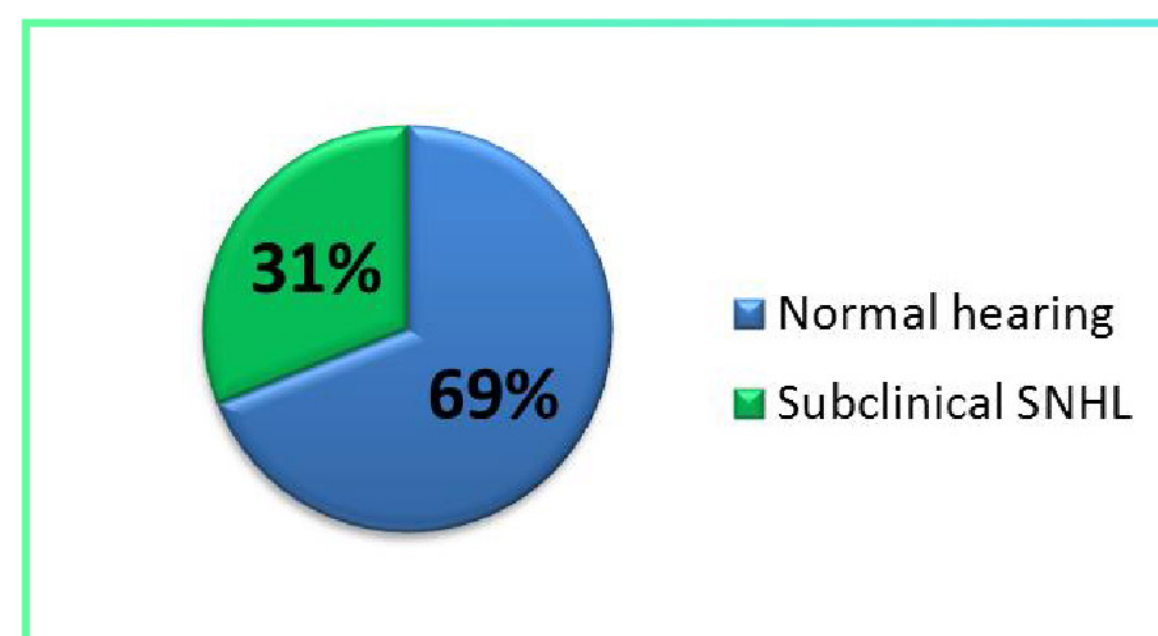
- A prospective cross-sectional clinical study was conducted on a total 58 T1D.M children of both sexes,  $\leq 18$  years of age, from March 2020 to September 2022. We excluded patients with any otological pathology, personal or family history of hearing loss, use of ototoxic medications, noise exposure.
- Patients underwent a clinical examination, HbA1c value, tympanometry test, DPOAE and PTA.
- 58 patients (30 F, 28 M) were divided into 3 groups based on age:  $<6$  (2 patients), 6 – 12 (29 patients), 13 – 18 (27 patients). According to the ADA 2014, the HbA1c value to be achieved in order for diabetes to be considered controlled varies according to the age stage.
- The DPOAE used in this study, uses two tonal stimulations ( $L1=64$  db –  $L2=54$  db) at two different frequencies called  $f1, f2$  ( $f1 < f2$ ). 2K, 3K, 4K, and 5K Hz were analyzed.

The test was conducted in a quiet room, and it was considered abnormal when the SNR was below 6 dB in at least a frequency assessed.

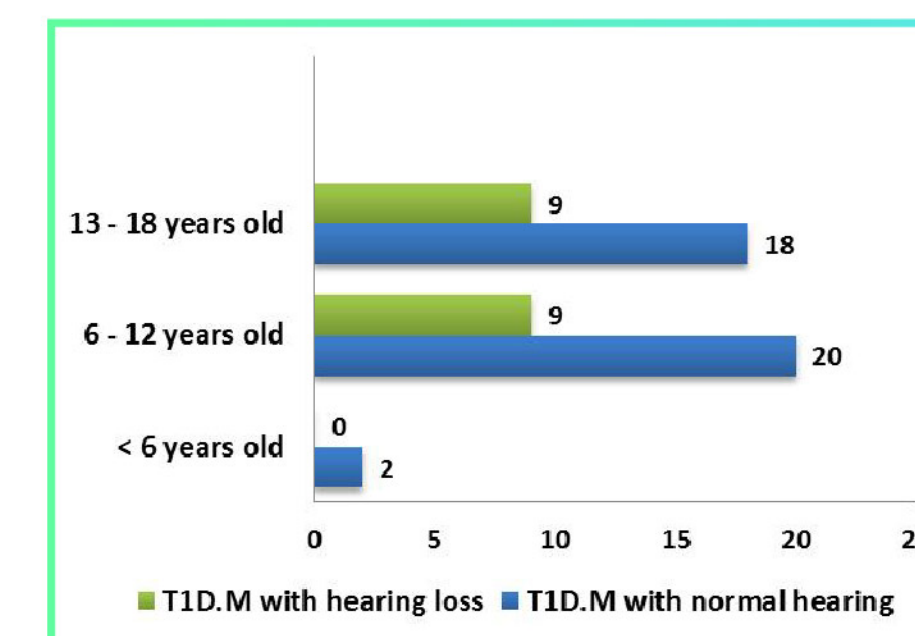
- Finally, patients underwent PTA aiming to cross-check the results.
- All inputs were gathered in a database, performing statistical analysis using SPSS statistic software. The results were considered significant if  $p\text{-value} \leq 0.05$ .

## 5. Results

- Out of the 58 patients, 18 (31%) had subclinical SNHL.



Average of patients with type 1 diabetes with normal hearing and subclinical sensorineural hearing loss

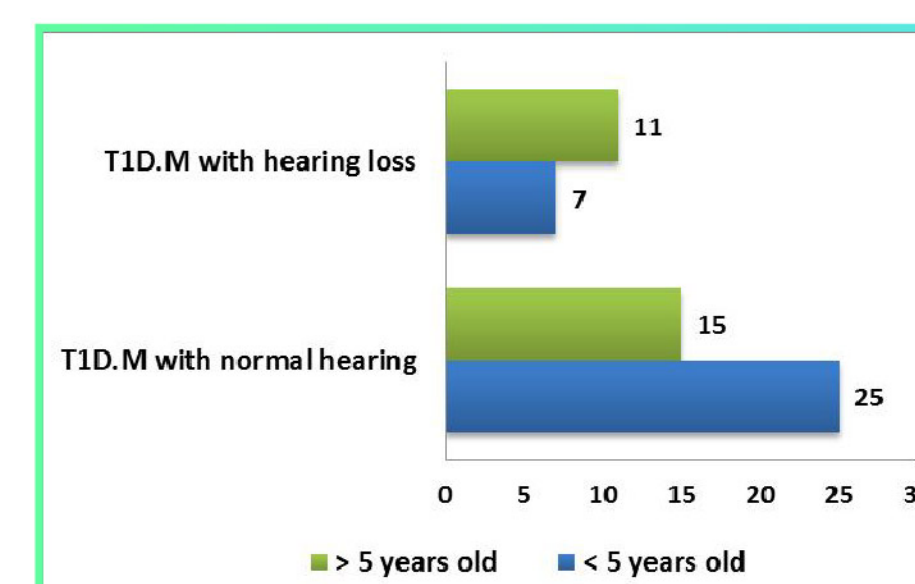


Comparison of both groups by age range.

- Out of 18: [11 (61.1%) had diabetes  $> 5$  years, 14 (77.8%) had uncontrolled diabetes according to HbA1c value, and 12 had complications during their diabetes].
- According to DPOAE results, out of 58 patients, 18 presented subclinical SNHL, predominately on the right ear, almost at high frequencies and 3K HZ was the most affected.
- Regarding PTA results, out of 58 patients, only 4 (6.9%) presented mild to moderate SNHL at high frequencies; 4K HZ (2 patients) and 8K HZ (2 patients).

### By studying the variables and their relation to the detected subclinical hearing loss;

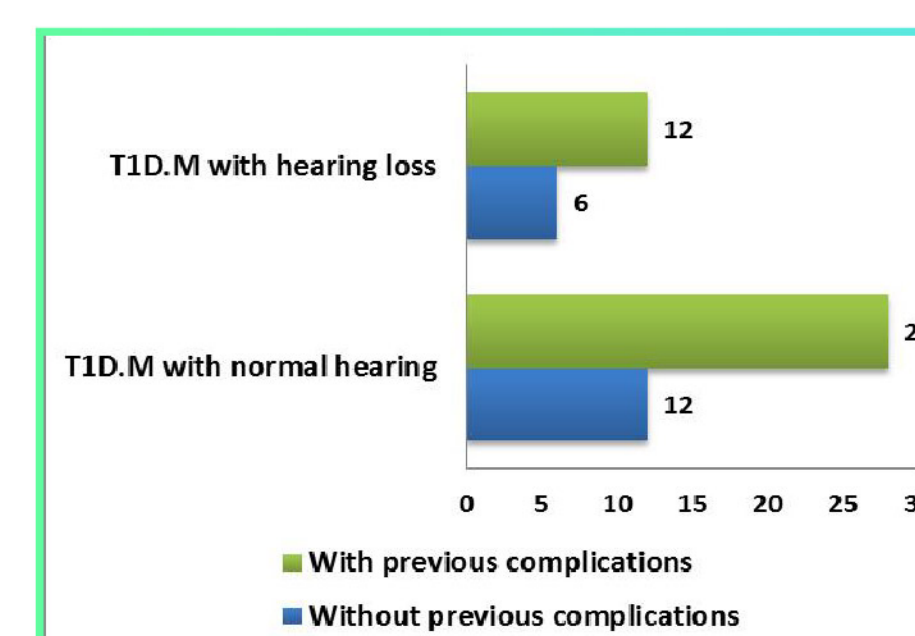
- Regarding time of evolution of T1DM, this being a statistically significant value ( $p = 0.046$ ).
- Regarding glycemic control according to HbA1c value; this being a statistically significant value ( $p = 0.004$ ).
- Regarding existence of a family history of D.M; it does not represent a risk factor ( $p = 0.089$ ).
- Regarding existence of previous complications in the context of D.M; this being a statistically significant value ( $p = 0.012$ ).



Comparison of both groups by T1D.M evolution time.

### By Studying the relationship between the results of DPOAE and PTA and the ability of DPOAE to detect subclinical SNHL that behavioral auditory tests do not;

- We found a statistically significant value ( $p = 0.002$ ).



Comparison of both groups by existence of previous complications during the context of D.M.

## 6. Discussion

Globally, the prevalence of SNHL in children with T1D.M was 33%, compared to 0.3%-0.5% in healthy children. In our study, the prevalence rate was 31%, which is very close to the global figures. Several studies, using the OAEs, showed a decrease in the response amplitude in patients with T1D.M in the presence of normal auditory thresholds, confirming the occurrence of early subclinical changes in the inner ear due to metabolic disorders. And the higher frequencies (4 k, 6 k, and 8-k Hz) are considered the most specific for cochlear injury diagnosis and are also the most frequently affected in the context of D.M. As abnormal OAE responses are associated with microangiopathy, there is expected to be a more cochlear dysfunction in patients with a high prevalence of diffuse microvascular complications.

## 7. Review of literature

In a study of 60 T1D.M patients by Ottaviani et al., an abnormal OAE response was detected in 28% of patients with normal auditory thresholds. Felicio et al., performed a study with 37 T1D.M patients submitted to DPOAE. An abnormal response was detected in 73% of them with normal auditory thresholds. They suggest that abnormal OAE responses in high frequency bands are associated with diabetes microvascular complications and could be a risk marker for them. Gonzalez et al., performed a study with 84 T1D.M patients submitted to PTA and HbA1c value. 14.3% presented bilateral mild-to-moderate SNHL with the right ear dominating. They considered each time of evolution with T1D.M for a period  $> 5$  years and uncontrolled D.M as risk factors.

## 8. Conclusion and recommendations

Uncontrolled T1D.M, the presence of previous complications during it and the age of D.M  $> 5$  years are considered risk factors for developing SNHL. DPOAE can detect the subclinical cochlear impairment that behavioral auditory tests do not and determine those who would benefit from regular audiological follow up and tighter D.M control. Given that, patients with diabetes should be instructed about the auditory damage and how to prevent it, aiming to improve glycemic control, avoid exposure to loud noises, ear infections and tympanic membrane perforations, which can endanger healthy hearing of them. We recommend establishing a hearing screening protocol for children with T1D.M that allow us to early hearing detection and intervention.

## 9. References

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