PHASE-UP (Preschool Hearing and Speech Education - University of Pittsburgh): Comparison of Preschool Hearing Screening Protocols

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Introduction

Universal newborn hearing screening (UNHS) has drastically reduced the age at which children are diagnosed with congenital hearing loss.

UNHS does not guarantee early identification and intervention of infants who have mild (i.e., 20-40 dB HL), late-onset, progressive, or fluctuating hearing loss. Also, there will always be a proportion of infants who are lost to follow-up and/or documentation after UNHS. As a result, the prevalence of hearing loss among children increases from 1-3 per 1,000 at birth to 9-10 per 1,000 at school-age. Universal preschool hearing screening programs could promote early identification and intervention for these children.

Clinical practice guidelines recommend the use of pure-tone audiometry along with tympanometry and/or otoscopy to screen hearing in the preschool population. However, the use of pure-tone audiometry in this population presents many challenges.

Otoacoustic emissions (OAEs) offer many advantages over pure-tone audiometry for preschool hearing screening. However, the sensitivity and specificity of OAEs when applied to hearing screening has been problematic (e.g., high false-negative rate). As a result, OAEs as a standalone measure have not been widely used to screen hearing in the preschool population.

The sensitivity and specificity of OAEs can be enhanced by using **two** pass-fail criterion (Hall 2016). These criterion are (1) distortion-product OAE (DPOAE) amplitude greater than 6 dB SPL above the noise floor (e.g., DPOAE-to-noise ratio) >6 dB, and (2) DPOAE amplitude ≥0 dB SPL.

The goal of this study is to determine the extent to which a two-criteria as opposed to one-criterion DPOAE pass-fail protocol would result in more effective hearing screening practices in the preschool population.

This poster presents results from preliminary data analyses.

Methods

This study involves a retrospective chart review of hearing screening results obtained from children seen in the Preschool Hearing and Speech Education – University of Pittsburgh (PHASE-UP) clinic from September 2018 to December 2018.

Inclusion criteria:
- Child age: 3 – 6 years
- Complete hearing screening battery
- Consent form on file

The hearing screening results came from a battery of three separate measures:
- Tympanometry and/or otoscopy
- DPOAEs at 2 – 4 kHz
- Pure-tone audiometry at 1, 2, and 4 kHz

Methods

The pass criteria for each screening measure are detailed in the table below.

Test	Criteria
Tympanometry and/or otoscopy	Pass • Tympanometric width (TW) ≤250 daPa, or • Patent pressure equalization (PE) tube, or • Normal tympanic membrane visualized on otoscopy
DPOAEs at 2 – 5 kHz	One-criterion DPOAE protocol • DPOAEs are present at a SNR of ≥6 dB at 3 out of the 4 frequencies assessed Two-criterion DPOAE protocol • DPOAEs are present at a SNR of ≥6 dB at 3 out of the 4 frequencies assessed, and • DPOAE absolute amplitude ≥0 dB SPL at those frequencies
Pure-tone audiometry at 1, 2, and 4 kHz	Pass • Response obtained at 20 dB HL at all frequencies assessed

Preliminary Results

A total of 297 children were included in the analyses. The charts of 11 children contained incomplete DPOAE data. As a result, the two-criteria DPOAE pass rate includes data from only 286 children.

1. What is the overall pass-fail rate for the typical, one-criterion DPOAE screening protocol?

Age (years)	# Passed / Total	Pass rate (%)
3	93 / 105	89
4	156 / 170	92
5	20 / 21	95
6	1 / 1	100
Total	**270 / 297**	**91**

2. What is the overall pass-fail rate for the stricter, two-criteria DPOAE screening protocol?

Age (years)	# Passed / Total	Pass rate (%)
3	77 / 102	75
4	142 / 164	87
5	18 / 20	90
6	- / -	-
Total	**237 / 286**	**83**

3. How do the typical and stricter DPOAE screening protocols compare?

FREQ Procedure

Table of typical by stricter				
	typical	stricter: Pass	stricter: Refer	stricter: Total
Frequency		237	23	260
Percent		82.87	8.04	90.91
Row Pct		91.15	8.85	
Col Pct	Pass	100	46.94	
		0	26	26
		0	9.09	9.09
		0	100	
	Refer	0	53.06	
		237	49	286
	Total	82.87	17.13	100
Frequency Missing = 11				

Fisher's Exact Test

Cell (1,1) Frequency (F)	237
Left-sided Pr ≤ F	1
Right-sided Pr ≥ F	<.0001
Table Probability (P)	<.0001
Two-sided Pr ≤ P	<.0001

Sample size = 286
Frequency missing = 11

Preliminary Results

One-criterion DPOAE screening protocol
Total pass rate: 91%.
Range in pass rate: 89-100%

Two-criterion DPOAE screening protocol
Total pass rate: 83%.
Range in pass rate: 75-90%

Future Directions

Analyses are underway on the present dataset to answer additional research questions, such as:

1. Are outcome data from one-criterion versus two-criterion DPOAE screening protocol significantly different or related?
2. What is the pass/fail rate for pure tone audiometric screening protocol and tympanometry/otoscopy screening protocol?
3. Are the pass/fail rates between pure tone audiometric screening protocol, one-criterion DPOAE screening protocol & two-criterion screening protocol, significantly related?
4. What is the percentage of children who passed the screening in both ears on all 3 screening measures? How many were referred to primary care physician (PCP) in one or both ears? How many were referred for a full hearing evaluation (audio) in one or both ears? How many were referred for both a PCP consult & audio?
5. Does a statistical relationship exist between age at screening & pass/fail rate on pure tone audiometric screening, typical DPOAE screening protocol or stricter DPOAE screening protocol?

PHASE-UP charts from January 2019 – March 2020 are currently being reviewed for inclusion in these analyses.

We hope to submit the comprehensive findings for peer-review publication soon.

References

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